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ANALYSING THE REGIONAL AND NATIONAL ECONOMIC CONSEQUENCES OF MOVING TOWARDS SUSTAINABLE FARMING SYSTEMS WITHIN THE UK.

Jonathan Henry Lloyd

A thesis submitted for the Degree of Doctor of Philosophy
in the Institute of Biomedical and Life Sciences, University of Glasgow.

Department of Agricultural and Food Economics
Management Division
SAC Auchincruive
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I hereby declare that this thesis represents all my own work unless otherwise stated in the body of the thesis. No portion of this thesis has been submitted in support of an application for another degree or qualification of this or any other university or institute of learning.



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September 2003.

Jonathan Henry Lloyd

Abstract

This thesis is an attempt to estimate the regional and national economic consequences of a wholesale move to sustainable agricultural systems in the UK. The study reviews definitions of agricultural sustainability, and draws a distinction between sustainable and organic farming systems. Farm-level definitions of sustainability are developed for all the main farm types encountered in the UK, and key indicators with targets are developed to assess and monitor any move towards sustainability. Linear Programming models are constructed, for 23 representative UK farm types under conventional and sustainable farming scenarios, to estimate the farm-level impacts of the adoption of sustainable farming at some point in the future. The farm-level models are aggregated to regional and national levels to estimate the likely changes in UK agricultural production of a more widespread adoption of sustainable farming practices. The wider economic effects of these changes at the regional and national levels are then examined by the use of output, income and employment multipliers.

The study found that the biggest financial losses were predicted to be on intensive livestock farms, and in the more productive agricultural regions in the East and the South. Losses in net farm income were greatest on pig and poultry farms on which incomes fell to 33% of the conventional incomes, specialist dairy incomes fell to 47%, and on mainly dairy farms they fell to 58%. Average incomes on cropping and large LFA farms fell only slightly to 97% of the conventional scenario, whilst incomes on small LFA farms rose slightly to 102% and on mixed lowland farms they increased to 119% of the conventional scenario.

The aggregated results project a fall in total net farm income for the UK to 85% of that under conventional farming. However the total net farm income for Scotland would rise, whilst the biggest losses would be projected for Wales and Northern Ireland. Agricultural output was projected to fall by £2.42 billion, leading to an indirect fall of £1.58 billion in the farm supply industries, and a further induced fall of £1.68 billion in household spending, totalling a net loss of output of £5.66 billion. There would be a negative direct effect on household incomes however of £167 million, with indirect losses of £84 million and induced losses of £565 million. Direct employment in agriculture was also projected to fall by 28,830 FTEs, which would lead to an indirect loss of 31,740 FTEs in industries supplying farming, and induced losses of 30,292 FTEs in the wider economy leading to an overall loss of 90,862 FTEs. Gains in direct agricultural employment were however projected for the South East of England, and the West of Scotland. The North West of Scotland being the only region, where there would be a net overall increase in employment.

Nationally sustainable agriculture would lead to a significant fall in the total income from farming, yet there would be substantial variations around the country, and between farm sectors. Indirect effects on the farm supply industries, and induced effects on households spending would lead to substantial losses, which would need to be offset against the environmental gains. The implications of these results for agricultural policy are discussed.

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Chapter 1. Defining Sustainable Agriculture

1.1. Introduction

There has been much public interest in the management of the rural environment, and in the concept of sustainable agriculture. The concept of agricultural sustainability has yet to be made a reality. The Policy Commission on Food and Farming has reported that the food and farming system within England was 'unsustainable in every sense of the word' (Cabinet Office 2002, pp.109). Research to date has concentrated on comparisons between conventional farming systems and organic ones, but a 'sustainable' system is usually regarded as something different. Much of the work to date looking at sustainable systems has been location specific but with highly variable ecologies across regions, it is difficult from these studies to forecast the regional economic impacts of the widespread introduction of sustainable farming practices.

Yet were sustainable farming practices to be adopted on a widespread scale across a country, it is expected there would be significant regional variations in the types of farming systems adopted, and in the wider economic impacts, due to differing ecological, topographical and climatic factors across regions (Webster 1997, 1995a). It is therefore important for those in charge of rural policy to know the extent of these variations at a regional level, and the effect on particular farming systems, so that public support for sustainable farming can be better targeted, and better rural regional policies may be implemented.

This thesis aims to analyse the regional and national economic consequences of moving to sustainable agriculture, in the United Kingdom. In order to do this a working definition of sustainable farming systems is first is derived, for the range of farm types found within the UK. The management of sustainable farm enterprises is then examined, and a set of production guidelines for sustainable farming are developed based upon the 'Integrated Farm Management' approach. This is followed by an examination of indicators of agricultural sustainability, and a core set of indicators selected, to provide a means of assessing the sustainability of the systems described. Chapter 4 develops linear programming models of the representative farm types found in the UK, and for a conventional base-line scenario and a scenario in which these farms are managed under sustainable farming systems. Chapter 5, aggregates these farm level models, to regional and national levels, attempts to estimate the likely effects on the wider rural economy, and links back to regional and national indicators of sustainability. The implications of the results for agricultural and rural policy, as well as the restructuring of the agricultural industry, are discussed in Chapter 6.

1.2. Defining a Sustainable Farming System

One of the most common definitions of sustainability is that of the Bruntland Commission of 1987 which defined sustainability as:

"Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs."

(World Commission on the Environment and Development 1987, pp. 8).

Pretty (1995) stated there have been over 70 further definitions each one slightly different from the next. He and many others such as Lampkin (1995), conclude that a precise definition is impossible. O'Riordan (1985) says the definition of sustainability is as an 'exploration into the tangled conceptual jungle where watchful eyes lurk at every bend.' In a similar vein Jackson (1992) states that the word expresses a concept and implies a set of principles which can only be applied in a site specific way. However sustainability not only relate to environmental and ecological issues, but to human needs and concerns as well. Thus the first principle of the Rio de Janero declaration (UNCED 1992) on environment and development states that:

'Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature '.

Pearce and Freeman (1991) explain the broad concept of sustainability by saying that wealth may be divided into economic capital, such as machines, buildings, money, human capital such as skills and health and environmental capital or natural resources. Sustainability entails that the total stock of all forms of wealth cannot be depleted, though how much of each kind to have depends upon the values placed upon them by society. This view allows for the clearing of tropical forest for agriculture if there is a need. Thus, environmental resources can be depleted as long as the loss is made up for by the accumulation of other forms of wealth that is human and economic capital. This is the broad view of sustainability where the three basic forms of capital are substitutes for one another. With this view we get the idea of compensating future generations for today's depletion of natural capital.

Thus sustainability involves trade-offs between a number of different competing goods. The UK Government's latest sustainable development strategy (DEFRA 2002a) has the following objectives:

1. Social Progress which recognises the needs of everyone;
2. Effective protection of the environment;
3. Prudent use of natural resources; and
4. The Maintenance of high and stable levels of growth and employment.

MAFF (2000a) describes the UK's official definition of sustainable agriculture, as one that ensures:

1. Continued availability to the consumer of adequate supplies of wholesome, varied and reasonably priced food produced in accordance with generally accepted environmental and social standards;
2. Maintenance of a flexible and competitive industry which contributes to an economically viable rural society;
3. Effective protection of the environment and prudent use of natural resources;
4. Conservation and Enhancement of the landscape, wildlife, cultural and archaeological value of agricultural land and
5. A high level of animal welfare.

Others however claim that environmental capital and man-made capital are not perfect substitutes, and we should be extremely careful about running down environmental capital. Leading on from this is the issue of irreversibility, a lot of environmental capital cannot be replaced once lost. An extinct species cannot be replaced, yet most man-made capital can be lost and replaced at will or within a time lag. This more restrictive definition of sustainability would mean any irreversible decline in natural capital would be deemed unsustainable. There are also renewable and recyclable natural resources such as those often found in the agricultural industry, where some rate of extraction or exploitation is sustainable. The suggestion is that these are handled by counting only destruction or exploitation which exceeds the natural rate of regeneration. Thus, Bawden (1991) stated that agricultural sustainability can be defined in different ways and sought through different means. He identifies four different groups of people, whose perspectives may be different and in conflict:

1. Those to whom sustainability relates to sufficiency of food;
2. Those who see it in an ecological context;
3. Those who see it as promoting vital coherent rural cultures;
4. Those who see it in a moral context.

These distinctions are important when considering what constitutes agricultural sustainability. Herdt and Steiner (1995) state that agricultural sustainability is concerned with the production of agriculture over time, and so sustainability is the result of the relationship between technological inputs and management, used on a particular resource base within a given socio-economic context. For this reason Wimberley (1993) identifies three types of agricultural sustainability policy, namely one concerned with the needs of society, one with agriculture and the last with rural communities. Each aspect of sustainability has its own interest group, with some seeing sustainability as a philosophy,

while others regard it as more of an economic strategy. Table 1.1 presents some of these groups, and the policies and issues with which they are concerned.

Table 1.1. Policy types, sustainability issues, and interest groups

Policy Type	Sustainability Issues	Interest Group
Social	Food and Fibre supply Natural Resources Environment Food Safety Food Costs Food Distribution Hunger and Malnutrition	Consumers Voters Environmental Groups
Agricultural	Natural and Biological Risks Farm Supports Production Controls Technical Information Marketing	Farmers Farm organisations Agribusiness Processors Distributors
Rural	Employment Education Health Social Services Infrastructure Quality of Life	Farm Residents Non Farm Residents Rural Business Communities

(From Wimberley 1993).

The multi-faceted nature of sustainable agriculture has lead to Rigby and Caceres (1997) to state that attempting to arrive at a precise operational definition of sustainable agriculture is problematic, because of the range of parties and different interest groups involved. No one would argue for a non-sustainable agriculture, so all groups argue from their own perspective of sustainability. Thus Rigby and Caceres say that much of the debate focuses on what elements of production are acceptable and those which are not. An OECD report of 1995 states that it is perhaps more useful to seek a consensus of opinion on whether an action will make a system more or less sustainable, than to try and evaluate sustainability against some absolute state (OECD 1995a). In industrial countries sustainable agriculture implies a reduction in farm inputs and environmental damage, and an end to the overproduction of food, yet in the third world the need is to increase production, without an undue increase in synthetic inputs or environmental damage. Accordingly agricultural policy is now largely concerned with encouraging extensive systems of production.

The British countryside itself is largely a product of the agricultural industry and to preserve the landscape and meet many environmental objectives we must have a viable agricultural industry, particularly in many areas such as the uplands, where farming is economically difficult. In such areas land has been lost to agriculture through afforestation, which in itself has had some unfortunate environmental consequences, and there has been concern about the decline of rural communities in such areas. The need is to maintain at least a minimum level

of agricultural activity, to protect these fragile ecosystems. For example Wolton (1994) reports the loss of culm grassland in the South West of England and claims that 12% is due to the decline of the profitability of beef production, leading to under-grazing and scrub invasion.

However taking land out of agricultural production is not necessarily the answer. It could be argued that the current system of set-aside is unsustainable because it takes land out of production, and leaves the rest to be farmed more intensively. Although set-aside was introduced primarily as a supply control measure it can be managed to meet other objectives (see Corbet 1995). However much depends on the details of the scheme of the type of management. Sotherton, Boatman and Robertson (1992) state that most set-aside in the five year scheme introduced in 1988 was managed by neglect and the resulting 'tumbledown' criticised by both farmers and conservationists.

Similarly allowing many marginal areas to go out of agricultural production would simply mean land being farmed more intensively elsewhere. Baldock and Mitchell (1995), report that there are areas of the EU where under-grazing of vegetation is causing significant problems such as scrub invasion of grassland and greater susceptibility to fire. The problem in the UK however has been considered to be overgrazing, and measures introduced in 1992; linked to the Hill Livestock Compensatory Allowances (HLCA) payments were intended to tackle this problem (Brouwer and Lowe 1998, pp. 127).

To many, Sustainable Farming conjures up pictures of a return to more traditional methods of farming practised in the past, such as the Norfolk four course rotation. There is doubt however as to the ability of such systems to guarantee the prosperity for rural communities necessary for sustainability. Johnstone (1991) demonstrates the loss of soil fertility over the 19th century in England, remarking that such a system in itself is unsustainable. A sustainable system would however entail some traditional practices, but in combination with new technology. Accordingly it is envisaged that a sustainable farming system would replace costly (in environmental and financial terms) synthetic inputs, with better management input and with new technology.

One of these new management practices is ICM (Integrated Crop Management). It requires increased attention to crops and the regular monitoring of crop health and of pest populations. Drummond (1994) describes it as farm practices which build on existing knowledge and combine the best of traditional methods with modern technology. One example of a new technology which could play a considerable role in a sustainable farming system are GPS (Global Positioning System) yield mapping systems, which could help farmers reduce applications of such synthetic inputs. Blundell (1994) states that advances in biology could mean increased biological efficiency in agriculture and the potential to reduce inputs. The integration of man's activities with natural processes must therefore be a key element in a sustainable system. It is perhaps this which is what Raymond (1991) calls 'Mid Tech' farming. Francis and Youngberg (1990) conclude that sustainable agriculture is a

system that utilises an understanding of natural processes along with the latest scientific advances to create integrated resource farming systems.

In drawing up conditions for sustainability it is important to define also what is being sustained, for how long and for whom? Allied to these issues are other questions. What is the acceptable use of inputs? On a practical level threshold limits for pest damage need to be estimated. Would a sustainable system involve following rigid codes of practice or could a more flexible approach be followed? What would be acceptable on one farm may not be on another, due to variations in soil, climate e.t.c. This is one of the problems with research to date mentioned by Webster (1995a), namely that, most trial results are location specific and could not be applied to a different climate or locality.

Herdt and Steiner (1995) say that sustainability can only be thought of in the context of a defined time period. Thus they say that experience has shown that important trends affecting the sustainability of a system usually become apparent in the first 20-40 years. Hansen and Jones (1995) say that a sustainable system is binary and that it will either sustain or fail in a future period. However, given that some environmental degradation must be accepted in the long run, it may be in practice a little more complicated. They conclude that failure could be expressed in several forms such as farm abandonment, conversion of land to non-agricultural use or the need to supplement income with off farm employment.

Webster (1995a) talks about a sustainable system in terms of being closed or open, sustainability implies a move towards a more closed system, whereby by products are consumed on the farm and the market intrudes only at the final stage. However it could be argued that a system can be sustainable and still rely on outside inputs, providing that there are no harmful consequences to the environment. There could be debate over the size of the system that is closed, namely whether we are talking at farm or a regional or national level. Kruseman *et al.* (1995) claim that although a system may be defined as sustainable at an individual farm or plot level it may not be sustainable at regional or national level. For example pollution of water by overuse of fertilisers may be a problem at regional or national level, but may not be a problem for certain individual farms. However regardless of the geographical scope of the system, it is true that a sustainable system would entail the maximum possible recycling of nutrients and waste products.

All this goes to show that a sustainable agricultural system is best seen as one which satisfies a set of guidelines, rather than adheres to a fixed prescription. As Conway and Barbier (1990) concluded agricultural sustainability is the ability to maintain productivity, whether of a field or farm or nation, in the face of stress or shock. Accordingly the following discussion tries to define the broad objectives of a sustainable farming system, as a basis for defining the governing guidelines.

1.3. Organic and Sustainable (Low Input) Farming Systems

The term 'Sustainable agriculture' is often used interchangeably with 'Organic agriculture'. Rigby and Caceres (1997) state that there are a variety of definitions of Organic farming.

However organic farming is defined in law, in the UK any product sold as organic must be produced according to that specified in UK Statutory instrument No. 2111 of 1992, The Organic Products Regulations 1992 (HMSO 1992a) which implemented European legislation Council Regulation (EEC) 2091/91. In the UK organic standards are administered by the United Kingdom Register of Organic Standards, and any food sold in the UK as organic must meet a minimum of UKROFS standards (UKROFS 2001). In practice the term 'Organic Farming' in the UK is taken to be that as defined by the Soil Association (2000), which prohibits the use of synthetic inputs. In contrast as yet there is no universally accepted definition or code for Sustainable Agriculture. The IOBC (International Organisation for Biological Control) has produced a set of guidelines for integrated production (see El Titi, Boller and Gendrier 1993), which were originally intended as a halfway house before a farm converted to full organic production. They state that integrated production is a farming system which:

1. Integrates natural resources and regulation mechanisms into farming activities to achieve maximum replacement of off farm inputs;
2. Secures sustainable production of high quality food and other products through ecologically preferred technologies;
3. Sustains farm income;
4. Eliminates or reduces sources of present environmental pollution generated by agriculture; and
5. Sustains the multiple functions of agriculture.

Similarly Conservation Grade production allows selected artificial fertilisers and a few carefully selected non-residual synthetic pesticides (Anon 1989). This was originally introduced as a half way step to organic production but is now seen as a system in its own right. The term 'conventional agriculture' refers to the standard modern farm practice of high input/high output farming, relying on full chemical control for crop protection, and animal health. According to Hansen (1996) the concept of 'conventional agriculture' was only developed in order to clarify and justify the alternative approaches. Thus, Knorr and Watkins (1984) define conventional agriculture as:

' Capital intensive, large scale, highly mechanised agriculture with monocultures of crops and extensive use of artificial fertilisers, herbicides and pesticides, with intensive animal husbandry.'

In other words conventional agriculture is what sustainable agriculture is not. Beus and Dunlap (1990) examined the writings of six conventional agricultural advocates, and six advocates of alternative agriculture, and suggested the following differences in perspective on a range of agricultural issues, which are shown in Table 1.2.

Table 1.2. Alternative and conventional agriculture

Alternative Agriculture	Conventional Agriculture
Decentralisation	Centralisation
Independence	Dependence
Community	Competition
Harmony with Nature	Domination of Nature
Diversity	Specialisation
Restraint	Exploitation

For example sustainable agriculture, would encourage diversity, in terms of a better mix of enterprises on farms, with more mixed farming systems, rather than the specialisation encountered within conventional farming. The last few years, however has seen the extensification of agriculture to a certain extent, as a result of economic pressures, food surpluses as well as environmental pressures. For instance OECD (1995 b,c) report a 31% reduction in the consumption of pesticides per km^2 of arable land in the UK from 1980 to 1991. While such reductions are accepted as an improvement in sustainability there are many other areas which conventional agriculture still needs reform to address as regards sustainability. Thus, it is generally perceived that sustainable agriculture continues to be distinct from conventional agriculture.

So what are these distinctions? It is generally accepted that sustainable, alternative, low-input agriculture does not preclude the use of 'synthetic' inputs such as pesticides, nitrogen fertiliser etc., and thus it is quite distinct from organic agriculture. However it is clear that there is an overlap between the two kinds of systems in that they both attempt to utilise the natural resource stock and natural nutrient cycles, attempt to utilise the natural disease resistance of crops and livestock and encourage natural systems of pest control. Both systems involve the substitution of chemical inputs derived from fossil fuels with management input or from chemical to other forms of pest management. Sustainable or Low-input farming is widely regarded as a middle ground between the Organic movement and Intensive high input/output production. Pretty (1995) has expressed this another way by saying, organic agriculture is a form of sustainable agriculture, but not all sustainable agriculture is organic.

Basically sustainable farming involves the tactical use of inputs when there is a clear need, rather than prophylactic or insurance application of sprays, fertiliser and antibiotics associated with conventional or intensive agriculture. However beyond this there is less agreement on its characteristics. Some believe that the only form of sustainable agriculture is that which does not deplete fossil fuels, and use external inputs. Others argue that the priority

is to ensure food supplies, and point to evidence that organic farming can be just as harmful to the environment as conventional agriculture. However while there is no clear comment on what precisely defines sustainable farming there is agreement on the environmental concerns that it needs to address. The next section considers these.

1.4. The Objectives of a Sustainable Farming System

Pretty and Howes (1993) reviewed the literature relating to sustainable farming and defined its objectives as:

1. A more thorough incorporation of natural processes into the agricultural production process;
2. A reduction in the use of off farm inputs;
3. A greater use of the biological and genetic potential of plant and animal species;
4. An improvement in the match between cropping patterns and physical limitations to ensure long-term sustainability of current production levels;
5. Profitable, whole farm management to conserve soil, waste, energy and biological resources.

Likewise Spedding (1994) describes the essential attributes of a future ideal agricultural system as:

1. It should be highly productive, of safe, high quality products (within identified constraints, such as those listed below);
2. It should be physically sustainable (i.e. use physical resources at rates or in ways which allow adequate long term development);
3. It should be biologically sustainable (i.e. the biological organisms and processes on which it depends must be sustainable in the long term) - this could encompass the avoidance of 'internal' pollution, such as the build up of heavy metals;
4. It should satisfy agreed standards for human and animal welfare;
5. It must not give rise to unacceptable pollution, by-products or effects (including visual);
6. It must be profitable (since they will not be practised if they are not), this also assumes that the products are wanted (otherwise there will be no demand and the business will collapse).

Similar sentiments were expressed by the FAO (1992), who concluded in respect of sustainable farming systems that agriculture must meet the challenges of food security, provide more employment and better incomes and contribute to the eradication of poverty, while and the same time conserving natural resources and protecting the environment. In drawing up a strategy for sustainable development, the UK Government concluded in 1994,

that to meet the needs of sustainable development agriculture had to balance a number of different aims (D.o.E. 1994a):

1. To provide an adequate supply of good quality food and other products in an efficient manner;

2. To minimise consumption of non renewable and other resources, including through recycling;

3. To safeguard the quality of soil, water and air; and

4. To preserve and, where feasible, enhance bio-diversity and the appearance of the countryside including the UK archaeological heritage.

More recently *The Policy Commission on the Future of Food and Farming* states that a profitable and sustainable farming and food sector is one that can compete internationally, is a good steward of the countryside, and provides good food and a healthy diet (Cabinet Office 2002).

1.5. The Issues Involved in the Agricultural Sustainability Debate

1.5.1. Environmental Issues

Much work on sustainability concentrates on its environmental aspects, and the damage to the natural environment and ecosystems that modern intensive agricultural practices cause. The environmental issues that are pertaining to sustainable farming include, biodiversity, landscape, pollution, water, air, soil and the use of non-renewable resources.

1.5.1.1. Bio-diversity

Modern arable farming is seen as being damaging to the biodiversity of the rural environment, in particular the use of chemical pesticides by intensive agriculture is clearly seen as damaging to natural fauna, and was first brought to light, in Rachel Carson's *Silent Spring* in 1962. Dempster (1987) reports that concern began with the use of organochlorine pesticides, as a result of seed eating birds dying during the period 1956-60, after consuming seed treated with aldrin, dieldrin, heptachlor; in addition birds of prey such as the sparrow hawk greatly decreased in numbers. Since these chemicals have been banned, there has been a recovery of sparrow hawk populations in some areas though not in the south of England (Dempster 1987).

With the ban of organochlorines, another group of chemicals organophosphates came into use as seed treatments, and there have been relatively few incidents reported of poisoning of wildlife by this group although, Stanley and Bunyan (1979) report the deaths of geese feeding on newly sown cereal seed, other incidents involving geese have also been reported.

Arden Clarke (1988) reviewed the literature relating to the impact of conventional pest control strategies on wildlife and the crop ecosystem. He quotes evidence of increased organochlorine levels in some wildlife species, and organophosphates, carbamates and synthetic pyrethroids. He describes how pesticides often have an even greater long-term

impact on the pests natural enemies, than the pest since pest populations recover faster since they still have an abundant food supply i.e. the crop; whilst the predators do not. Conventional agriculture and the use of pesticides depress insect populations, which affects animals higher up the food chain and the whole ecosystem. Selection pressure is put on target organisms to build up resistance, e.g. black grass resistance to herbicides (Moss and Cussans 1991). There are also problems with the use of synthetic pesticides in livestock farming. Strains of sheep scab, resistant to the organophosphorous formulation propetamphos (Clark *et al.* 1996) have been found in the UK. Lysyk (1996) discusses the development of Integrated Pest Management (IPM) for livestock systems and states that resistance management has become an important issue for producers which can be achieved by altering application methods from one season to the next, and alternating compounds from different chemical classes such as organophosphates and pyrethroid insecticides. However others believe that sustainable farming requires a wholesale change in management practices if biological diversity is to be maintained, however what those changes should be is far from clear.

Edwards-Jones and Howells (1997) used the Environmental Impact Quotient (EIQ) developed by Kovach, Petzoldt, Degni, and Tette (1992) to examine the toxicity of pesticides approved by the Soil Association for use on organic farms, and those typically used on conventional farming systems. They found that generally pesticides and fungicides permitted on organic systems were less toxic than those used on conventional systems, although there were some clear exceptions, such as Copper Sulphate and Bordeaux mix. They also pointed out that many organic pesticides required a high number of applications to be effective such as sulphur (x7) and rotenone (x6). Furthermore when the volume of application was considered along with toxicity they found that in some circumstances organic systems could have a higher environmental impact than conventional ones.

For this reason, biological control is seen as an alternative to synthetic pesticides as a form of disease control on sustainable and organic systems. One of the principles of IPM is farming so as to encourage the natural enemies of crop pests, who would keep pest populations down below that which would cause economic loss. Landis and Orr (1996) describe three general approaches to biological control, importation, augmentation and the conservation of natural enemies. 'Importation' refers to classical biological control where a pest of exotic origin is controlled by introducing a predator species from the pests original homeland. 'Augmentation' refers to manipulation of natural enemies to increase their effects either through colonisation or genetic enhancement. 'Conservation' involves reducing factors that interfere with natural enemies such as badly timed insecticide sprays or providing resources that natural enemies need in their environment. The use of beetle banks to provide a habitat for natural pest enemies as described by Wratten and Thomas (1990), clearly adds to the genetic diversity of the countryside, and to the diversity and ascetic value of the landscape.

However, some aspects of biological control have caused concern, particularly where biotechnology is involved. The release of genetically engineered organisms into the environment, whatever the intention could have a drastic impact upon native wildlife and organisms. Many in the wider community would be extremely concerned at the release of microbes, which could soon mutate and develop into different strains and attack different organisms to the target.

It is not only with arable farming, however that conventional agriculture has produced environmental problems, Roberts (1992a) discussed the strengths and weaknesses of grassland farming from an environmental point of view. He stated that the loss of grassland, the spread of intensive grassland and the loss of diversity within grasslands are major environmental problems. The move towards intensive production from grassland has resulted in the disappearance of the traditional hay meadow from the lowlands of Britain and much of the rich flora and fauna associated with that habitat. Table 1.3 indicates the decline in biodiversity across a variety of habitats from 1978 to 1990, and is based upon data taken from the countryside survey of 1990. The survey found that over this period there was a significant decline in species numbers in infertile or semi-natural grassland (Table 1.3).

Table 1.4 indicates the effects of different management options for grassland upon output and wildlife. Reseeding, drainage, chemicals, early cutting all has minor effects on productivity but have major effects on wildlife. Those activities, which were found to have major effects on wildlife, were the late cutting of grassland, grazing with cattle rather than sheep, and grazing intermittently rather than continuously.

Table 1.3. Gross change in plant diversity in major vegetation groups and linear features: 1978-1990

(a) Gross changes in species numbers recorded in plots surveyed in both 1978 and 1990 [1]					(b) Gross percentage changes in mean species numbers	
Great Britain			Mean species number		% change	
Major vegetation		All plots			All plots	
Groups	2			2		
		1978	1990	3		P
Crops/weeds		7.0	6.6		-6.2	NS
Tall grass/herb		13.3	13.8		3.8	
Fertile grassland		12.5	12.5		0.0	
Infertile grassland		21.2	18.6		-12.4	**
Lowland wooded		12.5	12.8		2.1	
Upland wooded		20.5	16.2		-20.7	**
Moorland grass		22.1	20.7		-6.2	
Heath/bog		17.6	18.7		5.8	*

(From DEFRA 2002d).

1. Plots are included regardless of whether the major vegetation group of the plot changed between 1978 and 1990. Thus gross changes *include changes within and between different vegetation groups.
2. Plots are allocated to the major vegetation group recorded in 1978.
3. Significance is based on paired t-tests: Probability (P) * <0.05, ** <0.01, *** <0.001.

Table 1.4. Generalised effects[1] of agricultural management options on utilised output and wildlife

	Utilised output	Higher Plants	Insects	Birds	Small Mammals
Increase fertility	+	-	-	-	0
Increase level of Utilisation	+	(-)	-	-	-
Increase proportion reseeded	(+)	-	-	-	(-)
Improve drainage	(+)	-	-	-	?
Use herbicides	(+)	-	-	V	?
Use pesticides	(+)	0	-	V	(-)
Increase proportion early cut	(+)	-	-	-	(-)
Increase proportion late cut	(-)	+	+	+	+
Graze with cattle rather than sheep	(-)	(+)	+	+	+
Graze intermittently rather than continuously	0	V	+	+	V

(From Wilkins and Harvey 1993).

[1] The direction of change, either positive or negative is indicated with symbols. Those not in parentheses indicate major effects. V signifies that direction of effect varies in different situations.

Changes in grass conservation techniques have also had an adverse effect on biodiversity, silage making rather than hay making leads to a more early cutting date, and losses in the diversity of higher plants, insects and birds (Wilkins and Harvey 1993). Thus in the uplands grassland improvements, and increased intensity of fertiliser use, coupled with increased stocking rates has also lead to the loss of many important habitats such as heather moor-land. In Cumbria between 1940-1970 for instance 70% of heather moorland was lost, of which half is attributed to overgrazing and the rest to afforestation and moorland conversion (NCC 1992). However this is not a simple relationship, and upland and hill pastures require active management in order to maintain biodiversity. The grazing of livestock on semi-natural vegetation prevents the invasion of scrub and maintains floristic diversity (Bignal and McCracken 1996), thus a certain level of agricultural activity is beneficial to the environment in the upland and hills. According to Brouwer and Lowe (1998) however in parts if the UK livestock numbers are falling below desirable levels from a land management/conservation point of view.

Biodiversity is not only an issue on grassland in upland areas, the area of chalk grassland in the lowlands of Britain declined significantly between the 1960s and the 1980s from over 40,000 ha to 35,000 ha with the biggest losses in Wiltshire. This decline was also associated with a greater fragmentation of these habitats (D.o.E. 1996a).

1.5.1.2. Landscape

Landscape is a concept, which includes not only natural beauty, but also according to the Countryside Council for Wales, cultural (historic, intellectual and spiritual) dimensions (see CCW 1996). This report says that as well as visual factors, sight, smell, feel and sound all contribute to landscape appreciation. The individuals experience of landscape is also affected by cultural background and their own personal and professional interests (CCW 1996).

Sustainable farming systems would make use of natural features such as hedgerows and field margins and are considered to enhance the landscape features of the countryside. The extra variety of crops and mixed farming systems would contribute to the patchwork type image of the British countryside, which is regarded with favour by the general public. Roberts (1992a) describes the loss of grassland in lowland Britain, saying that in the last 40 years more and more cropping has appeared and elms and other field edge trees have disappeared. In particular intensive agriculture has lead to the rapid loss of many traditional field boundaries, and has had a profound effect on the landscape of particularly lowland Britain, where arable farming has spread into many traditionally pastoral regions. Hedgerow lengths in Great Britain have decreased by an estimated 150,000 km between 1984 and 1990, with about a third through uprooting and the other two thirds through management neglect (D.o.E. 1996a). HMSO (1994) report that there was also a loss of quality, so that between 1978 and 1990 one plant species was lost for each 10m of hedge, representing an 8% loss in plant species diversity. Much of this may also be attributed to the increasing scale of farming

with bigger machinery, leading to bigger fields and a reduced need for boundaries. However neglect and reduced management also played a part. In conclusion, Sustainable and Organic farming systems which encourage diversity, would therefore have positive benefits to the landscape features of the British countryside, compared with a continuation of intensive methods and monocultures.

1.5.1.3. Pollution

Conventional agriculture is regarded as a significant source of pollution in the countryside. The report of the Royal Commission on Environmental Pollution (RCEP) entitled *Freshwater Quality* (HMSO 1992b), states that farmland forms a major proportion of water catchment areas, and agricultural activities have a considerable potential to pollute freshwater. The risks are increased with a trend towards intensification. Another RCEP report on *The Sustainable Use of Soils* (HMSO 1996c) states that there is a long-term link between the use of inorganic nitrogen fertiliser and nitrogen losses. However organic farming practices cannot simply be equated with environmental improvement, thus there is evidence that organic farming may in some circumstances lead to pollution. Nitrate leaching and losses from organic farms is well documented. Watson, Fowler and Wilman, (1993) measured nitrate leaching from organic grassland farms and found evidence of significant leaching from fields where a grass ley had been ploughed for winter cereals. The simple exclusion of inorganic sources of pollutants does not make the risk of nitrate leaching any less. Addiscott, Whitmore and Powlson (1991) state overall nitrate leaching from organic farms is less simply because they are less intensive. They give the example of organic livestock farms where the stocking rate is much less than conventional farms, so leaching is less. The danger on organic and low input farms is the use of grass/clover leys to build soil fertility and structure. Cuttle, Hallard, Gill and Scurlock (1996) report that nitrogen leaching from upland grass/clover plots amounted to 13-24 kg N/ha/annum, whilst for grass plots receiving 100 kg N/ha/annum the figure was 10-13 kg N/ha/annum. In particular there is considerable risk of leaching when these are ploughed up in the autumn and returned to arable production. Ploughing in the autumn appears to be one of the main causes of nitrate leaching, and it is for that reason that minimal or non-inversion tillage is often considered to be more environmentally friendly. In addition to less risk of nitrate leaching non-inversion tillage leads to lower fuel costs for the farmer, and less depletion of fossil fuels. There is however an increased risk from weeds and disease due to the poorer disposal of crop residues.

However it is not just nitrate leaching that is an environmental problem. The National Rivers Authority (NRA) and MAFF reports (1989,1990) stated that as long ago as 1988 17% of water pollution incidents arose from agriculture, and these tended to be some of the most serious cases. Thus agricultural pollution was the cause of 56% of prosecutions, arising from river pollution. With livestock farms presenting special problems Nicholson (1994) reviewed ways in which livestock farms could be sources of water pollution (see Table 1.5).

Table 1.5. Potential sources of water pollution from livestock production

Source Materials	Contaminants	Sources and Routes
Slurry Manure Dilute Effluent	Organic Material (BOD)	Buildings Storage Direct Discharge
Milk Silage Effluent	Nutrients (Nitrate, Phosphate)	Land Runoff Drain flow
Carcasses	Biological Material	Nutrient Leaching
Veterinary Products	Chemical Residues	

(From Nicholson 1994).

Among the worst of these are silage effluent and animal waste. Thus silage effluent is 200 times stronger in biological oxygen demand than raw domestic sewage and twice as strong as slurry (HMSO 1992). Haigh (1992) reports that in dry seasons silage effluent was responsible for around 15% of farm pollution incidents, whilst in wet ones it rose to about 25%. The quantity of grass silage has increased five fold since 1970, an increase which has been accompanied by a reduction in average dry matter from 280g/kg in the mid 1970s to 240g/kg in the 1980s and 1990s. This reduction in dry-matter content, has increased the potential for pollution. According to Haigh (1992), analysis of silages made in 1991 revealed that 14% of the silage was made with a dry-matter content below 190g/kg, but this fraction was responsible for 33% of the effluent produced. Likewise animal waste from intensive livestock farms is also highly pollutant, and is illegal. Pig and poultry farms are covered by the Integrated Pollution Prevention Control (IPPC) regulations as a sector which is deemed to have a high risk of causing pollution. These regulations state that farmers must by law use the best available technology (BAT) in order to minimise pollution, and require a permit to operate (Environment Agency 2001). However a lot of pollution is also connected with intensive dairy, beef and sheep systems. According to Nicholson, poultry production causes relatively fewer incidents due to the fact that poultry are housed in totally roofed areas, and that poultry excreta are normally handled as solids or semi solids.

With regards the relative merits of conventional and organic agriculture and water, although organic agriculture leads to less pollution from pesticide residues, the evidence is that a poorly managed organic or low-input systems are not any less likely to contribute to water pollution especially nitrate leaching than intensive ones. The same is true of air pollution from agriculture, which, takes the form of pollution from the manufacture of inputs such as fertilisers, pesticides together locally with exhaust fumes from tractors, and the smell from animal waste. Again organic farming systems that do not require synthetic chemical inputs are of course likely to be more sustainable than a low input, conventional system as regards pollution from manufactured inputs. However organic and low-input farming systems still make use of mechanical power and petrol/diesel powered machines, with all the

environmental problems associated with them, in addition to the issue of non renewable energy use. The number of machines on farms has rapidly increased on farms of all types as well as the size, leading to the increased use of fossil fuels and also increased air pollution from fumes. At the same time farming systems which rely on recycling animal waste are also have the potential to produce increased pollution from these sources as well as smell.

Air pollution from agriculture also occurs, and agriculture is a major source of two greenhouse gases. Approximately 71% of total UK ammonia emissions comes from animal waste in livestock agriculture, with 9% from non-livestock agriculture (DTI 2002). Livestock are the source of 34% of total UK methane emissions (DTI 2002).

1.5.1.4. Soil

Bullock and Thompson (1996) list the following as current threats to the sustainability of soil in the UK:

1. Declining levels of organic matter;
2. Soil erosion;
3. Loss of valuable peat soils;
4. Decrease in the quality of soil structure;
5. Possible loss of Biodiversity of soil fauna and flora.

To this list may be added the issue of pesticide contamination of soil and eutrophication by phosphates.

Arden-Clarke (1988) reviews the literature relating to soil erosion and structure in the UK, and reports evidence of soil erosion occurring in Britain since the 1950s. He concludes maintaining levels of soil organic matter is of critical importance in controlling soil erosion, and organic farming techniques are geared towards maintaining the organic matter levels in the soil. The proportion of grass/clover in the rotation is a key element in maintaining soil organic matter levels and structure, thus organic and low input systems utilising grass leys must be beneficial to the sustainability of the soil.

Soil compaction on organic/low input farms needs to be addressed, since often chemical control of weeds is replaced with cultivations and extra machinery going onto the land. Arden-Clarke does claim that the presence of a grass/clover ley does remove the need for many operations during one year of a rotation, and as a consequence of improved structure fewer cultivations are required in the preparation of seedbeds. There is also the question of the end product being removed from the farm ecosystem and sold on, therefore it is logical that this loss must be replenished from some source in the form of inputs (Harvey 1991).

The work of Lockertz *et al.* (1980) and Bujaki *et al.* (1995) report depletions of soil fertility under organic systems, while Johnstone (1991) reports on losses in soil fertility under the Norfolk four course rotation in the last century under conditions very similar to that on organic farming systems. Njos (1994) also states that this system was not entirely balanced and that there was a gradual decrease in soil organic matter over time.

1.5.1.5. Non Renewable Resources

In the aftermath of the oil crisis of the 1970s there was much concern over the efficiency of utilisation of fossil fuel resources and much effort was put into researching methods of improving energy efficiency in all sectors of the economy. It was out of this, that much of the early ideas about sustainable agriculture came about. Wilson and Brigstocke (1977) reported that while agriculture had become more efficient in many ways, it had become less efficient in terms of energy. Between 1905-1968 nitrogen[1] inputs increased eight-fold, phosphatic and potassic fertiliser use increased 30 fold, while crop yields merely doubled. Bonny (1993) looks at the energy use in French agriculture, and reported that between 1959 and 1977 and increasing amount of direct energy was needed to produce a given volume of product, but since then it has been decreasing. Spedding and Walsingham (1976) discuss the increasing dependence of intensive agriculture on fossil fuels. Jackson (1992) states that in the UK the energy value of the fossil fuel input to agriculture is twice the value of the food output. However in developing countries such as Pakistan the value of food output to fuel input is 3.3 to 1. However this is largely because of the use of hand labour, such a system would be extremely difficult to adopt in developed countries due to the lack of available labour.

Organic and conventional agriculture rely on increased cultivations for weed control, and utilise essentially the same machinery with the same energy requirements as conventional farms. Animal waste also has its energy cost in terms of fuel used handling, storing, treating and application. However Pimental (1984) estimates that using animal manure provides a three-fold energy saving over commercial fertiliser. Lockertz *et al.* (1980) compared organic and conventional corn belt farms and found that conventional farms were 2.3 to 2.4 times more energy intensive. Klepper *et. al.* (1977) found in a study of organic and conventional farms on the US corn belt that conventional farms where more than twice as energy intensive as organic farms, and that labour input for organic farms was 3.3 hours per acre while 3.2 hours per acre for the conventional ones.

Bujaki, Guzli and McKinlay (1995) compared energy ratios of inputs to outputs on organic and conventional farms in Scotland and Hungary. They found that for winter wheat production, Hungarian organic farms were five times more efficient than conventional farms, yet conventional potato production was 20% more efficient than organic production. In

[1] Nitrogen is one of the most energy intensive nutrients to produce, according to Lockertz (1980) 14,700 kcal of fossil fuel are needed to produce 1 kg of nitrate fertiliser compared with 300 kcal/kg for phosphorous and 1600 kcal/kg for potassium.

Scotland, conventional potato production was a 100% more efficient, and conventional winter wheat production 60% more efficient.

1.5.2. Economic Issues

Sustainability entails considering more than the environmental aspects of agriculture, it is about maintaining a profitable farming system over time, and maintaining thriving rural communities. Much of the more recent debate and discussion on sustainability has focussed on economic issues and the need to secure a viable economic future for agriculture (see Cabinet Office 2002).

1.5.2.1. Farm Viability

Several studies have examined the relative economic performance of organic or low input farming systems, with more conventional agriculture. The results indicate that while organic farming leads to lower yields, (see Table 1.6). Premiums received for organic produce make up farmers incomes to that of conventional farmers. According to Vine and Bateman (1981), organic farmers need premiums to generate incomes comparable with conventional farmers.

Table 1.6. Comparative yields for conventional and organic crops in Great Britain 1989

	Organic t/ha	Conventional t/ha
Winter Wheat	3.73	6.16
Spring Wheat	3.24	4.95
Winter Barley	3.09	5.31
Oats	3.59	4.41
Field Beans	1.97	2.96
Potatoes (Main Crop)	18.98	51.27
Onions	27.41	49.47

(From Murphy 1992).

Fowler, Midmore and Lampkin (1998) compare the financial performance of organic and comparable and conventional farms (see Table 1.7). They conclude that most farm types can maintain incomes once fully converted, however significant conversion costs exist, despite the availability of conversion subsidies.

Table 1.7. Comparison of economic performance of organic and conventional farms in England and Wales 1995/96

Farm Type	Net farm income of organic farms as a % of a comparable conventional farm
Cropping	132
Horticulture	57
Dairy	100
Mixed	74

(From Fowler, Midmore and Lampkin 1998).

A Low input system allows for any eventuality or disaster say a bad year where synthetic inputs could be used if needed to ensure adequate food for the population. Njos (1994) states

that it is reasonable to say that a system cannot be expected to endure a major climatic change such as an ice age, but should be able to sustain over normal variations of say a generation or a century.

Thus to be sustainable a system must have means to overcome poor years, and to survive and continue. A sustainable system needs the means to adapt to new conditions, and overcome new problems in future years. Sustainable systems would retain the option of using synthetic inputs, to prevent famine, farm bankruptcy, and any irreversible effects of a bad year or harvest. A sustainable system would also leave future generations the option of using such inputs, thus it would seek to conserve non-renewable resources by reducing their use.

It is generally agreed that for most of the last 50 years, there has been an imbalance between food production and the conservation of natural resources, and a sustainable system would bring the two goals back into balance. Many argue that conventional agriculture could not have carried on as it was, the high input systems that have come into being since the second world war in industrialised countries were damaging the soil and natural systems which agricultural production relies on. Thus eventually the gains in productivity would be lost. When fossil fuels run out, farmers would be left looking for alternative forms of inputs or means to build up soil fertility and control pests anyway. Work by Jordan, Hutcheon, Donaldson and Farmer (1995), as part of the LIFE (Low Input Farming and the Environment) from 1989 to 1994 gave the following results for the 5 year means of the system comparisons (see Table 1.8.). The study compared farms using a conventional and integrated rotations under two differing input regimes, standard farm practice to reflect conventional agriculture, and a low input option.

Table 1.8. Results of LIFE (Low Input Farming and the Environment) project 1989-1994

Conventional Rotation	Gross Margin	Integrated Rotation	Gross Margin
Standard Farm Practice	£577.76/ha	Standard Farm Practice	£576.60/ha
Low Input Option	£614.80/ha	Low Input Option	£558.45/ha

(From Jordan, Hutcheon, Donaldson and Farmer 1995).

They conclude that these results indicate that there is scope for a low input system, which is economically as viable as a conventional system, and is less environmentally damaging. Cain, Saunders and Wilcockson (1994) modelled the effects on farm incomes of the adoption of low input systems of farming for four farm types found in the UK. The results were based on using husbandry practices such as Conservation Grade or the RSPCA's (Royal Society for the Prevention of Cruelty to Animals) Freedom Food. The effect on farm incomes was estimated using computer spreadsheet models. They also compared the effects of moving to organic systems, but without any premium (see Table 1.9). These results show that moving to low input systems would be expected to have a less adverse effect on the more extensive

farm types such as hill and upland farms, however the losses on the organic farms would on the whole be much greater without a premium on organic produce.

Table 1.9. Changes in MII (Management and Investment Income) of four main farm types caused by the adaptation of low-input systems

Farm type	Intermediate	Organic
	(£ per adjusted ha)	
Dairy	-32	-95
Lowland livestock	-41	-145
Cropping	-18	-145
Hill and upland	-10	+32
Weighted average	-24	-125

(From Cain, Saunders and Wilcockson 1994).

The adoption of organic systems appeared to have a much more adverse effect on farm incomes, in most cases. The exception was hill and upland farming, which would already be farming extensively. They conclude that the adoption of such systems would clearly require some compensation to offset the fall in income. Murphy (1992) reports the following gross margins for winter wheat, and main crop potatoes produced on organic and conventional farms without premium (see Table 1.10).

Table 1.10. Gross margins in organic and conventional crop production without premium

	Organic £/Ha	Conventional £/Ha
Winter Wheat	291	466
Main-crop Potatoes	658	3389

(From Murphy 1992).

Thus it appears that without some form of compensation either through premiums or subsidies, a move to organic systems would have an adverse effect on farm profitability. The effect of moving to low input systems appears less disastrous or may lead to comparable levels of income with conventional systems.

1.5.2.2. Rural Employment

According to Stockdale, Findlay and Short (2000) the migration of rural to urban communities in most developed countries has been replaced by an urban to rural flow and rural repopulation tendencies. For example Copus (1995) states that rural depopulation in Scotland has now all but ceased apart from some of the most remote islands. The numbers of people engaged in agriculture in the UK however has been falling from 699.3 thousand in 1983 to 556.9 thousand in 2000 (MAFF 1997, DEFRA 2001b). Copus (1995) discusses the effects of such downsizing on the socio-economic sustainability of Scottish agriculture, and reports the agricultural labour is being most rapidly shed in the lowland, more accessible

predominately arable areas (where the population as a whole is expanding), whereas in more remote upland sheep farming areas agriculture is retaining or even expanding its workforce. In some of the island areas however he reports that rural depopulation is still happening. Hird (1997) in a report for the Sustainable Agriculture Food and Environment Alliance (SAFE) claims that organic agriculture would lead to a substantial increase in rural employment, not only on farms but further downstream in the food processing industries. From a review of studies the report concludes that organic agriculture requires a 10% higher labour requirement.

1.5.3. Social Issues

Issues of sustainability have now become overlaid not by just concerns about the environment, the prosperity of farming communities, but also about rural society, the safety of the food produced, the safety of farming methods, and the animal welfare aspects of livestock production methods.

1.5.3.1. Rural Society

The developments in conventional agriculture have lead to a change in the relationship between farming and many small towns in rural areas. Courtney (1997) states that the small market town has had a symbiotic relationship with agriculture as a first destination for farm outputs, a source provider of supplementary employment and income for farm households, a source of consumer goods and services. However he points out that the restructuring of rural society has effectively turned them into dysfunctional settlements. The alleged lack of understanding between town and country needs also to be addressed. The image of farming with the general public has significantly deteriorated since the war. Farming has come under attack from environmentalists and animal rights activists. Widdowson (1987) says that soon no farming system will be able to continue, if the urban voter considers it cruel or polluting.

1.5.3.2. Food Issues

It is quite clear that there is some dissatisfaction with the products of conventional agriculture and concern over food additives and modern food processing. According to Gregory (2000), the food safety scares of the 1980s such as *Salmonella* in Poultry, Food Additives and later on in 1990, BSE (Bovine Spongiform Encephalopathy) helped direct consumers towards organic and health foods. Tregear, Dent and McGregor (1994) carried out surveys of both consumers and retailers, they found that 29% of consumers had bought organic produce at some time, and of that group 45% claimed it was due to their own health compared with 9% who bought because it was less environmentally damaging. For non-buyers relative expense was cited as the main reason. The survey of managers of whole food shops found that managers felt that concern of personal health (41%) and family health were the main reasons for purchase. Neither supermarket nor whole food shop managers believed

that the supposedly less attractive appearance (less uniform) of organic food acted as a disincentive to purchase.

1.5.3.2.1. Consumer Health

It is the widely held view by many consumers that organic food is more healthy and nutritious than that which has been produced under conventional systems, or with the aid of chemical inputs. Tate (1994) describes the development of the market for organic food and states that the organic movement has a loud political voice, and is respected by the media. Gormley, O'Breirne and Downey (1989) state that consumer concerns and attitudes are significant factors in the efficient application of safe technologies in the agriculture and food industries, the consumer determines patterns of market demand and is increasingly involved in public policy e.g. regulations and priorities in research funding. They also say however that despite a high level of concern there is evidence that the consumer is poorly informed on health related issues.

1.5.3.2.2. Food Safety

There is concern over the consequences for human health of 'Factory Farming' techniques, which has lead to the scares over salmonella. People feared that diseases that are common in intensive livestock production could be passed on down the food chain to humans and this has lead to increased incidents of food poisoning.

The BSE crisis of 1996 has brought into focus modern beef production and the previous use of ruminant offal as cattle feed, which has shaken many consumers confidence in Beef. The organic movement has made much of the fact that there have been no cases recorded so far in organic herds, while many specialist grass based beef producers feel they were punished for something that was not their problem. Gregory (2000) states that the food scares of the 1980s helped to direct consumers attention towards organic and health foods. Some however have challenged the widely held view that organic food is safer than conventional food. Trewavas (2001) questions the safety of organic food on a number of issues, such as the potential for *E.coli.* infection from manure, and the risks from applications of sulphur sprays which contain lead, and spraying bacterial spores as biological control agents onto crops.

1.5.3.2.3. Food Quality

The Soil Association (2001a) claim that organic food is better than food produced by conventional farming in terms of nutritional quality, and human health. Woese, Lange, Boess and Werner Bögl (1997) reviewed studies on the quality of a range of foods produced by organic and conventional farming methods. The review of over 150 comparative studies involving a number of different methods did find some differences between food produced under the two systems. Conventional vegetables on the whole were found to have a higher nitrate content than those organically grown, lower pesticide residues were found in organic vegetables and fruit. In addition in the case of vegetables in particular leaf vegetables a

higher dry matter concentration was observed in organic crops compared with conventional ones. Nilsson (1979), who measured a range of chemical values in cabbages, carrots and leeks, and concluded that the exclusive use of organic manure's would not lead to a more healthy chemical composition or better storage ability. However other studies looking at the performance and productivity of animals fed on conventional and biologically grown feed, seem to indicate that conventional agriculture produces feed, inferior to biological agriculture. For instance Balfour (1975) found that an organic dairy herd produced a higher milk yield on a lower ration of concentrates, than a conventional herd. The evidence however is that food produced under organic systems does not taste any better or does not offer any nutritional benefits to consumers, over equivalent foods produced under conventional systems. The Foods Standards Agency (FSA) have however stated that in their view there is not enough evidence at present to say that organic foods are significantly different in terms of safety and nutritional content to those produced under conventional systems (FSA 2000).

1.5.3.2.4. Pesticide Residues

Mintel (1999) report that 43% of consumers are concerned about pesticide residues. It is a fact that many consumers feel better about a product, which they believe is free from the residues of chemical pesticides. There is however little scientific evidence that this is the case, although some may claim that organic food tastes better any benefits to health have yet to be proved. Hodges (1981) states that the fact that conventionally produced food contains pesticide residues reduces quality compared with organic food. The Pesticide Residues Committee describe how Maximum Residue Levels (MRLs) have been set for over 11,000 pesticide/commodity combinations (PRC 2001). These are designed to provide a check on whether the pesticides are being used correctly rather than safety limits. Thus exposure the pesticides in excess of the MRL does not necessarily mean a risk to health. On the actual level of pesticide residues in food according to PRC (2002), analysis of over 4,003 samples taken in 2001 from a variety of foodstuffs showed that:

1. 70.6 per cent did not contain detectable residues;
2. 28.7 per cent had residues below the MRL;
3. Less than one per cent had residues above the MRL.

In the USA 35% of food purchased contained detectable levels of pesticide residue (Food and Drug Administration 1990). The public perception of pesticides is still unfavourable however and in terms of social sustainability organic systems may be preferable, but of course this is balanced against consumer demand for cheap food, and the needs of farms to stay viable.

1.5.3.2.5. Genetically Modified Foods

One big difference between organic and conventional agriculture is the use of Genetically Modified (GM) organisms, with the rules of the organic certifying organisations prohibiting their use outright (Soil Association 2000, UKROFS 2001). There is currently a very fierce debate as to the human safety aspects of genetically modified foods, with a perceived backlash against the use of GM technology for food production (see BBC 2000). The Parliamentary Office of Science and Technology (1998) review the issues pertaining to the benefits and risks and public perceptions of GM crops. They review several consumer surveys and report that many members of the public are concerned about GM foods, particularly in Northern Europe. However they point out that this does not mean that consumers are likely to reject GM food out of hand rather they will assess each product on a case by case basis. They also conclude that GM products where the perceived benefits accrue to the producer rather than the consumer are among the least likely to be accepted. Grunert (2001) found that European consumer attitudes towards GM food are negative and for a sizeable proportion extremely negative. These negative attitudes are embedded in a system of more general attitudes of nature, technology and the marketplace, and while they are unlikely to change with more information on GM food, they may change with more experience of GM products and the use of GM with clear consumer benefits.

1.5.3.3. Farm Safety

Related to the health of consumers is also the issue of farm safety and the effects on the health of farmers and farm-workers of agricultural production methods. Issues pertaining to farm safety include Farm accidents, pesticide exposure and stress.

1.5.3.3.1. Farm Accidents

Farming is a dangerous occupation, increased mechanisation has lead to a high number of injuries and fatalities. There are more fatal accidents on farms than in any other industry but construction (Health and Safety Executive 2000).

1.5.3.3.2. Pesticide Exposure

Exposure to pesticides also present health problems to those engaged in agriculture. Pimental, Culliney and Bashore (1996) claim that throughout the world the highest levels of pesticide exposure are found in farm workers, pesticide applicators and people who live adjacent to heavily treated agricultural land. Stallones and Beseler (2002) have claimed to have found a link between pesticide exposure and depressive symptoms in the farm population. There has been particular concern in Britain over the use of organophosphorus based sheep dips and cases of ill health amongst farmers. Gray (1994) reports on surveillance carried out by the Veterinary Medicines Directorate (VMD) in 1992 and states that of 204 reports of suspected adverse reactions to veterinary products in humans, a significant proportion 132 (involving 137 people) involved organophosphate sheep dip.

1.5.3.3.3. Farm Stress

Deary (1994) reviews studies on stress in farming families, and quotes work by the Institute of Occupational Safety and Health, which ranked farming 12th out of a list of 130 'high stress' occupations, but points out that stress in agriculture has received relatively little empirical study. Pooley (1996) claims that farmers differ from the rest of the population in personality terms, in that they are more anxiously inclined than other occupations. In his study it was found that nearly half of the farmers had trait anxiety levels equivalent or higher than those found in psychiatric patients. In addition older farmers were found to have a higher level of trait anxiety than younger ones, which he says is probably a reaction to the perceived uncertainties of modern day agriculture. Pooley (1996) says that recent changes in farming practices are making things worse, farmers are increasingly isolated from their colleagues, instead of being part of a thriving community. The number of farm suicides has had particular attention, however reasons for the unusually high suicide rate amongst farmers and farm workers are varied. Possible causes are poor economic fortunes, isolation, and even the suggestion of viruses from animals causing depression. The average age of farmers has been increasing, fewer are fewer farmers sons are taking on the family farm, and numbers of people coming into the industry has also been falling.

1.5.3.4. Animal Welfare

Consumers are increasingly concerned about the means by which food is produced, in particular methods of livestock production, which are believed to cause unnecessary suffering to animals. Concerns about animal welfare and animal slaughter have contributed towards reduced meat eating (Gregory 2000). The OECD (1994) reported that intensive animal husbandry systems are characterised by greater animal confinement and a higher incidence of disease, leading to producers relying on disease treatment instead of prevention. Webster (1995) lists five freedoms, which set up the minimum standards of welfare, which are socially acceptable:

1. Freedom from thirst, hunger and malnutrition by ready access to fresh water and a diet to maintain full health and vigour;
2. Freedom from discomfort by providing a suitable environment including shelter and a comfortable resting area;
3. Freedom from pain, injury and disease by prevention or rapid diagnosis and treatment;
4. Freedom to express normal behaviour by providing sufficient space, proper facilities and company of the animals own kind;
5. Freedom from fear and distress by ensuring conditions which avoid mental suffering.

Certain people within society will always object to livestock production altogether on the grounds of ethics. Most people in the UK however still eat meat, yet many consumers are concerned about animal welfare, and value meat that has been produced under what they

perceived as welfare friendly conditions. These are commonly seen as what they perceive as natural conditions for the animals, and expressing a preference for more extensive forms of livestock production.

Thus to date the animal welfare debate has traditionally been confined to discussions on the intensive 'Factory Farming' methods of modern pig and poultry producers. More recently this has been extended to include the controversy over live exports of veal calves, the treatment of cattle and the general treatment of cattle, especially in the dairy sector. It was with regard to intensive pig and poultry production that the term 'Factory Farming' came about, where the animals are removed from the land and placed into a controlled environment inside. The foot and mouth epidemic of 2001 has brought the issue of animal health into sharp focus, clearly this impacts upon a number of issues relating to sustainability, since it not only threatens animal welfare but the economic viability of farming as well. The *Commission on the Future of Food and Farming* states, that the efficient and profitable production of livestock is dependent upon healthy animals (Cabinet Office 2001). In England, the Welfare of Farmed Animals (England) Regulations 2000, HMSO (2000) deals with the welfare of all species of farmed animals and sets minimum standards in terms of housing, provision of light and water, and restrictions upon natural behaviour. This legislation and other similar legislation applying to the rest of the UK, prohibits a number of agricultural practices on the grounds of welfare such as the routine tethering of animals. Animal welfare issues however should not be considered in isolation to the other aspects of sustainability and an integrative approach is necessary. Welfare standards may conflict with environmental standards e.g. a permanent outside yard may be recommended for dairy cattle as far as animal welfare is concerned, but may increase pollution risks unless all water run-off is collected (Schulte, Earley, van der Wouw and Culleton 1998).

Webster (1994) describes the development of veal systems, and the legislation in the UK, which effectively bans white veal production. The export of calves to other countries to be reared under conditions illegal in the UK is unacceptable to the many of the general public. The sexing of embryos could solve the problem and the technology exists, but is not yet available on a commercial scale. Breeding could also play a part, if farmers were to go down a more extensive road, then 'dual purpose' dairy breeds could return, where the male calves would be more useful for beef production than at present. In the mean time it is more cost effective to export calves for veal production in other EU countries than development alternative rearing systems here. Attempts have been made to produce veal more humanely such as the 'Quantock' system of group housed veal production, but according to Webster (1994) this failed due to increased disease incidence, and poor food conversion efficiency.

The organic livestock sector is often less well developed than that for crop products. On animal health issues under organic rules, (UKROFS 2001), will allow the use of chemical drugs providing no alternatives are available particularly in order to 'save life, to prevent

unnecessary suffering, or to provide the only way to restore the animal to full health.' The standards however emphasise the use of good stockman-ship, the use of natural resistance to disease, and alternatives to modern medicine such as homeopathy. The subject of animal welfare is a difficult issue for organic producers, Lazarus (1993) raises the issues involved, as states that the standards must put animal welfare first, if an animal is suffering from mange should you treat it with an environmentally unfriendly but effective product or let it suffer or kill it?

In a sense as far as animal health is concerned due to the demands of animal welfare the organic associations appear to have compromised and have opted for an integration of chemical and other means of disease control. This is in part due to the concern for animal welfare felt by the general public. Survey work by Halliday *et al.* (1994) revealed few organic farmers in Scotland reported significant problems regarding sheep and cattle health, however there did appear to be ignorance regarding *helminthoses* control of by grazing management. Some alternative treatments attempted for various disorders were found to be inappropriate or ineffective.

For the sheep and beef industries the problems have been with the export of live animals to the continent, and the stress involved in long journeys to other EU states. When considering animal welfare issues the dealers, slaughterers and hauliers need also to be taken into consideration, and any restrictions that society would place on them would have its effect on the farming industry. With extensification leading to lower stocking rates and fewer stock, there has been some concern that the management input on some farms will decrease and animals on some upland units will not be monitored adequately for disease, lambing problems e.t.c. According to Waterhouse (1994) the removal of inputs from the difficult conditions of hill farming, increases the likelihood of increased lamb mortality. Thus he concludes that nature conservation objectives in the uplands need to be balanced against a decline in animal welfare.

1.6. Balancing the Demands of Sustainability

Many of these issues are at odds with each other for instance the need to balance consumer food safety, with supply of food at a reasonable price; or say farm profitability with animal welfare. Thus three conclusions may be drawn from this:

1. 'Sustainable' farming is not a clearly defined system;
2. It is attempting to embrace conflicting aims;
3. In attempting to define the characteristics of such a system, it is recognised that this involves subjective judgement.

Any definition of a sustainable system will have to be flexible, looking at alternative approaches such as organic or integrated it was felt that the integrated approach would be a more appropriate system to model and represent a likely future sustainable farming system for the UK. It must be remembered however that this is a fairly subjective judgement, and a

matter of personal opinion. Rigby, Howlett, and Woodhouse (2000) state that sustainability is a concept which changes across space and time and between people. Thus agriculture in the 1940s and 1950s was driven by the need to produce food to meet the needs of the population of Europe, and agriculture responded to the policy signals to meet those needs. However consumers have other needs now be it for environmental goods; for recreation in the countryside or for animal welfare, and thus agriculture must be flexible enough to meet these needs. In the context of peoples values, organic and integrated systems represent an alternative viewpoints in the sustainability debate, however in practice it is likely that a mix of systems may form part of an overall move to sustainability as a whole.

This study will define sustainable farming systems by looking at integrated farming systems, and in drawing up operational guidelines for sustainable farming systems to use integrated crop management techniques, and low input farming systems, which do not preclude the use of synthetic inputs; but attempt to use natural processes in conjunction with chemical inputs.

Chapter 2. Towards a Practical Definition of Sustainable Farming Systems

2.1. Defining Sustainable Farming Systems

From the discussion in the previous chapter, it is clear that it is impossible to obtain a precise definition of sustainability and thus to characterise a precise definition of a sustainable farming system. In drawing up a prescription for a sustainable farming system, it is inevitable that a high degree of subjectivity will be involved. Having said it is generally agreed that a sustainable farming system must address a number of key issues namely biodiversity, landscape, pollution, water, air, soil, resources, farm viability, social issues and animal welfare. Thus the first part of the chapter seeks to define the characteristics of sustainable farming, before defining operational systems for individual farm types.

2.2. Integrated Farming Systems

A number of farm level systems studies of low-input or integrated systems of arable farming have been carried out (see Table 2.1). These systems may be seen as a sustainable alternative to conventional agriculture.

Table 2.1. Systems studies on Low input Arable Farming in the UK

Name of Study	Reference
The Boxworth Project.	Greig Smith, Frampton and Hardy (1992)
LIFE (Low Input Farming and the Environment)	Jordan, Hutcheon and Perks (1990)
RISC (Reduced Input Systems of Cropping)	Easson, Courtney and Picton (1995).
SCARAB (Seeking Confirmation About Results About Boxworth)	Bowerman 1994, Green, Ogilvy, Frampton, Cilgi, Jones, Tarrant and Jones (1995)
TALISMAN (Towards a Low Input System Minimising Artificial Nitrogen)	Bowerman, Young and Cook (1995), Young, Bowerman and Cook (1994).
LINK Integrated Farming Systems	Ogilvy, Turley, Cook, Fisher Holland, Prew, Spink (1995 and 1994). Cook, Turley, Spink and Drysdale (2000).

A long running experiment of particular interest is the LINK Integrated farming systems (Ogilvy *et al.* 1994, Bailey *et al.* 1997) which looked at integrated farming in six agro-ecological zones across the UK over five years. The main objective of this work was to test the practical and financial feasibility of such systems; whilst taking into account the levels of inputs being used and their environmental impact. A parallel study known as TIBRE or Targeted Inputs for a Better Rural Environment is an initiative by Scottish Natural Heritage

aimed at to showing how technology may be used in farming to benefit the environment. The TIBRE handbook outlines the technology and products which may be used profitably on farms, whilst enhancing or minimising damage to the environment (Scottish Natural Heritage 2000). This guide is designed for farmers who do not wish to convert to organic production or make radical changes to their farming systems, but much of the material contained with the handbook is relevant to sustainable farming systems.

Farm-scale experiments have been carried out in other European countries such as Germany with the Lautenbach Project (El Titi 1992) or INTEX which is due to run from 1989-1997. Work in France by the ITCF (Institut Technique des Céréales et des Fourrages) is described by Viaux and Rieu (1995) and Viaux, Roturier & Bouchet (1993). Research in the Netherlands is described by Vereijken (1985, 1989, 1990), for Switzerland the 'Third way' project is described by Häni (1989 and 1990). The results from these farm scale experiments provide information, on the economic, production and environmental characteristics of integrated systems.

In terms of yields integrated systems tended to yield less than conventional systems, but in some cases, as with LIFE, SCARAB and the Lautenbach experiment gross margins were higher than for comparable conventional systems. On all of the integrated systems there were decreases in the use of synthetic nitrogen, herbicides, fungicides and insecticides, while on most there were increases in weed infestation. The results were more mixed for pest and soil borne diseases, with some experiments indicating falls in pest infestation. Table 2.2 summarises the results obtained from a number of these systems experiments. The majority of the experiments indicated increases in the numbers of beneficial fauna such as arthropods, earthworms under the integrated systems, and reductions in inputs such as fertiliser and pesticides. The seven out of the ten reported increased weed infestation, however for pests and seed borne diseases the results were more inconclusive. All but two reported significantly diseased yields, but on SCARAB, LIFE and the Lautenbach experiment an increased farm gross margin was reported.

These studies are very much concerned with arable systems, as far as livestock farming is concerned we can look at studies like the low input dairy experiment done by Bax (1990) or work on legume-based farming which is reviewed by Hopkins, Davies and Doyle (1995). For livestock we must also consider animal welfare issues since to be sustainable a system must be acceptable to the general public and the consumers of food. Frameworks such as the ESA (Environmentally Sensitive Area) schemes currently in operation in the UK, can also provide pointers as they have specificity, with each scheme suited to encourage farming to protect a particular regional ecosystem. The *Upland Management Handbook* of English Nature (2001) would provide some guidelines for farming systems in the uplands.

Table 2.2. Summary of results[1] for integrated farming compared with conventional practice reviewed

	Economics		Agronomics									Environment			
Project	Y	GM	N	H	F	I	PGR	W	P	SD	BA	BM	EW	SM	S
Boxworth	-	-		-	-	-	=	+	+	O	+	O			
SCARAB	-	+		-	-	-	=	+	=		+		o	O	
TALISMAN	O	O	-	-	-	-	-	O	O	O	=				
RISC	O	O	-	-	-	-	-	O	O	O	O				
LIFE	-	+	-	-	-	-	-	+	=	=	+		+	=	=
Lautenbach	-	+	-	-	-	-		+	-	O	+		+		=
INTEX	-							-		+	+				
Netherlands	-	=	-	-	-	-	-	+			+	+	+		=
Third Way	O	O	-	-	-	-	-	+	O		+		+	+	
France	O	O	-	+	-	-	-	+	O						

Key: Y=Yield GM=Gross Margin N=Nitrogen H=Herbicide F=Fungicide I=Insecticide PGR=Plant Growth Regulator W=Weeds P=Pests SD=Soil Borne Diseases BA=Beneficial Arthropods BM=Birds and Mammals EW=Earthworms SM=Soil micro-organisms S=Soil Minerals. '+' = increase '-' = decrease '=' = no change 'O' = variable result

(From Holland, Frampton, Cilgy and Wratten 1994).

Other relevant frameworks for consideration are the IOBC (International Organisation for Biological Control) guidelines for integrated production (see El Titi, Boller and Gendrier 1993), Conservation Grade or Freedom Foods mentioned earlier or the code for the 'Real Meat Company' (Guy 1989).

2.3. General Guidelines for Achieving Sustainability

There are general principles and techniques, which need to be applied to all kinds of systems, such as the use of legumes to build up soil fertility, the IPM approach on crop farms, and the need to maximise animal welfare on stock farms. However there is much which is specific to each farm situation, and what might be accepted as sustainable in one situation might not be in another, due to differences in soil, climate and topography. The following section outlines the management practices which should be followed on all farm types and systems, in order to be considered sustainable; while those that follow are suggested guidelines for specific farm types and systems.

2.4. The Sustainable Management of all Farms

It might be expected that sustainable farming systems would meet the following guidelines.

Guideline 1. The revised MAFF codes of good practice for the protection of water (1998), air (1998) and soil (1998), and pesticides (1998) should be followed (See MAFF 1998 a,b,c,d). The guidelines for farming within Nitrate Vulnerable Zones (NVZs) (DEFRA 2002h), should be followed on all farms.

[1] The results here represent general trends, however variations within individual studies occurred.

Guideline 2. There should be regular soil testing with major nutrient analysis of soil every 3-5 years, to determine soil deficiency problems, and to assist decision making as regards applications of inorganic fertiliser (El Titi *et al.*1993).

Guideline 3. Traditional and historical farm buildings, barns and outhouses should be maintained and preserved, unless they contravene animal welfare or health and saftety guidelines.

Guideline 4. Systems for energy conservation should be installed on farms where practical, such devices would include, straw burning boilers and air heaters, energy production from manure, heat pumps and use of wind and water power (see ADAS 1980). Heating systems for farm buildings should not waste energy, if a building only needs heating for short periods e.g. a milking parlour a time switch should be installed to ensure it is not heated any longing than necessary.

Guideline 5. Hedgerows and natural field boundaries, ditches, dykes, archaeological features must be maintained. Traditional field boundaries and features should be maintained. There should be no herbicide applications to base of hedges. Farm woodland and coppices should be properly managed. Archaeological features on the farm should be preserved and left undisturbed where possible. The FWAG (Farming and Wildlife Advisory Group) guidelines for hedges and field boundaries should be followed (see Appendix 1). Hedges should be maintained and kept in a stock proof condition, to provide both shelter for stock and wildlife and be protected by fences. Bell, Henry and McAdam (1993) found that if the conservation value of hedges is to be maintained they need to be protected from intensive grazing. All footpaths should be maintained, and access should not be impeded, so long as it does not interfere with normal farming operations.

Guideline 6. All heath and safety legislation relating to farms should be complied with for both the farmer and employees.

Guideline 7. Farm records should be kept (as stipulated by El Titi *et al.* 1993), which include information on ecological indications as well as economic, they should include :

1. Basic farm data, total farm surface, surface of individual crops and varieties, number and species of animals;
2. Records of off-farm inputs and outputs;
3. Records of medication used for livestock;
4. Field operation records;
5. Yields (physical) and product export (sales);
6. Pest control on farms should be carried out in a lawful manner.

2.5. The Management of Specific Farming Systems

In addition to the sustainable practices which should be followed by all farms, there are management practices which should be applied within specific farming contexts. Those for specific livestock and cropping systems found in the UK are outlined below.

2.5.1. The Sustainable Management of Livestock Farms

2.5.1.1. All types livestock farming systems

The following guidelines can reasonably be expected to apply to all kinds of livestock farming systems.

Guideline 8. Livestock farming should maintain high standards of animal welfare for all stock types, and in all systems of production. The *Code of Good Practice for the Welfare of Sheep* should be followed (DEFRA 2002e).

Guideline 9. Stress at weaning is another important issue, Webster (1994) concludes that it is better to get weaning over as soon as possible to prevent maternal bonding developing and causing even greater stress later on.

Guideline 10. Biosecurity should be a key concern for livestock farmers. Livestock farmers should follow the guidelines contained in DEFRA (2000g), which includes the following key advice:

1. A herd/flock health plan should be drawn up with a vet;
2. The farm should be kept clean and tidy;
3. Fences and boundaries should be maintained to prevent contact with neighbours stock;
4. Animals should be kept away from freshly spread slurry for at least 6 weeks;
5. Care should be taken when bringing in new stock to the farm.

Guideline 11. There should be no use of artificial growth promoters, or the routine use of antibiotics in the feed for healthy animals.

Guideline 12. The system should aim for the maximum recycling of animal wastes and manuring. Thus a Farm waste management plan should be drawn up and implemented (MAFF 1995). Herd size should be matched to the land availiable for manure spreading. There should be a capacity for storage of 6 month's manure production as per the regulations in Denmark (Baldock and Mitchell 1995). In addition the Royal Commission on Environmental Pollution (RCEP) note that Danish agriculture has adopted on more constructive atttitide to slurry (HMSO 1992b). Thus in Denmark it is looked at more as a resource rather than a waste disposal problem, and the emphasis is on the constructive use and recycling of waste.

Guideline 13. Livestock systems should be adopted which maximise the use of grass/legume swards. Thus grazing leys chould be based upon white clover, while conservation leys could include red clover, or suitable larger leafed white clover varieties.

Guideline 14. Appropriate stocking rates for the farm type should be set, and where possible rotational grazing systems, should be operated.

Guideline 15. Where possible silage should be wilted before being ensiled. However as the RCEP notes while a wilt of 3-4 hours can be beneficial in reducing effluent production, the scope for this depends upon favourable weather conditions (HMSO 1992b). Harvesting silage directly into big bales may help also reduce problems provided that they do not leak, and care is taken when they are opened that liquor does not contaminate drains or watercourses (HMSO 1992b). In addition silage effluent, if managed properly may be used as a source of feed or fertiliser; but it must not be allowed to pollute any water systems.

Guideline 16. Weed control on grassland should use legume friendly sprays (see Appendix 2). Equally there should be no use of herbicides exept to control nettles (*Urtica dioica*), spear thistle (*Cirsium vulgare*), creeping (*Cirsium arvense*), curled dock (*Rumex crispus*), broad leafed dock (*Rumex obtusifolius*) or ragwort (*Senecio jacobaea*). Moreover all herbicides used for these purposes shall be applied by a weed wiper or by spot treatment with a knapsack sprayer. Bracken can be sprayed with Asulam, by widespread treatments, if other mechanical or biological control methods are not effective.

Guideline 17. The aim should be for clean grazing systems for parasitic worm control and chemical control only be used if impractical. Even then the specific chemicals used should be rotated to prevent the build up of resistance. Sheep and Cattle numbers should also be balanced to assist the management of a clean grazing system (El Titi *et al.* 1993).

Guideline 18. Only straw-based housing systems should be used.

Guideline 19. All Animals should be kept and housed in even batches to reduce stress.

Guideline 20. Humane calf rearing systems should be used, veal crates and calf stalls should not be used. Veal production systems should allow the rumen must be allowed to develop as per UK government legislation. Friesian cross calves should only be considered for veal production.

Guideline 21. Organophosphorous dips should only be used, where there is no effective alternative. Where the risk of sheep scab *Psoroptes ovis* and Blowfly *Lucilia sericata* is not considered to be high alternatives to plunge dipping should be considered, such as pour on treatments, systemic injections and spraying. Moxidectin can be considered as a non-OP treatment for controlling sheep scab O'Brien *et al.* (1995).

Guideline 22. The Groundwater regulations (1998) which incorporates the EU Groundwater directive (80/68/EEC) should be followed when using sheep dip (See DETR 2001). This states that a farmer must obtain prior authorisation from the Environment Agency to dispose of sheep dip to land if the dip contains certain listed substances (which includes organophosphates). This means that farmers need to dip in accordance with good environmental practice and plan in advance the means of disposal. The guidance contained within the DEFRA (2001a) *The Ground water protection code : use and disposal of sheep dip compounds* should be followed.

2.5.1.2. LFA (Less Favoured Area) farms

However for LFA farms more specific measures are required for sustainability. The LFAs contain many fragile ecosystems and habitats, which are regarded as scientifically important. Thus many of the ESA (Environmentally Sensitive Area) schemes in existence are in the

Upland areas, and these provide a basis for defining the criteria for sustainable farming systems. For all LFA farms the following guidelines might be expected to apply.

Guideline 23. A sustainable system should aim for the maximum use of legume based swards, by using suitable white clover varieties such as Kent wild white, S184, Tara and Gwenda (SAC 1998).

Guideline 24. Synthetic fertiliser use should be kept to a minimum and should only be used strategically. Management guidelines for white clover from Hopkins, Davies and Doyle (1995) suggest 50kg N /ha/ annum, maximum. There should be maintenance applications only of Phosphate and Potash.

Guideline 25. There should be no further hill land improvement, ploughing, reseeding, levelling or destruction of semi natural grassland. No installation of new drainage systems or substantial modification of existing systems.

Guideline 26. Bracken control by cutting may be done in July, preferably two cuts in a year June/July. Asulam only herbicide to be used to control bracken encroachment, preferably during July and as a last resort.

To these may be added more specific management requirements for individual habitats which are presented in Appendix 3 and those for specific enterprises in Appendix 4.

2.5.1.3. Dairy farms

The following guidelines should apply to sustainable dairy enterprises.

Guideline 27. Systems studies such as that by Bax (1990), and that by the MMB (Milk Marketing Board) (Anon. 1993) on extensive dairying has indicated that under legume based systems, the margin per cow can be just as much under conventional systems, however the stocking rate must be reduced.

Guideline 28. There should only be strategic use of inorganic nitrogen. With the maximum use of legume based swards, using larger leaf varieties such as Olwen, Menna e.t.c, better able to withstand higher sward heights optimal for cattle grazing.

Guideline 29. The recommendations of the FAWC (1997) report on the welfare of dairy cows should be followed where possible. Dairy housing systems based on loose housing on straw for increased cow comfort and welfare, should be adopted.

Guideline 30. Cows of high genetic merit should be kept on appropriate levels of nutrition to meet their metabolic demands. As such sustainable dairy farms should adopt an appropriate breeding policy. The system should avoid excessive holstein/dairy type, to maximise value of calves. Genetic selection should be based on milk quality rather than yield, on feed efficiency, and the ability to utilise forage, as well as for beef value of calves.

Guideline 31. Calves should be weaned within two weeks, to prevent maternal bonding, and to reduce stress at weaning.

Guideline 32. Dairy replacements should be reared on the farm, to improve the social cohesion of herd.

Guideline 33. A heat recovery unit should be installed to conserve energy in the milk refrigeration equipment, the heat removed being used to heat water (see ADAS 1980).

2.5.1.4. Pig farms

The following are guidelines which should apply to all pig production systems, whilst guidelines for specific pig enterprises are found in Appendix 5.

Guideline 34. Pig farms must adhere to the IPPC regulations (Environment Agency 2001).

Guideline 35. All pigs should be kept in accordance to the MAFF (1987a) *Codes of Recommendation For the Welfare of Livestock : Pigs.* In addition pigs kept outside should be kept in accordance with the recommendations of FAWC (1996) *Report on the welfare of pigs kept outside.*

Guideline 36. All pigs should have access to clean water.

Guideline 37. Pigs should be slaughtered as close to the point of production as possible, if any transport is involved it should conform to all regulations associated with the transport of animals. Gas stunning using 2% oxygen in argon should be the preferred method (see Raj and Gregory 1996).

2.5.1.5. Poultry farms

For poultry production as with pigs there should be an increased emphasis on animal welfare, along with improved measures to minimise pollution from stock kept under intensive systems of production. The guidelines are subdivided into those which should apply to all poultry farms, and those which apply to specific systems, such as laying hens, broilers and turkeys, and indoor and outdoor systems, which are presented in Appendix 6.

Guideline 38. Poultry farms must adhere to the IPPC (Integrated Pollution Prevention and Control regulations (Environment Agency 2001).

Guideline 39. All poultry producers should follow the MAFF (1987b) Codes of Recommendations For the Welfare of Livestock : Domestic Fowls.

Guideline 40. Stock should be slaughtered as close to the point of production as possible, if any transport is involved it should conform to all regulations associated with the transport of animals. Humane slaughter would preferably be by inert gas as described by Webster (1995a).

Guideline 41. The feed should be cereal based which is free from growth promoters and routine additions of antibiotics.

Guideline 42. All poultry if housed should be on deep litter/straw bedded systems, litter should be 10-15cm deep, which is enough to absorb manure. Ventilated litter floors should be considered Van Middlekoop, Veldkamp, Meijerhof and de Buisone (1994) report that ammonia emissions are reduced by 50-90% under ventilated litter systems, however they also reported increased dust within buildings. Another method investigated by Van der Hulst-Van Arkel and Rump (1994) added the microbe *T. pantotropha* to the drinking water supply resulted in a reduction of ammonia emissions due to the microbes breaking down uric acid.

Guideline 43. Air pollution should be minimised by an appropriate stocking rate, drinkers designed to reduce spillage and an effective ventilation system. (see Barrie 1994). To reduce odour maintain any manure within the poultry house should be kept in a dry condition, adding water will result in strong unpleasant odours.

Guideline 44. All poultry should have access to daylight, which is believed to reduce the incidence of cannibalism (Guy 1989).

2.5.1.6. Mixed farms

Sustainability would generally entail a move towards more mixed farming systems, particularly on some areas, which are mainly arable at the moment but where crop enterprises are only viable with a heavy use of chemical inputs. Mono-cultural agriculture would be replaced with longer crop rotations involving an increased range of crops and in many cases the inclusion of grass leys and livestock.

Guideline 45. The waste products of some enterprises could be used as inputs into others, e.g. unwanted calves from a dairy enterprise could be utilized in a beef enterprise.

Guideline 46. Where possible crop waste could be fed to livestock, straw, beet tops, waste beet, potatoes e.t.c. are all sources of animal feed.

Guideline 47. The choice of enterprises should be based on local conditions, soil, climate, proximity to markets e.t.c.

Guideline 48. Short to medium term grass/clover leys should be used for any livestock enterprise and to build up soil fertility for the any following crops, minimizing the need for inorganic fertilizer. These leys would be based around appropriate grass/clover varieties, and would only receive strategic applications of inorganic fertilizer. The parasitic worm burden on livestock would be significantly reduced if grazing on short / medium term grass leys in an arable rotation, and this should reduce the need for drug treatments. Pesticides should not be applied to short term grass leys, unless as part of a program to control the weeds of the arable crops in the rotation.

2.5.2. The Sustainable Management of Crop Production Systems

Crops farms should follow the principles of (ICM) Integrated Crop Management, as was the case in the arable based LIFE and LINK IFS experiments and other similar systems experiments discussed in section 2.2.

2.5.2.1. General Guidelines for mainly crop farms

The following guidelines should be applied to mainly arable farms, along with Appendix 11, which covers specific arable crops. Cook (1994) claims that the principles of ICM (Integrated Crop Management) adopted by LEAF (Linking the Environment and Farming) already meet the primary criteria defined by government as the target of a sustainable

agriculture, and are summarised by the following (from British Agrochemicals Association[1] 1995):

1. Crop rotations for pest, disease and weed control;
2. Appropriate cultivations;
3. Careful choice of varieties;
4. The targeted use of inputs such as pesticides and fertilisers;
5. Monitored energy efficiency;
6. Operational planning;
7. Management to care for habitats.

2.5.2.1.1. Rotations

Proper planning of rotations is essential for sustainable cropping systems. The following guidelines describe rotational management on sustainable crop farms.

Guideline 49. Rotations should be selected to prevent the build up of disease inoculum. The use of break crops to build soil fertility, tackle disease and weed problems e.g. grass/clover ley, lucerne, peas, or beans.

Guideline 50. Altering sowing dates, cultivations from year to year prevents any one particular weed from becoming a problem. For example including Spring cereals in a rotation helps to suppress the weeds encouraged by Winter sowing.

Lampkin (1990) produces tables, which summarise the suitability of different crop combinations in a rotation (see Appendix 7 and Appendix 8), and suggests the following as basic guidelines for an organic farm, which would also be applicable in a sustainable farming rotation.

Guideline 51. Deep rooting crops should follow shallow rooting crops, helping to keep soil structure open and assisting drainage. Crops which develop slowly and therefore are susceptible to weeds should follow weed suppressing crops. Alternate between crops of high and low root biomass. Alternate between leaf and straw crops. Nitrogen fixing crops should alternate with nitrogen demanding crops. Alternate between Winter sown and Spring sown crops.

Guideline 52. Whenever possible catch crops, green manners and under-sowing techniques should be used to keep the soil covered as much as possible, protecting it from erosion risks and reducing nutrient leaching in Winter.

Guideline 53. Where a risk of disease or soil-borne pest problems exists, crops should only appear in the rotation at appropriate intervals.

Guideline 54. Use variety and crop mixtures where possible. These are suitable for on farm use as feed, but if intended for sale marketing may be a problem.

[1] Now the Crop Protection Association

The following are examples of 'integrated' rotations used on the LIFE and TALISMAN experiments, and represent the kinds of rotations that would be expected on sustainable crop farms.

Table 2.3. Example integrated rotations

Authors	Rotation
Jordan, Hutcheon and Perks 1990	Winter Oilseed rape/ Winter Wheat/ Winter Oats/ Winter Beans/ Winter Wheat
Bowerman 1994	Break crop / 2 Cereals / Break crop / 2 Cereals.

Guideline 55. For sustainability there should be a minimum of four different crops in a rotation, although some crops may require longer breaks. To be considered as part of the rotation a crop must cover at least 10% of the arable land. Mixed cropping may also be used to reduce selection pressure on target organisms, to prevent the build up of resistance to chemicals in pest organisms. According to Lampkin (1990) the following approaches may be used (see Table 2.4).

Table 2.4. A description of mixed cropping systems

Method	Description
Border Cropping	Plants of a different species are planted round the edge of a crop.
Strip Cropping	Strips of crops of different species at intervals within a crop.
Intercropping	Alternate rows of different species.
Mixed Cropping or Poly-cultures	Two or more species combined at random.

(From Lampkin 1990).

Guideline 56. For some crops systems the inclusion of a fallow or set-aside could have benefits, in building up soil fertility, and as a measure against pests and diseases. Yarham and Gladders (1994) claim that five year set aside may be used to extend arable rotations and reduce the risk of soil borne diseases, though it is less effective than a cereal break crop in controlling cereal take all, weed grasses may act as a source of ergot and that five year set-aside may increase the risks of rhizooctonia root rot in subsequent barley crops. However it is more likely that a one year fallow similar to rotational set aside is use in sustainable farming systems, and as such the effects might not be as evident.

Guideline 57. Soil fertility should be maintained through using legumous crops such as peas and beans and green manures. Millington, Stopes and Woodward (1990) discuss stockless organic rotations and bringing in organic manure from outside the farm, this may be contrary however to the spirit of organic codes of practice as they point out, it is not however necessarily at odds with the principles sustainable agriculture.

2.5.2.1.2. Cultivations

Guideline 58. False seed bed techniques, inter hoeing e.t.c. should be used. Parish (1989) presents a review of non chemical weed control, and describes many suitable techniques which may be adopted.

Guideline 59. Minimal cultivation techniques should be carried out. Cultivations should be carried out when least likely to cause soil damage i.e. in Winter or unduly wet conditions. There should be no unnecessary cultivations, the correct machinery for job should be used and meteorological conditions should be considered, to avoid soil compaction. As an example on the LIFE project, Plumb (1995) states that crop residues were chopped and incorporated at harvest and the weeds and volunteers that grow during the intercrop period are incorporated at sowing.

2.5.2.1.3. Careful choice of varieties

Guideline 60. The careful choice of varieties is essential. Varieties should be chosen according to past disease problems, and the suitability to soil and climate. In addition, varieties which require high levels of inputs should be avoided.

Guideline 61. Rotation of crop varieties, use NIAB diversification groups (see Appendix 9) to prevent the build up of pest resistance, and to increase bio-diversity.

2.5.2.1.4. Targeted use of inputs

i Pesticides

Guideline 62. Pesticide use should be minimised and targeted in such a way so as to cause as little harm to the environment as possible, therefore the chemical selected should be the most selective so as to minimise off target effects.

Guideline 63. According to Tait (1987) economic thresholds should be used for crop protection decisions in an IPM system, Francis and Youngberg (1990) state that the economic threshold is a dynamic concept and depends on the cost and efficacy of the management input, production system economics, nature of the pest and population density.

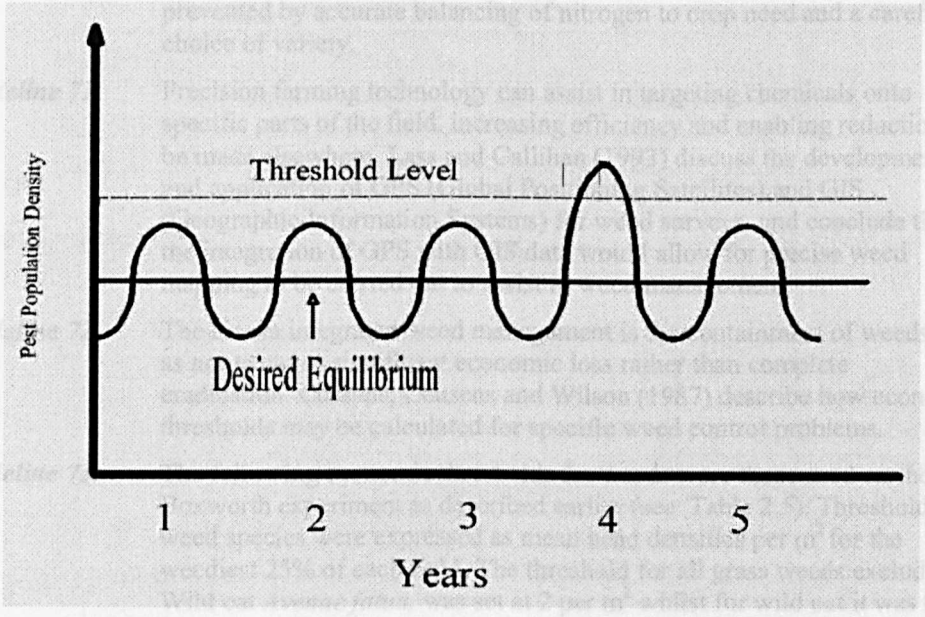
The problem with the economic thresholds used in conventional and the rational reductionist agriculture is that at present most economic thresholds do not account for the environmental damage or the externalities of crop protection measures see Tait (1987) and Pedigo (1996). Higley and Peterson (1996) discuss environmental risk and pest management and suggest that in drawing up Economic Injury Levels (EILs) the environmental cost of the damage should be included. Higley and Wintersteen (1992) discuss using contingent valuation surveys to establish estimates of the environmental costs. Thus once the costs have been estimated it would be relatively simple to draw up an environmental EIL. Higley and Peterson claim that as estimates of environmental costs are refined environmental EILs will become available to pesticide users, and that it is likely that as we move to more sustainable systems, action thresholds will move up as the environmental costs are estimated. One of the implications of this would be different thresholds for different chemicals as well as on different crops. A less safe insecticide should have a higher EIL than a less harmful one for instance. For sustainable systems thresholds would have to be flexible and change if new evidence of environmental damage comes to light or if other methods of pest control become more effective or if socio-economic conditions change.

Guideline 64. Farmers should spend time monitoring crops for signs of infection/infestation and access the need for crop protection sprays on the actual need and degree of risk. Records of crop problems/yields and crop management decisions should be kept from year to year to provide information on field histories to assist in decision making. Computer models and forecasting systems will undoubtedly have a role to play in assisting crop protection decisions in any sustainable system. Edwards-Jones (1993) reported at least 67 different systems for crop protection being found in the literature, most however for North America. O'Donovon (1995) states that most decision support systems for weeds currently base recommendations on single seasons weed populations and rarely address seed production by uncontrolled weeds.

Guideline 65. State the optimisation of inputs, requires information on the on the products available and when they are best applied. DEFRA (2001c) state that increasingly robust IT systems are being developed to assist in optimising the use of inputs, such as DESSAC (Decision Support System for Arable Crops) which assists with disease control on wheat.

Guideline 66. Francis and Youngberg (1990) claim that the most important pest management strategy will through systems design. The object should be to exclude pests through rotations and cultural methods and to keep them below any action threshold which would necessitate the use of chemicals. To be sustainable they suggest the objective of achieving this four out of every five years (see Figure 2.1).

Figure 2.1. Population dynamics of a potentially major pest in a sustainable agricultural system in which the population density is maintained below the damage/injury/ pathogenicity threshold in four our of five years



(From Francis and Youngberg 1990).

Guideline 67. When needed appropriate environmentally safe pesticides only are to be used. Appendix 10 presents a list of pesticides considered less harmful to beneficial arthropods. The MAFF and the HSE (Health and Safety Executive) code of good practice for pesticides should be followed. (MAFF 1998). Which states that the decision to use a pesticide should only be taken after thorough consideration of the following:

1. The Correct identification of the pest, weed or disease or other problem that is present or predicted and the probable degree of infestation or infection, with reference to economic damage thresholds if these are available;
2. Any previous experience in dealing with the problem and whether any other pest, disease or weed control measures alternative to pesticides alone might be used, such as biological control or integrated pest management which may be available for the type of problem identified;
3. Whether the use of a pesticide would be effective - that is whether a pesticide could be applied at the right time and whether resistance problems can be avoided.

Guideline 68. Insecticides are only to be applied to prevent imminent crop loss, as in LIFE experiment protocol (see Plumb 1995).

Guideline 69. Two strategies could emerge to reduce pesticide use in sustainable systems, that of low doses or the omission of applications altogether. In many instances dose rates may be reduced, without undue effect yields, thus reducing the total amount of active ingredient, and therefore the environmental damage. Bowerman, Young and Cook (1995), conclude that 50% reductions in dose rate appear to be a more reliable and low risk method of reducing pesticide use than the omission of applications.

Guideline 70. There should be no use of plant growth regulators. Lodging should be prevented by accurate balancing of nitrogen to crop need and a careful choice of variety.

Guideline 71. Precision farming technology can assist in targeting chemicals onto specific parts of the field, increasing efficiency and enabling reductions to be made elsewhere. Lass and Callihan (1993) discuss the development and application of GPS (Global Positioning Satellites) and GIS (Geographic Information Systems) for weed surveys, and conclude that the integration of GPS with GIS data would allow for precise weed mapping to be carried out to assist in weed management.

Guideline 72. The aim in integrated weed management is the containment of weeds, so as not to cause significant economic loss rather than complete eradication. Cussans, Cousens and Wilson (1987) describe how economic thresholds may be calculated for specific weed control problems.

Guideline 73. The following economic thresholds for weeds were those used on the Boxworth experiment as described earlier (see Table 2.5). Thresholds for weed species were expressed as mean head densities per m^2 for the weediest 25% of each field. The threshold for all grass weeds excluding Wild oat *Avenae fatua,* was set at 2 per m^2 whilst for wild oat it was 0.5 heads per m^2. For Couch grass *Ag. repens* a decision whether or not to spray in the Autumn was made in July based on the previous crop. The density of each dicotyledonous weed species in November and March was multiplied by a crop equivalent value and summed to give a crop equivalent for the mixed weed species community (Marshall 1987). If the mean for summed crop equivalents for the weediest 25% of the crop exceeded 5 crop equivalents per m^2 then the farmer would be advised to apply a broad leafed weed herbicide.

Table 2.5. Crop equivalent values for different weed species as used in the Boxworth experiment

Cleavers *Galium aparine*	1.73
Common Poppy *Papaver rhoeas*	0.89
Charlock *Sinapis arvensis*	0.90
Mayweeds *Tripleurospermum spp.*	0.62
Common Chickweed *Stellaria media*	0.50
Common Field Speedwell *Veronica persica*	0.20
Red Dead Nettle *Lamium purpureum*	0.18
Field Forget-me-not *Myosotis arvensis*	0.16
Ivy-Leaved Speedwell *Veronica hederifolia*	0.14
Field Pansy *Viola arvensis*	0.13
Venus's-looking-glass *Legousia hybrida*	0.12
Parsley-piert *Aphanes arvensis*	0.08

(From Grieg-Smith 1992).

Guideline 74. The results of the Boxworth project and that of LIFE, TALISMAN e.t.c. indicate that thresholds and crop monitoring can lead to significant reductions in synthetic inputs without undue loss of yield or profitability, the following Table 2.6 indicates the potential reductions that may be achieved.

Table 2.6. Pesticide use on the Boxworth experiment

Treatments	Insecticide	Herbicide	Fungicide
Full insurance	5.2	5.2	4.0
Supervised	0.8	3.4	2.6
Integrated	0.9	2.8	2.4

(From Greig-Smith 1992).

Guideline 75. On the Lautenbach experiment a 36% reduction in pesticide applications were made in an integrated system, which lead to a 5% greater gross margin compared with the conventional system (El Titi 1992). Pedigio (1996) estimates that pest monitoring, establishment of EILs and reduced pesticide dosage can reduce pesticide use by 30-50%. Table 2.7 shows the reductions that were made in pesticide use on the LIFE experiment while maintaining profitability.

Table 2.7. The reductions in pesticide use achieved under the LIFE experiment

Chemical Type	% Reduction
Herbicides	26%
Fungicides	79%
Insecticides	78%

(From Plumb 1995).

Guideline 76. Chemical groups should be rotated to prevent pesticide resistance amongst target organisms. If possible then mixtures of chemicals should be used in single applications, to further selection pressure on target organisms (see Gressel 1987). There should be no use of technology such as safeners or genetically engineered crops resistant to certain broad spectrum chemicals which are likely to increase the use of pesticides.

ii Fertilisers

The other main chemical input into crop production which needs to be considered are synthetic fertilisers. The following guidelines outline how reductions may be attained.

Guideline 77. Fertiliser applications should be based on the crops need. Soil should be tested regularly to determine nutrient levels and identify any deficiencies. Previous cropping should be considered and care should be taken to apply the fertiliser acurately. The good practice outlined in the MAFF booklet RB 209 *Fertiliser Recommendations for Agricultural and Horticultural Crops* (MAFF 2000c) should be followed.

Guideline 78. Timing of fertiliser and manure applications should be planned with care to avoid the leaching of nutrients. According to Lampkin (1990) they should be at points in the rotation where there is maximum nutrient offtake. Goss *et al.* (1988) demonstrated the losses through leaching from Autumn dressings of nitrogen fertiliser, which should not be carried out.

Guideline 79. In the LIFE project, according to Plumb (1995) fertilisers were determined by rotational demand, residual soil reserves and a target for achievable yield i.e. that which can be achieved irrespective of climatic variables. Spiertz (1980) and England (1986), report increasing levels of disease with nitrogen applications, while El Titi (1988) reports a positive correlation between N applied and incidence of pest attack in cereals. Therefore excessive nitrogen should also be avoided as part of a crop protection strategy.

Guideline 80. On mixed farms farm yard manure should be used to maintain/improve soil structure, and as a source of nutrients, but should be taken into consideration when deciding upon inorganic nutrient applications. The typical nutrient value of farm yard manure can be found in MAFF (2000c). In addition Goulding (1992) claims as much as 40 kg N/ha/annum may be finding its way to arable soils through atmospheric pollution from industry and should not be ignored.

Guideline 81. Fertilisers could be omitted from field margins, Powlson (1991) suggests that for a 10ha field leaving a 15m headland untreated (10% of the field) would result in a less than 10% reduction in yield. This could similarly be applied to other inputs such as pesticides and would leave the headlands to act as a harbour area for beneficial predator species.

Guideline 82. Widdowson (1987) reports on experiments at Haughley which show that as much as 50ppm of phosphorous becomes available under ecological systems (due to the biological activity of the soil), which is equivilent to 125kg/ha. There is however still depletion or 'mining' of the soil. The situation with Potassium is more serious, however Widdowson suggests that the use of green manures can help prevent depletion, other options are the use of rock potassic salts or cement kiln dust. Alternatively he suggests that if all waste including human waste is returned to the soil, methods will need to be found to prevent contamination with heavy industrial metals.

2.5.2.1.5. Monitored energy efficiency

Guideline 83. The following steps should be taken to reduce the use of fuel:

1. Through the regular and correct maintenance of machinery;

2. Using the correct machinery for a specific task;

3. Keeping vehicle idling kept to a minimum.

Guideline 84. Ball (1986) demonstrates considerable savings in fuel costs from the adoption of reduced tillage or direct drilling systems of cultivation which should be adopted in a sustainable agricultural system.

2.5.2.1.6. Operational planning

Guideline 85. A sustainable system would entail more complicated rotations, timing of inputs, crop monitoring and cultivations e.t.c requiring increased management input.

Guideline 86. The principles of ICM should be communicated to all farm staff.

Guideline 87. Comprehensive farm records should be kept to provide information for the decision making process.

Guideline 88. Sowing of winter cereals should be before mid October in most areas, to inhibit diseases encouraged by winter sowing.

Guideline 89. Fertiliser and manure applications should be planned and timed so as to minimise damage to the soil.

2.5.2.1.7. Management to care for habitats

Guideline 90. Management of field margins should aim to promote natural pest enemies, and to encourage the development of stable plant communities which do not contain aggressive weeds. No pesticides or fertiliser should be applied to field margins, to encourage natural pest predators. FWAG suggest leaving at least one metre of natural vegetation between the field boundary and the crop. English Nature (1993) report on two experiments aimed at restoring nature conservation interests of field margins while at the same time addressing weed control problems. They conclude that spraying field margins with glyphosate tends to exacerbate weed problems, while mowing sown wild flower or naturally regenerating field margins twice a year in spring and autumn would be optimal for biodiversity and for invertebrate populations. However this can lead to weed problems and they suggest careful timing of mowing to assist with weed control should be a priority in the first instance.

Guideline 91. No field in annual crops may exceed a lateral dimension of 100m (as per El Titi *et al.* 1993), otherwise fields have to be separated by annual or permanent vegetation barriers of at least 1m width to provide adequate ecological reservoirs/buffer zones.

In addition the following measures should be followed to avoid pollution to water systems.

Guideline 92. The soil should never be left bare over Winter, to minimise the risk of leaching.

Guideline 93. Catch or cover cropping over winter before Spring cereals to prevent leaching of nutrients. Early sowing is essential to maximise the period for nitrogen scavenging.

Guideline 94. There should be judicious use of crop residues to lock up nitrogen in the Autumn. Ploughing in straw in Autumn reduces nitrate loss, according to Powlson (1991) nitrate leaching can be reduced by as much as 30-40%, although it adds to the soil organic nitrogen which could cause more leaching in the long term if improperly managed.

Guideline 95. Ploughing and seeding should be in early Autumn or in late Winter or Spring. Addiscot *et al.* (1992) claim that early sowing makes the best use of soil organic matter mineralised in the Autumn.

Guideline 96. Minimal cultivations should be practised, evidence from Catt *et al.* (1992) indicate reductions in nitrate leaching form mineralisation from reduced tillage compared with conventional plough systems.

2.6. Using the Guidelines

The guidelines presented in this chapter represent the means by which sustainable farming systems should be implemented at the farm level. In this study the guidelines will themselves be used to provide the necessary choices between particular technologies and enterprises in modelling a move to towards sustainability at the farm level, and where possible will be incorporated into the management practices and activities of farm level-models of sustainable farming. Achieving sustainability will depend upon how these guidelines or similar guidelines are implemented and practised by farmers. However assessing whether a farming system is sustainable or not will require proper benchmarking and indicators to gauge whether the system is sustainable. As guidelines they are suggestions for management practices rather than a rigid set of rules to be applied in all circumstances. However, what is required is a definitive set of criteria by which to judge whether to accept a system as sustainable or not. Thus the next chapter will focus upon indicators of sustainability, and how to measure or benchmark the sustainability of a particular farm type, farming region or national agricultural system.

Chapter 3. Defining Benchmarks for Sustainable Farming Systems

3.1. Introducing Indicators of Sustainability

The previous chapter presented guidelines on what could be regarded as sustainable practices for key agricultural systems. There however is a need to define benchmarks in terms of the various prescribed actions. These may be defined in terms of the management action itself i.e. reduction nitrogen fertiliser use by 50%, or in terms of the effect i.e. 50% reduction in biodiversity loss. As a starting point various indicators of agricultural sustainability provide a basis for defining the benchmarks. The UK government recognised this in 1994 within the report *Sustainable Development the UK Strategy* (see D.o.E.1994a), which stated that indicators could be looked upon as the tools to assess progress towards sustainability and to say whether a country, region or particular system is sustainable or not. Thus succinctly English Nature (1994) stated that an environmental and sustainability indicator was:

' Nothing more than a suitable measure ..... Indicators are important for setting targets, and are the means by which environmental and economic policies are assessed. '

Significantly this definition also underlines that indicators provide a means of linking environmental impacts to socio-economic activity, however while the various sets of sustainability indicators may help in defining benchmarks, they are unlikely to provide the necessary quantitative measures in all cases.

This study requires indicators which may be easily calculated from farm level models and the following discussion is directed towards identifying practical indicators which may be used along side farm level models. A number of issues need to be considered, whether to calculate a single index figure or score, ranking indicators, setting targets, data sources and applying indicators across regions.

3.1.1. Indices and Indicators

Indices are averages of a variety of indicators, weighted numerically, to provide a one number summary of a range of factors (Holtz 1991). This is in effect a composite indicator. One such index is the United Nations Development Program (UNDP) Human Development Index which is published annually covering 160 countries, and measures the effectiveness of nations to deliver services essential to human needs and the equity of that delivery between different socio-economic groups.

Stockle *et al.* (1994) propose a framework for evaluating the sustainability of agricultural systems using nine attributes, and a list of constraints for each attribute, for example for the attribute of profitability, they list the constraints of low net income, low yields, high input costs and no markets. Each attribute has a weight, which is assigned subjectively by a panel

of experts, and then the attributes are scored based on the specific constraints: the weights and scores are then combined to produce a figure of merit for the system.

The approach is based upon being able to quantify the constraints, which as they say is not easy, due to limits of time and resources. Where this is not possible they suggest two other options expert opinion and simulation modelling.

Another approach is the use of so called 'environmental accounts' or Natural Resource Accounting. This uses conventional financial accounting methods, but includes external costs such as damage to the environment, to produce a modified form of GNP or a 'Green GNP' (see Lutz 1993, Ahmad, Serafy and Lutz 1989 and United Nations 1993). One example of such a system is in use in the Netherlands the National Accounting Matrix including Environmental Accounts (NAMEA) (see Dehaan and Keuning 1996).

3.1.2. A Sustainability Index

A Typical list of 40 indicators is difficult to interpret and utilise, which brings us back to the issue of indexes and whether it is desirable to construct a single figure sustainability index or score, so that we may easily compare different systems. Many in the literature (MacGillivray and Kayes 1995, Midmore, Russell and Jenkins 1995) argue that indicators should remain unbundled, so as to be more comprehensible and accessible to the general public and society. However as Walker (1995) points out the needs of policy makers are different, needing more aggregation of indicators in order to ease the decision making process. It would be desirable to have a set of unbundled indicators published for use and consultation by the general public, and from which an index or score of sustainability could be derived for the purposes of policy, and for assessing the overall sustainability of specific farming systems and regions.

It would be desirable to have a single figure measurement of sustainability (an example of one recent attempt is that of Sands and Podmore 2000), but to do this we must in some way weight each attribute. To create such an index we would have to have a means of objectively weighting all indicators, and assigning a value; which reflects societies wishes and preferences. In doing this we would in effect be ranking or prioritising them, and thus making a value judgement.

3.2. Ranking Indicators

Sustainability is a balance between environmental, economic and social factors, and it may be that in moving towards sustainability decision makers may have to make trade offs between some of them, for instance between biodiversity and farm viability. As mentioned in the last chapter by Paris (1994) it would be useful to be able to prioritise indicators. To do this weights have to be attached to each indicator, which would reflect the values and emphasis that society places upon that particular element of sustainability.

Methods for evaluating non market goods could be applied to indicators, to express them as a financial value, that we estimate that society would place upon them. It would be possible then if we know the likely impacts on indicators of any proposed policy then, we could carry out a cost benefit analysis to determine the optimum. If we could express indicators in terms of financial values, then it would also make them easier to compare with each other, between different regions and countries. Such studies and valuations could help in the selection and refining of indicators, leading to better more resonant indicators and more informed choices by the public.

Methods such as the Contingent Valuation Method (CVM) use surveys to create hypothetical markets for non-market goods (Hutchinson, Chilton and Davis 1995). If considering the indicators here, we would be considering non use or passive use values, as well as any utility values for a good that the public might have. Hutchinson *et al.* (1995) reviews some of the numerous problems associated with estimating non use values for environmental goods particularly information provision and respondent knowledge, comprehension and cognition. There have been numerous uses of CVM to value goods such as environmental preservation (Garrod and Willis 1995), animal welfare (Bennett and Larson 1996) and a reduction in the risk of food poisoning (Henson 1995). However the technique still has problems associated with it, on the grounds that is based in creating a hypothetical market, in which the respondents are not actually required to pay the amounts they claim they would. A study by Foster, Bateman and Harley (1997) looking at environmental preservation found that the mean hypothetical payment from an open ended CVM survey was likely to be at least four times as high as real payments collected from a comparable charitable appeal. Although the technique does have its problems and critics it is potentially feasible to rank indicators, according to the value that people would be prepared to pay for them.

Another alternative is to consider weighting indicators by expert opinion, Fresco and Kroonberg (1992) for instance suggest that natural resources with the least resilience should be given priority in any decisions on future land use. They say energy, air and to a lesser extent water are renewable resources, viewed within the time and spatial scales of a local or regional ecosystem. However after the loss of topsoil, it may take 100-1000 before a new organic topsoil is formed, therefore soil conservation should have priority over energy, air and water. Fresco and Kroonberg (1992) also say that lost genetic material can only be compensated for by the evolution of new species. Geological records show that after a major global extinction event, it takes several million years to restore species diversity, therefore biodiversity should be considered the most vulnerable of all.

Measurement of sustainability would however depend on personal values, as much as the definition of sustainability itself. The approach taken in this study is to present a disaggregated set of indicators, to allow discussion on the potential benefits and costs associated with moving to sustainability.

3.3. How do we select indicators/ benchmarks?

It is necessary to select indicators which would adequately describe the whole range of changes, to agriculture and the countryside which would come about as a result of moving to sustainability. Many different facets of sustainability could be measured, however for practical reasons it is necessary to select a list of indicators which can adequately cover all of the issues involved with sustainability. Anderson (1991) discusses how to select an environmental indicator and lists seven criteria, which are summarised as follows:

1. The indicator itself or the information it is calculated from should be readily available;
2. The indicator should be relatively easy to understand;
3. The indicator must be about something measurable;
4. An indicator must measure something believed to be important or significant in its own right;
5. There preferably should only be a short time lag between the state of affairs referred to and the indicator becoming available. It would be useful if indicators could be found which act as early warning signals about states of affairs likely or possible in the future;
6. It is useful if the indicator is based on information which could be used to compare different geographical regions and social groups;
7. It is useful if the indicator could be used to compare different countries.

Anderson (1991) states that a desirable characteristic for an indicator would be the ability to act as an early warning system, to detect undesirable environmental changes. Midmore *et al.* (1995) claim that it would be little use to have an indicator which would be the last to respond to environmental pressures. Azar, Holmberg and Lindgren (1996) look at what they define as socio-ecological indicators of sustainability, these indicators focus on the relationship between society and ecosystems, rather than the state of the environment. They say that indicators based on the state of the environment may give a warning too late, and merely indicate whether past activities were sustainable or not. Their socio-ecological indicators focus on the early part of the casual chain, and they claim they may give an earlier warning of environmental damage than environmental state indicators. Midmore *et al.* (1995) claim that it would be little use to have an indicator which would be the last to respond to environmental pressures. Azar *et al.* (1996) discussed the use of socio-ecological indicators and their potential benefit as an early warning of environmental problems. That is indicators which focus on societal activities and interactions with nature and societal resource use. These indicators focus early in the causal chain, and so would indicate a

change earlier than indicators of the state of the environment. This kind of indicator would be classed as a driving force indicator under the DSR (Driving Force-State-Response) conceptual framework for indicators developed by the OECD (OECD 1995b, 1997, 2001). The ECG report says that it has concentrated on current environmental problems and not those of yesterday. However merely reporting on current problems, would be no good if we wanted to monitor potential threats to sustainability. The full range of criteria for sustainability, or what we wanted to sustain would have to be included. Otherwise indicator sets would have to adapt and change over time to meet changing environmental, economic and social conditions. Overall Anderson concludes an indicator should aim to highlight what is significant rather than include everything. Parris (1995) states that an Agricultural Environmental Indicator (AEI) should not be considered in isolation, but that sets or appropriate sub sets should be established, similar to the suggestion by Midmore *et al.* The OECD (1995b, 1997) uses policy relevance, analytical soundness and measurability, as criteria for indicator selection. In this study the purpose of the indicators are to provide a benchmark in order to assess the environmental and social benefits of sustainability, thus policy relevance is not of direct importance, however analytical soundness and measurability are.

3.3.1. Analytical soundness

An indicator should be:

1. Be theoretically well founded in technical and scientific terms;
2. Be based on international standards and international consensus about its validity;
3. Lend itself to being linked to economic models, forecasting and information systems;
4. Indicators must be easily understood, and of limited complexity, while as Parris (1994) points out they must be able to communicate to both scientists and economists.
5. They must be measurable, which means developed from existing national or sub national statistical series. Work by the OECD however recognises that indicators might be developed for which little or no data exists at the moment.

3.3.2. Measurability

The data required to support the indicator should be:

1. Readily available or made available at a reasonable cost/benefit ratio;
2. Adequately documented and of known quality;
3. Updated at regular intervals in accordance with reliable procedures.

The Australian Department for Primary Industries and Energy (DPIE 1997) have also put forward four criteria for indicator selection, namely consistency, and the ability to be modelled, precisely defined and analysed.

i Consistency

Includes underlying principles, consistent classifications and maintenance of all traditional balances, for example relating to production, income, consumption, savings, investment, net worth etc.

ii Modelling

Allows formal modelling. For example the Netherlands NAMEA includes feedback from non-monetary to monetary variables and allows the model simulation of trade offs between different environmental objectives and most other objectives of macro-economic policy.

iii Indicator definition

A more precise definition of indicators embedded with in a system is more comparable internationally than a footloose indicator. Such indicators tend to be stable in their definition facilitating their acceptance.

iv Ability to be analysed

The causes, consequences and the value of indicators are able to be determined and assessed if they are part of a system.

A key criteria for the selection of indicators in this study will be the ability to be modelled, however it may not be possible as yet to model all aspects of sustainability. Therefore, a core set of indicators will be proposed for modelling, whilst another group will be selected as a basis for further discussion.

3.4. Regional/local issues

Sustainability entails meeting local demands and much work on indicators of sustainability has and is being conducted at a local level. Midmore *et al.* (1995) claim that environmental quality at a regional or national level is a 'more obscure concept' than that which they discussed for point indices. Regional or national Indicators are not intended to be accurate, but to assist decision making in a similar way to macroeconomic indicators (see Hope and Parker 1990).

The relative importance of a specific indicator will vary between regions and agri-environmental zones, for instance in some regions more fertiliser use may be justified than in others due to soil differences or more irrigation may be acceptable due to differences in climate. For instance in the indicator set adopted by the Environmental Challenge Group, hedge row loss is excluded from Scotland due to hedgerows not being a common feature there (MacGillivray and Kayes 1995).

The diversity of many of the geographical regions of the UK means that it may be more useful to split them down further into agri-environmental zones[1], however this means increasing the complexity of the information that would need to be assessed by any decision makers regarding sustainability. Sustainability needs to be assessed across the whole range of agri-environmental and regional zones as well as different farming systems. Indicators need to take account of regional differences therefore regional zones will have to be defined and indicators developed specifically for each zone. This could cause problems making comparisons between different regions, if different sets of indicators have been adopted and constructed in different ways. The report *Indicators of Sustainable Development for the UK* (HMSO 1996a) stated that it is hoped in time for a consensus to emerge which will lead to a core set of indicators which all local authorities and regions adopt, in addition to more relevant local indicators. Similarly they say that it might be that at an international level, it might be possible to draw up a core list of indicators to allow comparisons between countries.

Sunyer and Manteiga (1995) state that, since farming systems and environmental carrying capacities vary so much between regions, it would be difficult to construct a common agri-environmental indicator system, therefore the best AEIs should be picked for each region or zone. All over the country local regions have there own particular features which distinguish them from other places and which need to be taken into consideration. Local vegetation types need monitoring, habitats such as the East Anglian Fens, the Norfolk broads, and the Somerset levels need their own special indicators if they are to be monitored.

Parris (1995) points out that an indicator must be aggregated at the right level (i.e. farm, sector, regional, national etc) to be meaningful in policy terms. National agricultural data may be collected on the basis of political administration units rather than in terms of agri-environmental zones which may be a more appropriate sub-division of data for developing AEIs. He suggests that one possible means of overcoming this limitation is through the use of GIS (Geographical Information Systems) computer software. These packages are designed to collect manage analyse and display spatially reference data.

Fletcher and Phipps (1991) discuss data needs for agri-environmental management and comment that GIS can significantly improve the ability to analyse environmental problems using conventional approaches by significantly improving the quality and quantity of data available. A GIS system is designed to collect analyse and display spatially referenced data. The OECD (1997) state that GIS provides the potential to aggregate information according to agro-ecological zones, using data already collected at the administrative level, and may also help overcome the issue of confidentiality with highly aggregated data. Satellite technology and remote sensing could also be useful in collecting data on land cover. Croze

[1] As per the Countryside Survey 2000, which splits the UK into 6 Environmental zones (Countryside Survey 2000).

and Vandeweerd (1991) state that the cost of such information is coming down, and how it is becoming more accessible.

3.5. Targets for Sustainability

Parris (1995) discusses target and threshold values for agricultural environmental indicators, and says that they may be difficult to determine due to lack of scientific evidence. In addition certain targets may not be standardised because of regional variations. He concludes that where there is lack of evidence, targets or thresholds need to be incorporated into policy frameworks which allows adjustments taking into consideration the costs and benefits of achieving them. He also says that policy makers may also choose to adopt safe minimum standards in the absence of complete scientific evidence.

Indicators are normally quantitative, and are either measured in physical or financial terms, therefore quantitative targets would have to be drawn up for them to be of use. The report sets out objectives for each year, and lists actions taken. The UK series of reports *This Common Inheritance* (HMSO 1996b, 1997) also drew up regional objectives based on the four countries of the UK. Key quantitative targets are listed for the following issues global atmosphere, air quality and noise, freshwater and the sea, forestry, energy, waste, housing, biodiversity and biotechnology. Some other countries have made quantitative commitments relating directly to agriculture, such as United States and Norway commitments to reduce fertiliser use.

Pieri *et al.* (1995) state that standards are values which are desirable to achieve such as with air and water quality standards when discussing pollution. Goals are the ideal or what is desirable, but which may never be achieved. Targets are however values which are believed to be reachable in the short to medium term. Pieri *et al.* (1995) say that goals may be set as part of national policy, whilst targets are most relevant to specific development projects or district government programmes. In this study the indicators are presented with either a target, goal, or maximum/minimum threshold.

Sustainable agriculture infers balancing the needs of various groups which are often in conflict, namely farmers, consumers, the environment and animal welfare. A rise in agricultural prices would benefit farm viability and the needs of farmers, but may mean a rise in food prices to consumers adversely affecting consumer welfare. If stocking rates are either to low or too high then adverse ecological changes in some grassland habitats may be produced. As an example Den Ouden, Dijkuizen and Huirne (1996) analyse the relationship between pig welfare and environmental impacts. They say that measures to improve welfare such as increasing floor space leads to an increase in emissions of ammonia. Many indicators would therefore have an optimal value if this value is exceeded then something is out of equilibrium, and could be said to be moving away from sustainability.

The problem is in quantifying these thresholds. We would need to make judgements as to what is acceptable to the various groups of people in society that are concerned with

agricultural sustainability. Sustainability is a concept that involves meeting the needs of society and consultation between the various groups and decision makers. This is illustrated within the DSR framework for indicators of the OECD (1997, 2001), which has a feedback mechanism. Information about the environment and the economy flows to the 'actors' i.e. the administrations, households businesses and individuals and their responses acting to modify the pressures upon the environment. One such response could be to set targets, to modify targets or emission standards.

In many cases it is difficult to set targets due to lack of scientific evidence, or because of regional variations in what is acceptable or taken to be sustainable. When we are setting targets for sustainable agriculture, we also have to consider whether where there has been considerable loss or damage to one aspect of the environment, if we are aiming to halt the decline, or to reverse the damage if possible and to restore what has been lost.

We could include also a timescale dimension in any targets, such as saying a 50% reduction within 5 years. Agriculture could never move to sustainability overnight, and some transition period would be necessary. Many of the indicators have time lags, such as those concerned with water and soil quality, it might take many years for the driving forces, which influence these to have any effect on the state of water and soil quality. However the driving force and response indicators could be expected to change within a much shorter timescale, since they are more directly influenced by policy at a national level, and by the actions of farmers.

3.6. Data Issues

Most of the literature recognises that data collection needs to be improved before indicators of sustainability or environmental quality can be really effective. However the Environmental Challenge Group report claims however that there is an information overload and the problems are not due to lack of information, but in the selection of it, and the quality of it. More regional data needs to be collected, and work should be directed to collecting data on the basis on agri-environmental zones, rather than on the basis of administrative units. They identify the following problems with the existing data:

1. Collection of unhelpful data;
2. Doubts about the reliability, statistical significance and robustness of data;
3. Causality, do the data reflect human activity or natural variability ?
4. Lack of comparability over time and between UK countries and regions;
5. Excessive gaps between data gathering exercises;
6. Lengthy time-lags in public reporting of existing data.

Environmental information does not in many cases specifically relate to agriculture, and here we come across one of the problems mentioned in the literature by MacGillivray and Kayes 1995; that we cannot easily relate environmental damage directly to agricultural activity. It

would therefore be useful to find indicators of environmental damage that we can directly attribute to agriculture, and therefore be easily linked to farm level production models.

3.7. Indicators and the Analysis of Sustainable Agricultural Systems

To develop a set of indicators for agricultural sustainability each component of sustainability needs key indicators to be selected and targets set in order to determine if a specific farming system is sustainable or not. The following discussion reviews a list of potential indicators which might be used to monitor the sustainability of farming systems in the UK. It is intended that these indicators be used in an analysis of the consequences of the widespread adoption of sustainable farming practices in the UK. Their applicability to farm level models will be considered. For the modelling study it is essential that the changes in the indicator can be both forecasted and measured. Within each section other indicators are also presented, which although they are not directly modelled are related to farm practices and to the core modelled indicators; and from these some indication of environmental changes as a result of changing farm practice may be obtained.

3.8. UK Indicators for Sustainable Agriculture

As discussed earlier, indicators of sustainability are divided into 3 broad categories, namely environmental, economic and social. Accordingly the evaluation of potential practical indicators of sustainability for farming systems has centred on the three groups presented in Table 3.1.

Table 3.1. Range of issues covered by the indicators of sustainability

Environmental	Economic	Social
Biodiversity	Farm Viability	Food Issues
Landscape	Socio-economic Issues	Farm Safety
Pollution		Animal Welfare
Soil quality		
Resources		

The indicators are presented as core indicators which are intended for use in the models, and other indicators, which although useful for the wider debate on sustainability, would prove difficult to model.

3.9. Targets for the Indicators

The UK environmental targets and objectives have been set out in the DEFRA report *Foundations for Our Future* (DEFRA 2002h). These published indicators have been coupled with the results from systems experiments, such as the LIFE (Low Input Farming and the Environment) experiment (Jordan, Hucheon and Perks 1990) which indicate the kind of reductions in inputs or impacts that could be realistically achieved. For some indicators these results provide clear guidelines for the likely impacts and changes to indicators.

Where there are no official targets or little or no evidence from the literature about the likely impacts of moves to sustainable farming systems, the assumption has been that the objective is to maintain current trends or levels. The OECD suggest that it is the general direction of change and the range of values of the indicator which provide the most useful information for policy makers (OECD 1997). Where there is evidence of losses in environmental quality, the target should be set to restoring what has been lost. In some cases this might not be possible, due to irreversibility producing irrecoverable losses of many environmental goods.

3.10. Environmental Indicators

This group of indicators are designed to assess the environmental component of sustainability, and cover biodiversity, landscape, pollution of water and air, soil quality and resources.

3.10.1. Biodiversity

Biodiversity is a key environmental element of sustainability. Sustainable agriculture would aim to increase the biodiversity of wildlife and domestic flora and fauna. Sustainable farming systems would depend upon increasing diversity, growing a wider range of crops in order to assist in the control of pests and diseases.

i Core indicators

Indicator 1. Mean stocking rates

A stocking rate indicator would be useful as a driving force indicator of the intensity of agriculture and of the pressure on rare semi-natural and natural plant communities. Stocking rate indicators could, if refined further provide a warning of adverse vegetation changes, particularly in upland areas.

However, the average annual stocking rate does not tell very much, particularly about the management practices found in the country or area. Beaufoy, Baldock and Clark (1994) state that stocking rates do not indicate, how the land is grazed, the type of grazing system, or variations in stocking density throughout the year, which have a great impact on the vegetation.

The Farm Business Surveys (FBS) conducted in England and Wales, publish data on livestock units per effective forage hectare for different farm types within each region. At present information is not readily available on stocking rates for particular habitats, only the number of animals in a geographic region, thus it is only possible to calculate an overall stocking density, and within a region livestock may be concentrated in a small area or in a particular land class.

Target stocking rates must reflect regional variations in ecosystems, climate and farming systems. Sustainability is generally considered to imply the adoption of grass/clover based

systems of livestock production (see Guideline 13). According to Hopkins, Davies, and Doyle (1995) it is widely accepted that herbage production from grass/clover swards receiving zero nitrogen is about 80% of that from grass swards receiving 200-300kg N/ha. Therefore it is accepted that there would be a corresponding reduction in stocking rates, which would be compensated for by an improvement in production/head. Accordingly target stocking densities for sustainable farming systems should be set in Livestock Units (LSUs) / forage ha and would be specific to particular farming systems as in Table 3.2, and these targets could be easily incorporated into farm level models. These take the current figures recorded by the FBS surveys and reduce them by 20% to take account of a move to clover-based swards.

Table 3.2. Current stocking rates and target stocking rates by farming system and region
LSU/forage ha

	Dairy		Cattle & Sheep LL		Cattle & Sheep LFA		Mixed	
	Current	Target	Current	Target	Current	Target	Current	Target
Northern England	2.2	1.76	1.5	1.2	1.1	0.88	1.6	1.28
Yorkshire & Humberside	2.3	1.84	1.9	1.52	1.1	0.88	2.3	1.84
South East England	1.7	1.36	2.6	2.08	~~	~~	2.6	2.08
South West England	1.75	1.4	1.7	1.36	1.7	1.36	1.6	1.28
West Midlands	1.9	1.52	1.7	1.36	~~	~~	1.9	1.52
North West England	2	1.6	1.2	0.96	1.3	1.04	~~	~~
Scotland North West	2	1.6	1.8	1.44	1.2	0.96	2	1.6
Scotland North East	2	1.6	1.8	1.44	1.4	1.12	2	1.6
Scotland South East	2	1.6	1.8	1.44	1.4	1.12	2.1	1.68
Scotland South West	2	1.6	1.8	1.44	1.4	1.12	2.1	1.68
Wales	2	1.6	1.4	1.12	1.4	1.12	~~	~~
Northern Ireland	2.1	1.68	1.85	1.48	1	0.8	1.4	1.12
UK	2.0	1.6	1.75	1.4	1.1	0.9	1.6	1.3

(From FBS/FAS Data: Various).

Indicator 2. Number of crops in arable rotations.

The number of crops in a rotation, would provide an indication of the diversity of the cropping systems used at the farm level, to be considered part of a rotation, the crop must take up more than 10% of the cropping area (see El Titi, Boller, and Gendrier 1993). Such an indicator would be easily calculated from the farm plans generated from the farm level models. This indicator would however be applied to the arable farm models, and for sustainability it would be expected that in all cases there would be an increase in the number of crops within a specific farm rotation.

ii Other indicators

Indicator 3. Bird Populations

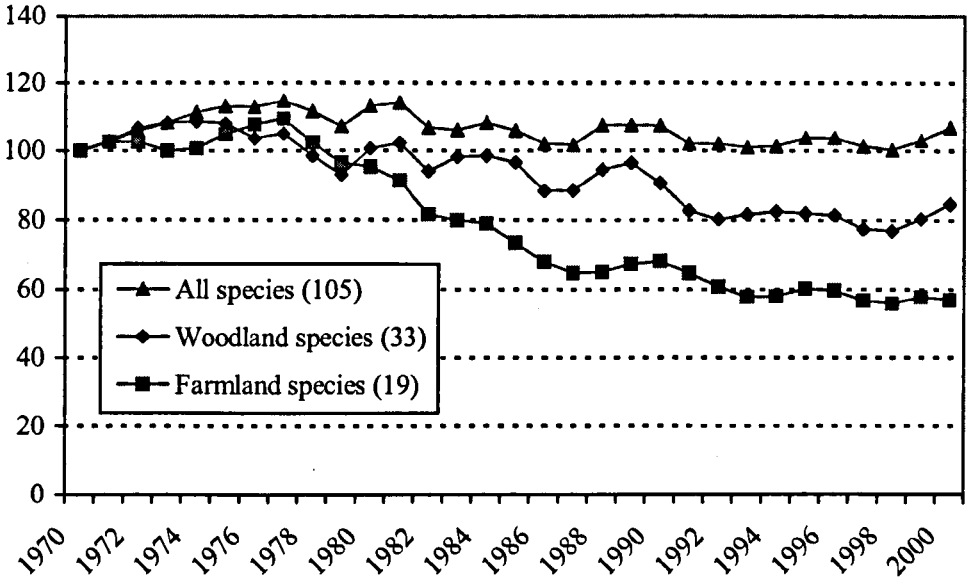
Sustainable agricultural practices would provide more habitat for farmland bird species, so it would be hoped that populations increase. Bird populations were chosen as an indicator in of biodiversity by the former Department of the Environment (1996a) since they are:

1. Wide ranging in distribution and tend to be near the top of the food chain;
2. Mobile, and tend to have relatively long life expectancies, leading to the integration of environmental effects over large areas and time spans; and
3. Birds are well studied and reasonably reliable data on population and geographical area are available over time.

The ECG, have adopted four bird species as indicators of biodiversity on farmland, namely the corn bunting, the grey partridge, the skylark and the song thrush (MacGillivray and Kayes 1995). Data on bird populations is collected annually by the British Trust for Ornithology in the Common Bird Census (CBC), and the Waterways Bird Survey (WBS). Annual changes in population size are calculated as percentages from summed territory counts for all plots that are covered in the same way in consecutive years. Population changes are available annually from the CBC for 74 species and 19 species for the WBS (See Furness, Greenwood and Jarvis 1993).

More recently DEFRA (2002a) have adopted bird populations as a 'headline' indicator of sustainable development. The trend in bird populations within the UK form 1970 to 1999 is illustrated in Figure 3.1. This indicates that although the total population of breeding birds has not declined over the last two decades, the numbers of farmland birds had declined to 58% of the 1970 numbers by 1999. Numerous studies have established that intensive agricultural practices lead to detrimental effects on populations of farmland birds (e.g. Fuller *et al.* 1995). Siriwardena, Baillie, Crick and Wilson (2001) examine the effects of changing agricultural activities on farmland birds, and suggest directions for the management of farmland which could potentially aid the recovery of farmland bird populations. They specifically examined the effects of crop type, pasture type and stocking rate on farmland bird breeding performance. They conclude that more arable farming was associated with lower breeding performance, and that higher stocking densities had a generally negative effect within grassland farming systems. Furthermore they established that break crops would have a generally positive effect. Therefore predictions of changes in these specific agricultural practices under sustainable farming systems would help provide an assessment of the likely effects on populations of farmland birds.

Figure 3.1. Index of breeding bird population's : a United Kingdom indicator of sustainable development



(From DEFRA 2002d).

Indicator 4. Plant diversity

The intensification of agriculture, with the increased use of fertilisers, pesticides and overgrazing has lead to a decline in plant diversity in agricultural ecosystems, (as described in Chapter 1). Reductions in fertiliser and chemical use together with more appropriate grazing management of grassland habitats should lead to an increase in plant biodiversity in agricultural landscapes.

Data on long term changes in plant diversity has been published by the D.o.E. (1996a) based on the 1990 Countryside Survey and is on the basis on habitat type. The data is based upon vegetation samples at a number of plots from within 508 separate 1km squares. Five main plots each covering 200m^2 were chosen randomly, and up to 17 linear plots covering hedges, ditches, stream sides were selected. In 1978 similar data had been collected from 256 separate 1km squares. Each vegetation plot surveyed was classed into vegetation type e.g. arable field, moorland, improved grass. The results of the two surveys are shown in Table 3.3. and Table 3.4.

Table 3.3. Species numbers within plots surveyed in both 1978 and 1990

Type of plots	Landscape Type									
	Arable		Pastural		Marginal Upland		Upland		GB	
	1978	1990	1978	1990	1978	1990	1978	1990	1978	1990
Main plots ($200m^2$)										
Arable fields	6.7	4.1	6.8	6.1	..[1]	..	..	..	6.7	4.8
Improved grass	9.8	8.7	10.2	10.7	13.9	13.3	7.3	8.7	10.3	10.3
Semi improved grass	21.5	20.3	22.2	19.2	22.2	23.8	19.8	21.2	21.9	20.6
Woodland	14.9	16.0	14.9	11.7	19.0	10.6	19.8	12.5	16.1	12.9
Upland grass			25.9	22.1	18.4	19.0	25.1	26.8	23.2	23.4
Moorland			15.6	12.1	12.4	16.3	18.9	20.2	17.7	19.0
Linear features (10x1m)										
Stream sides	16.1	14.6	18.1	15.0	20.7	19.5	23.9	20.7	19.5	17.1
Hedges	11.0	10.2	14.4	12.4	17.9	17.5	..	..	13.1	11.8

(From D.o.E 1996a).

Table 3.4. Percentage changes in mean species numbers within plots

Type of plots	Landscape Type									
	Arable		Pastural		Marginal Upland		Upland		GB	
		P[2]		P		P		P		P
Main plots ($200m^2$)										
Arable fields	-38	***	-10		..		..		-29	***
Improved grass	-11		5		-5		18		0	
Semi improved grass	-6		-14	*	7		7		-6	
Woodland	7		-22	**	-44	*	-37	*	-20	*
Upland grass	..		-15		3		7		1	
Moorland	..		-22	**	32	**	7	*	8	**
Linear features (10x1m)										
Stream sides	-9		-18	***	-6		-13	**	-12	***
Hedges	-7		-14	**	-2		..		-10	**

(From D.o.E 1996a).

Farm level models would provide estimations of crop types, and a crude measure of grassland types, e.g. rough grazing or improved pasture. Thus from predictions of changes in these farming practices and cropping, the likely effects on plant diversity might be elucidated. For instance an increase in extensive grassland at the expense of intensive grassland or arable cropping, would be expected to lead to higher plant species numbers. The direction of change in plant biodiversity also be indicated, using predictions of changes in the specific practices presented in the matrix by Wilkins and Harvey 1993 (see Table 1.4).

[1]Insufficient data to produce national estimates

[2] Significance is based on paired t test Probability (P) * <0.1, ** <0.01, *** <0.001

3.10.2. Landscape

Landscape is important for both the environmental and social elements of sustainability, it is linked to the biodiversity of agricultural ecosystems, and many people also place an aesthetic value on the landscape produced by traditional farming methods. The indicators of land cover published by the Department of the Environment (D.o.E 1996a), relevant to sustainable agriculture are the area of tilled land and the area of grassland. Sustainable agriculture should also aim to preserve the archaeological heritage of the countryside.

i Core Indicators

Indicator 5. Land Cover

Effects on the landscape could be measured by indicators monitoring the area of certain vegetation types such as lowland heaths, moorland etc. Many vegetation and landscape types are specific to each region. Some of these vegetation types are themselves important positive externalities of traditional farming systems, such as the habitats created under extensive grazing systems or traditional lowland hay meadows. Table 3.5 showing land use changes between 1990-1998 which was taken from the Countryside Survey 2000, and indicates that the areas of many semi-natural habitats such as calcareous grassland are still declining whilst over this period the area of arable land increased. Significantly the area of woodland is increasing within Great Britain.

Sustainable agriculture will most likely lead to land being taken out of agriculture and used for environmental purposes and/or recreation. However sustainability also implies that agriculture should be able to respond to changing circumstances, and in the future if food security is threatened land might have to be put back into production. Therefore sustainable land management means that land should not be developed for uses from which it cannot be easily returned to farming, therefore there should be no increase in built up areas. Sustainability will mean a move to more mixed farming systems, and a decline in the arable area as farms move to legume based, less intensive systems. Changes in farm enterprises will effect landcover, e.g. whether land goes into arable cropping or grassland. Other changes in agricultural practice will impact upon the stock of many of these habitats, for instance not using fertiliser on grassland which has previously been intensively managed will lead to ecological changes, and its reversion to a semi-natural habitat. Thus from changes in agricultural management indicators such as stocking rates and fertiliser use of grassland it will be possible to predict the implications for the stock of various habitats on farms, and therefore the regional and national changes expected.

Table 3.5.Estimated changes in the broad stock of habitats in the UK 1990-1998

	England and Wales		Scotland		Northern Ireland		United Kingdom	
Broad Habitat	000 ha	%[2]	000 ha	%[2]	000 ha	%[2]	000 ha	%[2]
Woodland habitats								
Broadleaved, Mixed and Yew Woodland	42	3.9	25	9.0	4	8.5	72	5.1
Coniferous Woodland	-16	-4.2	7	0.7	6	11.6	-3	-0.2
Intensive agriculture								
Improved Grassland	-102	-2.3	-1	-0.1	141	32.9	37	0.6
Arable and Horticultural	49	1.0	38	6.7	-20	-25.0	67	1.3
Semi-natural habitats								
Neutral Grassland	38	10.4	-30	-14.8	-118	-31.7	-109	-11.6
Bog	-1	-0.5	-17	-0.9	-13	-8.3	-32	-1.3
Dwarf Shrub Heath	0	0.1	-58	-5.4	-1	-7.6	-59	-3.9
Acid Grassland	-116	-17.1	-39	-4.9	-2	-8.0	-157	-10.4
Fen, Marsh and Swamp	43	27.1	55	18.7	-12	-18.6	86	16.6
Bracken	24	7.9	4	2.6	0	4.6	28	6.2
Calcareous Grassland	-9	-19.2	-5	-16.2	0	-7.2	-15	-17.8

1 Statistically significant changes ($p<0.5$) are shown in **bold** for England, Wales, Scotland and GB.

2 As a per cent of 1990 stock.

(From DEFRA 2002d).

ii Other Indicators

Indicator 6. Length of Linear Features

The length of linear features, such as hedgerows and stonewalls is a useful measure of a landscape feature particularly resonant with the general public. Field boundaries are regarded as important landscape features. More importantly they would be important to sustainable agriculture, since they provide habitat for insect predators, shelter for livestock, and are an important barrier against soil erosion and loss. Linear features are also in many cases regarded as historically and socially important, denoting ancient field boundaries, and as the remnants of ancient forests. The Countryside survey 2000 reveals the following data in Table 3.6, which indicates a significant loss of remnant hedgerows, and a significant increase in lines of trees, scrubs, relict hedges and fences within England and Wales. In Scotland where there are proportionately fewer hedges, there was a significant increase in lines of trees and scrubs and relict hedges and fences.

Sustainable agricultural practices should prevent further loss of traditional field boundaries, where possible restore relict[1] hedges, and also other new boundaries may also be created such as beetle banks, fallow strips e.t.c. Livestock enterprises are more likely to require field

[1] Relict hedges are boundaries that are recognisable as having once been hedges but have become for example rows of trees, or scrubs that are no longer stock proof boundaries.

boundaries, and stock barriers, and shelters. Changes in the length of linear features is therefore related to the specific changes in management and enterprise mix at the farm level.

Table 3.6. Length of landscape linear features (km)

	Length '000 km	SE '000km	% of 1998 stock	SE '000km	Change in Stock	% Change from 1990
England	Stock in 1998			Change in stock 1990-1998		
Hedge	449.3	21.3	35.8	-0.4	4.8	0
Remnant Hedge	52.3	4.3	4.2	-13.5	3.6	-20.9
Wall	105.8	12.8	8.4	-2.7	1.7	-2.5
Line of Trees/shrubs and relict hedge and fence	70	5.1	5.6	15.5	3.1	30.8
Line of Trees/shrubs and relict hedge	83.4	5.1	6.7	19.6	3	31.4
Bank Grass Strip	70	7.4	5.6	-1.9	2.5	-2.5
Fence	423.2	16.9	33.7	25.6	8.9	6.5
Total	1253.3	32.1	100	42.3	8.4	3.5
Scotland	Stock in 1998			Change in stock 1990-1998		
Hedge	19	4.4	5	0.8	0.8	4.6
Remnant Hedge	5.3	1.8	1.4	-0.9	0.5	-20
Wall	87.1	12	22.8	-1.5	1.6	-1.7
Line of Trees/shrubs and relict hedge and fence	11.1	1.9	2.9	1.4	0.6	14
Line of Trees/shrubs and relict hedge	13.3	1.9	3.5	2.4	0.7	22.2
Bank Grass Strip	12.4	3.4	3.2	0.8	1	6.3
Fence	233.7	16.9	61.2	8.6	3.3	3.9
Total	382	21.6	100	11.7	3.2	3.2

(From Countryside Survey 2000).

3.10.3. Pollution

Agricultural pollution is a result of the intensification of modern agriculture, poor nutrient management, agrochemicals from arable farming, and waste from intensive livestock enterprises. According to the D.o.E. (1996a), the gap between the nitrogen inputs and outputs illustrates the amount of nitrogen cycling through agricultural soils, with the potential to cause pollution. The Royal Commission on Environmental Pollution (RCEP) report *Freshwater Quality* (HMSO 1992b) states that farm land forms a major proportion of water catchment areas, and agricultural activities have a considerable potential to pollute freshwater. Another RCEP report on *The Sustainable Use of Soils* (HMSO 1996c) states that there is a long term link between the use of inorganic nitrogen fertiliser and nitrogen losses. Water is essential for human life, thus minimising water pollution is an important environmental component of sustainability. In developing indicators for agricultures impact on water quality, we would need to know the exact relationship between farming practices

and water quality. There is also pollution from other industries and sectors of the economy to account for, some of which may have a negative impact on agricultural production itself. Water quality may be monitored at both surface (i.e. river, canal, lake water) and ground water sites (i.e. underground aquifers), pollution impacts more quickly upon surface water quality, and has more implications for wildlife, while there is a greater time lag between farming practices and groundwater quality there is also greater implications for human health, since that is where most drinking water comes from. The Harmonised Monitoring Scheme carries out river water monitoring at 230 sites within the UK, at the tidal limits of major rivers, or at points of confluence of significant tributaries, data from which is published annually by the DEFRA within the *Digest of Environmental Statistics* (DEFRA 2002d).

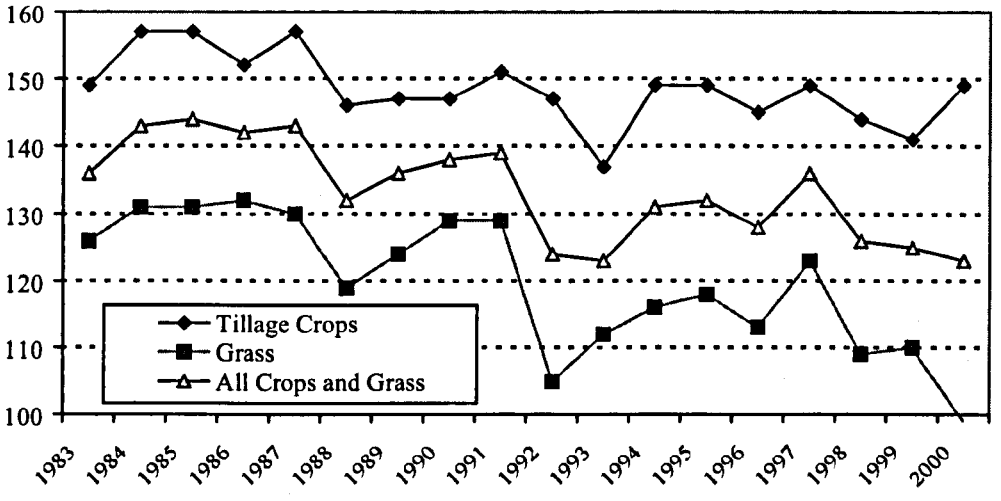
i Core Indicators

Indicator 7. Synthetic Fertiliser (NPK) Use

These are driving force indicators on the environment, but may also be said to be response indicators, as farmers make management decisions in response to both agricultural and environmental policies designed to reduce fertiliser and pesticide use. MacGillivray and Kayes (1995) however, identified a number of problems with the fertiliser/pesticide use indicators, as not all inputs have the same environmental impact. A reduction in the total use of pesticide does not necessarily mean an environmental improvement, since it does not tell us anything about the kind of substances being used. The main indicator sets to date have adopted the consumption or the intensity of consumption of such products as a proxy for impact, as described by Parris (1994).

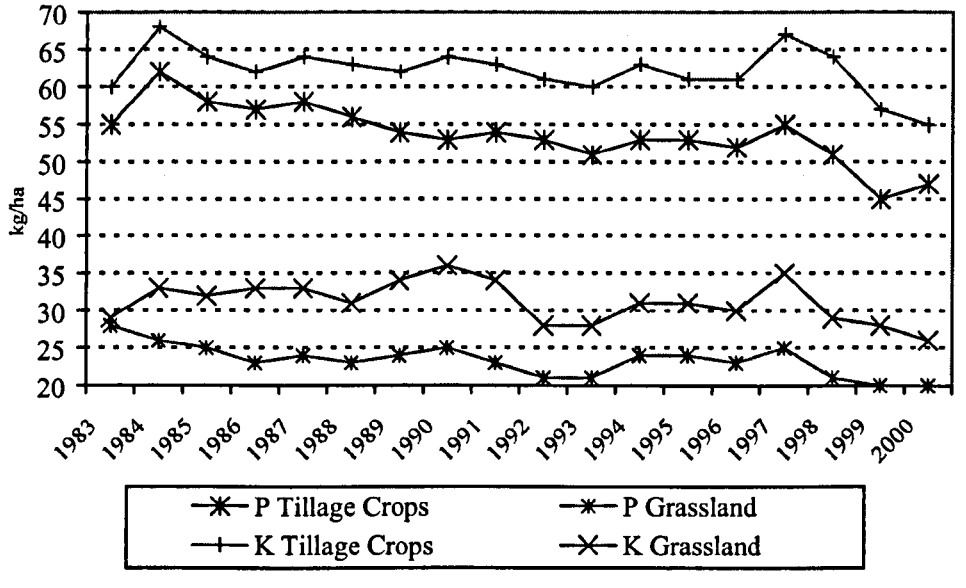
Strictly the indicators of fertiliser use would have to have different targets for each of farming systems, and regions found in the UK. Likewise for pesticide use, the use of sprays on grassland, for instance, is less likely to be acceptable than their use on arable crops. The British Survey of Fertiliser Practice (DEFRA 2001b), gives data on fertiliser use on all farm crops on mainland Britain on the basis of average application rate in kg/ha of N, P and K on arable crops and grass.

Figure 3.2. Trends in overall application rates for nitrogen fertiliser in the UK (1983-2000)



(From DEFRA 2001b).

Figure 3.3. Overall application rates for phosphate (P) and potash (K) fertiliser in the UK (1983-2000)

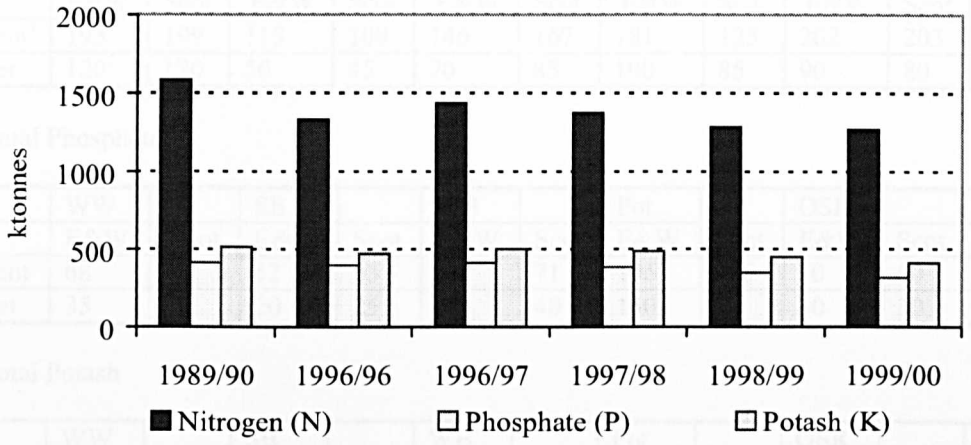


(From DEFRA 2001b).

The overall tonnage of fertiliser used in UK agriculture is shown in Figure 3.4, and this underlines the fact that since the 1980s there has been a substantial reduction in their use. This however does not imply that the current levels are sustainable. Data from the Fertiliser Manufacturers Association (FMA 2001) reveal that from 1989/90 to 1999/00 there has been

a 20.5% decrease in the total amount of synthetic plant food consumed, this the FMA states is partly due to the introduction of set-aside.

Figure 3.4. Synthetic fertiliser use in Great Britain 1989-1999



(From FMA 2001).

Systems studies such as LIFE, TALISMAN e.t.c. described in Chapter 1, indicate that for arable farming systems inorganic fertiliser could be reduced by up to half without significant loss of production (Plumb 1995). Therefore the targets for N, $P_2 0_5$ and $K_2 0$ use on specific crops are presented in Table 3.7 compared with figures for conventional farm practice.

For livestock systems based upon grass/legume swards there would be a greater scope to cut synthetic fertiliser use, Hopkins *et al.* (1987) suggested that a cut from the average of 130kg N/ha on grassland to 0-50kg N/ha. This would entail a reduction of about 75% overall. As far as phosphate and potassium fertilisers are concerned increasing organic matter contents of soil, the use of green manures and increased recycling of waste should make reductions possible, though less than that for nitrogen. Therefore an overall reduction of 50% has been adopted as the target (see Table 3.8).

Table 3.7. Current and target average field application rates for major tillage crops (kg/ha)

Total Nitrogen

	WW		SB		WB		Pot		OSR		SuB
	E&W	Scot	E&W	Scot	E&W	Scot	E&W	Scot	E&W	Scot	E&W
Current[1]	193	199	115	109	146	167	181	125	202	203	109
Target	120[2]	120	50	45	70	85	100	85	90	80	65

Total Phosphate

	WW		SB		WB		Pot		OSR		SuB
	E&W	Scot	E&W	Scot	E&W	Scot	E&W	Scot	E&W	Scot	E&W
Current	68	48	52	63	64	71	196	119	70	60	76
Target	35	40	20	25	30	40	150	60	30	30	40

Total Potash

	WW		SB		WB		Pot		OSR		SuB
	E&W	Scot	E&W	Scot	E&W	Scot	E&W	Scot	E&W	Scot	E&W
Current	76	37	62	82	81	75	279	167	76	76	141
Target	35	45	30	30	40	40	150	80	35	30	70

WW= Winter Wheat, SB = Spring Barley, WB = Winter Barley, Pot = Potatoes, OSR = Oilseed Rape, SuB = Sugar Beet

Table 3.8. Targets for fertiliser applications on grassland

Total N kg/ha Average Field Rate	Grazed		Silage		Hay	
	E&W	Scotland	E&W	Scotland	E&W	Scotland
Current[3]	140	114	189	177	108	110
Target	50	50	50	50	50	50
Total P_2O_5 kg/ha Average Field Rate	Grazed		Silage		Hay	
	E&W	Scotland	E&W	Scotland	E&W	Scotland
Current	35	34	45	53	32	39
Target	18	18	22	25	15	20
Total K_2O kg/ha Average Field Rate	Grazed		Silage		Hay	
	E&W	Scotland	E&W	Scotland	E&W	Scotland
Current	47	36	75	71	39	45
Target	23	18	37	45	20	23

[1] Year 2000 figures From DEFRA (2002b).

[2] Figure for breadmaking quality, for feed 90kg/ha

[3] Year 2000 figures From DEFRA (2002b).

Overall the adoption of sustainable systems of farming should lead to the absolute reductions in overall use of synthetic fertilisers in the UK, detailed in Table 3.9. Thus this indicator may be applied and estimated for the UK as a whole, in addition to the farm level.

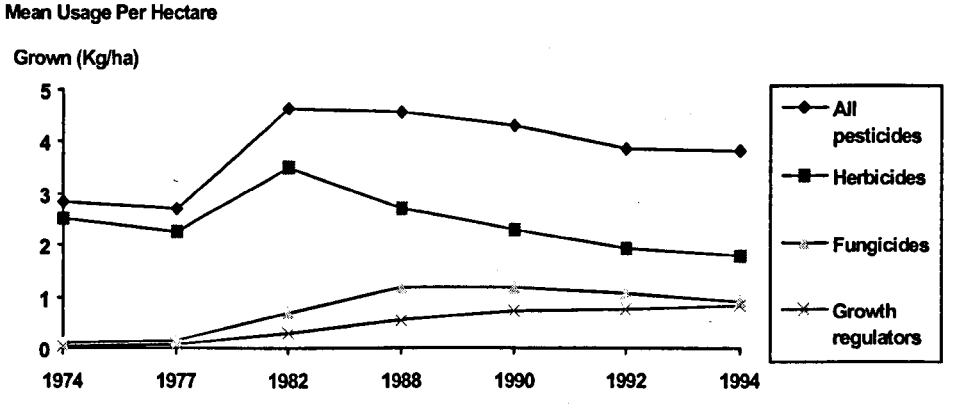
Table 3.9. Fertiliser use targets for the UK

(Tonnes/Annum)	Total N	Total P_2O_5	Total K_2O
Current[1]	1264	366	437
Target	632	183	219

Indicator 8. Intensity of Pesticide Use

The Royal Commission on Environmental Pollution (HMSO 1996c) states that the most serious problem associated with the use of pesticides is the contamination of ground water, surface water and drinking water, along with the effects on soil organisms which may have implications for soil quality. Surveys of pesticide usage in agriculture and horticulture are now fully co-ordinated by the Pesticide Usage Survey Groups of the Central Science Laboratory (CSL), and of the Scottish Agricultural Science Agency (SASA). The two survey groups now present combined reports of pesticide usage throughout Great Britain. (MAFF 1997) (see the Annual Reports, *DEFRA Pesticide Usage Surveys*). The UK indicator set (D.o.E 1996a) reports the intensity of pesticide use on cereal crops, expressed as mean usage per hectare grown (kg active ingredient/ha), on the assumption that the trends for cereals are typical of the situation for other crops. This indicator is shown in Figure 3.5 and shows the peak in pesticide use in the early 1980s and a steady decline since then.

Figure 3.5. Intensity of pesticide usage on cereal crops in Great Britain



(From D.o.E 1996a).

[1] 1999/2000 From FMA (2001).

To be of use however, targets are required for this indicator. The results of the Lautenbach experiment, LIFE and other work described in Chapter 1, suggest that a reduction of around 40% in overall pesticide use is achievable in a integrated arable system. There is however less scope for reducing herbicides compared with other pesticides. The results of the LIFE (see Plumb 1995) experiment indicate the following Table 3.10 are realistic targets.

The intensity of pesticide use would be easily modelled at the farm level, however the measure of pesticides applied to crops does not tell us as much as we would like. Total usage does not tell us anything about key substances such as organophosphates, which do a disproportionate amount of damage to the environment and the health of people.

Table 3.10. Target farm level pesticide reductions

	% Target reduction	1994[1] (Active Ingredient kg/ha)	Target (Active Ingredient kg/ha)
All pesticides	45%	3.846	1.773
Herbicides	25%	1.774	1.33
Fungicides	80%	0.914	0.183
Insecticides	80%	0.828	0.166
Growth Regulators	0%	0.135	0.000
Seed Treatment	80%	0.136	0.027

Falconer (1997) states that the objective of policy measures is to reduce the impact of pesticides rather than their use *per se*, and identifies several stages in the development of pesticide impact indicators:

1. Identify ecological and human health dimensions to which pesticide usage may cause concern;
2. Develop systems to score each chemical on each dimension;
3. Develop a system for weighting dimensions (e.g. according to values); and
4. Aggregate weighted scores across dimensions into an overall measure for environmental comparisons.

However, knowledge gaps with regard to the ecological and health impacts mean that the development of meaningful pesticide impact indicators is still not straightforward. Quinn & Edwards-Jones (1997) examined the use of impact ranking models in the regulation of pesticide use, and said that such models were practical aids to the decision making process at farm, regional or national levels. Such models in the future may improve the effectiveness of pesticide use indicators. An example of such a model is provided by Kovach, Petzoldt, Degni and Tette (1992).

[1] Pesticide Usage on Cereals

Kovach, Petzoldt, Degni and Tette (1992) develop an Environmental Impact Quotient (EIQ) to compare different pesticides and management practices (see also Levitan, Merwin and Kovach 1995). They use a algebraic equation to generate a composite index of environmental impact for each pesticide. A second equation is then used for site specific analysis based on the active ingredient and the total dosage. The EIQ has three components, which measures the impact on farm workers, consumers of food and on non-target flora and fauna. These three components of the indicator may be used separately or combined to give a single score, by taking a mean of the three sub components. Specifically the indicator may be developed by assigning a value of 1,3 or 5[1] for each of the following potential impacts.

Dermal Toxicity	DT	Soil Half Life	S
Chronic Toxicity	C	Bee Toxicity	Z
Systemicity	SY	Beneficial Arthropod Toxicity	B
Fish Toxicity	F	Plant Surface Half Life	P
Leaching Potential	L	Surface Loss Potential	R
		Bird Toxicity	D

The EIQs for each component are then calculated as follows:

$$\text{EIQ Ecological} = (F \times R)+(D \times (S+P)/2) \times 3 + (Z \times P \times 3) + (B+P \times 5) \quad (3.2.)$$

$$\text{EIQ Farm worker} = C \times (DT \times 5) + (DT \times P) \quad (3.3.)$$

$$\text{EIQ Consumer} = C \times ((S+P)/2) \times SY + L \quad (3.4.)$$

According to Quinn and Edwards-Jones (1997) a consistent rule of the model is that, the impact potential of each pesticide is equal to the toxicity of the chemical multiplied by exposure. These scores for each pesticide may by multiplied by the kg ai/ha to give a field use rate EIQ, and then the scores for each pesticide applied may be totalled in order to give an overall score for the management system.

Table 3.11. Example target pesticide impact scores

	kg ai/l	l/ha	kg ai/ha	Ecological EIQ	Field Use Rate EIQ
Diflufenican	0.5	0.5	0.25	82	20.5
Isoproturon	0.5	0.5	0.25	19	4.75
Mecoprop	0.57	1	0.57	25	14.25
Fenpropimorph	0.75	1	0.75	68	51
				Total	90.54

[1] 1 least harmful, 5 most harmful

ii Other Indicators

Indicator 10. Farm Pollution Incidents

As has been seen in Chapter 1, farm pollutants such as silage effluent, slurry, milk are highly damaging to water and to natural ecosystems, (see Chapter 1). Pollution incidents from agriculture are a major driving force or pressure upon the natural environment, which can be clearly linked with the state of water quality. The adoption of sustainable agricultural practices producing less potential for pollution should lead to the minimisation in the potential for water pollution incidents from agriculture. The Health and Safety Executive produce an annual report on pesticide incidents, with data on both incidents causing ill health and environmentally damage. During 2000/2001 170 incidents were reported, compared with an average of 220 over the last seven years, underlying the trend of reducing pollution (HSE 2001). However the potential for problems still exists, since in the previous year to this 1999/00 a record number of 254 incidents were reported.

Indicator 11. Nitrate and Phosphates levels in Water

The EU fifth action plan (CEC 1996) set a target of a standstill or reduction of nitrate levels in groundwater's, and a reduced incidence of surface waters with a nitrate content exceeding 50mg/l or giving rise to eutrophication of lakes and seas. Data from DEFRA (2002d) for surface reveals that in all regions the average of sites in the Harmonised monitoring scheme is below this. Since 1990, levels of nitrates in water at some sites in the Midlands, East Anglia and the Thames region exceeded this limit (see Appendix 14.a.). Looking at nitrate levels by landscape reveals that lowland arable areas experience significantly higher levels of nitrates in ground water levels than lowland pasture and upland areas (Appendix 14.c.). Some of these areas were designated Nitrate vulnerable zones (NVZs) in 1996, where restrictions were placed upon farming practices relating to nitrates. NVZs have now been expanded to cover most of the English lowlands (DEFRA 2002h). Data from DEFRA (2002d) for surface reveals that in all regions the average of sites in the Harmonised monitoring scheme is below this. However since 1990 in the Midlands, East Anglia and the Thames region some sites have exceed this limit (see Appendix 14.a.). Looking at nitrate levels by landscape reveals that lowland arable areas experience significantly higher levels of nitrates in ground water levels than lowland pasture and upland areas (Appendix 14.c.). Nitrate and phosphate levels in ground and surface water are related directly to the application of fertiliser by agriculture, and specific management practices on farms, therefore the effects of sustainable farming systems on this indicator will be looked at by specifically looking and nitrogen and phosphate use on farms.

Indicator 12. Pesticide Contamination of Water

Different pesticides have different impacts upon wildlife and upon human health, and we would have to have standards which reflected these differing levels of impact. Contamination of ground water has more serious implications for human health, since it is extensively used for drinking water supplies, and ground waters are rarely treated with anything more extensive than chlorine. There is also a greater lag between the use of pesticides and the contamination of ground water than of surface water.

An Environmental Quality Standard (EQS) is the concentration of a substance which must not be exceeded within the aquatic environment in order to protect it for its recognised uses (NRA 1995). Statutory EQSs have been set by the EC and in the UK by the D.o.E. The National Rivers Authority developed in 1995 non statutory EQSs for a range of pesticides in the aquatic environment, and these are presented in Appendix 16.

Data are available on pesticide contamination of both surface and ground water. Table 3.12 illustrates the % of sites sampled by the NRA[1] which failed an EQS in 1993. By looking at pesticide use on individual farms, and also the aggregate use of pesticides across a region or river catchment area, areas at risk of not meeting the EQS for a particular pesticide due to agricultural practices could be identified.

Table 3.12. The percentage of sites sampled by the NRA which failed EQS in 1993

Pesticide	Percentage of Site failing EQS	Pesticide	Percentage of Site failing EQS
All pesticides	3.8	Total DDT	0.14
Diazinon	1.25	Pentachlorophenol	0.09
PCSD/Eulan[2]	0.92	Azinphos methyl	0.06
Permethrin[1]	0.81	Malathion	0.06
HCH	0.66	Total Atrazine/simazine	0.06
Dichlorvos	0.34	Pp DDT	0.06
Cyfluthrin	0.33	Fenitrothion	0.03
Total drins	0.26	Hexachlorobenzene	0.03

(From NRA 1995).

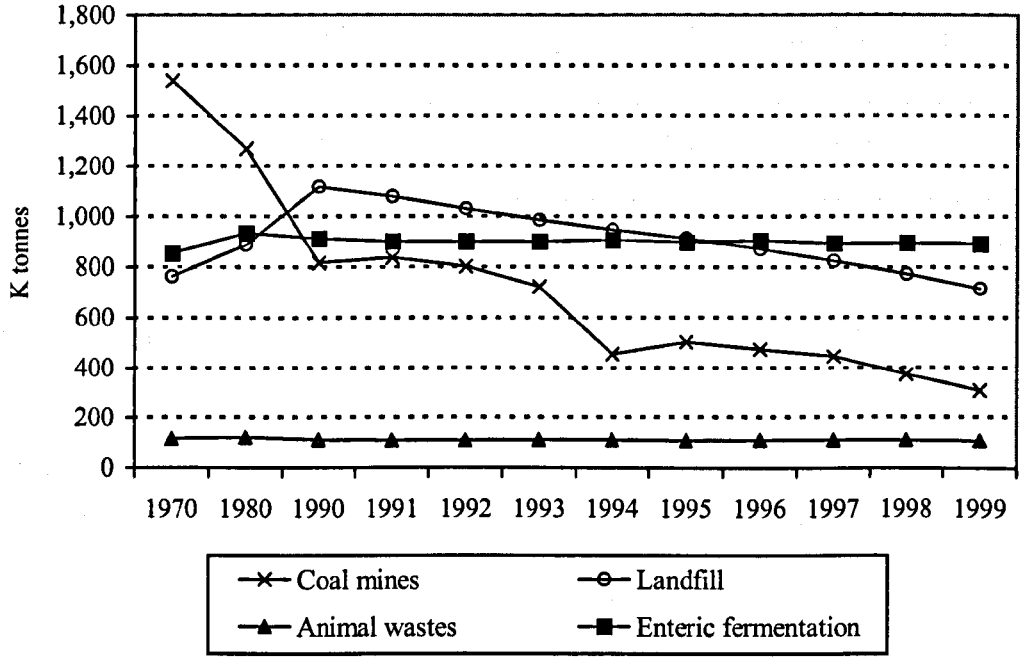
[1] National Rivers Authority, whose responsibilities have been taken over by the Environment Agency with England.

[2] Non Agricultural Uses (see NRA 1995)

Indicator 13. Methane production By Farm Animals

A key priority for the European Unions 6th Environmental Action Programme will be the ratification and implementation of the Kyoto protocol to cut greenhouse gas emissions by 8% over 1990 levels by 2008-12 (CEC 2001), and that this should be considered to be a first step towards a 70% reduction. In 1998 the EU agreed to redistribute this target for the EU as a whole, and as such the UK has a commitment to cut its green house gas emissions by 12.5% from 1990 levels (DEFRA 2002d). The indicator used is a basket of six key greenhouse gases. Agriculture is a major contributor to total emissions of one of them, namely methane. Figure 3.6 shows that in recent years whilst many of the other sources of methane have declined such as coal mining and land fill, emissions from the enteric fermentation of animals, and animal waste within farming have remained static. Thus livestock farming is now the biggest single source of methane emissions to the atmosphere.

Figure 3.6. Methane emissions from agriculture and other selected sources



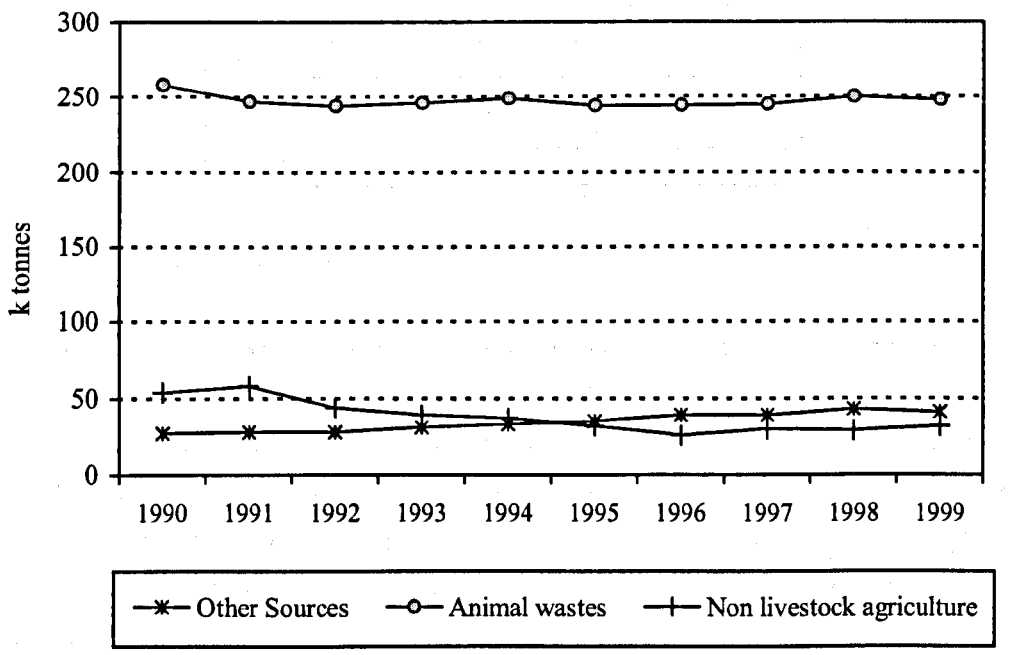
DEFRA (2002d).

Farm level practices and systems would influence methane emissions, however the total number of grazing animals would have a strong influence. A crude measure of methane emissions from livestock could therefore be estimated by looking at the average methane emission from enteric fermentation per grazing LSU within the UK. Calculation of this figure using data from DEFRA (2002b) gave a figure of 0.7765 tonnes per LSU. Although not entirely accurate this co-efficient would thus provide a rough means of estimated the total methane emissions from livestock.

Indicator 14. Ammonia Emissions From Agriculture

Ammonia emissions are also a major source of atmospheric pollution, of which livestock agriculture is the main culprit (Figure 3.7), and for which there has been little change over the past ten years.

Figure 3.7. Estimated Total UK emissions of ammonia (NH_3) 1990 – 1999



(From DEFRA 2002d).

The European Centre for Ecotoxicology and Toxicology of Chemicals estimated the total ammonia emissions figures for the UK in 1990 from farm animals and their waste. The emissions per head of each class of livestock are presented in Table 3.13.

Table 3.13. Ammonia emissions per head of livestock

	NH3-N Losses (t N)/head/annum
Cattle	
>2 years old	32.52
1year – 2 years	19.68
< 1 year	11.17
Pigs for slaughter	3.81
Boars and Sows	9.93
Sheep	1.54
Goats	0.88
Equines	9.82
Laying Hens	0.33
Table Fowl	0.08

(Calculated From ECETOC 1994).

The ammonia emissions depend upon the type of production systems, the winter and summer housing, fertiliser use and manufacture (ECETOC 1994), and these factors are likely to change in a move to sustainable farming systems. In addition ammonia emissions come from the use of nitrogenous fertiliser the ECETOC estimate the following emission factors for nitrate fertilisers (see Figure 3.8). Urea has an emission factor of 0.15, therefore applying one tonne of urea to land would be expected to lead to an emission of 0.15 tonnes of ammonia.

Figure 3.8. Ammonia emission factors for nitrate fertiliser

Fertiliser	Emissions Factor
Urea	0.15
Ammonium Nitrate	0.02

(Calculated From ECETOC 1994).

Ammonia emission from agriculture could be reduced by the extensification of agriculture, leading to fewer animals, and also by changes in production systems, better management of waste, and less use of nitrogen. Thus by using the ECETOC estimates a crude measure of the changes in total ammonia emissions from UK agriculture could be obtained.

3.10.4. Soil Quality

Maintaining soil quality is essential for a sustainable farming system. However data for soil appear to be less available compared with air and water issues. The RCEP report on *The Sustainable Use of Soil* says that in monitoring soil quality biological factors also need to be monitored (HMSO 1996c). Specifically they say that soil fauna can act as key indicators of

environmental change. At the very least they suggest that soil microbial mass should be measured. According to Arden-Clarke (1988) maintaining the organic matter content of soil is crucial in preventing soil erosion and deterioration of soil structure, therefore organic matter is considered an important indicator of sustainability.

i Core Indicators

Indicator 15. Soil Quality Index

A number of factors such as the soil structure, organic matter and winter soil cover all contribute towards soil quality. It is therefore proposed to develop an index of soil quality, which can be used in the models to examine to effects of sustainable cropping systems of soil sustainability. Each cropping activity will be scored on a 1-5 scale according to it's impact on:

1. Soil Structure;
2. Organic Matter; and
3. Winter Soil Cover.

A soil quality index for a whole farm can then be calculated by weighing the score according to cropping percentage. The mean of these three figures shall be used as an index of overall soil quality. In other words an equal weighting is given to each dimension. The scoring for the main arable crops are presented in Table 3.14.

Table 3.14. Characteristics of some crops in the context of rotation design.

Crop	Soil Structure	Organic matter	Winter Soil Cover
Wheat	2	1.5	1.5
Barley	2	1.5	1.5
Oats	2	1.5	1.5
Rye	2	1.5	1.5
Field Beans	2	2	1.5
Field Peas	2	2	1
Potatoes	1.5	0	0
Beet	1.5	0	0
Carrots	1.5	0	0
Maize	1	2	1.5
Rape	0	2	2.5
Turnips	0	2	2.5
Green manures non legumous	2.5	2.5	3
Green manures legumous	2.5	2.5	3
Red clover based Short term ley	4	4	4
White clover based Long term ley	4	5	4
Lucerne	4	5	4

Example indices for the following conventional and integrated rotations are shown in Table 3.15.

Table 3.15. Example Soil Quality Index scores for a sustainable and conventional crop rotation

Rotation	Sequence	Soil Quality Index
Conventional	Wheat/Rape/Wheat/Set Aside/Wheat/Beans/Wheat	0.89
Integrated	Grass/Grass/Wheat/Set Aside/Wheat/Beans/Wheat	1.71

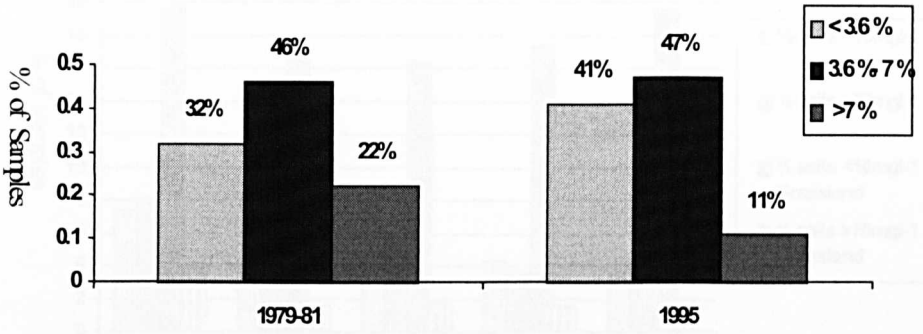
This scoring is based upon, an assessment by Lampkin (1990), of the suitability of crops in a rotational context (see Appendix 8). For sustainability soil quality should be maintained, and sustainable farming systems, should deliver an improvement on the soil quality index score for conventional rotations.

ii Other Indicators

Indicator 16. Organic Matter Content of Soil

The D.o.E. (1996a) proposed organic matter content in agricultural top-soils, the acidity of agricultural top-soils, and available nutrient concentrations as indicators of soil quality along with contamination with heavy metals. They say that there has been a small increase in the proportion of agricultural top soils found to have organic matter contents of less than 3.6% and a corresponding decrease in the proportion with more than 7% (see Figure 3.9). This seems to indicate an overall decline in soil organic matter content, and loss of soil quality. They conclude that this is due to the ley/arable rotations and certain other arable farming practices, although there is not a single threshold value for organic matter content below which the soil structure deteriorates. The organic matter content of soil is related to agricultural practices and in particular the system of farming adopted. According to Lampkin 1990, green manures, long and short term leys and legumes have a positive effect on soil organic matter whilst other arable crops such as cereals have a negative one (see Appendix 8). Thus by looking at changes within arable crop rotations on sustainable farming systems and in the soil quality index (Indicator 15), it would be possible to project the implications for soil organic matter.

Figure 3.9. The organic matter content of agricultural soils

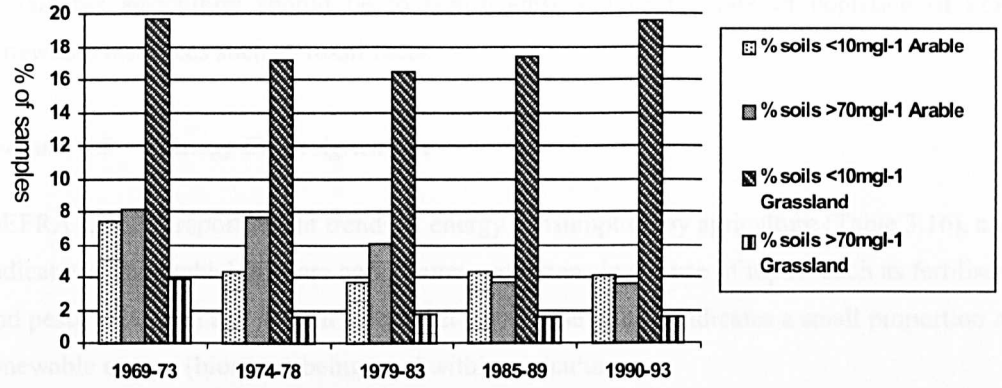


(From D.o.E. 1997).

Indicator 17. Phosphorous and Potassium Concentration in Soils

It is also important for sustainability to maintain the soils productive capacity and not to farm in a way that depletes soil nutrient reserves. Biological farming systems can help to maintain the reserves of soil nutrients, through increased biological activity in the soil, and the use of green manures (Widdowson 1987). Maintenance of soil phosphate and potash are considered especially important for sustainability. For instance available phosphorous concentrations below 10mg/l in soils can restrict crop growth. The proportion of arable soil samples below this level has decreased since 1969 (see Figure 3.10). However, the proportion above 70mg/l has also decreased. On grassland soils, there has been a decline from 4% to 2% of samples above 70mg/l, but the number of samples below 10mg/l has remained stable, at slightly over 15%.

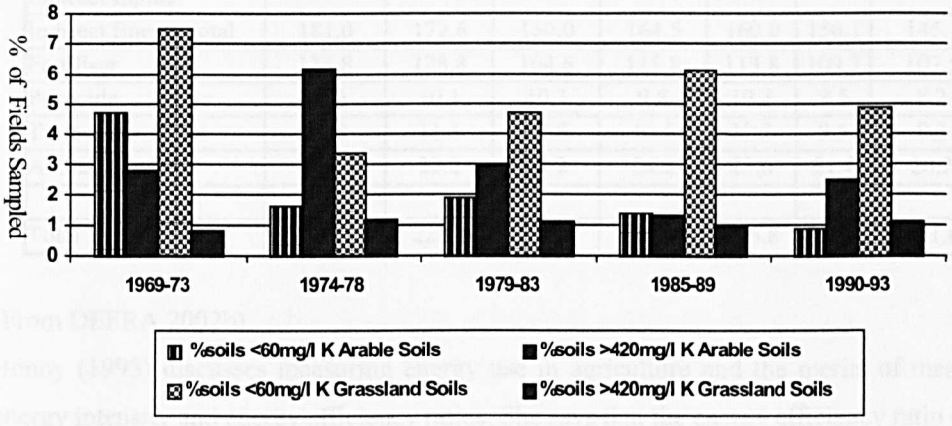
Figure 3.10. Available phosphorous in agricultural soils in England and Wales



(From D.o.E. 1997).

Potassium concentrations in agricultural soils in England and Wales have been relatively stable since 1969 (D.o.E 1996), as shown in Figure 3.11 below.

Figure 3.11. Available potassium in agricultural soils in England and Wales



(From D.o.E. 1997).

The indicators of phosphate and potassium levels in soil are clearly related to long term agricultural management practices, namely the specific cropping carried out, and the use of phosphate and potassic fertilisers. Therefore to assess these indicators, the specific changes in agricultural management should be looked at.

3.10.5. Resource Use

The sustainable use of non-renewable resources is a key element of sustainability. Suggested indicators of resource use for agriculture are energy use, agricultural productivity measured as a ratio of gross output and gross input and the use of fossil fuels. The objective for sustainable agriculture should be to significantly reduce the rate of depletion of non-renewable resources such as fossil fuels.

Indicator 18. Energy Use in Agriculture

DEFRA (2002b) report recent trends in energy consumption by agriculture (Table 3.16), and indicates a trend which mirrors agricultures reductions in the use of inputs such as fertilisers and pesticides, with a reduction in indirect energy use. It also indicates a small proportion of renewable energy (biomass) being used within agriculture.

Table 3.16. Trends in energy consumption by agriculture

units: PJ, Joules x 10^{15}	1985	1990	1993	1995	1997	1999	2000
Fuel							
Direct energy - total	59.3	56.3	57.1	58.1	56.8	51.9	46.5
Coal	0.3	0.5	0.3	0.4	0.2	0.1	0.1
Biomass	. .	3.1	3.1	3.1	3.1	3.1	3.1
Natural gas	2.9	4.0	4.7	4.5	5.7	5.9	5.3
Electricity	14.4	13.9	13.8	14.2	13.7	13.8	13.6
Petroleum	41.7	34.8	35.2	35.9	34.1	29.0	24.4
Indirect Inputs							
Indirect Energy total	181.0	172.6	150.0	164.5	160.0	150.1	145.1
Fertiliser	133.8	128.8	104.6	115.8	113.8	109.7	107.5
Pesticide	10.6	10.1	10.3	9.8	10.3	9.5	8.2
Tractor purchases	15.0	11.4	12.8	14.6	12.3	9.5	9.3
Animal Feeds	21.6	22.2	22.2	24.2	23.6	21.4	20.2
Total Energy	240.3	228.9	207.1	222.6	216.8	202.0	191.6

(From DEFRA 2002b).

Bonny (1993) discusses measuring energy use in agriculture and the merits of measuring energy intensity and energy efficiency ratios. She says that the energy efficiency ratio (that is ratio of dietary energy output to fuel expended to obtain it) varies widely, depending on the respective proportions of animal and plant products in the output. Therefore comparing energy efficiency in two different countries or regions would depend upon the relative importance of the crop and livestock industries in those regions.

The energy used by agriculture can be calculated directly from projections of cropping and farming changes, using the energy co-efficients estimated by Bonny (1993) and this indicator is thus selected for modelling at a national level.

Donaldson, Hughes and Leake (1996) report the following energy use in the LIFE experiment over 5 years (1990-1994) (see Table 3.17).

Table 3.17. Energy use on the LIFE experiment (MJ/ha)

	Con/CFP	Con/Li	Ifs/CFP	Ifs/Li
Winter Wheat	425	364	430	371
Set Aside	358	84	236	210
Winter Wheat	415/433	311/477	453	396
Winter Barley	421	389		
Winter Oilseed Rape	441	363	445	384
Winter Oats			374	328
Winter Beans			379	387
Mean	420	341	405	359

CON= Conventional Rotation, IFS = Integrated Rotation, CFP = Conventional Farm Spray Practice, LI=Low Input Spray Practice

(From Donaldson *et al.* 1996).

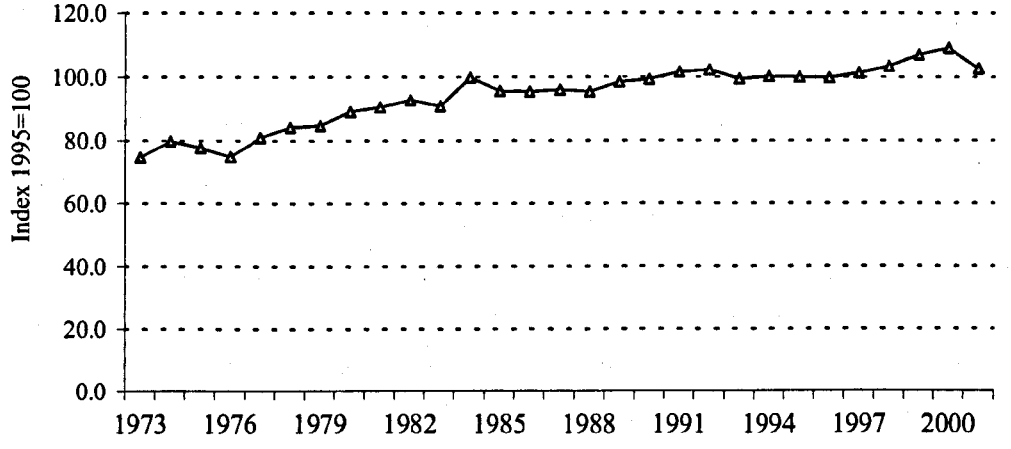
Over the whole rotation, the integrated low input system used 15% less energy than on the conventional rotation with standard farm practice inputs. This gives an indication of the kind of reductions that would be expected in a move to sustainable farming. Accordingly as a target a reduction of 15% in energy use has been set as an indicator of sustainability. The D.o.E. (1996a) stated that many new sources of coal, oil and natural gas have yet to be discovered and that current depletion rates are more sustainable than they would at first appear. However it is clear that sustainable agriculture should reduce its depletion of such reserves, at least to extend the number of years of supply, to allow more time to find alternative renewable sources of energy.

Indicator 19. Agricultural Productivity

Lynam and Herdt (1989) suggest that changes in productivity over time equate to a measure of sustainability. Sustainable agriculture is expected to rely on fewer inputs, but the inputs that it does use will need to be used more efficiently, therefore agricultural productivity is often included in indicators of sustainability. The UK Government (D.o.E. 1996a. MAFF 2000), in its indicators of sustainability measured agricultural productivity by taking total factor productivity; that is the ratio of the gross output of agriculture to total inputs valued at constant prices. Other environmental and social factors could potentially be included to provide an overall measure of sustainability, provided that they can be assigned a monetary value (Tisdell 1996). Figure 3.12 shows recent trends in the productivity of UK agriculture (from DEFRA 2002a), measured using the total factor productivity that is the ratio of total outputs to total inputs. Sustainability should mean a reduction in inputs to agriculture, but with a proportionately smaller fall in output, so greater returns per unit of input and an

increase in productivity can be expected. In the context of this study, it is assumed that productivity should not fall below its current levels.

Figure 3.12. Trends in agricultural productivity (final output per unit of all inputs)



(From DEFRA 2002a).

DEFRA (2001c) state that since producers pay different prices for inputs, and receive different prices for outputs, it is not necessarily the case that those who have the most efficient ratio of inputs to outputs are also the most profitable. However there is strong relationship between productivity and profitability, and that productivity might be improved through the dissemination of information on good agricultural practice. Productivity is reported for individual farm types, to assess changes in the relative efficiency at the farm level, and at a national level to assess the changes in the overall efficiency of UK agriculture.

3.11. Economic Indicators

Environmental impacts are however only one aspect of sustainability, the economic impacts of sustainability, also need quantifying. The following indicators are intended to monitor the economic sustainability of farming systems. The economic indicators may be subdivided into indicators of farm viability which deal directly with the financial and business performance of farms and socio-economic impacts, which deal with the wider economic effects of agricultural change. Shadbolt and Morriss (1997) claim that the indicators used to evaluate farm financial performance in any one year are different to those which might be used to assess the financial health of a business. For example excellent short term financial performance might be achieved at the expense of the long term financial health of the

business. Thus what Shadbolt and Morris say is often in parallel with the depletion of the businesses biophysical resources, which ultimately leads to the loss of farm productivity. Thus economic indicators of sustainability must capture elements of short and long term viability.

3.11.1. Farm Viability

These indicators are intended to provide a measure of the economic and business performance of agriculture at the farm level.

i Core Indicators

Indicator 20. Net Farm Income

Net farm income is widely taken as an indicator of farm viability, and is the total farm gross margin less the sum of the fixed costs. This represents the reward to the farmer for their own manual labour, management and interest on tenant type capital invested in the farm. Formerly MAFF and now DEFRA publish annual statistics on net farm income by type of farm in *Agricultural Incomes in the UK* (DEFRA 2002a) and also give information by country and by size of farm. Recent trends are reported as an index (Table 3.18).

Table 3.18. Net farm income by country and type of farm[1]

United Kingdom	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02[2]
Dairy	117	96	114	90	56	32	24	30	59
Cattle and sheep (LFA)	108	76	113	110	57	27	16	34	30
Cattle and sheep (lowland)		140	104	109	88	8	-3	–	–
Cereals	59	78	119	103	34	17	26	13	10
General cropping	65	111	126	64	27	46	10	24	23
Pigs and poultry	31	61	126	111	37	-36	-9	65	36
Mixed	74	86	122	91	14	3	56	61	50
All Types[3]		86	91	118	90	38	25	18	22

Average net farm income per farm: indices, 1994/95 - 1996/97 = 100

(From DEFRA 2002a).

Farmer's incomes have declined in real terms since 1993/94, and thus securing a reasonable living for those within agriculture is an important objective for sustainability, along with the environmental and social objectives. A move to sustainability should not be expected to worsen the welfare position of farmers. However this objective is problematical given that the environmental criteria for sustainability will lead to cuts in production, and therefore revenue, however cuts in input use is expected to compensate for this. In addition it also may be assumed that lower agricultural income overall may lead to a situation where there are

[1] Average net farm income per farm: indices, 1994/95 - 1996/97 = 100. Accounting years ending on average in February In real terms (as deflated by the RPI)

[2] Provisional

[3] Excluding Horticulture

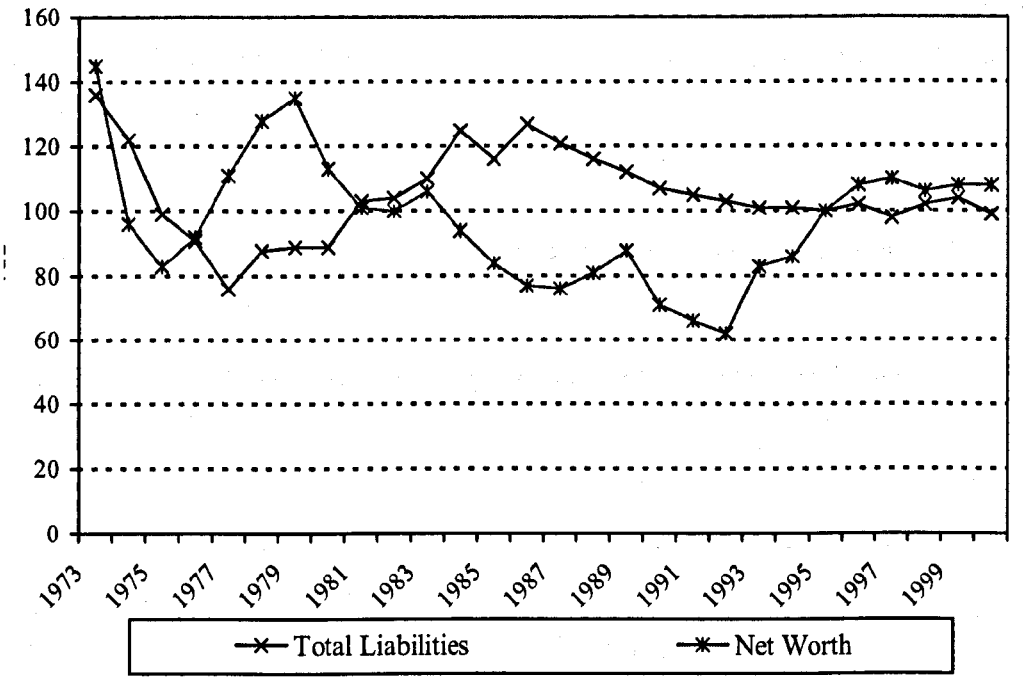
fewer farmers, thus maintaining income per head. For measuring sustainability we need to look at long-term trends in farm income, therefore it is suggested that the ten year mean of net farm income be used as the minimum threshold for farm sustainable farm incomes.

Indicator 21. Agricultural Borrowing

The ability to bear or cope with risk is also an important element of economic sustainability. Conway and Barbier (1990) defined agricultural sustainability as the ability to maintain productivity, whether of a field or farm or nation, in the face of stress or shock.

The elements of risk bearing ability identified by Beohlje (1994) are total assets, total liabilities, owners equity (or net worth), debt to asset ratio. In addition the review of economic indicators by Shadbolt and Morriss (1997) mentions that debt or the inability to borrow additional funds is often cited as a important determinant of a farmers ability to adopt conservation practices. DEFRA (2001b) provide an index in real terms of the total assets, liabilities and net worth of UK agriculture (see Figure 3.13).

Figure 3.13. Index of net worth and total liabilities for UK agriculture in real terms



(From DEFRA 2002b).

Farm level models could provide an assessment of the borrowing requirement of farms, and hence some influence on total assets and liabilities over time and would provide further information on the financial situation of farms after moving to sustainable agriculture.

ii Other Indicators

Indicator 22. Net Worth

For economic sustainability the net worth of agriculture should not decline in the long term. Maintaining the net worth of the business over time however depends on maintaining income, and minimising expenditure, and for this reason Net Farm Income is selected as the primary indicator for farm viability for modelling.

3.11.2. Socio-Economic Indicators

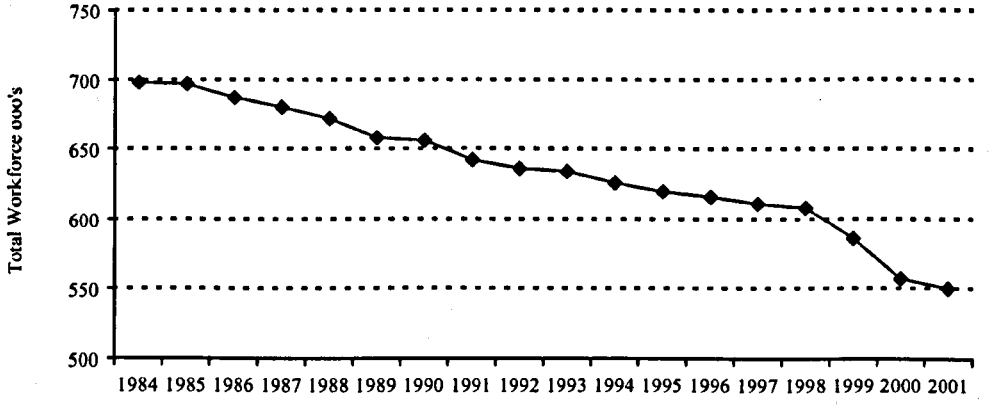
However the impact of any change in farming practices associated with a move towards sustainable farming systems will have an impact beyond farming, which needs to be addressed.

Indicator 23. Agricultural Labour Force

The numbers of people employed in agriculture would be an important measure of its contribution to employment in rural areas. The shift away from cropping, to more grass-based agriculture may mean a greater demand for skilled stock people, particularly if more welfare friendly systems of livestock farming are introduced (Stopes 1990), which might require a greater labour input per head.

However it is unrealistic to assume that sustainability will reverse the long term downward trend in agricultural employment. The total number of people employed in agriculture has been declining for many years, at an average rate of about 7,000 per year over the last 13 years as Figure 3.14 illustrates.

Figure 3.14. The decline in agricultural employment (total labour force including farmers and their spouses



(From DEFRA 2002b).

Falls in farm employment may be offset by increases in other sectors of the rural economy such as forestry and tourism. MAFF (2000a) state that while agricultural employment plays an important role in contributing to the maintenance of rural communities, it would not be sensible to set targets for it since it is largely determined by market conditions, and the available technology. McInerney (2002) states that the future of agriculture as a competitive industry is not in doubt, but that fewer people must expect it to provide their livelihood. Therefore no specific target for farm employment has been set, and for the purposes of this study provides a means to assess the impacts of agricultural sustainability on the wider rural economy.

The labour requirement of different crops and enterprises could be integrated into a farm LP model to provide an estimate of the labour needed for a sustainable scenario. The labour required could be expressed in Standard Man Days (SMDs)/annum, which according to Nix (1997) is a rough method of calculating regular labour requirements. It is assumed that 300 SMDs (1 SMD= 8 labour hours/year) are provided annually by one person, allowance being made for any manual labour being provided by the farmer himself. It is to be pointed out that this is a rough measure since it takes no account of seasonality, the level of mechanisation and the layout of individual farms which all effect labour requirements.

3.12. Social Indicators

The following section examines indicators of some of the social aspects of sustainability, namely food issues, human welfare issues such as heath and safety on farms and animal welfare. This is the most problematical of the areas of sustainability, since many of these aspects are very much a matter of personal opinions and values, and as such very hard to quantify.

3.12.1. Food Issues

Sustainable agriculture must address food issues such as safety and security. The problem here is identifying those food safety problems which are a result of practices on farms and which are not caused further down the food distribution system or by poor preparation by the consumer. Consumers are particularly worried about pesticides however (see section 1.5.3.2, page 24), and food quality indicators should focus on this issue, since it is directly related to farming practices.

i Core Indicators

Indicator 24. Consumer Pesticde Hazard Index

Data on pesticide contamination of food in the UK is published by the Pesticide Residues Committee (PRC 2002). Maximum residual levels (MRLs) have been established for pesticides. MRLs are designed to ensure that pesticides are being used correctly, and excedence of an MRL does not necessarily mean a risk to human health. The percentage of samples found to be above the MRL for any pesticide, however remains a useful indicator of

pesticide contamination of food. On the actual level of pesticide residues in food according to the PRC (2002), analysis of over 4,000 samples taken in 2001 from a variety of foodstuffs showed that:

1. 70.6 % did not contain detectable residues;
2. 28.7 % had residues below the maximum residue level (MRL);
3. less than 1 % had residues above the MRL.

Data on residues however does not necessarily reveal anything about the hazards from pesticide contamination of food. It is therefore proposed to use an index of pesticide hazard to consumers of food based upon the EIQ (Environmental Impact Quotient) developed by Kovach *et al.* 1992 (see Indicator 9).

The index is constructed as follows using scores for individual pesticides for chronic toxicity (C), systemicity (SY), plant surface half life (P), soil half life (S), and leaching potential (L).

$$\text{EIQ Consumer} = C \times ((S+P)/2) \times SY + L \qquad (3.5.)$$

To estimate the ecological impact of pesticides, the impact score for each pesticide can be totalled to give an overall score for the management system, and for which a maximum or threshold level can be assigned, which would be based upon the EIQ value of the pesticides and the total dosage rates. An example is provided in Table 3.19.

Table 3.19. Consumer pesticide index targets

	kg ai/l	l/ha	kg ai/ha	Consumer EIQ	Field Use Rate EIQ
Diflufenican	0.5	0.5	0.25	61	15.25
Isoproturon	0.5	0.5	0.25	8.5	2.125
Mecoprop	0.57	1	0.57	8	4.56
Fenpropimorph	0.75	1	0.75	16.6	12.45
				Total	34.38

Consumers are concerned about pesticides in food (Mintel 1999), and as for the environmental hazard index a target of halving the hazard to consumers is adopted. As for the Environmental Index, the Consumer Pesticide Hazard Index may be calculated directly from the models, however given that food is traded on a national basis, only a national figure is considered of value.

ii Other indicators

The following indicators have considerable resonance with the general public, since it would directly concern them.

Indicator 25. Incidents of Food Poisoning

Recent outbreaks of the *E.coli.* 0157 bacteria however have been linked with farming practice and the hygiene of livestock on farms moving to slaughter houses. Statistics on food poisoning for the UK are available from the Central office of statistics but, they cannot all be directly linked with farming practices, since many food poisoning cases are a result of poor hygiene beyond the farm gate. More detail on how *E.coli.* infections relate to farm practices would help in developing this indicator and in making it more targeted at assessing agricultural sustainability.

Indicator 26. Incidence of BSE (Bovine Spongiform Encephalopathy)

There has been particular concern over the beef and dairy industries in recent years due to the occurrence of BSE (Bovine Spongiform Encephalopathy) in UK cattle herds and the danger to human health. The disease has also had a considerable economic impact through loss of production, costs of control measures and restrictions on UK beef exports (McDonald and Roberts 1998). Therefore the number of confirmed cases of this disease is included as a food safety indicator for the livestock industry.

3.12.2. Farm Safety

Methods of production must also be acceptable to those producing food and so farm safety is included as a component of social sustainability. A key concern is the hazard arising from the use of pesticides. However it should be recognised that sustainability entails an improvement in all aspects of farm safety.

Indicator 27. Pesticide Operator Hazard Index

An index for pesticide operator hazard can be constructed using the method of Kovach *et al.* (1992) (see Indicator 9, page 72). The index is based upon chronic toxicity (C), dermal toxicity (DT), and plant surface half life (P).

$$\text{EIQ Farm worker} = C \times (DT \times 5) + (DT \times P) \qquad (3.6.)$$

The same procedure is followed as with the ecological impact of pesticides, the impact score for each pesticide can then be totalled to give an overall score for the management system,

(for examples see Table 3.20) and for which a maximum or threshold level can be assigned, which would be based upon the EIQ value of the pesticides and the total dosage rates.

Table 3.20. Operator hazard pesticide indices

	kg ai/l	l/ha	kg ai/ha	Farm worker EIQ	Field Use Rate EIQ
Diflufenican	0.5	0.5	0.25	95	23.75
Isoproturon	0.5	0.5	0.25	80	20
Mecoprop	0.57	1	0.57	64	36.48
Fenpropimorph	0.75	1	0.75	68	51
				Total	131.23

The aim for sustainable agriculture should be to half the operator risk from using agricultural pesticides. The index is calculated from the models in a similar manner to the Environmental and Consumer pesticide hazard indices, (see Indicator 9 page 72 and Indicator 24, page 89).

3.12.3. Animal Welfare

Sustainable agriculture should treat animals in a humane and civilised manner. What is or is not acceptable is decided by human values and beliefs, and so animal welfare is regarded as a social indicator. Animal welfare is not mentioned in any of the existing indicator sets examined, yet for sustainability we must consider them to be important social aspects of agriculture; and in particular farmers interaction with the general public at large. Duncan and Dawkins (1983) suggest five criteria for assessing farm animal welfare :

1. Animal Health;
2. Productivity;
3. Physiology;
4. Biochemistry;
5. Behaviour.

There are problems however with using productivity as an indicator of animal welfare, it could be argued that high levels of production are a result of good welfare, but the opposite could also be argued. At the same time indicators of physiological, biochemical and behavioural well being, present problems in terms of data and calibration. The potential exists for developing an index of animal welfare possibly based upon the five freedoms of Webster (1995). Schulte, Earley, van der Wouw and Culleton (1998) investigate developing an indicator of animal welfare based upon the five freedoms of Webster. However developing a comprehensive animal welfare index covering all sectors of livestock farming requires more information relating farming practices to the specific elements of these five freedoms DEFRA (2002a) state that an indictor of animal health was being developed as part of their overall animal health strategy. An indicator of the time taken to clear up poor cases of animal welfare was also proposed by DEFRA (2002a).

The list of core indicators (see Table 3.21) contains 11 environmental indicators, 2 economic and 3 social indicators. The relatively high number of environmental indicators is indicative diverse nature of many of the environmental problems caused by modern agriculture. To be of use in the analysis the indicators need targets, which reflect the objectives of sustainable farming systems across the range of farm types and regions of the UK, and where possible regional and farm type specific targets have been set for each indicator. Other indicators have also been presented for which is would be desirable to model, these indicators may be directly or indirectly linked to agricultural practices. This study will look at the predicted changes in farm practices from moving to sustainability, and these changes will also provide some indication of the likely changes in these indicators. (see Appendix 18).

As was discussed in section 3.1.2. the ideal situation would be a single figure measurement of sustainability, however given the controversies surrounding the definition of sustainable agriculture, the construction of the single index would require weightings, which would be difficult due to the personal belief factors involved in sustainability. Thus the approach taken to look at sustainable agriculture was to produce a suite of indicators, and to look at the relative changes in each of them resulting from moving to sustainable farming systems. In Chapter 6 these are compared with farm, regional and national targets, in order to gauge whether the farm plans generated by the models are sustainable or not, and to examine some of the potential benefits of sustainability compared to the costs.

In assessing sustainability, it is essential to look at a broad spectrum of issues, in order to prevent a focus on one at the expense of the others, and to provide a balanced view of sustainability. The core indicator set is therefore designed to cover as much as possible of the range of issues relating to sustainability. Other indicators are also discussed to provide a broader view of some of the changes, which would be expected from moving to sustainability.

Table 3.21. Summary of the core indicators to be included in the models of sustainable agriculture

Theme	Key Indicator	Level	% Change from current levels	Unit
Biodiversity	Mean Stocking Rates No of crops in a rotation	Farm, Regional Farm	-20% More than 4	LSU/ha Number
Landscape	Changes in land cover	Regional	Increase in Grassland Area ha	Ha
Pollution	Synthetic Fertiliser (NPK) use	Farm, Regional and National	-50%	'000 t/yr
	Intensity of Pesticide Use	Farm and regional	-80%	kg ai / ha
	Ecological Effects of Pesticides	Farm, Regional and National	-50%	Index
	Methane Emissions Ammonia Emissions	National National	-12.5% A reduction	K tonnes /annum K tonnes /annum
Soil	Soil Quality Index	Farm and Regional	Value of more than 1.5	Index
Resource Use	Energy use for crop production	Farm and National	-15%	MJ.
	Agricultural Productivity	Farm and National	No overall fall in productivity	Ratio Total inputs to total outputs
Farm Viability	Net Farm Income	Farm, Regional and National	No Target	£/yr
	Agricultural Borrowing	Farm	No increase in debt	
Socio-economic	Agricultural Labour Force	Regional and National	No Target	No
Food	Consumer Pesticide Hazard Index	National	-50%	Index
Farm Safety	Pesticide Operator Hazard Index	National	-50%	Index

Chapter 4. Modelling a Move to Sustainability at the Farm level

4.1. Objectives for the Model

Any analysis of the implementation of a move to sustainable systems of farming would require a model which have the following three characteristics:

1. It is capable of assessing at a regional level the impacts of farm level changes, including those on the farm supply industry and on rural employment;
2. It is capable of predicting the likely ecological changes in the countryside, through incorporating an environmental sub-model;
3. It is sufficiently detailed to differentiate between production regions in the UK.

This chapter discusses the construction of such a model and its use to predict the farm-level changes associated with a move to more sustainable farming, as defined in Chapter 3. It then goes on to describe the construction of a model and to estimate the likely farm-level impacts of moving to sustainable production systems.

4.2. Modelling Techniques

A choice of two distinct modelling techniques exist:

1. A macroeconomic approach, which relies upon direct statistical estimation of national supply functions for the farming industry;
2. A microeconomic approach which involves modelling the farm-level effects using mathematical programming and aggregating up to reveal the regional and national impacts.

The strengths and limitations of each of these two alternative approaches are considered in the following sections.

4.2.1. A Macro-economic approach

A macro-economic approach would provide a direct statistical estimation of the aggregate supply functions of the industry. This contrasts with a micro-economic approach that focuses on the individual decision-making unit and which better represents the technological, economic, social and (importantly for sustainable agriculture) environmental forces that influence a farmers decision-making process. Davey and Weightman (1971) have stated that the major appeal of the macro-economic type of model is that it provides a link between the farm and the industry as a whole. However, methods involving the analysis of time-series data rely on looking at a farms reactions to situations in the past or on historical trends. This kind of analysis would clearly be inappropriate here since there is no historical experience of

sustainable agriculture, at least as defined in Chapters 2 and 3. Furthermore, both conceptually and methodologically, it is difficult to incorporate the farm-level management constraints required by the pursuit of sustainability.

4.2.2. A Microeconomic Approach - Linear Programming (LP)

A micro-economic approach using mathematical programming has found favour in modelling the type of problem being considered in this study. Examples of this approach include Jones *et. al.* (1995), Yates and Rehman (1996,1997), Olson, Langley and Heady (1982). Howitt (1995b) states that mathematical programming models are widely used in the analysis of agricultural economic policy. The reason for this is that mathematical programming models enjoy three notable advantages, according to Buckwell and Hazel (1974):

1. Microeconomic models provide a wealth of information at the farm and regional levels, as well as at the national level;

2. Mathematical Programming models embody a complete causal system of the farm and its interrelationships with all other industry sectors;

3. Mathematical Programming models can cope with the fact that most farms produce many products using many different inputs. Hence, such models are well suited to examining the total impact of changes in relative production costs on the supply of individual products.

Added to this, being based upon normative assumptions mathematical programming models allow conditions that have not been experienced before to be studied, as is the case with a move to sustainable agricultural systems. Howitt (1994, 1995b) discusses the use of Linear Programming (LP), a variant of mathematical programming in the regional analysis of agricultural production systems and states that it has significant advantages in that it requires minimal data, shows how resources are used and can simulate the effects of environmental constraints. These benefits, however, must be weighed against several disadvantages and difficulties. In particular, one problem with the normative nature of LP is that it entails assuming that farmers are sufficiently rational in their decision-making process to follow a utility maximising model. In addition, Howitt cites three further empirical problems with LP. Firstly, the methods used to derive solutions against the base-year data have to strike a balance between poor base-year calibration and fully constrained models, which may bias policy predictions.

Secondly, changes in input costs or commodity support prices in the model do not cause changes in the dual values or types of output, unless they precipitate a change in the basis. This, Howitt states, leads to the well known stepwise response of LP models to parameterisation. For models based on aggregate data, the range between steps may be larger than many policy changes, thus making the models unsuitable for some kinds of policy analysis.

Thirdly, the assumption of fixed technical coefficients means that LPs cannot capture the gradual substitution of inputs as their costs or quantities are changed.

A final problem noted in a study relating to organic systems of farming by Midmore and Lampkin (1994) is that individual farms are not independent of the systematic parameters which govern changes and which, if adopted by considerable numbers, will cause changes in the system itself. For example, changes in national cropping patterns may lead to changes in market prices, which may have a further effect upon cropping patterns.

4.2.3. Conclusions

However, not withstanding the limitations of the micro-economic approach, on the basis of the preceding discussion the decision was taken to use LP to analyse the impacts and repercussions of the wholesale adoption of sustainable agriculture. This was based upon two observations. First, the current farming situation is being compared with a scenario in the future after the successful adoption of the sustainable farming methods, described in Chapters 1 and 2, and monitored using the indicators developed in Chapter 3. Thus, a static comparison was being performed and not an examination of the transition phase (although in reality the transition to sustainable agriculture would be over a number of years). Secondly the approach was focussed on changes in the farming systems due to technical requirements and the changes in the technologies used. It was assumed that UK farmers would be acting within the framework of the Common Agricultural Policy (CAP), as and such there would be no radical changes in commodity prices or input prices. However by looking at the changes in production, it will be possible to make some inferences about likely price changes under a sustainable agriculture scenario.

4.3. Methodological Issues in connection with the construction of the LP models

A number of issues need to be considered when constructing aggregate LP models of this type, namely aggregation bias, and farmer decision making under uncertainty. These problems, and techniques to overcome them are discussed in the following sections.

4.3.1. Aggregation

LP was originally a normative technique used for developing optimal farm plans (see Barnard and Nix 1980), where it could be assumed that the farmer would take rational production decisions in order to maximise the total farm gross margin. However, in this study the intention was to look at production changes and decisions on a regional or national scale. Therefore, it was necessary to aggregate farm-level models up to the regional and national level. Buckwell and Hazell (1972) state that one way to do this is to construct a farm model for each individual farm, and to solve these models taking into account the various interdependencies between farms, such as the movement of intermediate goods of

production, and competition for scarce resources. If the $\dot{x}_{kt}$ represents the total simulated output from a farm k in year t, then the aggregate supply vector for all farms is given by:

$$\sum_{k} \dot{x}_{kt} \tag{4.1.}$$

This may or may not equal $\sum_{k} \bar{x}_{kt}$ where $\bar{x}$ is the actual output vector of the farm k in year t. Differences may be due to:

1. Model Specification Error;
2. Inaccuracies in the data;
3. The incomplete specification of interdependencies between farms; and
4. The normative nature of the model.

However, for a model of UK agriculture over 200,000 separate LP models would be required, along with the necessary data for each farm. This is clearly impractical, so some degree of aggregation was necessary. According to Buckwell and Hazell (1972), this is normally done by using representative farms or by constructing aggregate regional models and the relative merits of these two approaches are discussed in the following sections.

4.3.1.1. The Representative Farm Method

The representative farm approach was widely used in the US in the 1960s and was employed by Davey and Weightman (1971) and Thomson and Buckwell (1979) in the development of the Newcastle model for UK agriculture. This approach was used more recently by Schipper, Jansen and Stoorvogel (1995) in a study of sustainable land use in Costa Rica, and by Yates and Rehman (1996, 1997); who looked at the impact of new bovine reproductive technologies in the UK Dairy industry. The representative farm approach classifies farms into sets of homogenous groups, and constructs a model for a representative farm in each group. Aggregate supply estimates are then obtained through appropriate weighting of the farm solution vector, according to the number of farms in each group. According to Buckwell and Hazell (1972), if $\dot{x}_{ht}$ denotes the solution vector of the representative farm for group h in the year t and k_{ht} is the number of farms in the group, then the aggregate supply for the group would be $k_{ht} \cdot \dot{x}_{ht}$ and the aggregate supply for all groups for the year t would be:

$$\sum_{h} k_{ht} \cdot \dot{x}_{ht} \tag{4.2.}$$

This estimate should be compared with the ideal estimate:

$$\sum_{k} \overline{X}_{kt} \qquad (4.3.)$$

Any discrepancy which arises between these two estimates would be due to aggregation bias. Ways of eliminating or reducing aggregation bias have been studied by a number of authors, most notably Day (1963), Barker and Stanton (1965), Sheehy and McAlexander (1965) and Frick and Andrews (1965). Day concluded that aggregation bias could be eliminated if farms were grouped according to the following conditions:

1. They are technically homogenous meaning that each farm has the same production possibilities, the same type of resources and constraints, the same levels of resources and the same level of managerial ability;
2. They exhibit pecunious proportionality – meaning that individual farmers within a group hold expectations about unit activity returns which are proportional to the average expectations; and
3. They exhibit institutional proportionality, meaning that the constraint vector of the programming model for each individual farm is proportional to the aggregate constraint vector.

Buckwell and Hazell (1972) note that Days requirements are very demanding, and that many authors have developed less stringent criteria. They suggest an approach that seeks to contain aggregation bias to an acceptable level rather than completely eliminating it. Thus, although a variety of criteria may be important, in practice Hazell and Norton (1986) state that minimising aggregation bias can be reduced to a few simple rules:

1. All farms within a group should have similar land-labour ratios, which means grouping farms by size class;
2. All farms within a group should have similar yields, which they say means, at the very least separating irrigated and non-irrigated farms;
3. All farms within a group should have the same predominant crops.

Likewise Kirke and Moss (1987) concluded that, if a number of farms are to be represented by a single LP model, then they must be technically homogenous, that is they have identical input-output coefficients and have proportional expectations of net revenue.

4.3.1.2. The Aggregate Region Approach

This approach involves aggregating the resources of a homogenous region or area and, programming the aggregated variables as a single farm. If x_{rt} denotes the solution vector for the region r in year t, then aggregation bias exists if:

$$x_{rt} \neq \sum_{k \in r} \dot{x}_{kt} \qquad (4.4.)$$

Buckwell and Hazell (1972) state that this is the approach which is generally adopted for recursive linear programming and spatial equilibrium models. The Land Use Allocation Model (LUAM) developed at the University of Reading is an example of such a model (see Jones *et al.* 1995). This divides the land base of England and Wales into 15 land classes on which the model chooses between ten forms of agricultural production activities. Another example is the model by Olson, Langley and Heady (1982), which looked at the impact of a move to organic farming systems on US agriculture. They used a model which contained 150 spatially delineated regions, aggregated for reporting purposes into 10 major production regions. Against this the aggregate region approach does not take account of the fact that production decisions are taken at the farm level. The data needs of this approach are less however, and it is a far simpler method than the representative farm approach. The regions selected nevertheless must be homogenous, but need not form single blocks of adjacent land (Buckwell and Hazell 1972).

Despite these advantages, the representative farm approach appears to offer clear advantages in terms of reducing aggregation bias and in modelling the production responses more accurately. Finally decisions relating to the introduction of sustainable farming practices will be taken at the farm level by individual farmers. Therefore it is on this basis that the representative farm approach was chosen as the optimum method for modelling sustainable farming systems.

4.3.2. Risk in Farm Models

Farm decisions are taken under conditions of risk and uncertainty, with farmers facing uncertainty in respect of markets and production variables such as yields, diseases and input/output relationships. There is plenty of evidence in the literature that farmers behave in a risk-adverse manner (Moscardi and De Janvry 1977, Dillon and Scandizzo 1978, Oglethorpe 1995 and Anderson and Hazell 1997). Essentially a farmer strives not only to maximise income, but also to obtain a stable income, and thus may not choose certain

production activities, if they are deemed too risky. According to Walker and Dillon (1976), using LP models in which profit is maximised without regard to behavioural aspects is unrealistic. Quadratic programming (QP) may be used to maximise expected income for a given level of income variance, and according to Norton and Hazell (1986) QP is a useful technique in farm planning analysis. However, the data requirements of such an approach are quite considerable, and many have looked for alternative approaches which permit the use of standard linear programming. Examples of such approaches are MOTAD (Minimisation and Total Absolute Deviation), Game Theory and Focal Loss Constrained Programming Models, which are discussed in the next section.

4.3.2.1. MOTAD (Minimisation of Total Absolute Deviation)

MOTAD (Minimisation of Total Absolute Deviation) was first developed by Hazell (1971) and has since become is a well established modification to standard LP techniques to enable the models to deal with risk (see for example Oglethorpe 1995, Hope and Lingard 1992). Hazell and Norton (1986) state that this approach is most relevant when the variance of farm income is estimated using time series or cross sectional data. Hazell (1971) proposed using an alternative measure of the variance to that of quadratic programming namely the sample Mean absolute deviation (MAD). A standard LP model will assume a single average co-efficient value, MOTAD on the other hand incorporates variability over a number of years (normally at least 5). Where historical gross margin data is available these normally form the basis of the variability in the MOTAD model, however according to Hazell and Norton (1986) cross sectional data may also be used.

According to Hardaker, Huirne and Anderson (1997), the MOTAD model typically takes the form:

$$\text{Maximise } E = c\,x - f \qquad (4.5.)$$

Subject to:

$$A\,x \leq b \quad \text{and } x \geq 0 \qquad (4.6.)$$

$$D = C - u\,c \qquad (4.7.)$$

$$-D\,x - I\,y \leq u\,o \qquad (4.8.)$$

$$P\,y \leq M,\ M \text{ varied} \qquad (4.9.)$$

$$\text{And } x, y \geq 0 \qquad (4.10.)$$

Where in equation 4.5, E is the expected profit or income c is a 1 by n vector of activity net revenues, x is a 1 by n vector of activity levels, and f is fixed or overhead costs. A is an m by n matrix of technical coefficients, and b is an m by 1 vector of resource stocks as for a standard linear programming problem, plus a non negativity constraint (equation 4.6.). The MOTAD modifications are represented in equations 4.7. and 4.11., where D is an s by n matrix of activity net revenues minus their mean with u an s by 1 a vector of ones, I is an s

by s identity matrix, y is an s by 1 vector of activity levels measuring negative income deviations by state, p is a 1 by s vector of probability of states and M is the mean absolute deviation of total net revenue. Usually the model is then solved by setting M to a arbitrarily high level is then progressively reduced until no further solutions are found. In practice the MOTAD method involves setting the LP tableau to minimise M over a range of target incomes to generate an (E) Expected Income, M (Mean Absolute Deviation) frontier. MOTAD typically provides an efficient set of farm plans very similar to the results obtained by quadratic programming according to Hazel and Norton 1986. MOTAD requires the same technical input-output data as for standard LP, with the following additions:

1. The Calculation of Deviations of Revenue for each outcome;
2. A constraint to calculate the Mean Absolute Deviation of Revenue.

The MOTAD approach requires additional constraints and activities for the calculation of the deviations in revenue for each activity, plus an additional constraint to calculate the mean absolute deviation. Even though the data requirements of the MOTAD approach are less than that for quadratic programming, to construct farm models would require a large amount of yield and input data, and revenue data to enable the construction of a time series of gross margins for each activity in each region of the UK. It would also require data for both the conventional and sustainable scenarios. Therefore a less data intensive method was sought for this study. Two such methods were considered game theory models and focus loss models, these are outlined in the following two sections.

4.3.2.2. Game Theory Models

McInerney (1967, 1969) developed an LP model for use in farm planning that incorporated elements of game theory to account for imperfect knowledge and uncertainty in farm production decisions. This was based upon the work of Swanson (1959), Walker, Heady, Tweeten and Pesek (1960) and Dillon and Heady (1961). The model assumed that a farmer was playing a game against nature, which might be represented as shown in Table 4.1.

Table 4.1. A minimax pay off matrix

		States of nature		
		S_1	S_j	S_n
Resource Use	A_1	c_{11}	c_{1j}	c_{n1}
Activities	A_i	c_{i1}	c_{ij}	c_n
	A_m	c_{m1}	c_{mj}	c_{mn}

(From McInerney 1969).

The set A_i denotes an array of production activities and resource use activities which are chosen by the farmer, while the states of nature $S_1 \ldots S_n$ represent conditions or phenomena of nature which cause returns from any activity to be uncertain or uncontrollable. The elements of the payoff matrix (c_{ij}) represent the returns to the farmer from adopting A_i for a given state of nature S_j.

There are several alternative decision criteria for selecting the optimal plan, but Hazell and Norton (1986) state that the two most common are the maximin and the minimax regret criteria. McInerney (1967) notes that these decision rules can either be incorporated into an LP model and be used to generate a single programmed solution, or a series of farm plans may be generated and then one selected by using the decision rules. The maximin approach maximises the minimum gain from any choice of resource use. Thus, for the following payoff matrix in Table 4.2, A_1 would be the optimum choice since it assures the largest minimum gain.

Table 4.2. Example pay-off matrix for game theory models

	S_1	S_2	S_3
A_1	25	30	40
A_2	10	30	60
A_3	20	25	30

McInerney (1969) has stated that for the maximin objective the problem could be expressed as:

Maximise income I subject to n constraints of the form

$$\sum_{i=1}^{n} c_{ij} p_i - I \geq 0 \quad (j = 1,.....n \;) \text{and} \sum_{i=1}^{n} p_i \leq L \qquad (4.11.)$$

where p_i is the acreage of activity A_i, L is the total land area and c_{ij} are elements of the payoff matrix, measuring the returns to the farmer resulting from the adoption of alternative activities . In addition there are a further r constraints, which represent the normal resource constraints of farm planning, namely:

$$\sum_{i=1}^{m} A_{ik} \; p_i \leq b_k \; (k = 1,..... \quad r) \qquad (4.12.)$$

In contrast the minimax regret criterion is based upon the assumption that a decision maker would want to minimise the regret, so that after making a decision he/she minimises the difference between the actual outcome and that achievable with perfect foresight (Hazell

and Norton 1986). According to McInerney (1969) the criterion is applied by reformulating the decision matrix to produce a new regret matrix $[r_{ij}]$. This is done by subtracting, for each state of nature in turn the payoff c_{ij} from the maximum ($Max_i c_{ij}$) payoff possible.
Thus:

$$[r_{ij}] = [(\text{Max}_i\, c_{ij}) - c_{ij}] \tag{4.13.}$$

The optimal farm plan would then be the one which produces the lowest possible maximum regret V*, Thus, the objective may be stated as:
Minimise V*

$$\text{Subject to the MiniMax Constraint} \begin{cases} R'P \le V^* \\ IP = L \end{cases} \tag{4.14.}$$

(4.15.)

$$\text{and the farm constraint s} \begin{cases} AP \le B \\ P \ge 0 \end{cases} \tag{4.16.}$$

(4.17.)

Where

R is an m x n matrix of regrets (r_{ij});

P is an m x 1 vector of activity levels (p_i);

I is an 1 x m unit vector;

L is the total acreage;

A is a k x m matrix of input-output coefficients (A_{ik}); and

B is a k x 1 vector of resource levels (b_k).

However, the main difficulty in the use of game theory models, as noted by McInerney (1969), lies in the definition and specification of the states of nature. In addition, in reality farmers approach most, if not all, of their decisions with some prior knowledge, and so it can be argued that the strict application of the minimax approach could lead to over-cautious behaviour.

4.3.2.3. Focus Loss Constrained Programming

In developing the Aggregate Programming Model of Australian Agriculture (APMAA) Walker and Dillon (1976) adopted a different approach to handling uncertainty, namely Focus Loss Constrained Programming (FLCP), which had been developed by Boussard and Petit (1967). This method is based upon the focal loss ideas of Shackle (1961,1958), and is described by Ford (2000). Shackle argued that it was senseless to conceive that an individual decision maker would consider the entire set of rival and mutually contradictory outcomes.

Shackle thought that it was the extreme outcomes, both favourable and unfavourable, which were of most interest to a decision maker. These he termed the focus gain and focus loss of the decision.

Boussard and Petit in their work assumed that farmers would chose, from among various possible actions, the one which would maximise the expected gain, provided that the possibility of ruin was so small that it could be neglected. In essence this approach assumes that farmers do not take into account probability, but look at the gross profits considered normal for the activity, and the focus of loss or worst possible outcome. Specifically Boussard and Petit (1967) took the focus loss to be the worst gross margin that could occur in a decade. Thus the focal loss was defined as:

$$f_j = \bar{c}_j - c_j^* \qquad (4.18.)$$

for all activities j, where $\dot{c}_j$ was the expected gross margin and c_j^* was the worst likely gross margin for each activity. For any farm plan the maximum permitted total loss was defined as the difference between the expected total gross margin and the minimum income (MINI). The latter was the income required to cover farm fixed costs, essential family living costs and debt repayment, so that the maximum permitted loss is given by:

$$LOSS = \sum_j \dot{c}_j X_j - MINI \qquad (4.19.)$$

The approach assumes that farmers diversify in order to reduce the risk of a bad year with one particular enterprise and the resulting effect on income. Boussard and Petit (1967) assumed that the diversification was such that the focal loss on one crop was only a fraction $1/k$ of the total permitted loss. Thus, no single activity j should have a focal loss greater than $1/k$ of the maximum permitted loss for the farm plan. This approach results in a sub-matrix shown in Table 4.3.

Table 4.3. The sub-matrix of security constraints used in focus loss modelling

Type of Constraint	Crop Activities X_1	X_2	X_n	Short Term Borrowing STBO	LOSS	Level of Constraint
Minimum Income Constraint	c_1	c_2	c_n	-1	-1	=MINI
Working Capital	b_1	b_2	b_n	-1		= FUND
Security Constraints	p_1				1/k	= 0
		p_2			1/k	= 0
			p_n		1/k	= 0
Objective Function	c_1	c_2	c_n	0	0	Maximum

(From Boussard and Petit 1967).

In simple terms, Table 4.3 represents an LP matrix with activities X_1 to X_n giving gross margins c_1 to c_n in the objective functions. These are constrained by i) a minimum income constraint ii) a working capital constraint (FUND) and iii) security or the focal loss constraints (MINI). Working capital may be supplemented by short-term borrowing represented by the column STBO. The column LOSS is the total permissible loss, which is as defined in equation 4.13.

In a study of French crop farms Boussard and Petit (1967) found that this method gave results which were closer to the actual cropping patterns chosen than a standard LP model, which did not include any risk constraints. However, the main advantage of this method according to Hazell and Norton (1986), is that relatively little information is required about possible gross margin outcomes and that standard linear programming techniques may be used. However, they point out two drawbacks to this approach namely:

1. It ignores co-variance relationships between gross margins; and
2. The focal loss coefficients f_j and the value of the constant k are inherently difficult to measure.

As regards the second of these, Boussard and Petit (1967) also stated that the weakest point was the arbitrary nature of estimating the values of the various parameters. However, they stated that the variations in risk the p_i's between crops were accounted for, and that there was no reason to assume that k varied from one crop to another. Walker and Dillon (1976) had tested the focal loss approach in the APMAA with two modifications, namely:

1. The value of each focus loss constraint was based upon the variance of the gross margin of the activity (as suggested by Kennedy and Franscisco 1974), and

2. A trade-off between the expected income and MINI (minimum income) was allowed in each LP matrix (as suggested by Webster and Kennedy, 1975).

Wijnands (1980) in a study of seed potato growers in Holland, compared various methods of risk programming including the focal loss method. He found however, that the models incorporating focal loss constraints produced results identical to ordinary LP models. In his model nevertheless, the above modifications were not used, and he also included an additional modification to allow for the build up of capital over a number of years. Kennedy and Fransciso (1974), however, suggested that the focus loss approach does have the advantage of being able to incorporate farmers expectations within the loss coefficients.

Sustainability itself may lead to increased production risks, as many chemical inputs have the effect of reducing variations in yields. The natural pest and disease control mechanisms which sustainable agriculture would seek to utilise may lead to greater variations in production. Data on the levels of risk in sustainable systems is scarce, adding to the difficulty of modelling of sustainable farms. For the purposes of this study an approach with minimal data requirements and one which could use standard linear programming was preferred. The focus loss method is a behavioural approach, which assumes that farmers consider the worst likely scenarios when planning. The focus loss method seems also a more appropriate method to model farm production under higher than normal levels of annual fluctuation in production, (see for example a study of the drought in the Sudan by Elamin 2000), which could be expected in sustainable systems.

Therefore for the purpose of this study the focal loss method would be tested and if it provided an improvement upon standard LP then it would be adopted. Obtaining adequate gross margin data to estimate the variance of a ten-year period as suggested by Kennedy and Fransico would, however, be problematic, so an alternative was sought. Farmers attached a high importance to price, cost or exchange rate volatility (Bowley 2001, NFU 2001). Therefore it is proposed to use the worst price over ten years as a basis for calculating the focal losses in the models. There are drawbacks with this approach as factors, such as the weather and the effects on yields would be ignored. In addition less variable sources of revenue, such as headage and arable aid payments, would also not be accounted for. However given the arbitrary nature of the calculations, it is felt that using price as an approximation is justified.

4.4. The Selection of Representative Farms

For each of the regions outlined in Table 4.4 representative farms were identified from Farm Business Survey data and the MAFF annual census (see Appendix 19). These regions were selected on the basis that they corresponded to MAFF Annual Census regions, and roughly to the regions used in the Farm Business Survey. The English regions were amalgamated as indicated in Table 4.4, due to incomplete or inconsistent data recording in some cases, and

for convenience. In the case of Cumbria which is within the FBS Northern Province, but within the MAFF North West region, it is included within the Northern region.

Table 4.4. The regions used in the aggregate LP model

Survey Province	MAFF Census Region	Survey Province	MAFF Census Region
Wales	Wales	South West England	South West England West Midlands
Scotland	Scotland	Central England	East Midlands North West England
Northern Ireland	Northern Ireland	Northern England	Northern England Yorkshire and Humberside
South East England	South East England East of England		

Farms within these regions were further subdivided into three size classes, based upon the following European Size Unit classes shown in Table 4.5.

Table 4.5. Sizes classes used for the representative farms

	England Wales and NI	Scotland
Small	8-40 ESU	8-16 ESU
Medium	40-100 ESU	16-40 ESU
Large	> 100 ESU	40+ ESU

Altogether 206 distinct farm types were identified as being found within the UK, from the FBS data. As it would be highly impractical to construct individual LP models for each of these farms types, a cluster analysis was performed in order to amalgamate the farm types into a manageable number of farms. Specifically, it was decided to use the 30 variables presented in Table 4.6 in the cluster analysis. These were selected on the basis that they represented the technical and financial factors which were suggested as being required for group homogeneity in the discussion by Hazell and Buckwell (1972), such as labour costs (criteria 1), yields (criteria 2), and cereal, grassland and fodder crop areas (criteria 3).

Due to missing data in the initial hierarchical cluster analysis, using an initial subset of variables (see Table 4.7), was performed in order to ascertain approximately how many homogenous clusters that the farms would form. The analysis was carried out using SPSS© software and specifically using the between-groups linkage method of clustering, involving measurement of the squared Euclidean distance between clusters. It was felt that these initial variables sufficiently distinguished the farms to provide an idea of the number of clusters into which the population should be divided, since these variables covered the main requirements for farms to have similar yields and similar crops and stocking rates, as stated by Hazell and Norton (1986).

Table 4.6. Variables used for clustering farms

LAND	Average size of farms in ha
OWNED[1]	Proportion of land owner occupied
STOCKING	Livestock units per forage ha
CAPITAL	£ Tenants capital /ha
MECHCAP	£ Machinery capital /ha
LIVECAP	£ Livestock capital /ha
NFI	£ Net Farm Income / ha
RETURN	% Return on Tenants Capital
BARLEYY	Winter Barley Yield t/ha
WHEATY	Winter Wheat Yield t/ha
OSRY	Winter Oilseed Rape Yield t/ha
MILKY	Milk Yield litres/cow/annum
RGRAZING	% of farm under rough grazing
GRASS	% of farm under grass
CEREALS	% of farm under cereals
LABCOST	£/ha Paid Labour Costs
MECHCOST	£/ha Machinery Costs
FERTCOST	£/ha Fertiliser Costs
FEEDCOST	£/ha Livestock Feed costs
SOWS	Average number of breeding sows
DAIRY	Average number of dairy cows
BEEF	Average number of Beef cows
EWES	Average number of breeding ewes
LSU	Total number of livestock units
GROSSOUT	£/ha Gross output
% LIVESTOCK OUTPUT	% of Total output from Livestock
% CROP OUTPUT	% of Total output from Crops
FIXED COSTS	£/ha Total Fixed Costs
FARMER & SPOUSES LABOUR	Value of Farmer and Spouses Labour
CAPLAB	Ratio of capital to labour

Table 4.7. Variables used in the initial hierarchical cluster analysis

LAND	Average size of farms in ha
OWNED	Proportion of land owner occupied
STOCKING	Livestock units per forage ha
NFI	£ Net Farm Income / ha
BARLEYY	Winter Barley Yield t/ha
WHEATY	Winter Wheat Yield t/ha
OSRY	Winter Oilseed Rape Yield t/ha
MILKY	Milk Yield litres/cow/annum
LSU	Total number of livestock units

[1] The variable '% owned' was defined as the proportion of farms in each group that were owner occupied, and was included to account for variations in tenure across the country and across different farm types.

The distance matrix in the agglomeration schedule indicated the dissimilarity between the clusters being combined at each stage, the higher the distance matrix the greater the variation within a cluster. By examining the distance matrix, it is possible to determine the optimum number of clusters that would reasonably represent the data (see Figure 4.1).

Figure 4.1. Determining the optimum number of farm clusters: the distance matrix versus the number of clusters

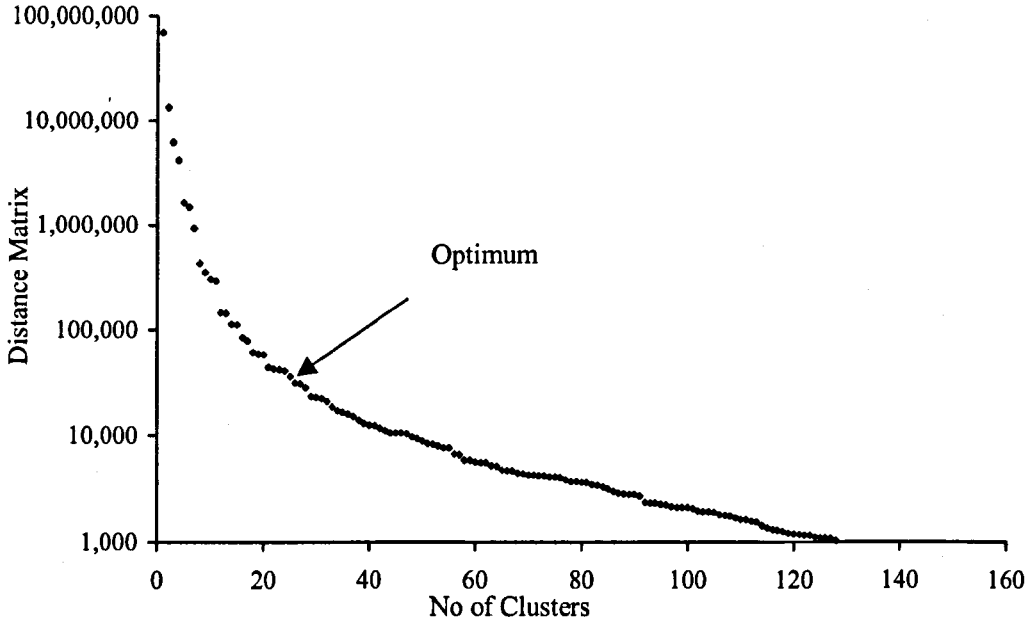


Figure 4.1 is the distance matrix plotted against the number of clusters. As the farm clusters were combined the level of dissimilarity within the clusters increased and the distance matrix increases as the clusters are combined into a smaller and smaller number. The distance matrix remained infinitesimal until the clustering is down to 130 clusters, rises slowly until around 25-20 clusters, when the distance matrix increased rapidly. Thus at this point further clustering would have lead to an unacceptable level of dissimilarity between the farms within a cluster. On Figure 4.1 the point closest to the origin represents the optimum number of clusters. Thus, the agglomeration schedule produced indicated that about 20-25 clusters appeared as the optimum number of farm clusters and hence the number of representative farms to model. Following this a K-means cluster analysis using all 30 variables was employed to cluster these farms into 25 clusters. Of these clusters, some containing only two or three members, were merged with others of a similar farm type to produce 23 relatively homogenous clusters. The 23 clusters are described in Appendix 20, while the exact composition by FBS farm type of each of these clusters is also presented in the Appendix 21.

When a number of key structural variables were examined for each farm cluster, it appeared as if the clusters could be further reduced into a number of farm groups of a broadly similar

structure. These only differed in terms of non-structural coefficients, such as yields and stocking rates, reflecting regional and size variations. Thus, another hierarchical cluster analysis was run on the farm clusters listed above, using the key structural variables in Table 4.8. As a result, the farms were finally grouped into 7 classes or groups, which are presented in Table 4.9. From this second stage aggregation, the seven farm groups identified had the characteristics outlined in Table 4.10.

Table 4.8. Key structural variables used for further clustering

Variable	Unit
CAPITAL	£ Tenants capital /ha
MECHCAP	£ Machinery capital /ha
LIVECAP	£ Livestock capital /ha
RGRAZING	% of farm under rough grazing
GRASS	% of farm under grass
CEREALS	% of farm under cereals
LABCOST	£/ha Paid Labour Costs
MECHCOST	£/ha Machinery Costs
FERTCOST	£/ha Fertiliser Costs
FEEDCOST	£/ha Livestock Feed costs
% LIVESTOCK OUTPUT	% of Total output from Livestock
% CROP OUTPUT	% of Total output from Crops
FIXED COSTS	£/ha Total Fixed Costs
FARMER & SPOUSES LABOUR	Value of Farmer and Spouses Labour / ha
CAPLAB	Ratio of capital/ha to labour/ha

Table 4.9. Comparison of groups and clusters

Group Name	Cluster Description
Pigs and Poultry	1. Pigs and Poultry Central England
	2. Pigs and Poultry Southern England and Wales
	3. Pigs and Poultry Scotland, Northern Ireland & the North of England
Cropping	4. Cropping South East England
	5. Cropping Central and Northern England
	6. Cropping Scotland, Northern Ireland and Western England
	7. Small Cropping Farms Wales
Mainly Dairy	8.Mainly Dairy Wales and Northern Ireland
	9.Small Dairy Northern England
	10.Large Dairy Scotland
	11.Mainly Dairy South West England
	12. Dairy and Sheep Southern England
Specialist Dairy	13.Specialist Dairy Central and Southern England
	14.Specialist Dairy North of England
Mixed Lowland	15.Mixed Lowland North & West
	16.Mixed Lowland South
Large Hill Farms	17.Large Hill Sheep Wales & Northern Ireland
	18.Large LFA North of England
	19.Large LFA Scotland
Small Hill Farms	20.Small LFA Beef Scotland
	21.Small LFA Farms South West England
	22.Small Hill Wales & Northern Ireland
	23.Small LFA North & Central England

Table 4.10. Description of the farm groups modelled

Variable	Pigs and Poultry	Cropping	Mainly Dairy	Mixed Lowland	Specialist Dairy	Small LFA	Large LFA
SIZE	1.81	1.81	2.09	2.01	1.94	1.71	2.53
LAND	38.45	139.76	125.89	132.15	32.82	150.73	873.54
OWNED	0.64	0.44	0.61	0.46	1.26	0.54	0.40
STOCKING	2.07	1.95	1.80	1.94	1.96	1.33	0.88
CAP	2566.02	1238.36	1630.49	1679.81	1033.57	1096.86	586.17
MECHCAP	1896.40	544.79	487.95	615.83	259.94	263.17	121.39
LIVECAP	1398.64	199.17	919.51	669.46	617.07	604.93	284.46
NFI	3564.99	313.73	290.68	256.64	244.93	152.42	104.59
RETURN	19.58	22.38	11.48	12.13	7.74	0.36	7.36
BARLEYY	5.59	5.97	5.47	5.67	3.91	5.78	5.77
WHEATY	6.88	7.18	7.01	6.95	4.32	6.98	7.13
OSRY	2.74	2.84	2.75	2.92	2.42	2.71	2.84
MILKY	5753.91	5407.83	5394.93	5541.06	2676.44	4359.49	4998.00
LAMB	77.45	157.75	86.56	82.60	2.13	58.52	47.34
FODDER	0.38	0.69	2.32	0.84	2.30	0.76	0.13
RGRAZING	13.84	1.21	11.64	3.45	2.55	27.68	58.27
GRASS	18.70	16.62	79.98	66.17	49.71	91.41	93.87
CEREALS	47.48	54.28	13.69	25.98	1.19	3.49	0.53
LABCOSTS	468.47	121.95	134.55	180.75	37.71	53.62	29.57
MECHCOST	738.79	238.13	219.11	253.80	133.46	118.87	63.59
FERTCOST	38.56	71.62	75.63	77.44	42.86	42.17	18.04
FEEDCOST	7602.66	60.79	332.79	108.44	224.24	94.55	51.88
POULTRY	0.00	0.00	0.00	5.59	1.07	0.45	48.05
SOW	142.18	0.00	2.84	0.09	1.07	0.59	0.00
DAIRY	0.00	1.37	63.55	13.31	37.62	1.84	0.84
BEEF	0.00	10.40	6.03	15.18	1.52	72.04	130.59
EWES	0.00	93.97	192.63	149.01	55.12	667.95	1778.22
LSU	76.47	278.37	229.99	263.88	57.58	198.43	678.59
OUTPUT	12846.21	1177.98	1559.36	1223.90	984.69	697.22	403.99
LIVEOUT	85.71	16.74	89.19	60.39	49.72	88.47	89.95
CROPOUT	19.20	75.54	7.54	31.47	1.19	5.12	4.14
FIXEDCOS	1284.64	621.55	612.40	624.05	460.88	314.97	226.86
FARMLAB	115.54	72.99	94.39	85.87	107.57	136.42	59.80
CAPLAB	5.77	7.39	10.68	7.56	6.60	8.96	11.91

(See Table 4.6 for the definitions of the variables).

4.5. Constructing the LP Models

A farm LP model was constructed for each of the 23 farm clusters. However, as identified clusters within the same class or group had a broadly similar structure, the models were replicated and non-structural coefficients changed in order to reflect the regional variations within the groups. Each cluster had similar land-labour ratios, yields and predominant

enterprises, satisfying the criteria laid down by Hazell and Norton (1986) for minimising the problem of aggregation bias. As the numbers of each farm type within a region are known from FBS and MAFF census data, aggregating the results from individual farm level to regional and national levels was possible.

The models took the form a traditional LP matrix with farm activities arranged into columns, and the constraints laid out in rows. The model matrices were constructed on Excel spreadsheets, and were converted to run on the specialist LP software package Lindo (Lindo Systems, 1999). The construction of the models is described further in the following sections.

4.5.1. The General Structure of the Models

The models were farm-level focal loss LP optimisation models, with the assumed objective being to select the enterprise mix which maximised net farm income. Each representative farm class differed in terms of the specific activities and constraints and co-efficient values, but the generalised structure of each model is given in Table 4.11. The constraint rows in bold and italics are those additional constraints, which are included in the models to represent the 'sustainable' scenario, and are discussed further in section 4.8.

Table 4.11. The generalised structure for the farm models

Constraints/ Activities	Labour hire	Feed Buy/Sell	Use Manure	Buy Fertiliser	Stock Buy/Sell	Straw Buy/ Sell	Crop Activities	Grazing/ Fodder Activities	Stock Activities	Short Term Borrowing	Loss	Indicators
Land							✓					
Labour	✓						✓	✓	✓			
Working Capital		✓		✓	✓	✓	✓	✓	✓	✓	✓	
Catch Cropping							✓					
Land Quality							✓					
Set Aside							✓					
BSP Limit									✓			
Straw Ties						✓	✓		✓			
Grazing Ties								✓	✓			
Fodder Ties								✓	✓			
Replacement Stock Ties					✓				✓			
Rotational							✓					✓
Pesticide							✓					✓
Fertiliser			✓	✓			✓					✓
Focal Loss Constraints							✓		✓		✓	

Note : ✓ represent links within the model

4.5.2. The Activities in the Models

In each farm model activities needed to be selected which reflected the range of enterprises and technologies available to each type of farm. For some farm types there were a broad range of enterprises, which were open to the farmer and were included in the models. For others, such as LFA farms, the range of options was more restricted, because of topography, altitude and climatic conditions. As well as the range of possible enterprises, there was variation in the intensity of the farming systems included in the matrix. The activities used in the models are described in Appendix 22. The first stage in modelling the economic impacts of a move to sustainable agricultural systems was to work out the likely effects on gross margins for the range of farm enterprises found in the UK, including any regional differences. For the base conventional situation, published data was taken from the SAC Handbook (SAC 1997). The mean gross margins assumed in the conventional models are presented in Appendix 23.

4.5.3. Validating the Models.

To look at the impact of a move to sustainable systems, a baseline, representing the current situation in UK agriculture was needed. This followed the approach of Russell and Fraser (1995) who looked at the impact of a policy of environmental cross-compliance on UK arable farming. To do this, they constructed a benchmark solution, which was compared with actual land use, output and gross margins as a check on the validity of the model. In their case, they found that the average farm-level gross margin was overestimated by only 4%, which they regarded as an acceptable performance. Regarding what are acceptable deviations between models and observed results, Berentsen and Gieson (1995) state that for various reasons such as imperfect information farmers do not run their farms as a linear programming model does. They argue that the focus should be on the differences between situations rather than on the level of results. If the difference in the broad ratios between farm types observed is predicted, then the estimated changes following management changes should provide a good estimation of the actual changes which would occur. Thus, if all the models appeared to underestimate or overestimate a parameter, this could be accounted for in the results, and the validity of the models, in respect to predicting changes, would not be impaired.

Thus the models will be validated in two parts, first by a comparison with the survey data for the base year of 1997, and secondly by running the models for a historical scenario, and assessing whether they were able to accurately predict observed historical changes. In order to gauge whether the conventional farm models were accurate representations of current farm practice, the results were compared with the reported farm cluster averages. The variables assessed were the projections for net farm income, proportions of cereals and grass, numbers of breeding livestock, fixed costs per ha, labour costs per ha and fertiliser costs per hectare. The crop year 1991/92 was selected for this purpose of the historical validation

being the last crop year before a major policy change in EU agriculture - the MacSharry reforms of the CAP (see Neville and Mordaunt 1993), the details of which are summarised in Appendix 34. By comparing the model predictions before this change and afterwards the validity of the models in representing the likely changes on these farms was assessed.

4.6. General Assumptions

There were certain core assumptions made, built into each of the LP models. These related to the construction of the activities within the models, and the constraint rows. Core assumptions are explained in the following sections, while those pertinent to specific model types follow. The gross margins for each activity used in the models are presented in Appendix 23. The following sections outline how they were calculated, together with the fixed and labour cost assumptions used in the models, together with the constraints applied to the conventional farms.

4.6.1. Cropping Activities

The cropping activities in the models represent the range of crops that may be grown on farms in each of the groups, and are presented in Appendix 22. The models select not only which crops are grown, but also which cropping systems to use. Both of these decisions are represented in the activities. Likewise variations in planting date (e.g. Winter/Spring cereals), and varieties (e.g. feed or bread-making wheat or early and main crop potatoes) are also be included. Where possible yields were taken from the various regional FBS reports and the cluster variable data, in order to reflect regional variation in the farm models. Eight yield regions are assumed in the models, based upon the yield reference areas for the Arable Aid Payment scheme, with the modification that England is split between Northern and Southern areas. The average regional yields of crops used in the models are presented in Appendix 26, and are derived from figures reported in the FBS data, and MAFF statistics.

As well as deciding upon the crop area and system, a farmer will also choose to vary production intensity. To represent this choice for each cropping option, three levels of nitrogen fertiliser input were included, namely average, high (average + 50%) and low (average –50%). Average was equated with the levels reported in the British Survey of Fertiliser practice and yields were estimated for each level of input using a quadratic response function in order to account for diminishing returns. The yield function fitted took the general form of:

$$Y = N^2 + N + K \qquad (4.20.)$$

Where:

Y = Yield tonnes/ha
N = Nitrogen Applied to Crop kg/ha
K= Constant

Specifically it was assumed that 55% of yield would be maintained with zero fertiliser applied, as reported by Russell and Fraser (1995). This along with the yield obtained using the average level of input, provided two points through which to fit a quadratic response function and estimate the co-efficients. The co-efficients estimated are presented in Appendix 29.

The costs of pesticides and sprays used by each activity were based upon the data given in the SAC Farm Management Handbook (1997) and were considered to be typical of farm practice. The seed rates and costs were taken from SAC Farm Management Handbook (1997) and were considered to be typical of standard farm practice. It was assumed for cereal crops that straw was baled and carted away, while the models allowed the option to sell/buy straw and to use straw as bedding/rough forage for livestock. The principal assumptions made about straw yields in relation to grain yields are shown in Table 4.12.

Table 4.12. Straw yields in the cropping activities

Cereal Crop	% of grain yield
Wheat	65
Barley	75
Oats	85
Rye/Triticale	75

(From SAC 1997).

4.6.2. Fodder/Grassland Activities

The seasonal DM (Dry Matter) production for grass was estimated for each nitrogen option using the data from the GM20 trials, (Morrison, Jackson and Sparrow 1980). The annual herbage production figure was apportioned into 3 time periods over a six-month growing season. The weightings from WAC (1993) for each time period are shown in Table 4.13.

Table 4.13. Seasonal herbage production

Period	Proportion of Total Yield
April-June	0.49
June-August	0.28
August-Oct	0.23

(From WAC 1993).

The grazing DM in kg/head needed by each stock activity was estimated over each period and linked to the grazing activities in the model. Options for the conservation of winter fodder included the production of silage (1,2, or 3 cuts) and aftermath grazing and the production of hay. The yields per cut and from aftermath grazing were estimated from figures given in SAC (1997). These were then linked to the winter fodder required by each livestock activity. Other fodder activities considered were the production of forage maize for ensilage and roots for ensilage or grazing. There was, however for reasons of husbandry a

maximum limit upon the proportion of forage maize that could be fed to livestock, which was assumed to be 75% (Ewing 1997).

4.6.3. Livestock Activities

In the model dairy activities had differing yield levels according to the specific farm group and calving dates (Spring, Summer, Autumn and All Year calving). Replacement heifers were assumed to be reared on farm or bought in. Sheep enterprises in the models included i) breeding ewes ii) rearing lambs for sale as stores or fat, and iii) varying breed type according to the specifics of the farm model. Replacement gimmers could be reared on farm or bought. The beef suckler cow enterprises had the same calving dates, as the dairy activities, with lowland or upland and hill suckler cow types, depending upon the specific farm group. Beef activities varied according to breed type (dairy, dairy bred cross, beef breeds), sex and production system e.g. 18 or 24 month beef, intensive bull beef. Calf rearing activities consisted of *ad lib* feeding systems with Friesian calves and bucket feeding systems with Friesian, medium-frame beef cross calves and large-frame beef cross calves.

The physical amounts of concentrates or cereal fed to livestock in the models were based upon values provided by SAC (1997) and were meant to reflect standard farm practice. The maximum stocking constraints used in the models were based upon the stocking densities in LSU (Livestock Units) per forage hectare calculated from the farm clustering variables. Manure produced by livestock activities was linked by tie lines to purchased fertiliser, which was expressed in kg nutrients per head, with the values of nutrients produced being taken from SAC (1993).

4.6.4. Labour Assumptions

The models contained three labour types namely i) the farmer's own or family labour, ii) full-time regular labour and iii) casual labour. The labour was divided into monthly periods, with a monthly breakdown of the labour required for each farm activity, measured in man hours. It was assumed that the availability of labour for hire in all the models was not limiting, but this would only apply to regular and casual labour as against farmer labour. The regular labour activity in the model hired labour over all twelve months. It was assumed that one full-time employee would provide 156 hours labour / month[1], with casual labour supplied on an hourly basis. The assumed salaries and wage rates were based on those rates quoted in SAC 1997. A standard hourly rate of £4.08 per hour was assumed for a general farm worker, with casual labour charged at a rate of 1.68 times this based upon the overtime rate quoted in SAC (1997). The wage rates on different types were calculated based upon the differentials calculated from the average annual salary figures quoted in SAC 1997 (see Table 4.14).

[1] This is based on a standard working week of 39 hours, over a 48 week working year.

Table 4.14. Labour costs within the farm models

	Standard Rate £/hr	Casual Rate £/hr	Regular Full Time Salary £/hr	Farm Types
General Farm Worker	£4.08	£6.73	£7,638	Lowland Mixed
General Stockman	£4.77	£7.86	£8,921	LFA, Pigs & Poultry
Tractor Driver	£4.77	£7.87	£8,933	Cropping
Dairy Stockman	£5.59	£9.23	£10,472	Dairy

4.6.5. Institutional Assumptions

Subsidies were included in the gross margin calculations for each activity and were set at 1997 levels. All the calculations in the models were based upon 1997 prices given in SAC Farm Management Handbook (SAC 1997). Thus the resultant models were partial equilibrium models, in that they assumed that changes in production did not have any further impact upon input costs or output prices. As discussed in section 4.2.2. this was considered acceptable as UK farmers operate in the main within the framework of institutionally determined prices under the CAP. Thus, it was felt that any changes in UK production were unlikely to have a radical effect upon farm gate prices and the costs of inputs. This may however, not be true for certain commodities such as fresh milk, which are not easily traded over long distances, and changes in UK production are likely to have a marked impact upon prices. The minimum set aside rate was 5% (as for the year 1997, SAC 1997), with options for sown cover or natural regeneration. In addition Winter or Spring oilseed rape for non-food use could also be grown on set-aside land. It was assumed that the farms did not receive payments from agri-environmental schemes such as Environmentally Sensitive Areas (ESAs) or the Countryside Premium Scheme (CPS). This was in order to estimate the full costs of moving to sustainable farming systems, since such schemes would have the effect of encouraging some of the environmentally friendly practices, which are inherent in sustainable farming.

4.6.6. Working Capital Constraints and Fixed Costs

Working capital constraints were included in the models, with the working capital available each year being based upon the tenant's capital of the farm obtained from the cluster variables. Working capital was deemed to be the tenant's capital minus machinery and livestock capital. As the models were looking at long-term changes in the farming system, and by definition fixed costs were only fixed in the short term, it was assumed that the fixed cost structure might change within the model. Fixed costs were apportioned to each individual enterprise on a per hectare or per head basis and are included as costs within the model (see Appendix 24). Machinery costs were estimated by taking contractors charges for the various machinery operations, required for each crop activity from the SAC handbook (SAC 1997) and using them as a proxy for an annual machinery charge. Buildings and fixed equipment charges were based upon the costs quoted in the SAC handbook, spread over ten years. Repairs and miscellaneous charges were taken from whole farm costs from the SAC handbook and allocated to various enterprises based upon the main enterprise type on the farm. Comparison of the values of total fixed cost per hectare given by the model also provide a means of validating the Conventional Farm Practice (CFP) model by comparing the predicted values with the actual farm cluster values.

4.6.7. Land Quality Constraints

The models included land quality constraints, with all land put into 5 classes based upon the MLURI land classification scheme (see Bibby 1992), the properties of which are summarised in the Table 4.15. Specifically potatoes and vegetable crops can only be grown on class 1 land. Other crops e.g. oilseed rape, linseed, sugar beet and vining peas can be grown on class 1 or 2 land , while cereals and spring field beans are cultivable on classes 1,2, and 3. Rough grazing land can obviously only be utilised for grazing. In addition, catch cropping can be carried out along with Spring-sown crops.

Table 4.15. The land classes in the models

	Description	MLURI Land Class Equivalent
Class 1	High quality land, capable of growing all crops, including potatoes and vegetable crops.	Class 1 & 2
Class 2	Good quality land, capable of growing a wide range of crops, including oilseed rape, linseed, sugar beet and vining peas.	Class 2
Class 3	Good to Average land, capable of growing cereals, and Spring field beans, and forage crops.	Class 3
Class 4	Average Quality land, mainly suited for Grassland. Short term and long term grass leys.	Class 4
Class 5	Poor Quality. Rough grazing land.	Class 6 & 7

The proportions of each land class included in the models were estimated from existing cropping patterns obtained from the FBS data, and are presented in Table 4.16.

Table 4.16. Land quality constraints used in the models (% of total farm area)

	% of total farm area				
	Class 1	Class 2	Class 3	Class 4	Class 5
1. Pigs and Poultry Central England	0	19	68	12	0
2. Pigs and Poultry Southern England and Wales	0	10	37	12	41
3. Pigs and Poultry Scotland, Northern Ireland & the North of England	0	19	68	12	1
4. Cropping South East England	8	22	40	30	0
5. Cropping Central and Northern England	1	20	40	38	0
6. Cropping Scotland, Northern Ireland and Western England	9	25	40	24	2
7. Small Cropping Farms Wales	8	22	40	29	1
8.Mainly Dairy Wales and Northern Ireland	0	2	12	80	6
9.Small Dairy Northern England	2	2	8	65	23
10.Large Dairy Scotland	0	1	5	84	10
11.Mainly Dairy South West England	2	3	34	61	0
12. Dairy and Sheep Southern England	2	3	34	51	10
15.Mixed Lowland North & West	0	0	10	87	3
16.Mixed Lowland South	1	5	10	81	3
13.Specialist Dairy Central and Southern England	1	2	28	66	3
14.Specialist Dairy North of England	1	7	25	63	4
17.Large Hill Sheep Wales & Northern Ireland	0	0	2	33	65
18.Large LFA North of England	0	0	5	15	80
19.Large LFA Scotland	0	0	2	68	30
20.Small LFA Beef Scotland	0	0	3	69	28
21.Small LFA Farms South West England	0	0	4	68	28
22.Small Hill Wales & Northern Ireland	0	0	4	75	21
23.Small LFA North & Central England	0	0	7	59	34

4.6.8. Risk Constraints - The Focal Loss Values

The discussion in section 4.3.2. has suggested that the focal loss method is the most convenient method for accounting for risk in this study. However the main drawback is the arbitrary nature of estimating some of the parameters. To estimate the focal loss as defined in equation (4.12), the worst price over a 12 year period from 1985 to 1997 was obtained for each enterprise type. This was expressed as a percentage of the mean price over this period. In the models this percentage was multiplied by the expected gross margin to obtained an approximation of the worst likely gross margin over ten years, and the focal loss values were calculated using equation 4.12. The following Table 4.17 summarises the focal losses used in the models, expressed as a percentage of the expected prices, using MAFF price indices for the period 1987 to 1997 (MAFF 2000b).

Table 4.17. The focus loss values used in the models

Year	Cereals	Root crops	Fresh vegetables	Other crop products	Livestock	Milk	Eggs
1985	89.80	91.70	100.28	64.20	92.43	79.70	73.27
1986	91.20	95.00	99.76	88.80	96.18	92.40	91.81
1987	92.80	96.10	97.09	90.70	91.06	81.50	71.90
1988	92.91	92.59	95.18	82.90	91.54	90.70	93.23
1989	98.91	96.07	97.18	93.20	96.08	91.90	94.74
1990	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1991	99.24	101.17	104.58	99.50	101.62	104.50	117.28
1992	100.80	96.43	105.68	86.00	105.53	100.50	124.72
1993	106.04	96.03	107.85	80.60	111.94	87.50	79.59
1994	106.40	98.00	93.55	121.70	107.60	87.00	74.77
1995	115.97	111.49	100.45	177.30	115.99	95.80	96.36
1996	114.35	103.36	102.54	105.20	117.80	107.50	112.64
1997	98.85	86.04	81.02	70.40	96.53	98.40	97.14
Mean	100.56	97.23	98.86	96.96	101.87	93.65	94.42
Worst	92.80	86.04	81.02	70.40	91.06	81.50	71.90
	92.28%	88.49%	81.95%	72.61%	89.39%	87.03%	76.15%

Boussard and Petit (1967) set the minimum income, as that which covered essential costs, such as fixed overheads and family living expenses. Kennedy and Francisco (1974) defined the minimum income as income indispensable for consumption. The models in this study are maximising net farm income, where all fixed costs are included in the model and the minimum income is taken as the level of private drawings. The level of private drawings on farms varies enormously, but a figure of £17,000 was set, based upon the average UK salary in 1997 (CSO 1998).

Wijnands (1981) suggested that the square root of the number of activities within the model be adopted as the value of k[1]. This was tested in a pilot focus loss models for a Mixed Lowland farm in the North (cluster 15 see Table 4.9). Two pilot farm models of this cluster were constructed:

1. A Standard LP Model with no focus loss constraints;

2. A focus loss constrained model run using a value of $k = \sqrt{n}$ where n is the number of farm activities, in this case 191, with k = 13.81, and four further runs where the values of k were 5, 10, 15 and 20 respectively.

The purpose of these pilot models was twofold, first to assess the effectiveness of the focal loss constraints within the models, and to provide an estimate of k within the models. A summary of the results of these pilot models is shown in Table 4.18. All the models produced solutions, which represented the broad cropping plan on these farms, with similar proportions of crops and grassland enterprises. However the LP model opted for dairy and pig production. Selecting a solution with a dairy herd of 61 compared with an average of

[1] Which is the constant within $1/k$ which is the focal loss of one activity in the models.

2.86 in the cluster data, and also selecting rearing pig activities. The focus loss models selected more sheep and suckler cows which had a lower focus loss value since they were less subject to price fluctuations (see Table 4.17). This selection of intensive livestock by the standard LP model lead to an overestimation of net farm income, predicting £523/ha compared with £144/ha.

The model containing the focus loss modifications provided a more realistic solution, and an improvement in the prediction of net farm income. The focus loss models did not necessarily opt for high margin activities but chose a more diverse range of cropping and stocking activities. Thus from the pilot models it was confirmed that the inclusion of focus loss constraints would provide an improvement over conventional LP, in terms of being better able to predict real production patterns. In addition that the value of k within the focus loss models be taken as the square root of the total number of focus loss constrained activities. The values of k used within the conventional and sustainable scenario farm models for each farm group are presented in Table 4.19.

Table 4.18. Results of pilot LP and focus loss models for a mixed lowland farm in the North

	Actual Farm Cluster Data	Model Projections					
		LP Model Results	Focus Loss Models Results				
			$k = n^2$ (13.8)	k=5	k=10	k=15	k=20
Net Farm Income £/ha	£144.35	£522.68	£161.33	£194.75	£168.60	£161.33	£156.66
Cereals (%)	18.92%	25.31%	26.57%	21.94%	26.84%	26.57%	26.40%
Other Crops (%)	5.22%	5.54%	5.54%	5.54%	5.54%	5.54%	5.54%
Grass (%)	75.02%	65.22%	65.22%	72.47%	65.22%	65.22%	65.22%
Fodder (%)	0.84%	1.44%	2.66%	0.04%	2.40%	2.66%	2.83%
Fert costs £/ha	£56.14	£0.00	£58.60	£68.57	£59.65	£58.60	£57.94
Non Labour Fixed Costs £/ha	£481.95	£438.14	£427.12	£478.71	£434.60	£427.12	£422.45
Labour Costs £/ha	£91.32	£235.52	£177.56	£189.92	£179.13	£177.56	£176.59
LSU (Total)	219	77	148	158	147	148	148
LSU per forage ha	1.68	0.86	1.68	1.68	1.68	1.68	1.68
Dairy Cows (No.)	2.86	61	18	68	27	18	12
Suckler Cows (No.)	18.81	0	41	0	28	41	49
Ewes (No.)	210	2	79	8	78	79	79
Rearing Pigs (No.)	0.00	1127	0	0	0	0	0
% Difference from Base Line							
Net Farm Income £/ha		262.09%	11.77%	34.91%	16.80%	11.77%	8.53%
Cereals (%)		33.77%	40.43%	15.96%	41.84%	40.43%	39.55%
Other Crops (%)		6.21%	6.21%	6.21%	6.21%	6.21%	6.21%
Grass (%)		-13.06%	-13.06%	-3.40%	-13.06%	-13.06%	-13.06%
Fodder (%)		71.62%	217.12%	-94.67%	185.46%	217.12%	236.91%
Fertiliser Costs £/ha		-99.42%	4.38%	22.15%	6.25%	4.38%	3.21%
Non Labour Fixed Costs £/ha		-9.09%	-11.38%	-0.67%	-9.83%	-11.38%	-12.34%
Labour Costs £/ha		157.90%	94.44%	107.97%	96.15%	94.44%	93.37%
LSU (Total)		-64.98%	-32.68%	-28.09%	-32.95%	-32.68%	-32.52%
LSU per forage ha		-48.92%	0.00%	0.00%	0.00%	0.00%	0.00%
Dairy Cows (No.)		2044.46%	526.99%	2269.79%	831.77%	526.99%	336.44%
Suckler Cows (No.)		-100.00%	118.27%	-100.00%	48.16%	118.27%	162.10%
Ewes (No.)		-99.25%	-62.55%	-96.38%	-62.75%	-62.55%	-62.42%
Rearing Pigs (No.)		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 4.19. The model risk constraints - values of k

Farm Group	Number of Activities	Value of k[1]
Pigs and Poultry	206	14.9
Cropping	191	13.8
Mainly Dairy	181	13.4
Specialist Dairy	181	13.4
Mixed Lowland	195	13.8
Large LFA	165	12.4
Small LFA	181	13.4

4.7. Validation of Conventional Farm Models

As discussed in section 4.5.3. the validation of the conventional farm models was carried out first by comparing the conventional model results for the base year 1997/98 and then by running the models for the year 1991/92, and assessing whether or not the models had adequately predicted the observed historical changes. A summary of the model results for each farm group for 1997/98 is presented in Table 4.20, summaries of individual cluster farm plans are presented in Appendix 31, with the full Lindo printout results presented in Appendix 32.

The models were run for the 1991/92 crop year, using data from the FBS/Farm Survey for 1991/1992 and other data from the SAC Farm Management Handbook 1991/92. A summary of the changes observed and predicted on each farm cluster is presented in Appendix 35. The full Lindo print out results are presented in Appendix 33 and a summary of the 1991/92 Group results and the observed and predicted farm level change is presented in Table 4.21. The following section now considers the validity of the models for each farm group. In comparing the 1991/92 data and 1997/98 data certain variables on the representative farms had to readjusted to take account of structural changes, for instance dairy cow numbers for 1991 were readjusted to account for changes in farm size. Thus whilst the figures quoted in survey data indicate an increasing average dairy herd size, if the figures are adjusted on a cow per ha basis, to take account of changes in farm size, the overall number of dairy cows/ha decreases and this on the representative farms, there were more cows to the area in 1991/92. Similar adjustments were made for sheep and cattle.

[1] Which is the constant within $1/k$ which is the focal loss of one activity in the models.

Table 4.20. Summary of the Conventional Farm Model Results for 1997 and comparison with 1997 Survey Data

	Pigs and Poultry			Cropping			Mainly Dairy			Specialist Dairy			Mixed Lowland			Large LFA			Small LFA		
	Base	Mod.	DIFF	Base	Mod.	DIFF	Base	Mod.	DIFF	Base	Mod.	DIFF	Base	Mod.	DIFF	Base	Mod.	DIFF	Base	Mod.	DIFF
Net Farm Income £/ha	3565	4481	**916**	314	480	**166**	291	558	**267**	487	735	**247**	257	169	**-87**	105	51	**-54**	152	120	**-32**
Fixed Costs £/ha	1285	1064	**-220**	622	616	**-6**	612	585	**-27**	934	636	**-298**	624	579	**-45**	227	193	**-34**	315	347	**32**
Gross M. £/ha	4850	5545	**696**	935	1096	**161**	903	1143	**240**	1421	1371	**-51**	881	749	**-132**	331	244	**-87**	467	467	**0**
Cereals %	47	77	**30**	54	36	**-18**	14	16	**2**	4	5	**1**	26	23	**-3**	1	0	**0**	3	3	**0**
Grass %	19	15	**-4**	17	16	**0**	80	81	**1**	90	94	**4**	66	67	**1**	94	97	**3**	91	94	**3**
Fodder %	0	1	**0**	1	0	**-1**	2	0	**-2**	4	0	**-4**	1	2	**1**	0	2	**2**	1	2	**1**
Other Crops %	33	7	**-26**	28	47	**19**	4	3	**-1**	2	1	**-1**	7	8	**1**	5	1	**-5**	0	1	**1**
Fertiliser Costs £/ha	39	5	**-33**	72	68	**-3**	76	41	**-35**	89	72	**-16**	77	68	**-9**	18	23	**5**	42	44	**2**
Labour Costs £/ha	468	461	**-8**	122	226	**104**	135	237	**103**	136	169	**33**	181	154	**-27**	30	37	**8**	54	30	**-24**
Ewes (No.)	0	0	**0**	94	43	**-51**	193	0	**-193**	92	0	**-92**	149	110	**-39**	1778	3581	**1803**	668	383	**-285**
Dairy Cows (No.)	0	0	**0**	1	0	**-1**	64	104	**40**	86	114	**28**	13	22	**9**	1	0	**-1**	2	0	**-2**
Suckler Cows (No.)	0	0	**0**	10	0	**-10**	6	0	**-6**	29	0	**-29**	15	42	**27**	131	139	**9**	72	42	**-30**
LSU (Total)	76	7	**-70**	278	50	**-229**	230	174	**-56**	150	140	**-10**	264	166	**-98**	679	630	**-49**	198	182	**-16**
Breeding Pigs (No.)	142	238	**96**																		

Base=Figures for 1997 from FBS data.

Mod. = Projections of conventional models for 1997.

Diff = Difference between conventional models and the data.

Table 4.21. The average, observed and predicted farm level changes from 1991/92 to 1997/98

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Labour Costs %	Ewes (No.)	Dairy Cows (No.)	Suckler Cows (No.)	Breeding Pigs (No.)
Pigs and Poultry											
Actual Change	-5532	-152	-17	-5	0	21	159	0	0	0	88
Predicted Change	-45	-580	59	-38	-2	-20	-23	0	0	0	14
Cropping											
Actual Change	181	95	-3	-4	0	7	-13	-50	-3	-12	...
Predicted Change	67	139	-19	-4	0	22	129	43	0	0	...
Mainly Dairy											
Actual Change	-72	107	3	-4	1	0	-36	-1	-20	-2	...
Predicted Change	-204	-119	16	-13	-4	2	-30	0	-39	0	...
Dairy Specialist											
Actual Change	21	-2	-1	0	2	-1	-33	-142	-13	15	...
Predicted Change	6	3	5	-1	-4	1	-60	0	-21	0	...
Lowland											
Actual Change	92	-303	2	-8	0	6	-373	64	8	7	...
Predicted Change	90	35	-4	1	-2	5	5	-16	4	28	...
Large LFA											
Actual Change	-3	110	-1	-2	0	4	-20	611	-2	63	...
Predicted Change	16	-32	-2	0	1	1	-12	2708	0	-86	...
Small LFA											
Actual Change	37	93	0	-2	0	2	-9	234	1	26	...
Predicted Change	-27	51	3	-2	-2	1	6	-182	0	20	...

4.7.2. Pig and Poultry

i Comparisons with the Cluster Data

For the group as a whole net farm income was overestimated by an average of £916/ha (or was predicted to be 126% of that of the cluster farm data). However, as net farm income per hectare was considerably higher than for the other farm types, being £4481/ha, this was considered as acceptable, since it reflected the intensive nature of pig and poultry enterprises. The results for each farm cluster within the group also reflected the relative differences in income between the various farm clusters (Appendix 31.a.), with the highest income being predicted for farms in cluster 1 in Central England. On average fixed costs were underestimated (by £220/ha), however this was still the highest figure for fixed costs out of the 7 seven farm groups. In comparison with the base-line figures given by the cluster averages, fertiliser costs were very much underestimated, while labour costs however were only slightly underestimated. The underestimation of fertiliser costs is likely to be due to an assumption of a more efficient use of slurry in the models, than may be the case in real life. The average area of cereals was overestimated, (an average of 77% compared with 47% in the data), whilst the area of other crops was underestimated. However since these farms are mainly not concerned with land based enterprises, this is not considered too big a discrepancy. The number of breeding pigs were overestimated in the models by an average

of 96 pigs per farm, whilst poultry enterprises were very much under represented in the models. However the overall structure of the businesses were correctly predicted with rearing pig or poultry activities being selected in all three pig & poultry representative farms (see Appendix 31).

ii Historical Predictions

The models predicted an average loss in net farm income over the period of 1991/92 to 1997/98 of £43/ ha compared with an average observed loss of £5532/ha (see Table 4.21). On two farm clusters within the group, the models correctly indicated a loss in incomes, however in both cases the losses were underestimated, whilst on one (cluster 2, farms in Southern England and Wales) there was an increased predicted, whilst in reality there was a fall in income. This underestimation, and an actual increase can be explained by the predicted increase in the cereal area on these farms, which did not happen in reality. In reality other factors such as lack of experience in cereals, or restrictions on the area qualifying for arable aid prevented such an expansion of cereal production. The models only predicted a very slight increase in the number of breeding pigs (an average of 14 sows per farm), compared with an observed figure in the data of an increase of 88 sows. In both years the models produced solutions broadly resembling the cluster groups, though while not correctly predicting some of the trends in land use, key trends such as pig numbers were predicted correctly, and therefore the models are considered to be acceptable representations of the pig and poultry farm clusters.

4.7.3. Cropping Farms

i Comparisons with the Cluster Data

Net Farm Incomes were overestimated in the cropping group by an average of £166/ha or were 153% of the cluster data. The highest incomes per hectare were predicted for cluster 4, farms in the South East of England, as was the case in the data (see Appendix 31.b.), however incomes on cluster 6 (the farms with the lowest incomes in the data) were overestimated. Fixed costs were underestimated however by only an average of £6/ha. The average fertiliser (£68/ha) estimated by the models was comparable with the observed data of £72/ha for fertiliser, whilst labour costs were overestimated by £104/ha.

The models predicted an average cereal area of 64% compared with 54% observed in the data, the regional variation in the proportion of cereals was reasonably well projected with the highest proportion on cluster 4 (South East England), and the lowest proportion on cluster 7 (small cropping farms in Wales). Livestock activities were under selected, with the total average number of livestock units (LSU) predicted on the farms being 50 rather than the 278 in the representative farm data. The models did select farm plans resembling the actual farms, and did fit the regional cropping patterns; and therefore the models were accepted as representing this farm group.

ii Historical Predictions

The models correctly predicted a rise in net farm incomes on all the farms within the cropping group (see Appendix 35.b.). However, this was underestimated by an average of £114/ha (actual change £181/ha, predicted change £67/ha). The models however also predicted an average increase in fixed costs per ha of £139 compared with an observed increase of £95. A shift towards non-cereal crops away from cereals on these farms tended to be overestimated by the models, the models predicting an average increase of 22% in the non cereal crop area compared with a figure of 2% observed (see Table 4.21). This was balanced by an average decrease in the cereal are of 19%. This shift is likely to be due to the introduction of arable aid for these crops. Despite this large overestimate the overall predictions are in the correct direction, and therefore the models are reasonably able to predict cropping changes in these farms.

4.7.4. Mainly Dairy

i Comparisons with the Cluster Data

Net farm incomes were overestimated in this group (by 267/ha or 191% of the cluster value on average). Average fixed costs however were predicted to be £585/ha compared with £612/ha in the cluster data. Despite this labour costs were overestimated for all of the models, by an average £103/ha for the group, or were at 175% of the cluster values. The predicted average herd size was 104 cows, compared with an average of 64 cows. In addition breeding ewes were not selected in the models, with rearing cattle selected as secondary enterprises instead. The model farm plans thus tended to be overspecialised, and failed to select secondary enterprises such as sheep and cereals. Land use however on these farms was on average close to the cluster data, with similar proportions of cereals, other crops and grassland selected in the models as in the data. Only on cluster 11, farms in the South West of England, was there any big divergence, with cereal production being over represented in the model (see Appendix 31.c.).

ii Historical Predictions

The models predicted a fall in average net farm income of £204/ha, whilst in reality there was an decrease of £72/ha. The models predicted an average fall in labour costs of around £30/ha (£36/ha in reality). The models did not however correctly predict changes in fixed costs as a whole, predicting a decrease of £119/ha on average compared with the increase of £107/ha which was observed. The models predicted an overall trend of declining cow numbers, which would reflect the fall in the national herd due to falling milk prices. However on two farm clusters, cluster 8 (Wales and Northern Ireland), and cluster 10 (large dairy farms in Scotland), the models were incorrect, with increased in herd sizes being projected. Whilst on cluster 9, for small farms in Northern England, a small increase in average herd size (+2 cows) was overestimated by the models (+42 cows). There is increasing concentration within this sector of farming, thus whilst many farm ceased milk

production over this period, the average herd size and farm size has increased. The data suggests that on the farms where herd numbers decreased, there was diversification into other sectors, e.g. non cereal crops on cluster 10, whilst other grassland activities such as rearing cattle were selected on cluster 8. Some of the regional LP models tended to be overspecialised and did not select these alternatives. Despite this the overall trends for the group were projected reasonably well, and thus the models are accepted being capable of representing changes on mainly dairy farms.

4.7.5. Specialist Dairy

i Comparisons with the Cluster Data

Net farm income for the group was overestimated by £247/ha, or was 150% of the cluster data. This is likely to be due to the underestimation of fixed costs on cluster 14 (specialist dairy in the North of England) were lower by £254/ha, than the data. The farm plans in both clusters, however reflected the cluster averages from the farm data, and selected predominately grassland and dairy activities. However as with the mainly dairy farm group sheep were also not selected in these models, with rearing cattle selected as a secondary enterprise. However the variation in herd sizes were reflected the farms in the North having an average of 73 cows in the cluster data, and 50 in the models, and the farms in the South having an average herd size of 99 in the cluster data and 178 in the models.

ii Historical Predictions

Both models correctly predicted either a fall or a rise in net farm incomes (see Appendix 35.d.), however in both cases however there was an overestimation of the changes in net farm income. On the specialist dairy farms in Central and Southern England, the models predicted a fall in cow numbers of an average of 44 cows, this compares with an average fall in cow numbers of 23 in the data. On the other farm cluster a slight fall in herd size was observed in the adjusted data (-3 cows), yet a small increase was projected (+1 cow). The average figures for the group however seem to represent the trends within these farms reasonably closely, however as pointed out the regional models did produce some small divergences from the data.

4.7.6. Mixed Lowland

i Comparisons with the Cluster Data

Incomes were underestimated, by an average of £87/ha, or was 65% of the cluster data. For cluster 15, mixed lowland farms in the North and West the model prediction was £17/ha over, whilst for cluster 16, mixed lowland farms in the South, income was underestimated by £187/ha (see Appendix 31.d.). This underestimation in cluster 16 may be due to the selection of more grassland activities, at the expense of cereals. Despite this model crop plans broadly reflected the cropping on these farms, with similar proportions of crops and grass, as the cluster data. The model for the farms in the North and West selected a plan with

27% of the land down to cereals, compared with 19% in the cluster data, and 65% grass compared with 75% in the cluster data. Likewise, for the farms in the South of England (cluster 16.) cereals made up 20% of the model farm, compared with 33% in the data, and grassland 71% in the model compared with 57% in the data. The farm model for the North and West selected 41 suckler cows, compared with 19 in the data, but the model for the farm in the South selected 12; in comparison to 22 in the data. Breeding ewe numbers were overestimated in the South whilst where underestimated for the North and West of the country. Despite these differences, the broad mix of enterprises on these farms were represented within the models.

ii Historical Predictions

The average rise in net farm incomes on these farms of £90/ha was close to the actual figure of £97/ha, The predicted change in income for cluster 15, mixed lowland farms in the North being overestimated, whilst the model for the other cluster 16 for farms in the South under estimated an observed increase in income (see Appendix 35.d.). The models predicted a slight increase in the area of grassland on these farms (1%), when in reality there was a bigger decrease (-8%). They were also able in both cases to predict an increase in the area of other crops predicted an average increase of 5% compared with a figure of 6% observed. The models predicted an average increase in labour costs per ha of £20, which was in the same direction with an increase of £64/ha observed. The data indicated an average increase in suckler cow numbers of 7 which is compared with a predicted increase of 28 cows, whilst an increase in dairy cow numbers of 8 cows, is comparable to a figure of 4 which was predicted by the models. In conclusion these models were able to reasonably represent the changes observed on these two representative farms.

4.7.7. Large LFA

i Comparisons with the Cluster Data

Incomes were underestimated for all the representative farms in the group, by an average of £54/ha, or it was 48% of the group data. Fixed costs also an average underestimated by £34/ha on average. The fixed costs for this group were the lowest of all the farm groups, and thus reflected the extensive nature of these farms. Despite these deviations the models produced plans which were overwhelmingly sheep and suckler enterprises as in reality, however sheep numbers were overestimated by an average of 1803 ewes, and suckler cow numbers also by an average of 9 cows in an average herd. The estimated net farm incomes for clusters 17 and 19 were close to the cluster data, being only underestimated by £23/ha and £19/ha respectively. The model for large hill sheep farms in Wales and Northern Ireland (cluster 17) however did not predict a net farm income close to the data underestimating income by £119/ha. One explanation for these discrepancies could be the lack of proper representation of economies of scale on these farms.

ii Historical Predictions

The models on average predicted a decrease in net farm income of £3/ha compared with predicted increase of £16/ha. However for the individual farm types, the models correctly predicted increased incomes on farms in Scotland, compared with decreases elsewhere (see Appendix 35.e.). The models predicted an increase in average flock size on these farms of 2,708 ewes, this is clearly an overestimate, compared with figures from the cluster data which predict an increase of 671 ewes only. Having said this the models do predict a trend of increasing sheep numbers, which was a response to increased headage payments, but they did not correctly predict the observed trends for suckler cows, and predicted a fall in numbers. These farms however are in the main sheep farms, and given the correct prediction of trends relating to flock size are considered to have reasonably represented the key trends on these farms over the period.

4.7.8. Small LFA

i Comparisons with the Cluster Data

For the group of smaller LFA farms the net farm incomes were underestimated (by £32/ha or were on average 79% the figure for the cluster data). Fixed costs were predicted on average to be exactly £32/ha over. Labour costs were predicted to be an average of £30/ha compared with a an average figure of £54/ha observed. Ewe numbers were predicted to be an average of 383 ewes, compared to 668 ewes observed in the cluster data. However suckler cows were also underrepresented being 42 cows in the models compared with 72 in the data. The cropping plans were thus consistent with the cluster descriptions, selecting mainly grassland, and sheep and suckler cow enterprises. The models did project some of the regional patterns observed (see Appendix 31.f.), with the biggest suckler herd being projected for the farms in cluster 20 (hill beef Scotland).

ii Historical Predictions

On average, the models failed to predict an increase in net farm income (-£37/ha, see Table 4.21). However in spite of this, for all the farms in the group the direction of change in incomes were predicted correctly (see Appendix 35.f.). Incomes were predicted to fall on farms in clusters 20 and 21 (farms in Scotland and the South West of England), yet they were predicted to rise in clusters 22 and 23 (farms in Wales, Northern Ireland, Northern and Central England). It was an underestimation of the increase (+£26/ha compared with +£160/ha) on farms in Wales and Northern Ireland (cluster 22) that lead to the average prediction of a fall incomes for the group. The models failed to predict an increase in sheep numbers, but did accurately predict an average increase in suckler cow numbers predicted an increase of 30 cows compared with a 28 cow increase observed. In both years the models produced plans similar to the cluster data.

4.7.9. Assessing the Models Performance

Table 4.22 summarises the deviations from the cluster means for net farm income, fixed costs and gross margin per hectare for the seven main groups or classes of farming over the two years in which the models were run.

Table 4.22. Deviation of the model results from the cluster group means for net farm income, fixed costs and gross margin /ha

	Net Farm Income		Fixed Costs		Gross Margin	
	% Deviation		% Deviation		% Deviation	
	1997/1998	1991/1992	1997/1998	1991/1992	1997/1998	1991/1992
Pigs & Poultry	25.69%	-50.25%	-17.15%	-0.28%	14.34%	-43.43%
Cropping	54.17%	211.16%	3.16%	-27.85%	20.27%	20.30%
Mainly Dairy	91.84%	87.85%	-4.42%	-21.09%	26.56%	24.92%
Specialist Dairy	49.20%	56.14%	-31.54%	-56.81%	-3.85%	-19.20%
Mixed Lowland	-34.02%	-51.80%	-7.15%	-57.29%	-14.98%	-56.46%
Large LFA	-51.40%	-67.31%	-14.80%	50.81%	-26.35%	-5.86%
Small LFA	-21.15%	28.04%	10.12%	22.55%	-0.08%	24.42%
	16.33%	30.55%	-8.83%	-12.85%	2.27%	-7.90%

In general the models tended to overestimate net farm income (by 16.33 % on average for 1997/98 and by 30.55% for 1991/92). Fixed costs were underestimated by 8.83 % on average, in 1997/98 compared with 12.85% in 1991/92. The predicted total farm gross margins overestimated the base line data by about 2.27 % in 1997/98, yet were overestimated by 7.9% in 1991/92. Whilst the average figures appear close to the base line data, for some farm types however the figures were considerably higher or lower such as net farm incomes for cropping farms in 1991/92. However these deviations need to be put into context by comparing them with the accuracy of other LP studies. The model constructed by Russell and Fraser (1995) predicted a farm gross margin of just over 4% of the real situation, but the cropping plans selected underestimated wheat by 83%, barley by 69% and sugar beet by 92%, whilst overestimated the area of oilseed rape 259%. Schipper *et al.* (1995) modelled sustainable land use in Costa Rica, and constructed 5 representative farm models, which on average produced gross margins, which were within 24% of the representative farm data. The model farms are intended as representative or average farms for a group, however in reality there is no such thing as an average farm, with the distribution of technical co-efficients for each group likely to be skewed which would impact upon the results.

In validating the models, and in accepting or rejecting them as representing reality, a range of factors should be considered, not just a single parameter. This thesis is directed at looking at changes in output and production patterns, therefore it was felt that in validating the models, the main consideration should be the representation of the cropping and stocking plans. In this respect the differences within the groups varied according to farm type. Thus, the results from the pig and poultry farm models were least representative of the regional variations found within the UK, the crop and dairy farms were most representative. One possible explanation for this is the lack of data on pig mortality and growth rates relating to

regional production differences in the pig and poultry enterprises themselves. In contrast for crop farms, data on yields were easily available from published data.

Since the models in this study on the whole reasonably represented the mix of cropping and stocking for the farm clusters, the models can be considered valid representations of current farming systems for the representative farm types. The models also where able to predict broader historical trends resulting from policy reform, and to exogenous price changes and are therefore adopted as a basis for examining the impacts of moving to sustainability.

4.8. The Assumptions used in the Sustainable Farm Models

These assumptions applied to all models representing the sustainable farm scenario, and were included in the models, in addition to the assumptions previously outlined. The assumptions about the management systems, used to achieve the objective of sustainability were based upon the decisions made in Chapters 1 and 2.

4.8.1. Cropping Activities

The gross margins for the sustainable scenario were based on the likely yields and input levels presented in Chapters 1 and 2, which in turn were based upon the LIFE (Jordan, Hutcheon and Perks 1990) and the LINK Integrated Farm Systems experiment's (Ogilvy 2000). For grassland activities, it was assumed that legumes were utilised and yield and stocking levels were based upon those derived from research conducted into white clover/grass systems (Hopkins, Davies, and Doyle, 1995; Swift, Vipond, Cleland, and Hunter, 1992; Bax 1990; Leach, Bax, Roberts, and Thomas, 2000). Pesticide use in the sustainable cropping activities is shown in Table 4.23, and is based upon the results of the LIFE experiment (Plumb 1995). Fertiliser use was based upon the field use rates and target field use rates for arable crops and grassland, in Table 3.7 and Table 3.8.

Table 4.23. Pesticide use assumptions used for sustainable system gross margins (% of conventional systems values)

Crops	Herbicide Use %	Fungicide Use %	Insecticide Use %
Winter wheat	75	20	20
Spring wheat	75	20	20
Winter barley	75	20	20
Spring barley	75	20	20
Winter oats	75	20	20
Spring oats	75	20	20
Rye/Triticale	75	20	20
Sugar beet	75	20	20
Oilseed Rape	75	20	20
Field Beans	75	20	20
Field Peas	75	20	20
Potatoes	75	20	20
Linseed	75	20	20
Field Vegetable Crops	75	20	20
Grassland Grazed	0	0	0
Grassland Hay	0	0	0
Grassland Silage	0	0	0
Kale	75	20	20
Dutch/ Stubble Turnips	75	20	20
Swedes & Turnips	75	20	20
Fodder Beet	75	20	20
Whole crop cereal	75	20	20
Forage Maize	75	20	20

The crop yield assumptions under sustainable systems were also based upon data from the six sites of the LINK experiment spread across the UK, including sites in the South, North, and West of England, along with Scotland. These provided information on the regional yield differentials that could be expected between sustainable and conventional production systems. Table 4.24 presents these differentials. Most yield data related to specific sites, and was therefore allocated to a specific region in the models, however some crops such as peas, and winter beans were only included in trials in one particular location, and therefore one single differential had to be assumed nationally.

Table 4.24. Yield differentials between Conventional Farming Systems (CFS) and Integrated farming systems (IFS) from the LINK IFS experiment

Crop	Region	Sites	Yields t/ha		
All Crops			CFS	IFS	% CFS/IFS
	Southern England	Scarewell	17	19	111.76%
	Southern England	Boxworth	7	6	85.71%
	Northern England	High Mowthorpe	13.0	12.0	92.31%
	Wales[1]	Lower Hope	19.0	17.0	89.47%
	Scotland	Pathead	7.0	6.5	92.86%
			9.7	9.9	102.76%
Cereals			CFS	IFS	% CFS/IFS
	Northern England	High Mowthorpe	8.0	7.5	93.75%
	Wales & Northern Ireland	Lower Hope	9.0	8.5	94.44%
	Scotland	Pathead	9.0	8.8	97.22%
	Southern England		8.3	7.4	88.67%
Winter Wheat					
	Southern England	Boxworth	9.0	7.0	77.78%
	Southern England	Manydown	7.0	6.5	92.86%
		Average	8.0	6.8	84.38%
Barley					
	Southern England	Manydown	6.0	6.2	103.33%
	Scotland	Pathead	7.0	6.0	85.71%
	Potatoes		CFS	IFS	% CFS/IFS
	Southern England	Scarewell	50.0	60.0	120.00%
	Northern England	High Mowthorpe	35.0	34.0	97.14%
	Wales & Northern Ireland	Lower Hope	55.0	50.0	90.91%
Other Break Crops	All		CFS	IFS	% CFS/IFS
Peas,	All	Boxworh	3.6	4.0	111.11%
Winter Beans	All	Boxworth	4.2	3.6	85.71%
Vining Peas	All	Manydown	6.0	5.8	96.67%
WOSR,	All	Manydown	3.6	3.4	94.44%

(From Ogilvy 2000).

4.8.2. Livestock Activities

For the grass/clover swards, assumed in the sustainable systems, compared to all-grass swards assumed in the conventional systems, a lower stocking rate (-20%) was assumed. On the grass/clover swards used in sustainable systems, the assumptions outlined in Table 4.25 were made about individual animal performance, based on a review of field-scale trials (Davies and Hopkins, 1996).

[1] Lower Hope in Herefordshire, was taken to represent Welsh and Northern Irish conditions

Table 4.25. Assumptions on individual animal performance on grass/clover swards

	% As compared with grass only sward
Sheep[1]	
Pre-weaning	106
Post-weaning	131
Beef[2]	106

In addition due to animal welfare considerations, increased provision of straw has been made for housed livestock activities (+20%).

4.8.3. Fixed Costs in the Sustainable Models

The fixed costs apportioned to each activity in the sustainable farm models are presented in Appendix 24.b. Increased housing costs which were apportioned to the fixed costs of each livestock activity to allow for improved housing. Lampkin (1999) presents livestock building costs for organic farms, which were used for the sustainable farm models (see Appendix 25). Fixed machinery, repairs and other costs for the sustainable arable crop activities were based upon the operational costs reported in the LINK IFS experiment (Ogilvy 2000), which may be summarised as a being 5% lower than on the conventional systems. Fixed costs on forage activities were assumed to remain as for conventional farms.

However sustainable farms will require increased use of labour and it is assumed that sustainable cropping systems will requires an increased labour input of 20%. It is also assumed that sustainable systems will also require a greater labour input per animal to be acceptable on animal welfare grounds, so sustainable livestock activities are taken to require 20% more.

4.8.4. Additional Constraints in the Sustainable Farm Models

Thus, in addition to the core constraints described in the previous sections, all the sustainable farm models had additional constraints to ensure that the overall farm plans adopted were sustainable. These were based upon the description of sustainable farming presented in Chapter 2, and are summarised in the following sections.

4.8.4.1. Rotational Constraints

To be considered sustainable no crop could be grown more than one year in four (see Guideline 55, page 40.), but some specific crops may require even greater breaks in the rotation (see Table 4.26). If a crop could not be grown more than one year in four in a rotation, then it was assumed that in any particular year it should not exceed 25% of the total cropping area. If the restriction is one year in five, then total cropping should not exceed 20% and so on. Therefore in the sustainable farm models, additional rotational constraints

[1] From Davies 1992

[2] Mean of work by Steen and Laidlaw (1986), Stewart and Haycock (1984), Younie *et al.* (1986)

limited the proportion of the cropping area for each specific crop, according to the break period required.

Table 4.26. The rotational constraints used in the sustainable farm models

Crop	Grown no more than one year in:
Cereals	4
Potatoes	4
Oilseed Rape	5
Sugar Beet	5

4.8.4.2. Constraints on the use of Inputs

The discussion on indicators in Chapter 3 found that for a system to be considered sustainable synthetic inputs must be reduced to the relative to the levels in conventional systems, by the proportions given in Table 3.7, Table 3.8 and Table 3.10. Accordingly additional constraint lines were added to the sustainable farm models to restrict the overall use of the various inputs across the farm, with the target reductions being set according to farm type, as in Table 4.27.

Table 4.27. Overall farm synthetic input use (percentage reduction from conventional levels)

Synthetic Input	Mainly Arable	Mainly Grassland
Nitrogen	50%	75%
Phosphate	50%	50%
Potash	50%	50%
Herbicides	20%	100%
Fungicides	80%	100%
Insecticides	80%	100%

4.9. Incorporating the Indicators of Sustainability

As discussed in Chapter 3, central to any assessment of whether a particular farming system is sustainable, there must be indicators of sustainability. These indicators may be included in the LP models as either constraints, activities or in the objective function (see Jansen *et al.* 1995). The methods by which these specific indicators have been incorporated into the models are shown in Table 4.28.

Table 4.28. Incorporating the indicators in the farm level models

Modelling	Indicator
Incorporated as constraints	Soil Quality Index (Indicator 15) Stocking Rates (Indicator 1) Fertiliser Use (Indicator 7) Pesticide Use (Indicator 8)
Activities in the models, or calculated directly from the activities.	No of crops in rotation (Indicator 2) Pesticide Impact Quotients impacts on the Environment (Indicator 9), Consumers (Indicator 24), Spray operators (Indicator 27) Agricultural Productivity (Indicator 19) Borrowing (Indicator 21)
Calculated indirectly or from the aggregate results for the models.	Methane emissions (Indicator 13) and Ammonia (Indicator 14) emissions Energy Use (Indicator 18) Agricultural Employment (Indicator 23) Land-cover (Indicator 5)
The Objective Function of the model	Net Farm Income (Indicator 20)

Certain indicators were incorporated as constraints within the models, for instance the soil quality index (Indicator 15). Scores for individual crops were estimated as described in section 3.10.4. Each crop has a score allocated (see Table 3.15) which are included in a row, along with a minimum value of 1.5 per hectare in the right hand side value. The result is that no farm plan could be selected which is less than this threshold value. Stocking rates (Indicator 1), fertiliser use (Indicator 7) and pesticide use (Indicator 8) were included in a similar manner.

For the indicators which have been incorporated as activities or calculated directly from activities, there were no constraints within the models, but their values were compared with the previously set targets from Chapter 3. The pesticide impact scores (Indicator 9) are calculated as previously described in section 3.10.3. The crop activities in the models used spray programmes presented within the SAC Farm Management Handbook (1997), and is representative of commercial practice. Each individual chemical was scored on a 1 to 5[1] basis for each of the variables used with the Environmental Impact Quotients for the Ecological, Consumer and Worker Impacts. This was done by assessing toxicity and lethal concentration[2] (LC_{50}) data in *The Pesticide Manual* (Tomlin 1997). The scores assumed for each chemical within the models are presented in Appendix 30. From these scores the impacts quotients were calculated for each chemical on a IQ score per kg ai (active ingredient) basis. By multiplication with the total kg ai/l (Tomlin 1997) and with standard application rates (from SAC 1997), an individual score for each chemical on a per ha basis

[1] 1 being least harmful, 5 most harmful

[2] A standard measurement of toxicity, e.g. if a chemical had a Mammalian LC_{50} score of 600mg/l then it would be expected that a dose of 600mg/l would prove lethal to 50% of all mammals.

was obtained (see Table 4.29 for an example calculation for winter wheat). In this example for instance the EIQ per kg ai for primicarb was 157, this was multiplied by the EIQ per litre of 78.5 and the application rate of 0.28 l per hectare to derive a score of 21.98 EIQs per hectare. This was totalled with the scores for the other chemicals used within winter wheat production, would give a score of 129.71 EIQs per hectare. Within the LP models, the scores for each cropping or grassland activity was incorporated into a constraint row, which would total up the EIQ for each farm plan generated.

Table 4.29. Example calculation of ecological impact quotient per ha for winter wheat

Spray Programme (Based on SAC 1997)	Chlorothalonil	Primicarb	Cypermethrin	Diflufenican + Isoproturon	Fenaxaprop-P-ethyl	Fluroxypyr	Imazalil	Total Ecological Impact Quotient / ha
DT (Dermal Toxicity)	3.0	5.0	3.0	3.0	3.0	3.0	3.0	
C (Chronic Toxicity)	5.0	5.0	5.0	3.0	3.0	3.0	5.0	
SY (Systemicity)	3.0	1.0	5.0	3.0	3.0	1.0	3.0	
F (Fish Toxicity)	3.0	3.0	3.0	3.0	3.0	1.0	3.0	
L (Leaching Potential)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
R (Surface Loss Potential)	1.0	3.0	1.0	3.0	3.0	1.0	1.0	
D (Bird Toxictiy)	1.0	5.0	3.0	3.0	3.0	5.0	3.0	
S (Soil Half Life)	1.0	5.0	1.0	3.0	3.0	3.0	5.0	
Z (Bee Toxicity)	1.0	3.0	5.0	3.0	3.0	3.0	5.0	
B (Beneficial Arthropod Toxicity)	3.0	3.0	5.0	3.0	3.0	3.0	5.0	
P (Soil Half Life/ Proxy for Plant Surface)	1.0	5.0	1.0	3.0	3.0	3.0	5.0	
kg ai per litre (From Tomlin 1997)	0.50	0.50	0.10	0.12	0.06	0.20	0.15	
Ecological IQ (calculated from Eq 3.4) per kg ai	17.00	157.00	37.00	81.00	81.00	91.00	153.00	
Total Ecological IQ per litre	8.50	78.50	3.70	9.72	4.46	18.20	22.95	
Application Rates (From SAC 1997) litres per hectare	3.00	0.28	0.25	1.00	1.25	1.00	0.06	Total EIQ/ha for Winter Wheat
Individual Ecological IQ per ha	25.50	21.98	0.93	9.72	5.57	18.20	1.32	129.71

The energy use on the farms (Indicator 18) was calculated directly from the cropping plans generated by the models using the following energy co-efficients from Bonny (1993). These are the amounts of energy required in the production of each unit of input. Thus if a farm used 1 tonne of nitrogen fertiliser, would require 58,600 MJ to manufacture.

Table 4.30. The co-efficients used for calculating energy use on farms

	Energy Co-efficients MJ/kg
Seeds	7.5
N	58.6
P	10.5
K	8.4
Pesticides	209.0
Fuel	45.3
Overheads	2.3

(From Bonny 1993).

The use of fertilisers, pesticides and seeds could be obtained directly from the farm plans, the use of fuel on the farms, was estimated from assumptions made about the machinery operations required for each crop activity and fuel consumption data from Whitney 1988 (see Table 4.31).

For example in the models a hectare of Winter Wheat would require Ploughing x1, Heavy Cultivation x1, Rotary Cultivation x1, Fertiliser Distribution x 2, Grain Drilling x1, Rolling x1, and 2 spray operations, and would therefore use 74l/ha of diesel fuel (see Table 4.32), which would use 3352.2 MJ/ha.

Table 4.31. Fuel use and machinery operations

Operation	Fuel use l/ha
Sub-soiling	15
Ploughing	21
Heavy Cultivation	13
Light Cultivation	8
Rotary cultivation	13
Fertiliser distribution	3
Grain Drilling	4
Rolling	4
Potato Planting	8
Mowing, Turning & Baling	3
Forage Harvesting	15
Spraying	1
Combine Harvesting	11
Potato Harvesting	21

(From Whitney 1988).

Table 4.32. Example fuel calculation for winter wheat

	l/ha	No of operations	Fuel
Ploughing	21	1	21
Heavy Cultivation	13	1	13
Rotary cultivation	13	1	13
Fertiliser distribution	3	2	6
Grain Drilling	4	1	4
Rolling	4	1	4
Spraying	1	2	2
Combine Harvesting	11	1	11
		Total Fuel	74

Air pollution from agriculture in the form of methane (Indicator 13) and ammonia (Indicator 14) emissions were estimated directly from the livestock numbers from aggregate farm model results. As was the impacts of pesticides on consumers (Indicator 24), and on spray operators (Indicator 27), and agricultural employment (Indicator 23).

Net farm income (Indicator 20) was used as an indicator of the viability of the farming systems, and it is also the objective function of model. The other core financial indicator is short term borrowing (Indicator 21), which was included as an activity within the model. Sustainable farms must be profitable, which is a condition of the minimum income constraints in the focus loss model. These indicators provide a further check upon the results of the sustainable farm models, to ensure that the farming systems are indeed sustainable.

The quantitative targets for each of the indicators, (summarised in Table 3.21) will be used for this assessment. The effects on other indicators discussed within Chapter 3, are inferred from the projections for these core indicators.

4.10. The Farm Level Impacts of Moving to Sustainability

In section 4.7. the results of conventional farm models were presented, and were accepted as being accurate representations of current farming practices on the 23 farm types. This section presents the models representing these farms under sustainable farming conditions. These incorporate the assumptions and constraints for sustainability, which would need to be applied and put into practice at the farm level. In the following section the results from the sustainable farm models are compared with the results for the simulated conventional farm plans presented in Table 4.20. This provides estimates of the farm-level impacts of moving to sustainable farming systems. A summary of the results from each farm cluster are presented in Appendix 36, and the full Lindo printouts are shown in Appendix 37.

Table 4.33. Summary the farm level impacts of moving to sustainability

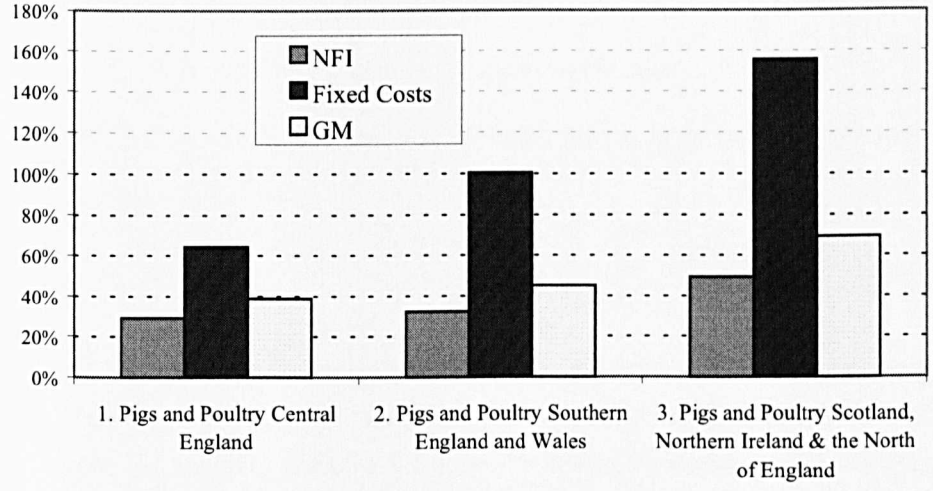
	Pigs and Poultry			Cropping			Mainly Dairy			Specialist Dairy			Mixed Lowland			Large LFA			Small LFA		
	CFP	SFP	%	CFP	SFP	%	CFP	SFP	%	CFP	SFP	%	CFP	SFP	%	CFP	SFP	%	CFP	SFP	%
Net Farm Income £/ha	4481	1494	33%	480	468	97%	558	323	58%	735	348	47%	169	201	119%	51	49	97%	120	123	102%
Fixed Costs £/ha	1064	1097	103%	616	421	68%	585	532	91%	636	700	110%	579	441	76%	193	232	120%	347	323	93%
Gross M. £/ha	5545	2592	47%	1096	889	81%	1143	856	75%	1371	1048	76%	749	642	86%	244	281	115%	467	446	95%
Cereals %	77	24	31%	36	33	91%	16	3	19%	5	3	71%	23	4	20%	0	1	..	3	2	50%
Grass %	15	49	330%	16	6	34%	81	89	110%	94	89	95%	67	78	117%	97	97	100%	94	95	101%
Fodder %	1	9	1073%	0	0	..	0	3	979%	0	5	..	2	10	445%	2	2	104%	2	3	193%
Other Crops %	7	17	247%	47	61	130%	3	5	170%	1	3	249%	8	7	89%	1	0	58%	1	0	..
Fertiliser Costs £/ha	5	0	0%	68	29	43%	41	14	34%	72	12	16%	68	25	37%	23	3	11%	44	11	25%
Labour Costs £/ha	461	580	126%	226	77	34%	237	213	90%	169	169	100%	154	125	81%	37	41	110%	30	24	79%
Ewes (No.)	0	0	..	43	0	..	0	106		0	0	..	110	373	339%	3581	3443	96%	383	389	102%
Dairy Cows (No.)	0	0	..	0	0	..	104	67	64%	114	76	67%	22	0	0%	0	0		0	0	..
Suckler Cows (No.)	0	0	..	0	5	..	0	0	..	0	0	..	42	0	0%	139	137	99%	42	53	125%
LSU	7	27	384%	50	11	22%	174	129	74%	140	110	79%	166	162	98%	630	603	96%	182	156	86%
Breeding Pigs (No.)	238	200	84%	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rearing Pigs (No.)	1085	768	71%	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Poultry Eggs (No.)	740	0	0%	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rearing Lambs (No.)	45	453	1015%	95	173	182%	0	28	..	0	0	..	368	722	196%	0	68	..	0	0	..
Rearing Cattle (No.)	10	25	244%	52	1	2%	108	106	98%	25	25	100%	132	118	89%	90	72	80%	129	70	55%

CFP = Conventional Farm Plan SFP = Sustainable Farm Plan

4.10.2. Pig and Poultry

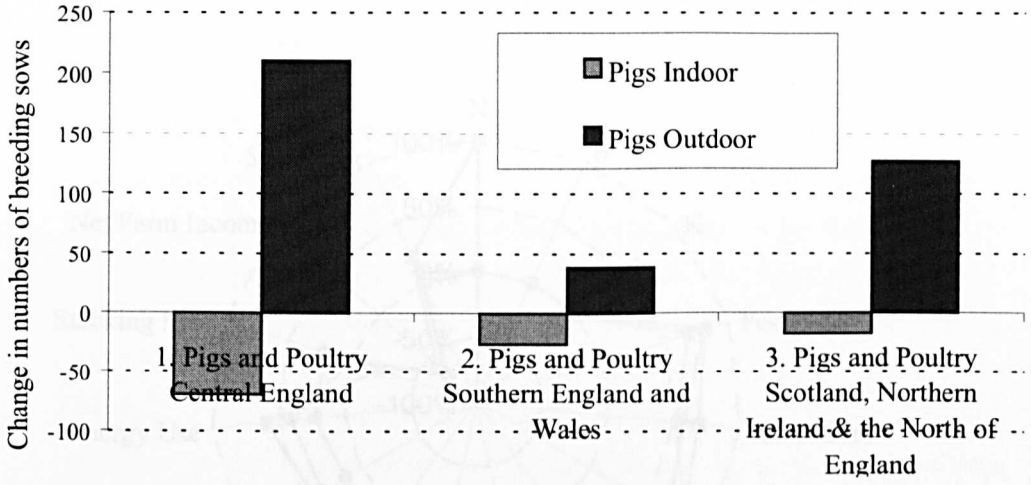
In a move to sustainable farming net farm incomes were predicted to fall to an average of £1491/ha, or to 33% of the conventional levels, while the total farm gross margins fell by over £2592/ha or to 44% of the conventional scenarios figure (see Figure 4.2). Fixed costs were predicted to rise by an average of £33/ha, or to 103% of the conventional farming levels. The biggest cuts in net farm incomes occurred on farms in the Southern England and Wales (to 29% of the conventional scenario), (see Figure 4.2) whilst the least were on those farms in Scotland, Northern Ireland and the North of England. This is possibly an effect of size, the larger farms in Scotland, Northern Ireland and the North having a greater opportunity to move into other more extensive land based enterprises, were able to maintain incomes proportionately better, despite fixed costs rising on these farms. On these farms, as well as moving towards outdoor pigs there was a shift to more grassland livestock principally rearing lambs and cattle, as well as other cropping activities, due to the higher fixed costs and labour charges associated with the sustainable intensive livestock. One consequence of these projections could be increased concentration within the sector, as many smaller pig units would amalgamate in order to benefit from economies of scale, and also to generate sufficient income to meet the farmer's personal objectives.

Figure 4.2. Predicted net farm income, gross margin and fixed costs changes on pig and poultry farms (% of conventional value)



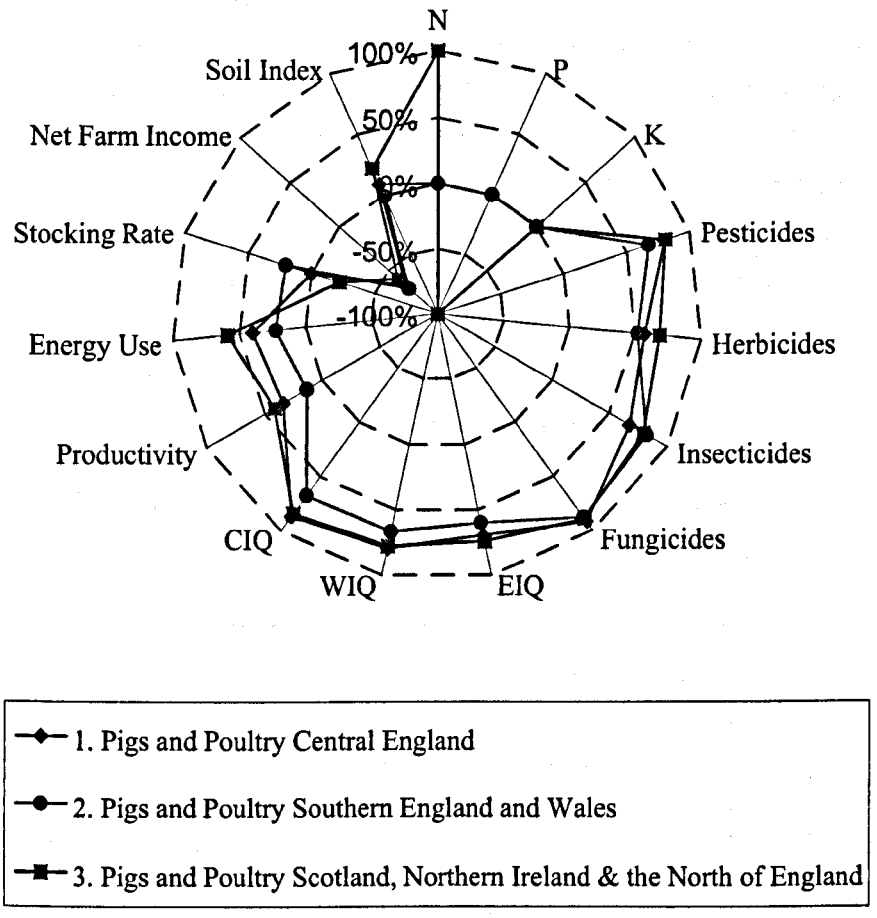
The size of the average pig herd fell, however there was a shift towards, outdoor pigs (Figure 4.3), with outdoor pig production accounting for an average of 66% of the breeding pigs found on the sustainable farms. Poultry production was predicted to disappear on the farms where it was present in the conventional models.

Figure 4.3. The changes in breeding pig herds from moving to sustainable farming systems



The effects on the selected farm level indicators are summarised in Figure 4.4, the figures represent the % improvement in each indicator, or the losses in each indicator. Thus a negative figure for the change in income represents a fall, and a negative effect, whilst the positive values reported for fertiliser and pesticide use represent the % decrease; and an improvement in terms of sustainability.

Figure 4.4. The projected changes in the sustainability indicators on pig and poultry farms (% change)

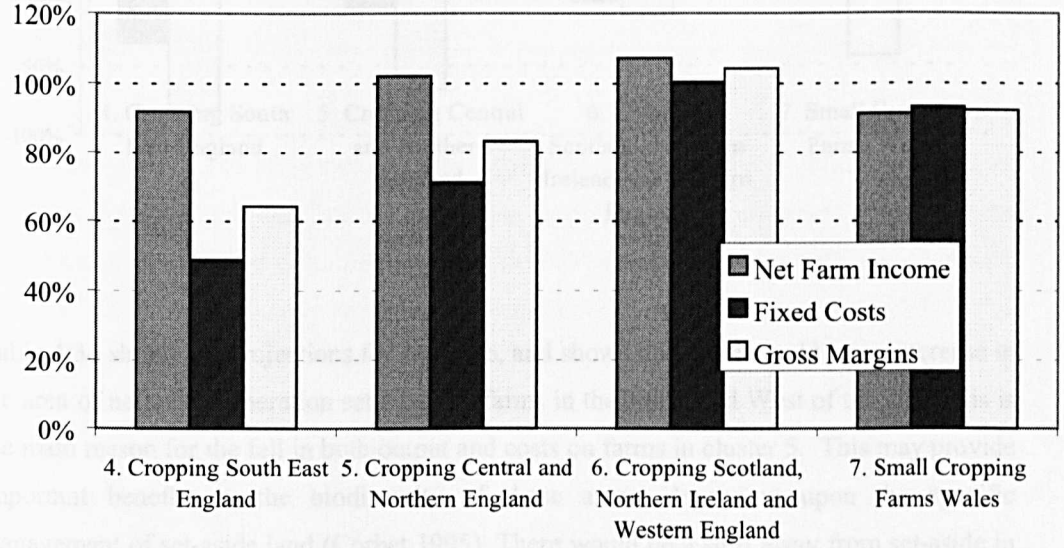


Whilst the indicators of sustainability would improve, (there would improvements in 10 out of 14 farm level indicators) this would be offset by a substantial decrease in incomes on these farms. The biggest gains in environmental terms on farms in this group are predicted to be on those farms in cluster 3, Scotland, Northern Ireland and the North of England. While conventional pig production is less dependent on land than other agricultural enterprises, sustainability will entail increased use of land with outdoor production accounting for more of production, and leading to a greater influence on the environment.

4.10.3. Cropping Farms

On crop farms the move to sustainable farming was projected to cut incomes by only 3% for the group. This is consistent would some of the studies which seem to indicate that in some circumstances incomes from sustainable cropping systems might be just as profitable as conventional ones (e.g. Falconer and Hodge 2000, Jordan *et al.* 1995). However there were regional variations, with farms in the South East of England (cluster 4) and Wales (cluster 7) experiencing incomes that were around 91-92% of that in the conventional scenario (see Figure 4.5). In contrast to this the model for representing farms in Scotland (cluster 6) predicted to increase their incomes by 107%, and farms in the North of England (cluster 5) to 102%. The main reason was that fixed costs were predicted to rise considerably on the farms in the South East of England, in contrast to the Scottish situation. However in the North of England, whilst output would fall, fixed costs would also fall considerably. Thus it would appear that on both these representative farms, sustainability could entail a win-win situation, delivering an enhanced environment as well as economic benefits.

Figure 4.5. Predicted net farm income, gross margin and fixed costs on cropping farms (% of the conventional scenario)



Some of the differences between the farm types in this group in predicted changes in income are likely to be due to the changes in the cropping enterprises on these farms (see Figure 4.6). The farms with the biggest falls in incomes had to make the biggest changes in the farming system. In all cases there was a move to a more balanced rotation, but this varied across the country, with predicted increases in crops other than cereals on all farms. The

farms which would experience the biggest financial losses were in the South East of England, since they initially had the highest proportion of cereals, the new rotational constraints of sustainability, meant a bigger reduction, and a greater loss in income. There was also a move away from cereals, and short term grass leys on farms in clusters 6 and 7 (Wales, Scotland, Northern Ireland, and the West of England) (see Figure 4.6). On the farms in Wales (cluster 8) there was a projected increase in the area of cereals (to 120% of conventional farming), which was within the rotational constraints set. On the Scottish farms there was proportionately less change in the rotations, hence the projected improvement in financial performance. The requirement to include some Spring crops in a sustainable rotation would possibly explain why the Scottish farms would improve their incomes, Spring crops would be relatively better suited to Scottish conditions.

Figure 4.6. Changes to enterprises on the cropping farms (% change in area)

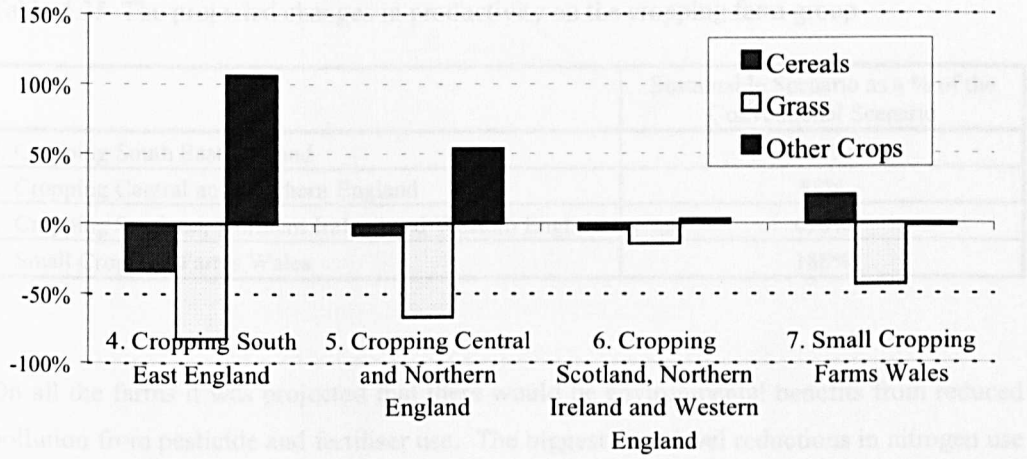


Table 4.34 shows the projections for set-aside, and shows that there would be an increase in the area of natural regeneration set-aside on farms in the North and West of the UK. This is the main reason for the fall in both output and costs on farms in cluster 5. This may provide important benefits to the biodiversity of these areas, depending upon the specific management of set-aside land (Corbet 1995). There would be a shift away from set-aside in the South and East, and a move towards non food crops. Non food crops in the models comprised on oilseed rape varieties for industrial use, however in the future might comprise of a wider range of crops such as biomass for energy or bio-diesel, which may contribute to a more broader policy of sustainable development by helping to reduce the reliance on fossil fuels.

Table 4.34. Projections for set-aside and non food crops in the farm models (% change)

	Natural Regeneration Set Aside	Non Food Crops
4. Cropping South East England	-4.05%	4.05%
5. Cropping Central and Northern England	47.52%	-4.25%
6. Cropping Scotland, Northern Ireland and Western England	0.70%	0.00%
7. Small Cropping Farms Wales	8.71%	0.00%

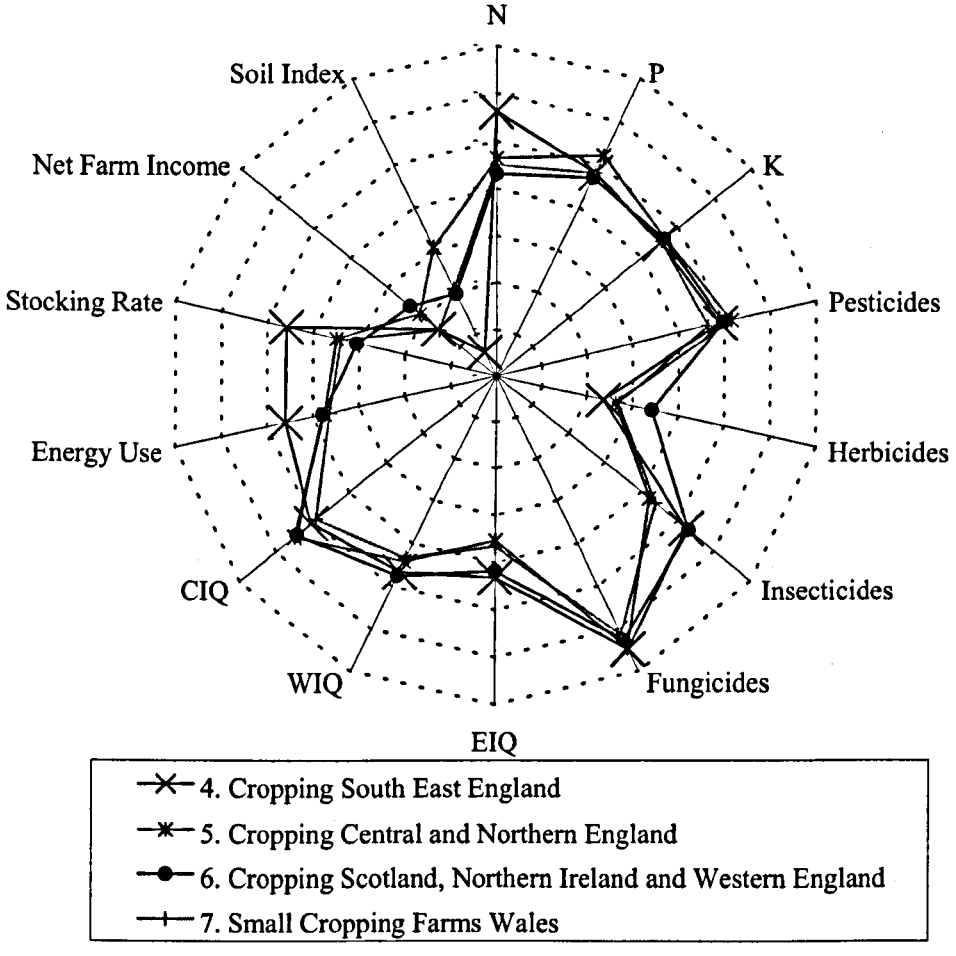
The projected changes in the farm indicators on each of these farms are shown in Figure 4.7 The productivity indicator (Indicator 19), taken as the ratio of outputs to inputs; indicated a big improvement in productivity especially on the farms in the South East of England (cluster 4), and the farms in Scotland, Northern Ireland, and Western England (cluster 6) (see Table 4.35).

Table 4.35. The projected changes in productivity on the cropping farm group

	Sustainable Scenario as a % of the Conventional Scenario
4. Cropping South East England	705%
5. Cropping Central and Northern England	88%
6. Cropping Scotland, Northern Ireland and Western England	690%
7. Small Cropping Farms Wales	188%

On all the farms it was projected that there would be environmental benefits from reduced pollution from pesticide and fertiliser use. The biggest farm level reductions in nitrogen use would come on the farms in the South East of England (cluster 4) with a reduction of around 70%, on the other farms there would be more modest reductions in the order of 50%. This would deliver important environmental benefits in reducing the pollution risk in some areas of high nitrogen concentrations in surface and ground water such as the East Anglia and the Thames water regions (see Appendix 14). There would be benefits from reduced use of fungicides in particular, although the actual volume reduction in fungicides would be proportionately bigger the reduction in the impact of pesticides on the environment measured by the Kovach index (Indicator 9). This would indicate that some of the chemicals for which there would be reductions would be relatively more benign to the environment, than those which remained.

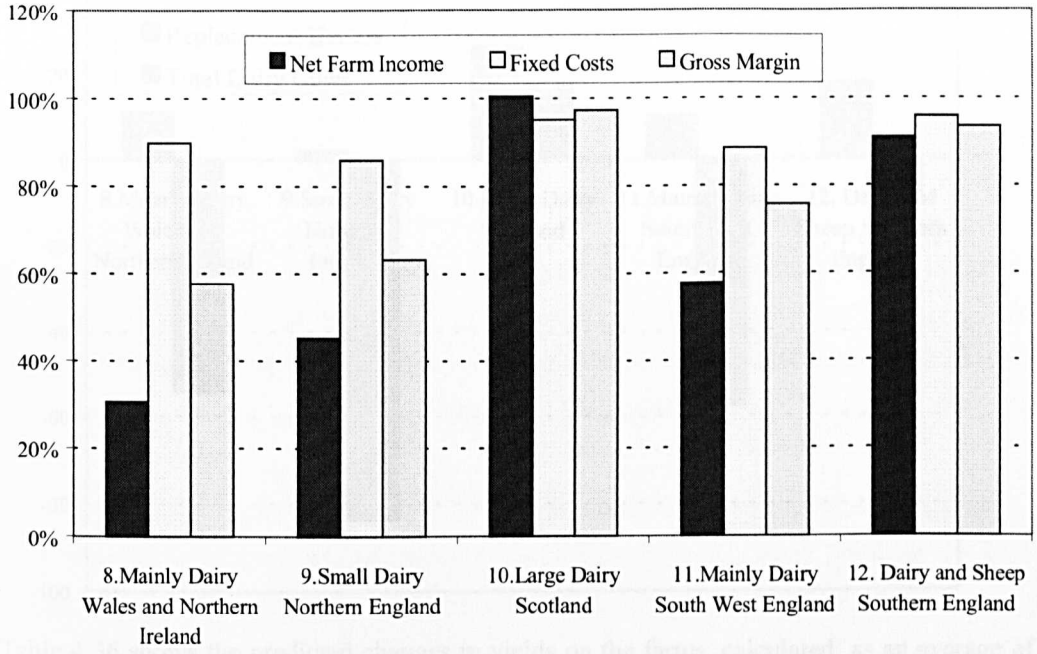
Figure 4.7. The projected changes in the sustainability indicators on cropping farms (% change)



4.10.4. Mainly Dairy

On the mainly dairy group of farms the models, predicted that a move to sustainable farming would cause net farm incomes would fall to 58% of those in the conventional farming scenario, with fixed costs per hectare being predicted fall to 91% of the conventional levels (Table 4.33). The smaller farms however in Wales and Northern Ireland (cluster 8) were predicted to suffer the biggest losses of income, where incomes would fall to around 31% of the conventional scenario (see Appendix 36.c.). On other larger holdings in Scotland (cluster 10), the falls in income were predicted to be slight with a fall of only £2/ha.

Figure 4.8. Net farm income changes on the mainly dairy farms



Therefore it seems that there would be considerable economic losses on these farms which might threaten the viability of dairy farming in some parts of the UK. These projections may possibly lead to an accelerated trend of farm amalgamations, and falling numbers of dairy farms, which would lead to some offsetting of the projections relating to herd size.

Figure 4.9 illustrates the projected changes in herd size after a move to sustainable dairy farming systems. For this group of farms dairy cow numbers would be expected fall from an average of 104 to 67. On the larger farms, the predicted reductions in average herd sizes tended to be less severe, with cow numbers on the large dairy farms in Scotland (cluster 10) actually increasing. On the larger dairy farms other non dairy activities such as cattle rearing became comparatively less attractive than on the smaller dairy farms. On the farms in cluster 9, small dairy farms in the North of England, it was predicted that the herd sizes would reduce to 11% of that in the conventional scenario, with a shift towards sheep enterprises, the farm model selecting a solution with a sheep flock of 89 ewes. Thus where farms were less restricted by the availability of land they were able to adopt more extensive dairy enterprises, and in Scotland even expend the herds as an alternative to other farm activities such as rearing cattle.

Figure 4.9. Predicted changes in dairy herd structures on mainly dairy farms (changes in number of animals)

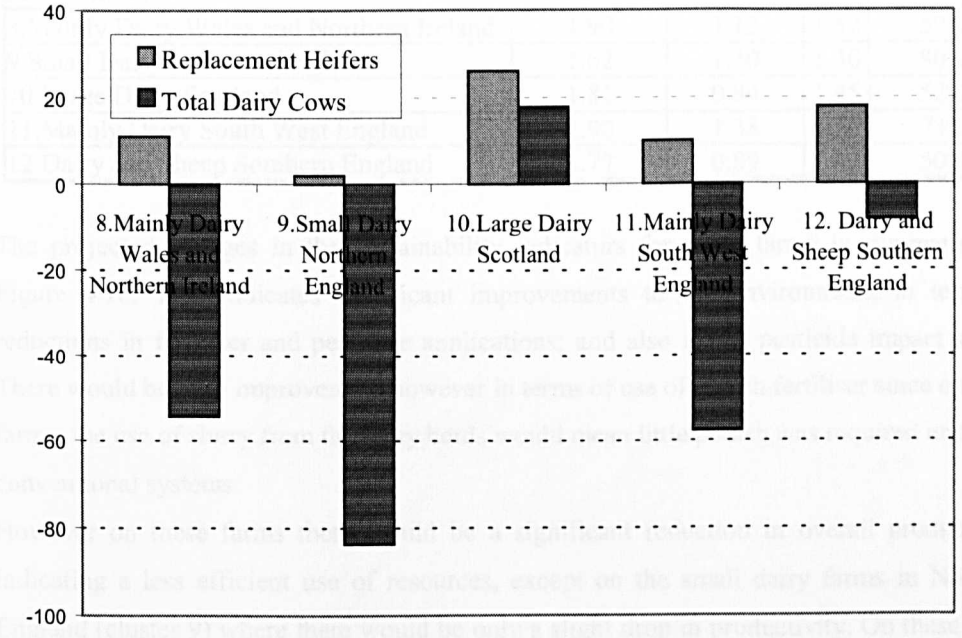


Table 4.36 shows the predicted changes in yields on the farms, calculated as an average of the yield potential of the cows selected in the models. On most of the farms there were predicted increases in yields under sustainable management, except for mainly sheep and dairy in the South West of England (cluster 12). This move would be plausible since individual animal production would be expected to increase, under the legume based systems expected in sustainable agriculture.

Table 4.36. The average milk yields on the mainly dairy farms under sustainable farming systems

	Milk Yields l / annum		
Farm Cluster	Conventional	Sustainable	% Sus/Conv
8.Mainly Dairy Wales and Northern Ireland	6896	6899	100%
9.Small Dairy Northern England	6752	8000	118%
10.Large Dairy Scotland	6145	7045	115%
11.Mainly Dairy South West England	6849	8000	117%
12. Dairy and Sheep Southern England	6202	6290	101%

On most of the farm clusters decreases in the overall stocking rate were projected (see Table 4.37), with an overall average decrease of 90%. However for cluster 9 small dairy farms in the north and Northern Ireland, it was projected that the stocking rate would increase.

Table 4.37. The projected stocking rates (LSU/forage ha) on the mainly dairy farms under sustainable farming

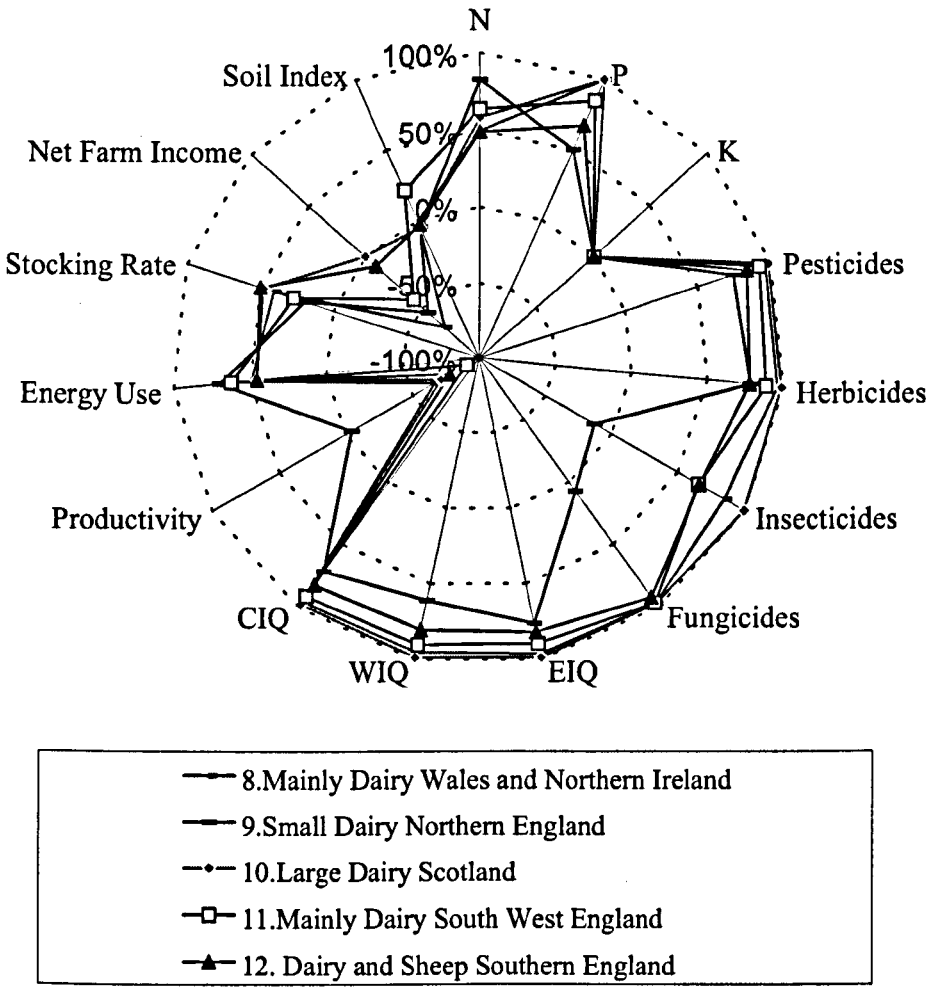
Farm Cluster	Conventional	Sustainable	Max	% Sus/Con
8.Mainly Dairy Wales and Northern Ireland	1.90	1.12	1.52	59%
9.Small Dairy Northern England	1.62	1.30	1.30	80%
10.Large Dairy Scotland	1.81	0.94	1.45	52%
11.Mainly Dairy South West England	1.90	1.38	1.52	73%
12.Dairy and Sheep Southern England	1.77	0.89	1.42	50%

The projected changes in the sustainability indicators for these farms is summarised in Figure 4.10. This indicates significant improvements to the environment, in terms of reductions in fertiliser and pesticide applications; and also in the pesticide impact scores. There would be little improvement however in terms of use of potash fertiliser since on these farms, the use of slurry from the dairy herds would mean little potash was required under the conventional systems.

However on these farms there would be a significant reduction in overall productivity, indicating a less efficient use of resources, except on the small dairy farms in Northern England (cluster 9) where there would be only a slight drop in productivity. On these farms there was a shift away from dairy farming leading to savings in labour and fixed inputs. On the other farms the lower output/ha of the sustainable dairy enterprises lead to a less efficient use of these resources.

Under the sustainable scenario there would be considerable environmental improvements leading from reductions in the use of nitrogen and phosphate fertilisers, leading to a reduction in the risk of pollution from these sources, and a reduced risk of water pollution. The biggest reductions in nitrogen use in this group being predicted for farms in the North of England, and the South West of England, whilst there would be smaller reductions elsewhere. However on these small dairy farms in the North, there would be a smaller improvement in the use and impact of pesticides, due to a shift to some arable crops.

Figure 4.10. The projected changes in the sustainability indicators on mainly dairy farms (% change)

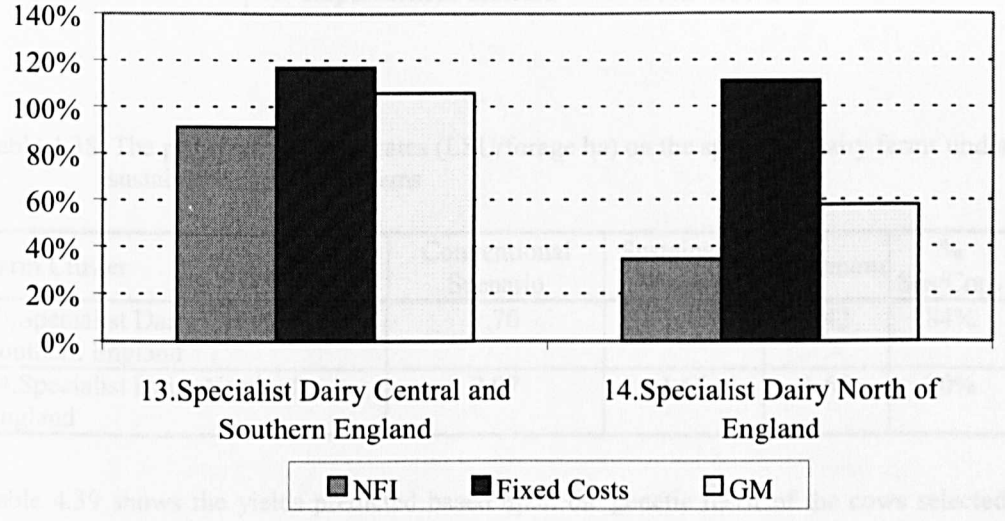


4.10.5. Specialist Dairy

Incomes on the specialist dairy farms were predicted to fall to an average of 47% of the level in the conventional scenario, with fixed costs increasing to around 110% of the conventional scenario. There was however a significant difference in the financial impacts on the two farm clusters within this group (see Figure 4.11). This difference may be explained by changes in the structure of enterprises on the farms. On the farms in Central and Southern England, the dairy cow numbers were increased at the expense of other livestock rearing activities (Figure 4.12). On the specialist dairy farms in the North of England, this was not the case and herd numbers decreased with a shift towards cereals, other crops, and livestock

rearing activities. Despite this there was a fall in overall output on these farms, and a significant effect on income with the incomes on cluster 14 in the North of England falling to 35% of the levels of conventional farming. On the farms in Central and Southern England (cluster 13), incomes only fell to 91% of the conventional level. The projected income for cluster 14 in the conventional scenario was overestimated however, and the reality may be a much smaller financial impact, but there would be a much bigger change in the farm structure. This may be due to differences in the relative productivity of grassland and arable land in these regions. On farms in Central and Southern England sustainability would entail further specialisation, to cover increased fixed costs. In the North of England however, alternative activities were sought to dairy cattle.

Figure 4.11. Net farm income, fixed cost and gross margin changes on the specialist dairy farms (as % of the conventional scenario)



For both farm types in this group, dairy cow numbers were predicted to fall, but on the Specialist farms in the North (cluster 14) there was a predicted increase in replacement heifer rearing (see Figure 4.12). Thus while there would be a smaller herd overall, the increased home rearing of replacements should lead to improved herd cohesion, and a less stressful environment for the animals.

On both farms in these groups the sustainable models selected the maximum permitted stocking rate under sustainable systems, which is the 20% reduction which could be associated with using legume based swards. The reductions in the stocking rates on the initially more intensive Specialist dairy farms in the North of England, would lead to some improvements in terms of a less intensive use of grassland, and benefits to biodiversity and wildlife on these farms.

Figure 4.12. Predicted changes in herd structure on specialist dairy farms (no of animals)

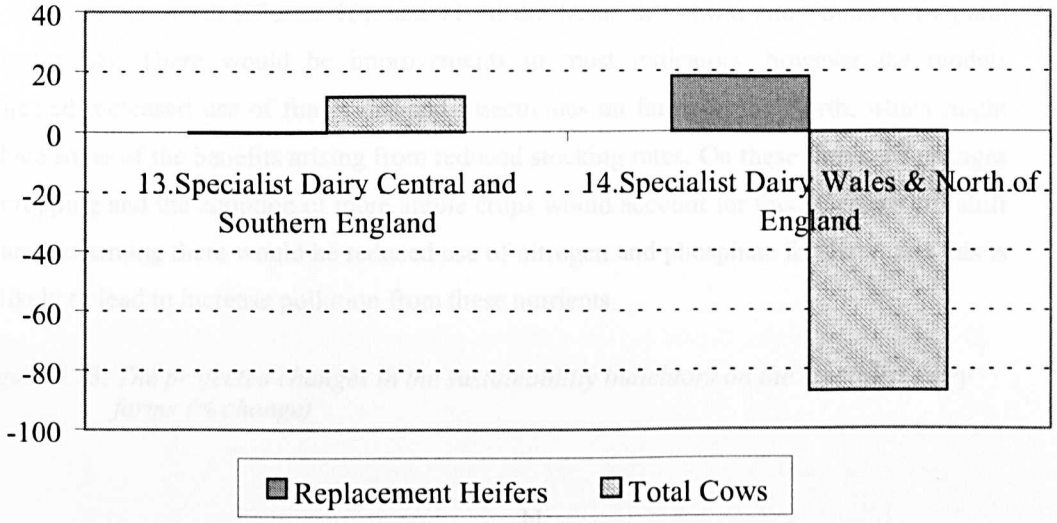


Table 4.38. The projected stocking rates (LSU/forage ha) on the specialist dairy farms under sustainable farming systems

Farm Cluster	Conventional Scenario	Sustainable Scenario	Maximum	% Sus/Conv
13.Specialist Dairy Central and Southern England	1.70	1.42	1.42	84%
14.Specialist Dairy North of England	2.07	1.65	1.65	80%

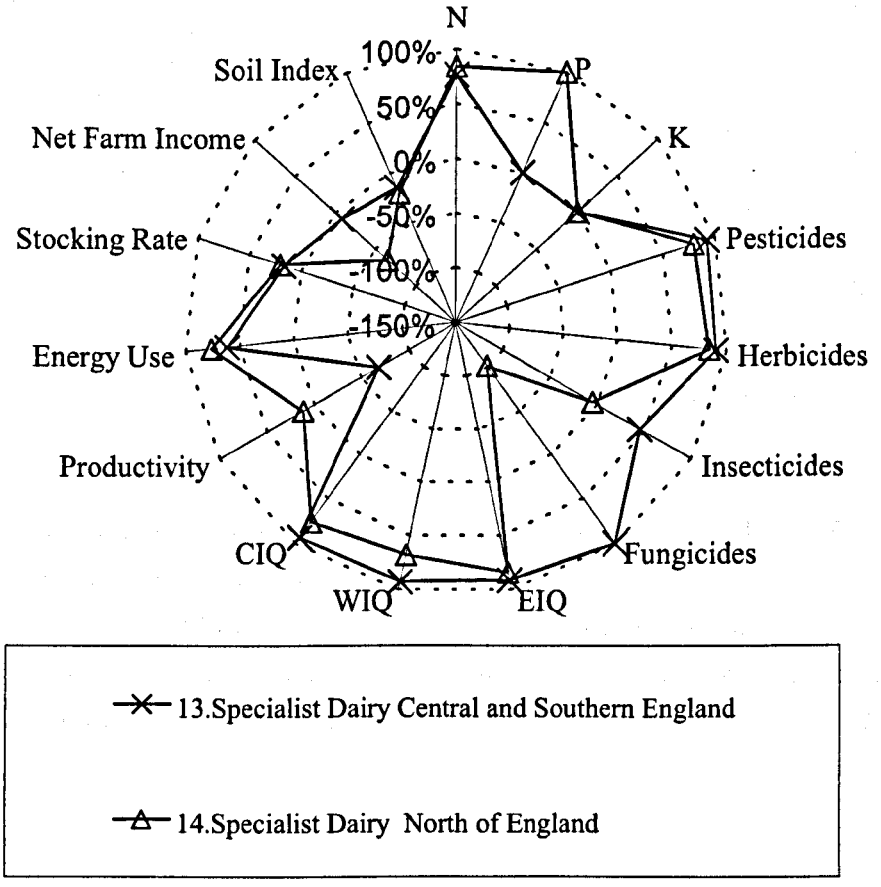
Table 4.39 shows the yields predicted based upon the genetic merit of the cows selected. Thus models predicted a slight increase in individual animal performance on the farms in the South. This meant that dairy farming remained an attractive option, and as these farms had sufficient grassland resources to keep higher yielding cows, the increased specialisation occurred. On the specialist dairy farms in the North, lower yielding systems were adopted; which would lead to the losses in output from dairy.

Table 4.39. The average milk yields on the specialist dairy farms under sustainable farming systems

	Milk Yields l / annum		
Farm Cluster	Conventional	Sustainable	% Sus/Con
13.Specialist Dairy Central and Southern England	6600	6756	102%
14.Specialist Dairy Wales & North of England	7043	6756	96%

Figure 4.13 illustrates the projected changes in the sustainability indicators on these farms, and shows that out of the 14 indicators of sustainability there would be improvements in 10 on farms in the North (Cluster 15), and 11 on the farms in Central and Southern England (Cluster 14). There would be improvements in most indicators, however the models projected increased use of fungicides and insecticides on farms in the North, which might reduce some of the benefits arising from reduced stocking rates. On these farms the changes in cropping and the adoption of more arable crops would account for this. Despite this shift to arable farming there would be reduced use of nitrogen and phosphate fertiliser, and this is unlikely to lead to increase pollution from these nutrients.

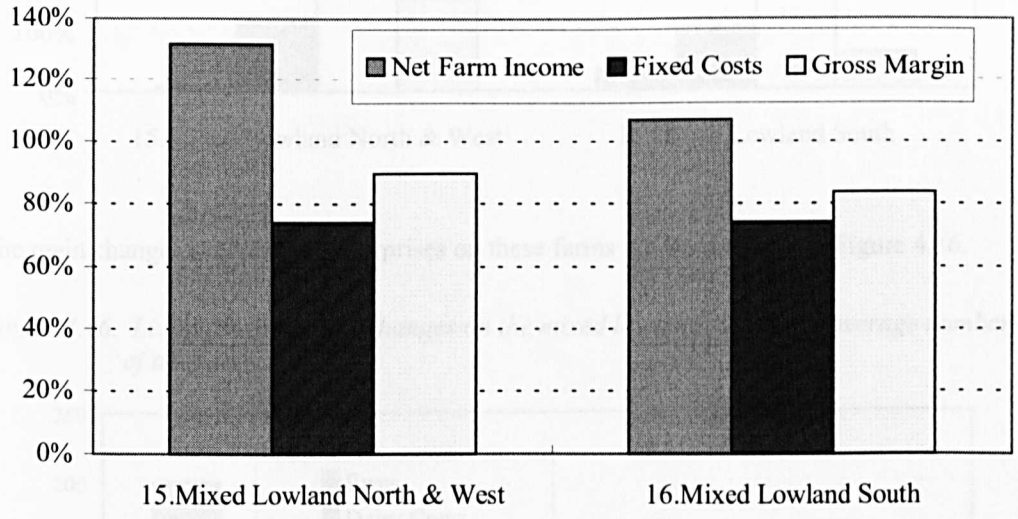
Figure 4.13. The projected changes in the sustainability indicators on the specialist dairy farms (% change)



4.10.6. The Mixed Lowland Farms

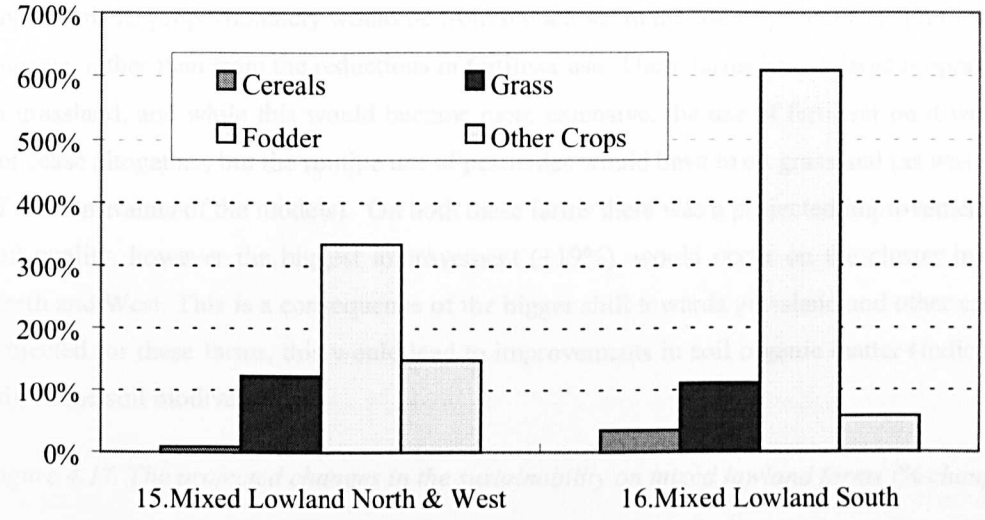
Incomes on the mixed lowland farms were predicted to rise (see Figure 4.14), following a move to sustainable farming, to an average of 119% of that in the conventional scenario. Fixed costs would fall to an average of 76% of that under the conventional scenario, whilst the farm gross margins would only fall to an average of 86%, thus this reduction in fixed costs, and a relatively smaller fall in output, would lead to a rise in net farm income. Both farms in the group would improve their incomes, however the biggest benefit is projected for farms in cluster 14, in covering the Northern and Western areas of the UK.

Figure 4.14. Net farm income, gross margin and fixed costs changes on the mixed lowland farms (as % of the conventional scenario)



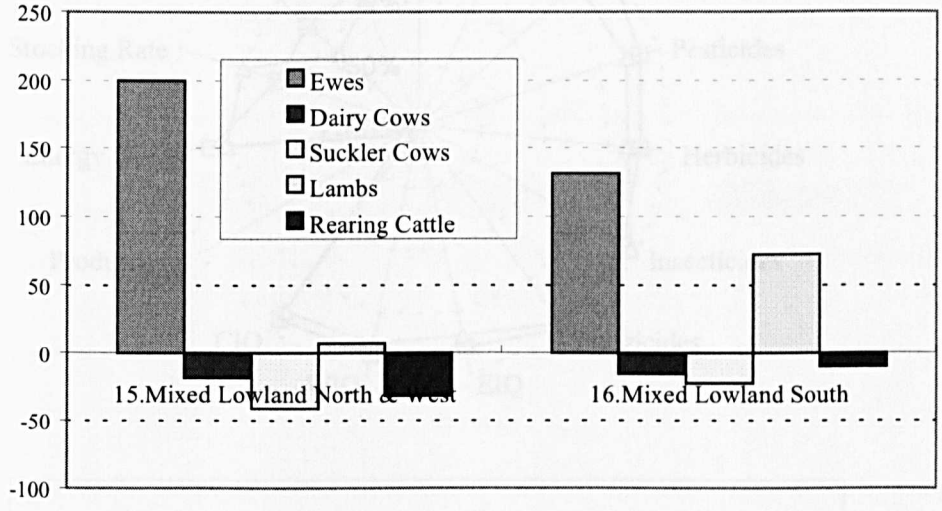
The projected changes in cropping on these farms are summarised in Figure 4.15.The grassland area on these farms would increase, to an average of 117% of that in the conventional scenario, whilst the area of other crops would fall, on the farms in the South (cluster 16.), but increase on farms in the North (cluster 15.). Cereal production would fall dramatically on both farm clusters, and would almost disappear on these farms in the North and West.

Figure 4.15. The cropping changes on the mixed lowland farms (as % of the conventional scenario)



The main changes in livestock enterprises on these farms are summarised in Figure 4.16.

Figure 4.16. Livestock enterprise changes on the mixed lowland farms (by average number of animals)

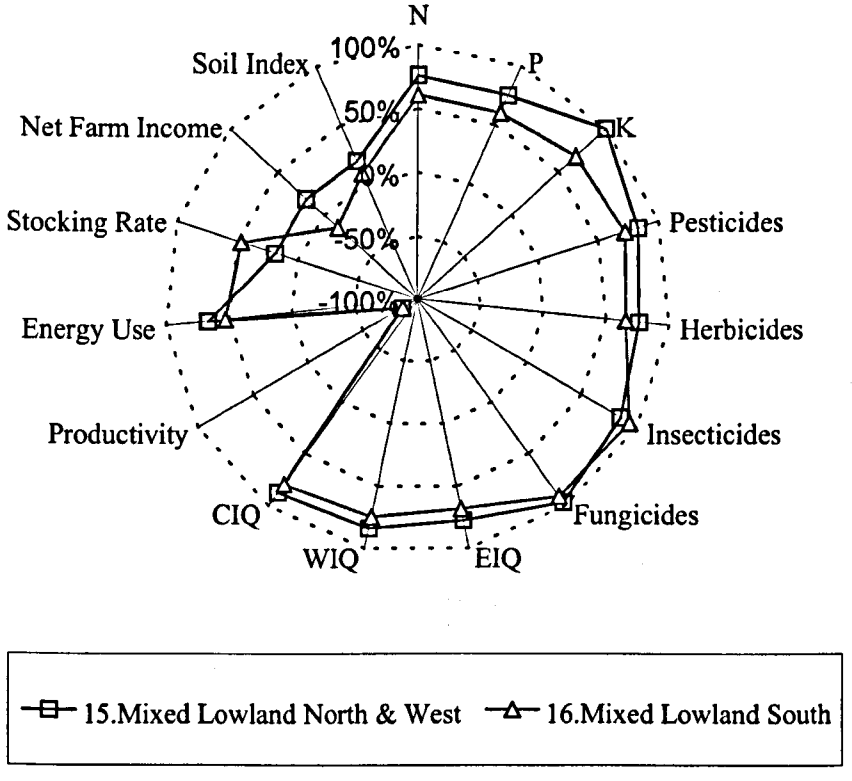


There was an overall swing towards livestock farming, principally through expanding lowland sheep enterprises, whilst beef enterprises would be cut back. Dairy enterprises would disappear on these farms, as more extensive livestock enterprises would become more attractive options. There would be a shift from suckler cows and rearing cattle, towards sheep enterprises, however there would be little change in the overall livestock units on the

farms, with an increased grazing and forage area, leading to reduced stocking rates overall and reduced grazing intensity.

The changes in the sustainability indicators are presented in Figure 4.17. The biggest improvements proportionately would be from reductions in the use of pesticides, and in their impacts, rather than from the reductions in fertiliser use. These farms have a large proportion of grassland, and while this would become more extensive, the use of fertiliser on it would not cease altogether, but the routine use of pesticides would have to on grassland (as was one of the constraints of the models). On both these farms there was a projected improvement in soil quality, however the biggest improvement (+19%), would occur on the cluster in the North and West. This is a consequence of the bigger shift towards grassland and other crops projected for these farms, this would lead to improvements in soil organic matter (Indicator 16), as the soil biodiversity.

Figure 4.17. The projected changes in the sustainability on mixed lowland farms (% change)



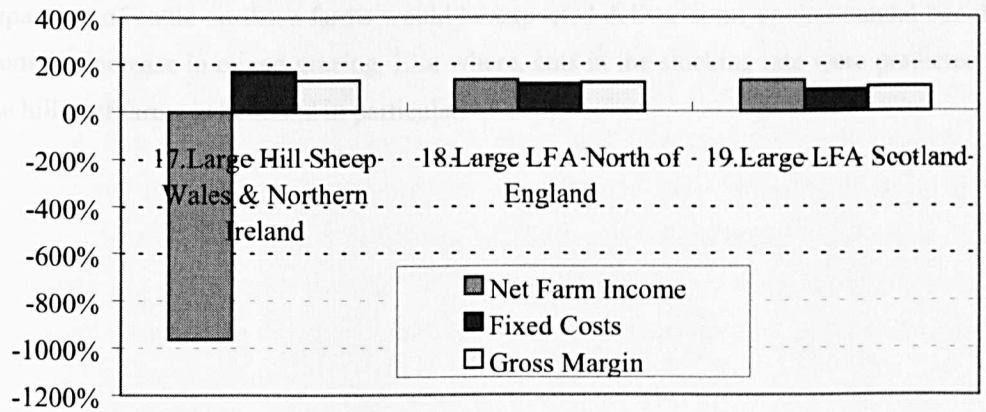
The biggest improvements overall in the indicators would be on the lowland farms in the North and West of the UK, which would deliver bigger improvements on 12 out of the 15 indicators, including an improvement in financial viability. One area where these farms would not deliver any benefits would be in terms on overall productivity, which would fall

for both farms. This is likely to be due to the shift away from arable farming toward, which would be less efficient in terms of labour.

4.10.7. Large LFA

On farms in this group a move to sustainable farming would increase incomes by an average of £147/ha (see section 4.10.), with the fixed costs falling by an average of £66/ha. The regional differences in the changes in incomes, gross margins and fixed costs per hectare are shown in Figure 4.18. Total farm gross margins would rise on two of the farms in the group, whilst they would be expected to fall on farms in the North of England, and these were the farm which would experienced the smallest proportional increase in incomes. The biggest rises were predicted to be on the farms in Scotland, with an increase of up to 500%, but this was from a low base in the conventional model , compared with the representative farm data. The large LFA farms in Wales and Northern Ireland however would be predicted to make a loss under the sustainable farming scenario. As discussed in Chapter 1, to be sustainable farming systems must be viable, therefore in the case of these farms, it would be the case that increased public support would be required to achieve sustainability. Alternatively the land might go out of farming and be put to other uses such as nature conservation, recreation or forestry.

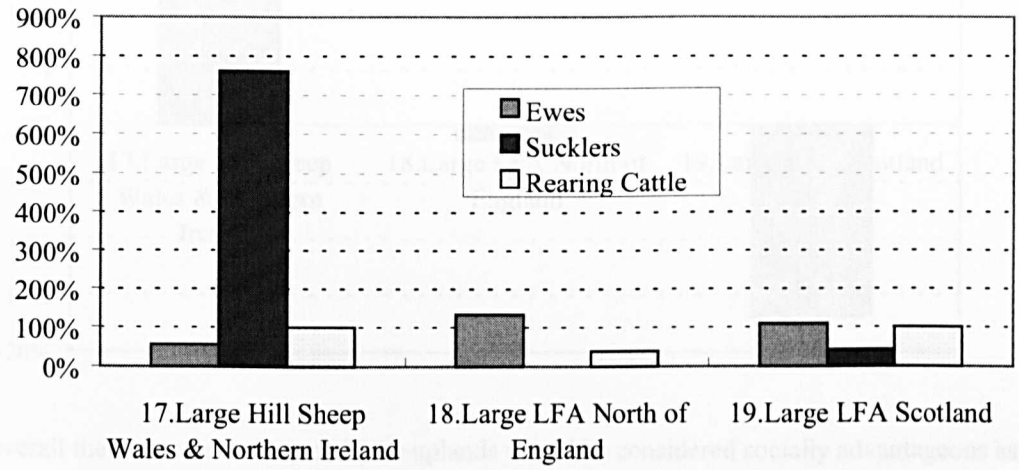
Figure 4.18. Net farm income changes on the large LFA farms



However the farms were predicted to remain as mainly grassland, with the main predicted enterprise changes are summarised in Figure 4.19. Sheep numbers were predicted to increase on large LFA farms in Wales and Northern Ireland to 123% of the conventional level and in Scotland to 141%. In Scotland the number of sucklers would also increase, to 118% of the

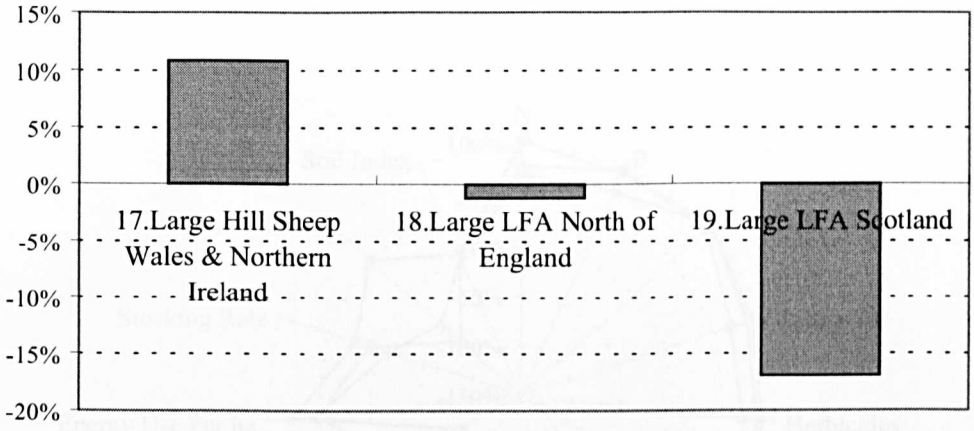
conventional levels, and rearing cattle enterprises would also expand. On farms in the North of England however, the herd numbers were predicted to fall slightly.

Figure 4.19. The enterprise changes on the large LFA Farms (as a % of the conventional scenario)



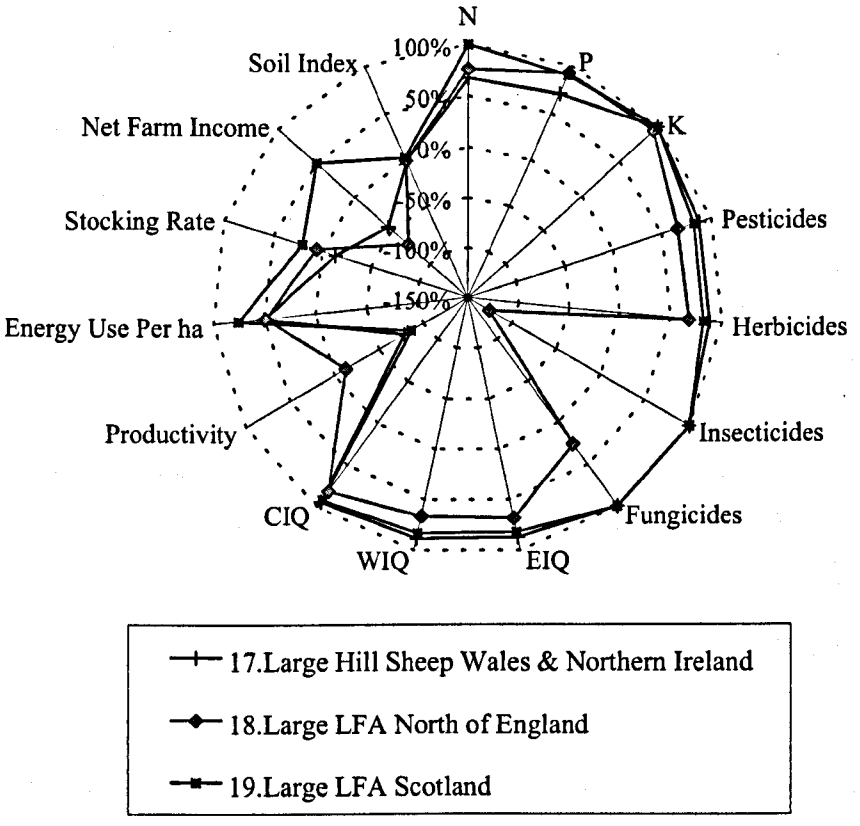
The overall stocking rate was predicted to fall on all farms in the group (Figure 4.20). However on cluster 17 the group of farms in Wales and Northern Ireland stocking rates would rise by just over 10%, largely due to the increase in suckler cow numbers. This expansion of cattle on these farms would be expected deliver some environmental benefits from the increase in mixed grazing. Else where, cuts in the stocking rate were predicted on the hill beef farms in Scotland in particular.

Figure 4.20. The projected stocking rate changes on large LFA farms (% LSU/forage ha)



Overall the increases in income in the uplands would be considered socially advantageous as policies are directed towards maintaining the population in these marginal areas for environmental reasons. On these farms, the main impact of moving to sustainable systems would be a substitution of sheep for beef enterprises leading to some important benefits to biodiversity. According to Wilkins and Harvey (1993) grazing with cattle rather than sheep would have positive effects on higher plant, insect, bird and small mammal species (see Table 1.4). There would also be a substantial reduction in fertiliser use on these farms, from an average of £17/ha to £3/ha, which might lead to many farmers considering conversion to organic systems. Whilst there would be environmental and economic gains on 2 of the clusters within this group, on the large LFA farms in Wales, sustainable agriculture would have to come at an increased cost, since any environmental gains would be offset by severe economic losses (see Figure 4.21). These projections highlight regional variations in the likely effects of moving to sustainability, with clear differences emerging in the costs of delivering sustainability throughout the UK, this issue and its implications for policy will be discussed further in Chapter 6.

Figure 4.21. The projected changes in sustainability indicators on large LFA farms (% change)



4.10.8. Small LFA Farms

Changes in net farm income fixed costs and gross margin associated with a shift to sustainable farming are shown in Figure 4.22 below. The net farm income was predicted to fall on all farms in this group, to an average of 74% of the conventional farm income for the group. There would however be considerable regional variations with incomes on the hill beef farms in Scotland (cluster 20) predicted to rise to 154% of that under the conventional scenario, whilst incomes on small hill farms in Wales and Northern Ireland would fall to 82% of that under the conventional scenario.

The main reasons for the fall in incomes, would be decreased output as a result of sustainability which would not be compensated for by decreased production costs. On the hill beef farms in Scotland cluster, the availability of family labour which is un-costed within

the models is likely to be a factor in the projected rise in incomes, since on all the other farms in the group, paid labour is still required although not as much as under conventional farming (see Appendix 36.f.).

Figure 4.22. Net farm income changes on the small LFA farms

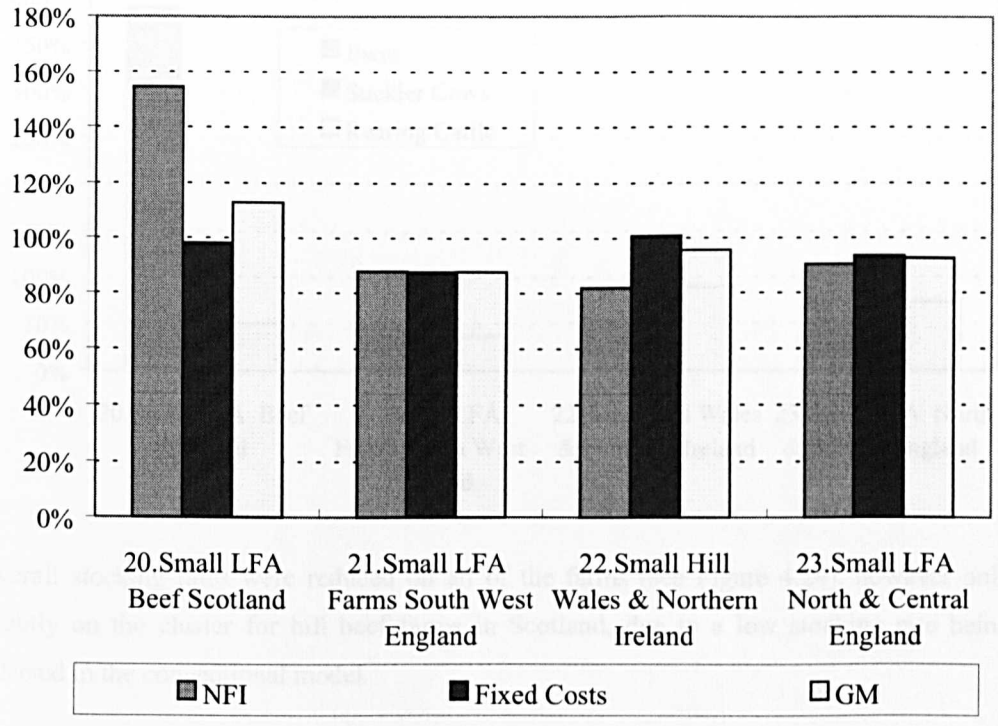
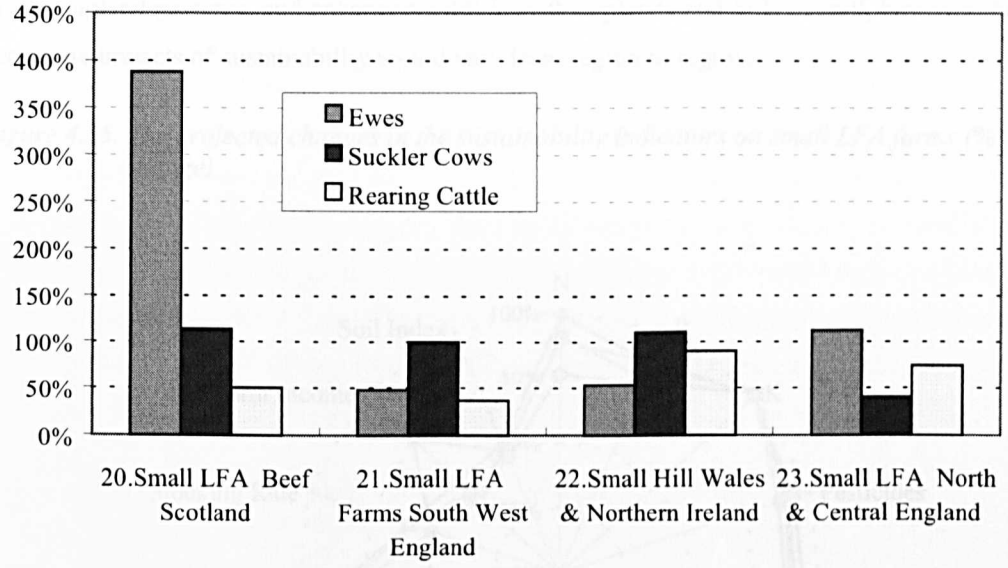


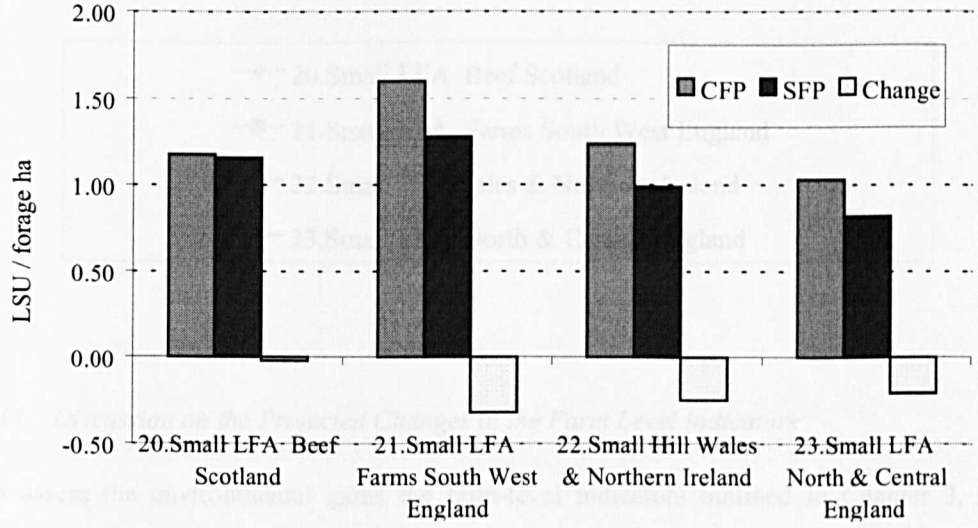
Figure 4.23 summarises the enterprise changes on these farms. There was a shift in the balance between sheep and cattle on these farms, with increases in suckler cows predicted for 3 out of the four farm clusters, and as for the large LFA farms benefits to wildlife and biodiversity could be expected from this shift towards the mixed grazing of sheep and cattle.

Figure 4.23. Enterprise changes on the small LFA farms (as % of the conventional scenario)



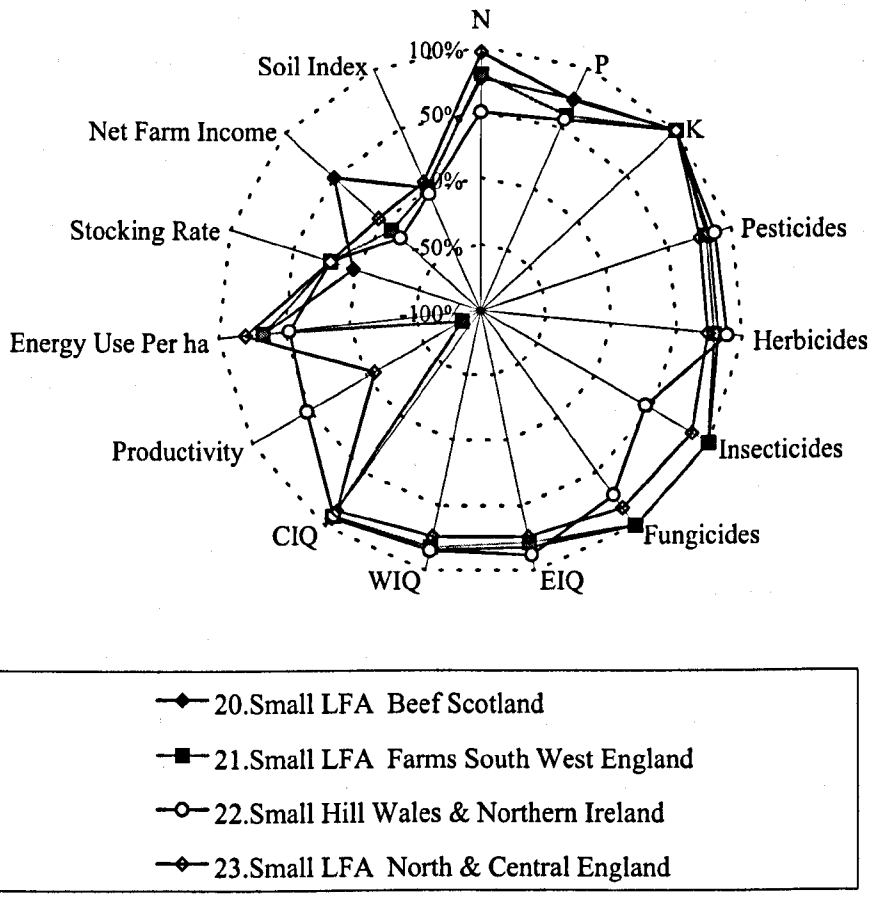
Overall stocking rates were reduced on all of the farms (see Figure 4.24), however only slightly on the cluster for hill beef farms in Scotland, due to a low stocking rate being selected in the conventional model.

Figure 4.24. The projected changes in stocking rates (LSU per forage ha) on small LFA farms



The environmental changes expected on these farms are shown in Figure 4.25. There would be big environmental improvements in terms of reductions is the use of fertiliser and pesticides, and their effects. As previously discussed the changes in stocking would also be expected to lead to important environmental improvements. Thus there would be more diverse upland pastures, and enhanced wildlife in the uplands and hills overall, however the economic impacts of sustainability would vary from region to region.

Figure 4.25. The projected changes in the sustainability indicators on small LFA farms (% change)



4.11. Discussion on the Projected Changes in the Farm Level Indicators

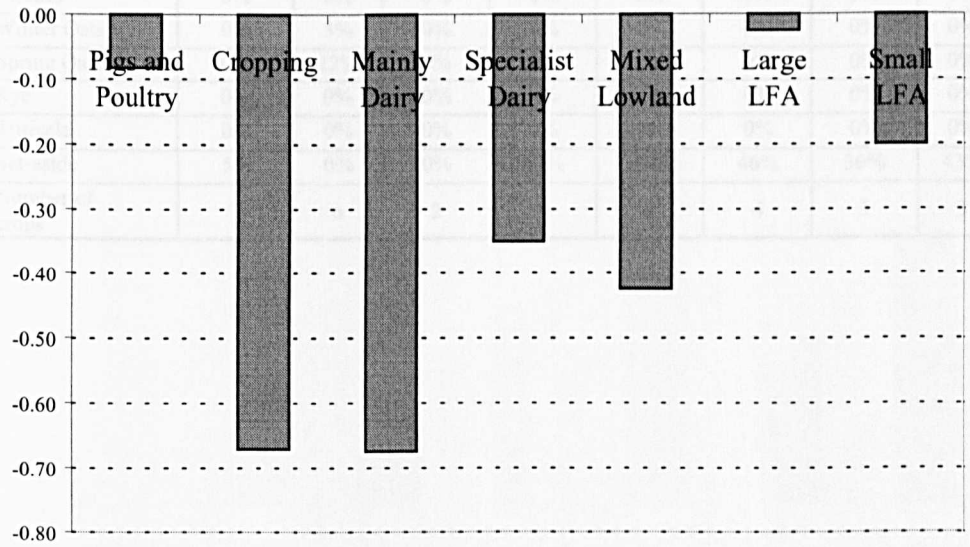
To assess the environmental gains the farm-level indicators outlined in Chapter 3, are presented as a check on whether the results of the sustainable farm models, meet the criteria and benchmarks for sustainability; as well as to give a regional picture of some of the environmental changes which would be expected from moving to sustainable farming

systems. Specifically attention is focussed on stocking rates, the number of crops in arable rotations, fertiliser use; pesticide use; the ecological effects of pesticides; and energy use for crop production.

4.11.1.1. Farm Stocking Rates (Indicator 1)

The models predict falls or no increase in stocking rates on most farm types (see Figure 4.26). Although in the sustainable farm models, the farms were constrained to a limit of 80% of that of current practice, other factors such as increased labour and fixed costs per animal would influence the stocking rate, and lead to further reductions beyond the 80% criteria set for sustainability. The biggest absolute falls in stocking rates were predicted to be on the cropping farms, and on the mainly dairy farms. These farms would be starting from the point of having fairly intensive grazing activities, and would have to become more extensive, as a result of moving to sustainability. Reductions in grazing intensity on these farm types, would lead in general to important ecological changes in the lowlands of the UK.

Figure 4.26. Predicted farm level changes in stocking rates (LSU/forage ha)



4.11.1.2. Number of Crops in Arable Rotations (Indicator 2)

The diversity of crops, which improves the diversity of the ecological niches in each of the rotations were calculated from the model results, and are presented in Table 4.40. On farms in the South East of England, Scotland and Northern Ireland there would be a doubling of the number of crops in a rotation, leading to enhanced conditions for wildlife species.

On the other farm clusters however there would only be three. For sustainability there should be at least four crops in the rotation; that is no single crop should exceed 25% of the

cropping area. This is achieved on all of the farms, however some farms (clusters 5 and 7, covering the North of England and Wales) are predicted to move to grassland and Set-Aside, so many of the other crops which would not be considered main crops within the new rotation.

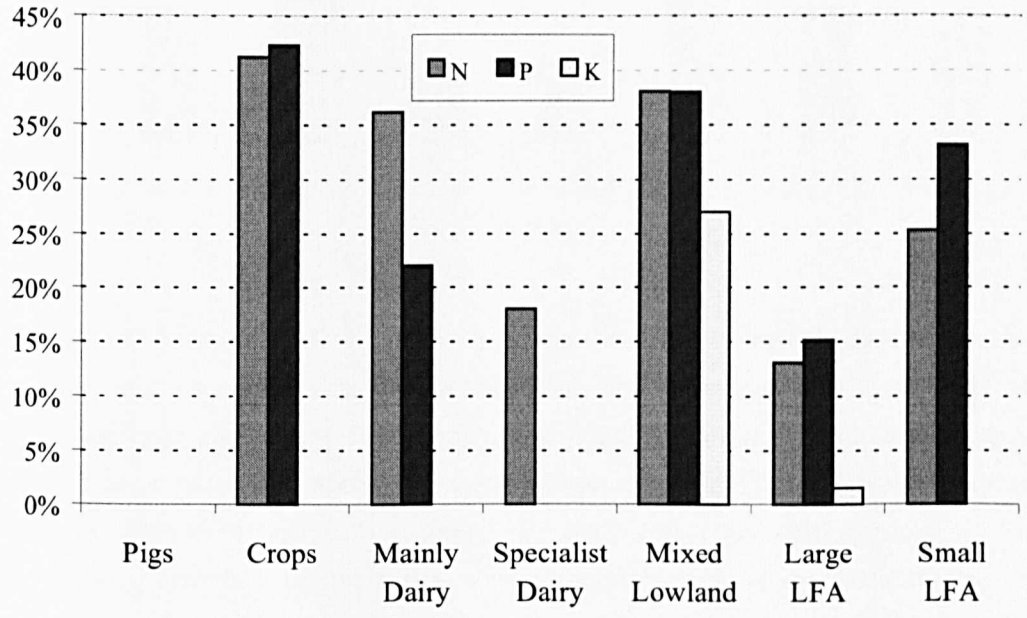
Table 4.40. The rotational changes predicted by the arable farm models

	4. Cropping SE England		5. Cropping Central and Northern England		6. Cropping NI Scotland and West		7. Small Cropping Farms Wales	
	Con	Sus	Con	Sus	Con	Sus	Con	Sus
Winter Wheat	58%	3%	38%	23%	35%	24%	34%	16%
Winter Barley	0%	11%	10%	0%	0%	0%	0%	0%
Spring Barley	0%	12%	0%	12%	0%	10%	2%	25%
W Oilseed R	0%	0%	6%	0%	0%	0%	0%	0%
S Oilseed R	0%	18%	0%	0%	0%	11%	0%	0%
Cabbage	10%	7%	2%	1%	9%	9%	8%	7%
Potatoes	0%	0%	0%	0%	0%	0%	2%	0%
Sugar Beet	0%	12%	0%	8%	0%	0%	0%	0%
Field Beans	27%	23%	45%	3%	10%	0%	18%	7%
Linseed	0%	0%	0%	0%	0%	0%	0%	0%
Vining Peas	0%	0%	0%	0%	0%	0%	0%	0%
Swedes	0%	0%	0%	0%	0%	0%	0%	1%
Winter Oats	0%	3%	0%	0%	0%	0%	0%	0%
Spring Oats	0%	12%	0%	0%	0%	0%	0%	0%
Rye	0%	0%	0%	0%	0%	0%	0%	0%
Triticale	0%	0%	0%	0%	0%	0%	0%	0%
Set-aside	5%	0%	0%	52%	46%	46%	36%	43%
Number of crops	3	6	2	3	2	4	3	3

4.11.1.3. Overall Farm Fertiliser Rates (Indicator 7)

The predicted changes in the use of nitrogen, phosphate and potash rates per hectare are presented in Figure 4.27. For the majority of farms nitrogen reductions were predicted to be well in excess of the target of 50% set in Chapter 3. The biggest reductions in nitrogen use was on the pig and poultry farms, which stopped using synthetic fertiliser altogether, substituting it for pig slurry, however pollution could still remain a risk on these farms if the proper slurry management guidelines are not carried out. Grassland farm types, such as the LFA farms, and the mainly dairy farms, would have on the whole bigger reductions than those farms, with a substantial arable enterprise, such as the mixed lowland Farms, and cropping farms. Despite this the projections for fertiliser are in excess of the conditions for sustainability (50% of current levels), and would lead to improvements in the environment in terms of a reduced pollution risk to water, and greater biodiversity on pasture land.

Figure 4.27. Farm level changes in NPK use (sustainable scenario as a % of the conventional scenario)

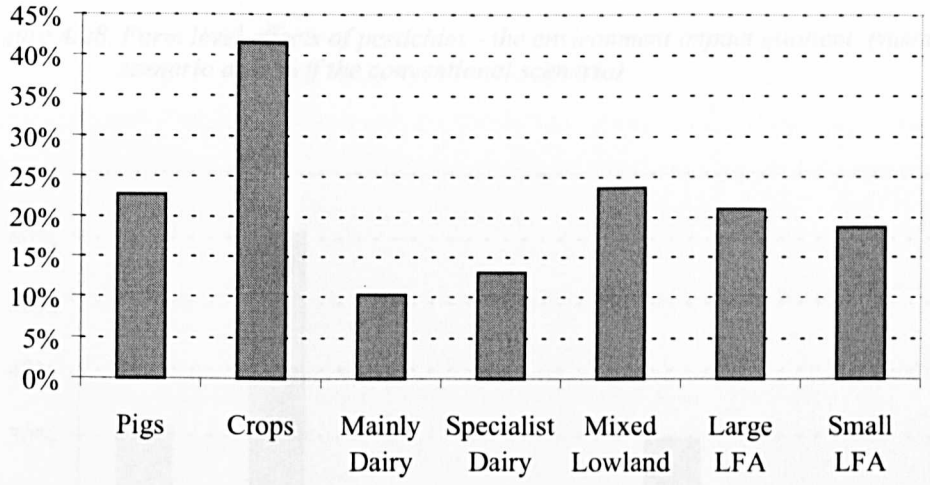


4.11.1.4. Pesticide use (Indicator 8)

The intensity of pesticide use is reported as the percentage of active ingredient per hectare used in the sustainable farm models, relative to the levels of use projected in the conventional models. Table 4.41 shows the average change in pesticide use for each farm group. The biggest reductions in pesticide use were projected for dairy farms, followed by stock farms; mixed farms and crop farms. As for fertilisers, on crop farms; where the biggest

problems are caused by pesticides the projections fall slightly below the limits set for sustainability.

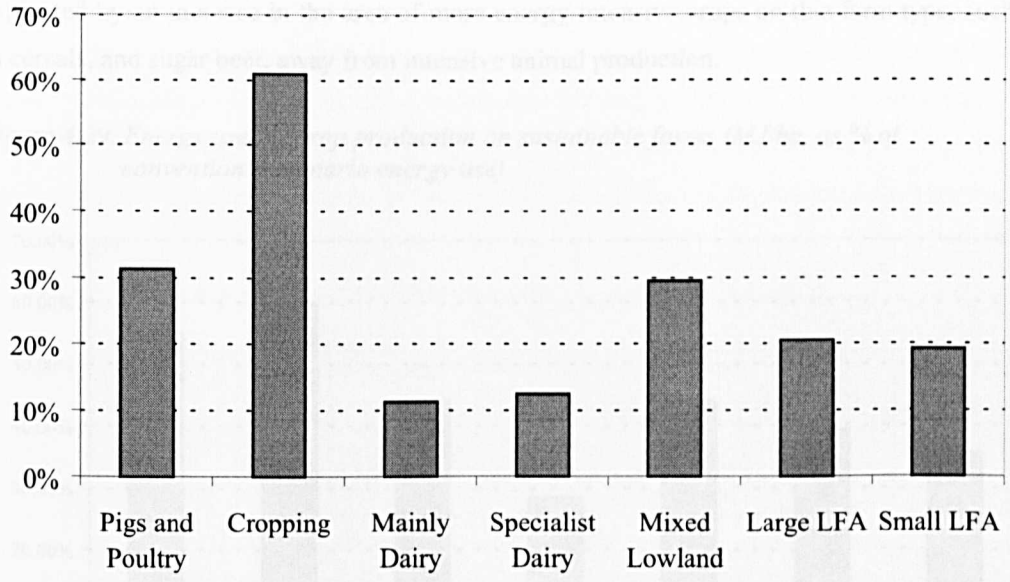
Table 4.41. Changes in farm level pesticide use (sustainable scenario as % of the conventional scenario)



4.11.1.5. Ecological Effects of Pesticides (Indicator 9)

The predicted impacts of the changes in pesticide use are presented in 0. This shows that in all cases the ecological impact of the use of pesticides was reduced less than 60% of the level under the conventional scenario.

Figure 4.28. Farm level effects of pesticides - the environment impact quotient (sustainable scenario as a % if the conventional scenario)

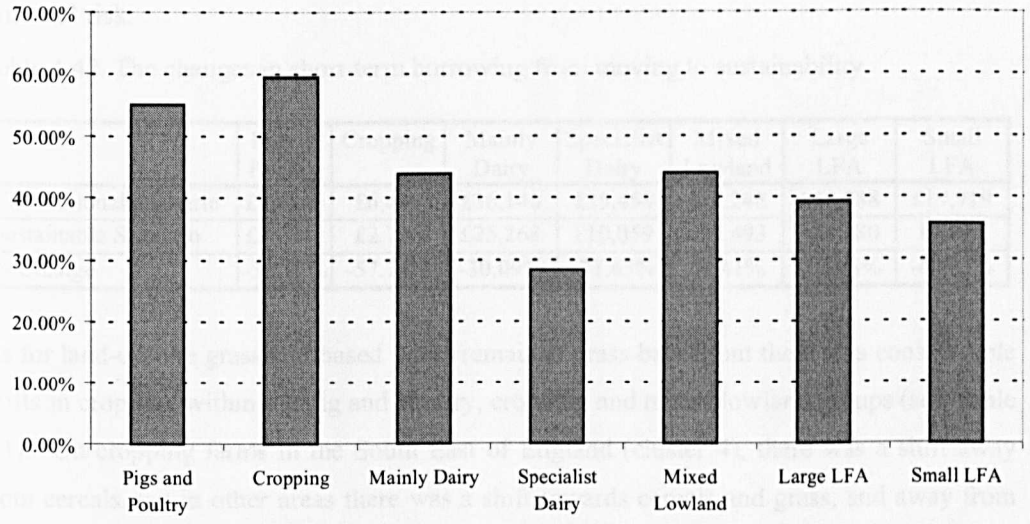


On many of the farm types, the projected reductions in the impact of pesticides on the environment as measured by the Kovach index was not as great as the total reduction in the use of pesticides, e.g. on crop farms pesticide use fell to 42% of the conventional scenario, however the impact of pesticides on the environment only fell to 61%. This suggests that there are disproportionate cuts in those pesticides which are least harmful to the environment. Therefore careful selection of chemicals would be crucial in moving to sustainable crop farming, if the full ecological benefits of reducing pesticide use is to be realised.

4.11.1.6. Farm level changes in Energy Use for Crop Production (Indicator 18)

Figure 4.29 shows the estimated changes in energy use on the farms, in MJ/ha. These were calculated from the cropping patterns predicted from the models, and the energy co-efficients from Bonny (1993). As regards energy use the criteria for sustainability set was that energy use should be reduced by 15%, as was achieved in the LIFE experiment. As the figure illustrates on the majority of farms this was achieved, however there was one exception, namely cluster 2 (pigs and poultry in the South, Wales and Northern Ireland). This may be explained by an increase in the area of more energy intensive crops on this farm type, such as cereals, and sugar beet, away from intensive animal production.

Figure 4.29. Energy use for crop production on sustainable farms (MJ/ha, as % of conventional scenario energy use)



4.12. Discussion on the Farm Level Impacts

The biggest fall in net farm incomes is projected on the pig and poultry farms, followed by the dairy farms. Cropping and LFA farms would in general suffer small falls in incomes, whilst Mixed lowland farms would gain. This would be expected since dairy and pig farms would be required to make the greatest changes in their management, in order to meet the conditions for sustainability. While the less intensive more grassland-based farms would need to cut back fertiliser and other inputs and make more use of legumes, these changes would entail a smaller loss in production, and less radical changes to the infrastructure of the farms. The results from the crop farms, suggest a strong degree of regional variation, but

show that in some circumstances ICM systems, can be more profitable than conventional farming.

The sustainable models also predicted a reduction in borrowing (Indicator 21) by most farm types, as shown in Table 4.42. The exception to this was the mixed lowland farm group. Sustainable systems would require less working capital, but the falls in income would mean that farmers would have less money to reinvest in their business on a year-to-year basis anyway. The biggest reductions in borrowing occurred on the cropping farms, and the LFA farms. On some of the crop farms where land was predicted to go into set-aside this would greatly reduce the working capital requirement. On the LFA farms and dairy farms, extensification would also lead to a substantially lower working capital requirement. These projections for borrowing would have long term implications for agricultural debt, which would be expected to decline under a sustainable farming scenario. Thus the liabilities of these farms would decline thus having a positive effect on net worth, (Indicator 22.) and as put forward by Beohlje (1994), an improvement in the ability of the business to cope with financial risk.

Table 4.42. The changes in short-term borrowing from moving to sustainability

	Pigs & Poultry	Cropping	Mainly Dairy	Specialist Dairy	Mixed Lowland	Large LFA	Small LFA
Conventional Scenario	£93,843	£6,449	£36,146	£35,458	£17,248	£49,788	£19,919
Sustainable Scenario	£58,042	£2,726	£25,268	£10,059	£22,493	£18,880	£7,842
% Change	-38.15%	-57.74%	-30.09%	-71.63%	30.41%	-62.08%	-60.63%

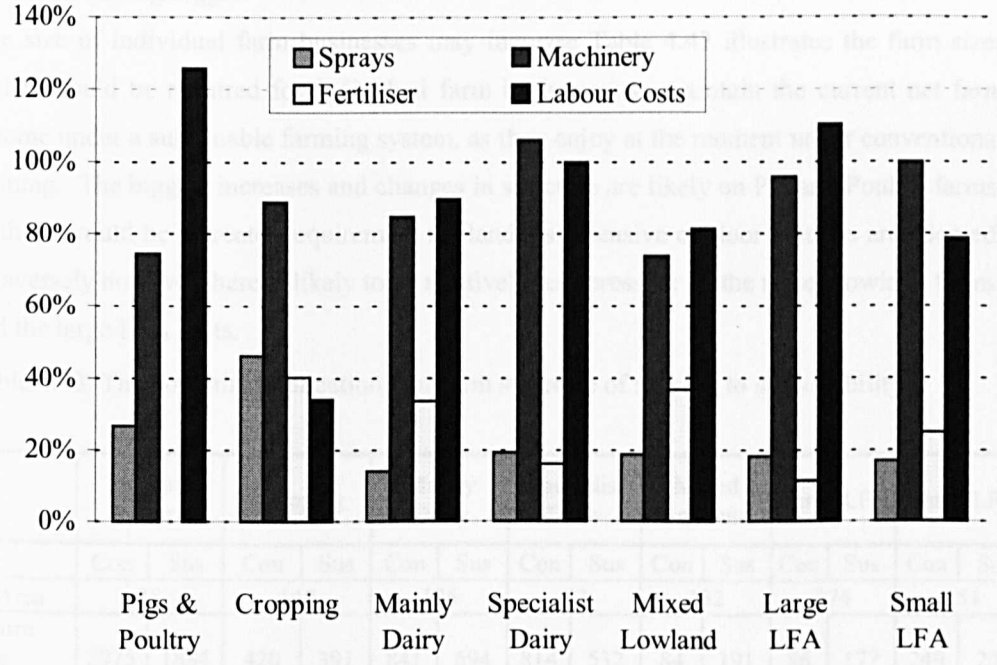
As for land-use the grassland-based farms remained grass-based, but there was considerable shifts in cropping within the pig and poultry, cropping and mixed lowland groups (see Table 2.1). On cropping farms in the South East of England (cluster 4), there was a shift away from cereals, yet in other areas there was a shift towards cereals and grass, and away from other crops. On all these farms there was a shift towards more diverse cropping systems, due to the rotational constraints of sustainability.

On all farms stocking rates were predicted to fall, actual stock numbers fell also in most cases with the exception of rearing cattle on mixed lowland, and the larger LFA farms, ewes on the larger LFA farms, and suckler cows on the smaller LFA farms. Thus in the LFAs there is predicted to be a shift towards cattle on the smaller farms, with increases in sheep numbers on the larger farms with less productive pastures, and greater land resources.

Figure 4.30 summarises changes in spray, machinery, fertiliser and labour costs on each of the farm types. Spray costs fell on all farm types, however less so on cropping and pig and poultry farms, where different crops were included in rotations, and there were assumed to be changes associated in the types of chemicals used, including the use of more expensive (though less environmentally damaging) sprays used with these activities.

In contrast, in the case of machinery costs the picture is more complex they were projected to increase to nearly 120% of the conventional cost, on the small LFA farms, and also slightly on the specialist dairy farms. One possible explanation for this is the small predicted increase in fodder crops and cereals on these farms (see section 4.10.), which would have a proportionately large impact upon the machinery costs of a largely grassland farm. Whilst on these other farm types the machinery costs fell. The biggest falls occurred on the cropping and pig and poultry farms, where the farm systems changed towards more grassland, and less machinery intensive cereals and other crops. However within the cropping group, those farms in the South East of England were projected to increase machinery expenditure, due to more break crops being included in the rotation.

Figure 4.30. Changes in selected farm costs (sustainable farm costs as % of conventional costs)



Labour costs were predicted to increase on the pigs and poultry and the large LFA farms. Thus it would be expected that this would lead to an overall increase in employment opportunities in these sectors, whilst employment in the arable sector would be expected to fall dramatically. Spray and fertiliser costs would fall by a large amount on all farms. These inputs require fossil fuels to produce, and as such their prices are directly related to the prices of oil and natural gas; which can be volatile. Thus by moving to sustainability, some of the price risks associated with farm inputs are lessened.

Sustainable farming is likely to be associated with significant restructuring of the industry. Most definitions of sustainable agriculture do not necessarily imply that farming would

support more or less people, but that it provides a realistic livelihood for those engaged in it. The models assume fixed farm sizes and business structures, however in the long term sustainable farming may lead to structural changes in terms of increased farm size, a reduction in costs, and the pooling of machinery and equipment between farms in to cut overheads. The results of the LP models tended to indicate that the least intensive farms and the larger farms within each group were the least affected financially. Therefore over time it would be expected that this would accelerate the trend towards bigger farms. This may seem at odds with some ideas relating to sustainable agriculture, in that small farms are seen as more beneficial to the environment. However the larger farms are better able to overhead costs, and this would make them better able to adapt to sustainability. Certainly the total income from farming is predicted to fall slightly as a result of moving to sustainability, and this is likely to lead to a continuation of the long term trend of people leaving the industry, and farms getting bigger.

The size of individual farm businesses may increase Table 4.43 illustrates the farm sizes which would be required for individual farm businesses to maintain the current net farm income under a sustainable farming system, as they enjoy at the moment under conventional farming. The biggest increases and changes in structure are likely on Pig and Poultry farms, as there would be a greater requirement for land, as extensive outdoor systems are adopted. Conversely however there is likely to be relatively less pressure on the mixed lowland farms, and the large LFA units.

Table 4.43. The potential implications for farm structure of moving to sustainability

	Pigs and Poultry		Cropping		Mainly Dairy		Specialist Dairy		Mixed Lowland		Large LFA		Small LFA	
	Con	Sus	Con	Sus	Con	Sus	Con	Sus	Con	Sus	Con	Sus	Con	Sus
Land Area	38		140		126		77		132		874		151	
Net Farm Income (£/ha)	2975	1884	420	391	841	694	814	532	84	191	86	177	249	200
Total Income (£'000)	£114	£72	£59	£55	£106	£87	£62	£41	£11	£25	£75	£154	£38	£30
Equivalent Area (ha)		61		150		153		117		58		425		188
		158%		107%		121%		153%		44%		49%		124%

The predicted decrease in net farm income and labour requirements could also lead to the prevalence of more part-time systems of farming. In practical terms however a part time system in which the farmer is engaged in alternative employment would have to be relatively simple, with only one or two main enterprises and those which would not make demands on time incompatible with another job. Thus, livestock enterprises may be difficult in these circumstances. Sustainable farms will have a more diverse range of enterprises, with more

complex systems, and this diversity may be problematical. A more likely possibility for many farmers is the development of land-based alternative enterprises such as forestry and tourism, which could have the added benefit in enhancing the farm environment.

Overall, the results from the farm-level models show that there was considerable variation within the groups and between representative farms for different parts of the UK, in terms of the changes expected from a move to sustainable farming systems. Thus, moving to sustainability would mean considerable regional variations in effects, particularly in net farm income, and in the regional outputs of agricultural commodities. The economic effects from the wholesale adoption of sustainable farming systems would therefore be expected to show significant regional variations, with consequences for the structure of the wider rural economy. In the next chapter these representative farm models provide the basis for estimating the regional and national shifts in output arising from a wholesale move to sustainable systems, and from which the further economic consequences for wider rural employment at the regional level are projected.

Chapter 5. The Regional and National Impacts of Moving to Sustainability

5.1. Aggregating the Results to the Regional and National Levels

The models developed in the last chapter provide predictions of the impact of moving to sustainability at the farm level. As discussed in section 4.10. there were notable regional differences within the farm sectors. In order to obtain estimates of the differences in regional impacts, the representative farm models were aggregated. Data on the number and size of each representative farm type were obtained from the MAFF[1] Annual Census (MAFF 1998), along with the FBS data from which the farm cluster data were taken. Table 5.1. presents the data on farm holdings and area for each region. By multiplying the farm numbers with the cropping and stocking plans from the appropriate representative farm model, the regional and national economic impacts were estimated. Table 5.2 illustrates as an example how the cereal area for Wales was calculated. The proportions of cereals on each of the representative farm types was multiplied by the average farm size, which was calculated from the census data, and by the number of farms. Thus dairy farms for example, would have 10.39% of their area down to cereals, with an average size of 62.41 ha there would be an average of 6.49ha per farm. Multiplied by the number of dairy farms in Wales (3,809), this would mean a total of 24,710 ha of cereals this farm type. The cereal area on each of the farm types was then totalled to give a overall figure of 128,838 ha, or 8.76% of the total land area.

[1] Now carried out by DEFRA

Table 5.1. Representative Farm Type Numbers By Region .

	Pig & Poultry	Cropping Farms	Mainly Dairy	Specialist Dairy	Mixed Lowland	Lowland C. and S.	Large LFA	Small LFA
Northern England								
No.	183	973		1751		4052	199	3432
Mean ha	17	149		79		55	540	109
Yorkshire & Humberside								
No.	855	4866	728	804		6131		2661
Mean ha	17	116	64	71		38		77
North West								
No.	454	1139	923	1607		3233		3001
Mean ha	11	58	79	52		21		44
East Midlands								
No.	505	6100	1274		3794	2533		718
Mean ha	14	135	66		45	42		42
Eastern England								
No.	1019	9132	239		3955	1367		
Mean ha	13	134	58		40	30		
South East								
No.	718	3992	888			11438		
Mean ha	18	152	89			40		
South West								
No.	2615	12095	2110	6752	18206	15091	62	4478
Mean ha	17	116	104	63	41	43	458	62
West Midlands								
No.	575	3138	2531	0	5568	6108	0	0
Mean ha	15	105	65	0	42	33	0	0
Scotland NW								
No.	89	603	76		2535	405	324	5111
Mean ha	21	77	118		215	67	1154	158
Scotland NE								
No.	197	3418	112		3671	148	119	1868
Mean ha	74	104	103		83	86	1483	203
Scotland SE								
No.	95	1381	88		1350	75	60	944
Mean ha	20	145	107		64	91	1574	216
Scotland SW								
No.	147	483	1607		3079	318	254	4005
Mean ha	19	83	106		62	79	1357	186
Wales								
No.	452	470	3809		6225	3541	578	12545
Mean ha	13	68	62		24	39	189	64
Northern Ireland								
No.	940	880	5121		2536	4942		13143
Mean ha	8	37	51		27	25		32

(From MAFF 1998).

Table 5.2. An example regional area calculation – cereals in Wales

Equivalent Farm Cluster	Census Type	Number of farms from Census 1998 (a)	Average size of farm from Census 1998 (b)	Proportion of cereals on farm From Model Results (c)	Cereals per farm (ha) (d= b x c)	(e = a x d)	Cereals as a % of Total land area
2. Pigs and Poultry Southern England and Wales	Pigs	452	13.45	44.64%	6.01	2,715	
7. Small Cropping Farms Wales	Cropping	470	68.03	32.09%	21.83	10,261	
8.Mainly Dairy Wales and Northern Ireland	Dairy	3809	62.41	10.39%	6.49	24,710	
15. Mixed Lowland	Lowland	6225	24.24	26.57%	6.44	40,091	
15. Mixed Lowland	Mixed	3541	38.65	26.57%	10.27	36,363	
17.Large Hill Sheep Wales & Northern Ireland	LFA	578	188.74	0.13%	0.25	142	
22.Small Hill Wales & Northern Ireland	LFA	12545	63.58	1.83%	1.16	14,557	
		Total land area [1]	1,470,104		Total cereals area	128,838	8.76%

[1] Sum of the product of columns a and b

Table 5.3 shows a summary of the regional cropping patterns by the percentage of the total area accounted for by each crop grown, along with the figures from the 1998 census data. The models predictions clearly show the broad regional cropping variations found within the UK. Notably Western and Northern regions have a far higher proportion of grassland, with more arable cropping located on the Eastern side of the country. Thus, the aggregate model predicted that under the conventional farming in Wales 86% of farmland was under grassland, compared with 95% in reality, and 32% of the East Midlands was projected to be under grassland, compared with 43% in reality. The models did tend to overestimate the area of other arable crops and projected an area of 13% for the whole of the UK down to these, rather than the observed figure of 9%. However, the overall land use figures from the aggregate model are sufficiently close enough to the census data, to say that the base line models were an accurate representation of conventional farming practice, and the current farming situation in the year 1997/98.

Table 5.3. Summary of regional cropping from base line solution - crop Year 1997/98

	Cereal Area		Grass Area		Fodder		Other Crops	
	Predicted % 97/98	Actual % 97/98	Predicted % 97/98	Actual % 97/98	Predicted % 97/98	Actual % 97/98	Predicted % 97/98	Actual % 97/98
Northern England	13%	13%	77%	83%	2%	0%	7%	4%
Yorkshire & Humberside	25%	37%	53%	47%	1%	1%	21%	15%
North West England	21%	13%	70%	81%	2%	2%	7%	5%
East Midlands	32%	43%	39%	33%	1%	1%	29%	23%
Eastern England	40%	51%	30%	20%	0%	1%	29%	28%
South East England	33%	34%	45%	47%	1%	2%	22%	18%
South West England	23%	20%	59%	69%	1%	3%	17%	8%
West Midlands	29%	28%	42%	57%	1%	2%	27%	13%
Scotland North West	11%	2%	83%	97%	1%	0%	5%	1%
Scotland North East	19%	23%	60%	68%	1%	1%	20%	8%
Scotland South West	7%	3%	88%	96%	1%	0%	4%	0%
Scotland South East	17%	24%	60%	69%	1%	1%	23%	6%
Northern Ireland	11%	4%	83%	95%	2%	0%	4%	1%
Wales	9%	3%	86%	95%	2%	1%	3%	1%
UK	20%	21%	63%	69%	1%	1%	15%	9%

Table 5.4 presents the aggregate livestock numbers estimated by the conventional farm models for 1997/98, along with the actual figures from the census data in that year. Absolute numbers were too high for dairy cows, suckler cows and sheep, yet were underestimated for breeding pigs. Nevertheless the models do predict a clear pattern of beef and sheep enterprises being concentrated in the North and West, with suckler cows, along with breeding sheep. However the numbers of both sheep and suckler cows were overestimated. The breeding pig numbers projected did not fit with the census data as well, since breeding pig numbers were underestimated in three key areas for pig production within the UK namely Yorkshire and Humberside, the East of England and the South West of England.

Table 5.4. Summary of breeding livestock numbers by region from base line LP model

	Dairy Cows		Suckler Cows		Breeding Sheep		Breeding Pigs	
	Model	Actual	Model	Actual	Model	Actual	Model	Actual
Northern England	306,873	155,544	193,950	159,277	1,595,506	2,343,121	16,320	12,197
Yorkshire & Humberside	192,407	140,676	136,508	99,918	662,159	1,222,163	78,274	185,086
North West England	114,386	222,738	61,218	38,588	375,501	517,306	36,759	23,789
East Midlands	100,820	124,591	95,759	79,548	363,728	724,377	52,753	63,064
Eastern England	49,167	44,761	62,985	48,091	1,545,293	220,772	64,560	149,690
South East England	144,886	134,881	145,868	85,500	1,147,176	809,649	64,089	65,053
South West England	798,911	581,162	262,609	211,090	904,918	1,990,918	84,247	85,678
West Midlands	176,272	238,283	136,882	102,749	454,939	1,334,028	64,790	36,834
Scotland North West	86,393	7,951	681,509	93,381	2,321,755	893,532	10,062	5,537
Scotland North East	53,099	18,721	335,480	102,985	1,119,830	281,426	76,879	41,123
Scotland South West	163,021	167,659	528,557	208,944	1,948,279	1,544,748	14,672	3,506
Scotland South East	20,333	15,068	155,598	83,391	554,022	694,108	9,834	13,774
Northern Ireland	383,485	287,661	158,286	344,704	1,823,990	1,449,824	41,957	66,929
Wales	362,240	276,523	278,345	224,543	3,809,126	5,667,989	29,480	9,979
UK	2,952,293	2,416,219	3,233,555	1,882,709	18,626,223	19,693,961	644,677	762,239

Table 5.5 presents the projections for rearing stock. Rearing stock numbers were not projected by the models as well as breeding stock numbers, with an overestimate in cattle numbers, and an underestimate for rearing pigs.

Table 5.5. Summary of rearing livestock numbers by region from base line LP model

	Rearing Cattle		Rearing Lambs		Rearing Pigs	
	Model	Actual	Model	Actual	Model	Actual
Northern England	514,424	514,807	832,187	2,841,697	29,133	106,850
Yorkshire & Humberside	659,260	405,540	1,165,000	1,492,452	139,726	1,857,970
North West England	290,656	313,707	262,604	624,443	212,533	243,471
East Midlands	812,913	372,406	1,113,150	912,308	305,012	590,377
Eastern England	936,232	163,711	2,677,415	227,718	381,665	1,561,567
South East England	896,929	347,558	2,150,951	936,763	378,885	539,888
South West England	1,205,465	1,177,406	2,520,427	2,107,427	498,053	779,828
West Midlands	588,270	514,347	983,253	1,561,234	374,604	389,213
Scotland North West	1,160,812	161,655	1,914,938	1,201,185	17,961	26,239
Scotland North East	627,484	265,716	1,105,799	469,565	137,237	341,115
Scotland South West	976,306	638,069	724,909	2,421,915	26,192	35,297
Scotland South East	263,834	170,435	317,830	1,176,334	17,555	111,146
Northern Ireland	623,707	1,134,978	659,673	1,536,788	74,898	586,464
Wales	985,231	808,552	958,126	5,751,615	79,089	80,804
UK	10,541,522	6,988,887	17,386,262	23,261,444	2,672,544	7,250,229

Some features of the UK livestock industry, such as the stratification[1] of the sheep flock; resulting in a trade in replacements between upland and lowland areas, would not be represented by the models, as the individual farm models do not trade with each other. This could possibly explain some of the discrepancies, certainly as the models put no limit on

[1] Crossbred lambs from upland and hill flocks are finished in lowland areas.

buying in rearing stock; however in reality this would be influenced by the availability of store animals from other farms. However the overestimation of breeding animal numbers compensates for this to some extent. However, the aim of the models are to estimate the changes in total output by commodity, and this is not regarded as a serious problem. As with the farm level models, however the main points of interest are the proportional changes in the system, and the differences between regions and commodities, rather than the absolute changes in values.

5.2. The Models Prediction of Historical Trends

The observed changes in the census data from 1991/92 to 1997/1998 were compared with the changes predicted by the aggregate conventional models (see Table 5.6). The models overestimated a fall in the area of cereal production (predicting 8.2% rather than 1.2%), and an increase in the area of other non-cereal crops predicting an 85% increase rather than a 35% increase. This mirrors the projections of the farm models, in overestimating the amount of changes in cropping as a response to arable aid payments. In both years the models underestimated the area of grassland within the UK, and overestimated the area of other crops. The models did not correctly predict a trend of a rise in the area of fodder crops, however given that fodder crops make up a relatively small area of the total agricultural land of the UK, this is not considered a serious problem.

As for breeding livestock, the models underestimated the fall in the national dairy herd, projecting (-1.2% compared with -8.2%) whilst overestimated an increase in suckler cow numbers projecting 65.2% compared with 13.6% (see Table 5.7). Changes in breeding ewe numbers were underestimated projecting a fall of 2.4% compared with 4.5% in reality, whilst a fall in breeding pig numbers were overestimated.

Whilst overall the models did not correctly predict a decrease in the number of rearing lambs, this was however due to a disproportionate increase in rearing lambs predicted for the East of England. However increases in rearing lambs throughout Scotland were correctly predicted, whilst decreases in some English regions were also correctly projected. Therefore the models seem to be able to pick up some regional trends. Decreases in rearing cattle numbers were overestimated (-35%) compared with (-4%) in reality, whilst an observed increase in rearing pig numbers was overestimated, projecting 27% rather than 18%.

Table 5.6. Changes in regional agricultural production observed in the census data 1992-1998 and predicted by the conventional models for 1991/92 and 1997/98

Cropping Areas	Cereals		Grass		Fodder		Other Crops	
	Predicted % Change 92-98	Actual % Change 92-98	Predicted % Change 92-98	Actual % Change 92-98	Predicted % Change 92-98	Actual % Change 92-98	Predicted % Change 92-98	Actual % Change 92-98
Northern England	-2.8%	-6.8%	-3.6%	-3.0%	-28.0%	-61.1%	114.9%	36.0%
Yorkshire & Humberside	-24.1%	-2.9%	-1.3%	-4.6%	-39.5%	3.0%	86.6%	22.0%
North West England	68.5%	-1.2%	-11.6%	-7.0%	-60.2%	61.0%	72.4%	20.6%
East Midlands	-30.5%	1.6%	2.8%	-5.3%	-0.5%	17.5%	81.4%	42.9%
Eastern England	-25.2%	-3.5%	66.7%	-12.1%	-31.5%	54.2%	5.8%	18.9%
South East England	-25.2%	-2.1%	22.3%	-14.4%	-31.5%	68.5%	16.6%	15.4%
South West England	25.6%	1.9%	-19.5%	-8.9%	-51.4%	45.2%	203.1%	92.8%
West Midlands	-2.8%	-0.9%	-26.5%	-8.7%	-38.6%	59.1%	158.6%	33.3%
Scotland North West	26.8%	6.5%	-5.0%	-3.6%	-59.3%	-20.8%	431.1%	129.5%
Scotland North East	3.0%	9.2%	-17.6%	-3.4%	-58.3%	-34.7%	210.2%	75.3%
Scotland South West	44.3%	-4.9%	-4.3%	-3.0%	-65.3%	-3.1%	431.1%	213.6%
Scotland South East	-3.4%	-2.0%	-18.8%	-3.1%	-62.3%	-23.2%	212.8%	33.5%
Northern Ireland	78.4%	-2.5%	-5.1%	5.6%	-65.5%	-46.5%	214.4%	-29.7%
Wales	50.4%	-5.9%	-2.7%	-1.8%	-55.0%	34.9%	193.3%	130.2%
UK	-8.3%	-1.2%	-5.8%	-4.4%	-51.9%	23.0%	85.8%	31.8%

Table 5.7. Changes in regional breeding livestock numbers observed in the census data 1992-1998 and predicted by the conventional models for 1991/92 and 1997/98

Livestock Numbers	Dairy Cows		Suckler Cows		Breeding Ewes		Breeding Pigs	
	Predicted % Change 92-98	Actual % Change 92-98	Predicted % Change 92-98	Actual % Change 92-98	Predicted % Change 92-98	Actual % Change 92-98	Predicted % Change 92-98	Actual % Change 92-98
Northern England	3.8%	-7.8%	47.6%	3.9%	3.5%	4.3%	-23.5%	-21.7%
Yorkshire & Humberside	10.1%	-9.6%	84.3%	16.9%	-21.0%	1.8%	-23.5%	-0.2%
North West England	-48.4%	-9.7%	97.2%	14.3%	-20.3%	2.1%	37.1%	-17.2%
East Midlands	-23.6%	0.0%	170.3%	0.0%	20.0%	0.0%	37.1%	0.0%
Eastern England	23.1%	-23.6%	176.2%	7.6%	916.9%	-3.2%	1.6%	-5.7%
South East England	-12.0%	-19.5%	176.2%	20.2%	226.0%	-6.1%	1.6%	-6.1%
South West England	-8.8%	-11.0%	69.9%	19.0%	-32.1%	-31.0%	1.6%	-6.5%
West Midlands	-29.0%	-11.2%	176.2%	18.0%	37.8%	1.1%	37.1%	-13.7%
Scotland North West	40.1%	-12.1%	49.3%	-1.1%	-25.5%	-19.2%	-23.5%	163.4%
Scotland North East	36.9%	-19.9%	49.8%	8.1%	-25.6%	-22.9%	-23.5%	35.6%
Scotland South West	17.6%	-5.5%	47.4%	10.7%	-25.5%	-20.0%	-23.5%	3.0%
Scotland South East	30.6%	-7.4%	48.3%	9.3%	-25.5%	-18.3%	-23.5%	35.7%
Northern Ireland	28.1%	6.8%	89.2%	30.8%	-8.5%	18.3%	-23.5%	13.7%
Wales	28.7%	-9.8%	56.6%	8.6%	0.6%	7.7%	1.6%	-16.1%
UK	-1.2%	-8.6%	65.2%	13.6%	-2.4%	-4.9%	-4.5%	-1.3%

The aggregate predictions of the models as for the farm level models, did tend to overestimate certain key trends over the period, but on the whole the aggregate results for the models were able to predict the broad changes in UK agriculture over this period. It is on this basis that they are accepted as being able to predict the production changes the regional

and national levels as a result of moving to sustainable farming systems across the country. This will in turn provide the basis for projected the wider economic effects of moving to sustainable farming systems, which is the ultimate objective for this thesis.

Table 5.8. Changes in regional rearing livestock numbers observed in the census data 1992-1998 and predicted by the conventional models for 1991/92 and 1997/98

Livestock Numbers	Rearing Cattle		Rearing Lambs		Rearing Pigs	
	Predicted % Change 92-98	Actual % Change 92-98	Predicted % Change 92-98	Actual % Change 92-98	Predicted % Change 92-98	Actual % Change 92-98
Northern England	-29%	-6%	-8%	1%	63%	-21%
Yorkshire & Humberside	-34%	-7%	-41%	-49%	63%	91%
North West England	-12%	-1%	-15%	0%	58%	-14%
East Midlands	-13%	-12%	-61%	-9%	58%	6%
Eastern England	-9%	-18%	301%	-20%	13%	7%
South East England	-14%	-16%	39%	-16%	13%	-1%
South West England	-39%	-7%	44%	61%	13%	-2%
West Midlands	-48%	-9%	-32%	-7%	58%	9%
Scotland North West	-42%	-3%	43%	23%	63%	78%
Scotland North East	-56%	-16%	29%	1%	63%	32%
Scotland South West	-40%	1%	39%	14%	63%	-14%
Scotland South East	-55%	-3%	37%	15%	63%	41%
Northern Ireland	-35%	11%	30%	9%	63%	11%
Wales	-31%	-1%	36%	-1%	-49%	-12%
UK	-35%	-4%	12%	-1%	27%	18%

5.3. The Regional and National Effects on Agricultural Production of Moving to Sustainable Farming Systems

Using the same procedure as for the conventional farm models in section 5.1. , the sustainable farm models were aggregated to estimate the regional production patterns after a widespread move to sustainable farm production systems. The following sections outline the predicted changes in agricultural output by region.

5.3.1. Regional changes in cropping

The changes in cropping and stock numbers projected are summarised in Table 5.9 and Table 5.10. The UK cereals area was predicted to decline by 1,572,000 ha or 46% of the existing area, whilst the area of other crops including Set-Aside would increase by 1,006,000 ha or by 40%, and the area of grassland would increase slightly by 2%. However there would be marked regional variations in the shifts in the grassland area, with big increases in the West Midlands (+22%) and the South West of England (+13%). However there would be a substantial decline in some of the more Eastern areas, such as the East Midlands (-19%) and the Eastern Counties of England (-50%). In these areas, there was a big increase in non-cereal crop production, as crop enterprises became more extensive their areas expanded at the expense of relatively less profitable livestock activities. Thus sustainability would lead to some specialisation with some regional farming systems concentrating on farming enterprises in which they have a relative competitive advantage. Despite the apparent contradiction of sustainability leading to more mixed farming systems, the expansion of the

arable farming area in the East would be of a more diverse range of crops, than is currently grown (see section 4.11.1.2). Proportionately the biggest falls in the cereal area were predicted to be in the West of Scotland (-85%) where cereal production was projected to become less viable, whilst in the East of Scotland the reductions were less marked. For most regions of England and Wales, the cereal area was predicted to fall by around 30-50%, due to the rotational requirements for sustainability. In other Western and Northern areas of England, the changes were not as great in absolute terms, but followed a similar pattern of a move away from cereals to other crops and grassland. Falls in the grassland area were predicted in the South West of England (-155,000 ha), since in this area cropping farms were predicted to increase production of non-cereal arable crops.

These results should be put into context of the models tendency to overestimate the historical changes (particularly the changes in the cereals and other crops areas), and that it is unlikely that the overall shifts will be as extreme as that predicted by the models, however the models do illustrate the regional pattern of changes in UK agriculture from moving to sustainability which would be expected.

Overall the projections do appear credible, as in the East there are shifts towards more non-cereal cropping, and in other lowland areas towards more grassland. Further to the West and North there was predicted to be less change in the actual cropping patterns, with most land remaining as grassland, and a decline in arable production.

Table 5.9. Summary of changes in regional cropping patterns after moving to sustainability (change '000ha and % change)

Change '000 ha	Cereal Area		Grass Area		Fodder Area		Other Crops	
	Actual Change (ha)	% Change	Actual Change (ha)	% Change	Actual Change (ha)	% Change	Actual Change (ha)	% Change
Northern England	-51.78	-40%	-3.86	-1%	17.02	88%	38.62	52%
Yorkshire & Humberside	-76.70	-27%	-68.34	-12%	19.11	127%	125.93	54%
North West England	-56.45	-63%	23.84	8%	12.57	183%	20.04	63%
East Midlands	-92.24	-24%	-92.57	-19%	21.57	196%	163.23	47%
Eastern England	-213.53	-36%	-219.52	-50%	20.16	557%	412.89	98%
South East England	-165.74	-44%	-71.42	-14%	47.48	566%	189.68	75%
South West England	-236.73	-58%	135.38	13%	52.29	218%	49.06	17%
West Midlands	-123.54	-46%	86.98	22%	39.30	380%	-2.74	-1%
Scotland North West	-166.98	-85%	117.82	8%	55.78	259%	-6.63	-8%
Scotland North East	-103.73	-44%	67.90	9%	30.21	257%	5.61	2%
Scotland South West	-88.94	-82%	70.05	5%	31.96	277%	-13.07	-22%
Scotland South East	-33.99	-33%	22.17	6%	10.99	267%	0.83	1%
Northern Ireland	-74.04	-71%	56.05	7%	9.22	58%	8.77	24%
Wales	-87.68	-68%	64.50	5%	11.66	40%	11.53	28%
UK	-1572.06	-46%	188.99	2%	379.32	197%	1003.75	40%

5.3.2. The Regional Changes in Livestock Farming arising from Sustainability

Table 5.10. Summarises the projected changes in livestock numbers throughout the UK. There is anticipated to be a reduction in numbers of livestock of all types across the country, with the exception of breeding sheep (+43%) along with a big increase in rearing lamb enterprises (+2043%). This projection is likely to be unrealistic since it would be checked

by the availability of store lambs from the uplands, however it is clear that sheep production would expand in many areas. This is likely to be due to the relative individual performance of sheep under white clover systems compared with cattle, in particular the growth rates of lambs post weaning (see Table 4.25). The biggest increases being in lowland areas, where farms have to resources to finish animals; and where arable farming would become less viable.

Suckler cow numbers would fall in all areas, however as discussed with the farm level projections suckler cow herds would expand on some LFA farms; thus suckler cow numbers would expand in LFA areas in Wales and Northern Ireland, and on the smaller but less marginal parts of the LFA area in Scotland, but suckler cow numbers overall would fall in all regions. In these areas cattle grazing and the associated environmental benefits would be delivered by sustainability. In other areas additional incentives to farmers may be desired to encourage cattle grazing.

The national dairy herd was projected to fall to under half the number of that under the conventional farming scenario, the number of breeding sows would fall by 18%, and the number of rearing pigs would fall by 23%. However there would be an increase in rearing pigs in some areas of the North of the UK, covering Scotland, Northern Ireland, Northern England and Yorkshire.

These projections on livestock numbers would have implications in many areas, as discussed reduced grazing pressure would lead to improved biodiversity. On a national level the reductions in ruminant livestock, and that of intensive dairy cattle in particular would help to reduce emissions of greenhouse gases such as ammonia and methane.

Table 5.10. Changes in regional stocking after moving to sustainability (change '000 head)

	Dairy Cows		Suckler Cows		Breeding Sheep		Rearing Cattle		Lambs		Breeding Pigs		Rearing Pigs	
Northern England	-165.63	-54%	-136.05	-70%	782.99	49%	-101.87	-20%	692.85	4245%	-1.29	-8%	28.57	98%
Yorkshire & Humberside	-126.75	-66%	-77.12	-56%	580.63	88%	-247.27	-38%	1970.92	2518%	-6.18	-8%	137.05	98%
North West England	-15.54	-14%	-39.85	-65%	362.37	97%	-76.64	-26%	374.85	1020%	-6.32	-17%	-95.66	-45%
East Midlands	-79.58	-79%	-44.81	-47%	875.61	241%	-517.37	-64%	3550.66	6731%	-9.07	-17%	-137.29	-45%
Eastern England	-40.77	-83%	-9.89	-16%	-852.07	-55%	-753.88	-81%	-1270.16	-1967%	-19.45	-30%	-208.46	-55%
South East England	-97.07	-67%	-119.54	-82%	458.25	40%	-474.77	-53%	927.74	1448%	-19.30	-30%	-206.95	-55%
South West England	-448.03	-56%	-180.22	-69%	1538.09	170%	-1205.46	-100%	1198.47	1423%	-25.38	-30%	-272.04	-55%
West Midlands	-134.77	-76%	-127.92	-93%	1418.02	312%	-112.87	-19%	2000.89	3088%	-11.14	-17%	-168.62	-45%
Scotland North West	-78.18	-90%	-175.69	-26%	2180.03	94%	-250.19	-22%	752.74	7481%	-0.79	-8%	17.62	98%
Scotland North East	-42.50	-80%	-88.92	-27%	1099.11	98%	-136.53	-22%	534.24	695%	-6.07	-8%	134.61	98%
Scotland South West	-7.00	-4%	-62.67	-12%	1524.67	78%	-355.88	-36%	325.96	2222%	-1.16	-8%	25.69	98%
Scotland South East	-11.71	-58%	-23.04	-15%	470.80	85%	-77.52	-29%	692.85	7045%	-0.78	-8%	17.22	98%
Northern Ireland	-203.21	-53%	-28.03	-18%	-742.25	-41%	136.07	22%	692.85	1651%	-3.31	-8%	73.46	98%
Wales	-199.49	-55%	-5.99	-2%	-1681.01	-44%	95.21	10%	692.85	2350%	-8.88	-30%	-95.19	-55%
UK	-1650.18	-56%	-1119.74	-35%	8015.23	43%	-4078.98	-39%	13137.72	2038%	-119.12	-18%	-749.99	-27%

5.3.3. The reliability of the projections

The aggregate model results project the potential changes in agricultural production of a wholesale move to sustainable farming for the 14 regions of the UK. The predicted regional differences may be attributed to the following factors:

1. Farm type differences, which were identified in the previous chapter, for example differences in impacts upon pig and poultry farms, and dairy farms;
2. Regional farm differences, between those farms of the same farm type, but with different yields and structure;
3. Differences with the existing regional production patterns, which are reflected by the farm type census data.

In general sustainability is widely expected to lead to a shift away from arable farming in many areas and to the adoption of more mixed farming practices. However in some areas there was a counter trend observed of increased specialisation in more extensive arable enterprises and Set-Aside. In terms of landscape the models suggest, as expected that the biggest changes in land cover type would be in the lowland regions of Britain, where the most radical changes in crop production would need to occur to satisfy the conditions for sustainability. Significantly it was in these areas of the country where the biggest intensification of agriculture took place after the Second World War and where pastoral farming was replaced by intensive arable cropping that there was a move back to grassland.

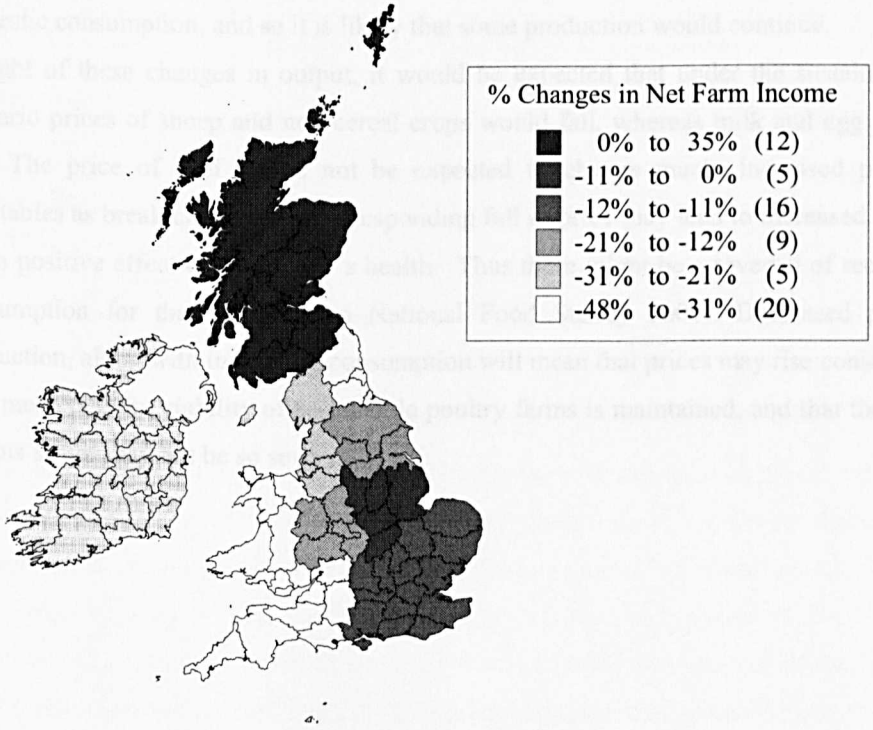
5.4. Changes in Net Farm Income from Moving to Sustainability

Net farm income for the UK was predicted to fall to 85% of that under the conventional scenario as indicated in Table 5.11, or by around £829 million. There were significant regional variations within this however. Figure 5.1 depicts the predicted regional changes in total net farm income in percentage terms after a wholesale move to sustainable farming. Net farm income would fall, in all areas of the UK apart from all parts of Scotland. The biggest losses however would occur in Wales and Northern Ireland where net farm income would fall to almost 57.72% and 52.61% of that in the conventional farming scenario. This is likely to arise because of the sharp decline in incomes predicted on the dairy and large LFA farms in Wales and Northern Ireland.

Table 5.11. The projected changes in total net farm income by region from moving to sustainability

	Conventional Farming Scenario	Sustainable Farming Scenario	% Sus/Con
Northern England	£295,230,002	£196,111,148	66.43%
Yorkshire & Humberside	£398,838,224	£315,644,486	79.14%
North West England	£130,192,515	£98,556,322	75.70%
East Midlands	£393,321,781	£359,740,666	91.46%
Eastern England	£907,963,969	£806,117,218	88.78%
South East England	£571,905,124	£504,504,179	88.21%
South West England	£818,766,127	£564,554,071	68.95%
West Midlands	£359,775,264	£314,823,342	87.51%
Scotland North West	£245,299,258	£329,563,699	134.35%
Scotland North East	£345,996,766	£368,993,543	106.65%
Scotland South West	£241,882,620	£301,435,738	124.62%
Scotland South East	£156,621,819	£178,985,676	114.28%
Northern Ireland	£322,543,428	£169,704,861	52.61%
Wales	£352,862,536	£203,685,742	57.72%
UK	£5,541,199,432	£4,712,420,692	85.04%

Figure 5.1. Summary of the % changes in total net farm income by region from moving to sustainability



5.5. The Estimated changes in Regional Agricultural Output from Moving to Sustainability

Associated with these changes in cropping patterns and income, were also changes in output, input purchases and employment and these ancillary changes are described in the next section.

5.5.1. Changes in Value of Output By Commodity

Table 5.12 shows the change in output in thousands of pounds by commodity, for each of the regions of the UK. The losses would occur in the dairy sector (-£2.3 billion), cereals (-£8 billion), pigs and poultry (-£0.4 billion) and beef (-£22 million). There would however be increased output of some arable crops e.g. oilseed rape (+£1.6billion), potatoes (+£37million and other crops (+£26million). There would also be increased output from sheep production (+£1billion).

This would undoubtedly lead to increased imports of some commodities, particularly cereals, pig and poultry products, and beef. Milk production was expected to fall to around two thirds of current levels, though it is doubtful that this could happen in reality, as imports not could make up the resulting deficit in UK consumers demand for fresh milk entirely, however the import of processed milk products could occur, with UK farmers specialising in the higher value fresh milk market. Nevertheless some output could be shifted from the processing sector to make up the shortfall, with cheese and butter being imported. Commercial egg production was predicted to disappear from the UK, but again it is also doubtful whether imports could make up all of domestic consumption, and so it is likely that some production would continue.

In light of these changes in output, it would be expected that under the sustainable farming scenario prices of sheep and non-cereal crops would fall, whereas milk and egg prices would rise. The price of beef would not be expected to change much. Increased production of vegetables as break crops, and a corresponding fall in price may lead to increased consumption and a positive effect on the nation's health. Thus there might be a reversal of recent trends in consumption for these foods (see National Food Survey 2001). Decreased poultry meat production, along with increasing consumption will mean that prices may rise considerably, and thus mean that the viability of sustainable poultry farms is maintained, and that the projections for this sector may not be so severe.

Table 5.12. National changes in output by commodity (change in £'000 and as a percentage of base line solution)

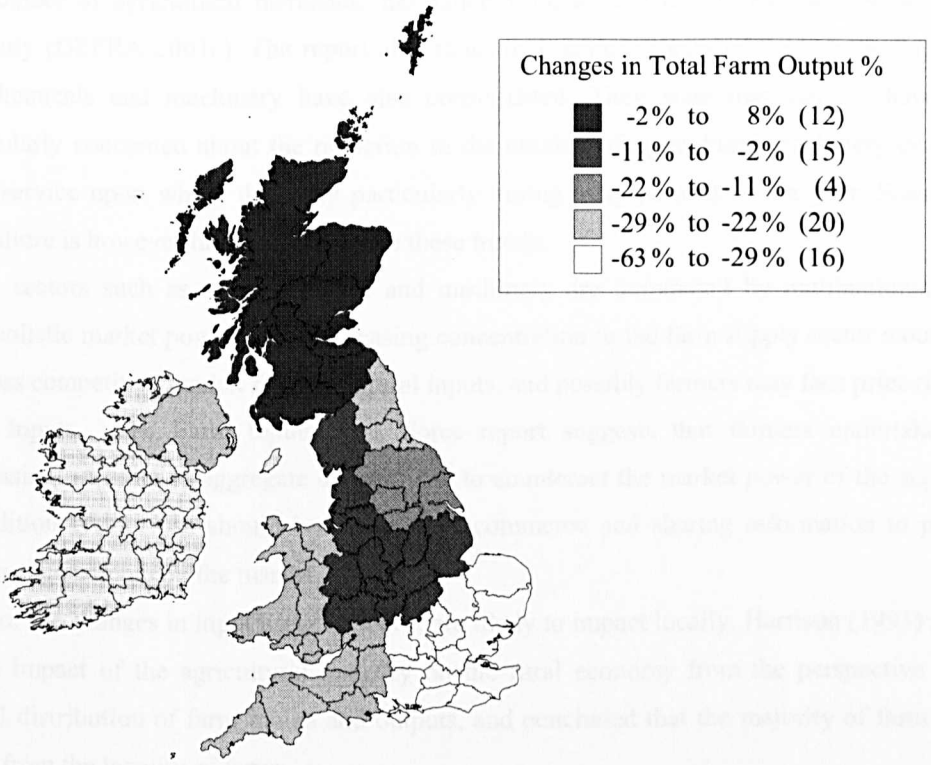
	Cereals	% Sus/Con	Potatoes	% Sus/Con	Oilseed Rape	% Sus/Con	Other Crops	% Sus/Con
Northern England	-£8,949	86%	-£1,393	94%	-£3,226	0%	£4,916	110%
Yorkshire & Humberside	-£36,400	80%	-£926	96%	-£10,372	5%	-£40,334	76%
North West England	-£13,275	63%	£7,308	283%	-£952	28%	-£3,907	82%
East Midlands	-£42,133	83%	£11,730	169%	-£14,713	4%	-£70,697	73%
Eastern England	-£354,364	26%	£2,281	118%	£91,925	..	£230,248	121%
South East England	-£168,643	32%	£5,281	118%	£45,636	..	£89,413	115%
South West England	-£54,516	68%	£8,261	112%	£15,358	1536%	-£38,394	83%
West Midlands	-£35,789	75%	£18,270	160%	£14,615	..	-£55,585	74%
Scotland North West	-£18,752	50%	-£1,894	95%	£1,988	4941%	-£16,865	63%
Scotland North East	-£46,487	67%	-£4,523	80%	£15,292	4974%	-£39,298	80%
Scotland South West	-£14,158	49%	-£951	93%	£1,748	3020%	-£7,719	73%
Scotland South East	-£22,187	70%	-£2,339	70%	£8,513	21311%	-£20,267	81%
Northern Ireland	-£9,167	61%	£0	100%	£130	108%	£2,209	112%
Wales	-£12,645	55%	-£3,270	83%	£55	..	-£6,240	78%
UK	-£837,462	56%	£37,834	112%	£165,996	591%	£27,480	101%

	Cattle	% Sus/Con	Sheep	% Sus/Con	Pigs	% Sus/Con	Milk	% Sus/Con
Northern England	-£24,441	89%	£65,094	150%	£2,854	112%	-£277,822	46%
Yorkshire & Humberside	-£45,216	82%	£132,660	232%	-£8,771	92%	-£139,981	61%
North West England	-£17,941	84%	£33,914	192%	£5,493	115%	-£13,437	93%
East Midlands	-£79,067	73%	£255,446	411%	-£54,191	53%	-£109,534	27%
Eastern England	-£167,454	50%	-£149,689	46%	-£80,287	44%	-£54,259	0%
South East England	-£63,941	76%	£87,395	142%	-£79,702	44%	-£125,659	0%
South West England	£145,890	141%	£171,039	192%	-£104,770	44%	-£725,829	45%
West Midlands	£46,863	128%	£215,054	365%	-£66,555	53%	-£185,900	30%
Scotland North West	£33,203	106%	£162,587	179%	-£1,127	92%	-£99,783	13%
Scotland North East	£31,312	111%	£88,912	182%	-£8,615	92%	-£52,642	26%
Scotland South West	-£65,347	86%	£88,918	172%	-£1,644	92%	£31,559	113%
Scotland South East	£3,629	103%	£31,362	176%	-£1,102	92%	-£13,019	54%
Northern Ireland	£59,542	125%	-£59,751	65%	-£4,702	92%	-£294,223	51%
Wales	£120,452	133%	-£62,477	76%	-£36,662	44%	-£317,569	47%
UK	-£22,515	99%	£1,060,465	153%	-£439,779	63%	-£2,378,099	49%

5.5.2. The Predicted Regional Changes in the Total Output From Agriculture

There would generally be a negative effect on agricultural output, with a total net loss of £2.4 billion. As the pattern of farming is predicted to change, so it is expected that there will be changes in the intensity and the value of the outputs. Figure 5.2 summarises the changes in the total value of outputs in agricultural production, (the total value of the output of all commodities) by region. Agricultural output would increase in two areas of the UK the North West and the South West of Scotland. In Scotland however the increased output would be as a result of shifts in livestock farming. In the North West of Scotland there would be increased output of sheep and beef, whilst in the South West there would be increased production of milk and a small increase in output from non-food oilseed rape; which would be grown on set-aside land.

Figure 5.2. Regional changes in the total value of farm output (%)



5.5.3. Predicted changes in demand for Agricultural Inputs

Table 5.13 and Figure 5.3 present the estimated changes in the purchase of agricultural inputs both by specific input and as a percentage of the value of total inputs to agriculture. Conventional agricultural systems rely on the purchase of external inputs, while sustainable farms and regions would be expected to be less reliant on the purchase of inputs. Total inputs into UK agriculture were predicted to fall by nearly 26.95% from £14.8 billion, to £10.9 billion, with proportionately the biggest falls in Yorkshire and Humberside and the East Midlands. In these regions, these are areas where big shifts from cereals cropping to more extensive cropping systems, without a move to grassland. In these areas such as the East Midlands there would be increased demand for inputs associated with farm machinery.

In other areas such as the West Midlands the increases in the grassland area, lead to increased demand for some products and services associated with livestock production such as fencing, which offset the fall in demand for chemical inputs. Overall the only input for which increased demand would be expected nationally would be for buildings and services associated with buildings (+£73 million). This is likely to be due in the main to increased requirements for building space for animals kept housed under animal welfare friendly farming systems.

This is one aspect of sustainability where there clearly would be knock on effects on the wider economy. The farm supply sector has undergone considerable consolidation in recent years, with a large number of job losses. In contrast to the farming the sector receives no government

subsidies, and firms within it have responded through increasing concentration and diversification into other activities. The report of the DEFRA Farm Inputs Task Force states that the number of agricultural merchants has fallen from around 600 in the late 1980s to 200 currently (DEFRA 2001c). The report also states that manufacturers of feed-stuffs, fertilisers, agrochemicals and machinery have also consolidated. They state that farmers have been particularly concerned about the reduction in the number of agricultural machinery dealers, a local service upon which they rely particularly during busy periods of the year. Sustainable agriculture is however likely to accelerate these trends.

Many sectors such as agro-chemicals and machinery are dominated by multinationals with oligopolistic market power. Thus increasing concentration in the farm supply sector would lead to a less competitive market for agricultural inputs, and possibly farmers may face price rises for some inputs. The Farm Inputs Task Force report suggests that farmers undertake joint purchasing in order to aggregate demand and to counteract the market power of the suppliers, in addition greater use should be made of E. commerce and sharing information to provide greater transparency in the market.

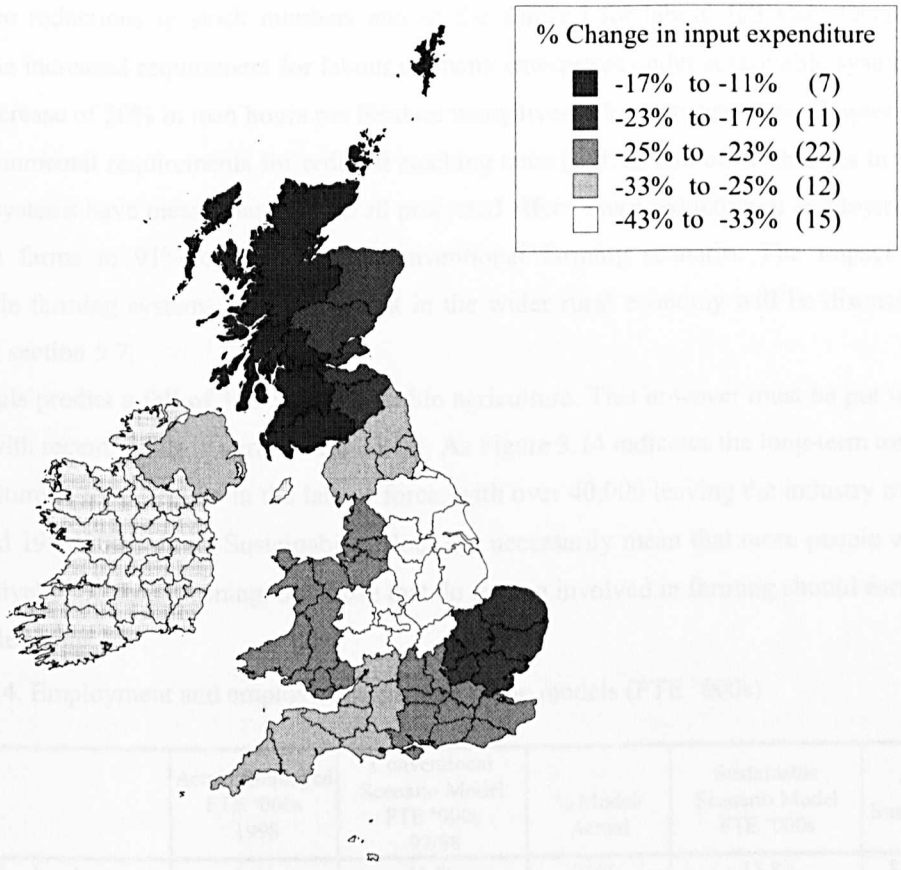
Most of the changes in input usage however are likely to impact locally, Harrison (1993) looked at the impact of the agricultural industry on the rural economy from the perspective of the spatial distribution of farm inputs and outputs, and concluded that the majority of farm inputs come from the locality of farms.

Table 5.13. Estimated changes in total inputs purchased by agriculture by region. (change in £'000 and % change)

	North	Yorkshire & Humberside	North West	East Midlands	Eastern England	South East	South West	West Midlands	Scotland NW	Scotland NE	Scotland SW	Scotland SE	NI	Wales	UK
Sprays	-£22,429	-£33,295	-£13,059	-£41,673	-£76,797	-£54,242	-£62,939	-£38,999	-£41,458	-£36,444	-£28,158	-£16,276	-£14,010	-£33,310	-£513,089
	-67.26%	-55.88%	-74.68%	-53.36%	-62.61%	-66.22%	-74.16%	-69.21%	-84.48%	-69.74%	-84.98%	-66.81%	-75.50%	-83.14%	-68.25%
Seeds	-£7,819	-£29,942	-£3,761	-£43,328	**£11,719**	**£5,826**	-£12,135	-£9,813	-£4,789	-£11,477	-£2,377	-£5,803	-£690	-£2,703	-£117,093
	-19.16%	-42.70%	-20.82%	-48.76%	**10.39%**	**7.78%**	-13.68%	-17.77%	-7.75%	-18.71%	-5.00%	-19.28%	-2.37%	-5.69%	-14.16%
Vet Med	-£7,430	-£6,642	-£960	-£709	-£15,864	-£6,536	-£15,199	£2,796	**£6,849**	**£2,518**	**£6,548**	**£1,638**	-£5,112	-£2,956	-£41,060
	-37.79%	-111.92%	-45.83%	-10.22%	-140.53%	-80.99%	-134.47%	42.96%	**86.37%**	**35.30%**	**105.02%**	**47.56%**	-143.98%	-51.71%	-45.23%
Fuel	-£343	**£863**	-£290	**£1,460**	-£102	-£695	-£2,633	-£1,452	-£2,367	-£1,484	-£1,577	-£638	-£593	-£1,210	-£11,062
	-7.41%	**14.54%**	-13.84%	**21.04%**	-0.90%	-8.61%	-23.30%	-22.32%	-29.85%	-20.80%	-25.30%	-18.53%	-16.71%	-21.16%	-12.19%
Repairs	-£13,594	-£42,001	-£5,828	-£57,472	**£13,262**	**£7,242**	-£1,819	£414	**£770**	**£10**	**£1,606**	**£206**	-£1,628	-£3,851	-£102,683
	-8.66%	-30.42%	-11.42%	-35.96%	**7.48%**	**5.36%**	-1.04%	0.42%	**0.16%**	**0.00%**	**0.38%**	**0.16%**	-1.95%	-1.79%	-3.86%
Machinery	-£23,368	-£52,675	-£13,903	-£69,169	**£14,413**	-£1,043	-£36,962	-£18,864	-£30,947	-£17,237	-£15,685	-£5,441	-£6,643	-£20,182	-£297,706
	-21.23%	-33.75%	-26.41%	-37.00%	**6.26%**	-0.61%	-17.47%	-16.38%	-16.37%	-12.99%	-10.46%	-8.91%	-7.73%	-14.11%	-14.92%
Fertilisers	-£44,956	-£45,742	-£15,356	-£42,492	-£86,775	-£58,978	-£84,146	-£32,330	-£68,223	-£44,493	-£52,190	-£20,570	-£15,837	-£42,672	-£654,760
	-83.26%	-70.21%	-74.85%	-55.86%	-61.28%	-58.12%	-74.97%	-52.79%	-80.87%	-70.86%	-80.34%	-69.10%	-51.95%	-66.50%	-67.58%
Fencing	-£481	-£3,664	**£330**	-£6,936	-£15,287	-£10,432	£428	-£3,451	-£4,600	-£2,131	-£3,978	-£1,092	-£1,134	-£2,425	-£54,852
	-3.13%	-21.46%	**4.14%**	-37.17%	-67.96%	-42.48%	1.15%	-18.81%	-15.40%	-13.20%	-14.88%	-16.35%	-5.65%	-9.58%	-19.14%
Concentrates	-£61,300	-£72,141	-£14,813	-£44,301	-£45,129	-£50,085	-£174,614	-£57,216	**£3,423**	-£24,675	£13,584	-£1,145	-£69,787	-£66,338	-£664,536
	-50.94%	-60.32%	-22.51%	-65.76%	-74.68%	-60.41%	-56.31%	-62.69%	**7.20%**	-37.63%	18.29%	-7.20%	-41.67%	-38.43%	-45.48%
Buildings	-£24,082	-£6,956	**£1,046**	-£11,916	**£90,181**	**£18,787**	-£11,469	-£20,619	**£11,749**	**£11,335**	**£34,986**	**£13,145**	-£9,563	-£23,170	£73,454
	-15.83%	-5.21%	**1.69%**	-8.70%	**46.67%**	**11.82%**	-4.93%	-18.86%	**3.55%**	**6.33%**	**11.70%**	**14.95%**	-7.32%	-11.24%	3.04%
Misc	-£112,497	-£196,170	-£44,988	-£251,837	-£151,427	-£139,564	-£257,070	-£116,034	-£32,869	-£93,846	-£70,522	-£36,771	-£55,852	-£71,073	-£1,630,521
	-66.41%	-65.98%	-62.91%	-63.73%	-30.08%	-39.72%	-63.73%	-52.62%	-19.11%	-53.98%	-72.82%	-47.57%	-70.54%	-69.67%	-52.38%
Total	-£318,297	-£488,364	-£111,582	-£568,374	-£261,808	-£289,721	-£658,557	-£295,569	-£162,462	-£217,925	-£117,763	-£72,747	-£180,849	-£269,890	-£4,013,908
	-36.30%	-45.10%	-29.45%	-46.09%	-16.32%	-23.81%	-38.31%	-34.75%	-11.04%	-21.34%	-9.47%	-15.40%	-26.89%	-25.74%	-26.95%

(Note : Positive changes indicated in bold).

Figure 5.3. Estimated changes in the purchase of total agricultural inputs by region (% change relative to base line levels)



5.5.4. The Predicted changes in Labour patterns

Regional levels of agricultural employment were estimated, for both the conventional and sustainable scenario. These were done by taking the aggregate demand for labour from the LP models, and converting them into an FTE (Full Time Equivalent) figure[1], as well as accounting for the number of self-employed farmers. The projections for the changes in agricultural employment in the regions as a result of moving to sustainability are presented in Table 5.14. The projections for the conventional scenario, however overestimate the number of FTEs engaged within agriculture, for example employment in the North West of Scotland is overestimated by over 417%. They also do not account for the spread around the country of farm employment, with employment being more evenly spread around the UK than is the case in reality.

[1] 1 FTE was assumed to provide 1876 hours / annum

Having said this the proportionate changes do appear plausible, in the regions, where there were shifts back to grassland farming, such as Midlands of England, where employment would increase because of the increased grassland area and because of a move from cereals to more labour intensive break crops. In other areas where livestock farming predominates, there were reductions in stock numbers and so the demand for labour fell also. Overall, despite the increased requirement for labour on many enterprises under sustainable systems, e.g. an increase of 20% in man hours per head on many livestock enterprises (see Chapter 4), the environmental requirements for reduced stocking rates (-20%), and other changes in the farming systems have meant that the overall projected effect was a reduction in employment levels on farms to 91% of that in the conventional farming scenario. The impact of sustainable farming systems on employment in the wider rural economy will be discussed further in section 5.7.

The models predict a fall of 36,334 FTEs within agriculture. This however must be put into context with recent trends in agricultural labour. As Figure 3.14 indicates the long-term trend in agriculture is for a decline in the labour force, with over 40,000 leaving the industry over the period 1999-2001 alone. Sustainability does not necessarily mean that more people will derive a livelihood from farming, but those that do remain involved in farming should earn a reasonable living.

Table 5.14. Employment and employment changes in the models (FTE '000s)

Region	Actual Employed FTE '000s 1998	Conventional Scenario Model FTE '000s 97/98	% Model/ Actual	Sustainable Scenario Model FTE '000s	% Sus/Con
Northern England	6.44	16.50	256%	13.87	84%
Yorkshire & Humberside	23.50	22.59	96%	19.61	87%
North West England	23.60	13.62	58%	12.97	95%
East Midlands	30.04	20.96	70%	24.22	116%
Eastern England	45.78	38.92	85%	33.64	86%
South East England	53.65	34.73	65%	33.40	96%
South West England	40.15	82.89	206%	73.94	89%
West Midlands	26.17	27.36	105%	28.89	106%
Scotland North West	5.00	20.87	417%	14.28	68%
Scotland North East	10.90	16.36	150%	13.50	83%
Scotland South West	12.50	11.29	90%	8.29	73%
Scotland South East	9.40	12.00	128%	11.04	92%
Northern Ireland	16.00	34.42	215%	34.41	100%
Wales	19.13	38.50	201%	35.13	91%
UK	322.26	391.00	121%	357.20	91%

However these projections may actually be an underestimate. Farmers have always tended to substitute labour for capital, and over time the level of employment and the numbers of people working within agriculture has fallen, whilst the level of mechanisation has increased. *The Policy Commission on the Future of Food and Farming* notes that the availability of casual and seasonal labour on some farms in becoming a problem, since the UK has

relatively low levels of unemployment, and many people are put off by the idea of farm work (Cabinet Office 2002). Thus on many of the farms where increased labour might be required if seasonal labour on cropping farms in particular is not available, this might lead to increased investment in machinery instead.

5.6. Discussion and Conclusions

This chapter has taken the farm level models developed in previous chapter, and aggregated them using MAFF farm Census data for 1998 to estimate the regional and national changes in agricultural production from moving to sustainable agricultural systems. In the Southern and Easterly regions of England there were predicted to be considerable changes in cropping patterns, coupled with economic losses, whilst in more Northerly areas and in the rest of the UK, farmland remained predominately as grassland. However as implied by sustainability, the economic effects and hence some of the wider implications of sustainability were different, with Scotland benefited both in terms of the economy and environment, whilst in Wales, Northern Ireland and to a lesser extent England the sustainability would clearly come at a price.

5.7. Investigating the Impacts on Wider Employment in the Rural Economy

The previous section discussed the projected impacts upon labour directly employed on farms, but the models also indicate considerable changes in the outputs from agriculture and in the purchase of inputs, and their regional distribution. Moving to agricultural sustainability will therefore have considerable effects on other sectors of the rural economy, which are interrelated to farming. Input-output analysis may be used to describe the way in which individual sectors of the economy relate to one another as a whole (Midmore 1991), and this technique has been widely used in various studies to look at the linkages between agriculture and other sectors of the economy. Using input-output tables it is possible to derive 'Economic Multipliers' which measure the effects of a unit change in agricultural output on income and employment in the economy. There have been a number of studies to assess the employment effects of changes in agricultural production such as Mitchell (1996), Harrison-Mayfield (1999), Johns and Leat (1986), and Leat and Chalmers (1991).

5.7.1. A Description of Input-Output Tables

Johns and Leat (1985) described the structure of input-output tables. In simple terms an input-output table shows the amount of each sectors total output that is sold to each of the other producing sectors, and the amount of each sectors inputs purchased from other sectors. Sales are assigned to rows and purchases are assigned to columns, thus forming a matrix of flows between sectors. However not all of a sectors output will be sold to other industries, as part will pass into household consumption, exports, government consumption, fixed capital and tourist expenditure. Likewise a portion of inputs into any industry will not come from

other sectors, but from wages, sales from final demand, taxes on expenditure, and subsidies. Table 5.15 depicts an input-output table, with the transaction matrix, final demand and primary inputs quadrants, together with direct transactions between primary inputs and final demand. C denotes household consumption, T exports, and F the other components of final demand, such as general government consumption, fixed capital formation, stock change and tourist expenditure.

Table 5.15. The structure of an input-output table

Purchasing Sector	To/From	1,2.....n	C T F	
Producing Sectors	1 2 . n	$X_{11}X_{12}$ X_{21} Transaction Matrix X_{nn}	Final Demand	X_1 . . X_n
	L M V	Primary Inputs	Direct Transfers	L_T M_T V_T
		X_1.....X_n	C T F	

The total output of a sector i would therefore be:

$$X_i = \sum_{j=1}^{n} x_{ij} + D_i \qquad (5.1.)$$

Where X_i = Total Output of Sector i

x_{ij} = Output of sector i used as an input by sector j

D_i = is the output of sector i passing into final demand ($C_i + T_i + F_i$)

The intermediate output of sector i is represented by x_{ij} or the demand for its output, and D_i represents the final demand for the output of sector i. The intermediate output of sector i may be expressed as a proportion of inputs into sector j, so that:

$$x_{ij} = a_{ij}X_j \qquad (5.2.)$$

Or

$$a_{ij} = \frac{x_{ij}}{x_j} \qquad (5.3.)$$

Johns and Leat (1986) stated that these a_{ij} s are known as technical co-efficients (or input-output co-efficients). These co-efficients are treated as constants and so the level of inputs used by an industry varies in direct proportion to total output. This, however precludes the possibilities of economies of scale and input substitution. Thus substituting equation 5.2. into equation 5.3 gives:

$$X_i = \sum_{j=1}^{n} a_{ij} X_j + D_i \qquad (5.4.)$$

Or expressed in matrix form for all sectors:

$$X = AX + D \qquad (5.6.)$$

$$\text{Where } X = \begin{bmatrix} X_1 \\ \\ x_n \end{bmatrix}; \quad A = \begin{bmatrix} A_{11} & & a_{1n} \\ & & \\ a_{n1} & & anm \end{bmatrix}; \quad D = \begin{bmatrix} D_1 \\ \\ D_n \end{bmatrix} \qquad (5.7.)$$

Rearranging equation (5.5) gives:

$$X - AX = D \qquad (5.8.)$$

$$(1-A)X = D \qquad (5.9.)$$

$$X = (1-A)^{-1}D \qquad (5.10.)$$

Equation 5.10. is known is the Leontief inverse, which is used to predict the effect on the output (X) of each sector arising from a change in final demand D. Each element r_{ij} in the Leontief inverse shows the direct and indirect effects on the output of each sector from an increase in sales of one pound to final demand by sector j. The r_{ij}'s are summed down one column with the sum showing the effect on all sectors of a change in final demand for sector j. Thus the output multiplier for sector is given by:

$$\sum_{i=1}^{n} r_{ij} \qquad (5.11.)$$

Specifically a value of 1.4 for agriculture would imply that a that a direct increase in the final demand for the agricultural sector of £1million would lead to a direct increase of £1million in the output of the agricultural sector plus additional indirect increases in the outputs of all industries of £400,000, making a total change in output of £1.4 million.

5.7.2. Direct, Indirect and Induced Effects of Changes in Final Demand

In addition to the direct and indirect effects of a change in the final demand in one particular sector, there is also the induced effect which is additional economic activity caused by increased spending through additional wages and salaries. These are incorporated into so called type II multipliers. Whereas type I multipliers measure the relationship between the indirect and direct effects, type II multipliers measure the indirect and induced effects in relation to the direct effects. Thus type II output multipliers may be calculated by closing the input-output model with respect to households, by moving the income from employment row and the household consumption column into the transactions matrix, effectively treating households as a single industrial sector. Then the direct, indirect and induced effects of increased household spending can be calculated from the inverse of the $(I-A^*)$ matrix, where A^* is the A matrix enlarged by one sector (households). As for the type I output multiplier, summing each element r^*_{ij} of the columns of the $(I-A^*)^{-1}$ gives the total effect of a change in output (direct, indirect and induced). Equations 5.11 and 5.12 describe the difference between a type I and a type II multiplier.

$$\text{Type I Multiplier} = \frac{\text{Direct and Indirect Effects}}{\text{Direct Effect}} \qquad (5.11.)$$

$$\text{Type II Multiplier} = \frac{\text{Direct Indirect and Induced Effects}}{\text{Direct Effect}} \qquad (5.12.)$$

A type II multiplier would therefore capture additional effects to a type I, and is therefore considered a more comprehensive measure of the wider effects of a change in a particular sector of the economy. Three types of multipliers may be derived, namely output, income and employment multipliers, and the derivation of each of these is described in Johns and Leat (1984), and is summarised in Appendix 38.

5.7.2.1. Regional Multipliers

National input-output tables may be used to calculate multipliers which would estimate changes in output income and employment at the national level. However, regional economies may be more specialised than at the national level, due to the comparative advantage of particular regions for certain products. In particular they are more dependent on imports from outside the region. Johns and Leat (1986) stated that two approaches could be

used to convert a national table into a regional one. Namely survey techniques and non-survey techniques. Survey techniques determine the elements of the transaction matrix by collection of primary data. Non-survey techniques use mechanistic methods to estimate the transaction matrix. Thus an national input-output table may be converted into a regional one by replacing the national co-efficients by regional specific technical co-efficients and modifying the import co-efficients, to give a regional transaction matrix. Johns and Leat (1986) described how this was done using the GRIT (Generation of Regional Input/Output Table) method, and this is outlined in Appendix 39.

5.7.2.2. Farm Sector Multipliers

The published national input-output table treats agriculture as a single sector, according to Doyle (2000). However there are significant differences between farm enterprises and their linkages with the rest of the economy, and so it has been estimated that certain enterprises have much higher income and employment multipliers than for agriculture as a whole. The most common means of dealing with this problem, has been to estimate individual input-output co-efficients from separate farm enterprises; using either econometric techniques (see Leat and Chalmers 1991); or to use survey methods (see Midmore 1987). In this study the input-output co-efficients for each main enterprise type were available from the LP solutions, and so it was decided to disaggregate the agricultural sector into six enterprise types, namely cereals, non-cereal crops, beef, sheep, pigs/poultry and milk. To estimate the type I and type II employment multipliers for each sector however, it is necessary to have employment data by sector; which is not readily available. Two approaches were considered to overcome this. The first involves weighting agricultural employment figures generated in the models, by either a sector output by region, while the second uses labour expenditure for the weighting. Given the difficulties in predicting the spread of farm employment across the regions from the models it was decided to weight the census data available by the regional output of sector, to provide an estimate of sector employment.

5.7.3. Criticisms of the Input-Output Approach

Bailey (1996) discussed the problems of the Leontief approach to analysing the agricultural sector, and criticised some of the restrictions implied by the application of Leontief input-output techniques. He argued that, the imposition of a production technology; which could only exhibit constant returns to scale at unity and elasticity of input and output substitution equal to zero was tenuous. Agriculture is also a multi-product sector and therefore this added to the difficulties in using this method.

A second criticism is that input-output tables are only a snap shot of a particular economy, and it is assumed that technical co-efficients will remain constant. However this is unlikely in reality as technology will change over time, and in the case of a move to sustainable agriculture, the production technology is likely to change. Sustainability entails the substitution of chemical inputs for labour and other inputs, so the assumptions regarding fixed technology clearly will not hold. Multipliers could however be estimated for the projected situation after the move to sustainability, and would provide detail, on some of the changes in the linkages between agriculture and the rest of the economy, arising as a result of this shift.

A further criticism of input-output modelling stated by Doyle (2000) is that estimated economic multipliers strictly only measure the upstream effects of changes in agricultural output, that is changes which affect the demand for agricultural inputs. Estimating the downstream linkages from agriculture is more difficult. One study by Papadas and Dahl (1999) developed these so called 'supply' driven input output multipliers. Sustainable agriculture would clearly affect the mix of outputs to the UK food industry. This technique however would not however capture effects due to changes in input use, since a major outcome of sustainable agriculture would be the fall in the use of purchased farm inputs. Harrison (1993) also concludes that the majority of farm inputs are purchased relatively local to farms. It was felt therefore that the upstream effects would have proportionately the greatest impact therefore it was decided that in this study using the traditional final demand multipliers would seem more appropriate.

5.8. Conclusions

The use of final demand multipliers to investigate the changes in the wider economy arising from sustainable farming is therefore not perfect. However alternatives such as the 'Supply driven' multipliers discussed in the last section have drawbacks also. Despite the above mentioned-drawbacks to using input-output multipliers to estimate the potential wider employment effects of the adoption of sustainable agricultural systems, the use of multipliers would seem an appropriate method for assessing the impacts of moving to sustainability; as

well as a means for exploring the linkages between agriculture and the rest of economy arising from sustainability.

5.9. Estimating the wider economic consequences of moving to sustainability

Using the procedures outlined in the previous section regional type I and II output, income and employment multipliers for the 14 regions and for each of the following agricultural sectors, (cereals, non cereal crops, beef, sheep, pigs and poultry, milk) were derived. Multipliers for energy, manufacturing, construction, distribution, transport and communications, business services, and other services were also estimated and are presented for comparative purposes in Table 5.17. The multipliers were calculated using the published 1990 UK Input/Output tables (Central Statistical Office 1994), from which the national 'A' matrix presented in Appendix 40 was obtained. The regional employment figures were obtained for each sector, with the agricultural employment figures obtained from the census data for 1998 and weighted for each sector. The proportion of spending on agricultural inputs, was allocated to each industrial sector according to the proportions laid out in Table 5.16.

Table 5.16. Allocation of farm inputs between industrial sectors

	Sprays	Seeds	Vet & Med	Fuel	Repairs	Machinery	Fertilisers	Fencing	Concentrates	Buildings	Misc	Labour
Cereals	0%	10%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%
Other Crops	0%	10%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Beef	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sheep	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
P & P	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Milk	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Energy	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%
Manufacturing	100%	80%	30%	0%	50%	100%	100%	50%	50%	0%	0%	0%
Construction	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%
Distribution	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Transport	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Business Services	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	33%	0%
Other services	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	33%	0%
Household	0%	0%	70%	0%	50%	0%	0%	50%	0%	50%	34%	100%

Employment data for each of the other sectors was obtained from Central Statistical Office (1998) and NISRA (2001) for Northern Ireland and are given in Appendix 41. All of the regional and sector multiplier estimates are also presented in Appendix 44, for the conventional and sustainable scenarios. Table 5.17 presents the mean of the regional multiplier estimates, as well as the highest and lowest regional values.

Table 5.17. Estimated type I and II output, income and employment multipliers for the agricultural sector and other business sectors

		Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Cereals	Mean	1.9403	2.9454	1.2578	4.7234	2.3390	3.4138
	Highest	2.0613	3.2252	1.9909	5.5997	4.7407	6.6191
	Lowest	1.8572	2.7222	1.1033	3.2430	1.3441	1.6862
Other Crops	Mean	1.3454	1.7894	1.1028	3.4647	1.4842	1.9439
	Highest	1.4880	2.1961	1.4862	3.9408	2.3561	3.7896
	Lowest	1.1984	1.4527	1.0412	2.5059	1.0578	1.1376
Beef	Mean	1.5096	2.3077	1.0939	2.6879	1.6901	2.5446
	Highest	1.6031	2.5786	1.5166	3.1334	2.7955	4.4256
	Lowest	1.3829	2.0776	1.0179	2.2317	1.1790	1.4386
Sheep	Mean	1.2697	1.9172	1.0556	2.0963	1.3654	1.9771
	Highest	1.4123	2.1188	1.3620	2.5569	1.9305	3.4361
	Lowest	1.1340	1.7100	1.0145	1.6920	1.0429	1.2531
P & P	Mean	1.3747	1.6815	1.0689	6.2356	1.4929	1.8176
	Highest	1.4316	1.7687	1.3605	8.5455	2.2087	2.7918
	Lowest	1.3150	1.6152	1.0122	4.7507	1.1841	1.2874
Milk	Mean	1.3826	1.9769	1.1456	2.6838	1.6094	2.3615
	Highest	1.4045	2.0953	1.4037	3.3195	2.3546	4.2523
	Lowest	1.3445	1.7748	1.0601	1.9555	1.1527	1.3138
Energy	Mean	1.7500	2.4962	2.2163	2.9910	3.1036	7.0536
	Highest	1.8445	2.7064	2.3614	3.8188	4.1025	14.0866
	Lowest	1.5923	2.1902	1.7961	2.3286	1.8608	1.8715
Manufacturing	Mean	1.6489	2.8633	2.6685	2.4838	1.9021	3.1497
	Highest	1.7426	3.1936	3.4644	2.8277	2.3477	4.7081
	Lowest	1.5348	2.3446	1.5951	2.0007	1.6358	2.4103
Distribution	Mean	1.5651	2.9008	1.5137	2.2457	1.6004	1.8624
	Highest	1.6339	3.2101	1.5884	2.5623	1.6912	2.0194
	Lowest	1.3943	2.2049	1.3976	1.6968	1.4070	1.5028
Business Services	Mean	1.8255	3.1712	2.4197	2.9715	1.7299	2.5135
	Highest	1.8390	3.5681	2.6608	5.0308	1.7842	2.8529
	Lowest	1.7968	2.1683	1.8288	2.5977	1.6302	1.9125
Other services	Mean	1.2049	3.0243	1.1317	1.6566	1.1233	2.4222
	Highest	1.2456	3.3527	1.2364	1.7921	1.1597	2.7070
	Lowest	1.0892	2.5509	1.0910	1.4075	1.0598	1.8862

A number of issues arise when comparing these estimates, with those of other studies. Doyle (2000) reviewed a number of studies and found that on the whole cattle, pigs and poultry have consistently much higher income and employment multipliers than agriculture as a whole. In contrast, dairying and cereal farming has relatively low linkage effects.

Here the estimate for pigs appears too low, while that of cereals too high. The under-representation of pigs and poultry and overestimation of the cereal area in the model solutions are likely to be to blame for this. Having said that, the estimates for the agricultural

sector as a whole are consistent compared with other sectors with energy having as expected the highest values, and the service industries the lowest.

5.9.1.2. The Output Effects

The full estimated output, income and employment effects of moving to sustainability are presented in Appendix 45. The changes in output predicted by the models for each region, were taken as the direct changes resulting from a move to sustainable farming, which were presented in section 5.5. The indirect and induced effects arising from the changes in agricultural output are summarised in Table 5.18. The net direct effect of a wholesale move to agricultural sustainability is a direct fall in agricultural output of £2.42 billion, leading to an indirect fall of £1.57 billion and further induced falls of £1.68 billion, totalling £5.66 billion. Thus moving to sustainable farming systems would be expected to have a substantial effect on the rural economy. The total loss of £5.66 billion would represent a loss to National Gross Domestic Product (GDP) of 0.66% of the total GDP of £750 billion for the UK in 1997 (CSO 1998).

Analysing the effects on a sector basis reveals that the economic benefits of increased sheep and non cereal crop production would be offset by the reduction in milk output and the losses associated with it. Whilst the total output of beef would fall, in some regions where production would increase (such as Wales and Northern Ireland) there would be disproportionately high knock-on benefits, and thus the overall direct, indirect and induced effect of the changes in beef production would be positive. However in these regions, big losses in other sectors such as milk lead to large overall losses.

Table 5.18. UK direct, indirect and induced changes in output

	Direct Changes in Output (£)	Type I Output effects (£)	Type II Output effects (£)	Total Effects (£)
Northern England	-£246,401,026	-£110,629,353	-£136,993,625	-£494,024,004
Yorkshire & Humberside	-£160,760,255	-£105,708,546	-£102,797,683	-£369,266,483
North West England	-£6,410,845	-£12,974,070	-£13,077,304	-£32,462,219
East Midlands	-£107,128,795	-£123,021,807	-£78,951,836	-£309,102,437
Eastern England	-£473,829,291	-£382,248,545	-£571,562,876	-£1,427,640,713
South East England	-£206,035,194	-£211,378,550	-£236,769,137	-£654,182,881
South West England	-£583,113,153	-£274,604,780	-£253,216,861	-£1,110,934,794
West Midlands	-£48,529,960	-£72,319,028	-£9,236,793	-£130,085,781
Scotland North West	£58,167,684	-£4,884,603	£18,078,806	£71,361,888
Scotland North East	-£24,984,880	-£35,392,775	-£8,023,967	-£68,401,622
Scotland South West	£31,014,121	-£14,632,691	-£1,384,158	£14,997,272
Scotland South East	-£16,492,843	-£16,763,552	-£10,191,635	-£43,448,031
Northern Ireland	-£311,650,859	-£102,323,105	-£125,029,213	-£539,003,178
Wales	-£319,441,851	-£106,016,870	-£151,171,671	-£576,630,392
UK	-£2,415,597,148	-£1,572,898,274	-£1,680,327,953	-£5,668,823,375
Cereals	-£837,462,304	-£757,778,334	-£864,448,251	-£2,459,688,889
Other Crops	£233,663,487	£2,937,149	£23,189,268	£259,789,903
Beef	-£22,515,245	£31,371,737	£28,200,678	£37,057,169
Sheep	£1,060,465,293	£222,978,680	£643,677,135	£1,927,121,108
P & P	-£471,649,512	-£159,093,473	-£147,499,142	-£778,242,127
Milk	-£2,378,098,866	-£913,314,033	-£1,363,447,641	-£4,654,860,541
Total	-£2,415,597,148	-£1,572,898,274	-£1,680,327,953	-£5,668,823,375

5.9.1.3. The Income Effects

The estimated direct income coefficients, the direct indirect income coefficients and the direct indirect and induced income coefficients were used to calculate the changes in income arising from the predicted changes in the level of output, and are presented in Appendix 45.a. The impacts on incomes are summarised in Table 5.19. The overall net effect on direct income in agriculture was predicted to be negative, with a fall in incomes from the profits and from agricultural employment of £167 million. This figure is considerably less than the predicted fall in total net farm income of £829 million, this could be due to the increased employment in some sectors, having a disproportionate effect due to a higher earnings for employees in those sectors, such for skilled stockman whose earnings would be higher than the average for agricultural workers. Overall this reduction lead to a negative indirect income effect of £84 million, and a further induced loss of £565 million. Given that type II income multiplier estimates were considered to be too high for some agricultural sectors, the induced losses may be considered to be an overestimate. In the East and West Midlands of England,

gains in direct incomes were predicted due to increased agricultural employment in these areas. However these gains were offset by disproportionately high induced losses in certain farm sectors. The figure of a total loss in income to the whole economy of £817 million is slightly less than the projected loss in income to farmers. Incomes in other rural sectors such as tourism would also be likely to benefit as a result of sustainable farming, and are not accounted for in the models; and may further offset some of the losses to agricultural income.

Table 5.19. Regional net direct, indirect and induced changes in income

	Direct Income Effects (£)	Indirect Income Effects (£)	Induced Income Effects (£)	Total Effects (£)
Northern England	-£17,874,749	-£3,819,134	-£44,865,560	-£66,559,443
Yorkshire & Humberside	-£4,583,065	-£1,966,344	-£42,107,213	-£48,656,621
North West England	-£534,440	-£1,575,920	-£4,127,877	-£6,238,237
East Midlands	£4,116,732	-£1,815,231	-£40,497,432	-£38,195,931
Eastern England	-£89,492,878	-£51,293,510	-£135,598,790	-£276,385,178
South East England	-£24,674,959	-£3,382,412	-£86,417,250	-£114,474,620
South West England	-£12,495,493	-£8,885,001	-£98,451,320	-£119,831,814
West Midlands	£13,221,957	-£1,483,999	-£16,199,613	-£4,461,655
Scotland North West	£9,520,176	-£703,080	£1,105,692	£9,922,788
Scotland North East	£5,422,164	-£940,964	-£8,499,210	-£4,018,011
Scotland South West	£2,996,649	£63,439	-£3,752,997	-£692,909
Scotland South East	£658,644	-£409,430	-£5,346,520	-£5,097,306
Northern Ireland	-£28,741,969	-£3,647,754	-£35,853,467	-£68,243,189
Wales	-£25,531,127	-£4,218,485	-£44,603,603	-£74,353,214
UK	-£167,992,357	-£84,077,824	-£565,215,159	-£817,285,340
Cereals	-£92,670,242	-£45,044,884	-£281,876,147	-£419,591,272
Other Crops	£6,843,345	£2,863,581	£1,323,876	£11,030,801
Beef	£7,646,269	-£10,444,993	£19,435,715	£16,636,991
Sheep	£159,187,260	£792,322	£153,168,968	£313,148,550
P & P	-£13,666,240	-£932,803	-£56,688,729	-£71,287,772
Milk	-£235,332,749	-£31,311,047	-£400,578,842	-£667,222,638
Total	-£167,992,357	-£84,077,824	-£565,215,159	-£817,285,340

Thus despite big losses in income within agriculture itself, the overall loss in incomes in to the wider economy would be minimal, however as the previous section indicated there would be a considerable loss in output, thus there would be considerable implications to the wider rural economy from moving to sustainability.

5.9.1.4. The Employment Effects

The projected effects on employment in the wider economy are presented in Table 5.20. The direct employment co-efficient, direct indirect employment coefficient and the direct indirect and induced employment coefficients were used to estimate the wider changes in employment and are presented in Appendix 45.d. A net fall in direct employment of 28,830 FTEs is predicted, leading to 31,740 indirect losses, and 30,292 induced losses throughout

the UK. The biggest falls in direct employment are predicted in the East of England (22,989 FTEs), the South West (17,960 FTEs) and the South East (10,754 FTEs) While in some regions such as Scotland and the South East direct employment is predicted to increase, the only region of the UK where there would be an overall positive effect on employment from moving to sustainable agriculture is in the North West of Scotland. Increased employment in the sheep and other crop sectors would be offset by losses due to the decline of other farm sectors, notably milk and cereals.

Table 5.20. The net regional direct, indirect and induced changes in employment

	Direct Employment Effects (No. FTE)	Indirect Employment Effects (No. FTE)	Induced Employment Effects (No. FTE)	Total (No. FTE)
Northern England	-1548	-1804	-1928	-5280
Yorkshire & Humberside	-3086	-1943	-1494	-6523
North West England	-345	-253	-195	-793
East Midlands	-2692	-2290	-1119	-6101
Eastern England	-4820	-7514	-10655	-22989
South East England	2908	-6367	-7295	-10754
South West England	-9254	-5001	-3706	-17960
West Midlands	-1204	-1407	-131	-2742
Scotland North West	293	-169	231	355
Scotland North East	-289	-652	-109	-1050
Scotland South West	416	-596	-43	-223
Scotland South East	-383	-315	-138	-837
Northern Ireland	-4365	-1635	-1564	-7564
Wales	-4461	-1795	-2144	-8400
UK	-28830	-31740	-30292	-90862
Cereals	-24132	-16041	-17165	-57338
Other Crops	28563	624	1550	30737
Beef	-3880	-1008	-1970	-6858
Sheep	19009	4419	10465	33893
P & P	-10972	-3214	-2627	-16813
Milk	-37417	-16521	-20545	-74483
Total	-28830	-31740	-30292	-90862

It is projected that there would be indirect losses of 31,740 FTEs in the industries supplying agriculture. According to Reed (2001), there are no there are no reliable statistics as to the exact number employed with the agricultural supply sector, however he quotes an estimate of only 11,000 in total for the UK. A whole range of businesses supply goods and services to farms, some deal exclusively with farmers, such as agrochemicals, however many others service other industries along side farming such as financial service sector. Thus the impact of a change to sustainable agriculture would clearly be felt beyond the farm gate, across a wide spectrum of rural businesses. Bryden and Bollman (2000) state that employment in tourism in rural areas has been growing in all types of rural area, thus this is likely to be one sector which can offset some of the losses from moving to sustainable agriculture. They say

that increasingly rural areas are becoming less dependent on resource based industries such as farming, fishing and forestry, and there is a shift towards more service and information based sectors.

5.10. The Sustainable Multipliers

As discussed in section 5.7.3. , input-output analysis assumes that technology remains fixed, however in moving to sustainability, clearly agricultural technology will change. Table 5.21 presents estimates for the multipliers under the scenario of sustainable agriculture, with all of the multipliers presented in Appendix 44. Table 5.22 presents a summary the estimated changes in the multipliers after the transition to sustainable farming systems. The changes in output, and income multipliers are largely negative, which is as expected since would require fewer inputs. However some of the estimates of changes in the employment multipliers were positive, particularly for other crops, sheep and pigs and poultry. Thus is due to the need for increased labour per unit under the sustainable scenario. The changes in the non agricultural multipliers are shown also, and the biggest changes are expected in the energy and manufacturing sectors, due to sustainable agriculture's lower reliance on chemical inputs. Thus sustainable agriculture will lead to a lessening of linkages between the farm sector and other sectors for instance sustainable cereal production would lead to a big fall in type I and type II output multipliers due to lesser reliance on purchased inputs than in conventional cereal production. The smallest change was predicted for the sheep sector, being an extensive enterprise to start with, and a sector that was projected to expand under the sustainable farming scenario.

Table 5.21. Summary of the multipliers for the agricultural and other sectors under the sustainable farming scenario

		Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Cereals	Mean	1.7518	2.6373	1.1392	4.2086	2.0373	2.9323
	Highest	2.1419	3.8727	1.1838	5.3510	3.7885	5.2773
	Lowest	1.6160	2.2523	1.0292	2.9836	1.2697	1.5328
Other crops	Mean	1.2664	1.6045	1.0605	3.4127	1.3512	1.6791
	Highest	1.3704	1.8042	1.0917	4.4341	2.2333	3.0288
	Lowest	1.2014	1.4233	1.0320	2.4897	1.0916	1.2213
Beef	Mean	1.3854	1.9666	1.0382	2.6989	1.5070	2.1323
	Highest	1.4722	2.2365	1.0639	3.0610	2.4281	3.6015
	Lowest	1.2673	1.7734	1.0000	2.0816	1.1570	1.3831
Sheep	Mean	1.2663	1.8817	1.0160	2.0487	1.3390	1.8983
	Highest	1.3978	2.2048	1.0255	2.5382	2.0311	3.3098
	Lowest	1.1580	1.6988	1.0000	1.0000	1.0000	1.0000
Pigs/poultry	Mean	1.1694	1.3717	1.0145	3.0630	1.2114	1.4228
	Highest	1.1853	1.4334	1.0222	3.6272	1.4630	1.8363
	Lowest	1.1603	1.3154	1.0000	2.3553	1.0879	1.1514
Milk	Mean	1.2867	1.7554	1.0623	2.2546	1.4132	1.9366
	Highest	1.3802	2.0301	1.1084	2.9893	2.0364	3.2630
	Lowest	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Energy	Mean	1.7493	2.4916	2.2617	2.9832	3.1065	7.0495
	Highest	1.8444	3.4127	3.2167	3.8179	4.1073	14.1061
	Lowest	1.5324	2.1764	1.2116	1.9971	1.3101	1.8657
Manufacturing	Mean	1.6366	2.8368	2.6560	2.4615	1.8878	3.1147
	Highest	1.7392	3.1417	3.2167	2.7902	2.3308	4.6409
	Lowest	1.5324	2.3393	2.4265	1.9971	1.6316	2.4007
Distribution	Mean	1.5890	3.0577	1.2194	2.1677	1.3303	1.8614
	Highest	1.6843	3.4127	1.2440	2.4760	1.4081	2.0217
	Lowest	1.4179	2.3310	1.1988	1.7888	1.2113	1.5038
Transport	Mean	1.5640	2.8923	1.4991	2.2398	1.6015	2.5125
	Highest	1.6314	3.2093	1.5526	2.5534	1.6914	2.8572
	Lowest	1.3942	2.2038	1.3916	1.6957	1.4079	1.9144
Business Services	Mean	1.8243	3.1626	2.4930	2.9643	1.7288	2.4161
	Highest	1.8364	3.5534	2.6111	5.0272	1.7834	2.6961
	Lowest	1.7965	2.1675	2.3825	2.5942	1.6295	1.8850
Other services	Mean	1.2044	3.0148	1.1126	1.6530	1.1231	1.6915
	Highest	1.2454	3.3381	1.1450	1.7918	1.1595	1.8324
	Lowest	1.0891	2.5494	1.0881	1.4067	1.0598	1.4716

Table 5.22. The mean changes in input/output multipliers arising from sustainable farming systems

	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Cereals	-0.1885	-0.3080	-0.1186	-0.5148	-0.3017	-0.4816
Other crops	-0.0790	-0.1849	-0.0423	-0.0520	-0.1330	-0.2648
Beef	-0.1242	-0.3411	-0.0557	0.0111	-0.1831	-0.4122
Sheep	0.0070	-0.0178	-0.0366	-0.0281	-0.0064	-0.0787
Pigs/poultry	-0.2052	-0.3098	-0.0545	-3.1725	-0.2816	-0.3948
Milk	-0.0959	-0.2215	-0.0833	-0.4291	-0.1963	-0.4250
Energy	-0.0006	-0.0046	0.0454	-0.0077	0.0029	-0.0041
Manufacturing	-0.0123	-0.0265	-0.0125	-0.0224	-0.0143	-0.0350
Distribution	-0.0025	-0.0112	-0.0582	-0.0070	0.0003	-0.0011
Transport	-0.0012	-0.0084	-0.0146	-0.0058	0.0011	-0.0009
Business Services	-0.0012	-0.0086	0.0733	-0.0073	-0.0011	-0.0061
Other services	-0.0005	-0.0095	-0.0191	-0.0036	-0.0002	-0.0042

5.11. Discussion

Overall it appears that the economic effects on the wider rural economy will be negative for the UK as a whole, but with some regional variations. The North West of Scotland was the only region, which would clearly benefit from sustainable farming systems. In other regions however there would clearly be costs to the farm sector and to the wider economy from moving to sustainability. Whilst sustainable farming will mean a reduction in physical output, that is the private goods from agriculture, the production of the public goods such as the environment would be expected to increase, and this is considered in the following section.

5.12. The Key Regional and National Indicators of Environmental Sustainability

In addition to the changes in production estimated by the aggregate linear programming model changes in the subset of indicators chosen at the end of Chapter 4 are presented. These can be used as a check whether the systems of farming predicted in the models may be considered sustainable, as well as allowing analysis of some of the trade-offs between some of the conflicting objectives implicit in sustainability, namely the economic losses versus environmental benefits. The following section examines the changes in a subset of these indicators, as a result of moving to sustainable farming systems. In order to gauge the non economic benefits. The indicators are presented at two levels namely, regional and national levels.

5.13. Regional Indicators of Sustainability

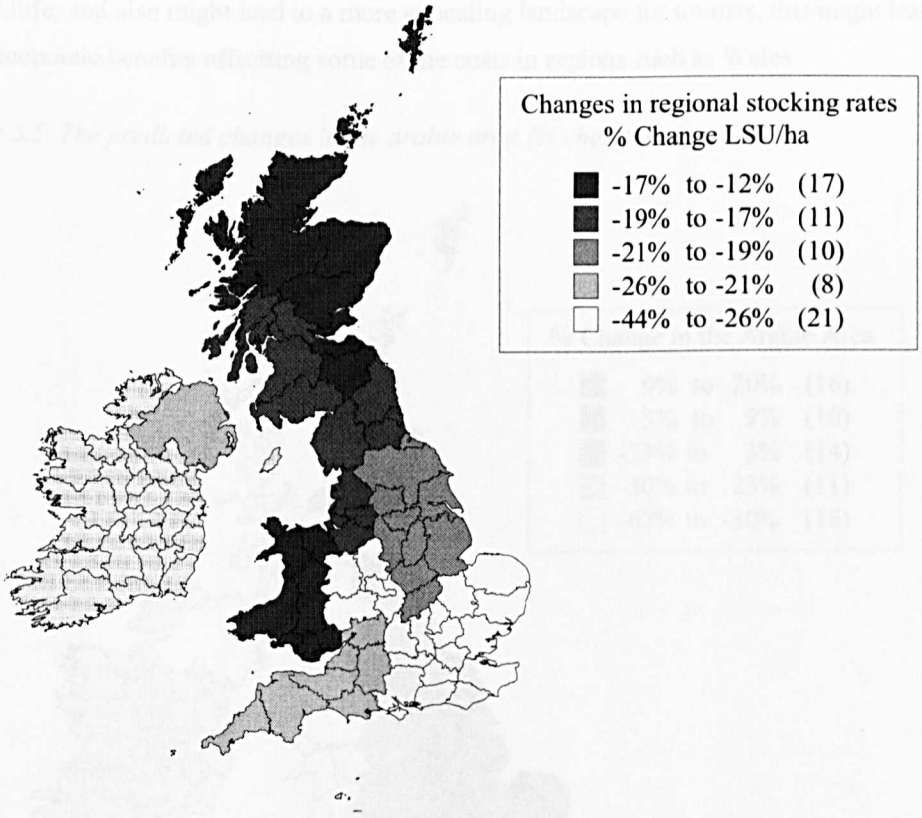
The aggregate model results, and the input-output model indicates, that there would be significant economic impacts arising from moving to sustainable farming systems. The next section considers the impacts upon some of the regional environmental indicators discussed in Chapter 3. These indicators are presented on a regional basis in order to look at the spread of environmental impacts across the country, and which therefore may be set against the economic impacts. The discussion and review of environmental indicators in Chapter 3 found that the environmental problems relating to sustainability differ between ecosystems and regions. For example, the levels of nitrates and phosphates in ground water are higher in the South Eastern and Central English regions than elsewhere. Specifically the regional level indicators, which were aggregated from the farm-level models were stocking rates, land use, fertiliser use, the ecological effects of pesticides and the soil quality index.

5.13.1. Biodiversity

5.13.1.1. Changes in Regional Stocking Rates (Indicator 1)

As discussed in Chapter 3 stocking rates provide a rough measure of the pressures of modern livestock farming particularly on upland habitats, where there has been concern about loss of biodiversity due to overgrazing. Figure 5.4 illustrates the projected changes in regional stocking rates as LSU per forage ha.

Figure 5.4. Changes in regional stocking rates (% change LSU/ha)



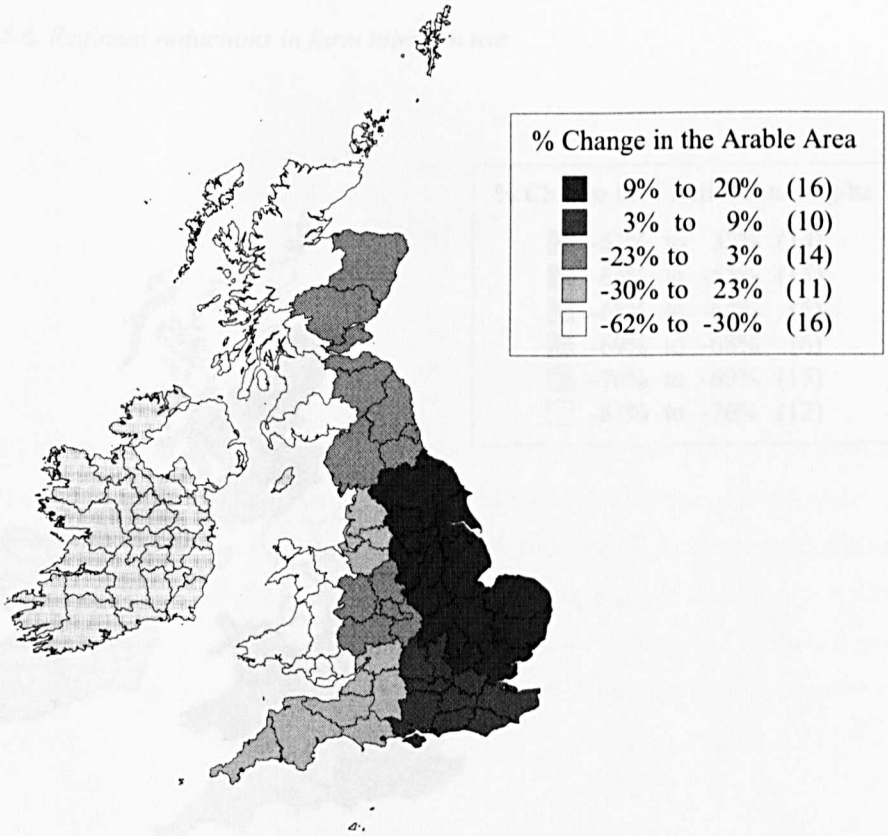
The biggest falls are projected to occur in the South East, the East of England and the West Midlands. These changes would be expected to have a positive effect upon the environment, the reduction in grazing utilization leading to an increase in plant biodiversity (Wilkins and Harvey 1993). An increase in the population of breeding birds would be expected since this is associated with lower grazing intensities. (see Siriwardena, Baillie, Crick and Wilson 2001).

5.13.2. Landscape

5.13.2.1. Regional Changes in Land Cover (Indicator 5)

The aggregate results would provide some indication of the changes in the landscape, which would be expected after the adoption of sustainable farming systems. Figure 5.5, illustrates the predicted changes in the arable area, and projects increases in the East and South. The increases however would due to the increased planting of break-crops, such as oilseed rape and potatoes and the uptake of set-aside. In areas such as the South West of England, and the West Midland, it would be expected that there would be less arable cropping, and more grassland and fodder crops. This would have implications for the landscape, and would provide a more varied 'patchwork' of crops and grass. These changes would provide benefits for wildlife, and also might lead to a more appealing landscape for tourists, this might lead to some economic benefits offsetting some of the costs in regions such as Wales.

Figure 5.5. The predicted changes in the arable area (% change)



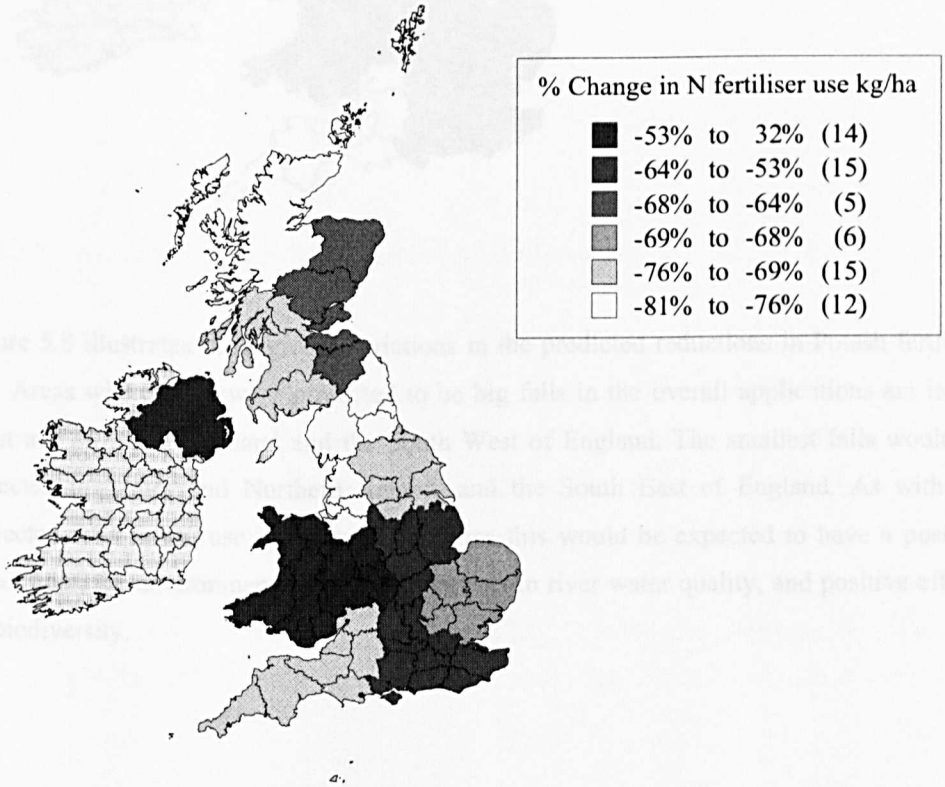
5.13.3. Pollution

5.13.3.1. Regional Changes in Fertiliser Use (Indicator 7)

Figure 5.6 indicates the regions where the greatest falls in fertiliser use are expected. The discussion on indicators in chapter 3 identified the Midlands, Anglian and Thames water regions as having counties as having high levels of nitrates in ground water (>50 mg/l) (see section 3.10.3.).

However as the map indicates, the biggest falls are projected for the North West of Scotland, the North West of England; and the South West of England. However reductions in nitrate fertiliser use are projected for the Eastern Counties of England and the North West of England thereby benefiting these river catchment areas and should lead to some improvement in river water quality. Reductions in nitrogen applications elsewhere would also be expected to have a positive effect upon plant insect and bird biodiversity, particularly in the upland and hill areas of Scotland and the North and South West of England (see Wilkins and Harvey 1993).

Figure 5.6. Regional reductions in farm nitrogen use



Appendix 14.b. and Appendix 14.c. indicate that the landscape types most at risk from phosphate contamination of ground water are the Midlands, the Thames and the North West. Whilst there would be reductions in all areas of the UK, including reductions in phosphate use in excess of 70% in the North West of England; the reductions in the Thames region,

corresponding to the South East region in the models, and in the Midlands would not be as great. Thus additional measures may be necessary to provide environmental improvements in these areas.

Figure 5.7. Regional reductions in farm phosphate use

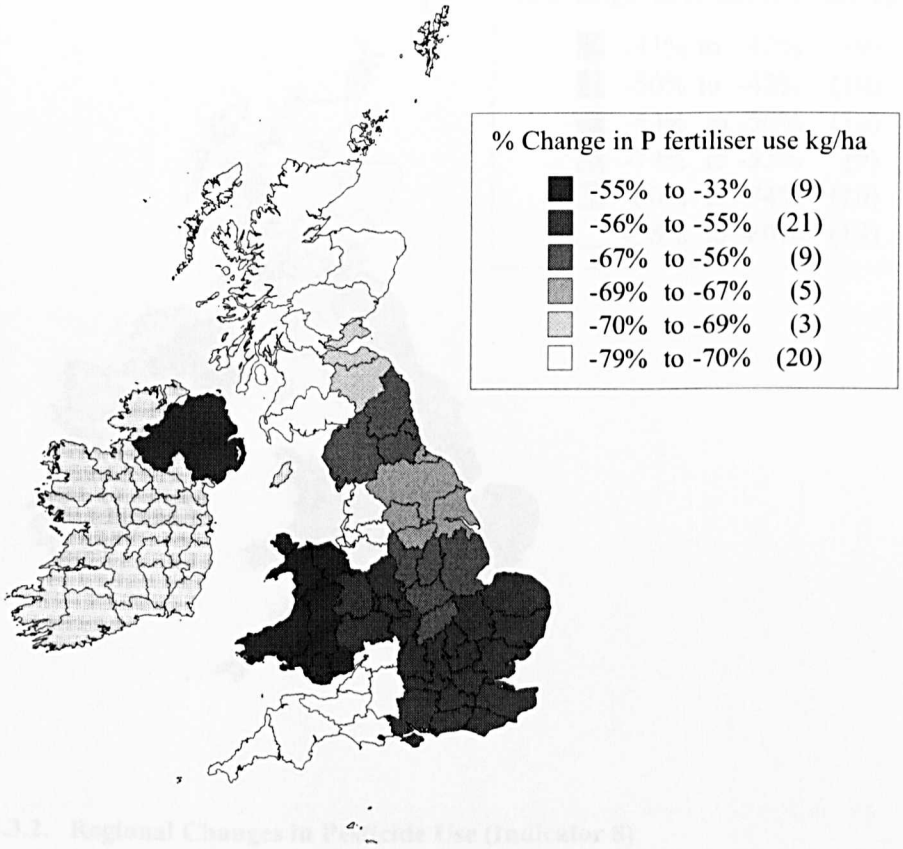
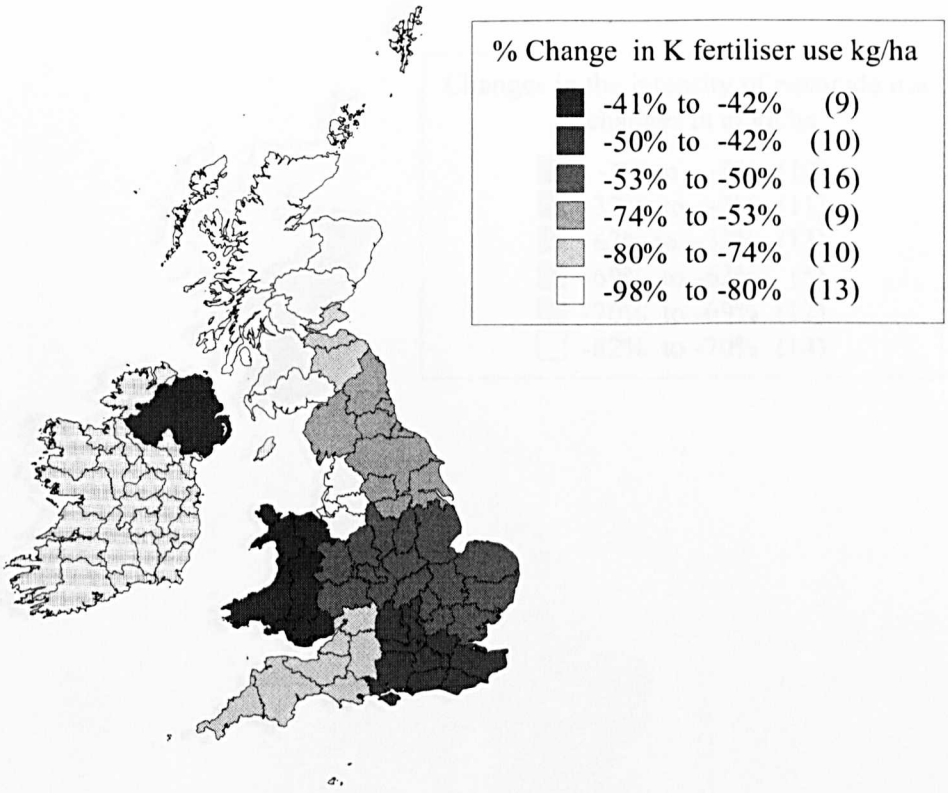


Figure 5.8 illustrates the regional variations in the predicted reductions in Potash fertiliser use. Areas where there were projected to be big falls in the overall applications are in the West and North of Scotland and the South West of England. The smallest falls would be expected in Wales and Northern Ireland, and the South East of England. As with the projected falls in the use of nitrogen on farms this would be expected to have a positive effect upon the environment, with improvements in river water quality, and positive effects on biodiversity.

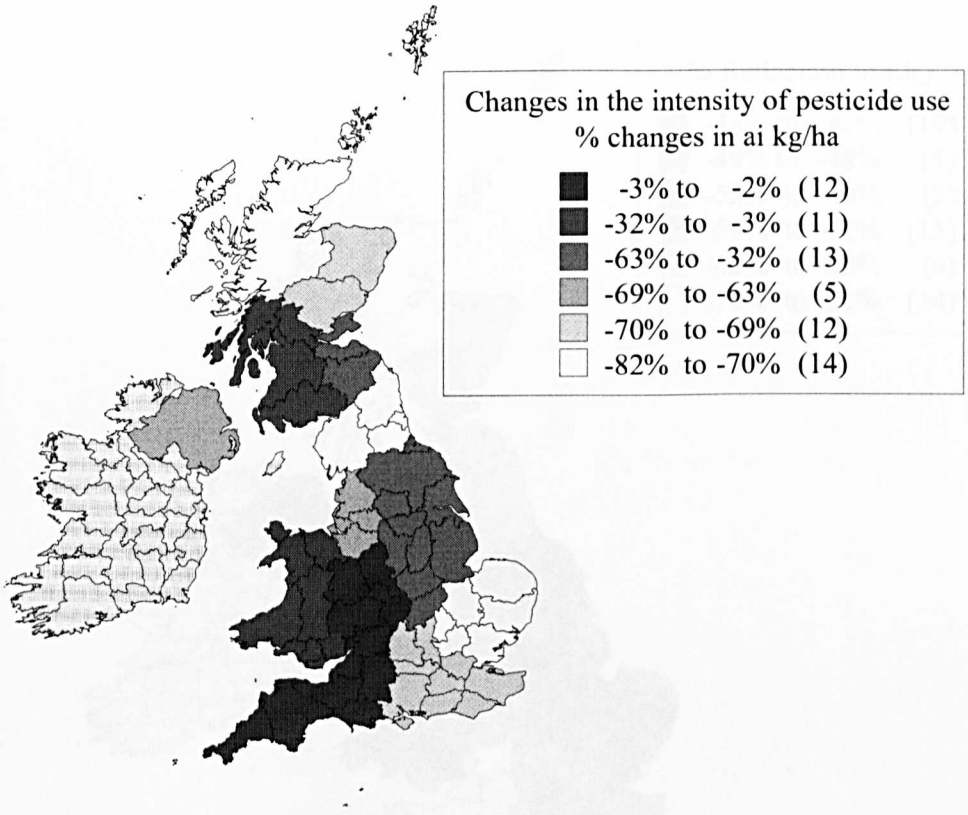
Figure 5.8. Regional reductions in farm potash use



5.13.3.2. Regional Changes in Pesticide Use (Indicator 8)

Figure 5.9 illustrates the predicted changes in the overall use of pesticides. The smallest reductions were predicted to be in the west of the country, where relatively low levels would be applied in the first place where there is an greater preponderance of grassland. In the North West of Scotland where although low levels of pesticides are currently used, the very extensive farm types in these regions would almost cut them out altogether. Given the similar projections for synthetic fertiliser use, this raises the possibility that in reality many of these farms would convert to organic production, as is the case currently, where a large proportion of the UK's organic farms are located in this region (Soil Association 2001b).

Figure 5.9. Regional changes in the intensity of pesticide use



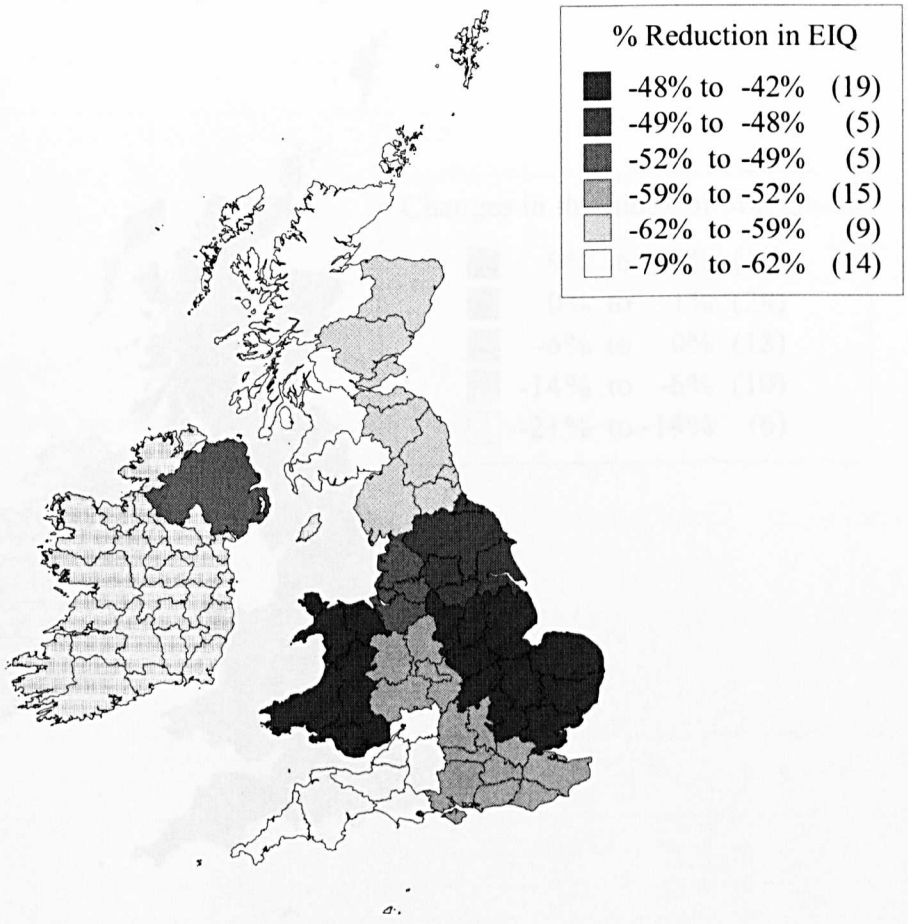
The smallest reductions were projected for Wales, the South West of Scotland and the South West of England. In the Eastern Counties of England, and the South East where arable farming there would also be substantial reductions which would lead to improvements in water quality, leading to a reduction in the risk of pesticide contamination of surface and groundwater.

5.13.3.3. Regional Changes in the Ecological Effects of Pesticides (Indicator 9)

As explained in Chapter 4, the total use of pesticides does not necessarily provide any information on the ecological damage caused, so the Kovach index was calculated from the pesticides used on the various farm enterprises. Figure 5.10 illustrates the predicted changes in the ecological effects of pesticide use (using the Kovach index described in Chapter 3 and incorporated into the models as described in Chapter 4), relative to the current conventional farming situation. The index reveals that the biggest ecological benefits would be found in the Western half of Scotland and the South West of England, where the reductions in impacts would be more than 62%. Some of these regions were not predicted to show the greatest reductions in the volume of use of pesticides, for example the South West of Scotland where the reduction was only 3%. The use of less harmful sprays was implicit in

the adoption of sustainable farming systems, in addition to reductions in the intensity of pesticide use.

Figure 5.10. Regional changes in ecological effects of pesticides



5.13.4. Soil Quality

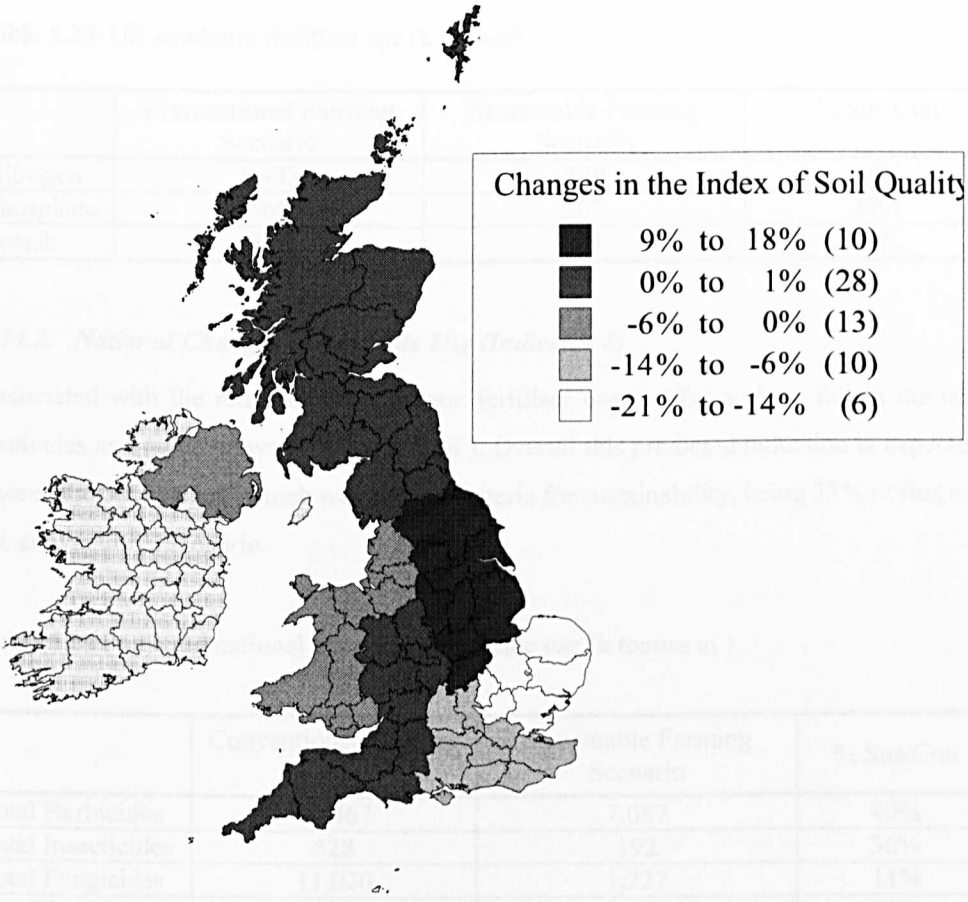
The expected improvements in soil quality have been discussed in the previous chapter, the Soil Quality index can however be aggregated to provide a picture of the regional changes in soils and soil quality.

5.13.4.1. Soil Quality Index (Indicator 15)

Figure 5.11 shows the projected regional changes in the soil quality index developed in Chapter 4. The figure shows that the biggest improvements in soil quality, in terms of soil structure, organic matter, and winter soil cover, would be in the East Midlands, Yorkshire and Humberside, whist in most areas there would be little or no improvement. In five regions however there would be a decline in soil quality. In Wales, Northern Ireland, and the North West of England, there would be a fall of up to 6%. In the South East of England, and the Eastern counties there would however be falls of up to 21% on the index. This is due to

increased specialisation in arable crops on some of the farm models, sustainable farming systems would lead to higher yields for some crops, and this shift to arable systems would lead to losses in soil quality.

Figure 5.11. Regional changes in soil quality



5.14. The National Indicators of Sustainability

It was not possible to derive regional level indicators of environmental improvement for all of the indicators. For some indicators, including the indices of the impacts of pesticides upon consumers and farm spray operators, only national figures could be derived. Some of the regional indicators such as fertiliser use and pesticide use are also presented at a national level for comparative purposes. The results of this analysis are presented in the following section.

5.14.1. National Changes in Fertiliser (NPK) use (Indicator 7)

Overall synthetic fertiliser use for the whole country provides an indication of the use of non-renewable resources in UK agriculture, while the regional figures provide an indication of the regional pollution threat. The projected national changes in fertiliser use are shown in Table 5.23. The base line models predicted a total UK fertiliser use of 2.56 million tonnes,

compared with the actual figure of 2.34 million tonnes in the scenario year of 1997/98 (FMA 2001). Within a move to sustainable farming the use of all synthetic nutrients was predicted to be reduced by over 50% to 1.2 million tonnes. This implies a significant saving in non-renewable resources and a fall in excess of the 50% reduction required for the targets for sustainability to be met.

Table 5.23. UK synthetic fertiliser use (k tonnes)

	Conventional Farming Scenario	Sustainable Farming Scenario	% Sus/Con
Nitrogen	1,493	529	35%
Phosphate	566	207	37%
Potash	512	171	33%

5.14.2. National Changes in Pesticide Use (Indicator 8)

Associated with the reduction in synthetic fertiliser use, is also a sharp fall in the use of pesticides and other sprays (see Table 5.24). Overall this predicted reduction is expected to exceed the 50% target, which was set as a criteria for sustainability, being 33% of that under the conventional scenario.

Table 5.24.Predicted national changes in pesticide use (k tonnes ai)

	Conventional Farming Scenario	Sustainable Farming Scenario	% Sus/Con
Total Herbicides	14,467	7,087	49%
Total Insecticides	528	192	36%
Total Fungicides	11,020	1,227	11%
Total Pesticides	26,001	8,548	33%

5.14.3. Changes in Methane Emissions (Indicator 13)

Methane emissions from livestock would fall to 82% of the conventional scenario, or by 226 k tonnes. Total emissions for the scenario year of 1997 totalled 2892 k tonnes, therefore the predicted reduction from sustainable agriculture would be in the order of 7.8%, which should be compared with the figure of 12% which is the UK's commitment to cut emissions of greenhouse gases under the Kyoto protocol. Therefore further reductions would be required in other sources of methane, or further reductions would be required from agriculture; in order to meet this target. The projections might be an underestimate however, as the actual fall in LSUs may be greater, since the projections for increases in sheep are likely to have been overestimated, and in this case agricultural sustainability would mean that the UK would be close to its target as far as methane emissions are concerned.

Table 5.25. The projected changes in methane emissions from livestock under sustainable farming

	Conventional Scenario	Sustainable Scenario	% Sus/Con
LSU's '000	16370	13454	
Methane k T	1271	1045	82.19%

5.14.4. Changes in Ammonia Emissions (Indicator 14)

The projected changes in ammonia emissions from livestock agriculture are shown below (Table 5.26. The ammonia emissions for agriculture were estimated using the co-efficients calculated from ECETOC (1994) (see Table 3.13 and Figure 3.8). The estimate for the conventional scenario of 489 k tonnes per annum, compares reasonably well with the published figure of . Sustainability would lead to an overall reduction in ammonia emissions from livestock agriculture, to around 71.46% of that under the sustainable scenario. This however is a crude calculation, based upon co-efficients, which would be likely to change under sustainability, as improved management of waste, other measures would lead to further cuts in emissions. However, it is clear that the projected changes in livestock numbers alone would lead to a significant reduction in this form of pollution.

Table 5.26. The projections for ammonia emissions from agriculture under the sustainable farming scenario

Source of Emission	NH3-N Losses (tN)/head/annum	Conventional Scenario Numbers	Conventional Scenario Emissions k T	Sustainable Scenario Numbers	Sustainable Scenario Emissions k T	% Sus/Con
Cattle						
>2 years old	0.0325	6,185,848	201	3,415,888	111	55.22%
1year – 2 years	0.0197	5,270,761	104	3,788,149	75	71.87%
<1 year	0.0112	5,270,761	59	3,788,149	42	71.87%
Pigs						
Pigs for slaughter	0.0038	2,767,736	11	2,017,744	8	72.90%
Boars and Sows	0.0099	644,677	6	525,561	5	81.52%
Sheep	0.0015	36,573,416	56	57,726,372	89	157.84%
Fertiliser						
Ammonium Nitrate	0.0200	1,493	49	529	17	35.40%
Total Emissions			486		347	71.46%

5.14.5. National Changes in Energy Use in Agriculture (Indicator 18)

The overall saving in indirect energy from purchased inputs to UK agriculture resulting from changes in farming practice would be 71.6 Pica Joules. This is equivalent to 1.56m oil tonnes equivalent, put into context it represents a figure equivalent to 1.22% of the UK's domestic oil production of 128 million tonnes (DTI 2002). This fall in the indirect energy consumption from moving to sustainable farming systems would be equivalent to 33% approx of the total

energy use in agriculture[1]. Thus sustainable agriculture will lead to significant savings in fossil fuel use in the food chain. However if sustainability leads to a big fall in domestic food production, some extra energy costs might be incurred by having to import foodstuffs, and some of this saving would be offset by increased fuel energy used in transport and distribution.

5.14.6. The Productivity of UK Agriculture (Indicator 19)

One of the criteria for sustainability was that agriculture remained productive, that there should be increased efficiency of use of inputs. The ratio of the value of outputs to inputs under conventional agriculture was predicted to be 1.16, whilst under the sustainable scenario this was estimated to be 1.38. Thus under the sustainable scenario the overall productivity of UK agriculture would be improved. This is despite the wide variations in the shifts in productivity reported in section 4.10.

5.14.7. Consumer Pesticide Hazard Index (Indicator 24)

Food products are traded from region to region, and therefore the effects of pesticide contamination on consumers cannot be easily attributed to production from particular regions. Therefore for this indicator; only a national figure is reported. Aggregating up the results from the farm level models implies that the predicted index of the hazard from pesticides to the consumers of food in the UK would fall from a value of 1501 million to 545 million or a reduction of 64%. According to this index therefore, there would be a considerable benefit to consumers, and to consumer confidence in food.

5.14.8. Pesticide Operator Hazard Index (Indicator 27)

As for the index of hazards to consumers through pesticides, a figure was calculated for the hazard to farm operators, on a national basis. The models predicted that, the index would fall from a score of 1866 million to 519 million a reduction of around 72% and well within the target of 50% set for sustainability. Thus it is projected that there would be a significant reduction in the health risks posed by chemical use to agricultural employees.

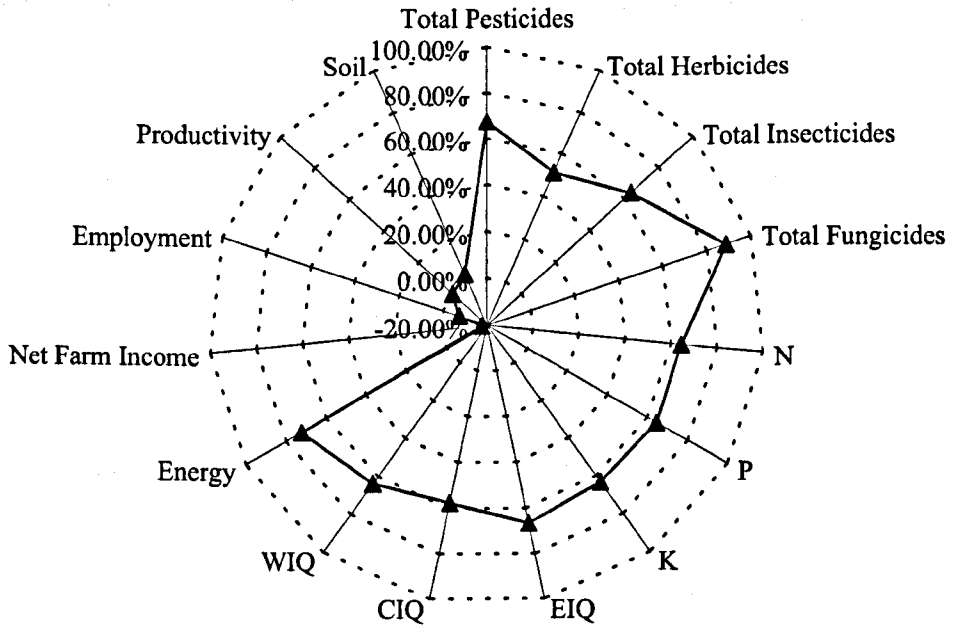
5.15. The National Environmental Benefits of Moving to Sustainability

The primary focus of this study is to look at the economic costs of sustainability, however the changes in the above indicators as a result of moving to sustainable farming systems provide extra insight into the impacts of such systems. The previous chapter found that many of the economic impacts were negative, but that these had to be set against the potential environmental gains, which are measured in this chapter. As with the economic changes predicted, and as expected, the environmental benefits predicted by the models, were not evenly distributed across the UK.

[1] 33% of the 216.6 PJ used in the year 1997 (from DEFRA 2002b).

Figure 5.12 shows the relative changes in the various environmental indicators at a national level, as well as changes in farm income and employment. The gains and losses between the various indicators are not evenly distributed. Total farm income would be maintained, but employment would be expected to fall. There would only be a small However for the environmental benefits, the reductions in fungicides were estimated to be relatively more than that of the other types of agro-chemicals, the least would be in relation to soil quality, for which there would only be a small improvement.

Figure 5.12. National changes in selected sustainability indicators



Pretty *et al.* (2000) estimate the total external costs of UK agriculture as being £2.3[1] billion for 1996, this figure only includes those externalities which give rise to financial costs such as the costs of cleaning drinking water, therefore they state that this figure is likely to be an underestimate. Sustainable farming systems would eliminate much of this cost, through reductions in externalities such as pollution. This figure is over 2.5 times the estimated losses in net farm income arising from moving to sustainability (£829million), and the overall costs in terms of losses of income in the rest of the economy (£817million). Thus on the face of it the sustainable systems would produce overall benefits to the economy and the environment. However within this there would be significant regional variations in many of the effects, and therefore the benefits and costs would not be spread evenly around the country with some regions such as Scotland clearly gaining.

[1] Range for 1990 to 1996 £1149m to £3907m

5.16. Conclusions

This chapter has looked at the estimated impacts upon the wider economy, and also at some of the regional and national environmental consequences. Only in one region the North West of Scotland was there predicted to be clear economic and environmental benefits from moving to sustainable systems, and therefore sustainability would imply a win-win situation. Scotland contains a high proportion of the UK's organic farms (Soil Association 2001b), thus it could be argued that sustainable practices are being adopted already for economic reasons. In most of the UK sustainable farming would therefore require some form of policy intervention to be achievable, the implications of these results for agricultural and rural policy will therefore be discussed in the concluding chapter of the thesis.

Chapter 6. Discussion and Conclusions

6.1. Summary of the Results

In Chapters 1 and 2, working farm-level definitions of sustainable systems were developed for all farm types found within the UK. In Chapters 3 and 4, indicators and appropriate targets for sustainability were set, and in Chapters 5 and 6 aggregate LP models were developed to assess the impacts of the adoption of these systems at the farm level, regional and national levels. The study looked at the impacts of moving to sustainability on agricultural production systems found throughout the UK, the purchase of inputs, and the value of agricultural outputs, and the wider employment effects on the rural economy. These implications are briefly considered in this chapter before the implications for rural policy and future research are considered.

6.1.1. Agricultural Production

The adoption of sustainable farming systems was predicted to have significant impacts upon agricultural production in the UK, along with the purchase of farm inputs. These changes projected to take place at farm, regional and national levels, are summarised and discussed in this section.

6.1.1.1. The Farm Level

As regards the farm-level impacts there were significant differences in the effects of moving to sustainability between different farm types. Thus pig and poultry farms were projected to experience a fall to 33% of the previous level. The comparable estimates for specialist dairy farms was 47%, for mainly dairy farms 58%, large LFA farms 97%, cropping farms 97%, small LFA farms 102% and mixed lowland farms 119%. Thus the more capital intensive farm types, pig and poultry and specialist dairy were predicted to be the biggest losers from sustainability. Cropping farms were perhaps the exception to this rule. However in some regions, the higher yields predicted for break crops on sustainable systems offset much of the losses on other enterprises. There were also differences between farms of the same type located in different parts of the UK. Thus, cropping farms in the South would expect a fall in income, but cropping farms in Scotland and the North would expect a rise in incomes. In relative terms grassland enterprises were forecast to suffer a smaller fall in returns or even an increase, compared with many cropping enterprises (see Appendix 23). Thus in many of the sustainable farm models grassland farm enterprises were selected in favour of cropping enterprises found on the conventional farms, in addition to an increased grassland area due to rotational reasons. On arable farms it was also a requirement to shift towards spring-sown crops, as they are considered more beneficial to the environment. This shift also allowed the

planting of catch crops, such as fodder rape, which could be utilized by livestock, hence the increase in fodder crops predicted for some regions.

6.1.1.2. Regional and National Level Impacts

At the regional level the economic impacts of the changes from moving to sustainable farming, are a consequence of the farm-level impacts, and also of the numbers of particular farm types to be found within a region. In most regions the area of grassland and of non-cereal crops increased. This was a direct consequence of the rotational requirements of sustainable agriculture, and the need to adopt less intensive enterprises on farms. However one concern arising from the projections is that while thriving farm businesses are necessary for a sustainable agricultural industry, the models predict significant falls in production and income. This could be interpreted as implying that the current number of full time farmers is unsustainable. Certainly current falls in agricultural income are prompting many in the industry to consider restructuring their businesses either by finding alternative 'off farm' income, expanding to reduce fixed costs and maintain income. These changes are not accounted for in the LP models constructed in this study, however they are pertinent to the debate on sustainability in that the lower levels of income predicted will undoubtedly lead in the long term to some form of restructuring of farm businesses. In the wake of the foot and mouth epidemic of 2001, many farmers are reconsidering their future in the industry and further restructuring will be inevitable.

6.1.2. Farm Outputs

The regional level changes in the production of agricultural commodities could have considerable implications for the industries downstream from agriculture. The models predict increased concentration of production for some crop products in areas where non cereal cropping would expand. On the other hand they indicate the more widespread production of sheep and beef. Thus it might be that a move to sustainable agriculture would have further regional implications in terms of the location of other elements of the food chain, as food processors may relocate in order to reduce transportation costs. Increasingly, farmers and food processors are looking to add value to their products, and one way of doing this is to add a regional identity to the product, so as in effect create a regional brand. Bryden and Bollman (2000) discuss the impact of globalisation on employment in rural areas, and mention there are increased opportunities for local producers to penetrate global (niche) markets. The increased specialisation of particular regions, as a result of sustainable farming practices may increase the opportunity to do this, while in addition promoting the regional environmental benefits of these systems.

6.1.3. Farm Inputs

The models used in the study assumed that there was no change in the relative cost of inputs to outputs, on the basis that farmers buy from highly concentrated industries and have little

influence over input prices. There were as expected substantial reductions in the demand for chemical inputs such as fertilisers (-67.57%) and pesticides (-68.25%), due to the shift away from intensive arable production. Fencing and other expenditure did not fall as drastically, since they are associated with livestock production, and the increased inclusion of grassland in the rotation in some areas such as the East Midlands, and the South West of England would account for this. There would be a slight increase in demand for some goods and services associated with farm buildings.

6.1.4. The Employment and Income Effects

As outlined in Chapter five changes in agricultural production and employment will have wider economic impacts. Estimates of the likely employment effects of moving to sustainable farming systems on the UK rural economy indicated that these would be negative. Total employment in agriculture was predicted to fall by roughly 28,830 FTEs across the UK. However this was made up of a rise in employment in the general arable and sheep sectors of 47,572 FTEs, a decrease in labour demand on beef; milk and cereal farms of 76,401 FTEs. There would also be associated falls employment in industries allied to agriculture of 31,740 FTEs. The parallel direct effect of household incomes of moving to sustainable farming in the UK was estimated to be a direct decrease in household incomes of £167 billion representing the losses due to falls in net farm income, and reduced employment in agriculture, but to this needs to be added indirect and induced losses giving a total loss of £817 billion. This is due to the disproportionate falls in the output of certain, commodities, namely cereals and milk, whilst the gains in the output of sheep and other crops lead to relatively smaller indirect and induced gains.

6.2. The Credibility of the Results

The credibility of the predictions rely upon the credibility of farm-level linear programming models, therefore the accuracy of the their predictions are evaluated before assessing the reliability of the input/output multipliers and the predictions made for the wider economy.

6.2.1. The Reliability of the Farm LP models

The farm-level models form the basis of the all the results, and thus are crucial to their credibility. The credibility of the sustainable farm models is linked to whether the conventional models accurately reflect the true production patterns on farms of comparable types, and therefore the impacts of moving to sustainability are accurately quantified. Running a historical validation of the models indicated that they had tendency to overestimate key trends at the farm level, however these were less acute when the models were aggregated to produce regional and national projections. The assumptions implicit in linear programming that farmers operate in a profit maximising manner are clearly not always the case in reality, and that even with the focus loss modifications to account for risk

adverse behaviour, in many cases other personal objectives are driving farmer behaviour. The models are constructed on the basis of representative farm types, from the FBS data, these are in effect 'average farm' types, which do not exist in reality. Enterprise performance and costs may vary enormously, the distribution of which may not be even, and would effect the accuracy of the predictions.

Some of the conventional farm model results clearly do not fit with the base line data as well could be hoped, but since the interest is in the changes in production and the regional shifts in enterprises, the direction of changes are the most critical. The run of the models using historical data for 1991/1992 indicated that the models would predict key trends relating to the main enterprises encountered on the farms.

One final possible problem with the aggregate results derived from the LP models could be aggregation bias, as was discussed in Chapter 4. For this reason the procedures outlined in that chapter were intended to minimise aggregation bias to an acceptable level. The aggregate results for the conventional scenario, seem to predict regional cropping and stock relatively well as was discussed in Chapter 5. National figures for outputs and inputs to the conventional agricultural industry also seem to be reasonable in terms of accuracy. Accordingly the farm-level models seem to form a reasonably sound basis for predicting the changes, however it should be noted that the projections are considered to be overestimates in many cases. Despite this the predicted direction of changes, are likely to be more accurate, and thus in interpreting the results it is identifying the direction of changes across the regions that is of key importance.

6.2.2. The Reliability of the Income and Employment Multipliers

The type II employment multipliers, estimated from the conventional models, are comparable with values estimated in previous studies, as reviewed by Doyle (2000). The estimates from the sustainable scenario were generally lower than in the conventional case reflecting the lower requirements for purchased inputs on the sustainable enterprises. In some cases however, where the multipliers increased, it would be most likely to be due to increased labour, as is the case of non-cereal crops, and sheep. The estimated loss of 90,862 FTEs is, however, considered pessimistic due to the factors discussed in section 5.7.3. Nevertheless, the regional variations in the employment effects appear plausible. Thus there is increased employment in some regions resulting from shifts to more labour intensive systems of farming e.g. livestock, whilst in others there would be losses in employment due to extensification.

6.3. The Methodological Limitations of the Study

However the interpretation of these results also requires other issues to be considered. In particular there are a number of methodological issues which need to be considered when

looking at the results of the study, namely the definition of sustainability, the limitations of LP and the limitations of input-output tables. Each is considered in the following sections.

6.3.1. Defining Sustainability

Sands and Podmore (2000) state that sustainable agriculture must move from a qualitative state to a quantitative one, if operational definitions are to be drawn up and appraised. The thesis only looks at one particular definition of sustainability, in order to examine some of the regional aspects of sustainability. However, as was discussed in the sections 1.1 and 1.2. there are many definitions, and disagreements over the exact nature of sustainability. As discussed in Chapter 1, sustainability is a matter of personal values, so any kind of consensus is by definition impossible. This poses problems, when assessing the sustainability of a particular system, (see Chapter 3), since to analyse the concept of sustainability it is necessary to state and quantify exactly what is being taken as a sustainable system. Accordingly, the results of the study are only valid in so far as the underlying definitions of sustainability are accepted. Alternative definitions may very in the strength of assumptions, i.e. that that a 75% cut in pesticide use is assumed rather than 50%; or in their scope. Other specific issues may also be included, such as limiting 'food miles', and the use of GM crops. The outbreak of foot and mouth disease in 2001, has put increased emphasis, on issues relating to animal health, welfare and bio-security. Whilst these have always been part of the sustainability debate, a sustainable system must be capable of change to meet new demands and conditions, and change its emphasis over time.

6.3.2. The Limitations of LP

A number of limitations were mentioned in chapter four, when discussing the selection of LP as the most appropriate method to model the changes in the farming systems. Firstly the models predict likely changes in agricultural production, and the shift in output around the regions of the UK on the assumption that assumed that changes in UK production would be unlikely to have a significant impact upon World and European agricultural commodity prices. However this may not be the case, especially with a major shift in production patterns implied by sustainability. Moreover it is unlikely that such a move would be confined to the UK. However where major shifts are projected it is possible to judge the likely effects on prices of changes in production.

6.3.3. Limitations of the multipliers

As discussed in Chapter 6, input-output tables provide only a snap shot in time of an industry and its links with the rest of the economy. In moving to sustainability the technology of agricultural production will change, and therefore the technical co-efficients which are derived from the transactions matrix, and used in the derivation of the multipliers; will also change. To try to overcome this, multipliers were separately estimated for the sustainable scenario in order to examine the likely relationship between a sustainable agricultural

industry in the UK, and the rest of the economy. In addition, some of the environmental changes are likely to have in the long-term effects other rural industries such as tourism which are not captured in this analysis.

If the Leontief inverse is to hold a number of assumptions must be made which clearly would hold in the case of moving to sustainable agriculture, and would have bearings on the projections made. According to Midmore (1987) the main restrictive assumptions are:

1. Each unit of output from the industrial sectors within the model is easily substitutable between uses by the consuming sectors;
2. The Production function for each sector is linear homogenous of degree one, so that there are no economies of scale;
3. There is perfect complimentarity and zero substitutability between all inputs to each industrial sector.

6.4. The Implications for Agricultural and Rural Policy

The mainly negative projections for farm incomes, implies that any move to sustainable systems is likely to be lead by policy makers; who will look to implement such a change. The models estimate the production patterns at some point in the future, and do not explore the means by which the move to sustainability is made. However they do identify those systems of farming which will need to make the greatest changes in their management, and to which public funds might need to be targeted. Recent constitutional changes within the UK mean that most aspects of agricultural policy are now devolved issues and the responsibility of separate administrations in each of the countries of the UK, and therefore the regional patterns highlighted in this study would have an important bearing. The administrations have produced strategy documents, on the future direction of agriculture within each country, (Cabinet Office 2002, SEERAD 2001, DARDNI 2001, NAWAD 2001). These are key documents which are intended guide the direction of agriculture in each country. There are many common elements within in each document, such as the need for farming to become more market orientated and strengthening links with other parts of the food chain. The results of this study would seem to indicate that in the implementation of sustainable farming systems, the measures introduced need to be specific to each country, and would incur a greater cost in Wales, and Northern Ireland for instance than Scotland. There are also considerable variations within England in the costs and impacts of sustainable farming, with comparatively bigger economic losses in the Northern areas, and the South West, than in the more Southern and Eastern areas.

The study used prices for the 1997 crop year and since then many agricultural prices have fallen substantially, with farmer's incomes under severe pressure. These circumstances, coupled with the further removal of support for production, which would make the

economics of the sustainable systems relatively more favourable and attractive to farmers than suggested by the model results. These policy implications are now considered in more detail.

6.4.1. Developments in Agricultural Policy

The study assumed no changes in the current agricultural support system. UK Agriculture operates within the framework of the CAP (Common Agricultural Policy), which is in the process of reform. The shifts in production arising from sustainability would lead to reductions in support payments in some areas, due to falling livestock numbers or shifts from arable to grassland leading to savings in arable aid payments (see Table 6.1).

Table 6.1.The projected changes in direct subsidy payments to agriculture by region

	Change in Direct Subsidies (£)
Northern England	-£33,324,567
Yorkshire & Humberside	-£44,691,619
North West England	-£24,318,567
East Midlands	-£58,169,604
Eastern England	-£60,482,443
South East England	-£47,575,926
South West England	-£20,781,761
West Midlands	-£13,891,655
Scotland North West	£2,498,419
Scotland North East	-£17,103,175
Scotland South West	-£15,658,859
Scotland South East	-£3,340,862
Northern Ireland	-£21,814,090
Wales	-£41,444,616
UK	-£400,099,326

Overall shifts in production would lead to a saving of £400 million. Clearly this money could be redirected into agriculture to help offset some of the losses projected in farm incomes. Thus the cost of sustainability would be the net reduction in farm incomes (-£829 million), offset by this saving in direct support payments, this comes to a figure of £429 million. This is lower than the figure given by the *Policy Commission on the Future of Food and Farming* of the costs of sustainability of £500 million (Cabinet Office 2000), and it is also considered an overestimate, due to the issues discussed in section 6.2. In addition there may also be other savings which would offset these costs, namely in reduced export subsidies and market intervention. However the study shows that the effects would clearly be localised, and that in some areas such as Scotland sustainability could be achieved at relatively little cost.

Webster (1997) comments that moving to sustainable agricultural systems across Europe may lead to aggregate reductions in the production of some commodities, which would help in the achievement of GATT agreements; and to reduce subsidised exports. The models

predicted big cuts in cereals and milk production, and a modest cut in beef production – all commodities where are still surpluses (see Table 6.2 and Table 6.3).

Table 6.2. Commodity intervention in the UK 5 year average of closing stocks 1996-2001

Commodity	Average closing stocks 1996-2001 ('000 tonnes)
Wheat : Bread making	17.50
Barley	284.50
Rye	7.66
Beef: boneless	58.25
Butter	6.83
Skimmed milk powder	48.50

(From DEFRA 2002b).

Table 6.3. Expenditure by the intervention board 5 year average 1996-2001

Commodity	Average Expenditure by Intervention Board 1996-2001 £ million
Cereals	48.44
Sugar	119.01
Beef and veal (non-BSE)	1.49
Beef and veal (BSE)	551.69
Sheep-meat	0.54
Pig-meat	4.67
Milk products	163.29
Processed goods	35.43
Other (b)	34.29
Total	958.85

(From DEFRA 2002b).

These reductions in subsidy payments would help the UK to meet it's commitments under the GATT agreement, and to meet conditions for further trade reforms under the current round of World Trade Organisation (WTO) negotiations which began in Seattle 2000. There is likely to be further reform of the CAP linked to the on-going WTO (World Trade Organisation) negotiations, which began in 2000. The removal of public support from agricultural commodity prices could have a number of impacts upon the adoption of possible sustainable farming systems. Lower commodity prices could very well force farmers to consider cutting costs, and may well lead to the further adoption of the more extensive systems. Thus, if the models were run under scenarios of a reformed CAP, the sustainable farming systems could very well compare more favourably with the conventional ones. Production costs on the sustainable farms were certainly projected to be lower per hectare than on the conventional farms. Thus in a situation of lower prices, such farms would also appear more able to cope with any cost-price squeeze. As mentioned in Chapter 1, agricultural extensification is already happening due to economic pressures, and at some

point the kinds of systems of production analysed in this study could become more viable than the conventional alternative.

Sustainability also implies structural changes in the farming industry. Certainly the agricultural industry in the UK is currently in a state of great change, with many farmers and farm employees are leaving the industry, due to poor economic returns, with many farms are becoming part-time. Agricultural change invariably has an impact upon the environment, as the intensification of farming after the war has shown. Then the forces driving this change were the CAP and the need to increase food production to meet the needs of the EU's urban population. Liberalisation will lead to new drivers of change, which will lead to impacts upon the environment and the British Countryside. The long-term trend is for fewer farmers and lower food prices. With both trends unlikely to be reversed, many farmers will be faced with choosing between increasing the land holding to maintain income, part time farming, diversification, or leaving the industry. Some are responding by moving to the production of niche high quality food products rather than simply the production of agricultural commodities, witnessed by the rapid growth in the organic sector.

6.4.2. Policies for moving to sustainable farming systems

This study has demonstrated that there would be considerable economic costs to farmers in adopting sustainable agricultural systems. Whilst at the same time there would be considerable environmental benefits, upon which the general public may place a value. However, these would be external benefits, for which under a free market the farmer would not receive payment, and any damage caused through farming operations would not be costed to the farmer. Thus it is likely that a free market alone would not lead to the adoption of sustainable farming systems. Thus implies that the projected scenarios associated with sustainable farming would not be realised without public intervention. What form this intervention would take is open to debate.

Payments to farmers for environmental purposes is accepted by the WTO as being a legitimate form of support, so environmental subsidies could be paid and would swing the economics in the favour of the sustainable farming systems. This study has estimated the costs of moving to sustainability on a regional basis. Environmental payments are not included in the models, in order to estimate the complete costs of moving to sustainability. It has shown there is considerable variations in these costs, but it is clear that those areas where there are high costs of moving to sustainability, are also places where are the most pressing environmental problems at present, e.g. nitrates in water and the loss of habitats in the South East of England. Furthermore these are the regions where we can expect the least environmental benefits. These are the regions where there would be the greatest economic losses at the farm level, and therefore where the greatest levels of support per hectare should be targeted.

Another option could be to regulate for sustainability, through restrictions on inputs, increased and stricter animal welfare regulations and regulations to improve environmental and animal welfare practices. There has been increased environmental, animal welfare and food safety legislation has been introduced within the UK, examples being the Welfare of Farmed Animals Regulations (HMSO 2000) and the expansion of Nitrate Vulnerable Zones (DEFRA 2000h). This approach is cheaper in terms of public expenditure, in that the costs of sustainability are borne mainly by the farmer rather than the taxpayer. This study seems to indicate that these costs would be considerable, and that they would have wide spread effects on the rural economy. In addition to this there would be the other costs associated with enforcing and policing the increased regulation. As with the example of the UK legislation unilaterally banning the use of sow stalls, this could place UK agriculture at a competitive disadvantage, if having to compete with imports produced under less strict legislation.

Another critical factor is successfully realising a sustainable agricultural industry in the UK will be the development of the necessary skills among farmers to be able to implement it, even in the regions and for the sectors where there are clear economic benefits. As such this need for additional knowledge and skills represents another barrier to the uptake of sustainable farming systems. As outlined in Chapter 2 sustainable farming systems depend on a range of techniques and technology which will need to be selected for use on individual farms. Local knowledge has been recognised as been important in the development of sustainable agriculture (Hussanein and Kloppenburg 1995), and local information exchange and networks would be of vital importance in moving to sustainability. It is clear that farmers will need to develop new skills and knowledge in a number of areas. Information on environmentally friendly systems of farming is provided by FWAG (Farming and Wildlife Advisory Groups) who are organised on a local basis, and therefore ideally suited to provide extension on the regionally specific production systems found within the UK. Similarly the network of LEAF demonstration farms, also provides an important means to promote the ideas and technology implicit in sustainable agriculture. Finally handbooks such as the TIBRE handbook produced by Scottish Natural Heritage (1997), and the training and resources pack from the British Agrochemical Association (1995), provide another means to communicate the techniques to farmers. However sustainability is a more holistic concept than those covered in these publications, and thus suggests that there is a need to prepare much more comprehensive guidelines, if such a move is to occur on a widespread basis.

Finally marketing initiatives could potentially be used to maximise the price of food produced under sustainable systems provided it was labelled that consumers were prepared to pay more than for food produced under conventional systems. Regional branding of food may also enable farmers to increase the returns for food production, offsetting possibly the economic losses estimated in this study, as there is strong evidence that foods with a strong regional identity are increasingly popular with consumers. The two regions projected to

suffer the biggest losses, Wales and Northern Ireland are therefore well placed to take advantage of these opportunities, both having distinct identities, and reputations for clean, natural environments.

6.4.3. Implications for Agricultural Trade

The effects of a move to sustainable farming would have also have effects beyond the UK. Thus the results suggest that with the adoption of sustainable agriculture throughout the UK, and assuming no changes in food consumption patterns, the UK would become significantly more reliant upon imports, with implications for the balance of trade. However as cereal production is likely to fall there may also be savings in export refunds, and would help the UK and the EU in meeting its obligations under the GATT agreement and likely WTO agreements to reduce the volume of subsidised exports. The models predicted an increase in the output of other crops, and non-food crops, which are no longer eligible for such refunds. Production of beef was predicted to remain at close to current levels however increased sheep meat production could lead to surplus if excess domestic production could not be exported. Reduced production costs in all sectors, will improve the competitiveness of UK agriculture on world markets, and for commodities in which there would an increase in production such as sheep-meat and some crop products they may be increased opportunities to export.

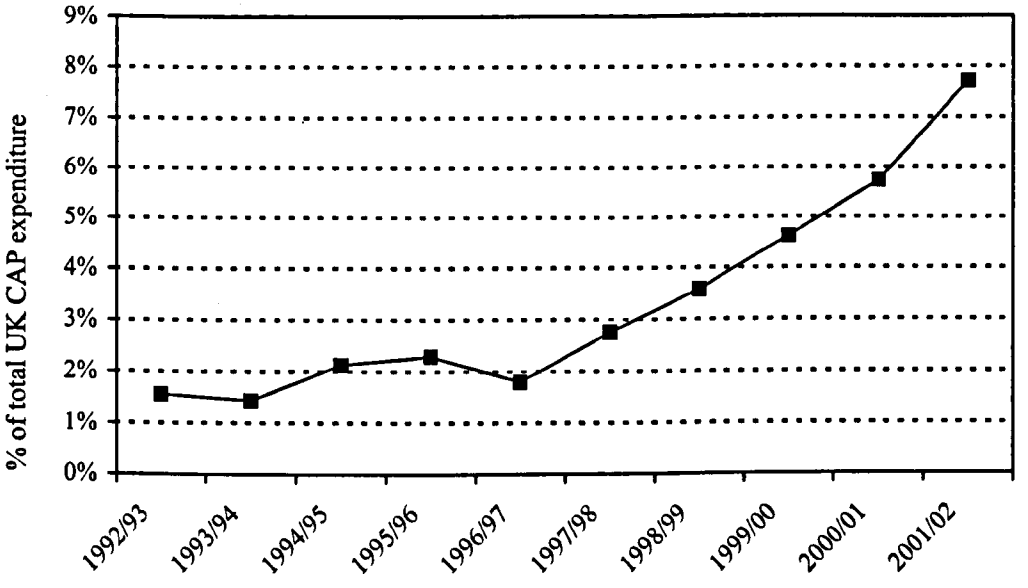
At the same time with the production shifts anticipated there would be an increase in food imports, particularly for cereals, pig and poultry products and possibly some processed dairy products. Thus it could be argued that the UK is in effect exporting its environmental damage elsewhere, since overseas producers might intensify production to meet the UK's demands. Increased transportation and transaction costs are implied by more external trade this may lead to increases in the price of food to UK consumers. Increased transport costs, and the use of fossil fuels might also be the result of having to transport food over longer distances as well as an increase in 'food miles' which may in itself be unacceptable, and contrary to the objective of sustainability.

6.4.4. Agri-Environmental Policy

Chapter 5 revealed that there would be regional disparities in the environmental benefits accruing as a result of moving to sustainable farming systems. Farmers in those areas of the country such as Wales and Northern Ireland, where there would be the greatest farm level economic losses, would clearly require greater encouragement to move to sustainable systems, than areas where agriculture would gain. It is clear from this study that agri-environmental policy should be targeted on a regional basis. If the objective is for agricultural sustainability across the whole country then resources would have to be allocated to these farming regions, rather than to regions where the environmental outcomes

would be achieved a lower cost. It this respect it is noticeable that current environmental schemes operating within the UK such as the ESA (Environmentally Sensitive Area) schemes, and the Countryside Stewardship scheme (see DEFRA 2002a) tend to focus on the peripheral areas. To date expenditure on environmental schemes has only formed a small but rising proportion of the total spending on the CAP (see Figure 6.1).

Figure 6.1. Spending on agri-environmental schemes as a proportion of total public spending on the CAP in the UK



(From DEFRA 2002a).

The horizontal measures introduced as part of the Agenda 2000 package of reforms (MAFF 2000d), have provided for increased spending on agri-environmental schemes. The policy commission on the future of food and farming has proposed an increased rate of modulation, and the introduction of a more integrated agri-environmental scheme (Cabinet Office 2002).

6.5. General Discussion

The results of the farm level models and the aggregated results reveal significant regional differences in the consequences of moving to sustainable agricultural systems within the UK. As expected the more intensive farm production systems, which require the biggest changes in management, tended to perform less well in relation to more extensive farm types under sustainable systems. Thus the pig and poultry, and dairy farms, were predicted to experience the biggest falls in net farm income. Those regions of the UK where these farm types predominated, consequently experienced the biggest changes in terms of falls in total farm income, changes in cropping and stocking, and environmental gains in the form of reductions in the use of synthetic inputs and pesticide. The study has shown that the trade off's between

economic and environmental gains are unlikely to be uniform across the country, and this means that policies designed to encourage sustainable farming will need to be regionally specified and highly targeted.

6.6. Benefits of the research to other users

The information on the shifts in demand for agricultural inputs and in the regional production patterns of UK agriculture is also of benefit to the agricultural supply industry and food processing industries. In particular the models estimate that in lowland areas there will be a move towards more mixed agriculture, away from purely arable farming, or from mainly to cereals to more mixed rotations. This provides information on changing potential markets for those providing services to the agricultural industry, and those buying farm produce. The move more grassland farming into some areas of the English lowlands, would mean significant changes to the farm supply industry in these regions.

6.7. Suggestions for Further Research

The study is an initial exploration in to the regional impacts of a wholesale move to sustainable systems, but there are a number of issues which the study does not address which relate to sustainability; and which should the subject of further studies.

6.7.1. Sustainability and Policy reform

As discussed in section 6.4.1. the sustainable farms may be more economically viable under the conditions resulting from reform of the CAP, and further trade liberalisation resulting from the Seattle round of the WTO negotiations. A further line of investigation would be to use the models to examine a range of reformed policy scenarios in order to identify the kind of reforms and conditions under which sustainable farms could become more profitable. Included within this scenario could be the type of environmental payments needed. The results under the unreformed, pre-Agenda 2000 scenario suggest that the biggest costs and biggest differences from conventional systems would be in the lowlands and in the South, and also in the sectors which currently enjoy the least market support such as pig-meat, poultry and eggs. Agenda 2000 lead to further price cuts, and increased headage payments (MAFF 2000d), and thus is likely to have made sustainable systems even more attractive. Further reform as is expected, is likely to improve the viability of sustainable relative to conventional agriculture even further. However there again may be highly regional effects, and these need to be estimated and projected to see the overall picture.

6.7.2. Weak and Strong sustainability

The study only examines the definition of Sustainability that was outlined in Chapters 1 and 2. However as was mentioned in Chapter 6, the nature and precise definition of sustainability is very much down to individual choice and the value placed upon each of the particular

components. The linear programming approach adopted in this study would allow comparisons on differing definitions through varying the specific constraints at the farm level and the interactions with the linked indicators of sustainability. Thus, the impacts of alternative scenarios for sustainability could be examined. The study looks at a relatively limited range of options for sustainable production and further work could include a greater range of activities in the farm models, including the option of organic conversion.

6.7.3. Organic Agriculture

The sustainable farm models in some the regions such as the North West of Scotland, predicted a decline in fertiliser and pesticide use, which was well in excess of the target set for sustainability. These farm types could be relatively easy to convert to organic systems, compared with other more intensive lowland farms in more agriculturally productive regions. A mixed integer linear programming approach could be used to model the impacts of a move to sustainability using a mix of low-input and organic systems of farming. Such a study would also provide information on the potential extent of the organic sector in the UK.

6.7.4. Sustainable Agriculture and the Rest of Society

The agricultural industry does not work in a vacuum; it relies on the urban population for its customers, and for a significant proportion of its inputs. Other industries have a significant impact upon agriculture, such as food processing, retailing, transport and the agricultural supply industry. The models developed in this study, however are not able to account for any such changes. Concentration in the supply chain has been a key feature of modern agriculture, with fewer and fewer processors and retailers buying the output from farms. In addition farmers now buy inputs from large multinational companies.

Wider moves towards a sustainable society could have impacts upon agriculture, which could have implications for the types of products demanded from agriculture, both for food, environmental and social products, as well as their relative values, and the costs of inputs to agriculture. Models could be developed which also looked at economic activities beyond the farm gate, and the likely implications of these activities becoming sustainable, and how these changes would further affect agricultural production, together with the wider economic effects. As pointed out in the discussion on the projected regional changes in agricultural output, a sustainable livestock supply chain will need to be established, so that abattoirs are located in the livestock producing regions.

A sustainable food system would entail ensuring an adequate supply of safe, affordable food for consumers, without undue damage to the environment, and the natural ecosystems which support food production. Modern conventional agriculture has lead to oversupply of cheap food, but at the cost of damaging the environment, food safety problems, and long-term doubts over the ability of farming to sustain levels of production into the future. This study has revealed some of the economic costs for farmers of adopting sustainable systems.

Consumers may be willing to pay those costs to ensure environmental protection, animal welfare, and perceived health benefits of food from such a system. Currently there is a big demand for organic food, the market for which is growing at around 40% per year, where consumers pay a higher price for a product, which they believe has certain health and environmental benefits over conventionally produced food (Mintel 1999).

6.7.5. Valuing the benefits

The models estimate the private economic costs of sustainability to individual farm enterprises, and also the aggregate costs at regional and national levels, including some of the environmental benefits. Further valuation studies, using techniques such as contingent valuation could obtain the value society would place upon these benefits, in order to assess whether moving towards these systems will lead to a net benefit to society as a whole. Currently implicit in this study is the assumption that the environmental gains outweigh any economic costs from a social viewpoint. However it is unclear whether consumers and taxpayers are willing to compensate farmers for the projected economic losses.

6.7.6. GIS and the Analysis of Sustainable Agriculture

Even within the regions examined in this study there exist considerable variations in topography, terrain and climate, which would effect agricultural production, and so have a significant bearing on the costs and implications of sustainability within a region. More detailed regional aspects of sustainability could be investigated by the use of GIS technology (as mentioned in section 3.4. and the discussion on indicators in Chapter 3). Fletcher and Phipps (1993) conclude that advances in computing mean that the use of GIS for such a purpose has become cost-effective. Advances in remote sensing and satellite technology will also no doubt play an important role in the collection and interpretation of environmental data. The linking of GIS technology with farm level linear or mathematical programming models would provide an effective means to evaluate sustainability at specific locations.

6.8. Summary and Conclusion

The thesis has developed working farm-level definitions of agricultural sustainability, and has used these definitions to build farm level LP models to estimate the potential impacts of moving to these systems. These models were aggregated to estimate the regional and national changes in UK agricultural production, and the further effects upon employment in the rural economy were estimated from them. The study found regional variations in impacts at both the farm level and also at a regional level. These may be ascribed to inherent differences between farms of the same type in different regions of the UK, and at a regional level because of differences in the relative proportions of different farm types.

To summarise moving to sustainable farming would have the following regional and national economic impacts upon UK agricultural production. There would be significant regional variations across the UK in the impacts and consequences of moving to sustainable

agriculture. As expected *a priori* the biggest changes in cropping and stocking were in the lowlands, particularly in the Southern regions of England, were there was a shift away from cereal farming, towards more mixed rotations. Incomes fell on most farms, however there were some predicted rises particularly for mixed farms in the lowlands, resulting in significant regional variations in the wider income and employment effects. The upland areas would remain predominately as grassland, however with lower overall stocking rates, but with shifts in the balance between suckler cows and sheep.

The study has shown that there would be a clear trade off between the economic losses arising from a move to sustainable farming and the environmental gains. Along with the direct losses in farm income, there are considerable indirect and induced losses, thus society is not faced with a win-win situation.

Bibliography

Aarts, H. and Visser, C. (1985). A Management information system for weed control in winter wheat. *Proceedings of the Brighton Crop Protection Conference, Weeds. Farnham, UK: BCPC*, pp. 679-86.

Abel, C. and Hill, P. (1993). Focus on LEAF. *Farmers Weekly*, 22nd January 1993, pp38-41.

ADAS (1980). *Energy Conservation in Agriculture.* An Assessment of some practical opportunities. B2287. MAFF Publications.

ADAS (1984). *Control of Pests and Diseases of Oilseed Rape.* MAFF Publications.

ADAS (1986). *Use of Fungicides and Insecticides on Cereals.* MAFF Publications.

ADAS (1987). *Cereal Pest Control Leaflet P858.* MAFF Publications.

Addiscott, T.M., Whitmore, A.P. and Powlson, D.S. (1991). *Farming, Fertilisers and The Nitrate Problem.* CAB International, pp. 123-127.

Ahmad, Y.J., El Serafy, S. and Lutz, E.L. (Eds.) (1989). *Environmental Accounting for Sustainable Development.* Washington DC: The World Bank.

Alford, D.V., Emmet, B.J., Green, M.R., Murchie, A.K., Williams, I.H., Raw, K.A. , Walters, K.F.A. (1995). Field Experiments to Assess the Status and Importance of Trichomalus Perfectus, A Parasitoid of Seed Weevil on Winter Oilseed Rape in the UK. In : *Rapeseed Today and Tomorrow. Proceedings of the 9th International Rapeseed Congress Cambridge UK 4-7th July 1995,* pp. 1301-1303.

Anderson, J.R. and Hazell, P. (1997). Risk Considerations in Agricultural Policy Making. In : Huirne, R., Hardaker, J., Dijkhuizen, A. (1997). *Risk Management Strategies in Agriculture: State of the Art and Future Perspectives.* Mansholt, Wageningen.

Anderson, V. (1991). *Alternative Economic Indicators.* Routledge : London and New York.

Anon. (1989). *Conservation Grade Standards.* The Guild of Conservation Grade Food Producers.

Anon. (1993). Clover project proves lucky for some. *Milk Producer*, **June 1993**, pp.14-15.

Arden-Clarke, C. (1988). *The Environmental Effects of Organic/Biological Farming Systems.* Political Ecology Research Group. Oxford.

Arey, D.S. (1993). Effect of Straw on the behaviour and performance of growing pigs in "Straw Flow" pens. *Farm Building Progress*, **112**, 24-25.

Azar, C., Holmberg, J., Lindgren, K. (1996). Socio-ecological indicators for sustainability. *Ecological Economics*, **18**, 89-112.

Bailey, A. (1996). Problems with Leontief Technology and Agriculture: the Case of Producing Commodities with More than One Input. In: *Rural Economic Modelling : An Input-Output Approach* (Ed. P. Midmore), pp. 85-97.

Bailey, A., Rehman, T., Park, J., Keating, J. and Tranter, R. (1997). Towards a method for the Economic Evaluation of some Environmental Indicators in UK Integrated Arable Farming Systems. Paper Presented at the Agricultural Economics Society Conference 1997. University of Reading.

Baldock, D. and Mitchell, K. (1995). Cross Compliance Within the Common Agricultural Policy. *A Review of Options for Landscape and Nature Conservation*, pp. 58. Institute for European Environmental Policy.

Balfour, E. (1975). *The Living Soil and the Haughley Experiment.* London : Faber and Faber.

Ball, B.C. (1986). Cereal Production with broadcast seed and reduced tillage: A review of recent experimental and farming experience. *Journal of Agricultural Engineering Research*, **35**, 71-95.

Barker, R. and Stanton, B. (1965). Estimation and Aggregation of Firm Supply Functions. *Journal of Farm Economics*, **47(3)**, 701-712.

Barnard, C.S. and Nix, J.S. (1980). *Farm Planning and Control. 2nd Edition.* Cambridge. Cambridge University Press.

Barrie, L.A. (1994). Evaluation of Poultry Odour Emissions and Environmental Impacts. In : *Proceedings of the 9th European Poultry Conference. Glasgow UK August 7-12th 1994*, pp. 256-259.

Bawden, R.J. (1991). Systems thinking and Practice in Agriculture. *Journal of Dairy Science.* **74**, 2362-2373.

Bax, J. (1990). A Comparison of Grass/White Clover with Grass/Nitrogen in an Intensively Managed Dairy Systems Study. In : *Management Issues For the Grassland Farmer of the 1990's. BGS Occasional Symposium No. 25 (Ed. C.S. Mayne)*, pp. 193-195.

BBC (2000). *Food firms back down on GM.* News item 7th March 2000 http://news.bbc.co.uk/hi/english/uk/newsid_669000/669013.stm (Visited at 7th March 2000).

Beaufoy G., Baldock, D., Clark, J. (1994). *The Nature of Farming. Low intensity farming systems in nine European countries.* Joint Nature Conservation Council.

Bell, A.C., Henry, T. and McAdam, J. (1993). Grassland Management and its effect on the wildlife value of field margins. In : *Grassland Management and Nature Conservation. BGS Occasional Symposium No 28* (R.J. Haggar & S. Peel), pp. 185-189.

Bennett, R. and Larson, D. (1996). Contingent Valuation of the Perceived Benefits of Animal Welfare Legislation : An Exploratory Survey. *Journal of Agricultural Economics*, **47(2)**, 224-235.

Berentsen, P. and Giesen, G. (1995). An Environmental-Economic Model at Farm level to Analyse Institutional and Technical Change in Dairy Farming. *Agricultural Systems*, **49**, (1995) 153-175.

Beus, C. and Dunlop, R. (1990). Conventional versus alternative agriculture : the paradigmatic roots of the debate. *Rural Sociology*, **55(4)**, 590-616.

Bibby, J.S. (Ed.). (1991). *Land Capability Classification for Agriculture.* Macaulay Land Use Research Institute. Aberdeen.

Bignal, E. and McCracken. D. (1996). Low Intensity Farming Systems in the Conservation of the Countryside. *Journal of Applied Ecology*, **33**, 413-424.

Blundell, T. (1994). New Scientific Opportunities for a Sustainable Agriculture. *Journal of the Royal Agricultural Society of England*, **155**, 19-28.

Bockstaller, C. and Giradin, P. (1996). The crop sequence indicator; a tool to evaluate crop rotations in relation to the requirements of Integrated Arable Farming Systems. In : *Rotations and Cropping Systems, Aspects of Applied Biology, 47, 405-408.*

Boehlje, M. (1994). Evaluating Farm Financial Performance. *Journal of the American Society of Farm Managers and Rural Appraisers*, **58(1)**, 109-115.

Bonny, S. (1993). Is Agriculture Using More and More Energy ? A French Case Study. *Agricultural Systems*, **43**, 51-66.

Boussard, J. M., and Petit, M. (1967). Representation of a Farmers Behaviour Under Uncertainty with a Focus-Loss Constraint. *Journal of Farm Economics*, **49**, 869-880.

Bower, M.M. (1961). Erosion in Pennine peat bogs. *Transactions of the Institute of British Geographers*, **29**, 17-30.

Bowerman, P, Young, J.E.B. and Cook, S.K. (1995). Effects of Reducing Pesticide Inputs in the First Four Years of TALISMAN. In : *Integrated Crop Protection : Towards Sustainability ?* BCPC/SFS Symposium No 63, pp.305-312.

Bowerman, P. (1994). Sequels to the Boxworth Project. *Journal of the Royal Agricultural Society of England*, **155**, 45-56.

Bowerman, P., Young, J. and Cook, S. (1994). Economic Results of farming with reduced levels of inputs : Report of the first years of TALISMAN. *Arable Farming Under CAP Reform, Aspects of Applied Biology* **40**, 69-76.

Bowley, F. (2001). Farm Risk Management – Barriers in the Adoption of Risk Management Tools by British Farmers. Paper Presented at the Agricultural Economics Society Conference. Harper Adams University College, Shropshire 10-13th September 2001.

British Agrochemicals Association (1995). *ICM Integrated Crop Management : A complete training and resources pack.* British Agrochemicals Association.

Brouwer, F. and Lowe, P. (1998). (Eds.). CAP and the Rural Environment in Transition. A Panorama of National Perspectives. Wageningen Press.

Brown, L.R., Flavin, C., and Hane, H. Starke, L. (Ed.) (1996). *Vital Signs 1996-1997 : The Trends that are shaping are future.* Earthscan Publications.

Brown, R.M., McClelland, N.I., Deininger, R.A. and Tozer, R.G. (1970). A water quality index do we dare ? *Water sewage works*, **117(10)**, 339-343.

Bryden, J. and Bollman, R. (2000). Rural employment in industrialised countries. *Agricultural Economics*, **22**, 185-197.

Bujaki, G., Guzli, P., and McKinlay, R.G. (1995). Comparison of energy output/input of conventional and organic agriculture in Scotland and Hungary. In : *Integrated Crop Protection : Towards Sustainability ? BCPC/SFS Symposium No 63*, pp.179-182.

Bullock, P. and Thompson, T. (1996). Towards a strategy for the sustainability of the soil resources of the UK. In *Soils, Sustainability and the Natural Heritage* (Eds. J. Gordon and M. Usher). Scottish Natural Heritage. HMSO.

Burn, A.J. (1987). Cereal Crops. In : *Integrated Pest Management* (Eds. A.J. Burn, T.H. Coaker, P.C. Jepson), pp. 209-256.

Cabinet Office (2002). *Farming and Food - A Sustainable Future.* Report of the Policy Commission on the Future of Food and Farming. Cabinet Office. HMSO. London.

Cain, P.J., Saunders, C.M., and Wilcockson, S.J.(1994). The Economics of Low Input Farming. *Farm Management*, **8(12)**, 541-549.

Carson, R. (1962). *Silent Spring.* London : E Baylis and Son.

Catt, J.A., Christian, D. G., Goss, M.J., Harris, G.L. and Howse, K.R. (1992). Strategies to reduce nitrate leaching by crop rotation, minimal cultivation and straw incorporation in the Brimstone farm experiment, Oxfordshire. In : *Nitrate and Farming Systems. Aspects of Applied Biology no 30*, 255-262.

CCW. (1996). *The Welsh Landscape : A Policy Document.* Countryside Council For Wales.

CEC. (1996). Progress Report from the Commission on the Implementation of the European Community Programme of Policy and Action In Relation to the Environment and Sustainable Development "Towards Sustainability". Office for Official Publications for the European Communities.

CEC (2001). *Environmental 2010 : Our Future, Our Choice.* The Sixth Environment Action Programme. European Commission. Office for Official Publications for the European Communities.

Central Statistical Office (1994). *Input-Output Tables for the United Kingdom.* 10th Edition. Government Statistical Service.

Central Statistical Office (1998). *Annual Abstract of Statistics.* Government Statistical Service.

Clark, A.M., Stephen, F.B., Cawley, G.D., Bellworthy, S.J. and Groves, B.A. (1996). Resistance of the Sheep Scab mite *Psoroptes ovis* to prometamphos. *Veterinary Record*, **139**, pp. 451.

Conry, M. and Dunne, B. (1993). Effects of nitrogen timing and frequency of fungicide applications on grain yields of winter barley in Ireland. *Journal of Agricultural Science, Cambridge*, **120**, 181-186.

Conway, G.R. and Barbier, E.B. (1990). *After the Green Revolution : Sustainable Agriculture for Development.* Earthscan Publications : London.

Cook, J.W., Kettlewell, P.S. and Parry, D.W. (1995). The Effect of Foliar Applied Potassium Chloride on *Erisiphe Graminis* infecting wheat. In : *Integrated Crop Protection : Towards Sustainability ? BCPC/SFS Symposium* No 63, pp. 363-370.

Cook, R.J. (1994). Research Experience of ICM in action. In : *Proceedings from Integrated Crop Management. The Road to Future Profit.* 11th April 1995 at the National Agricultural Centre, Stoneleigh, Warwickshire.

Cook, S.K., Turley, D., Spink, J., and Drysdale, A. (2000). Link Integrated Farming Systems (A field scale comparisons of arable rotations). Volume II: The economic evaluation of input decisions. HGCA Project Report No 173.

Cooksley, J. (1994). Water, water everywhere - but you'll pay through the nozzle to use it. *Arable Farming*, March 1994, 12-14.

Copus, A. (1995). Agricultural Downsizing and Socio-Economic Sustainability in Scotland. In *: SAC Environmental & Food Sciences. Research Report 1995-1996.* Scottish Agricultural College. Edinburgh.

Corbet, S. (1995). Insects, plants and succession: advantages of long-term set-aside. *Agriculture, Ecosystems and Environment*, **53**, 201-217.

Countryside Survey (2002). *Countryside Survey 2000.* Final Report. HMSO.

Courtney, P. (1997). Small Towns and the Rural Economy: Death of the Market Town ?. Poster Paper. Paper Presented at the Agricultural Economics Society Conference, Edinburgh 21st –24th March 1997.

Cousens, R. (1985). A simple model relating weed loss to weed density. *Annals of applied biology*, **107**, 239-52.

Cousens, R., Doyle, C., Wilson, B. and Cussans, G. (1986). Modelling the Economics of Controlling *Avena fatua* in Winter Wheat. *Pesticide Science*, **17**, 1-12.

Croze, H. and Vandeweerd, V. (1991). Monitoring and Data Management Technology for Environmental Assessment. In *: Environmental Information for the 21st Century. Proceedings Environmental Information Forum. Montreal Canada, May21-24th*, pp. 109-127.

CSO. (1997). *Annual Abstract of Statistics 1997.* HMSO London.

Cussans, G.W., Cousens, R.D. and Wilson, B.J. (1987). *Progress Towards Rational Weed Control Strategies.* In : Rational Pesticide Use (Ed. K.J. Brent & R.K. Atkin), pp. 301-313. Cambridge University Press.

Cuttle, S.P., Hallard, M., Gill, E.K., Scurlock, R.V. (1996). Nitrate leaching from sheep-grazed upland pastures in Wales. *Journal of Agricultural Science, Cambridge*, **127**, 365-375.

DARDNI (2001). *Vision for the Agro-food Industry.* Department of Agriculture and Rural Development Northern Ireland.

D.E.T.R. (2001). *Guidance on the Groundwater regulations 1998.* Department of the Environment Transport and the Regions. HMSO. London.

D.o.E. (1994a). *Sustainable Development : The UK Strategy.* Department of the Environment. HMSO. London.

D.o.E. (1994b). *The UK Environment.* The Department of the Environment. HMSO. London.

D.o.E. (1996a). Indicators of Sustainable Development for the United Kingdom. Department of the Environment. HMSO. London.

D.o.E. (1996b). *Digest of Environmental Statistics No 18.* Department of the Environment. HMSO. London.

D.o.E. (1997). *Digest of Environmental Statistics.* Department of the Environment. HMSO. London.

D.P.I.E. (1997). Methodological Considerations- Sustainability Indicators. Off World Wide Web. http://www.dpie.gov.au/dpie/cpd/survey_a.html (16th January 1997). The Department for Primary Industries and Energy.

Davey, B. and Weightman, P. (1971). A Microeconomic Approach to the Analysis of Supply Response in British Agriculture. *Journal of Agricultural Economics*, **22**, 297-320.

Davies, D. A. (1992). Potential of White clover in the less favoured areas of the United Kingdom. *Herba*, **5**, 52-55.

Davies, D. A. and Hopkins, A. (1996). Production Benefits of legumes in grassland. In : *Legumes in Sustainable Farming Systems* (Ed. D. Younie). BGS Occasional Symposium No. 30, pp. 234-246.

Day, R.H. (1963). On Aggregating Linear Programming Models of Production. *Journal of Farm Economics*, **45**, 797-813.

Dee, N., Baker, J., Drobny, N., Duke, K., Whitman, I. and Fahringer, D. (1973). An environmental evaluation system for water resource planning. *Water Resources Research*, **9(3)**, 523-535.

DEFRA (2001a). *The Ground water protection code : use and disposal of sheep dip compounds.* Department of the Environment, Food and Rural Affairs. HMSO. London.

DEFRA (2001b). British Survey of Fertiliser Practice. Fertiliser Use on Farm Crops for the Crop Year 2000. Department of the Environment, Food and Rural Affairs. HMSO. London.

DEFRA (2001c). *Report of the Farm Inputs Task Force.* From www.defra.gov.uk (Visited May 2002).

DEFRA (2002a). *Foundations for our future.* Department of Environment, Food and Rural Affairs. HMSO. London.

DEFRA (2002b). *Agriculture in the United Kingdom 2001.* Department of the Environment, Food and Rural Affairs. HMSO. London.

DEFRA (2002c). *Farm Incomes in the United Kingdom 2001/2002.* Department of the Environment, Food and Rural Affairs. HMSO. London

DEFRA (2002d). *Digest of Environmental Statistics.* www.defra.gov.uk (Visited May 2002).

DEFRA (2002e). *Code of Recommendations for the Welfare of Sheep.* Department of the Environment, Food and Rural Affairs. HMSO. London.

DEFRA (2002f). *Code Recommendations for the Welfare of Laying Hens.* Department of the Environment, Food and Rural Affairs. HMSO. London.

DEFRA (2002g). *Better Biosecurity Provides, Peace of Mind, Healthy Stock and a More Viable Business.* PB350. Department of the Environment, Food and Rural Affairs. HMSO. London.

DEFRA (2002h). *Guidelines for farmers in NVZs (Nitrate Vulnerable Zones) – England.* Department of the Environment, Food and Rural Affairs. HMSO. London.

Dehaan, M. and Keuning, S. (1996). Taking the environment into account - The NAMEA approach. *Review of income and wealth*, **2**, 131-148.

Dempster, J.P. (1987). Effects of Pesticides on Wildlife and Priorities in Future Studies. In : *Rational Pesticide Use* (Ed. K.J. Brent & R.K. Atkin), pp. 17-25. Cambridge University Press.

Den Ouden, M, Dijkhuizen, A., and Huirne, R. (1996). The Economic Impact of Animal Welfare and Environmental Measures in Pig Production Chains. Paper Presented at the VII-th European Congress of Agricultural Economists. Edinburgh, September 3-7th 1996. *Redefining the Roles for European Agriculture.*

DETR (2001). The Ground Water Regulations 1998. Department of the Environment Transport and the Regions. HMSO.

Dillon, J. and Heady, E. (1961). A model for entrepreneurial decisions under free competition. *Metroeconomica*, **13**, 20-28.

Dillon, J.L. and Scandizzo, P.L. (1978). Risk Attitudes of Subsistence Farmers in North East Brazil : A Sampling Approach. *American Journal of Agricultural Economics*, **60(3)**, 425-435.

Donaldson, G., Hughes, J. and Leake, A. (1996). *Rotations and Cropping Systems, Aspects of Applied Biology*, **47**, 383-386.

Doyle, C. (2000*). Up and downstream linkages of the agricultural sector: A Review of UK-based studies.* A Study prepared for the Scottish Executives Rural Affairs Department.

Deary, I. (1994). An Introduction to Family and Business Stress in Farm Families. In : *Rural and Farming Systems Analysis. European Perspectives* (Eds. J. Dent & M. McGregor). CAB International, pp. 213-221.

Drummond, C.J. (1994). Integrated Crop Management and Environmental Auditing. *Journal of the Royal Agricultural Society of England*, **155**, 177-182.

Duncan, I. and Dawkins, M. (1983). The Problem of Assessing "Well Being" and "Suffering" in Farm Animals. In : *Indicators Relevant to Farm Animal Welfare* (D. Smidt (Ed.)), 13-24. Martinus Nijhoff Publishers for the Commission of the European Communities.

D.T.I. (2002). *Digest of Energy Statistics 2002.* Department of Trade and Industry. HMSO London.

Dunning. R.A. (1982). Sugar Beet Pest, Disease and Weed Control and the Problems Posed by Changes in Husbandry. In : *Decision Making In the Practice of Crop Protection. Proceedings of the 1982 British Crop Protection Symposium* (Ed. R.B. Austin), pp. 143-154. BCPC.

Easson, D.L. (1993). Reducing the Input of Agrochemicals in Cropping Systems. *Agriculture in Northern Ireland*, **7**, 20-21.

Easson, D.L., Courtney, A.D. and Picton, J, (1995). The Effects of Reduced Fertiliser and Herbicide Input Systems on the Yield and Performance of Cereal Crops. In : *Integrated Crop Protection : Towards Sustainability ?* BCPC/SFS Symposium No 63, pp.313-320.

ECETOC (1994). Ammonia Emissions to Air in Western Europe. European Centre for Ecotoxicology and Toxicology of Chemicals

Edwards-Jones, G, and Howells, O. (1997). An Analysis of the Absolute and Relative Sustainability of the Crop Protection Activity in Organic and Conventional Farming Systems. In : *Resource Use in Organic Farming, Proceedings of the Third ENOF Workshop; Ancona 5-6 June 1997.* (Eds. J. Isart & J. Llerena).

Edwards-Jones, G. (1993). Knowledge based systems for crop protection: theory and practice. *Crop protection*, **5**, 143-150.

El Titi, A. (1988). Influences of cultural factors and practices on integrated pest management systems in cereal crops. In : *1988 CEC/IOBC/EPPO Conference - Integrated crop protection from principles to practical implementation*, 69-74.

El Titi, A. (1992). The Lautenbach Project 1978-89. Integrated Wheat Production on a Commercial Arable Farm, South West Germany. In : *The Ecology of Temperate Cereal Fields.* (Eds. C.G. Firbank, N. Carter, J.F. Darbyshire and G.R. Potts) pp. 399-411. Oxford Blakewell Scientific Publications.

El Titi, A., Boller, E.F., Gendrier, J.P. (1993). *Integrated Production Principles and Technical Guidelines.* IOBC/WPRS Bulletin OILB/SROP Vol 16(1) 1993.

Elamin, E.M. (1998). Towards understanding the behaviour of small farmers facing additional risk of a cash orientated policy: the case of the dryland of western Sudan. *Sudan Journal of Agricultural Research*, **1**, 79-85.

England , R.A. (1986). Reducing the nitrogen input on arable farms. *Journal of Agricultural Economics*, **37(1)**, 13-24.

English Nature (1993). *The Conservation Management of Arable Field Margins.* English Nature Science No 18. English Nature.

English Nature (1994). *Sustainability in Practice.* Planning for Environmental Sustainability. English Nature.

English Nature (2001). *The Upland Management Handbook.* Working today for Nature tomorrow. English Nature.

Environment Agency (2001). IPPC Technical Guidance Note. Integratied Pollution Prevention Control. Standard Farming Installation Rules and Guidelines. Version 3, June 2001. Environment Agency.

Evans, R. (1977). Overgrazing and soil erosion on hill pastures with particular reference to the peak district. *Journal of the British Grassland Society*, **32**, 65-76.

Ewing, W. (1997). *The Feeds Directory.* Context Publications.

Falconer, K. (1997). Environmental Policy to Reduce Contamination From Agricultural Pesticides : Policy Design and Evaluation Using a Farm Level Assessment Model. Paper given at the Postgraduate AES Conference, Edinburgh 19-21 March 1997.

Falconer, K. and Hodge, I. (2000). Conversion to Low Input Farming and Pesticide Policy. *Farm Management Journal*, **10(9)**, 525-538.

FAO (1992). Sustainable development and the Environment. pp. 4. FAO. Rome.

FMA (2001). *Fertiliser Review 2001*. Fertiliser Manufacturers Association.

Farming and Wildlife Advisory Group (2001). http://www.fwag.org.uk (Visited 21st January 2001).

FAWC (1992). *Report on the welfare of Broiler Chickens*. Farm Animal Welfare Council.

FAWC (1996). *Report on the welfare of pigs kept outside*. Farm Animal Welfare Council.

FAWC (1997). *Report on the welfare of dairy cattle*. Farm Animal Welfare Council.

Feber, R.E., Johnstone, P.J., Macdonald, D.W. and Firbank, L.G. (1995). The Effects of Organic and Conventional Systems on the Abundance of Pest and Non-Pest Butterflies. In : *Integrated Crop Protection : Towards Sustainability ?* BCPC/SFS Symposium No 63, pp.261-267.

Food and Drug Administration. (1990). *Food and Drug Administration Pesticide Program Residues in Foods: 1989*. Journal of the Association of Official Analytical Chemistry.

Food Standards Agency (2000). *Position Paper. Food Standards Agency View on Organic Foods*. Food Standards Agency.

Ford, J. (2000). *G.L.S. Shackle*. Edward Elgar Publishing Limited. Chapter 3. Shackles Theory of Decision Making Under Uncertainty: Exposition; exegetical critique; and some applications, pp. 70-125.

Foster, V., Bateman, I., and Harley, D. (1997). Real and Hypothetical Willingness to Pay for Environmental Preservation: A Non-Experimental Comparison. *Journal of Agricultural Economics*, **48(2)**, 123-138.

Fowler, S., Lampkin, N. and Midmore, P. (1998). *Organic Farm Incomes in England and Wales 1995/96*. Aberystwyth : Welsh Institute of Rural Studies, University of Wales.

Francis, C. And Youngberg, P. (1990). Sustainable Agriculture. In: *Sustainable Agriculture in Temperate Zones* (Eds. C. Francis, C., Butler Flora, L. King) pp. 1-120. New York: Wiley Interscience.

Fresco, L. and Kroonenberg, S. (1992). Time and Spatial Scales in Ecological Sustainability. *Land Use Policy*, **9**, 155-168.

Frick, G. and Andrews, R. (1965). Aggregation Bias and Four Methods of Summing Farm Supply Functions. *Journal of Farm Economics*, **47(3)**, 696-700.

Fuller, R.J., Gregory, R., Gibbons, D., Marchant, J., Wilson, J. Baillie, S., Carter, N. (1995). Population declines and range contractions among lowland farmland birds in Britain. *Conservation Biology*, **9**, 1425-1441.

Furness, R.., Greenwood, J., and Jarvis, P. (1993). Can birds be used to monitor the environment. In : *Birds as Monitors of Environmental Changes* (Eds. R. Furness and J. Greenwood), pp. 23.

FWAG. *Farming and Field Margins*. Farming and Wildlife Advisory Group.

FWAG. *Hedges and Field Boundaries*. Farming and Wildlife Advisory Group.

Garod, G. and Willis, K.G. (1995). Valuing the Benefits of the South Downs Environmentally Sensitive Area. *Journal of Agricultural Economics*, **46(2)**, 160-173.

Gimingham, C.H. (1992). *The Lowland Heath Management Handbook*. English Nature Science No 8. English Nature.

Goss, M.J., Colburn, P., Harris, G.L. and Howse, K.R. (1988). In : *Nitrogen Efficiency in Agricultural Soils* (Eds. D.S. Jenkinson and K.A. Smith), pp. 269-282. Barking : Elsevier Applied Science.

Gray, A. (1994). Suspected adverse reaction surveillance scheme 1992: Summary of Results. *Veternary Record*, **135**, 77-81.

Green, M.R., Ogilvy, S.E., Frampton, G.K., Cilgi, T., Jones, S., Tarrant, K., and Jones, A. (1995). SCARAB : The Environemental Implications of Reducing Pesticide Inputs. In : *Integrated Crop Protection : Towards Sustainability ?* BCPC/SFS Symposium No 63, pp.321-330.

Gregory, N.G. (2000). Consumer Concerns About Food. *Outlook on Agriculture*, **Vol 29(4)**, 251-257.

Greig-Smith, P, Frampton, G, Hardy, T (1992). Pesticides, Cereal Farming and the Environment. The Boxworth Project. MAFF Publications.

Greig-Smith P, and Griffin, M.J. (1992). Summary and Recommendations. *Idid,* pp 200-215.

Gressel, J. (1987). Strategies for the prevention of herbicide resistance in weeds. In : Rational pesticide use (Eds. K.J. Brent and R.K. Atkin) pp. 183-196. Cambridge : Cambridge University Press.

Grunert, K. (2001*). European Consumers attitudes to the use of genetic modification in food production.* Paper Presented at the Agricultural Economics Society Conference, Harper Adams University College , September 2001.

Guy, R. (1989). Ethical Problems in Farming Practice. In : *The Status of Animals : Ethics Education and Welfare* (Eds. D. Paterson & M. Palmer). CAB International, pp. 87-93.

Haigh, P. (1992). Grass silage effluent Production in England and Wales. In : *Forward with Grass into Europe. BGS Occasional Symposium No. 27.* (Eds. A. Hopkins & D. Younie), pp. 147-150.

Häni, F. (1989). The Third Way, a research project in ecologically orientated farming systems in Switzerland, pp. 51-66. *IOBC/WPRS Bulletin 1989/XII/5.* Wageningen, The Netherlands.

Häni,F. (1990). Farming systems research at Ipsach, Switzerland - The " Third way " project. *Swiss Journal of Agricultural Science*, **29**, 257-271.

Hanley, N., MacMillan, D., Wright, R. Bullock, C., Simpson, I., Parisson, D., and Crabtree, R. (1998). Contingent Valuation Versus Choice Experiments: Estimating the Benefits of the Environmentally Sensitive Areas in Scotland. *Journal of Agricultural Economics*, **49(1)**, 1-15.

Hansen, J.W. (1996). Is Agricultural Sustainability a Useful Concept ? *Agricultural Systems*, **50**, 117-143.

Hansen. J.W. & Jones. J.W. (1995). A Systems Framework for Characterizing Farm Sustainability. *Agricultural Systems.* **51**, 185-201.

Harrison, L. (1993). The Impact of the Agricultural Industry on the Rural Economy – Tracking the Spatial Distribution of the Farm Inputs and Outputs. *Journal of Rural Studies*, **9**, 81-88.

Harvey, D.R.(1991). Agriculture and the Environment : The Way Ahead. In :. *Farming and the Countryside : An Economic Analysis of External Costs and Benefits*, (Ed. N. Hanley) pp. 227. CAB International.

Hazell, P. (1971). A linear alternative to quadratic and semi Variance Programming for Farm Planning Under Uncertainty. *American Journal of Agricultural Economics*, **21**, 239-52.

Hazell, P. (1971). A linear alternative to quadratic and semi-variance programming for farm planning under uncertainty. *American Journal of Agricultural Economics* **53**, 53-62.

Hazell, P. and Norton, R. (1986). *Mathematical Programming for the Economic Analysis of Agriculture.* MacMillan Publishing Company.

Health and Safety Executive, (2001). *Pesticide Incidents Report 2000/2001.* Field Operations Directorate Investigations 1st April 2000-31 March 2001. Health and Safety Executive.

Henson, S. (1996). Consumer willingness to pay for Reductions in the Risk of Food Poisoning in the UK. *Journal of Agricultural Economics, 47(3),* 403-420.

Herdt, R.W. and Steiner, R.A. (1995). Agricultural Sustainability, Concepts and Conundrums. In : *Agricultural Sustainability : Economic, Environmental and Statistical Considerations* (Eds. V. Barnett, R. Payne and R. Steiner), pp. 3-13. John Wiley & Sons.

Higley, L.G. and Peterson. R.K.D. (1996). Environmental Risk and Pest Management. http//:www.ent.agri.umn.edu/academics/ classes/ipm/ chapters/higley.htm (11 Dec. 96).

Higley, L.G. and Wintersteen, W.K. (1992). A novel approach to environmental risk assessment of pesticides as a basis for incorporating environmental costs into economic injury levels. *American Entomology*, **38,** 34-39.

Hird, V. (1997). *Double Yield : Jobs and Sustainable Food Production.* SAFE Alliance.

HMSO (1992a). *Statutory Instrument No 2111, 1992. The organic products regulations 1992.* HMSO : London.

HMSO (1992b). *Freshwater Quality.* Royal Commission on Environmental Pollution. HMSO. London.

HMSO (1994). *Biodiversity – The UK Action Plan.* HMSO. London.

HMSO (1996a). *Indicators of Sustainable Development for the United Kingdom.* Government Statistical Service. HMSO. London.

HMSO (1996b). *This Common Inheritance*, 1996 Annual Report. Reporting on the UK's Sustainable Strategy of 1994. HMSO. London.

HMSO (1996c). *Sustainable Use of Soil.* Royal Commission on Environmental Pollution 19th Report. HMSO : London.

HMSO (1997). *This Common Inheritance*, 1997 Annual Report. Reporting on the UK's Sustainable Strategy of 1994. HMSO. London.

HMSO (2000). *Statutory Instrument No 1870, 2000. The Welfare of Farmed Animals (England) Regulations 2000* . HMSO. London.

Hocking, P.M. (1994). Role of Genetics In Safeguarding and Improving The Welfare of Poultry. In : *Proceedings of the 9th European Poultry Conference. Glasgow UK August 7-12th 1994*, pp. 233-236.

Hodges, R.D. (1981). A Qualitative Comparison between conventional and biological agriculture. In : *Biological agriculture. A scientific approach to organic f*arming (Ed. B. Stonehouse). Butterworths, London. UK.

Holland, J.M., Frampton, G.K., Cilgy, T. and Wratten, J.D. (1994). Arable acronyms analysed. A review of integrated arable farming systems research in Western Europe. *Annals of Applied Biology*, **125**, 399-438.

Holliday, R.J. (1991). Peace of Mind from Extensification. In : *Grass on the Move* (Ed. A. Hopkins), pp. 13-19.

Holtz, S. (1991). Reporting Environmental Information. In : *Environmental Information for the 21st Century*. Proceedings Environmental Information Forum. Montreal Canada, May21-24th, pp. 128-144.

Hope, C and Parker, J. (1990). Environmental information for all : the need for a monthly index. *Energy Policy*, **18(4)**, 312-319.

Hope, J. and Lingard, J. (1992). The influence of risk aversion on the uptake of Set-aside: A MOTAD and CRP approach. *Journal of Agricultural Economics*, **43(3)**, 401-411.

Hopkins, A., Davies, D.A., Doyle, C.J. (1995). White Clover its Present Role and Future. Prospects in British Grassland Farming. *Journal of the Royal Agricultural Society of England*, **156**, 11-23.

Howitt, R.E. (1994). *New Economic Modelling Methods For Measuring Agricultural and Environmental Interaction.* Paper Presented At The Agricultural Economics Association Annual Conference. Exeter April 8-11th 1994.

Howitt, R.E. (1995a). A Calibration Method For Agricultural Economic Production Models. *Journal of Agricultural Economics*, **46(2)**, 147-159.

Howitt, R.E. (1995b). Positive Mathematical Programming. *American Journal of Agricultural Economics*, **77**, 329-342.

Hubbard, L. and Ritson, C. (1997). Reform of the CAP : From Mansholt to MacSharry. In *The Common Agricultural Policy* (Eds C. Ritson and D. Harvey). CAB Publications, pp. 81-94.

Hussanein, N. and Kloppenburg, J. (1995). Where the Grass Grows Again: Knowledge Exchange in the Sustainable Agriculture Movement. *Rural Sociology* **60(4)**, 721-740.

Jackson, G.H. (1992). Towards Sustainable Crop Production Technologies. IXth Royal Show International Symposium. *Journal of the Royal Agricultural Society of England, 153,* 160-168.

Jansen, D.M., Stoorvogel. J.J., and Schipper, R.A. (1995). Using sustainability indicators in agricultural land use analysis: an example from Costa Rica. *Netherlands Journal of Agricultural Science*, **43**, 61-82.

Johns, P. and Leat, P. (1985). *An Input-Output Model for the Grampian Region.* The North of Scotland College of Agriculture.

Johnston, A.E. (1991). Potential changes in soil fertility from arable farming including organic systems. *Proceedings of the Fertiliser Society no 306.*

Jones, P. J., Rehman, T., Harvey, D.R., Tranter, R. B., Marsh, J. S., Bunce, R. G. H., & Howard, D. C. (1995) *Developing LUAM (Land Use Allocation Model) and modelling CAP reforms.* CAS Paper 32. The University of Reading, Centre for Agricultural Strategy.

Jordan, V and Stinchcombe, G. (1986). Interactions between fungicide, plant growth regulator, nitrogen fertiliser applications, foliar disease and yield of Winter barley. *Annals of Applied Biology*, **108**, 151-165.

Jordan, V, Hutcheon, J, Donaldson, G. and Farmer, D. (1995). Research into and development of Integrated Farming Systems for Less Intensive Arable Crop Production: Progress 1989-1994. In : *Integrated Crop Protection : Towards Sustainability ?* BCPC/SFS Symposium No 63, pp.287-295.

Jordan, V., Hutcheon, J. and Perks, D.A. (1990). Approaches to the Development of Low Input Farming Systems. In : *Crop Protection in Organic and Low Input Agriculture.* Proceedings of a symposium organised by the British Crop Protection Council (Ed. R. Unwin,), pp. 9-17.

Jordan, V., Stinchcombe G., and Hutcheon, J. (1989). Fungicide and nitrogen applications in relation to the improvement of disease control and yield in Winter barley. *Plant Pathology,* **38,** 26-34.

Jordan, V., Stinchcombe G., and Todd S. (1985). Interaction of nitrogen growth regulators and fungicide applications with Winter barley disease and Yield. *Fungicides for Crop Protection, BCPC Monograph No. 31,* 367-370.

Köbrich, C. and Rehman, T. (1996). Sustainability and the MCDM Paradigm. Model Constuction and Optimization. Paper Presented at the VII Congress of the European Association of Agricultural Economists. Edinburgh, September 1996.

Kirke, A. and Moss, J. (1987). A Linear Programming Study of Family Run Dairy Farms in Northern Ireland. *Journal of Agricultural Economics*, **37(2)**, 257-269.

Klepper, R., Lockeretz, W., Commoner, B., Gertler, M., Fast, S., O'Leary, D. and Blobaum, R. (1977). Economic Performance and Energy Intensiveness on Organic and Conventional Farms in the Corn Belt : A Preliminary Comparison. *American Journal of Agricultural Economics*, **59(1)**, 1-12.

Knorr, D. and Watkins, T.R. (Eds.). (1984). *Alterations in Food Production.* Van Nostrand Reinhold. New York.

Kovach, J., Petzoldt, C., Degni, J. and Tette, J. (1992). A Method to Measure the Environmental Impact of Pesticides. *New York's Food and Life Sciences Bulletin*, **139,** 1-8.

Kruseman, G., Ruben, R., Kuyvenhoven, A., Hengsdijk, H. and van Keulen, H. (1995). Analytical Framework for Disentangling the Concept of Sustainable Land Use. *Agricultural Systems*, **50**, 191-207.

Lal, R. (1991). Tillage and Agricultural Sustainability. *Soil and Conservation Research*, **20**, 133-146.

Lampkin, N. (1990). *Organic Farming.* Farming Press Books.

Lampkin, N. (1994) Estimating the Impact of Widespread Conversion to Organic Farming on Land Use and Physical Output in the United Kingdom. In : *The Economics of Organic Farming : An International Perspective* (Eds. N. Lampkin & S. Padel). CAB International.

Lampkin, N. (1995). Economic Issues in Sustainable Soil Management. In : *Soil Management In Sustainable Agriculture,* (Eds. H.F. Cook and H.C. Lee). pp. 71-83. Ashford: Wye College Press.

Landis, D.A and Orr, D.B. (1996). *Biological Control : Approaches and Applications.* http://www.ent.agri.umn.edu/academics/classes/ipm/chapters/landis.htm. (Visited 11th December 1996).

Lass, L.W. and Callihan, R.H. (1993). GPS and GIS for Weed Surveys and Management. *Weed Technology*, **7**, 249-254.

Lazarus, P. (1993). What is animal welfare? *New Farmer and Grower*, **Autumn 1993**, 34-35.

Le Neindre, P. (1993). Evaluating Housing Systems for Veal Crates. *Journal of Animal Science*, **71:5**, 1345-1354.

LEAF (2001). Linking the Environment and Agriculture. http://www.countrylife.org.uk/leaf/active.htm. (Visited 5th January 2001).

Leat, P. and Chalmes, N. (1991). Analysing agricultural adjustment in Grampian using an input/outpur model of the agricultural and food complex. In : Midmore, P. (Ed.). *Input-output models in the agricultural sector*, pp. 57-71. Aldershot: Avebury.

Levitan, L., Merwin, I. and Kovach, J. (1995). Assessing the relative environmental impacts of agricultural pesticides the quest for an holistic method. *Agriculture, Ecosystems and Environment*, **55**, 153-168.

Lindo Systems (1999). www.lindo.com. (Visited 20th December 1999).

Lockertz W., Klepper, R., Commoner, B., Gertler, M., Fast, S., O'Leary, D., Blobaum, R. (1980). Economic and Energy Comparison of Crop Production on Organic and Conventional Corn Belt Farms. In : *Agriculture and Energy* (Ed. W. Lockertz). Academic Press. London, pp. 85-101.

Lockertz W. (1980). Energy Inputs for Nitrogen, Phosphorous and Potash Fertilisers. In *Handbook of Energy Utilisation in Agriculture.* (Ed. D. Pimentel), pp. 23-24. CRC Press, Boca Raton, Florida.

Lutz, L. (Ed.). (1993). *Toward Improved Accounting for the Environment.* Washington DC: The World Bank.

Lynam, J.K. and Herdt, R. (1989). Sense and Sustainability: Sustainability as an objective in international research. *Agricultural Economics*, **3**, 381-398.

Lysyk. T. (1996). Livestock IPM. http//:www.ent.agri.umn.edu/academics/classes/ipm/chapters/lysyk.htm (Visited 11th December 96).

McDonald, S. and Roberts, D. (1998). The Economy-Wide Effects of the BSE Crisis: A CGE Analysis. *Journal of Agricultural Economics*, **49(1)**, 458-471.

MacGillivray, A. (1995). Indicators, Indicators Everywhere. In : *Accounting for change, Papers from an International Seminar, Toynebee Hall, October 1994* (Ed. A. MacGillivray), pp. 11-14. The New Economics Foundation.

MacGillivray, A., and Kayes, R. (1995). *Environmental Measures : Indicators for the UK Environment.* Environment Challange Group (Friends of the Earth, International Institute for Environment and Development, The New Economics Foundation, The Royal Society for Nature Conservation - the Wildlife Trusts partnership. The Royal Society for the Protection of Birds, World Wide Fund for Nature UK, Wildlife and Countryside Link), 1995.

MacGillivray,A. and Zadek, S. (1995). *Accounting for change. Indicators for Sustainable Development.* The New Economics Foundation.

MAFF (1980). *Energy conservation in agriculture an assessment of some practical opportunities B2287.* HMSO. London.

MAFF (1987a). *Codes of Recommendation For the Welfare of Livestock : Pigs.* HMSO. London.

MAFF (1987b). *Codes of Recommendation For the Welfare of Livestock : Domestic Fowls.* HMSO. London.

MAFF (1992). *Digest of Agricultural Census Statistics.* HMSO. London.

MAFF (1995). *Farm Waste Management Plans : Making Better Use of Nutrients while Minimising the Risk of Water Pollution. PB2298.* HMSO. London.

MAFF (1996). *Seventh Report of the Working Party on Pesticide Residues.* 16th September 1996. MAFF & D.o.E. HMSO. London.

MAFF (1997). http://www.maff.gov.uk/esg/statinfo/statlist.htm (Visited 22nd May 1997).

MAFF (1998a). *Code of Good Agricultural Practice For the Protection of Water (The Water Code).* HMSO. London.

MAFF (1998b). *Code of Good Agricultural Practice For the Protection of Air (The Air Code).* HMSO. London.

MAFF (1998c). *Code of Good Agricultural Practice For the Protection of Soil (The Soil Code)*. HMSO. London.

MAFF (1998d). *Pesticides : Code of Practice for the Safe Use of Pesticides on Farms and Holdings*. HMSO. Health and Safety Executive. London.

MAFF (1998e). *Digest of Agricultural Census Statistics*. HMSO. London.

MAFF (2000a). *Towards Sustainable Agriculture*. A Pilot Set of Indicators. HMSO.

MAFF (2000b). www.maff.gov.uk. (Visited at 25th April 2000).

MAFF (2000c). *Fertiliser Recommendations For Agricultural and Horticultural Crops (RB 209)*. HMSO. London.

MAFF (2000d). *CAP Reform Agreement – An information document. Agenda 2000 CAP reform – the outcome*. HMSO. London.

Marshall E.J.P. (1987). *Using Decision Thresholds for the Control of Grass and Broad-Leaved Weeds at the Boxworth E.H.F.* In : Weeds. Proceedings of the 1987 British Crop Protection Conference, pp. 1059-1066.

Martin, S. and Seeland, G. (1999). Effects of Specialisation in cattle production on ecologically harmful emissions. *Livestock Production Science*, **61**, 171-178.

McInerney , J. (1967). "Maximin" programming - An approach to farm planning under uncertainty. *Journal of Agricultural Economics*, **18(2)**, 279-289.

McInerney, J. (1969). Linear Programming and Game Theory Models - Some Extensions. *Journal of Agricultural Economics*, **20(2)**, 269-278.

McInerney, J. (2002). Re-orientating UK Agriculture. *Farm Management*, **11(4)**, 217-241.

Midmore, P. (1987). The impact of farm prosperity on the rest of the Welsh economy. Discussion Paper, Department of Agricultural Economics and Marketing, University of Wales, Aberystwyth.

Midmore, P. (1991). Input-Output in Agriculture: A Review. In : *Input-Output Models in the Agricultural Sector* (Ed. P.Midmore), pp. 5-20.

Midmore, P. and Lampkin, N. (1994). Modelling the impact of widespread conversion to organic farming : An overview. In : *Input-output models in the agricultural sector*, (Ed. P. Midmore), pp.371-380. Aldershot: Avebury

Midmore, P., Russell, S., and Jenkins, T. (1995). *Developing a Holistic Approach to the Concept of Environmental Quality*. A Report for Scottish Natural Heritage. University of Wales, Aberystwyth.

Millington, S, Stopes, C and Woodward, L. (1990). Rotational design and the limits of organic systems. The stockless organic farm? In : *Crop protection in organic and low input agriculture*: Proceedings of a symposium organised by the British Crop Protection Council (Ed. R. Unwin) pp. 163-173. Farnham : BCPC.

Milne, J. (1995). Grazing intensity and vegetation change. In : Livestock Production and Land Use in Hills and Uplands. Occasional Publication No 18 - British Society of Animal Production 1994 (Eds. T. Lawrence, D. Parker, P. Rowlinson), pp. 23-29.

Mintel (1999). Organic Food and Drink. Mintel International Group Limited. November 1999.

Mitchell, M. (1996). Measuring the regional economic impact of pluriactivity on Scottish farms. In : *Rural Economic Modelling: An Input-Output Approach* (Eds. P. Midmore and L. Harrison-Mayfield), pp. 35-44. Wallingford: CAB International.

Morris, M.G. and Rispin, W.E., (1994). Rotational Management of Grasslands and Invertebrate Diversity. In : *Grassland Management and Nature Conservation*, (Eds. R.J. Haggar and S. Peel), pp. 205-209.

Morrison, J., Jackson, M.V., and Sparrow, P.E. (1980). The response of perennial ryegrass to fertiliser nitrogen in relation to climate and soil. GRI Technical Report No 27. Grassland Research Institute, Hurley.

Morton, R.W. (1965). An index number system for rating environmental quality. *Journal of Water Pollution Control, 37,* 300-306.

Moscardi, E. and de Janvry, A. (1977). Attitudes towards risk Among Peasants: An Econometric Approach, *American Journal of Agricultural Economics*, **46(2),** 227-232.

Moss, S.R. and Cussans, G.W. (1991). The Development of herbicide resistant populations of *alopecurus myosuroides* (black grass) in England. In : *Herbicide resistance in weeds and crops* (Eds. J.C. Casey, G.W. Cussans, R.K. Atkin), pp. 45-55. Oxford : Blackwell Scientific Productions.

Moule,G. (1988). Diseases of Crops. In : *Primrose McConnels Agricultural Notebook* (Ed. R.J. Halley & R.J. Soffe),pp. 265-287.

Murphy, M.C.(1992a). *Organic Farming as a Business in Great Britain.* Agricultural Economics Unit, University of Cambridge, Cambridge.

Murphy, M.C.(1992b). *Farming, Food Consumption and the Environment.* In : The Ecology of Temperate Cereal Fields. (Eds. C.G. Firbank, N. Carter, J.F. Darbyshire and G.R. Potts) pp. 69-91. Oxford Blakewell Scientific Publications.

NAWAD (2001). *Farming for the Future – A New Direction for Farming in Wales.* National Assembly for Wales Agriculture Department.

National Food Survey (2001). *National Food Survey 2000.* MAFF Publications. HMSO. London.

NCC (1992). *Nature Conservation and Agricultural Change No 25,* pp. 16. Nature Conservancy Council.

Neville, W. and Mordaunt, F. (1993). *A Guide to the Reformed Common Agricultural Policy.* Estates Gazette. London.

Newman, S.M. (1992). Agroforestry : Complementary or Alternative to Farm Woodlands ? In : *Proceedings of NAC Conference Farm Woodlands Real Crops for Real Needs.* Jointly Organised by RASE and Fountain Forestry. 3rd November 1992 at the NAC.

NFU (2001). *Farm Risk Management: Overcoming the Obstacles.* NFU Economics Report, February 2001.

NIAB/PMB (1993). *Potato Diseases.* National Institute of Agricultural Botany & Potato Marketing Board.

Nicholson, R.J. (1994). Sources of Water Pollution. In *: Proceedings of the 9th European Poultry Conference. Glasgow UK.* August 7-12th 1994, pp. 260-263.

Nilsson, T. (1979). Yield, storage ability, quality and chemical composition of carrot, cabbage and leek at conventional and organic fertilizing. *Acta Hort,* **93,** 209-223.

NISRA (2001). www.nisra.gov.uk . Northern Ireland Statistics and Research Agency. Visited 10th January 2001.

Nix, J. (1997). *Farm Management Handbook. 27th Edition 1997.* Wye College, University of London.

Njos, A. (1994). Future land utilization and management for sustainable crop production. *Soil and Tillage Research*, **30**, 345-357.

NRA & MAFF (1989,1990). *Water Pollution From Farm Waste.* National Rivers Authority, MAFF.

NRA. (1995). *Pesticides in the Aquatic Environment.* National Rivers Authority Water Quality Series No. 26.

O'Brien D.J., Parker, L.D., Menton,C., Keaveny, C., McCollum,E., O'Laoide,S. (1995) Treatment and Control of *psoroptic mange* (sheep scab) with moxidectin. *Veterinary Record*, **139**, 437-439.

O'Donovan, J.T. (1995). Computerised decision support systems : Aids to rational and sustainable weed management. *Canadian Journal of Plant Science*, **76(1)**, 3-7.

O'Riordan, T. (1985). What does sustainability really mean ? : In Sustainable development in an Industrial Economy, CEED Report 1985.

OECD (1994). Towards Sustainable Agricultural Production: Cleaner Technologies. OECD Paris.

OECD (1995a). *Sustainable Agriculture. Concepts Issues and Policies in OECD Co*untries. OECD Paris.

OECD (1995b). *Environmental Indicators OECD Core Set.* OECD Paris.

OECD (1995c). *Environmental Data Compendium 1995.* OECD Paris.

OECD (1997). *Environmental Indicators for Agriculture.* OECD Paris.

OECD (2001). *Environmental Indicators for Agriculture. Volume III Methods and Results.* OECD Paris.

Ogilvy, S.E. (Ed.). (2000). *Link Integrated Farming Systems (A field scale comparison of arable rotations). Volume I : Experimental Work.* HGCA No. 173.

Ogilvy, S.E., Turley, D.B., Cook, S.K., Fisher, N.M., Holland, J., Prew, R.D. and Spink, J. (1994). Integrated farming - putting together systems for farm use. *Aspects of Applied Biology 40, Arable farming under CAP reform*, 53-68.

Ogilvy, S.E., Turley, D.B., Cook, S.K., Fisher, N.M., Holland, J., Prew, R.D. and Spink, J. (1995). LINK Integrated Farming Systems : A Considered Approach to Crop Protection. In : *Integrated Crop Protection :Towards Sustainability?* BCPC/SFS Symposium No 63, pp.331-338.

Oglethorpe, D. (1995). Sensitivity of Farm Plans Under Risk Adverse Behaviour: A note on the Environmental Implications, *Journal of Agricultural Economics*, **46(2)**, 227-232.

Olson, K.D., Langley, J., Heady, E.O. (1982). Widespread adoption of organic farming practices : Estimated impacts on US Agriculture. *Journal of Soil and Water Conservation*, **37**, 41-45.

Ott, W.R. (1978). *Environmental indices : theory and practice.* Ann Arbor, Michigan : Ann Arbor Science.

Pandey, S. and Hardaker, J. (1995). The role of modelling in the quest for sustainable farming systems. *Agricultural Systems*, **47**, 439-450.

Papandas, C. and Dahl, D. (1999). Supply Driven Input-Output Multipliers. *Journal of Agricultural Economics*, **50(2)**, 269-285.

Parish, S. (1990). A review of non-chemical weed control techniques. *Biological Agriculture and Horticulture*, **7**, 117-137.

Parliamentary Office of Science and Technology (1998). *Genetically Modified Foods, Benefits and Risks, Regulation and Public Acceptance.* The Parliamentary Office of Science and Technology.

Parris, K. (1994). *Environmental Indicators for Agricultural Policy Analysis.* Paper Presented at the Agricultural Economics Society Annual Conference 8-11th April 1994. University of Exeter.

Parris, K. (1995). OECD Agri-Environmental Indicators : Preliminary Work. Paper Presented to the Resource Policy Consortium Symposium. *"Developing Indicators for Environmental Sustainability : The Nuts and Bolts".* Washington D.C. United States 12-13th June 1995.

Pearce, D. and Freeman, S. (1991). Information requirements of Policy Decision Makers. In : Environmental Information for the 21st Century. Proceedings Environmental Information Forum. Montreal Canada, May21-24th,pp. 128-144.

Pedigo, L.P. (1996). Economic Thresholds and Economic Injury Levels. http://www.ent.agri.umn.edu/academics/classes/ipm/chapters/pedigo.htm (Visited 11th Dec 1996).

Penny, A., Widdowson, F.V. and Jenkyn, J.F. (1986). Results from experiments on Winter Barley measuring the effects of amount and timing of nitrogen and some other factors on the yield and nitrogen content of the grain. *Journal of Agricultural Science, Cambridge,* **106,** 537-549.

Pesticides Residue Committee (2002). *Annual Report of the Pesticide Residues Committee 2001.* HMSO. London.

Pimental, D. (1984). *Alternatives for reducing energy inputs in crop production.* CAB International.

Pimental, D., Culliney, T.W., Bashore, T. (1996). Public health risks associated with pesticides and natural toxins in foods. http://www.ent.agri.umn.edu/academics/classes/ipm/chapters/pimental.htm (11th December 1996).

Plumb, R. (1995). Sustainable Production Systems. In : *Institute of Arable Crops Research Annual Report 1995.*

Pooley, J. (1996). Rural Stress - Growing Your Business in an Adverse Climate. *Agricultural Progress,* **71,** 37-43.

Pretty, J. and Howes, R. (1993). *Sustainable Agriculture in Britain : Recent Achievements and New Policy Challenges.* Sustainable Agriculture Programme of the International Institute for Environment and Development.

Pretty. J.N. (1995). *Regenerating Agriculture.* pp.11. EarthScan.

Pretty, J.N., Brett, C., Gee, D., Hine, R., Mason, C., Morison, J., Raven, H., Rayment, M., van der Bijl, G. (2000). An assessment of the total external costs of UK Agriculture. *Agricultural Systems,* **65,** 113-136.

Quinn, F. and G. Edwards-Jones. (1997). The use of impact ranking indices in the regulation of pesticide use: an examination of the strengths and weaknesses. *Paper presented at the annual Agricultural Economics Society Conference,* Edinburgh University, March 21st-23rd, 1997.

Raj, A B. M. and Gregory, N.G. (1996). Welfare Implications of the Gas Stunning of Pigs 2. Stress of Induction of Anaesthesia. *Animal Welfare, 5,* 71-78.

Raymond, W.F. (1991). The Role of 'Mid Tech' Farming. *Journal of Farm Management,* **7(9),** 443-450.

Reed, J. (2000). Rural Scotland, Adaptation, Businesses and Communities. Consequences for the Agricultural Supply Industry. Paper Presented at the SAC Outlook Conference. Edinburgh, November 2000.

Richardson, H. (1972). *Input-Output and Regional Economics*. Weidenfeld and Nicolson. London, pp 115-130.

Rigby, D. and Caceres, D. (1997). *The Sustainability of Agricultural Systems. Paper No. 10.* Institute For Development Policy and Management. University of Manchester.

Rigby, D., Howlett, D. and Woodhouse, P. (2000). *A Review of Indicators of Agricultural and Rural Livelihood Sustainability.* Sustainability Indicators for Natural Resource Management and Policy. Working Paper Series. Paper No 1. Institute for Development Policy and Management, University of Manchester.

Roberts, R. (1992a). The Strengths and Weaknesses of Grassland Farming in an Environmental Context. In : *Forward with Grass into Europe. BGS Occasional Symposium No. 27.* (Eds. A. Hopkins & D. Younie), pp. 53-61.

Roberts, D. (1992b). *UK Agriculture in the Wider Economy: An Analysis using a Social Accounting Matrix.* PhD Thesis. University of Manchester.

Roderick, S., Short, N. and Hovi, M. (1996). *Organic Livestock Production. Animal Health and Welfare Research Priorities.* The University of Reading. Veterinary Epidemiology and Economics Research Unit. 24th October 1996.

Rolston, M.P. (1987). Herbicide Effects. In : *White Clover* (Ed. W.M. Williams). CAB International, pp. 513.

Russell, N. and Fraser, I.M. (1995). The Potential Impact of Environmental Cross-Compliance on Arable Farming. *Journal of Agricultural Economics*, **46(1)**, 70-79.

SAC (1991). *Farm Management Handbook 1991/92.* Scottish Agricultural College. SAC Publications. Edinburgh.

SAC (1993). Fertilisers, Manures, Slurries and Waste Management Plans. SAC Publications. Edinburgh.

SAC (1997). *Farm Management Handbook 1997/98.* Scottish Agricultural College. SAC Publications. Edinburgh.

SAC (1998). *Recommended Grass and Clover Varieties.* Technical Note T476. SAC Publications. Edinburgh.

Sands, G. and Podmore, T. (2000). A Generalized Environmental Sustainability Index for Agricultural Systems. *Agriculture, Ecosystems and the Environment*, **79**, 29-41.

SASA (1993). *Pesticide Usage in Scotland, Usage of Pesticides on Sheep 1993.* Scottish Agricultural Science Agency.

Savory, J. and Hughes, B.O. (1993). *Proceedings 4th European Symposium on Poultry Welfare* (Eds.) Potters Bar: UFAW, pp. 87-125 and 125-157.

Scottish Natural Heritage (2000). TIBRE - Targeted Inputs for a Better Rural Environment. New Options for Arable Farming. Scottish Natural Heritage.

Schulte, R., Earley, B. van der Wouw, S., and Culleton, N. (1998). Animal Welfare - Development of a Methodology for its Assessment. *Farm and Food*, Autumn 1998, 20-23.

SEERAD (2001). *A Forward Strategy for Scottish Agriculture.* Scottish Executive Environment and Rural Affairs Department.

Shackle, G.L. (1958). *Time in Economics.* Amsterdam: North Holland.

Shackle, G.L. (1961). *Decision order and Time in Human Affairs.* Cambridge : Cambridge University Press.

Shadbolt, N. and Morris, S. (1997). Financial Indicators of Sustainability for Farming Businesses and Families: A Conceptual Model to link these Indicators to those used for Environmental and Social Sustainability. In : *Proceedings of the 11th International Farm Management Congress Volume I, July 14th to 19th, Calgary Alberta Canada*, pp. 259-273.

Sheehy, S. and McAlexander, R. (1965). Selection of Representative Benchmark Farms for Supply Estimation. *Journal of Farm Economics*, **47(3)**, 681-695.

Shepherd C. (1990). Keeping Pigs Outdoors : A Producers View. In : *Outdoor Pigs : Principles and Practice* (Eds. B.A. Stark, D.H. Machin, J.M. Wilkinson). Chalcombe Publications, pp. 13-20.

Siriwardena, G., Ballie, S., Crick, H. and Wilson, J. (2001). Changes in Agricultural Land Use and Breeding Performance of some Granivorous Passerines in Great Britain. *Agriculture, Ecosystems and the Environment*, **84**, 191-206.

SOAFD (1991). Prevention of Environmental Pollution From Agricultural Activity. Scottish Office.

Soil Association (2000). *Standards for Organic Agriculture.* Soil Association Certification Ltd.

Soil Association (2001a). *Organic Farming, Food Quality and Human Health. A Review of the Evidence.* Soil Association Publications.

Soil Association (2001b). *Organic Food and Farming Report 2001.* Soil Association Publications.

Sotherton, N., Boatman, N., and Robertson, P. (1992). The use of set-aside land for game conservation. In *Set-aside.* Monograph No. 50. (Ed J. Clarke). Bracknell BCPC Publications. pp. 223-229

Spedding, C.R.W & Walsingham, J.M. (1976). The Production and Use of Energy in Agriculture. *Journal of Agricultural Economics*, **27**, 19-29.

Spedding, C.R.W. (1994). *Sustainability in Animal Production Systems*, Hammond Memorial Lecture, BSAS Winter Meeting.

Spellerberg, I.F. (1991). *Monitoring Environmental Change.* Cambridge : Cambridge University Press.

Spiertz, F. (1980). Grain production of wheat in relation to nitrogen, weather and diseases. In : *Association of applied biologists meeting 1979, Opportunities for increasing crop yields*, (Eds. R.G. Hurd, P.V. Briscoe, C. Dennis). London, Pitman, pp. 97-114.

Stallones, L. and Beseler, C. (2002). Pesticide poisoning and depressive symptoms among farm residents. *Annals of Epidemiology*, **12(6)**, 389-394.

Stanley, P.I. and Bunyan, P.J. (1979). Hazards to wintering geese and other wildlife from the use of dieldrin, chlorfenvinphos and carbophenothion. *Proceedings of the Royal Society, London*, **205**, 31-45.

Steen, R. and Laidlaw, A. (1986). The effects of low and high inputs of fertiliser nitrogen on the stock carrying capacity of grass/white clover swards. In *Grazing* (Ed. J Frame). BGS Occasional Symposium No 19, pp. 39-43.

Steinhart, C.E., Schierow, L.J., Sonzogni, W.C. (1982). An environmental quality index for the Great Lakes. *Water Resources Bulletin*, **18(6)**, 1025-1031.

Stewart, T.A. and Haycock, R.E. (1984). Beef production from low N and high N S24 perennial ryegrass/Blance white clover swards - a six year farm-let scale comparison. *Research and Development in Agriculture*, **1**, 103-113.

Stockdale, A., Findlay, A. and Short, D. (2000). *Journal of Rural Studies*, **16**, 243-257.

Stockle, C., Papendick, R., Saxton, K., Campbell, G., and van Evert, F. (1994). A Framework for evaluating the sustainability of agricultural production systems. *American Journal of Alternative Agriculture*, **9**, 45-51.

Stopes, C. (1990). Organic Farming and the Role of Livestock. In : *Extensive and 'Organic Livstock Farming Systems : Animal Welfare Implications.* Proceedings of a Symposium organised by the Universities Federation for Animal Welfare and the Humane Slaughter Association. September 10th-11th 1990, pp. 11-17.

Swanson, E. (1959). Selection of crop varieties: An illustration of game theoretic technique. *Revista Internationale di Scienze Economiche e Commercialli*, **6**, 3-14.

Swift, G., Vipond, J., Cleland, A. and Hunter, E. (1992). A Sustainable Grass-Clover Sward for Sheep. In In : *Forward with Grass into Europe. BGS Occasional Symposium No. 27.* (Eds. A. Hopkins & D. Younie), pp. 170-172.

Tait, E.J. (1987). Planning an IPM system. In : *Integrated Pest Management* (Eds. A.J. Burn, T.H. Coaker, P.C. Jepson), pp. 189-207.

Tate,W.B. (1994). Development of the Organic Industry and Market. In : *The Economics of Organic Farming : An Economic Perspective* (Eds. N.H. Lampkin & S. Padel),pp. 14-25.

Theunissen, J. (1995). Intercropping and Biological Control of Pests and Weeds. In : *Integrated Crop Protection : Towards Sustainability ?* BCPC/SFS Symposium No 63, pp. 27-31.

Tisdell, C. (1996). Economic indicators to assess the sustainability of conservation farming projects : An evaluation. *Agriculture, Ecosystems and the Environment*, **57**, 117-131.

Tomlin, C. (1997). *The Pesticide Manual. A World Compendium.* 11Th Edition. BCPC. Farnham.

Trewavas, A. (2001). Urban Myths of Organic Farming. *Nature*, **410**. 409-410.

Tregear, A., Dent, J.B. and McGregor, M.J. (1994). The Demand for Organically grown Produce. *British Food Journal*, **96(4)**, pp.21-25.

Tshirley. J. (1992). *The use of indicators for sustainable agriculture and rural development.* Rome: Food and Agriculture Organization of the United Nations, 1992. Conference World Resources Institute Workshop on Global Environmental Indicators. 1992, Washington D.C.

Turner, R. (1993). Sustainability: principles and practice. In : *Sustainable Environmental Economics and Management : Principles and Practice (* Ed. R. Turner) . Belhaven Press, London.

UKROFS (2001). *UKROFS Standards for Organic Food Production.* United Kingdom Register of Organic Food Standards.

UNCED. (1992). Earth Summit. Agenda 21. The United Nations programme of action form Rio. United Nations Publication.

UNEP (1997). *UN System wide Earthwatch Programme Document.* Off World wide web http://www.unep.ch/earthw.html (24th January 1997).

United Nations (1992). *Earth Summit Agenda 21 : The United Nations Programme of Action From Rio.* United Nations. New York.

United Nations (1993). *Integrated Environmental and Economic Accounting.* Series F, Number 61: New York.

Van der Hulst-Van Arkel, M.C. and Rump R. (1994). Microbiol control of Ammonia Volatilization From Poultry Manure. In : *Proceedings of the 9th European Poultry Conference. Glasgow UK August 7-12th 1994*, pp. 193-195.

Van Middlekoop J.H. , Veldkamp T. , Meijerhof R. and de Buisone F.E. (1994). Reduction of Ammonia Emission By Housing On a Ventilated Litter Floor. In : *Proceedings of the 9th European Poultry Conference. Glasgow UK August 7-12th 1994*, pp. 197-199.

Veeman, T.S.(1991). Sustainable Agriculture : An Economist Reaction. *Canadian Journal of Agricultural Economics*, **39**, 587-590.

Venus, C.A. and Cain, P.J. (1997). The Effect of likely future changes in hill farming support on farm incomes. *Farm Management*, **9(9)**, 440-452.

Vereijken, P. (1985). Alternative Farming Systems at Nagele: Preliminary Results and prospects. In : *Sustainable Agriculture and integrated farming systems 1984 conference proceedings* (Eds. C. Edens, C Fridgen, S Battenfield). East Lansing USA: Michigan State University Press.

Vereijken, P. (1989). Experimental Systems of integrated and organic wheat production. *Agricultural Systems*, **30**, 187-197.

Vereijken, P. (1990). Research on Integrated arable farming and organic mixed farming in the Netherlands. *Swiss Journal of Agricultural Research*, **29**, 249-256.

Viaux, P. and Rieu,C. (1995). Integrated Farming Systems and Sustainable Agriculture in France. In : *Integrated Crop Protection : Towards Sustainability ?* BCPC/SFS Symposium No 63, pp.297-303.

Viaux, P., Roturier, C. and Bouchet, C. (1993). Integrated arable farming systems in France. *Proceedings of Conference on Integrated Arable Farming Systems*, Nitra, 18-20 August, 1993, pp. 24-33.

Vine,D. And Bateman,D.(1981). *Organic Farming Systems in England and Wales. Practice Performance and Implications.* University of Wales, Aberystwyth.

WAC (1993). *Grassland Planning for Efficient Livestock Production.* A study manual prepared the Crop Production Department. Welsh Agricultural College, Aberystwyth.

Walker, N., and Dillon, L. (1976). Development of an Aggregate Programming Model of Australian Agriculture. *Journal of Agricultural Economics*, **27(2)**, 243-247.

Walker, O., Heady, E., Tweeten, L., and Pesek, J. (1960). Application of Game Theory Models to Decisions on Farm Practices and Resource Use. Iowa State University Agriculture Experimental Station, Research Bulletin No. 488, Ames, IA.

Walker, P. (1995). Local Sustainability Indicators. In : *Accounting for change, Papers from an International Seminar, Toynebee Hall, October 1994* (Ed. A. MacGillivray), pp. 69-71. The New Economics Foundation.

Waterhouse, A. (1994). Extensification - implications for animal performance, health and welfare. In : *Livestock Production and Land Use in Hills and Uplands.* Occasional Publications No 18 - British Society of Animal Production 1994 (Ed. T.L. J. Lawrence, D.S. Parker and P. Rowlinson),pp. 43-51.

Watson, C.A., Fowler, S.M. and Wilman, D. (1993). Soil inorganic-N and nitrate leaching on organic farms. *Journal of Agricultural Science*, **120**, 361-369.

Watt, A.S. & Jones, E.W. (1960). The ecology of the Cairngorms. Part I. The environment and altitudinal zonation of vegetation. *Journal of Ecology*, **36**, 283-304.

Webster J. (1995b). *Farm Animal Welfare : A Cool Eye Towards Eden.* Blackwell Scientific Publishing.

Webster J.P.G. (1995a). Analysing the Economic consequences of sustainability in farming systems. In : *Integrated Crop Protection : Towards Sustainability ?* BCPC/SFS Symposium No 63, pp. 3-12.

Webster, J. and Kennedy, J. (1975). Measuring Farmers Trade-offs between expected income and Focus-Loss income. *American Journal of Agricultural Economics*, **57(1)**, 97-105.

Webster, J.P.G. (1997). Assessing the economic consequences of sustainability in agriculture. *Agriculture, Ecosystems and the Environment*, **64(2)**, 95-102.

Webster, J..P.G. (1999). The Challenge of Sustainability at the Farm Level: Presidential Address. *Journal of Agricultural Economics*, **50(3)**, 371-387.

Whitby, M. and Adger, N. (1996). Natural and Reproducible Capital and the Sustainability of Land Use in the UK. *Journal of Agricultural Economics*, **47(1)**, 50-65.

Whitney, (1988). Choosing and Using Farm Machines.

Wibberley, J. (1995). Cropping Policy & Farming Systems: Integrity & Intensity in International Perspective. *Jornal of the Royal Agricultural Society of England*, **156**, 43-55.

Widdowson, R. (1987). *Towards Holistic Agriculture : A Scientific Approach.* Pergamon Press : Oxford, pp. 154.

Wijnands, J. (1980). Farm Planning with the Risk Crop Seed Potatoes; A Comparison and an Application of Methods of Risk Programming. In : *Consideration and Modelling of Risk in the Agribusiness Sector* (Eds. C Hennig Hauf & G Scheifer). Proceeding of the Second Symposium of the European Association of Agricultural Economists. Kiel 16th-18th September 1980.

Wilkins, R. and Harvey, J. (1993). Management Options to achieve Agricultural and Nature Conservation Management Objectives. In : *Grassland Management and Nature Conservation. BGS Occasional Symposium No 28* (R.J. Haggar & S. Peel), pp. 86-94.

Wilson, E.J., Wells, T.C.E. and Sparks (1994). Are calcareous grasslands in the UK under threat from nitrogen deposition ? an experimental determination of a critical load. *Journal of Ecology*, **83**, 823-832.

Wilson, M.J., Hughes, L.A. and Glen, D.M. (1995). Developing Strategies for the Nematode, *Phasmarhabditis Hermaphrodita,* as a biological control agent for slugs in Integrated Crop Management Systems. In : *Integrated Crop Protection : Towards Sustainability ?* BCPC/SFS Symposium No 63, pp. 33-40.

Wilson, P.N. and Brigstocke T. (1977). *Energy and UK Agriculture.* Long Range Planning Vol. 10. 64-70.

Wimberley, R.C. (1993). Policy Perspectives on Social, Agricultural and Rural Sustainability. *Rural Sociology*, **58(1)**, 1-29.

Woese, K., Lange, D., Boess, C., Werner Bögl. A Comparision of Organically and Conventionally Grown Foods – Results of a Review of the Relevant Literature. *Journal of Food Science and* Agriculture, **74**, 281-293.

Wolton, R.J.(1994). Conservation of the Culm Grasslands of South-West England. In : *Grassland Management and Nature Conservation* (R.J. Haggar & S. Peel Eds.), pp320-322.

World Commission on Environment and Development (1987). *Our Common Future* (The Bruntland Report), Oxford University Press, Oxford, UK.

Wratten, S.D. and Thomas, W.B. (1990). Environmental manipulation for the encouragement of the natural enemies of pests. In : *Crop protection in organic and low input agriculture*: Proceedings of a symposium organised by the British Crop Protection Council (Ed. R. Unwin) pp. 87. Farnham : BCPC.

Yarham, D.J. and Gladders, P. (1994). The Influence of set-aside on crop diseases. In : *Aspects of applied biology 40, Arable Farming under CAP reform*, pp. 227-284.

Yates, C. and Rehman, T. (1996). Integration of Markov and Linear Programming Models to assess the farm gate and national consequences of adopting new bovine reproductive technologies into United Kingdom Agriculture. *Journal of Operations Research*, **47**, 1327-1342.

Yates, C. and Rehman, T. (1997). The Development of a Mathematical Modelling Strategy For Assessing The Socio-economic Consequences of Adopting New Bovine Reproductive Technologies into UK Agriculture. *Paper Presented at the Agricultural Economics Society Conference, Edinburgh 1997.*

Young, A. (1989). *Agroforestry for Soil Conservation.* CAB International and the International Council for Research in Agroforestry.

Young, J.E.B., Bowerman, P., Cook, S.K. (1994). The Talisman experiment - observations and implications for integrated pest and disease management of arable crops in the UK. *Proceedings of the Brighton crop protection conference - Pests and diseases 1994*, 125-134.

Younie, D., Heath, S.B., Yackminie, D.S., Carr, G.W. (1986). Development of a low input beef system based upon White Clover. In Frame, J. (Ed.). Grazing. British Grassland Society. Maidenhead UK. pp 230-232.

Zanin G., Berti, A., and Toniolo L. (1993). Estimation of economic thresholds for weed control in winter wheat. *Weed research*, **33**, 459-467.

Appendices

Appendix 1. The Farm and Wildlife Advisory Group Guidelines on Hedges and Field Boundaries

The Golden Rules

Always

Give the field boundary as much care and attention as the crop. It requires special management.

Leave at least one metre of natural vegetation between the field boundary (hedge, fence, wall e.t.c.) and the crop.

Identify and rank all boundaries on the farm for their wildlife, landscape and historical importance. Draw up a written long-term plan for their management.

Avoid the inadvertent use of pesticides and fertilisers on the field boundary.

Consider creating additional grassy ridges to help natural pest control in crops.

Try to

Manage or create field boundaries to make the most of the available potential.

Identify and give priority to those boundaries, which act as important links between wildlife areas, both on and off the farm.

Manage field boundaries in conjunction with adjacent habitats, both on and off the farm.

Clear ditches and cut hedges either on a minimum two or three year cycle or on a coppicing or laying rotation. Work in the season, which will reduce disturbance to wildlife.

Avoid

The removal of boundary structures or the replacement of walls and hedges by fences.

Appendix 2. List of Clover Safe Herbicides

Chemical	Rate (kg/ha)	
	Seedling	Established
Alloxydim	2	2
AMS	3	3
Benazolin	0.2-0.4	0.4-1.12
Benfluralin	1.1-1.25	
Bensulide	3.4-5.6	
Bentazone	1.4	1.4-3.4
Benzoylprop-ethyl	1.5-2.0	1.5-2.0
Butylate	4.5-6.7	
Carbetamide	2.5-2.8	2.5-4.5
Chloridazon	3.6	3.6
Chlorpropham	2.7	5
Chlorthal-dimethyl	10	
4-CPA	4	2.0-4.0
2,4-DB	1.5-2.2	2.2
Dichlobenil	1.1-2.2	4.0-9.0
Diclofop-methyl	1	2.1
Difenzoquat	1	1
Dimefuron		0.8
EPTC	3.4-5.6	
Fenoaprop		0.24
Fenthiaprop		0.24
Flamprop-methyl	0.7-1.0	
Fluazifop	0.4-0.5	1.5
Fosamine	4.8-9.6	4.8-9.6
Ioxynil	0.8-1.1	0.8
Lenacil	0.3-1.2	
Linuron		
MCPB	1.5-2.2	1.5-2.2
Mefluidide		0.5-1.0
MH	4	4
Nitralin	0.6	
Pebulate	3.0-4.0	
Pendimethalin	1.5-2.0	
Prometryne	0.35-0.75	0.5
Propham	4.4	4.8
Propyzamide	1.2	1.2-3.4
Thiobencarb	6	
Tri-allate	1.4-1.7	
Trifluralin	0.8-1.6	
Vernolate	3.4-4.5	

(From Rolston 1987).

Appendix 3. Management Guidelines for Specific Natural and Semi-Natural Habitats

Appendix 3.a. Chalk Grassland

Roberts (1992a) gives details of the following Countryside Stewardship guidelines for chalk and limestone grassland.

Guideline 97. The management of existing grasslands should be by grazing without cultivation, fertiliser or pesticides.

Guideline 98. The restoration of grassland with suitable indigenous grass seed and management of low level livestock grazing without cultivation.

Guideline 99. Quiet informal recreation on a permissive basis on suitable land.

Guideline 100. Specific works to assist with the rehabilitation or to restore land once in intensive management.

Guideline 101. Maximum load for application of nitrogen 50 kg/ha/annum, before vegetation adversely affected, see Wilson, Wells and Sparks (1995).

Guideline 102. Morris and Rispin (1994) recommend rotational grazing in order to maintain invertebrate diversity on chalk grassland.

Appendix 3.b. Lowland Heath

Guideline 103. Lowland heath should be maintained, there should be no ploughing, levelling, reseeding, overseed, scarify, roll or other cultivation of the land.

Guideline 104. Grazed, but not overgrazed, not grazed with pigs or poultry, and where alternative land is available, livestock should be excluded from 15th March and 16thMay each year. There should be no supplementary feeding of livestock in winter.

Guideline 105. There should be no use of organic or inorganic fertiliser, lime, slag or pesticides. There should also be no irrigation.

Appendix 3.c. Traditional Hay Meadows

Guideline 106. No hay or silage before early July, with at least one cut being made. Livestock must be excluded for at least 7 weeks before cutting.

Guideline 107. During grazing period stocking must not exceed 1 LSU/ha, and must not lead to overgrazing, poaching or undergrazing.

Guideline 108. No synthetic fertiliser, only FYM at no more than 12.5 tonnes/ha, no pesticides or insecticides.

Appendix 3.d. Water Side Landscapes

The following guidelines are based on those suggested by Roberts (1992a) for pastures near water, grazing marshes or areas of flood plain.

Guideline 109. The management of existing grassland areas of landscape and wildlife value by light grazing or cutting for hay, and by maintaining high water levels.

Guideline 110. The restoration and creation of waterside landscapes and habitats, including the conversion of intensively managed land, to traditional grassland management, either by natural regeneration or on drier soils, by established a new sward consisting of native grasses.

Guideline 111. Quiet informal recreation on a permissive basis on suitable land.

Guideline 112. Specific works to assist the rehabilitation of neglected areas, or to accelerate the restoration of land once in intensive management. For example the creation or restoration of features such as reed beds, pollarded willows or wet fen.

Appendix 3.e. Coastal Areas

Management guidelines for coastal areas are based on those of Roberts (1992a).

Guideline 113. The management of existing grassland areas of landscape and wildlife value by light grazing or cutting for hay, and by maintaining high water levels.

Guideline 114. The restoration of intensively farmed areas by natural regeneration should be carried out, or by establishing a grass sward of native species.

Guideline 115. Specific works to assist the rehabilitation of neglected areas, or to accelerate the restoration of land once in intensive management. The creation or restoration of specific coastal landscape features such as reed beds or salt marsh.

Appendix 3.f. Heather Moor land

Guideline 116. Management should encourage the regeneration of heather and other moorland habitats, where it has been lost. There should be no liming, organic or inorganic fertiliser, pesticides, and insecticides, applied to these.Appropriate grazing, so there is no overgrazing and depletion of heather, poaching, or undergrazing leading to ageing of heather population. Appropriate stocking rates can be based on the area of the country (see Table A. 3.1).

Table A. 3.1. Suggested regional stocking rates for heather moorland/heath

Region	Stocking Rate (Ewes/ha/annum)
Eastern Scotland	1.5-2
Western Scotland	1
North West England	1
North East England	1.5.
West Wales	1
Welsh Borders, Midlands, South Pennines	1.5
South Wales, South West England	2

(From Gimingham 1992).

Guideline 117. Appropriate moorland burning policy, to encourage wide spread of heather patches of differing age. Milne (1994) states that the use of fire has been central to management practices that have been used to maintain heather.

Guideline 118. No supplementary feeding of livestock during winter on heather moorland, to avoid local overgrazing, and the spread of non native grass species.

Appendix 3.g. Semi Natural Rough Grazing

Guideline 119. There should be No cultivations, reseeding, levelling.

Guideline 120. No stocking above 0.75 LSU/ha, and such that it does not poach, overgraze or undergraze.

Guideline 121. No applications of lime, slag, fertiliser, pesticides or insecticides.

Appendix 3.h. Traditional Hay Meadows

Guideline 122. No hay or silage before early July, with at least one cut being made. Livestock must be excluded for at least 7 weeks before cutting.

Guideline 123. During grazing period stocking must not exceed 1 LSU/ha, and must not lead to overgrazing, poaching or undergrazing.

Guideline 124. There should be no synthetic fertiliser, only farm yard manure at no more than 12.5 tonnes/ha. There should be no use of pesticides or insecticides.

Appendix 4. Management Guidelines for Specific Extensive Livestock Systems

The following are guidelines, which are applicable to specific types of livestock enterprise.

Appendix 4.a. Specialist Sheep LFA

Guideline 125. The sheep breeds kept should be suitable to the area and conditions. Animals should be hardy enough to survive the adverse conditions encountered within the hills and uplands, with particular attention paid to maternal instincts.

Guideline 126. There should be acceptable levels of shepherding and monitoring of flocks in winter and at lambing times.

Guideline 127. Traditional bracken cutting for bedding should be maintained.

Guideline 128. No use of fertility treatments or biotechnology to boost lambing percentage above levels which the nutrition of the ewe can not support.

Appendix 4.b. Specialist Beef LFA

Guideline 129. The cattle breeds kept should be suitable to the area. Animals should be hardy enough to survive the adverse conditions encountered within the hills and uplands, with particular attention paid to maternal instincts.

Guideline 130. Suckler cows should be crossed to beef bulls, and produce animals to go on to 18 month grass based finishing systems. Calves reared with dam, weaning at 6 months of age.

Appendix 4.c. Lowland Cattle & Sheep Farms

Guideline 131. A grass clover system should be adopted, Swift, Vipond, Cleland and Hunter (1992) report that a small leaved clover tetraploid perennial ryegrass combination is pesistant under continuous sheep stocking, and that lower production costs make the system viable under lowland conditions.

Guideline 132. Lambing percentages in keeping with ability to shepherd flock at lambing time.

Guideline 133. Nitrogen applications based on soils actual need, and in keeping with policy of making use of legumes. Strategic use of inorganic nitrogen only.

Guideline 134. When sheep fed on fodder roots adequate 'run back' to prevent lying in mud during resting periods.

Appendix 5. Management Guidelines for Specific Pig Enterprises

Appendix 5.a. Outdoor Pig Production

Guideline 135. The site should provide, easy access to food and water and a comfortable dry lying area. Water supply should be appropriate for the number of animals kept, and is especially important for farrowing sows. Good access to the water trough should be maintained, particular attention should be paid to water in freezing conditions. Areas of high rainfall which are easily waterlogged should be avoided, to avoid problems with mud underfoot.

Guideline 136. The Stocking density should be so that ground conditions are maintained. FAWC (1996) suggest that on an ideal site this should be 25 sows per ha across the site.

Guideline 137. The site should ensure isolation from other pig units if risk of cross infection. There should be no sharp stones which could lead to feet problems.

Guideline 138. Sites should be rotated to prevent the build up of disease. The pigs would contribute to the fertility of fields in arable rotations, but where they are regularly standing there could be problems, as reported by Shepherd (1990), where trackways were clearly seen in subsequent arable crops. He also reports that Couch and Mayweed frequently follow pigs in following arable crops, therefore pigs should be carefully integrated into an any arable rotation with this in mind.

Guideline 139. Shelters should be well bedded and draught free during winter months. Adequate provision should be made to protect pigs from extremes of weather, both hot and cold.

Guideline 140. The stock should be bred so as to be able to survive the extremes of weather conditions found in the locality. Breeding sows should be selected for mothering ability, caring for piglets and ability to protect the nest from other sows.

Guideline 141. Farrowing sows and piglets should be inspected at least twice daily, and all stock inspected at least once a day. No piglet should be weaned at less than 3 weeks of age.

Appendix 5.b. Indoor Pig Production

Guideline 142. Adequate straw bedding and ventilation should be provided. Straw based systems of housing, in pens rather than stalls. Straw Flow systems as described by Arey (1993) can be used where deep bedding proves expensive, the minimum straw required by a growing pig per day would be 200g to allow them to express normal patterns of behaviour.

Guideline 143. When housed in groups, care should be taken to avoid aggression, bullying and other behavioural problems, particularly at feeding times. Feed should be distributed widely and steps taken to avoid aggression between animals.

Guideline 144. Adequate ventilation, heating, lighting within buildings should be provided. Buildings should be properly insulated to maximise energy efficiency, minimising energy consumption.

Guideline 145. Pig slurry is especially high in nutrients, where possible it should be used on any crops grown on farms. However all regulations and codes for the storage of waste should be complied with.

Appendix 6. Management Guidelines for Specific Poultry Enterprises

Appendix 6.a. The Laying Hen

The following guidelines should apply specifically to laying hen enterprises.

Guideline 146. The DEFRA (2002f) publication *Recommended code of practice for laying hens* should be followed.

Guideline 147. If behavioural problems do occur then if necessary de-beaking may be carried out with laying hens.

Guideline 148. Hens should be housed in small groups rather than the large colonies associated with conventional agriculture in order to prevent abnormal behaviour and aggression. If kept indoors laying hens should not be kept in large colonies, so that aggression, mob hysteria and behavioural problems do not occur.

Appendix 6.b. Indoor Egg Production Systems

Guideline 149. For indoor layers cages of 4-6 birds are acceptable, with the following features (Webster 1995):

1. A suitable nesting site;
2. A Perch, to improve fitness of feet;
3. 900cm^2 space per bird (additional to that within nest boxes).

Guideline 150. Access to daylight must be provided, which is believed to reduce the incidence of cannibalism (Guy 1989).

Appendix 6.c. Outdoor Egg Production Systems

Guideline 151. The Ground to which the birds have access to should mainly be covered in vegetation. FAWC (1992) advise rotation of pasture to ensure this. The Free Range Poultry enterprise must be integrated into the rotation, with any other livestock or arable enterprises on the farm, the manure addition to the soil should be considered when planning the next use for the field/fields.

Guideline 152. Outdoor layers should not be kept at any stocking density greater than 400 birds/ha.

Guideline 153. Flocks and portable houses should be moved regularly to avoid land becoming fowl sick and the development of muddy conditions leading to the ill health of birds.

Guideline 154. Precautions should be taken to protect the birds from predators such as foxes, dogs and cats.

Guideline 155. Shelter from rain should always be available, plus windbreaks should be provided on exposed sites. The housing must ensure that the birds do not suffer from extremes of temperature. There should be sufficient openings of sufficient size so as to allow a reasonable proportion of birds to enter or exit at any particular time.

Guideline 156. A concrete strip should be provided immediately outside the house in order that the area does not become excessively muddy.

Guideline 157. Feed and water must not be allowed to remain in a stale or contaminated condition, particular attention must be paid to water in freezing conditions. The feed should be spread over a wide area to allow to expression of normal foraging behaviour.

Appendix 6.d. Guidelines for Broiler chickens and Turkeys

i Indoor systems

Guideline 158. Genetic selection should not be for rapid muscle growth, which would cause the problems associated with leg weakness. Ideally they should be bred for slaughter at 70-90 days.

Guideline 159. The maximum recommended stocking density for broiler chickens is 34kg of bird mass / m^2, at which according to Webster (1995a) healthy birds continue to find feed and water, and the problems of aggression are unknown. Turkeys at this density continue to behave aggressively and debeaking is recommended, however for chickens if kept below the maximum stocking density it should not be practised.

Guideline 160. According to Guy (1989) and the Real Meat Company, behavioural problems in table birds should be solvable without recourse to debeaking.

ii Outside Systems

Guideline 161. Strains of birds should be selected so as to be genetically suitable for outside conditions, as well as those strains which are slower growing, which do not tend to have problems with leg weakness.

Guideline 162. The feed should be spread over a wide area to allow to expression of normal foraging behaviour.

Appendix 7. The Suitability of Different Crop Combinations in the Rotation

		Preceding Crop													
Following Crop		Wh	wb	Sb	r	O	m	pe	Fb	lr	ley	mc	ep	Be	Br
Winter wheat	Wh	--	--	--	o	O	o	++	++	o	o	++	++	O	O
Spring Wheat	Wh	--	--	--	o	O	++	+	++	++	++	++	+	++	++
Winter Barley	Wb	O	--	--	o	O	--	++	-	o	o	--	++	--	--
Spring Barley	Sb	O	--	O	o	O	++	-	-	--	o	++	+	++	++
Winter Rye	R	O	o	O	o	O	o	++	++	o	o	O	++	-	-
Spring Rye	R	O	o	O	o	O	++	+	++	++	++	++	+	++	++
Oats	O	O	o	o	o	-	++	++	++	++	++	++	+	++	++
Maize	M	++	++	++	++	++	-	++	++	++	++	++	+	++	++
Peas	Pe	++	+	++	++	++	-	--	--	--	++	++	+	++	++
Field Beans	fb	++	+	++	++	++	++	--	--	--	++	++	+	++	++
Lucerne	Lr	+	o	++	++	O	o	--	--	--	--	++	++	++	++
Ley	Ley	O	o	++	++	++	o	++	++	o	o	++	++	++	++
Main crop pots	Mc	++	+	++	++	++	++	++	++	++	++	-	-	++	++
Early pots	Ep	++	+	++	++	++	++	++	++	++	++	-	-	++	++
Beets	Be	++	++	++	++	++	++	++	++	++	++	++	+	--	--
Brassicas	Br	++	++	++	++	++	++	++	++	++	++	++	+	--	--

++ Good

o Good but unnecessary, other crops make better use of the preceding one. Could be use in combination with catch crop or green manure.

o Possible Limited Applications

- not advisable if preceding crop harvested late in dry areas, if pest risk exists (mainly nematodes), or if danger of lodging (e.g. Spring barley after legumes).

-- Inadvisable.

(From Lampkin 1990).

Appendix 8. The Characteristics Of Some Crops In The Context Of Rotation Design

Crop	Rooting Depth	Residual Biomass	Soil Structure	Organic matter	Nitrogen balance	Weed control	Self tolerance	Break (yrs)	Winter Soil Cover
Wheat	O/+	0.9-1.7	-/+	-/o	-	-/o	-	2-4	-/+
Barley	O/+		-/+	-/o	-	-/o	-/o	2-4	-/+
Oats	O/+		-/+	-/o	-	-/+	--	5	-/+
Rye	O/+		-/+	-/o	-	o/+	+	-	-/+
Field Beans	O	0.5-2.3	o	O	+	-/o	-/+	4-5	-/+
Field Peas	O		o	O	+	--	--	6-7	-
Potatoes	-	0.6-1.0	-/o	--	--	-/+	--	4-5	--
Beet	-		-/o	--	-	-/+	--	4-5	--
Carrots	-		-/o	--	-	-/+	-	3-4	--
Maize	O	1.8-2.2	--/o	O	--	-/+	+	-	--/+
Rape	O	1.3-1.5	o	O	-	+	--	3-4	-/+
Turnips	O		o	O	-	-/+	--	3-4	-/+
Green manures									
Non Legumous	-/+	0.9-3.0	o/+	O/+	-/o	+	+/-	-	+
Legumous	-/+		o/+	O/+	o/+	+	+	-	+
Red clover based Short term ley	+	4.5-5.5	++	++	+++	++	--	6	+ +
White clover based Long term ley	O	6.0-8.0	++	+++	++	++	o/+		+ +
Lucerne	++		++	+++	+++	+/-	--	5	+ +

+++	Excellent
++	Very good/deep/large
O	Good/deep/large
o	Neutral/average/medium
-	Bad/shallow/small
--	Very bad

(From Lampkin 1990).

Appendix 9. Varietal Diversification Scheme to reduce the spread of Mildew in Spring barley

Diversification Group.	1	3	4	5	6	7	9	10	11
1	+	+	+	+	+	+	+	+	+
3	+	M	m	+	+	+	m	m	m
4	+	M	m	+	+	+	m	+	+
5	+	+	+	m	+	+	+	m	+
6	+	+	+	+	M	+	m	+	+
7	+	+	+	+	+	m	+	+	+
9	+	m	m	+	M	+	m	+	+
10	+	m	+	m	+	+	+	m	+
11	+	m	+	+	+	+	+	+	m

\+ Good combination low risk.

m Risk of mildew spread.

M Strong risk of mildew spread.

Source : NIAB

Appendix 10. Pesticides that are less harmful to beneficial arthropods in the order of their increased toxicity

Insecticides and Acaricides	Fungicides
Dipel	Nimrod
(Bacillus thuringiensis)	(Bupirimate)
Torque	Bayleton
(Fenbutatin-oxide)	(Triadimefon)
Aazomate	Ronilan
(Benzoximate)	(Vinclozolin)
Dimilin	Orthocid 83
(Diflubenzuron)	(Captan)
Tedion V 18	Cercobin-M
(Titration)	(Thiophanate-methyl)
Kelthane	Ortho Difolatan
(Dicofol)	(Captafol)
Spruzit-Nova-fl.	Derosal
(Pyrethrum + pip.butoxide)	(Carbendazim)
Pirimor	Daconil500
(Primicarb)	(Chlorothalonil)
	Plondrel
	(ditalimfos)
Herbicides	
Illoxan	Pomarsol forte
(Diclofop-methyl)	(Thiram)
Semeron	Dithane Ultra
(Desmetryne)	(Manozeb)
Betanal	
(Phenmedipham)	
Kerb 50 W	
(Propyzamid)	

(From Hussan 1987).

Appendix 11. Integrated Management of Specific Arable Crops

Appendix 11.a. Wheat

Guideline 163. As a general rule only first wheat's should be grown in an integrated rotation, to cut out the need for high levels of inorganic nitrogen and other chemical inputs.

Guideline 164. Disease control decisions should be based observations made at key growth stages, and economic thresholds for particular diseases should be developed, this would allow the targeting of fungicides rather than prophylactic applications. Table A. 11.2 summarises cultural control methods, the chemical control available and thresholds.

Table A. 11.2. Disease control in Winter wheat

Disease Problem	Cultural Control	Chemical Control
Black sooty moulds (*Cladpsporium spp.*)	Symptom of other disease problem.	No effective chemical control.
Ergot (*Claviceps purpurea*)	Control vectors Black grass and Meadow foxtail. Deep ploughing after harvest of affected crop is recommended.	No effective chemical control.
Eyespot (*Psuedocercosporella herpotrichoides*)	Rotations, two-year grass break or three-year cereal break. Varietal resistance.	Where more than 20% of tillers affected in period GS30-31. Use a mixture of MBC and Prochloraz.
Brown foot rot and Ear blights (*Fusarium spp.*)	Crop rotation. Avoid susceptible varieties.	No effective chemical control.
Mildew (*Erysphe Graminis*)	Avoid susceptible varieties. Disease likely on fertile soils, avoid excessive nitrogen. Use varietal diversification groups.	Spray as soon as any pustules are obvious on any of the green leaves in the period between flag leaf visible and complete ear emergence. Foliar applied Potassium Chloride may be used (see Cook, Kettlewell and Parry (1995).
Brown Rust (*Puccinia recondite*)	Avoid susceptible varieties.	A spray should be applied as soon as brown rust can be found readily on the upper leaves and there is evidence that the disease is spreading in the crop. Spraying after the watery ripe stage is unlikely to be profitable.
Yellow Rust (*Puccinia striiformis*)	Avoid early sowing. Use varietal diversification groups. Avoid susceptible varieties.	Spray when more than 10 affected tillers/m^2.

Disease Problem	Cultural Control	Chemical Control
Septoria diseases (*Septoria nodorum, Septoria tritici*)		Apply fungicide when disease present on older leaves in crop or disease confirmed in area. Or four or more days with at least 1mm rain in the previous two weeks or a single day with over 5mm in the same period. Optimal time to spray soon after flag leaf emergence. Use mixtures and rotate fungicides as several resistant strains about.
Take all (*Gaeumannomyces graminis*)	Oats in the rotation can usually control most strains found in cereal growing areas. Good drainage. Avoid loose seedbeds. Avoid deficiencies in Potash or Phosphate. Adequate nitrogen in Spring. Avoid early sowing.	No effective chemical control.

(From ADAS 1986).

Guideline 165. The basis of the crop protection programme on the reduced input treatment for the Boxworth project was the ADAS (1987) leaflet P858 *Cereal Pest Control.* These thresholds for chemical control used in conventional and ' rational reductionist ' agriculture should be modified to account for environmental costs, as more information is available.

Guideline 166. Pest control should be carried out in an integrated manner, using a mixture of cultural/rotational and chemical control, using economic thresholds. As described in Table A. 11.3.

Table A. 11.3. Managed pest control in Winter cereals

Pest	Cultural Control	Chemical Control/ Threshold
Grain aphids as BYDV (Barley Yellow Dwarf Virus) vectors	Avoid early sowing dates (before Mid October)	
Grain aphids as direct pests *(Sitobion avenae, Rhopahosiphum podi , Metopolophium dirhodum)*		Threshold of 5 aphids per ear on a sample of at least 50 ears at beginning of flowering.
Frit Fly *Oscinella Frit*		Threshold of 10% of plants damaged at 1-2 leaf stage.
Leather Jackets (*Tipula paludosa)*	Good consolidation of seedbed, good tilth.	15 or more found in ten separate 30cm lengths across field. Cholorpyrfios, or gamma HCH.

Pest	Cultural Control	Chemical Control/ Threshold
Slugs	Good firm seedbed. Biological control may be possible with the Nematode *Phasmarhabditis Hermaphrodita.* (See Wilson, Hughes and Glen 1995)	
Wheat Fly bulb (*Delia coarctata)*	Inclusion of Winter Oats in rotation Or Spring Wheat or Spring Barley drilled after mid march. Avoid working fields in Early August. Do not drill below 50mm deep.	Use seed treatments for later sown crops following potatoes or sugar beet.
Wire Worms (*Agriotes spp.*)	Firm, fine seedbed, adequate nutrients.	Gamma HCH only approved insecticide, seed treatment uses minimum amount of chemical.
Yellow Cereal Fly (*Opomyza florum)*	On crops sown before October chemical treatment is rarely justified.	Only if sown after mid October, if no history of damage, no previous insecticide applications for BYDV and less than 200 plants/m^2

Guideline 167. Cousens, Doyle, Wilson and Cussans (1986) use a mathematical model to estimate a threshold for weed control of wild oat *Avena fatua of* 2-3 plants / m^2. Zanin, Berti and Toniolo (1993) estimate thresholds for 23 different herbicides and 7 different weed species. The following thresholds are also reported for weeds in winter wheat (see Table A. 11.4).

Table A. 11.4. Economic thresholds for weeds in wheat

Weed	Economic Threshold (Plants / m^2)	Reference
G.Aparine	0.5	Aarts & Visser (1985)
A Myosuroides	30-50	Cousens (1985)
Avena spp.	8-12	Cousens (1985)

(From Zanin *et al.* 1993).

Guideline 168. LIFE has indicated that a reduction in inorganic nitrogen of up to 50% of standard farm practice may be effected, in an integrated system. Applications should be based upon annual plant and soil analysis. The guidelines for wheat given in MAFF (2000c) should be followed. Wheat of breadmaking quality can be grown with 120 kg N/ha, compared with a typical figure for conventional farming of 180kg N/ha (SAC 1997). Fertiliser applications should be timed so as to cause minimum environmental problems especially leaching , and when it is needed by the crop.

Appendix 11.b. Barley

Guideline 169. Winter Barley should generally also be used as the first cereal crop in a rotation, where no winter wheat is grown, also as a second cereal after Winter wheat. Table A. 11.5 illustrates disease suggested control methods for winter barley.

Table A. 11.5. Disease Control in Winter Barley.

Disease Problem	Cultural Control	Chemical Control
Barley Yellow Mosaic Virus	Varietal resistance.	
Eyespot (*Psuedocercosporell a herpotrichoides*)	Include spring crops in rotation. Varietal resistance. Avoid early sowing.	Where more than 20% of tillers affected in period GS30-31. Use a mixture of MBC and Prochloraz.
Mildew (*Erysiphe Graminis)*	Avoid early sowing. Autumn crops on light land at risk. Varietal resistance.	Mildew in Autumn and Winter does not normally lead to loss of yield unless growth of crop is severely checked therefore chemical control cannot be justified.
Rhyncosporium, (*Rhyncosporium secalis*)		Spray if more than 10% of lower leaf area is affected in Autumn. Spray Jan - Mid March if disease can be found on the youngest leaves. Later if disease found on any of the top three leaves especially at or soon after flag leaf emergence, a spray should be applied but not later than the completion of or ear emergence.
Net Blotch (*Pyrenophora teres*)	Seed borne disease, carried on trash from previous seasons crop, ensure proper disposal.	Leaf sheath erect to first node visible growth stage, spray if net blotch can be found readily in the crop. If flag leaf visible and before end of flowering, spray if disease on top three leaves. In the Autumn spray if disease affects more than 10% of lower leaves. If being sprayed for mildew a mixture effective against both should be considered.
Brown Rust (*Puccinia hordei*)	Use varietal resistance.	Spray susceptible varieties if disease found on any of the top three leaves.

Disease Problem	Cultural Control	Chemical Control
Yellow Rust (*Puccinia striiformis*)	Use varietal resistance.	For resistant varieties, spray when evidence of spread from early patches (foci) or 10 tillers affected/m^2.
Snow Rot (*Typhula incarnata*)	Avoid light soils Avoid growing successive crops of winter barley on the same land. Use varietal resistance.	

(From ADAS 1986).

Guideline 170. Crop nutrition, work on LIFE has indicated that a reduction in inorganic nitrogen of up to 50% of standard farm practice may be effected, in an integrated system. Jordan, Stinchombe and Hutcheon (1989), Jordan and Stinchombe (1986) and Jordan, Stinchcombe and Todd (1985) report that delaying the main nitrogen top dressing on Winter barley from mid March to mid April can lead to improved grain quality and lower disease levels reducing the need for fungicides. Work by Conry and Dunne (1993) in indicates that although yields are increased by small but significant amount if application is delayed, the levels of disease did not appear affected. Penny, Widdowson and Jenkyn (1986) report an increase in yield from applications in April and increased %N in grain as well as increased N efficiency, but also found disease levels varied from year to year. On the whole it would seem that if a nitrogen top dressing is applied April would be a more sustainable option than the tradition March, due to increased efficiency and benefits from reduced disease incidence.

Appendix 11.c. Oats.

Guideline 171. Oats may be grown as a second cereal in a rotation.

Guideline 172. The nitrogen requirement for oats is generally less than that for wheat and barley, and can therefore reduce the overall input use over the whole rotation.

Guideline 173. The two main diseases of winter oats are Crown rust *Puccinia coronata* and Mildew *Erysphe Graminis* for which resistant varieties can be found. Growing susceptible varieties of Spring oats next to Winter crops should be avoided.

Appendix 11.d. Rye /Triticale

Guideline 174. Rye and Tritcale crops are a suitable second cereal on land light.

Guideline 175. The nitrogen requirement for rye/triticale is generally less than that for wheat and barley, and can therefore reduce the overall input use over the whole rotation.

Guideline 176. These crops are resistant to Eyespot *Psuedocercosporella herpotrichoides* fungus which attacks wheat and barley, but susceptible to another strain which attacks all three crops. A fungicide should be applied if more than 20% of shoots bear eyespot lesions.

Guideline 177. Rye and Triticale are susceptible to lodging, this may be avoided by choosing suitable varieties, and avoiding excessive soil fertility, however plant growth regulators may still be needed on these crops if lodging still proves a problem.

Appendix 11.e. Sugar Beet

Guideline 178. May be used as break in a mainly cereal rotation, should be used as opportunity to control weeds of Autumn sown crops, and to control grass weeds.

Guideline 179. Inorganic fertiliser applications should be made strategically and be based on soil and plant analysis. Sugar beet will respond to Sodium applications, apart from on organic, peaty and fen silt soils (see MAFF 2000c).

Guideline 180. Avoid other brassica crops such as oilseed rape in the same rotation or in close proximity on the same farm.

Guideline 181. Irrigation should only be practised when there is a clear need i.e. to prevent entire crop loss in drought conditions.

Guideline 182. There is a need for cover crop or a green manure crop over the Winter, to prevent nitrate leaching, as crop is Spring sown.

Guideline 183. Weed control is most important during early stages of crop growth and at harvest, the aim should be to contain weeds at levels so there is little economic damage. Weed beet should be controlled by hand rouging when population is still small before problem becomes more severe. If spraying is considered necessary band spraying should be practised to reduce active ingredient applied. Weeds should be tolerated between rows to provide alternative food source for pests, and to provide protection from wind damage. Main weed problems are bindweed, knotgrass, redshank, fathen, dead nettle, mayweed, creeping thistle, wild oats, and grass weeds. Particularly attention should be paid to Fathen since it is a brassica weed, and may be a vector of brassica diseases such as club root. For a discussion on weed, pest and disease control in sugar beet (see Dunning 1990).

Guideline 184. Avoid close beet rotations, sugar beet or other brassica crops should not be grown on a field any more than one year in three. Thus there should be a break of two years between crops.

Guideline 185. The Table A. 11.6 deals with control of disease of sugar beet and indicates the cultural control methods available as well as how pesticides may be targeted.

Table A. 11.6. Disease control in sugar beet/fodder beet/mangolds.

Disease	Cultural Control	Chemical Control
Virus Yellows (Aphid vectors- Peach Potato- *Myzus persicae*- black bean aphid- *Aphis fabae*)	Varieties, sow early, avoid very low plant populations, use aphicides, and delay virus infection, avoid close proximity of foot crops to steckling beds and previous crops.	Inspect plants regularly and spray of more than one plant in four has aphids.
Downy Mildew (*Peronospora farinosa*)	Varieties, avoid close proximity of seed and root crops. Avoid early sowing or root crops on heavy soils.	
Powdery Mildew *(Erysiphe spp.*)		Spray foliage with wettable sulphur or triadimefon at first sign of disease in Summer.
Beet Rust (*Uromyces betae*)		Spray at first sign of disease with triadimenol.
Leaf Spots (*Ramularia beticola, Phoma betae*)		Spray seed crops only at first sign of disease during Summer months. Maximum of 3 applications at 14-21day intervals with fentin hydroxide.

(From Moule 1988).

Table A. 11.7 deals with suggested pest control methods for sugar beet.

Table A. 11.7. Control of pests on sugar beet

Pest	Cultural Control	Chemical Control / Threshold
Millipedes, Symphylids (*Scutigerella immaculata*), Spring tails (*Onychiurus spp.*)	Silts and chalky soils most heavily infested.	Seed furrow applications of aldicarb + HCH, bendiocarb, benfuracarb, carbofuran or carbosulfan. Or spray soil with gamma HCH.
Wood mouse (*Apodemus sylvaticus*)	Avoid spillage and exposure of seed. Proprietary break back mouse traps, placed in pipes or suitable containers to protect birds/non target organisms.	Proprietary mouse baits 3-4/ha in the open fields. Placed in pipes or suitable containers to protect birds/non target organisms.
Wireworms (*Agriotes spp.*)	None	Seed furrow treatments of aldicarb, bendiocarb, carbosulfan, carbofuran, and thiofanox. Work gamma HCH into seedbed using higher rates if on organic soil.

Pest	Cultural Control	Chemical Control / Threshold
Beet flea beetle (*Chaetocnema concinna*)	Early sowing of crops.	Spray rows with carbaryl or gamma HCH only when necessary.
Cutworms	Also pest of potatoes, avoid proximity inn rotation.	Band spraying with triazophos applied in large volumes of water, in late afternoon when cutworms are most likely to come to the surface.
Skylark (*Alauda arvensis*)	Scarecrows, hawk shaped silhouettes, shooting	
Peach potato aphid (*Myzus persicae*)	Sow early and encourage early rapid growth. Virus resistant varieties in recognised 'Yellows' areas. Plough in plant residues on previous years beet fields. Destroy debris on cleaner/loader and mangold and fodder beet clamp sites before aphid migration gets underway in April. Avoid proximity to seed crops.	
Leatherjackets (*Tipula spp.*)	Avoid crops following grassland of if not possible, plough grassland before September.	Gamma HCH as spray or bait, or methiocarb as a surface bait if slugs also a problem.
Black bean aphid (*Aphis fabae*)	Early sowing	Normally by sprays used against peach potato aphid. Primicarb recommended.
Beet cyst nematode (*Heterodera schachtii*)	Avoid light sandy or peaty soils, avoid frequent cropping with brassicas except fodder radish, radish, prompt weed control, destruction of all residues: - No known infection 1 yr in 3 Infected by no heavy yield loss 1 yr in 4, Yields affected rest 4 yrs then follow a long rotation.	Not justified, except soil fumigation on soils where potato cyst nematode also a problem.
Free-living nematodes (Docking disorder) (*Trichodorus and Longidorus spp.*)	Avoid light sandy soils and provide good growing conditions.	Seed furrow applications of aldicarb, carbofuran, carbosulfan or oxamyl in high-risk situations, where there is a history of infection.
Pygmy beetle (*Atomaria linearis*)	None	Methiocarb present in seed pellet. Thiofax used for aphid control also effective.

(From Moule 1988).

Guideline 186. Where a high risk of *Rhizomania* exists the resistant variety Rizor should be grown. The disease is soil borne, decontamination of machinery, sprayers e.t.c. should be thorough. Wheel dipping should take place at the sugar beet factory.

Appendix 11.f. Oilseed Rape

Guideline 187. Oilseed rape is a brassica crop, and therefore should not be grown in close proximity in a rotation to other brassica's such as sugar beet. Oilseed rape should not be grown more than one in five years in a rotation, and is best not grown in the same rotation as sugar beet.

Guideline 188. Inorganic fertiliser applications should be made strategically and be based on soil and plant analysis (see MAFF 2000c).

Guideline 189. Early sowing, and the establishment of 80 plants/m^2 helps to minimise the competitive damage caused by weeds (Plumb 1995).

Guideline 190. Irrigation should only be practised when there is a clear need i.e. to prevent entire crop loss in drought conditions.

Guideline 191. Insecticides should not normally be applied to crops in flower since bees are particularly attracted to this crop. If necessary then a benign spray should be used (see Appendix 2), and it should be applied in the evening when bees are not active or in cloudy cool conditions. Endosulfan and Phosalone are regarded as the least harmful chemicals to bees, but azinphos-methyl+demeton-S-methyl sulphone, gamma HCH and triazophos are all highly toxic to bees (ADAS 1984). Local bee keepers should be informed well in advance before applying insecticide to oilseed rape, and the Bee Keepers Spray Warning Liaison officer should also be informed if a liaison scheme exists in the area.

Guideline 192. Alford *et al.* (1995) report that the parasitic wasp (*Trichomalus Perfectus*) can give significant control of seed weevils on oilseed rape crops; they found that the level of parasitism was lower when insecticide (particularly Triazophos) was applied post flowering. When Spring crops are grown, there should be a catch crop over the winter, which can be incorporated in the Spring to boost soil fertility or utilised by livestock. Disease control in oilseed rape is as follows (Table A. 11.8) with information taken from ADAS (1984) and Moule (1988).

Table A. 11.8.Disease control in oilseed rape and brassicas

Disease	Cultural Control	Chemical Control
Blackleg (*Leptosphaeria Maculans, Phoma lingam*)	Varieties, Isolate crop from other brassicas and previous crops, Use treated seed, chop burn and deeply plough oil seed rape stubble soon after harvest, the use of direct drilling for following cereal crop reduces risk, by leaving debris buried, use at least a four year break between brassica crops.	Seed treatments: - Benomyl + thiram, carbendazim + thiram, iprodione, thiabendazole Benomyl, carbendazim, chlorothalonil, Prochloraz, thiabendazole, thiophanate-methyl, vinclozolin.
Powdery Mildew (*Erysiphe Crucuferarum*)	Varieties, delayed sowing in Spring and Summer sown crops.	At first sign of disease use one of the following: - Benomyl Sulphur Dinocap

Disease	Cultural Control	Chemical Control
Light Leaf Spot (*Pyrenopeziza brassicae / Cylindrosporium concentricum*)	Varieties, isolate crop from other brassica crops and Previous stubble, use treated seed, Chop burn, and deeply plough stubble soon after harvest, use at least a four year break between brassica crops.	At 25% of the leaf area affected and showing signs of spreading use: - Benomyl, prochloraz, carbendazim, thiabendazole, chlorothalonil, thiophanate-methyl, iprodione, vinclozolin
Dark leaf spot (*Alternaria spp.*)	Isolate crop from other brassica crops and Previous stubble, use treated seed, chop burn, and deeply plough stubble soon after harvest, avoid early sowing (before 20th August).	Use thiram seed soak treatment or dry seed treatment with iprodione. Spray with iprodione can be applied if *Alternaria* detected on the upper leaves and stems between mid flowering and the end of flowering.
Downy Mildew (*Peronospora parasitca*)	Isolate crop from other brassica crops and Previous stubble, Chop/burn and deeply plough stubble soon after harvest, Avoid very thick plant populations and low lying cold wet fields.	Not normally necessary, but foliar applications on seedlings and young plants of the following may be beneficial: - Chlorothalonil, dichlofluanid, metalaxyl + mancozeb, ofurace + bisdithiocarbamate, zineb
Cauliflower Mosaic Virus (Aphid vectors- *Myzus Persicae* and *Brevicoryne Brassicae*)	Isolate crop from other brassica crops and previous stubble. Control aphid populations through bio control and natural enemies.	Aphicides: - Demeton-s-methyl, dimethoate, malathion, mevinphos, thiometon
Club root (*Plasmodiophora brassicae*)	Varieties, No cropping more than one year in five, avoid transport of infected soil on boots, avoid feeding of infected fodder roots on fields planned for future brassica production, lime to at least p. H. 6. 5, improved drainage may be beneficial, use a break of at least eight years after infection.	Sterilisation of seedbed with dazomet. Transplant application. Pre plant dip treatments with one of the following: - Calomel, Benomyl, carbendazim, thiophanate-methyl
Sclerotinia stem rot (*Sclerotinia sclerotiorum*)	Avoid over cropping of brassicas (No more than one year in 5), Use sclerotinia free seed and equipment, Chop and burn stems and stubble, followed by deep ploughing of remaining debris.	An application at first petal fall with one of the following will control Sclerotinia, Botrytis spp. and Alternaria spp. infections: - Iprodione, prochloraz, thiophanate-methyl, vinclozolin.

(From ADAS 1984, Moule 1988).

Guideline 193. The following measures should be used to control pests on brassica crops (Table A. 11.9).

Table A. 11.9.Pest control in oilseed rape and brassicas

Pest	Cultural Control	Chemical Control / Threshold
Field Slug (*Deroceras reticulatum*)	Increase in numbers usually follows oilseed rape crops, so good rotations important.	Metaldehyde or Methiocarb pellets.
Brassica Flea beetles (*Phyllotreta spp.*)		Seed dressing with gamma HCH
Rape winter stem weevil (*Ceutorhynchus picitarsis*)		No thresholds established. As for Cabbage stem flea beetle.
Pigeon (*Columba palumbus*)	Sow early and encourage rapid germination and growth. Scaring devices most effective mid Jan to mid March, shooting.	Dalaphon and TCA applied to control grass weeds and volunteer cereals render crop unpalatable for a few weeks.
Cabbage Stem weevil (*Ceutorhynchus quadridens*)	Avoid sowing Spring crops in close proximity to previous seasons crops.	Sprays to control pollen beetles and seed weevils will control it.
Cabbage Aphid (*Brevicoryne brassicae*)	None	Only when an appreciable portion of the crop is infected. Use primicarb if other means fail.
Pollen Beetles (*Meligethes spp.*)	None	Average populations of 15-20 beetles per plant to justify spraying during green to yellow bud stage. Most winter rape crops should not need spraying. Backward crops might need spraying if numbers reach 5 per plant while still at the susceptible bud stage. On Spring crops the threshold is 3 per plant. Crops should not be sprayed when in flower.
Brassica Pod Midge (*Dasyneura brassicae*)	None	On Winter rape control of seed weevil usually protects the crop, specific treatments of phosalone or triazophos may be tried. Spraying headlands only may be enough due to weak flight of midge. On Spring crops control as for seed weevils pre-flowering.
Cabbage Seed Weevil (Ceutorhynchus assimilis)	Using integrated rotations should avoid the problem, since it mainly occurs where substantial areas of brassica crops have been grown for many years. Natural enemies often keep weevils below economic threshold.	On assessing 15-20 plants, an average of one weevil per plant at any time during flowering justifies control post flowering either with phosalone or Alphacypermethrin. On Spring crops apply those sprays recommended for the pollen beetle. Avoid Triazophos post flowering to assist natural pest populations.

Pest	Cultural Control	Chemical Control / Threshold
Nematodes	Maintain adequate length of time between oilseed rape and sugar beet in the rotation to control beet cyst nematode.	
Cabbage Root Fly (*Delia radicum*)	None	Carbofuran applied at drilling for control of Cabbage stem flea beetle.
Cabbage stem flea beetle (*Psylliodes chrysocephala*)	Do not grow crops next to previously infected crops.	Autumn if more than 5 larvae per plant are found on a random sample of at least 20 plants. Treatments after December not justified. Treatments include carbofuran, fonofos, cyfluthrin, cypermethrin, deltamethrin, fenvalerate, gamma HCH, permethrin, priimiphos-methyl or alphamethrin.

Appendix 11.g. Field Beans and Peas

Guideline 194. Peas and Beans should be used as break crop in cereal rotation or as a legumous crop to assist in building up soil fertility in stockless cropping systems.

Guideline 195. Peas and Beans are legumous crops which are able to contribute atmospheric nitrogen. There is no need to apply inorganic applications. Applications of other nutrients should be made strategically. (see MAFF 2000c).

Guideline 196. Varieties should be selected for resistance to known pest & disease problems in the area, rather than yield (see the appropriate NIAB Leaflet for peas and beans).

Guideline 197. Disease control should be as laid out in Table A. 11.10, and pest control as in Table A. 11.11.

Table A. 11.10. Disease control in field peas and beans

Disease	Cultural Control	Chemical Control
Damping off, foot rot and seed borne diseases. (*Pythium Phytophora, Fusarium, Ascochyta and Colletotrichum* spp. but not Halo Blight)	Use disease free or treated seed, avoid sowing in cold wet soils, chop burn and preferably plough stubble soon after harvest, avoid poorly drained soils.	Seed treatment: - Peas: - drazoxolon, thiram, Field Broad Beans, benomyl, drazoxdon, and thiram. Dwarf Beans drazoxolon, thiram
Leaf, Stem and Pod Spots (*Ascochyta pisi*-Peas, *Ascochyta fabae*-Field Beans, *Botrytis fabae*-Chocolate Spot of Field and Broad Beans, *Collectotrichum Lindemuthianum*-Anthradonose of dwarf/navy beans)	As for above seed borne diseases.	At first sign of disease build up in Spring spray with benomyl, carbendazim, and iprodione thiophanate - methyl or vinclozolin repeated three weeks later if necessary. OR a single application at flowering

Disease	Cultural Control	Chemical Control
Pea Wilt (Fusarium oxysporum)	Use disease free or treated seed. Varieties, use at least a four year break after a healthy crop of peas or beans, longer if unhealthy.	None available.
Halo Blight (Dwarf, Navy Beans) (*Pseudomonas phaseolicola*)	Use disease free seed, Isolate crops from other dwarf bean crops and previous stubble, Chop/burn and deeply plough stubble soon after harvest, Avoid poorly drained or low lying fields.	Foliar treatment. If occurrence is likely spray every 10-14 days from emergence to pod set with copper oxychloride.
Grey Mould/Pod rot of peas/beans (*Botrytis* spp.)	Chop/burn and deeply plough stubble soon after harvest, Avoid poorly drained or low lying soils.	
Downy Mildew (Peronospora viciae)		If required spray at first sign with Metalaxyl + Mancozeb or Chlorothalonil on field broad beans.

(From Moule 1988).

Table A. 11.11. Pest Control of Fields Peas and Beans

Pest	Cultural Control	Chemical Control
Pea and Bean Weevil (*Sitona lineatus*)	Encourage early rapid growth	On peas foliar sprays azinphos methyl + demeton-S-methyl sulphone, carbaryl, cypermethrin, fenitrothion, fenvalerate, permethrin or triazophos when leaf damage is seen. On beans Spring crops most at risk and treatment with cypermethrin, fenvalerate, permethrin, or triazophos.
Pea cyst nematode (*Heterodera goettingiana*)	Lengthen the interval between host crops.	Mix oxamyl granules in the seedbed before drilling, supplement to not alternative to lengthening the rotation.
Pea midge (*Contarinia pisi*)	Avoid proximity to previous years pea fields.	In vining peas crops should be sprayed when oldest green buds are 6mm long, about 7 days before flowering. In other crops leading shoots should be examined as they become susceptible and should be sprayed if more than 15% of plants affected. Sprays include: - azinphos methyl + demeton-S-methyl sulphone, carbaryl, demeton-S-methyl, dimethoate, fenitrothion and triazophos.
Black bean aphid (*Aphis fabae*)	Sow early and encourage rapid early growth.	Spray just before flowering when ADAS/Imperial College warnings are issued. Treatment may be restricted to headlands. Foliar applications of disulfoton or phorate, or sprays of demeton-S-methyl, primicarb or thiometon. Primicarb is the least harmful to bees, and applications should be made in the evening.

Pest	Cultural Control	Chemical Control
Pea Aphid (*Acyrthosiphum pisum*)	None	Foliar sprays, on crops for human consumption when colonies easily seen and numbers increasing. On crops for animal feed, when 50% of plants affected between flowering and four trusses set. Active ingredients include: - Azinphos, methyl + demeton-S-methyl sulphone, cypermethrin, deltamethrin, demeton-S-methyl, dimethoate, fenitrothion, fenvalerate, heptenophos, malathion, mevinphos, nicotine, oxydemeton-methyl, primicarb and thiometon.

Appendix 11.h. Potatoes

Guideline 198. Monoculture of potatoes should not be practiced, potatoes should be grown on an integrated rotation, on the same land no more than one in four.

Guideline 199. Potatoes provide the opportunity to control grass weeds in a cereal based rotation, also weed control may be carried out using inter row hoeing rather than chemically. In some circumstances weeds growing between rows could act as a harbour for beneficial insects.

Guideline 200. Inorganic fertilisers should be applied strategically (see MAFF 2000c).

Guideline 201. Seed bed preparation should be thorough, a clod free ridge is essential.

Guideline 202. Crop protection should involve the strategic use of chemicals where there is the high risk of disease or specific problems have occurred in the past. Both the cultural and chemical control methods for potato diseases are summarised in Table A. 11.12.

Guideline 203. Sprouting or Chitting that is manipulation of the pysiological age reduces the disease risk. Irrigation can reduce the risk of common scab where that is a problem, however can set up the initial conditions for Potato blight. Rouging should be practised to remove virus infected plants early on in crop cycle. Ensure healthy parental stock, to start with.

Table A. 11.12. The control of disease in potatoes

Disease	Cultural Control	Chemical Control/ Threshold
Potato Blight (*Phytophthora Infestans*)	Choose appropriate varieties, clean pre sprouted seed, avoid late Sowings, avoid close proximity with earlies or previous potato fields, stable well-earthed ridges. Destroy ground keepers or potatoes on dumps or in clamps. Isolate dumps from growing areas, defoliate and harvest early. Store tubers in cool dry conditions. Allow two weeks between haulm killing and lifting.	The fungus has exhibited resistance to phenylamide fungicides. Use the Smith warning period.

Disease	Cultural Control	Chemical Control/ Threshold
Potato leaf roll virus (Main aphid vector Peach Potato aphid - *Myzus persicae*) Potato Virus Y	Use certified virus free VTSC seed, varieties, isolate new seed from home saved seed, isolate dumps from growing areas, destroy ground keepers or potatoes on dumps or in clamps, Rouge virus infected plants early in the season. isolate growing fields form allotments, market gardens and housing areas.	Control aphid infestations in chitting houses, stores potato dumps. Use primicarb or another predator friendly spray.
Potato Virus X (mild mosaic)	Use certified virus free VTSC seed, varieties, isolate new seed from home saved seed, destroy groundkeepers, Disinfect clothing and machinery.	None
Black Leg (*Erwin carotovora var. atroseptica*)	Use certified virus free VTSC seed, Avoid cutting or damaging seed at planting, avoid poorly drained fields, avoid putting wet tubers in store, lift early under clean dry conditions thus reducing tuber damage, Hot water seed treatment.	Fumigation using a bactericide may reduce seed tuber infection.
Spraing (Tobacco rattle virus- Vectors- Nematodes) Also Potato mop top virus - (Vector- power scab fungus)	Varieties, efficient weed control in previous crops may lower nematode populations. Avoid home saved seed in virus prone areas. Control of Powdery scab will alos help control this virus.	Use aldicarb, carbofuran, oxamyl, and phorate when used for wireworm control.
Gangrene (*Phoma exigua var. foveata*)	Varieties, Early lifting of main crops (before 10th October), Avoid damage at lifting riddling time, curing period of 10 days at 10-13^{o}C after lifting and riddling will help heal wounds and prevent infection.	
Common Scab (*Streptomyces scabies*)	Varieties, Avoid liming potato or the previous crop. Avoid low organic matter soils, Irrigate crop especially during June, and Avoid scabby seed.	Quintozene
Powder Scab (*Spongospora subterranea*)	Varieties, Avoid use of infected sites for at least 5 years after last potato crop, avoid over liming, do not feed infected tubers to stock.	Mazin applied as a seed treatment may give some control.
Pink rot and watery wound rot (*Phytophthora* and *Pythium spp.*)	Avoid the variety King Edward; avoid damaging tubers at lifting/riddling time especially under damp soil conditions. Extend period between potato crops to eight years of more and prevent infection of clean fields. Improve drainage.	None Available.

Disease	Cultural Control	Chemical Control/ Threshold
Wart Disease (*Synchytrium endobioticum*)	Varieties, avoid spread on infected implements and dung spread on infected tubers. Rest field for 30 years outbreaks must be reported to DEFRA (notifiable disease.)	Not permitted.
Black scurf and Stem canker (*Thanatephorus cucumeris*)	Use well-sprouted healthy seed; avoid early deep plantings in cold dry conditions, harvest early, and long rotations.	Fungicides iprodione, pencycuron and tolclofos-methyl applied to seed reduce the incidence of stem canker in the field and black scurf on the progeny tubers.
Silver Scurf (*Helminthosporium solani*)	Avoid planting infected tubers; early harvest and cool dry storage will help reduce levels.	The disease affects appearance but not yield, therefore chemical control should not normally be considered.
Skin Spot (*Polyscythalum pustulans*)	Prespout seed before planting and discard infected tubers. Avoid cold wet harvesting. Store tubers in boxes under dry ventilated conditions.	Thiabendazole, imazalil, and fumigant 2-aminobutane applied within two weeks of lifting may reduce incidence. Thiabendazole and imazalil available are suitable seed treatments.

(From Moule 1988 & NIAB/PMB 1993).

Guideline 204. The following presents guidelines for pest control in potatoe crops (Table A. 11.13).

Table A. 11.13. Pest Control in Potatoes.

Pest	Cultural Control	Chemical
Slugs	Some varieties less susceptible.	Metaldehyde and Methiocarb may help.
Cutworms	Adequate weed control.	Chemical control usually too late.
Wireworms	Avoid potatoes after permanent grass.	
Potato cyst nematode (*Globodera rostochiensis* and *G. pallida*)	Early varieties tend to escape infection, practice good crop rotation, eliminate ground keepers, use classified seed and avoid once grown seed from eelworm infested soils.	Nematicides available but toxic, use only if absolutely necessary. In this case a high action threshold should be adopted.

(From NIAB/PMB 1993).

Guideline 205. Disorders of potatoes may all be prevented by cultural methods as described in Table A. 11.14.

Table A. 11.14. The Prevention of Potato Disorders.

Disorder	Control
Little Potato	Avoid excessive sprout growth in seed, avoid storing at too high a temperature before planting and avoid deep planting and poor seedbeds.
Coiled Sprout	As above, with over compaction of ridges at planting.
Growth Cracks	Irrigation during dry periods. Do not confuse with cracks caused by potato mop top and similar viruses.
Second Growth	Use of irrigation to regulate water supply.
Mechanical damage	Allow skins to set after haulm destruction, careful handling, ensure harvester set correctly, some varieties more prone to damage.
Bruising	Careful handling reduce long drops and crushing, high dry matter tubers more susceptible e.g. Record.
Jelly end rot	Use of irrigation to regulate water supply.
Stem end and Vascular browning	Avoid excessive fertilizer, chemical destruction of haulm.
Internal Browning	No proven control methods. May be due to mineral deficiencies.
Hollow Heart	Limit tuber size, through closer spacing or early haulm destruction. Some varieties more prone.
Blackheart	Avoid overheating in store.
Frost damage	Never expose tubers to temperature below freezing, avoid planting seed if showing chilling injury as eyes may be affected and cause happiness.
Chemical damage	Correct use of chemicals.
Internal Pigmentation	Adopt wider row widths.
Lenticellular out growth	Avoid harvesting under wet conditions.
Fertilizer damage	Avoid light soils and high fertilizer rates.

Appendix 11.i. Linseed, Evening Primrose, Borage, Sweet Corn and Field Vegetable Crops

Guideline 206. Inorganic fertilizer must be applied strategically, for recommendations see MAFF (2000c).

Guideline 207. All such crops should be considered as break crops in cereal rotations, and may be used to break the life cycles of pests, weeds and diseases of cereal crops.

Guideline 208. The principles of ICM should apply although in many cases economic thresholds have not been established for many lesser widely grown crops and information is scarce. Nominal thresholds for crop protection should be established based on previous experience and records using the same principles outlined earlier based . Although less precise than thresholds based upon economic injury levels these kinds of subjective thresholds can help to reduce pesticide applications (Pedigo 1996).

Appendix 11.j. Herbage Seed Production

Guideline 209. Extra attention should be paid to the control of seed borne diseases if crops are grown for commercial seed production or for home saved seed. In such crops extra chemical control may be justified, than in normal crops in sustainable systems.

Appendix 11.k. Catch Crops

Guideline 210. Catch crops are grown for only part of the season prior to the main crop (see ADAS 1978). In a sustainable system catch crops would be sown in the Autumn to provide ground cover and soak up excess nitrogen over to winter period prior to the establishment of a Spring sown crop. They may be utilized by stock on mixed farms or ploughed in to provide a green manure on in cropping only systems.

Guideline 211. There should be particular attention to rotations. The Table A. 11.15 illustrates the range of catch crops, and the preceding and following crops.

Table A. 11.15. The rotational management of catch crops

Preceding Main Crop	Following Main Crop	Choice of Catch Crop	Time of Utilisation by Stock.
Early Potatoes or Vining Peas harvested in June	Winter Cereals sown in October	Stubble turnips (if minimum of ten weeks growing period) Fodder Radish (Min 7-8 weeks growing period)	September August-September
Early Potatoes, Vining Peas, or grass grazed or conserved until the end of June	Spring Cereals Other Spring crops	Stubble Turnips Forage Rape Fodder Radish Italian Ryegrass Hungry Gap Kale or Rape Kale Marrow Stem or Thousand Headed Kale	Late Sept-Nov/Dec Late Sept-Dec/Jan Sept-Oct October or March/April November-December (Marrow Stem) January-March (Thousand headed)
Cereals harvested mid July to Early August	Spring cereals or other Spring crops	Stubble Turnips Forage Rape Fodder Radish Italian Ryegrass Hungry Gap Kale or Rape Kale Rye	Late October December Late October January October October-March March/April March/April
Cereals, oilseed rape or other crops harvested by end or August	Spring cereals or other Spring crops	Italian Ryegrass	November-March

(From ADAS 1978).

Appendix 12. The OECD List of Agri-Environmental Indicators

Soil Erosion:

Topsoil losses in tonnes per unit of agricultural land area per year.

Climatic Disasters:

Frequency of disasters (floods, droughts, fire, hurricanes, etc) and their cost for the agricultural sector.

Infestation of Weeds, Pests and Disease :

Number of infestations and the area affected and/or expenditure on control compared with previous year.

Stratospheric ozone depletion :

Atmospheric concentration of ozone-depleting substances and radiation of UV-B at ground level.

Acidification :

Exceeding of the critical loads of potential acid in water and soil.

Toxic contamination :

Concentrations of key heavy metals in inland waters.

Socio-economic Pressures :

Population Density : Trends in the population density per unit of agricultural land area and the ratio of farm population to total agricultural land area.

Land Use :

Changes in the composition to total land use between agriculture and other uses in the economy (included land protected for environmental purposes) and between different agricultural activities.

Farm Practices and Management Skills :

Consisting of indicators showing the extent and changes in farm practices and managerial skills related to:

1. Soil conservation, including adoption rates of sustainable land management practices;
2. Pesticide management, including the share of farms using integrated pest management, the annual frequency of pesticide application and the share of pesticide expenditure in total farm expenditure;

3. Farm waste management, including the share of farm waste recycled, the time of manure spreading, manure storage capacity and the ratio of area under commercial fertiliser to area under manure farming (organic farms);
4. The level and proportion of farmers with educational qualifications and managerial training.

Intensity of Agricultural Production :

Crop Production Intensity : Crop yields per hectare;
Livestock Production Intensity : In terms of head per hectare and/or converted into animal units per hectare.
Intensity of Farm Input Use :
Consisting of indicators showing intensity of use of the following inputs :
1. Fertilisers, including the use of commercial fertiliser and livestock manure applied per unit area of agricultural land and the nutrient content;
2. Pesticides, including the use of pesticides applied per unit area of agricultural land in terms of active ingredients, a breakdown of pesticide use between herbicides, fungicides, insecticides and other pesticides; and the use of pesticides across the economy (forestry, households, horticulture e.t.c.);
3. Water, including the area under irrigation and annual irrigation investment expenditure;
4. Energy, including total energy consumption by agriculture, the expenditure on energy by agriculture and energy use per unit of agricultural output;
5. Labour and machinery, use of labour and farm machinery per unit area of agricultural land.

Agricultural Productivity and Sustainability:

This indicator is the conventional measure of agricultural productivity (i.e. the ratio of the volume of production to the volume of resources used) adjusted for the costs and benefits of the environmental externalities and public goods associated with agricultural production. In the short term it will be difficult to develop such an indicator and instead changes in the conventional measure of farm productivity could be tracked against trends in resource depletion and environmental damage.

Agricultural Fertility:

This indicator reveals the extent to which farm practices effects agricultural fertility though changes in:
1. The nitrogen and phosphorous balance (links with intensity of farm input use);
2. Soil quality, through the combined effects on soil of erosion compaction, acidification, salination, water-logging, pollution from fertiliser and pesticide contaminants, and biological

quality (links with *Genetic diversity*). A diversity in this respect is separating out the impact on soil erosion from farm management practices as opposed to external environmental effects (links with Soil erosion, Acidification, Toxic contamination);

3. Energy Use Efficiency: Indicator to measure the efficiency of energy use in agriculture through an input/output ratio and the ratio of renewable to non renewable sources of energy used by agriculture (links with intensity of farm input use);

4. Water Use Efficiency: Indicator to measure efficiency of crops to use water from the soil and water use per unit area irrigated (links with intensity of farm input use).

Genetic Diversity:

This indicator includes the diversity of plant species in rangeland; the biological quality of soil; the extent of diversification in cropping and livestock production systems; and the extent of different plant species and livestock breeds used by agriculture and the existence of gene banks.

Quantity of Water:

Indicator to show the extent to which agriculture is depleting groundwater reserves and use of water per unit value of output relative to other sectors in the economy (links with *Intensity of farm unit use* and *Energy use efficiency*).

Air :

Greenhouse Gases: Indicator to provide a carbon balance for agriculture to show whether agriculture is a net source or sink of atmospheric carbon.

Acid Forming Air Emissions : Indicator to reveal extent to which agricultural activities contribute to the process of acidification mainly through the production of livestock manure and the use of fertilisers (line with *Acidification*).

Dispersion of Other Air Pollutants:

Indicator to monitor the effects of air-borne pesticide residues from pesticide spraying and associated farm worker and public safety problems; wind eroded soil and impairment of air quality and dust related health problems; and smells from livestock production units.

Natural Habitats and Landscape:

Natural Habitats: Indicator to show the impact of agriculture on three types of natural habitat:

1. Terrestrial habitats including the changes protected areas (line with *Land use*); changes in the type of vegetative land cover; the extent and changes in threatened species of wildlife (link with *Genetic diversity*); and the length of contact zone between agriculture and native

habitats to help reveal the impact of agriculture on these habitats through dispersal of weeds, seeds and feral pests.

2. Freshwater habitats, including the changes in the area of freshwater habitats, including wetlands (link with *Land use*), and the extent and changes in threatened freshwater species (link with *Water Quality*).

3. Marine habitats, includes the impact of agricultural activity on biological life in marine waters (link with *Water Quality*).

Landscape:

Indicator to include possible monetary valuation of the positive and negative impact of agricultural activity on the environment and physical changes in specific landscape features, for example the length of hedges and stonewalls.

Appendix 13. MAFF Pilot set of indicators for Sustainable Agriculture

Issue	Area	Indicator
A. Agriculture within the rural economy and society	Structure of the Agriculture Industry	Agricultural Assets and Liabilities
		Age of Farmers
		Percentage of holdings that are tenanted
		EU Producer Support Estimate (PSE)
	Farm Financial Resources	Payments to Farmers for Agri-environment Purposes
		Total Income From Farming
		Average Earnings of Agricultural Workers
	Agricultural Productivity	Agricultural Productivity
	Agricultural Employment	Agricultural Employment
	Management	Adoption of Farm Management Systems
B. Farm Management Systems	Organic Farming	Area converted to Organic Farming
	Codes of Practice	Knowledge of codes of Agricultural Practice
	Pesticide Use	Pesticides in Rivers
		Pesticides in Ground Water
		Quantity of Pesticide Active Ingredients Used
		Spray Area treated with Pesticides
		Pesticide Residues in Food
C. Input Use	Nutrients	Nitrate and Phosphorous Losses From Agriculture
		Phosphorous levels of Agricultural Topsoils
		Manure Management
	Greenhouse Gas Emissions	Ammonia Emissions From Agriculture
		Emissions of Methane and Nitrous Oxide from Agriculture
	Energy	Direct Energy Consumption By Farms
		Trends in Indirect Energy Inputs to Agriculture
	Water	Use of Water for Irrigation
		Organic Matter Content of Agricultural Topsoil's
D. Resource Use	Soil	Accumulation of heavy metals in Agricultural Topsoil's
	Agricultural Land	Area of Agricultural Land
		Change in Land Use from agriculture to hard development
	Non Food Crops	Planting of non food crops
	Environmental Conservation	Area of Agricultural Land Under Commitment to Environmental Conservation
E. Conservation Value of Agricultural Land	Landscape	Characteristic Features of Farmland
	Habitats	Area of Cereal Field Margins Under Environmental Management
		Area of Semi-natural Grassland
	Biodiversity	Populations of Key Farmland Birds

(From MAFF 2000c).

Appendix 14. Concentration of Nitrates and Orthophosphates in Surface Water

Appendix 14.a. Annual average[1], highest[2] and lowest[3] mean concentrations of nitrates by region: 1980, 1990 – 2000

Great Britain												mg/l $(NO_3)^4$
Region	1980	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
England and Wales												
North West												
Average	11.6	13.6	15.8	15.4	15.3	14.9	19.7	24.2	21.7	17.2	17.1	15.7
Highest site mean	31.0	30.6	36.1	41.8	36.4	38.8	83.6	87.1	76.2	42.6	48.4	42.2
Lowest site mean	2.6	1.8	2.1	2.2	1.9	1.5	1.8	2.6	3.3	2.4	1.7	1.7
North East												
Average	14.3	14.0	15.0	17.5	16.9	16.5	17.6	19.4	19.2	19.8	17.7	16.6
Highest site mean	33.0	35.5	36.7	45.9	43.5	41.0	42.3	49.3	44.0	47.0	42.5	41.7
Lowest site mean	1.8	1.5	1.7	1.5	1.7	1.9	2.2	3.0	3.1	3.8	2.3	2.7
Midlands												
Average	33.6	39.9	40.8	39.2	38.3	36.4	38.3	43.1	41.9	42.1	38.8	36.0
Highest site mean	52.5	61.8	63.3	61.1	59.8	56.6	64.2	71.9	70.9	65.8	64.1	61.4
Lowest site mean	9.9	10.6	12.1	11.0	10.4	10.1	10.1	16.2	12.8	12.5	12.1	9.9
Anglian												
Average	38.4	29.8	31.9	36.9	39.5	37.4	34.2	34.1	30.9	41.7	39.6	37.3
Highest site mean	52.0	39.7	44.2	47.4	50.4	43.5	40.6	43.5	44.2	55.6	57.6	62.7
Lowest site mean	26.0	20.9	14.7	25.1	26.4	28.4	28.8	27.1	23.0	31.5	28.2	27.1
Thames												
Average	37.6	35.2	36.0	35.7	34.0	32.6	32.8	36.8	36.2	36.8	33.7	33.2
Highest site mean	70.6	58.5	56.1	51.3	43.5	44.8	42.4	53.9	55.1	52.7	60.4	55.9
Lowest site mean	20.6	24.6	25.3	20.8	21.5	22.6	24.1	23.9	22.4	23.2	21.1	21.8
Southern												
Average	20.2	23.0	24.8	22.6	22.6	21.3	21.8	24.7	25.8	22.8	21.6	20.4
Highest site mean	26.1	33.4	36.5	36.7	36.0	30.7	30.3	37.5	38.1	31.6	30.7	29.3
Lowest site mean	11.2	11.9	12.8	10.6	10.0	10.1	7.8	11.2	14.4	9.7	8.7	9.6
South West												
Average	15.0	17.4	20.4	18.1	18.7	18.0	18.4	20.2	20.6	19.8	15.5	18.0
Highest site mean	36.9	36.9	48.6	38.8	41.0	38.1	37.3	37.8	41.6	39.6	38.0	35.1
Lowest site mean	4.7	5.7	6.3	6.4	5.7	4.6	5.3	6.2	6.3	5.7	5.7	5.4
Welsh												
Average	6.2	7.8	7.4	7.4	7.1	6.3	6.3	9.3	8.6	8.2	7.7	7.0
Highest site mean	18.6	24.7	20.5	18.9	19.9	18.1	17.7	27.9	25.2	28.3	27.4	30.5
Lowest site mean	0.8	0.6	1.1	0.9	0.8	0.7	1.1	1.2	0.9	1.0	1.0	0.7
Scotland												
SEPA North												
Average	5.7	5.4	6.6	6.5	6.5	6.5	6.7	7.0	7.2	8.2	7.3	7.4
Highest site mean	25.7	28.5	33.1	33.7	33.5	33.1	34.0	35.7	34.4	37.4	35.9	35.1
Lowest site mean	0.2	0.2	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.5	0.6
SEPA East												
Average	11.4	11.7	14.1	16.6	19.1	12.5	12.8	14.5	11.5	11.1	13.4	13.2
Highest site mean	28.8	34.3	39.5	42.0	41.7	36.1	38.7	39.4	24.5	25.5	39.5	41.3
Lowest site mean	1.9	0.8	1.4	2.5	4.1	2.0	2.4	3.5	3.4	4.1	2.9	2.1
SEPA West												
Average	6.5	5.6	6.5	5.2	5.3	5.6	5.5	7.3	6.9	6.7	4.8	5.1
Highest site mean	13.8	10.7	15.1	10.2	12.5	11.9	12.1	13.1	13.0	14.2	9.3	8.5
Lowest site mean	1.3	1.2	1.4	1.1	0.6	1.0	1.2	1.7	1.0	1.4	1.2	0.8
GB Average	15.9	16.2	17.7	17.8	17.9	16.7	17.4	19.8	19.2	19.6	17.8	17.0
90th percentile	35.2	34.5	39.5	39.4	39.3	38.1	36.9	40.3	38.3	41.4	38.0	36.4
10th percentile	2.4	2.0	2.3	2.2	2.0	1.9	2.2	2.9	2.7	2.7	2.3	2.2
Number of HMS	239	222	224	224	225	225	226	226	222	214	225	227
sites monitoring												

[1]Average of all annual site means in the region, each being given equal weight, irrespective of the number of samples taken. Values below the limit of detection have been equated to one half the detection limit.
[2]Highest annual site mean of all sampling sites in the region.
[3]Lowest annual site mean of all sampling sites in the region.
(From DEFRA 2002d).

Appendix 14.b. Annual average[1], highest[2] and lowest[3] mean concentrations of orthophosphates by region: 1980, 1990 – 2000

Great Britain												mg/l (P)
Region	1980	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
England and Wales												
North West												
Average	0.55	0.80	0.83	0.57	0.63	0.60	0.94	1.07	1.05	0.76	0.94	0.78
Highest site mean	3.61	5.08	4.51	2.65	3.08	2.28	3.17	3.77	3.06	2.76	3.32	2.10
Lowest site mean	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03	0.03	0.06	0.03
North East												
Average	0.30	0.58	0.53	0.46	0.34	0.37	0.56	0.65	0.58	0.64	0.58	0.41
Highest site mean	1.18	2.55	2.13	2.05	1.37	1.62	2.48	3.16	2.51	2.13	1.90	1.79
Lowest site mean	0.01	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.04	0.03	0.02
Midlands												
Average	1.16	1.83	1.57	1.24	1.10	1.04	1.43	1.74	1.68	1.30	1.03	1.00
Highest site mean	2.99	3.93	3.77	3.30	2.93	2.98	3.67	4.60	4.56	4.13	3.53	2.82
Lowest site mean	0.09	0.13	0.10	0.14	0.08	0.09	0.10	0.07	0.09	0.10	0.10	0.10
Anglian												
Average	0.67	1.20	1.12	0.71	0.58	0.53	0.68	0.85	0.91	0.68	0.46	0.03
Highest site mean	1.70	2.57	1.82	1.08	1.86	1.42	1.30	1.60	2.05	1.42	1.60	0.03
Lowest site mean	0.09	0.09	0.05	0.03	0.03	0.07	0.04	0.04	0.04	0.07	0.07	0.03
Thames												
Average	1.45	2.25	1.96	1.60	1.12	1.10	1.44	1.82	2.02	1.40	1.26	0.99
Highest site mean	3.55	4.66	3.86	3.35	2.50	2.62	2.57	3.81	4.11	2.84	3.65	2.35
Lowest site mean	0.31	0.84	0.75	0.32	0.37	0.38	0.58	0.64	0.77	0.55	0.21	0.22
Southern												
Average	0.43	0.93	0.59	0.59	0.46	0.43	0.71	0.74	0.67	0.52	0.53	0.37
Highest site mean	1.03	3.24	1.45	1.49	1.41	1.27	2.36	1.88	1.91	1.59	1.53	0.79
Lowest site mean	0.07	0.17	0.15	0.16	0.12	0.12	0.11	0.12	0.12	0.10	0.10	0.09
South West												
Average	0.21	0.32	0.22	0.23	0.20	0.19	0.24	0.27	0.24	0.20	0.16	0.19
Highest site mean	1.24	1.76	0.93	0.83	0.78	0.69	1.05	1.11	0.92	0.69	0.73	0.65
Lowest site mean	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Welsh												
Average	0.13	0.18	0.14	0.11	0.08	0.06	0.07	0.08	0.08	0.06	0.07	0.04
Highest site mean	1.03	2.17	1.83	0.93	0.50	0.56	0.66	0.87	0.77	0.63	0.74	0.38
Lowest site mean	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Scotland												
SEPA North												
Average	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Highest site mean	0.08	0.12	0.11	0.10	0.07	0.10	0.10	0.13	0.12	0.07	0.08	0.08
Lowest site mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SEPA East												
Average	0.15	0.16	0.16	0.13	0.11	0.15	0.16	0.21	0.21	0.15	0.11	0.10
Highest site mean	0.70	0.86	0.77	0.56	0.48	0.72	0.83	0.83	1.04	0.42	0.47	0.37
Lowest site mean	0.01	0.01	0.01	0.00	0.03	0.03	0.02	0.02	0.02	0.01	0.02	0.02
SEPA West												
Average	0.19	0.18	0.20	0.20	0.14	0.18	0.22	0.24	0.21	0.15	0.12	0.13
Highest site mean	0.76	1.01	1.33	0.85	0.72	0.95	1.02	1.02	0.67	0.57	0.41	0.45
Lowest site mean	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
GB average	0.40	0.64	0.56	0.44	0.37	0.36	0.50	0.59	0.58	0.45	0.40	0.33
90th percentile	1.10	2.05	1.70	1.20	1.07	0.99	1.48	1.81	1.73	1.43	1.19	1.04
10th percentile	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Number of HMS sites monitoring	239	222	224	224	225	225	226	226	222	214	225	227

1 Average of all annual site means in the region, each being given equal weight, irrespective of the number of samples taken. Values below the limit of detection have been equated to one half the detection limit.

2 Highest annual site mean of all sampling sites in the region.

3 Lowest annual site mean of all sampling sites in the region.

(From DEFRA 2002d).

Appendix 14.c. Annual average[1] concentrations of nitrates and orthophosphates by landscape type: 1980, 1990 – 2000

Nitrates	Annual averages - mg/l (NO_3)														
Landscape type			No. of sites[3]	1980	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Lowland arable															
GB			48	22.9	21.9	24.0	24.9	25.7	23.3	22.6	24.1	22.9	24.8	23.6	22.8
England			27	30.6	28.8	30.1	30.6	31.6	30.6	29.3	30.6	29.7	32.6	30.9	29.5
Scotland			21	12.6	12.8	15.8	14.8	15.6	13.8	13.9	15.7	12.4	12.0	13.9	14.2
Lowland pastural															
GB		[4]	60	12.9	13.0	14.8	14.4	14.1	13.4	14.6	17.5	17.0	15.9	15.0	13.9
England			40	15.2	15.3	17.6	17.1	17.0	16.3	17.9	20.9	20.4	19.3	18.3	16.8
Wales		[5]	19	7.3	8.4	8.9	8.4	7.8	7.0	7.4	10.2	9.7	8.8	8.1	7.8
Scotland			1	9.2	13.9	13.0	..	..	11.9	13.2	17.6	15.1	12.8	12.9	10.6
Uplands	GB	[4, 6]	51	4.8	4.7	5.2	4.9	5.1	4.5	4.8	6.0	5.6	5.9	5.5	5.1
TOTAL	GB	[4]	159	13.4	13.1	14.6	14.5	14.6	13.6	13.9	15.8	15.2	15.5	14.8	13.8
Orthophosphates	Annual averages - mg/l (P)														
Landscape type			No. of sites[3]	1980	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Lowland arable															
GB			48	0.48	0.74	0.61	0.52	0.38	0.38	0.52	0.63	0.65	0.48	0.42	0.32
England			27	0.71	1.17	0.94	0.78	0.59	0.56	0.78	0.94	0.98	0.7	0.66	0.55
Scotland			21	0.17	0.16	0.17	0.18	0.1	0.15	0.18	0.22	0.21	0.13	0.12	0.12
Lowland pastural															
GB			60	0.3	0.42	0.39	0.29	0.29	0.26	0.38	0.42	0.36	0.27	0.31	0.24
England			40	0.37	0.55	0.52	0.39	0.38	0.35	0.52	0.57	0.49	0.39	0.44	0.34
Wales		[5]	19	0.09	0.14	0.1	0.08	0.08	0.06	0.08	0.08	0.08	0.05	0.06	0.04
Scotland			1	0.62	0.62	0.57	0.42	0.48	0.39	0.49	0.81	0.73	0.36	0.47	0.37
Uplands	GB	[6]	51	0.07	0.06	0.05	0.05	0.05	0.05	0.06	0.07	0.07	0.05	0.05	0.05
TOTAL	GB		159	0.28	0.4	0.35	0.29	0.24	0.23	0.32	0.37	0.36	0.27	0.27	0.2

[1] Average of all annual site means in the landscape type, each site being given equal weight, irrespective of the number of samples taken. Values below the limit of detection have been equated to one half the detection limit.

[2] Slight changes to data since previous editions due to increased accuracy in calculations.

[3] Number of sites in 2000

[4] 1992 & 1993 figures for nitrate concentrations in lowland pastural rivers do not include data for Scotland

[5] Lowland pastural rivers in Welsh EA region.

[6] Rivers not passing mainly through lowland arable and pastural landscapes, ie those passing mainly through upland and marginal upland landscapes, but also some rivers passing mainly through more than one landscape type.

(From DEFRA 2002d).

Appendix 15. Annual average concentrations of nitrates in selected groundwater sites experiencing elevated nitrate levels: 1980, 1990 – 2000

Borehole	County		Annual averages - mg/l (NO_3)											
	Year		80	90	91	92	93	94	95	96	97	98	99	00
Armthorpe	South Yorkshire		54.1	56.9	59.0	58.7	61.8	57.6	60.6	r 59.5	56.9	55.7	55.5	58.1
Barrow	Humberside		..	64.7	69.3	66.2	74.9	75.0	71.2	r 67.7	70.6	76.2	80.9	81.3
Branston Booths	Lincolnshire		35.5	34.1	33.6	34.4	40.5	45.4	r 38.5	r 33.2	r 29.9	36.7	37.6	35.3
Carlton	North Yorkshire	1	..	51.6	51.9	53.5	50.2	r 50.3	r 36.3	37.4	34.9	34.3	34.5	31.5
Chipping	Hertfordshire		34.1	32.0	27.5	31.7	r 36.5	r 37.6	40.2	r 37.2	27.2	31.6	40.2	44.8
Clayhill	Lincolnshire	3	32.8	42.1	37.9	39.9	37.5	41.0	58.9	r 56.7	r 55.4	64.4	53.1	47.9
Abbey Mead	Berkshire	4	..	59.6	39.4	50.5	47.9	r 42.1	35.3	19.3	24.0	24.3	20.0	22.0
Duckaller	Devon		41.0	52.7	46.9	54.0	54.0	57.0	61.4	61.0	r 64.0	63.1	64.4	64.5
Eddisbury	Cheshire	2	44.7	44.5	42.9	46.5	r 51.4	r 46.4	56.1	52.1	52.4	56.3	61.4	67.3
Egford	Somerset		35.2	45.6	40.6	40.4	42.0	40.2	35.9	37.7	36.7	42.8	37.5	..
Kilham	Humberside		40.1	42.7	43.8	44.3	43.9	36.7	r 48.8	49.1	48.4	44.4	40.8	41.5
Thornton	Humberside	5	41.6	49.0	51.6	51.0	49.8	50.4	r 47.3	r 39.4	r 41.9	45.9	49.2	33.1
Ogbourne	Wiltshire		..	37.2	r 33.9	35.1	r 52.8	52.3	49.1	r 46.8	37.2	54.7	61.7	59.3
Organsdale	Cheshire	6	..	49.0	r 62.0	r 61.7	r 50.1	r 49.9	r 51.0	51.1	r 62.2	64.7	61.1	..
Shenstone	Staffordshire		53.4	67.4	69.2	66.3	68.8	44.6	72.4	74.0	72.7	72.4	69.8	72.9
Tack Lane	West Midlands		48.2	48.0	48.8	r 48.2	47.1	46.9	48.0	46.2	47.3	47.3	48.1	48.1
West Meon	Hampshire		20.9	..	25.0	25.0	33.9	29.1	26.7	26.5	28.2	30.7	29.8	33.8
Borehole	County													
Number of Readings	Year		80	90	91	92	93	94	95	96	97	98	99	00
Armthorpe	South Yorkshire		66	26	18	19	16	6	8	4	12	6	4	10
Barrow	Humberside		..	26	29	29	29	28	17	r 21	10	8	10	12
Branston Booths	Lincolnshire		37	50	81	53	53	74	r 57	r 82	r 56	55	50	49
Carlton	North Yorkshire	1	..	50	46	47	40	r 24	43	8	r 25	24	28	32
Chipping	Hertfordshire		4	2	2	2	7	r 1	r 21	r 9	9	5	2	26
Clayhill	Lincolnshire	3	30	40	47	47	45	51	47	r 25	r 2	4	19	10
Abbey Mead	Berkshire	4	..	52	49	62	56	33	34	38	r 4	3	5	3
Duckaller	Devon		14	33	12	54	26	9	24	51	r 48	51	22	11
Eddisbury	Cheshire	2	1	9	3	2	7	r 9	9	16	r 18	4	13	2
Egford	Somerset		12	76	61	215	240	245	156	131	151	152	153	..
Kilham	Humberside		43	48	46	50	53	31	r 52	13	49	54	52	52
Thornton	Humberside	5	47	49	55	53	52	62	r 13	r 27	r 13	23	17	8
Ogbourne	Wiltshire		..	90	r 68	211	r 30	57	57	59	12	11	8	11
Organsdale	Cheshire	6	..	6	r 3	5	5	r 3	r 8	6	r 2	1	3	..
Shenstone	Staffordshire		2	3	4	3	9	9	36	29	27	2	4	1
Tack Lane	West Midlands		10	18	71	53	15	12	12	14	12	6	14	6
West Meon	Hampshire		4	..	12	16	23	53	51	52	8	11	65	64

[1] The 1996 reading is from a different sampling point within the site so the average may not be directly comparable with the earlier values.

[2] Readings from 1994 onwards were from a different sampling point within the site and so averages from this date may not be directly comparable with earlier values.

[3] Readings from 1989 onwards were from a different sampling point within the site and so averages from this date may not be directly comparable with earlier values.

[4] In 1996 this site replaced Dorney used in earlier Digests, as data from that site were becoming very limited, so the average for 1996 is not directly comparable with the earlier data.

[5] In 1996 this site replaced Little London as the latter was no longer sampled, so the average for 1996 is not directly comparable with the earlier data

1. This site replaces Sandyford which was used in earlier Digests, as data from that site were becoming very limited. The 1995 readings were from a different sampling point within the site and so the average may not be directly comparable with earlier values.

(From DEFRA 2002d).

Appendix 16. Environmental Quality Standards Used by the NRA for the protection of aquatic life (freshwater)

Pesticide	Max µg/l	Average Annual µg/l	95 Percentile µg/l
HCH(A)		0.1 (0.5 NNS)	
PpDDT		0.01	
Total DDT		0.025	
Pentachlorophenol (A)		2	
Total drins		0.03	
Endrin		0.005	
Hexachlorobenzene		0.03	
Total, Atrazine/Simazine (A)	10 (PWRc)	2 (P)	
Azinphos methyl	0.04 (PWRc)	0.01 (P)	
Dichlorvos (A)		0.001 (P)	
Endosulfan (A)	0.3 (PWRc)	0.003 (P)	
Fenitrothion (A)	0.25 (PWRc)	0.01 (P)	
Malathion (A)	0.5 (PWRc)	0.01 (P)	
Trifluralin (A)	20 (PWRc)	0.1(PWRc)	
Diazinon (A)	0.1 (P NRA)	0.01(P NRA)	
PCSD's (A)			0.05 (P)
Cyfluthrin (A)			0.001(P)
Sulcofuron (A)			25(P)
Flucofuron (A)			1(P)
†Tributyltin (A)	0.02(P)		
†Triphenyltin (A)	0.02(P)#		
Permethrin (A)			0.01(P)

P=Proposed D.o.E.
A= Approved for use in UK

PWRc = Proposed Water Research Centre

All others are statutory

(From NRA 1995).

P NRA = Proposed NRA
†= Data on TBT and TPT was not available for this report
NNS = National Network Sites

#= 0.09µg/l at abstraction points

Appendix 17. Pesticide Contamination of Water

Appendix 17.a. Pesticides in surface water samples England and Wales 1995-1999

Pesticides	Percentage of samples over 100 ng/l [1]					Percentage of samples over 500 ng/l [1]				
	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
Most Commonly found Pesticides										
Mecoprop	9.9	14.1	16.4	11.2	14.8	3.5	4.0	4.5	4.8	3.4
Diuron	14.3	10.7	12.7	8.6	12.7	3.8	2.6	3.2	3.2	4.5
Isoproturon	18.8	19.4	17.4	7.7	12.1	6.5	6.6	5.0	3.1	4.9
2,4-D	5.9	6.7	7.2	9.9	6.5	1.9	1.4	1.3	3.0	1.9
Simazine	4.2	6.1	5.9	4.2	4.2	0.2	0.4	0.3	0.3	0.1
Atrazine	2.2	2.7	4.9	2.8	2.5	0.1	0.2	0.4	0.3	0.2
Bentazone	1.5	1.6	1.5	2.6	2.0	0.2	0.0	0.2	0.6	0.2
Chlorotoluron	4.6	3.7	1.4	1.0	1.6	1.2	0.9	0.3	0.2	0.4
Pentachlorophenol (PCP)	3.1	3.2	1.5	1.3	0.8	1.1	1.0	0.2	0.3	0.0
Dicamba	0.3	0.3	0.4	0.5	0.6	0.1	0.0	0.0	0.3	0.1
Lindane (Gamma HCH)	1.1	0.8	0.8	0.2	0.1	0.0	0.2	0.1	0.0	0.0
Other selected pesticides										
Permethrin	0.6	2.4	3.6	2.6	0.5	0.0	0.1	0.4	0.4	0.2
Dieldrin	0.1	0.2	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0
Sulcofuran	4.6	6.9	0.6	0.2	0.0	4.6	6.9	0.6	0.2	0.0
pp DDT	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
op DDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Endrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aldrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diazinon	2.4	3.7	4.3	2.3	0.9	0.7	0.6	0.5	0.1	0.1
Cypermethrin	1.0	2.0	2.7	1.5	0.3	0.0	0.0	0.1	0.1	0.0
Dichlorprop	1.8	2.0	4.3	4.8	3.9	0.5	0.4	1.1	1.5	0.9
Dnoc	13.5	8.3	12.6	8.0	3.5	3.1	4.4	4.1	2.5	0.3
Flutriafol	56.3	62.3	57.3	54.3	55.3	56.3	36.4	39.2	25.2	28.2
MCPA	8.1	10.1	10.6	9.7	8.4	3.0	3.2	3.3	4.7	2.1
MCPB	1.2	0.8	0.7	1.4	1.3	0.4	0.3	0.1	0.3	0.4
PCSD or Eulan	5.4	4.4	4.4	1.8	1.8	0.4	0.6	0.2	0.0	0.2
Pirimicarb	6.5	11.9	18.7	16.9	10.1	4.9	6.7	13.4	9.7	6.3
Propetamphos	2.1	2.7	2.9	1.4	0.7	0.8	0.7	0.2	0.1	0.2

[1] Levels are for illustrative purposes only - see text. In some samples the Limit Of Detection (LOD) was greater than 500ng/l.

Appendix 17.b. Pesticides in Groundwater samples in England and Wales 1995-1999

	Percentage of samples over 100 ng/l 2					Percentage of samples over 500 ng/l 2				
	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
Most commonly found pesticides										
Mecoprop	19.1	29.9	33.0	26.6	35.4	17.3	25.8	28.4	24.0	31.6
Atrazine	8.3	10.4	8.7	11.8	5.1	1.3	2.3	1.1	1.1	1.1
Simazine	0.4	1.4	2.6	1.5	1.8	0.2	0.8	0.8	0.5	0.0
Isoproturon	3.4	1.8	2.1	2.1	1.6	1.0	0.9	0.7	0.5	1.0
2,4-D	0.7	0.0	0.7	0.5	1.5	0.7	0.0	0.2	0.2	1.0
Lindane (Gamma HCH)	0.0	1.7	1.0	0.0	0.7	0.0	0.4	0.4	0.0	0.0
Diuron	6.0	0.8	2.0	1.5	0.5	1.6	0.0	0.5	0.3	0.0
Chlorotoluron	0.8	0.3	0.3	0.8	0.3	0.5	0.3	0.0	0.7	0.3
pp DDT	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dieldrin	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other selected pesticides										
Primicarb	0.0	0.0	4.0	0.0	9.8	0.0	0.0	4.0	0.0	9.8
Dichlorprop	2.4	0.5	1.0	0.5	4.5	1.2	0.0	0.5	0.2	3.3
Dicamba	2.7	2.3	1.7	0.5	3.0	2.7	2.3	1.1	0.3	2.3
MCPA	1.1	2.2	3.2	2.3	3.0	0.7	1.3	1.9	1.4	1.7
MCPB	1.2	0.0	4.6	0.2	2.6	1.2	0.0	3.1	0.2	1.3
Pentachlorophenol	0.4	2.0	0.0	0.0	1.2	0.4	0.7	0.0	0.0	0.0
Bentazone	0.0	0.5	1.4	2.3	0.4	0.0	0.0	0.5	0.2	0.4
Propetamphos	0.3	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Aldrin	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.4	0.0
op DDT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Endrin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diazinon	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DNOC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

1. The methodology for calculating the figures has changed for data from 1995. For this reason, data are not given pre-1995 because they are not directly comparable.
2. Levels are for illustrative purposes only - see text. In some samples the Limit Of Detection (LOD) was greater than 500ng/l.

Appendix 18. Potential Indicators of Sustainability for UK Agriculture

	Key Indicator[1]	DSR[2]	Unit	Model
Environmental				
Biodiversity	**Mean Stocking Rates**	D	LSU/ha	✓
	Number of Crops in Arable Rotations	D	No.	✗
	Changes in bird populations	S	Index	✗
	Plant diversity on farmland	S	Index	✗
Landscape	**Changes in land cover**	S	ha	✓
	Length of linear features	S	km	✗
Pollution	**Synthetic Fertiliser (NPK) use**	D	kg/ha	✓
	Intensity of Pesticide Use	D	kg ai/ha	✓
	Ecological Effects of Pesticides	S	Index	✓
	Ammonia and Methane Emissions	S	mg/l	✗
	Nitrate and Phosphate levels in Water	S	ng/l	✗
	Pesticides Contamination of Water	D	No. of incidents	✗
	Farm pollution incidents	S	%	✗
	% of Samples taken exceeding EQS's/0.1g/l	S	k tonnes	✗
Soil Quality	**Soil Quality Index**	S	Index	✓
	Organic matter content of soils	S	%	✗
	Content of available P	S	mg/l soil	✗
	Content of available K	S	mg/l soil	✗
Resource Use	**Energy use for crop production**	D	kW hr-1	✓
	Agricultural Productivity	S	t tonnes	✓
	Depletion of fossil fuels	S	tonnes oil equivalent	✗
Economic				
Farm Viability	**Net Farm Income**	S	£/yr	✓
	Short Term Borrowing	S	£	✓
	Net Worth	S	£	✗
	Agricultural Labour Force	S	No. FTE's	✓
Social				
Food	**Consumer Pesticide Hazard Index**	S	Index	✓
	Incidents of food poisoning	S	No.	✗
	Incidence of BSE	S	No.	✗
Farm Safety	**Pesticide Operator Hazard Index**	S	Index	✓
Animal Welfare	Animal Welfare Index	S	Index	✗

[1] Core Indicators in Bold Text

[2] D= Driving Force S=State R=Response

Appendix 19. List of Data Sources for the Models

Data in Model	Source
National Data	MAFF Agricultural Census 1998 and 1992 Farm Incomes in the UK 1997.
Yorkshire and Humberside	Farm Business Survey Results (1996/97) and (1991/92). York. Askham Bryan.
The South West England	University of Exeter Farm Management Handbook 1994.
The South East of England	Farm Incomes in the South East of England 1992. Wye College.
The East Midlands	Farming in the East Midlands (96/97) and (91/92). University of Nottingham.
The North of England	Farming in Northern England (1997) and (1991). University of Newcastle-upon-Tyne.
The West Midlands	Farming in the West Midlands (1996/97) and (1991/92). University of Reading.
The East of England	Farming in the East of England (1995/96) and (1991/92). University of Cambridge.
Scotland	SAC Farm Management Handbook (1997, 1992), Economic Report on Scottish Agriculture (1998,1992).
Wales	Farm Business Survey Results for Wales 1997/98 and 1991/1992. Welsh Institute of Rural Studies.
Northern Ireland	Farm Accounts in Northern Ireland 1997/1998 and 1991/1992. Department of Agriculture Northern Ireland.

Appendix 20. The Composition By Farm Type of the Representative Farm Clusters

	Group	Cluster Description	FBS Description	Region
1	Pigs & Poultry	Pigs and Poultry Central England	Pig & Poultry	CENT
			Mixed Farms	CENT
			Pig & Poultry	CENT
			Pig & Poultry	CENT
			Pig & Poultry	CENT
2		Pigs and Poultry Southern England & Wales	Pig & Poultry	NI
			Pig & Poultry	SE
			Pig & Poultry	SE
			Pig & Poultry	SE
			Pig & Poultry	WA
3		Pigs and Poultry Scotland NI & North	Pig & Poultry	CENT
			Pig & Poultry	NI
			Arable with intensive livestock	NO
			Arable with intensive livestock	NO
			Arable with intensive livestock	NO
			Pig & Poultry	SCO
			Pig & Poultry	SCO
			Pig & Poultry	SCO
			Pig & Poultry	SW
			Pig & Poultry	SW
			Pig & Poultry	SW
4	Cropping	Cropping SE England	Cereal Farms	SE
			Cereal Farms	SE
			Cereal Farms	SE
			Fen Arable	SE
			Fen Arable	SE
			Fen Arable	SE
			General Cropping Farms	SE
			General Cropping Farms	SE
			General Cropping Farms	SE

	Group	Cluster Description	FBS Description	Region
5		Cropping Central and Northern England	Arable roots and veg	CENT
			Arable roots and veg	CENT
			Arable roots and veg	CENT
			Cereal Farms	CENT
			Cereal Farms	CENT
			Cereal Farms	CENT
			General Cropping Farms	CENT
			General Cropping Farms	CENT
			General Cropping Farms	CENT
			Mixed Farms	CENT
			Arable with livestock Mainly Crops	NO
			Cereal Farms	NO
			Cereal Farms	NO
			Cash Roots	NO
			Cash Roots	NO
			General Cropping Farms	NO
			General Cropping Farms	NO
			Mixed Farms	NO
6		Cropping NI Scotland and SW	Cereal Farms	NI
			Cereal Farms	NI
			Cereal Farms	SCO
			Cereal Farms	SCO
			Cereal Farms	SCO
			General Cropping Farms	SCO
			General Cropping Farms	SCO
			Lowland Cropping Cattle and Sheep	SCO
			Lowland Cropping Cattle and Sheep	SCO
			Lowland Cropping Cattle and Sheep	SCO
			Mixed Farms	SCO
			Arable and Dairy	SW
			Cereal Farms	SW
			Cereal Farms	SW
			Cereal Farms	SW
			General Cropping Farms	SW
			General Cropping Farms	SW
			General Cropping Farms	SW
7		Small Cropping Farms Wales	Arable with livestock Mainly Crops	NO
			Cereal Farms	NO
			Cash Roots	NO
			General Cropping Farms	NO
			Cereal Farms	WA
			General Cropping Farms	WA
			General Cropping Farms	WA
8	Mainly Dairy	Mainly Dairy Wales and NI	Dairy Farms	NI
			Dairy Farms	NI
			Dairy LFA	WA
			Dairy LFA	WA
			Dairy Farms	WA
			Mixed Farms	WA

	Group	Cluster Description	FBS Description	Region
9		Small Dairy Northern England	Arable with livestock Mainly stock	NO
			Dairy with arable	NO
			Dairy LFA	NO
			Dairy LFA	NO
			Dairy Farms	NI
			Mixed Farms	NI
			Mixed Farms	NI
			Mixed Farms	NO
10		Large Dairy Scotland	Dairy LFA	NO
			Dairy Farms	SCO
			Dairy LFA	WA
11		Mainly Dairy SW England	Arable with dairy	CENT
			Arable with Dairy	CENT
			Arable with Dairy	CENT
			Mixed Farms	CENT
			Mixed Farms	NO
			Dairy Farms	SCO
			Mainly Dairy Farms	SW
			Mainly Dairy Farms	SW
			Mainly Dairy Farms	SW
12		Sheep and Dairy Southern England	Mainly Dairy LFA	CENT
			Mainly Dairy LFA	CENT
			Mainly Dairy LFA	CENT
			Lowland dairy sheep cattle and arable	SE
			Mixed Farms	SW
			Mixed Farms	SW
			Mixed Farms	SW
13	Specialist Dairy	Specialist Dairy Central & Southern England	Specialist Dairy LFA	CENT
			Specialist Dairy LFA	CENT
			Specialist Dairy LFA	CENT
			Specialist Dairy Farms	SW
14		Specialist Dairy North & Central England	Dairy Farms	CENT
			Dairy Farms	CENT
			Dairy Farms	CENT
			Specialist Dairy	CENT
			Specialist Dairy	CENT
			Specialist Dairy	CENT
			Dairy Farms	NO
			Dairy Farms	NO
			Dairy Farms	NO
			Dairy with arable	NO
			Dairy with arable	NO
			Specialist Dairy Farms	SW
			Specialist Dairy Farms	SW
			Dairy Farms	WA
			Dairy Farms	WA

	Group	Cluster Description	FBS Description	Region
15	Mixed Lowland	Mixed Lowland North and West	Arable with beef & sheep	CENT
			Arable with beef & sheep	CENT
			Lowland Cattle & Sheep	CENT
			Lowland Cattle & Sheep	CENT
			Lowland Cattle & Sheep	CENT
			Arable with livestock Mainly Crops	NO
			Arable with livestock Mainly stock	NO
			Arable with livestock Mainly stock	NO
			General Cropping Farms	NI
			Lowland Cattle & Sheep	NI
			Lowland Cattle & Sheep	NI
			Lowland Cattle & Sheep	NO
			Lowland Cattle & Sheep	NO
			Lowland Cattle & Sheep	NO
			Dairy Farms	SCO
			Lowland Cattle & Sheep	SCO
			Lowland Cattle & Sheep	SCO
			Lowland Cattle & Sheep	SCO
			Mixed Farms	SCO
			Mixed Farms	SCO
			Lowland Cattle & Sheep	SE
			Lowland Cattle & Sheep	SE
			Lowland Cattle & Sheep	SW
			Lowland Cattle & Sheep	SW
			Lowland Cattle & Sheep	SW
			Lowland Cattle & Sheep	WA
			Lowland Cattle & Sheep	WA
			Lowland Cattle & Sheep	WA
			Mixed Farms	WA
			Mixed Farms	WA
16		Mixed Lowland South	General Cropping Farms	NI
			General Cropping Farms	SCO
			Lowland sheep cattle and arable	SE
			Lowland sheep cattle and arable	SE
			Dairy Farms	SE
			Dairy Farms	SE
			Dairy Farms	SE
			Lowland Cattle & Sheep	SE
			Dairy and Arable	SE
			Dairy and Arable	SE
			Mixed Farms	SE
			Mixed Farms	SE
			Mixed Farms	SE
17	Large LFA	Large Hill Sheep Wales & NI	hill cattle & sheep	NO
			Hill sheep	SCO
			hill cattle & sheep	WA
			Hill sheep	WA
			Upland Cattle & Sheep Farms	WA

	Group	Cluster Description	FBS Description	Region
18		Large LFA North Central England	LFA Cattle & Sheep	CENT
			Upland Cattle & Sheep Farms	NO
			LFA Cattle & Sheep	SCO
19		Large LFA Scotland	Hill cattle & sheep	NO
			Hill cattle & sheep	NO
			Hill sheep	SCO
			Hill sheep	SCO
			Hill sheep	WA
20	Small LFA	Small LFA Beef Scotland	Hll beef	SCO
			Hll beef	SCO
			Hll beef	SCO
			hill cattle & sheep	WA
21		Small LFA Farms South West England	Hill sheep and cattle	SW
			Hill sheep and cattle	SW
			LFA Cattle & Sheep	SW
			LFA Cattle & Sheep	SW
			LFA Cattle & Sheep	SW
22		Small Hill & LFA Farms Wales & NI	LFA Cattle & Sheep	NI
			LFA Cattle & Sheep	NI
			Marginal Farms	NO
			LFA Cattle & Sheep	SCO
			LFA Cattle & Sheep	SCO
			hill cattle & sheep	WA
			Hill sheep	WA
			Upland Cattle & Sheep Farms	WA
			Upland Cattle & Sheep Farms	WA
23		Small LFA North and Central	Hill sheep	CENT
			Hill sheep	CENT
			Hill sheep	CENT
			LFA Cattle & Sheep	CENT
			LFA Cattle & Sheep	CENT
			Upland Cattle & Sheep Farms	NO
			Upland Cattle & Sheep Farms	NO

Appendix 21. Description of the Representative Farm Clusters

	1. Pigs and Poultry Central England	2. Pigs and Poultry Southern England and Wales	3. Pigs and Poultry Scotland, Northern Ireland & the North of England	4. Cropping South East England	5. Cropping Central and Northern England	6. Cropping Scotland, Northern Ireland and Western England	7. Small Cropping Farms Wales	8.Mainly Dairy Wales and Northern Ireland	9.Small Dairy Northern England	10.Large Dairy Scotland	11.Mainly Dairy South West England	12. Dairy and Sheep Southern England	13.Specialist Dairy Central and Southern England	14.Specialist Dairy North of England	15.Mixed Lowland North & West	16.Mixed Lowland South	17.Large Hill Sheep Wales & Northern Ireland	18.Large LFA North of England	19.Large LFA Scotland	20.Small LFA Beef Scotland	21.Small LFA Farms South West England	22.Small Hill Wales & Northern Ireland	23.Small LFA North & Central England
SIZE	1.8	1.8	1.8	2.0	2.2	1.9	1.1	2.0	1.3	3.0	2.2	2.0	1.8	2.1	1.9	2.1	3.0	1.6	3.0	1.8	1.8	1.6	1.7
LAND	55.5	18.1	41.8	156.3	162.5	173.5	66.7	80.9	60.7	141.8	197.7	148.3	63.5	89.5	129.5	134.8	974.4	579.9	1066.3	128.9	163.6	128.8	181.6
OWNED	0.7	0.7	0.6	0.3	0.4	0.6	0.5	0.8	0.7	0.7	0.5	0.4	0.4	0.5	0.5	0.4	0.5	0.4	0.4	0.5	0.7	0.6	0.4
STOCKING	1.8	2.3	2.1	2.7	1.7	1.8	1.6	1.9	1.6	1.8	1.9	1.8	1.8	2.1	1.7	2.2	0.8	0.5	1.3	1.5	1.6	1.2	1.0
CAP	1717.2	3626.3	2354.6	1786.3	1045.3	1005.4	1116.5	1685.8	1439.1	1754.4	1629.7	1643.5	2065.0	2304.5	1411.1	1948.5	593.4	331.8	833.4	1103.0	1128.0	1083.7	1072.7
MECHCAP	605.5	4363.2	720.5	689.0	523.8	422.0	544.3	560.3	388.2	493.8	549.3	448.2	517.8	648.5	350.6	881.1	155.0	70.7	138.5	333.9	276.0	286.7	156.0
LIVECAP	679.9	1914.4	1601.6	85.7	172.3	320.1	218.6	1024.9	856.3	1067.6	742.8	906.0	1232.0	1453.7	816.0	522.9	368.6	174.2	310.6	772.0		547.7	495.2
NFI	7219.9	1306.3	2168.8	428.7	334.6	202.4	289.2	429.1	178.0	409.9	256.1	180.3	487.7	487.3	144.4	368.9	124.0	91.4	98.4	167.4	71.2	224.2	146.9
RETURN		31.2	8.0	20.5	28.1	16.4	24.5	14.5	5.8	14.7	13.0	9.5	13.4	16.5	6.0	18.2	10.8	4.3	7.1	-2.4	-8.6	8.1	4.3
BARLEYY	5.6	5.2	6.0	6.0	6.0	6.4	6.1	5.0	5.2	5.8	5.8	5.7	5.7	5.8	5.9	5.5	5.5	5.9	5.9	6.6	5.4	5.7	5.4
WHEATY	6.7	6.7	7.3	6.5	7.3	7.7	7.3	6.6	7.1	7.2	7.2	7.0	6.5	6.9	7.3	6.6	6.9	7.3	7.3	7.8	6.1	7.3	6.7
OSRY	2.9	2.7	2.7	3.0	2.9	2.7	2.8	2.7	2.6	2.8	2.7	3.0	2.7	2.7	2.7	3.1	2.8	2.9	2.9	2.9	2.3	2.8	2.8
MILKY	6208.0	5337.5	5716.2	5339.0	5974.6	5440.6	4877.2	5014.0	4893.9	5380.7	6014.9	5671.1	5350.8	5997.1	5708.3	5373.8	5076.0	4755.0	5163.0	4321.0	3287.0	4562.4	5267.6
LAMB		1.2	153.7		157.0		158.5	1.2	137.4	61.6	146.0		0.0	150.7	82.6		1.0	1.0	140.0	1.1		34.5	140.0
FODDER	0.0	0.4	0.8	0.7	0.1	1.3	0.7	0.4	0.0	0.8	8.4	2.1	2.5	5.4	0.8	0.8	0.1	0.1	0.2	0.8	0.8	0.8	0.7
RGRAZING	0.0	40.9	0.7	1.2	0.3	2.3	1.0	6.3	22.5	19.0	0.0	10.3	3.0	3.3	2.9	4.0	65.0	79.8	30.0	28.4	27.7	20.6	34.0
GRASS	11.5	18.7	25.9	14.0	11.4	24.0	17.1	95.7	92.4	88.2	50.9	72.7	97.3	82.9	75.0	57.3	97.8	98.7	85.0	93.2	92.0	89.7	90.8
CEREALS	53.4	47.48	41.5	63.7	50.7	54.2	48.6	2.0	7.3	4.2	32.0	23.0	0.3	6.8	18.9	33.0	0.6	0.0	0.9	4.9	3.5	5.6	0.0
LABCOSTS	547.0	601.3	257.1	171.7	106.2	105.0	104.9	75.4	118.1	150.0	229.1	100.2	73.3	199.5	91.3	270.2	25.8	15.8	47.1	49.3	71.2	48.9	45.1
MECHCOST	1365.2	491.9	359.3	280.1	214.4	250.9	207.1	219.6	171.9	219.3	248.6	236.3	264.8	295.7	168.7	338.9	59.0	26.7	105.1	138.8	106.0	116.8	113.9
FERTCOST	58.9	3.0	53.8		73.4	71.8	69.6	88.5	61.0	90.4	81.9	56.4	83.6	93.8	56.1	98.7	21.9	8.0	24.2	59.4	38.4	43.4	27.5
FEEDCOST	12144.8	8699.3	1963.9		51.1	66.7	64.6	295.7	347.3	340.7	365.9	314.4	446.4	485.5	175.5	41.4	54.0	22.6	79.0	101.3	81.5	85.4	110.1

	1. Pigs and Poultry Central England	2. Pigs and Poultry Southern England and Wales	3. Pigs and Poultry Scotland, Northern Ireland & the North of England	4. Cropping South East England	5. Cropping Central and Northern England	6. Cropping Scotland, Northern Ireland and Western England	7. Small Cropping Farms Wales	8.Mainly Dairy Wales and Northern Ireland	9.Small Dairy Northern England	10.Large Dairy Scotland	11.Mainly Dairy South West England	12. Dairy and Sheep Southern England	13.Specialist Dairy Central and Southern England	14.Specialist Dairy North of England	15.Mixed Lowland North & West	16.Mixed Lowland South	17.Large Hill Sheep Wales & Northern Ireland	18.Large LFA North of England	19.Large LFA Scotland	20.Small LFA Beef Scotland	21.Small LFA Farms South West England	22.Small Hill Wales & Northern Ireland	23.Small LFA North & Central England
POULTRY								0.0		0.0	0.0		0.0	0.0	5.6		0.0	96.1			0.0	0.9	
SOW	201.6	102.9	122.1	0.0	0.0	0.0	0.0	0.4	11.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0
DAIRY	0.0	0.0	0.0	0.0	0.0	4.1	1.4	52.5	27.3	97.7	68.4	72.0	73.1	98.8	2.9	23.8	2.5	0.0	0.0	0.0	4.0	3.4	0.0
BEEF	0.0	0.0	0.0	0.0	10.4	23.9	7.3	1.9	6.3	0.4	0.0	21.6	0.9	57.7	18.8	11.6	68.9	19.5	303.4	92.5	81.9	39.7	74.1
EWES	0.0	0.0	0.0	94.0	119.0	85.1	77.9	75.9	154.1	237.5	20.5	475.2	108.1	75.9	210.4	87.6	2287.6	901.6	2145.5	209.8	1362.5	511.8	587.7
LSU	97.1	42.0	90.3	400.1	276.7	331.9	104.7	152.3	99.1	255.4	372.1	271.1	113.0	186.9	219.4	308.3	466.1	193.5	1376.2	190.9	248.9	164.7	189.3
OUTPUT	27086.7	7580.8	3871.2	1255.7	1216.9	1046.9	1192.5	1589.0	1274.9	1653.7	1867.8	1411.5	1967.3	2274.2	967.5	1480.3	471.1	162.6	578.3	744.5	556.4	814.0	674.0
LIVEOUT	80.6	95.7	80.8	13.7	12.0	25.3	15.9	96.3	87.0	95.3	75.3	92.1	97.3	91.9	67.5	53.3	94.5	89.8	85.6	85.1	88.9	88.5	91.4
CROPOUT	39.9	1.3	16.4	78.5	80.8	66.6	76.2	0.7	10.1	2.3	21.2	3.4	0.3	6.0	25.1	37.8	1.5	1.0	9.9	7.2	4.6	5.1	3.7
FIXEDCOS	906.4	1716.0	1231.5	692.7	555.9	649.1	588.5	375.0	563.3	638.2	829.6	656.0	919.6	948.2	482.0	766.1	241.9	143.5	295.2	365.0	248.4	270.2	376.3
FARMLAB	53.1	102.8	190.8	30.7	93.4	85.2	82.6	60.6	104.4	100.9	86.1	120.0	213.0	198.2	104.6	67.2	29.7	44.2	105.5	200.4	141.8	98.6	104.9
CAPLAB	4.8	5.6	6.9	9.1	5.6	8.8	6.0	23.7	5.7	8.4	5.4	10.4	11.1	7.5	8.5	6.7	13.2	14.4	8.1	16.4	3.0	9.2	7.3

Appendix 22. The Production Activities in the farm models

Activity	Description	P & P	Crops	Dairy Main	Dairy Specialist	Lowland	Large LFA	Small LFA
WW1	Feed Wheat	✓	✓	✓	✓	✓		
WW2		✓	✓	✓	✓	✓		
WW3		✓	✓	✓	✓	✓		
BW1	Bread making wheat	✓	✓	✓	✓	✓		
BW2		✓	✓	✓	✓	✓		
BW3		✓	✓	✓	✓	✓		
MSBAR1	Malt Spring Barley	✓	✓	✓	✓	✓	✓	✓
MSBAR2		✓	✓	✓	✓	✓	✓	✓
MSBAR3		✓	✓	✓	✓	✓	✓	✓
WB1	Feed Winter Barley	✓	✓	✓	✓	✓	✓	✓
WB2		✓	✓	✓	✓	✓	✓	✓
WB3		✓	✓	✓	✓	✓	✓	✓
SBAR1	Feed Spring Barley	✓	✓	✓	✓	✓	✓	✓
SBAR2		✓	✓	✓	✓	✓	✓	✓
SBAR3		✓	✓	✓	✓	✓	✓	✓
WO1	Winter Oats	✓	✓	✓	✓	✓	✓	✓
WO2		✓	✓	✓	✓	✓	✓	✓
WO3		✓	✓	✓	✓	✓	✓	✓
SO1	Spring Oats	✓	✓	✓	✓	✓	✓	✓
SO2		✓	✓	✓	✓	✓	✓	✓
SO3		✓	✓	✓	✓	✓	✓	✓
RYE1	Rye	✓	✓				✓	✓
RYE2		✓	✓				✓	✓
RYE3		✓	✓				✓	✓
TRIT1	Triticale	✓	✓				✓	✓
TRIT2		✓	✓				✓	✓
TRIT3		✓	✓				✓	✓
WOSR1	Winter Oilseed Rape	✓	✓	✓	✓	✓	✓	✓
WOSR2		✓	✓	✓	✓	✓	✓	✓
WOSR3		✓	✓	✓	✓	✓	✓	✓
SOSR1	Spring Oilseed Rape	✓	✓	✓	✓	✓	✓	✓
SOSR2		✓	✓	✓	✓	✓	✓	✓
SOSR3		✓	✓	✓	✓	✓	✓	✓
LIN50	Linseed	✓	✓	✓	✓	✓	✓	✓
LIN80		✓	✓	✓	✓	✓	✓	✓
LIN120		✓	✓	✓	✓	✓	✓	✓
SFB1K	Spring Field Beans	✓	✓	✓	✓	✓	✓	✓
SFB2K		✓	✓	✓	✓	✓	✓	✓
SFB3K		✓	✓	✓	✓	✓	✓	✓
SETSC	Set-aside Sown cover	✓	✓	✓	✓	✓	✓	✓
SETNR	Set-aside Natural Regeneration	✓	✓	✓	✓	✓	✓	✓
WORSA1	Winter Oilseed Rape Set Aside	✓	✓	✓	✓	✓	✓	✓
WORSA2		✓	✓	✓	✓	✓	✓	✓
WORSA3		✓	✓	✓	✓	✓	✓	✓

Activity	Description	P & P	Crops	Dairy Main	Dairy Specialist	Lowland	Large LFA	Small LFA
SORSA1	Spring Oilseed Rape Set Aside	✓	✓	✓	✓	✓	✓	✓
SORSA2		✓	✓	✓	✓	✓	✓	✓
SORSA3		✓	✓	✓	✓	✓	✓	✓
SBEET1	Sugar Beet	✓	✓	✓	✓	✓	✓	✓
SBEET2		✓	✓	✓	✓	✓	✓	✓
SBEET3		✓	✓	✓	✓	✓	✓	✓
POTEW1	Early Potatoes	✓	✓	✓	✓	✓	✓	✓
POTEW2		✓	✓	✓	✓	✓	✓	✓
POTEW3		✓	✓	✓	✓	✓	✓	✓
PTMCW1	Potatoes Main crop	✓	✓	✓	✓	✓	✓	✓
PTMCW2		✓	✓	✓	✓	✓	✓	✓
PTMCW3		✓	✓	✓	✓	✓	✓	✓
PMCWBPP1	Potatoes Maincrop Ware Bakers and Prepackers	✓	✓	✓	✓	✓	✓	✓
PMCWBPP2		✓	✓	✓	✓	✓	✓	✓
PMCWBPP3		✓	✓	✓	✓	✓	✓	✓
PTPOF1	Potatoes Processing Off Field Contract	✓	✓	✓	✓	✓	✓	✓
PTPOF2		✓	✓	✓	✓	✓	✓	✓
PTPOF3		✓	✓	✓	✓	✓	✓	✓
PTPEXST1	Potatoes Processing Ex Store Contract	✓	✓	✓	✓	✓	✓	✓
PTPEXST2		✓	✓	✓	✓	✓	✓	✓
PTPEXST3		✓	✓	✓	✓	✓	✓	✓
POTSEED1	Potatoes Mainly Seed	✓	✓	✓	✓	✓	✓	✓
POTSEED2		✓	✓	✓	✓	✓	✓	✓
POTSEED3		✓	✓	✓	✓	✓	✓	✓
POTDUAL1	Potatoes Dual Seed and Ware	✓	✓	✓	✓	✓	✓	✓
POTDUAL2		✓	✓	✓	✓	✓	✓	✓
POTDUAL3		✓	✓	✓	✓	✓	✓	✓
SWEDES1	Swedes Culinary		✓					
SWEDES2			✓					
SWEDES3			✓					
CAB1	Cabbage		✓					
CAB2			✓					
CAB3			✓					
CABWW1	Cabbage Winter White		✓					
CABWW2			✓					
CABWW3			✓					
VIN1	Vining Peas	✓	✓					
VIN2		✓	✓					
VIN3		✓	✓					
GR0	Grass Grazing	✓	✓	✓	✓	✓	✓	✓
GR1		✓	✓	✓	✓	✓	✓	✓
GR2		✓	✓	✓	✓	✓	✓	✓
GR3		✓	✓	✓	✓	✓	✓	✓
GR4				✓	✓	✓		
GR5				✓	✓	✓		

Activity	Description	P & P	Crops	Dairy Main	Dairy Specialist	Lowland	Large LFA	Small LFA
GR6		✓	✓	✓	✓	✓	✓	✓
GR7				✓	✓	✓		
GR8				✓	✓	✓		
GR9		✓	✓	✓	✓	✓		
SILAGE1	Silage One Cut	✓	✓	✓	✓	✓	✓	✓
SILAGE2	Silage Two Cut							
SILAGE3	Silage Two Cut	✓	✓	✓	✓	✓	✓	✓
SILAGE4	Silage Three Cut	✓	✓	✓	✓	✓	✓	✓
HAY1	Hay	✓	✓	✓	✓	✓	✓	✓
HAY2		✓	✓	✓	✓	✓	✓	✓
HAY3		✓	✓	✓	✓	✓	✓	✓
HAY4		✓	✓	✓	✓	✓	✓	✓
HAY5		✓	✓	✓	✓	✓	✓	✓
FMAIZE1	Forage Maize without Plastic	✓	✓	✓	✓	✓	✓	✓
FMAIZE2		✓	✓	✓	✓	✓	✓	✓
FMAIZE3		✓	✓	✓	✓	✓	✓	✓
FMAIZEP1	Forage Maize with Plastic	✓	✓	✓	✓	✓	✓	✓
FMAIZEP2		✓	✓	✓	✓	✓	✓	✓
FMAIZEP3		✓	✓	✓	✓	✓	✓	✓
SWEDESGR.	Swedes Grazed	✓	✓	✓	✓	✓	✓	✓
TURNIPSGR.	Turnips Grazed	✓	✓	✓	✓	✓	✓	✓
KALEAGE dr.	Kaleage Drilled	✓	✓	✓	✓	✓	✓	✓
KALEAGE Br.	Kaleage Broadcast	✓	✓	✓	✓	✓	✓	✓
Rape Broad	Forage Rape Broadcast	✓	✓	✓	✓	✓	✓	✓
Rape Drilled	Forage Rape Drilled	✓	✓	✓	✓	✓	✓	✓
Rape DD	Forage Rape Direct Drilled	✓	✓	✓	✓	✓	✓	✓
Fbeet1	Fodder Beet	✓	✓	✓	✓	✓	✓	✓
Fbeet2		✓	✓	✓	✓	✓	✓	✓
Fbeet3		✓	✓	✓	✓	✓	✓	✓
FRYE1	Forage Rye		✓				✓	✓
FRYE2			✓				✓	✓
FRYE3			✓				✓	✓
IRG1	Italian Rye Grass		✓	✓	✓	✓	✓	✓
IRG2			✓	✓	✓	✓	✓	✓
IRG3			✓	✓	✓	✓	✓	✓
FRAPECC1	Forage Rape Catch Crop		✓					
FRAPECC2			✓					
FRAPECC3			✓					
TURNCC1	Turnips Catch Crop		✓					
TURNCC2			✓					
TURNCC3			✓					
MUSTCC1	Mustard		✓					
MUSTCC2			✓					
MUSTCC3			✓					
LLBE1	Lowland Ewes	✓	✓	✓	✓	✓		
LLBE2		✓	✓	✓	✓	✓		

Activity	Description	P & P	Crops	Dairy Main	Dairy Specialist	Lowland	Large LFA	Small LFA
LLBE3		✓	✓	✓	✓	✓		
HILLSTP1	Hill Ewes							
HILLSTP2								
HILLFLG1								
HILLFLG2								
UPCLBE1	Upland Ewes							
UPCLBE2								
UPHBML	Upland Ewes Mules							
CBE1	Crossbred Ewes	✓	✓	✓	✓	✓		
CBE2		✓	✓	✓	✓	✓		
CBE3		✓	✓	✓	✓	✓		
DBFEWE1	Draft Ewes			✓	✓	✓		
DBFEWE2				✓	✓	✓		
DBFEWE3				✓	✓	✓		
WINFINMK	Winter Finishing Lambs	✓	✓	✓	✓	✓		
WINFINLK		✓	✓	✓	✓	✓		
WINFINBF		✓	✓	✓	✓	✓		
WINFINSK		✓	✓	✓	✓	✓		
AFLGR		✓	✓	✓	✓	✓		
GIMMERING	Gimmers	✓	✓	✓	✓	✓		
INDOORLA		✓	✓	✓	✓	✓		
HREA26	Dairy Replacements		✓	✓	✓			
HRA30			✓	✓	✓			
HRA36			✓	✓	✓			
HRS30			✓	✓	✓			
HRS36			✓	✓	✓			
Dsp4000	Dairy Cows			✓	✓			
Dsum4000				✓	✓			
Daut4000				✓	✓			
DAll4000				✓	✓			
Dsp5000			✓	✓	✓			
Dsum5000			✓	✓	✓			
Daut5000			✓	✓	✓			
DAll5000			✓	✓	✓			
Dsp6000				✓	✓			
Dsum6000				✓	✓			
Daut6000				✓	✓			
DAll6000				✓	✓			
Dsp7000				✓	✓			
Dsum7000				✓	✓			
Daut7000				✓	✓			
DAll7000				✓	✓			
Dsp8000			✓	✓	✓			
Dsum8000			✓	✓	✓			
Daut8000			✓	✓	✓			
DAll8000			✓	✓	✓			
LLSUCKNJ	Lowland Sucklers	✓	✓			✓		
LLSUCKFA		✓	✓			✓		

Activity	Description	P & P	Crops	Dairy Main	Dairy Specialist	Lowland	Large LFA	Small LFA
LLSUCKMJ		✓	✓			✓		
LLSUCKAO		✓	✓			✓		
UPSUCKNJ	Upland Sucklers							✓
UPSUCKFA								✓
UPSUCKMJ								✓
UPSUCKAO								✓
HILLSU1	Hill Sucklers						✓	
HILLSU2							✓	
HILLSU3							✓	
18MthST	18 Month Beef	✓	✓	✓	✓	✓	✓	✓
18mthHF		✓	✓	✓	✓	✓		✓
24mthFr	24 Month Beef	✓	✓	✓	✓	✓		✓
24mthB		✓	✓	✓	✓	✓		✓
OWSCSBST		✓	✓	✓	✓	✓		✓
OWSCSBHF		✓	✓	✓	✓	✓		✓
OWSCWBST		✓	✓	✓	✓	✓		✓
OWSCWBHF		✓	✓	✓	✓	✓		✓
WFLFDBST		✓	✓	✓	✓	✓		✓
WFMFDBST		✓	✓	✓	✓	✓		✓
WFSCST		✓	✓	✓	✓	✓		✓
WFSCHF		✓	✓	✓	✓	✓		✓
BSDBXSTL		✓	✓	✓	✓	✓		✓
BSDBXSTM		✓	✓	✓	✓	✓		✓
OWSCSTWB		✓	✓	✓	✓	✓		✓
OWSCHFWB		✓	✓	✓	✓	✓		✓
OWSCSTSB		✓	✓	✓	✓			
OWSCHFSB		✓	✓	✓	✓			
OWMJST		✓	✓	✓	✓			
OWMJHF		✓	✓	✓	✓			
RYCSBMST		✓	✓	✓	✓			
RYCSBLST		✓	✓	✓	✓			
RYCABMST		✓	✓	✓	✓			
RYCABLST		✓	✓	✓	✓			
WFLFBST		✓	✓	✓	✓			
SFLFBST		✓	✓	✓	✓			
IBBFCF	Intensive Bull Beef	✓	✓	✓	✓			
IBBBXSF		✓	✓	✓	✓			
IBBSCCF		✓	✓	✓	✓			
IBBSCSF		✓	✓	✓	✓			
CRFBFs1	Calf Rearing	✓	✓	✓	✓			
CRMBBFs1		✓	✓	✓	✓			
CRLBBFs1		✓	✓	✓	✓			
CRFALst1		✓	✓	✓	✓			
CRFBFhf1		✓	✓	✓	✓			
CRMBBFh1		✓	✓	✓	✓			
CRLBBFh1		✓	✓	✓	✓			
CRFALhf1		✓	✓	✓	✓			

Activity	Description	P & P	Crops	Dairy Main	Dairy Specialist	Lowland	Large LFA	Small LFA
BPIG3WKW	Breeding Pigs 3 Weeks	✓						
BPIG4WKW	Breeding Pigs 4 Weeks	✓						
BPIGOUT	Breeding Pigs Outdoor	✓						
FPIGPORK	Feed Pigs Porkers	✓						
FPIGCUT	Feeding Pigs Cutters	✓						
FPIGBAC	Feeding Pigs Baconers	✓						
FPIGHEA	Feeding Pigs Heavy	✓						
PULREAR	Rearing Pullets	✓						
EGGCAGE	Eggs Caged System	✓						
EGGRANGE	Eggs Free Range	✓						
EBARN	Eggs Barn	✓						
CHBROILE	Chicken Broilers	✓						
TFFthen	Turkey Hens	✓						
tfftstag	Turkey Stags	✓						

Appendix 23. The Mean, Maximum and Minimum Activity Gross Margins Used in the Models (£/ha or £/head)

	Conventional Farm Models			Sustainable Farm Models		
	Mean	Max	Min	Mean	Max	Min
WW1	£708.70	£748.92	£629.83	£652.10	£708.61	£605.69
WW2	£757.50	£841.81	£696.87	£765.83	£899.10	£646.28
WW3	£797.98	£840.41	£713.68	£717.87	£759.48	£645.94
BWW1	£904.68	£961.02	£808.30	£816.49	£876.58	£766.57
BWW2	£967.26	£1,072.51	£894.27	£956.03	£1,123.39	£805.40
BWW3	£1,019.16	£1,068.31	£915.82	£901.73	£941.81	£823.04
MSBAR1	£733.39	£878.01	£635.58	£774.02	£858.71	£689.58
MSBAR2	£761.53	£872.97	£638.47	£794.30	£927.72	£672.88
MSBAR3	£840.02	£1,008.33	£715.52	£868.75	£933.71	£762.60
WB1	£241.13	£720.62	£51.58	£250.07	£639.83	£86.29
WB2	£247.73	£713.79	£60.74	£262.60	£740.82	£51.66
WB3	£265.71	£818.36	£65.23	£263.56	£728.72	-£28.10
SBAR1	£199.43	£641.10	£28.11	£252.57	£645.30	£127.24
SBAR2	£210.55	£693.97	£32.47	£261.05	£753.22	£128.73
SBAR3	£219.79	£716.69	£41.25	£270.14	£724.68	£133.59
WO1	£546.71	£573.14	£482.43	£530.65	£565.11	£501.93
WO2	£585.68	£614.14	£518.70	£577.52	£603.14	£517.56
WO3	£608.81	£639.91	£548.48	£582.80	£604.56	£535.14
SO1	£546.67	£603.72	£475.17	£541.77	£571.93	£508.75
SO2	£590.34	£623.45	£506.73	£595.52	£643.71	£519.38
SO3	£610.50	£682.25	£541.94	£595.02	£651.50	£536.95
RYE1	£448.21	£466.08	£398.85	£432.15	£460.91	£403.68
RYE2	£477.12	£497.05	£429.63	£468.90	£488.94	£432.66
RYE3	£486.76	£505.66	£438.18	£465.52	£480.43	£444.43
TRIT1	£486.06	£502.68	£437.68	£467.14	£497.49	£437.83
TRIT2	£519.02	£536.63	£471.63	£508.11	£529.78	£469.90
TRIT3	£528.45	£546.05	£481.05	£504.35	£519.26	£483.26
WOSR1	£714.69	£771.78	£665.86	£696.66	£759.91	£646.15
WOSR2	£736.07	£769.57	£668.20	£785.58	£828.15	£710.02
WOSR3	£777.15	£835.21	£727.22	£742.73	£794.01	£704.01
SOSR1	£722.10	£771.97	£675.21	£763.02	£832.63	£718.70
SOSR2	£743.65	£797.75	£643.75	£731.77	£779.58	£618.87
SOSR3	£767.83	£818.61	£720.97	£808.62	£866.97	£776.97
LIN1	£483.17	£519.69	£430.86	£459.56	£490.28	£407.78
LIN2	£491.58	£520.10	£449.10	£500.97	£540.45	£443.55
LIN3	£513.70	£552.46	£454.20	£481.80	£507.18	£436.18
SFB20K	£598.98	£627.55	£564.92	£607.19	£648.90	£558.48
SFB40K	£655.13	£676.43	£623.43	£607.91	£625.22	£572.22
SFB60K	£675.24	£707.67	£637.22	£680.28	£704.76	£638.12
SETSC	£253.26	£273.00	£224.00	£260.16	£276.25	£227.25
SETNR	£295.26	£315.00	£266.00	£302.16	£318.25	£269.25
WORSA1	£552.02	£572.99	£522.38	£513.56	£541.60	£480.41
WORSA2	£574.27	£604.60	£526.90	£585.00	£619.52	£539.52
WORSA3	£608.19	£629.66	£568.58	£554.48	£593.95	£518.93
SORSA110	£505.08	£532.38	£466.08	£553.46	£582.89	£513.43
SORSA2	£518.24	£546.32	£453.32	£517.00	£547.25	£442.75
SORSA3	£544.60	£574.06	£497.10	£592.44	£612.25	£559.56
SBEET1	£818.32	£921.91	£789.29	£668.38	£711.76	£633.65
SBEET2	£896.31	£958.44	£893.48	£893.86	£991.49	£836.05

	Conventional Farm Models			Sustainable Farm Models		
	Mean	Max	Min	Mean	Max	Min
SBEET3	£987.38	£1,027.70	£959.10	£787.32	£802.04	£750.90
POTEW1	£2,171.54	£2,360.55	£2,162.94	£1,602.36	£1,686.92	£1,505.92
POTEW2	£2,458.18	£2,458.18	£2,458.18	£2,600.50	£3,385.04	£2,196.39
POTEW3	£2,637.69	£2,642.14	£2,539.83	£1,947.82	£2,017.37	£1,852.41
PTMCW1	£1,935.49	£2,118.76	£1,873.41	£1,426.96	£1,544.96	£1,320.37
PTMCW2	£2,186.74	£2,222.51	£2,185.11	£1,931.26	£2,997.84	£1,576.19
PTMCW3	£2,387.69	£2,404.69	£2,311.72	£1,769.88	£1,811.87	£1,658.28
PMCWBPP1	£2,242.32	£2,429.57	£2,227.18	£1,848.90	£2,869.98	£1,504.36
PMCWBPP2	£2,536.42	£2,582.22	£2,529.55	£2,212.87	£3,334.57	£1,854.15
PMCWBPP3	£2,720.53	£2,773.06	£2,613.15	£2,514.22	£4,263.76	£2,028.48
PTPOF1	£1,929.65	£2,129.68	£1,650.05	£1,976.90	£3,862.34	£1,190.28
PTPOF2	£2,167.65	£2,211.88	£1,872.75	£2,324.91	£4,394.31	£1,393.32
PTPOF3	£2,316.66	£2,366.74	£2,011.47	£2,626.73	£5,458.23	£1,521.01
PTPEXST1	£2,377.08	£2,638.94	£1,966.15	£2,279.07	£4,482.82	£1,390.53
PTPEXST2	£2,677.79	£2,743.04	£2,242.79	£2,702.20	£5,121.06	£1,645.04
PTPEXST3	£2,866.06	£2,939.15	£2,415.11	£3,067.84	£6,397.54	£1,805.10
POTSEED1	£3,322.65	£3,791.79	£2,061.97	£1,995.97	£4,018.20	£1,212.81
POTSEED2	£3,727.04	£3,934.80	£2,375.37	£2,414.75	£4,634.11	£1,475.57
POTSEED3	£3,980.26	£4,204.20	£2,570.58	£2,774.17	£5,865.95	£1,640.81
POTDUAL1	£2,657.11	£3,033.68	£1,705.11	£2,211.47	£4,300.13	£1,394.63
POTDUAL2	£3,002.36	£3,155.23	£1,983.21	£2,642.89	£4,935.59	£1,664.67
POTDUAL3	£3,218.54	£3,384.22	£2,156.43	£3,013.31	£6,206.53	£1,834.49
SWEDES1	£2,366.14	£2,366.14	£2,366.14	£1,916.52	£1,916.52	£1,916.52
SWEDES2	£1,906.97	£2,493.32	£1,720.90	£1,947.72	£2,435.21	£1,654.68
SWEDES3	£2,595.52	£2,595.52	£2,595.52	£2,134.95	£2,134.95	£2,134.95
CAB1	£1,906.46	£2,466.21	£992.01	£1,244.63	£1,244.63	£1,244.63
CAB2	£1,652.44	£2,636.46	£1,234.99	£1,496.84	£2,203.87	£1,103.03
CAB3	£2,161.18	£2,773.26	£1,149.49	£1,437.56	£1,437.56	£1,437.56
CABWW1	£5,034.65	£6,989.57	£3,062.67	£4,609.95	£6,946.78	£2,341.99
CABWW2	£5,812.46	£7,242.96	£3,189.36	£5,611.64	£7,233.52	£4,050.95
CABWW3	£5,376.82	£7,445.13	£3,290.45	£4,970.31	£7,463.24	£2,550.86
VIN1	£267.23	£267.23	£267.23	£208.45	£266.88	£187.83
VIN2	£287.53	£287.53	£287.53	£277.46	£291.74	£236.98
VIN3	£304.75	£304.75	£304.75	£248.75	£313.06	£226.05
GR0	-£28.93	-£7.98	-£44.98	-£22.65	£0.00	-£35.00
GR50	-£42.12	-£35.95	-£52.95	-£26.48	-£20.00	-£36.00
GR75	-£43.12	-£37.95	-£52.95	-£27.17	-£22.00	-£37.00
GR125	-£43.12	-£37.95	-£52.95	-£27.17	-£22.00	-£37.00
GR150	-£43.12	-£37.95	-£52.95	-£27.17	-£22.00	-£37.00
GR175	-£43.12	-£37.95	-£52.95	-£27.17	-£22.00	-£37.00
GR200	-£43.12	-£37.95	-£52.95	-£27.17	-£22.00	-£37.00
GR250	-£43.12	-£37.95	-£52.95	-£27.17	-£22.00	-£37.00
GR300	-£43.12	-£37.95	-£52.95	-£27.17	-£22.00	-£37.00
GR375	-£43.12	-£37.95	-£52.95	-£27.17	-£22.00	-£37.00
SILAGE125	-£43.25	-£40.95	-£52.95	-£27.30	-£25.00	-£37.00
SILAGE220	-£43.25	-£40.95	-£52.95	-£27.30	-£25.00	-£37.00
SILAGE275	-£43.25	-£40.95	-£52.95	-£27.30	-£25.00	-£37.00
SILAGE300	-£43.25	-£40.95	-£52.95	-£27.30	-£25.00	-£37.00
HAY0	-£47.17	-£42.95	-£47.95	-£31.43	-£27.00	-£32.00
HAY50	-£48.04	-£42.95	-£48.95	-£32.35	-£27.00	-£33.00
HAY75	-£48.91	-£42.95	-£49.95	-£33.26	-£27.00	-£34.00
HAY125	-£49.78	-£42.95	-£50.95	-£34.17	-£27.00	-£35.00

	Conventional Farm Models			Sustainable Farm Models		
	Mean	Max	Min	Mean	Max	Min
HAY200	-£50.65	-£42.95	-£51.95	-£35.09	-£27.00	-£36.00
FMAIZE1	-£325.50	-£292.50	-£694.50	-£303.89	-£287.63	-£304.63
FMAIZE2	-£328.76	-£292.50	-£769.50	-£303.89	-£287.63	-£304.63
FMAIZE3	-£332.02	-£292.50	-£844.50	-£303.89	-£287.63	-£304.63
FMAIZEP1	-£532.50	-£499.50	-£901.50	-£510.89	-£494.63	-£511.63
FMAIZEP2	-£535.76	-£499.50	-£976.50	-£510.89	-£494.63	-£511.63
FMAIZEP3	-£539.02	-£499.50	-£1,051.50	-£510.89	-£494.63	-£511.63
SWEDESGR.	-£123.78	-£123.78	-£123.78	-£99.34	-£99.34	-£99.34
TURNIPSGR.	-£106.58	-£106.58	-£106.58	-£82.14	-£82.14	-£82.14
KALEAGEdr.	-£279.50	-£279.50	-£279.50	-£279.50	-£279.50	-£279.50
KALEAGEBr.	-£196.03	-£196.03	-£196.03	-£196.03	-£196.03	-£196.03
RapeBroad	-£72.60	-£72.60	-£72.60	-£57.75	-£57.75	-£57.75
RapeDrilled	-£69.30	-£69.30	-£69.30	-£54.45	-£54.45	-£54.45
RapeDD	-£104.60	-£104.60	-£104.60	-£89.75	-£89.75	-£89.75
Fbeet1	-£251.22	-£251.22	-£251.22	-£195.70	-£195.70	-£195.70
Fbeet2	-£251.22	-£251.22	-£251.22	-£195.70	-£195.70	-£195.70
Fbeet3	-£251.22	-£251.22	-£251.22	-£195.70	-£195.70	-£195.70
FRYE1	-£72.00	-£72.00	-£72.00	-£72.00	-£72.00	-£72.00
FRYE2	-£72.00	-£72.00	-£72.00	-£72.00	-£72.00	-£72.00
FRYE3	-£72.00	-£72.00	-£72.00	-£72.00	-£72.00	-£72.00
IRG1	-£108.00	-£108.00	-£108.00	-£90.00	-£90.00	-£90.00
IRG2	-£108.00	-£108.00	-£108.00	-£90.00	-£90.00	-£90.00
IRG3	-£108.00	-£108.00	-£108.00	-£90.00	-£90.00	-£90.00
FRAPECC1	-£96.00	-£96.00	-£96.00	-£74.48	-£74.48	-£74.48
FRAPECC2	-£96.00	-£96.00	-£96.00	-£74.48	-£74.48	-£74.48
FRAPECC3	-£96.00	-£96.00	-£96.00	-£74.48	-£74.48	-£74.48
TURNCC1	-£110.85	-£110.85	-£110.85	-£89.33	-£89.33	-£89.33
TURNCC2	-£110.85	-£110.85	-£110.85	-£89.33	-£89.33	-£89.33
TURNCC3	-£110.85	-£110.85	-£110.85	-£89.33	-£89.33	-£89.33
MUSTCC1	-£39.00	-£39.00	-£39.00	-£36.13	-£33.00	-£39.00
MUSTCC2	-£39.00	-£39.00	-£39.00	-£36.13	-£33.00	-£39.00
MUSTCC3	-£39.00	-£39.00	-£39.00	-£36.13	-£33.00	-£39.00
LLB1	£58.41	£65.47	£50.97	£53.82	£74.75	£29.76
LLBE2	£69.16	£73.09	£57.63	£61.71	£77.56	£40.25
LLBE3	£77.76	£86.26	£59.82	£67.79	£89.50	£46.65
HILLSTP1	£23.61	£25.81	£21.21	£20.48	£23.84	£15.84
HILLSTP2	£26.93	£28.98	£24.83	£22.68	£25.92	£17.92
HILLFLG1	£39.36	£43.15	£31.78	£39.23	£45.43	£35.43
HILLFLG2	£41.58	£45.92	£36.65	£39.87	£43.32	£37.07
UPCLBE1	£46.02	£46.91	£43.36	£38.92	£47.13	£34.29
UPCLBE2	£36.97	£37.87	£34.27	£31.77	£39.99	£27.11
UPHBML	£55.28	£56.65	£51.20	£45.98	£54.57	£40.21
CBE1	£40.92	£47.20	£32.72	£37.30	£51.97	£23.52
CBE2	£49.12	£55.11	£42.00	£43.60	£58.15	£23.73
CBE3	£54.90	£61.80	£42.45	£47.46	£64.00	£21.47
DBFEWE1	£28.39	£43.46	£22.28	£20.95	£31.16	£16.78
DBFEWE2	£29.75	£47.46	£21.16	£22.82	£35.32	£17.99
DBFEWE3	£33.41	£51.71	£26.05	£24.81	£39.59	£19.31
WINFINMK	£41.40	£50.02	£17.50	£45.69	£52.68	£18.02
WINFINLK	£41.50	£49.35	£19.72	£45.54	£52.03	£20.35
WINFINBF	£22.03	£28.26	£6.60	£25.11	£29.95	£6.60
WINFINSK	£29.62	£37.38	£7.81	£33.25	£39.41	£8.38

	Conventional Farm Models			Sustainable Farm Models		
	Mean	Max	Min	Mean	Max	Min
AFLGR	£32.98	£42.86	£10.31	£39.41	£45.14	£12.57
GIMMERIN	-£55.12	-£53.07	-£55.32	-£55.32	-£55.32	-£55.32
INDOORLA	£17.88	£22.56	-£0.49	£20.43	£24.08	£5.56
HREA26	-£108.94	£442.60	-£367.40	-£105.53	£442.60	-£397.40
HRA30	-£84.19	£467.35	-£342.65	-£80.78	£467.35	-£372.65
HRA36	-£38.19	£513.35	-£296.65	-£48.58	£513.35	-£326.65
HRS30	-£73.44	£478.10	-£331.90	-£68.31	£478.10	-£361.90
HRS36	-£44.69	£506.85	-£303.15	-£48.18	£506.85	-£333.15
Dsp4000	£794.64	£796.20	£782.20	£800.20	£816.20	£686.20
Dsum4000	£857.00	£860.50	£829.00	£862.56	£880.50	£750.50
DAut4000	£754.34	£755.90	£741.90	£759.90	£775.90	£645.90
DAll4000	£777.44	£779.00	£765.00	£783.00	£799.00	£669.00
Dsp5000	£933.38	£993.50	£802.50	£937.23	£1,013.50	£802.50
Dsum5000	£1,006.04	£1,067.50	£876.50	£1,009.88	£1,087.50	£876.50
DAut5000	£897.88	£958.00	£767.00	£901.73	£978.00	£767.00
DAll5000	£920.38	£980.50	£789.50	£924.23	£1,000.50	£789.50
Dsp6000	£1,136.88	£1,139.80	£1,113.55	£1,142.44	£1,159.80	£1,029.80
Dsum6000	£1,159.14	£1,164.00	£1,120.25	£1,164.69	£1,184.00	£1,054.00
DAut6000	£1,114.68	£1,117.60	£1,091.35	£1,120.24	£1,137.60	£1,007.60
DAll6000	£1,128.08	£1,131.00	£1,104.75	£1,133.64	£1,151.00	£1,021.00
Dsp7000	£1,273.71	£1,277.60	£1,242.60	£1,279.27	£1,297.60	£1,167.60
Dsum7000	£1,304.74	£1,309.80	£1,264.30	£1,310.30	£1,329.80	£1,199.80
DAut7000	£1,235.52	£1,239.80	£1,201.30	£1,241.08	£1,259.80	£1,129.80
DAll7000	£1,255.12	£1,259.40	£1,220.90	£1,260.68	£1,279.40	£1,149.40
Dsp8000	£1,344.36	£1,406.90	£1,215.90	£1,348.21	£1,426.90	£1,215.90
Dsum8000	£1,370.42	£1,433.50	£1,242.50	£1,374.27	£1,453.50	£1,242.50
DAut8000	£1,331.76	£1,394.30	£1,203.30	£1,335.61	£1,414.30	£1,203.30
DAll8000	£1,352.46	£1,415.00	£1,224.00	£1,356.31	£1,435.00	£1,224.00
LLSUCKNJ	£382.34	£402.48	£346.60	£407.87	£435.99	£381.83
LLSUCKFA	£315.75	£331.36	£279.24	£337.09	£364.04	£319.88
LLSUCKMJ	£437.22	£463.01	£399.84	£463.09	£492.59	£438.43
LLSUCKAO	£444.00	£468.36	£411.18	£470.89	£501.99	£431.83
UPSUCKNJ	£490.94	£498.68	£471.40	£508.09	£515.10	£485.94
UPSUCKFA	£424.03	£429.79	£401.74	£437.69	£443.07	£413.42
UPSUCKMJ	£548.07	£554.44	£527.45	£566.56	£572.24	£543.08
UPSUCKAO	£555.64	£563.56	£536.58	£574.19	£581.42	£552.26
HILLSU1	£527.91	£537.86	£518.17	£545.35	£552.49	£535.58
HILLSU2	£374.21	£409.26	£347.65	£385.81	£422.58	£358.74
HILLSU3	£315.48	£402.37	£247.67	£323.73	£414.82	£253.33
18MthST	£247.88	£318.25	£204.75	£258.83	£275.23	£228.93
18mthHF	£255.31	£312.40	£226.40	£269.50	£290.62	£248.52
24mthFr	£321.78	£475.30	£292.30	£335.56	£352.52	£312.52
24mthB	£322.88	£476.40	£293.40	£336.76	£353.72	£313.72
Owscsbst	£78.85	£155.46	£71.46	£86.97	£98.60	£72.46
Owscsbhf	£97.50	£98.63	£92.63	£107.32	£117.45	£92.63
Owscwbst	£67.87	£144.44	£60.44	£78.03	£91.49	£62.44
Owscwbhf	£96.09	£97.13	£92.13	£107.92	£119.81	£93.13
WFLFDBST	£49.92	£132.54	-£45.47	£72.29	£84.90	-£14.10
WFMFDBST	£97.51	£139.20	-£2.41	£117.23	£136.23	£22.83
WFSCST	£91.16	£154.89	-£16.35	£113.85	£147.35	£11.70
WFSCHF	£85.17	£125.80	-£15.10	£104.66	£123.18	£9.89
BSDBXSTL	£33.22	£104.27	£18.02	£62.15	£69.18	£50.18

	Conventional Farm Models			Sustainable Farm Models		
	Mean	Max	Min	Mean	Max	Min
BSDBXSTM	£83.07	£85.37	£68.37	£107.90	£114.03	£93.03
OWSCSTWB	£75.72	£77.94	£61.94	£103.03	£107.16	£89.16
OWSCHFWB	£82.96	£84.88	£67.88	£107.16	£110.03	£92.03
RYCSBMST	£117.56	£194.13	£110.13	£138.44	£215.01	£131.01
RYCSBLST	£135.96	£212.53	£128.53	£155.21	£231.78	£147.78
RYCABMST	£120.88	£197.40	£113.40	£141.60	£218.12	£134.12
RYCABLST	£135.48	£212.00	£128.00	£154.38	£230.90	£146.90
WFLFBST	£81.64	£143.83	-£17.77	£122.57	£123.48	£118.48
SFLFBST	£38.04	£89.40	-£44.40	£67.56	£68.52	£63.52
IBBFCF	£201.60	£278.03	£194.03	£210.24	£278.03	£194.03
IBBBXSF	£219.47	£220.34	£215.34	£228.77	£244.10	£215.34
IBBSCCF	£165.31	£241.75	£157.75	£176.17	£241.75	£157.75
IBBSCSF	£171.31	£172.18	£167.18	£182.16	£199.93	£167.18
CRFBFs1	£20.00	£20.00	£20.00	£20.00	£20.00	£20.00
CRMBBFs1	£16.00	£16.00	£16.00	£16.00	£16.00	£16.00
CRLBBFs1	£12.00	£12.00	£12.00	£12.00	£12.00	£12.00
CRFALst1	-£6.40	-£6.40	-£6.40	-£6.40	-£6.40	-£6.40
BPIG3WKW	£518.69	£518.69	£518.69	£121.88	£121.88	£121.88
BPIG4WKW	£539.51	£539.51	£539.51	£168.09	£210.24	£139.99
BPIGOUT	£459.25	£459.25	£459.25	£206.73	£256.97	£173.23
FPIGPORK	£13.89	£13.89	£13.89	£13.89	£13.89	£13.89
FPIGCUT	£42.11	£42.11	£42.11	£169.99	£361.82	£42.11
FPIGBAC	£58.11	£58.11	£58.11	-£99.48	£58.11	-£335.87
FPIGHEA	£54.92	£54.92	£54.92	-£96.34	£54.92	-£323.22
PULREAR	£7.79	£31.20	£1.93	£1.93	£1.93	£1.93
EGGCAGE	£1.12	£1.12	£1.12	-£2.22	-£2.22	-£2.22
EGGRANGE	£6.96	£6.96	£6.96	£2.45	£2.45	£2.45
EBARN	£2.78	£3.21	£2.65	-£0.15	-£0.15	-£0.15
CHBROILE	£1.09	£1.27	£1.05	£1.05	£1.05	£1.05
TFFthen	£7.75	£12.77	£6.50	£6.50	£6.50	£6.50
tfftstag	£8.29	£12.99	£7.11	£7.11	£7.11	£7.11

Appendix 24. Total Fixed Costs Apportioned in the Models
Appendix 24.a. Fixed Costs in the Conventional Scenario

Fixed Costs Conventional Pig and Poultry Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/ha	£/ha	£/ha	£/ha	£/ha
Wcereals	£210	£25	£43	£75	£353
Scereals	£210	£25	£43	£75	£353
Potatoes	£487	£100	£51	£600	£1,238
Oilseeds(food)	£212	£25	£51	£75	£363
Oilseeds(non f.)	£154	£25	£51	£75	£305
Sugar beet	£167	£25	£51	£75	£318
Linseed	£212	£25	£51	£75	£363
Cabbage	£154	£25	£51	£75	£305
Field Beans	£189	£25	£51	£75	£340
Vining Peas	£79	£25	£51	£75	£230
Swedes	£184	£25	£51	£75	£335
Grass	£179	£25	£45	£25	£274
Grass Sil1 cut	£222	£50	£45	£6	£323
Grass Sil2 cut	£330	£50	£45	£12	£437
Grass Sil3 cut	£399	£50	£45	£19	£513
Fodder	£337	£25	£45	£25	£432
Setaside	£184	£50	£45	£150	£429
Forage Maize	£270	£50	£45	£50	£415

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£8.00	£2.31	£0.00	£10.31
Suckler Cows	£80.00	£23.11	£2.68	£105.79
Dairy Cows	£150.00	£28.89	£2.63	£181.52
Cattle Grazed	£70.00	£18.78	£2.93	£91.70
Store Cattle	£70.00	£18.78	£2.64	£91.42
Finishing Cattle	£70.00	£18.78	£2.86	£91.64
Calves	£30.00	£9.82	£5.00	£44.82
Lambs Grazed	£3.00	£1.16	£0.00	£4.16
Lambs Housed	£15.00	£1.16	£0.00	£16.16
Rep Hf	£100.00	£28.89	£0.00	£128.89
Sows Housed	£10.00	£0.00	£0.00	£10.00
Sows Free Range	£7.50	£0.00	£0.00	£7.50
Weaners	£5.00	£0.00	£0.00	£5.00
Intensive Beef	£70.00	£0.00	£0.00	£70.00
Poultry Housed	£0.10	£0.00	£5.00	£5.10
Poultry Barn	£0.15	£0.00	£5.00	£5.15
Poultry Free Range	£0.25	£0.00	£5.00	£5.25
Puls Rearing	£0.15	£0.00	£5.00	£5.15
Eggs Caged	£0.15	£0.00	£2.00	£2.15
Eggs Free Range	£0.03	£0.00	£2.00	£2.03
Eggs Barn	£0.08	£0.00	£2.00	£2.08

Fixed Costs Conventional Cropping Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/ha	£/ha	£/ha	£/ha	£/ha
Wcereals	£207	£25	£43	£135	£410
Scereals	£207	£25	£43	£135	£410
Potatoes	£487	£100	£51	£600	£1,238
Oilseeds(food)	£212	£25	£51	£145	£433
Oilseeds(non f.)	£154	£25	£51	£145	£375
Sugar beet	£224	£25	£51	£145	£445
Linseed	£212	£25	£51	£145	£433
Cabbage	£154	£25	£51	£145	£375
Field Beans	£184	£25	£51	£145	£405
Vining Peas	£79	£25	£51	£145	£300
Swedes	£184	£25	£51	£145	£405
Grass	£179	£25	£45	£75	£324
Grass Sil1 cut	£280	£25	£45	£81	£431
Grass Sil2 cut	£388	£25	£45	£237	£695
Grass Sil3 cut	£399	£25	£45	£319	£788
Fodder	£393	£25	£45	£75	£538
Setaside	£240	£25	£45	£75	£385
Forage Maize	£240	£25	£45	£75	£385

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£12.00	£1.94	£0.00	£13.94
Suckler Cows	£110.00	£19.44	£0.00	£129.44
Dairy Cows	£171.00	£24.30	£0.00	£195.30
Cattle Grazed	£10.00	£15.79	£0.00	£25.79
Store Cattle	£58.00	£15.79	£0.00	£73.79
Finishing Cattle	£100.00	£15.79	£0.00	£115.79
Calves	£26.80	£8.26	£0.00	£35.06
Lambs Grazed	£1.00	£0.97	£0.00	£1.97
Lambs Housed	£5.00	£0.97	£0.00	£5.97
Rep Hf	£134.20	£24.30	£0.00	£158.50
Intensive Beef	£100.00	£0.00	£0.00	£100.00

Fixed Costs Conventional Dairy Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/ha	£/ha	£/ha	£/ha	£/ha
Wcereals	£210	£25	£43	£75	£353
Scereals	£210	£25	£43	£75	£353
Potatoes	£487	£100	£51	£600	£1,238
Oilseeds(food)	£212	£25	£51	£175	£463
Oilseeds(non f.)	£154	£25	£51	£175	£405
Sugar beet	£167	£25	£51	£175	£418
Linseed	£212	£25	£51	£175	£463
Cabbage	£154	£25	£51	£175	£405
Field Beans	£189	£25	£51	£175	£440
Vining Peas	£79	£25	£51	£175	£330
Swedes	£184	£25	£51	£175	£435
Grass	£179		£45		£224
Grass Sil1 cut	£222		£45	£6	£273
Grass Sil2 cut	£330		£45	£12	£387
Grass Sil3 cut	£399		£45	£19	£463
Fodder	£337		£45	£0	£382
Setaside	£184		£45	£0	£229
Forage Maize	£240		£45	£0	£285

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£4.00	£2.31	£0.00	£6.31
Suckler Cows	£134.20	£23.11	£0.00	£157.31
Dairy Cows	£50.00	£28.89	£30.00	£108.89
Cattle Grazed	£5.00	£18.78	£0.00	£23.78
Store Cattle	£40.00	£18.78	£0.00	£58.78
Finishing Cattle	£50.00	£18.78	£0.00	£68.78
Calves	£20.00	£9.82	£0.00	£29.82
Lambs Grazed	£0.00	£0.00	£0.00	£0.00
Lambs Housed	£2.00	£1.16	£0.00	£3.16
Rep Hf	£80.00	£28.89	£0.00	£108.89
Intensive Beef	£0.00	£0.00	£0.00	£0.00

Fixed Costs Conventional Specialist Dairy Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/ha	£/ha	£/ha	£/ha	£/ha
Wcereals	£210	£25	£43	£100	£378
Scereals	£210	£25	£43	£100	£378
Potatoes	£487	£100	£51	£500	£1,138
Oilseeds(food)	£212	£25	£51	£300	£588
Oilseeds(non f.)	£154	£25	£51	£300	£530
Sugar beet	£167	£25	£51	£300	£543
Linseed	£212	£25	£51	£300	£588
Cabbage	£154	£25	£51	£300	£530
Field Beans	£189	£25	£51	£300	£565
Vining Peas	£79	£25	£51	£300	£455
Swedes	£184	£25	£51	£300	£560
Grass	£179	£25	£45	£50	£299
Grass Sil1 cut	£222	£50	£45	£56	£373
Grass Sil2 cut	£330	£50	£45	£62	£487
Grass Sil3 cut	£399	£50	£45	£69	£563
Fodder	£337	£25	£45	£75	£482
Setaside	£184	£25	£45	£75	£329
Forage Maize	£240	£25	£45	£75	£385

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£8.00	£2.31	£0.00	£10.31
Suckler Cows	£100.00	£23.11	£0.27	£123.38
Dairy Cows	£50.00	£14.44	£72.60	£137.04
Cattle Grazed	£0.00	£18.78	£0.29	£19.07
Store Cattle	£51.20	£18.78	£0.26	£70.24
Finishing Cattle	£70.00	£18.78	£0.29	£89.06
Calves	£26.80	£9.82	£0.50	£37.12
Lambs Grazed	£0.00	£0.20	£2.00	£2.20
Lambs Housed	£33.00	£1.16	£0.00	£34.16
Rep Hf	£55.00	£28.89	£10.00	£93.89
Intensive Beef	£0.00	£0.00	£0.00	£0.00

Fixed Costs Conventional Mixed Lowland Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/ha	£/ha	£/ha	£/ha	£/ha
Wcereals	£210	£25	£43	£195	£473
Scereals	£210	£25	£43	£195	£473
Potatoes	£487	£100	£51	£650	£1,288
Oilseeds(food)	£212	£25	£51	£225	£513
Oilseeds(non f.)	£154	£25	£51	£225	£455
Sugar beet	£167	£25	£51	£225	£468
Linseed	£212	£25	£51	£225	£513
Cabbage	£154	£25	£51	£225	£455
Field Beans	£189	£25	£51	£225	£490
Vining Peas	£79	£25	£51	£225	£380
Swedes	£184	£25	£51	£225	£485
Grass	£179		£45		£224
Grass Sil1 cut	£222		£45	£6	£273
Grass Sil2 cut	£330		£45	£12	£387
Grass Sil3 cut	£399		£45	£19	£463
Fodder	£337		£45	£0	£382
Setaside	£184	£50	£45	£0	£279
Forage Maize	£166		£45	£0	£211

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£2.50	£2.31	£2.00	£6.81
Suckler Cows	£50.00	£23.11	£50.00	£123.11
Dairy Cows	£120.00	£28.89	£100.00	£248.89
Cattle Grazed	£0.00	£18.78		£18.78
Store Cattle	£80.00	£18.78	£0.00	£98.78
Finishing Cattle	£50.00	£18.78	£50.00	£118.78
Calves	£40.00	£9.82	£0.00	£49.82
Lambs Grazed	£0.20	£0.00	£0.00	£0.20
Lambs Housed	£1.00	£1.16	£0.00	£2.16
Rep Hf	£134.20	£28.89	£0.00	£163.09
Sows Housed	£10.00	£0.00	£0.00	£10.00
Sows Free Range	£10.00	£0.00	£0.00	£10.00
Weaners	£5.00	£0.00	£0.00	£5.00
Intensive Beef	£0.00	£0.00	£0.00	£0.00
Poultry Housed	£1.50	£0.00	£0.00	£1.50
Poultry Barn	£1.50	£0.00	£0.00	£1.50
Poultry Free Range	£0.50	£0.00	£0.00	£0.50
Puls Rearing	£1.50	£0.00	£0.00	£1.50
Eggs Caged	£0.10	£0.00	£0.00	£0.10
Eggs Free Range	£0.10	£0.00	£0.00	£0.10
Eggs Barn	£0.10	£0.00	£0.00	£0.10

Fixed Costs Conventional Large LFA Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/ha	£/ha	£/ha	£/ha	£/ha
Wcereals	£210	£50	£43	£50	£353
Scereals	£210	£50	£43	£50	£353
Potatoes	£487	£200	£51	£500	£1,238
Oilseeds(food)	£212	£50	£51	£50	£363
Oilseeds(non f.)	£154	£50	£51	£50	£305
Sugar beet	£167	£50	£51	£50	£318
Linseed	£212	£50	£51	£50	£363
Cabbage	£154	£50	£51	£50	£305
Field Beans	£189	£50	£51	£50	£340
Vining Peas	£79	£50	£51	£50	£230
Swedes	£184	£50	£51	£50	£335
Grass	£179		£45		£224
Grass Sil1 cut	£222		£45	£6	£273
Grass Sil2 cut	£330		£45	£12	£387
Grass Sil3 cut	£399		£45	£19	£463
Fodder	£337		£45	£0	£382
Setaside	£184	£50	£45	£50	£329
Forage Maize	£240	£25	£45	£25	£335

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£0.20	£1.16	£0.00	£1.36
Suckler Cows	£60.00	£23.11	£0.00	£83.11
Dairy Cows	£171.00	£28.89	£0.00	£199.89
Cattle Grazed	£0.00	£18.78	£0.00	£18.78
Store Cattle	£50.00	£18.78	£0.00	£68.78
Finishing Cattle	£80.00	£18.78	£0.00	£98.78
Calves	£10.00	£9.82	£0.00	£19.82
Lambs Grazed	£0.20	£0.12	£0.00	£0.32
Lambs Housed	£33.00	£1.16	£0.00	£34.16
Rep Hf	£171.00	£28.89	£0.00	£199.89

Fixed Costs Conventional Small LFA Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/ha	£/ha	£/ha	£/ha	£/ha
Wcereals	£210	£25	£43	£275	£553
Scereals	£210	£25	£43	£275	£553
Potatoes	£487	£25	£51	£650	£1,213
Oilseeds(food)	£212	£25	£51	£275	£563
Oilseeds(non f.)	£154	£25	£51	£275	£505
Sugar beet	£167	£25	£51	£275	£518
Linseed	£212	£25	£51	£275	£563
Cabbage	£154	£25	£51	£275	£505
Field Beans	£189	£25	£51	£275	£540
Vining Peas	£79	£25	£51	£275	£430
Swedes	£184	£25	£51	£275	£535
Grass	£179	£0	£45		£224
Grass Sil1 cut	£222	£0	£45	£6	£273
Grass Sil2 cut	£330	£0	£45	£12	£387
Grass Sil3 cut	£399	£0	£45	£19	£463
Fodder	£337	£0	£45	£0	£382
Setaside	£184	£0	£45	£300	£529
Forage Maize	£240	£0	£45	£50	£335

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£10.00	£2.31	£0.00	£12.31
Suckler Cows	£100.00	£23.11	£0.00	£123.11
Dairy Cows	£171.00	£28.89	£0.00	£199.89
Cattle Grazed	£0.00	£18.78	£0.00	£18.78
Store Cattle	£51.20	£18.78	£0.00	£69.98
Finishing Cattle	£100.00	£18.78	£0.00	£118.78
Calves	£26.80	£9.82	£0.00	£36.62
Lambs Grazed	£6.50	£1.16	£0.00	£7.66
Lambs Housed	£33.00	£1.16	£0.00	£34.16

Appendix 24.b. Fixed Costs in the Sustainable Scenario

Fixed Costs Sustainable Pig and Poultry Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/ha	£/ha	£/ha	£/ha	£/ha
Wcereals	£210	£25	£43	£75	£353
Scereals	£210	£25	£43	£75	£353
Potatoes	£487	£100	£51	£600	£1,238
Oilseeds(food)	£212	£25	£51	£75	£363
Oilseeds(non f.)	£154	£25	£51	£75	£305
Sugar beet	£167	£25	£51	£75	£318
Linseed	£212	£25	£51	£75	£363
Cabbage	£154	£25	£51	£75	£305
Field Beans	£189	£25	£51	£75	£340
Vining Peas	£79	£25	£51	£75	£230
Swedes	£105	£25	£51	£75	£256
Grass	£74	£25	£45	£25	£169
Grass Sil1 cut	£148	£50	£45	£6	£249
Grass Sil2 cut	£182	£50	£45	£12	£289
Grass Sil3 cut	£217	£50	£45	£19	£331
Fodder	£120	£25	£45	£25	£215
Setaside	£64	£50	£45	£150	£309
Forage Maize	£206	£50	£45	£50	£351

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£9.60	£2.31	£0.00	£11.91
Suckler Cows	£96.00	£23.11	£2.68	£121.79
Dairy Cows	£180.00	£28.89	£2.63	£211.52
Cattle Grazed	£84.00	£18.78	£2.93	£105.70
Store Cattle	£84.00	£18.78	£2.64	£105.42
Finishing Cattle	£84.00	£18.78	£2.86	£105.64
Calves	£36.00	£9.82	£5.00	£50.82
Lambs Grazed	£3.60	£1.16	£0.00	£4.76
Lambs Housed	£18.00	£1.16	£0.00	£19.16
Rep Hf	£120.00	£28.89	£0.00	£148.89
Sows Housed	£12.00	£0.00	£0.00	£12.00
Sows Free Range	£9.00	£0.00	£0.00	£9.00
Weaners	£6.00	£0.00	£0.00	£6.00
Intensive Beef	£84.00	£0.00	£0.00	£84.00
Poultry Housed	£0.12	£0.00	£5.00	£5.12
Poultry Barn	£0.18	£0.00	£5.00	£5.18
Poultry Free Range	£0.30	£0.00	£5.00	£5.30
Puls Rearing	£0.18	£0.00	£5.00	£5.18
Eggs Caged	£0.18	£0.00	£2.00	£2.18
Eggs Free Range	£0.03	£0.00	£2.00	£2.03
Eggs Barn	£0.09	£0.00	£2.00	£2.09

Fixed Costs Sustainable Cropping Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/ha	£/ha	£/ha	£/ha	£/ha
Wcereals	£207	£25	£43	£135	£410
Scereals	£207	£25	£43	£135	£410
Potatoes	£487	£100	£51	£600	£1,238
Oilseeds(food)	£212	£25	£51	£145	£433
Oilseeds(non f.)	£154	£25	£51	£145	£375
Sugar beet	£167	£25	£51	£145	£388
Linseed	£212	£25	£51	£145	£433
Cabbage	£154	£25	£51	£145	£375
Field Beans	£184	£25	£51	£145	£405
Vining Peas	£79	£25	£51	£145	£300
Swedes	£105	£25	£51	£145	£326
Grass	£74	£25	£45	£75	£219
Grass Sil1 cut	£148	£25	£45	£81	£299
Grass Sil2 cut	£182	£25	£45	£237	£489
Grass Sil3 cut	£217	£25	£45	£319	£606
Fodder	£120	£25	£45	£75	£265
Setaside	£64	£25	£45	£75	£209
Forage Maize	£176	£25	£45	£75	£321

	Buildings	Fencing	Total
	£/head	£/head	£/head
Breeding Ewes	£14.40	£1.94	£16.34
Suckler Cows	£132.00	£19.44	£151.44
Dairy Cows	£205.20	£24.30	£229.50
Beef Cows	£132.00	£19.44	£151.44
Cattle Grazed	£12.00	£15.79	£27.79
Store Cattle	£69.60	£15.79	£85.39
Finishing Cattle	£120.00	£15.79	£135.79
Calves	£32.16	£8.26	£40.42
Lambs Grazed	£1.20	£0.97	£2.17
Lambs Housed	£6.00	£0.97	£6.97
Rep Hf	£161.04	£24.30	£185.34
Intensive Beef	£120.00	£0.00	£120.00

Fixed Costs Sustainable Mainly Dairy Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/Ha	£/Ha	£/Ha	£/Ha	£/Ha
Wcereals	£210	£25	£43	£75	£353
Scereals	£210	£25	£43	£75	£353
Potatoes	£487	£100	£51	£600	£1,238
Oilseeds(food)	£212	£25	£51	£175	£463
Oilseeds(non f.)	£154	£25	£51	£175	£405
Sugar beet	£167	£25	£51	£175	£418
Linseed	£212	£25	£51	£175	£463
Cabbage	£154	£25	£51	£175	£405
Field Beans	£189	£25	£51	£175	£440
Vining Peas	£79	£25	£51	£175	£330
Swedes	£105	£25	£51	£175	£356
Grass	£74		£45		£119
Grass Sil1 cut	£148		£45	£6	£199
Grass Sil2 cut	£182		£45	£12	£239
Grass Sil3 cut	£217		£45	£19	£281
Fodder	£120		£45	£0	£165
Setaside	£64		£45	£0	£109
Forage Maize	£176		£45	£0	£221

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£4.80	£2.31	£0.00	£7.11
Suckler Cows	£161.04	£23.11	£0.00	£184.15
Dairy Cows	£60.00	£28.89	£30.00	£118.89
Cattle Grazed	£6.00	£18.78	£0.00	£24.78
Store Cattle	£48.00	£18.78	£0.00	£66.78
Finishing Cattle	£60.00	£18.78	£0.00	£78.78
Calves	£24.00	£9.82	£0.00	£33.82
Lambs Housed	£2.40	£1.16	£0.00	£3.56
Rep Hf	£96.00	£28.89	£0.00	£124.89
Intensive Beef	£0.00	£0.00	£0.00	£0.00

Fixed Costs Sustainable Specialist Dairy Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/Ha	£/Ha	£/Ha	£/Ha	£/Ha
Wcereals	£210	£25	£43	£100	£378
Scereals	£210	£25	£43	£100	£378
Potatoes	£487	£100	£51	£500	£1,138
Oilseeds(food)	£212	£25	£51	£300	£588
Oilseeds(non f.)	£154	£25	£51	£300	£530
Sugar beet	£167	£25	£51	£300	£543
Linseed	£212	£25	£51	£300	£588
Cabbage	£154	£25	£51	£300	£530
Field Beans	£189	£25	£51	£300	£565
Vining Peas	£79	£25	£51	£300	£455
Swedes	£105	£25	£51	£300	£481
Grass	£74	£25	£45	£50	£194
Grass Sil1 cut	£148	£50	£45	£56	£299
Grass Sil2 cut	£182	£50	£45	£62	£339
Grass Sil3 cut	£217	£50	£45	£69	£381
Fodder	£120	£25	£45	£75	£265
Setaside	£64	£25	£45	£75	£209
Forage Maize	£176	£25	£45	£75	£321

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£9.60	£2.31	£0.00	£11.91
Suckler Cows	£120.00	£23.11	£0.27	£143.38
Dairy Cows	£60.00	£28.89	£130.00	£218.89
Cattle Grazed	£0.00	£18.78	£0.29	£19.07
Store Cattle	£61.44	£18.78	£0.26	£80.48
Finishing Cattle	£84.00	£18.78	£0.29	£103.06
Calves	£32.16	£9.82	£0.50	£42.48
Lambs Grazed	£0.00	£0.20	£2.00	£2.20
Lambs Housed	£39.60	£1.16	£0.00	£40.76
Rep Hf	£66.00	£28.89	£10.00	£104.89

Fixed Costs Sustainable Large LFA Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/Ha	£/Ha	£/Ha	£/Ha	£/Ha
Wcereals	£210	£25	£43	£75	£353
Scereals	£210	£25	£43	£75	£353
Potatoes	£487	£100	£51	£600	£1,238
Oilseeds(food)	£212	£25	£51	£75	£363
Oilseeds(non f.)	£154	£25	£51	£75	£305
Sugar beet	£167	£25	£51	£75	£318
Linseed	£212	£25	£51	£75	£363
Cabbage	£154	£25	£51	£75	£305
Field Beans	£189	£25	£51	£75	£340
Vining Peas	£79	£25	£51	£75	£230
Swedes	£105	£25	£51	£75	£256
Grass	£74		£45		£119
Grass Sil1 cut	£148		£45	£6	£199
Grass Sil2 cut	£182		£45	£12	£239
Grass Sil3 cut	£217		£45	£19	£281
Fodder	£120		£45	£0	£165
Setaside	£64	£50	£45	£50	£209
Forage Maize	£176	£25	£45	£25	£271

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£0.24	£1.16	£0.00	£1.40
Suckler Cows	£72.00	£23.11	£0.00	£95.11
Dairy Cows	£205.20	£28.89	£0.00	£234.09
Cattle Grazed	£0.00	£18.78	£0.00	£18.78
Store Cattle	£60.00	£18.78	£0.00	£78.78
Finishing Cattle	£96.00	£18.78	£0.00	£114.78
Calves	£12.00	£9.82	£0.00	£21.82
Lambs Grazed	£0.24	£0.12	£0.00	£0.36
Lambs Housed	£39.60	£1.16	£0.00	£40.76
Rep Hf	£205.20	£28.89	£0.00	£234.09

Fixed Costs Sustainable Small LFA Farms					
	Machinery	Buildings	Repairs	Misc.	Total
	£/ha	£/ha	£/ha	£/ha	£/ha
Wcereals	£210	£25	£43	£275	£553
Scereals	£210	£25	£43	£275	£553
Potatoes	£487	£25	£51	£650	£1,213
Oilseeds(food)	£212	£25	£51	£275	£563
Oilseeds(non f.)	£154	£25	£51	£275	£505
Sugar beet	£167	£25	£51	£275	£518
Linseed	£212	£25	£51	£275	£563
Cabbage	£154	£25	£51	£275	£505
Field Beans	£189	£25	£51	£275	£540
Vining Peas	£79	£25	£51	£275	£430
Swedes	£105	£25	£51	£275	£456
Grass	£74	£0	£45		£119
Grass Sil1 cut	£148	£0	£45	£6	£199
Grass Sil2 cut	£182	£0	£45	£12	£239
Grass Sil3 cut	£217	£0	£45	£19	£281
Fodder	£120	£0	£45	£0	£165
Setaside	£64	£0	£45	£300	£409
Forage Maize	£176	£0	£45	£50	£271

	Buildings	Fencing	Misc.	Total
	£/head	£/head	£/head	£/head
Breeding Ewes	£12.00	£2.31	£0.00	£14.31
Suckler Cows	£120.00	£23.11	£2.61	£145.72
Dairy Cows	£205.20	£28.89	£2.61	£236.70
Beef Cows	£120.00	£23.11	£2.61	£145.72
Cattle Grazed	£0.00	£18.78	£2.61	£21.39
Store Cattle	£61.44	£18.78	£2.61	£82.83
Finishing Cattle	£120.00	£18.78	£2.61	£141.39
Calves	£32.16	£9.82	£2.61	£44.59
Lambs Grazed	£7.80	£1.16	£0.00	£8.96
Lambs Housed	£39.60	£1.16	£0.00	£40.76
Rep Hf	£161.04	£28.89	£0.00	£189.93
Intensive Beef	£0.00	£0.00	£0.00	£0.00

Appendix 25. Building Costs on Organic Livestock Farms

	£ / head
Cows and Cattle Housing	£796
Straw covered yard	£215
+ Feed passage, barrier and troughs	£300
Kennel Building	£540
Portal Framed Building with Cubicles	£316
+ Feed stance, passage, barriers and troughs	£260
Loose box 16 m^2 floor area laid to falls, rendered to walls	
Sheep Housing	£17
Penning, Troughs, feed barriers and drinkers	£93
Purpose built sheep shed, concentrate troughs, feed passage and barrier for forage feeding	
Pig Housing	£386
Yards with floor feeding (lying area 1 m^2 /100kg lwt)	£1800
Boar pens as part of sow house	£220
Arks un insulated	£350-450
Arks insulated	
Poultry Housing	14-16/bird
Perchery/Barn 200m^2	12-17/bird
Free range : maximum stocking rate 620/ha and 500/house	
Storage	£/t stored
Silage	48-44
Slurry	£/m^3
Lined lagoon with safety fence	20
Glass lined steel slurry silo - small	33
medium	24
large	19

(From Lampkin 1999).

Appendix 26. Median Crop Yields Assumed in the Models

	Yields Tonnes/ha															
	Southern England		Scotland		Scotland LFA		Wales		Northern Ireland		Wales LFA		NI LFA		Northern England	
	Conv	Sus	Conv	Sus	Conv	Sus	Conv	Sus	Conv	Sus	Conv	Sus	Conv	Sus	Conv	Sus
Spring OSR	2.50	2.57	2.40	2.23	2.40	2.23	2.40	2.15	2.00	1.79	2.00	1.79	2.00	1.79	2.50	2.31
WO	4.00	3.55	4.00	3.89	4.00	3.89	4.00	3.78	4.00	3.78	4.00	3.78	4.00	3.78	4.00	3.75
SO	4.00	3.55	4.30	4.18	4.30	4.18	4.30	4.06	4.00	3.78	4.00	3.78	4.00	3.78	4.00	3.75
POTS	41.00	49.20	41.00	38.07	41.00	38.07	41.00	37.27	41.00	37.27	41.00	37.27	41.00	37.27	41.00	39.83
POTS EARLY	22.00	26.40	22.00	20.43	22.00	20.43	22.00	20.00	22.00	20.00	22.00	20.00	22.00	20.00	22.00	21.37
CAB	25.00	25.69	19.75	18.34	19.75	18.34	22.25	19.91	19.75	17.67	22.25	19.91	19.75	17.67	21.13	19.50
CABWW	57.75	59.34	40.00	37.14	40.00	37.14	40.00	35.79	40.00	35.79	40.00	35.79	40.00	35.79	60.00	55.38
VIN PEAS	2.00	1.93	2.00	1.93	2.00	1.93	2.00	1.71	2.00	1.71	2.00	1.71	2.00	1.71	2.00	1.93
SUGAR BEET	30.00	30.83	30.00	27.86	30.00	27.86	30.00	26.84	30.00	26.84	30.00	26.84	30.00	26.84	30.00	27.69
SFB	4.00	3.43	4.00	3.43	4.00	3.43	4.00	3.43	4.00	3.43	4.00	3.43	4.00	3.43	4.00	3.43
Spring Barley	5.00	4.43	6.00	5.83	5.30	5.15	6.00	5.67	4.90	4.63	4.90	4.63	4.90	4.63	5.00	4.69
Malting spring Barley	5.00	4.43	6.00	5.83	5.30	5.15	6.00	5.67	4.90	4.63	4.90	4.63	4.90	4.63	5.00	4.69
Triticale	4.00	3.55	4.00	3.89	4.00	3.89	4.00	3.78	4.00	3.78	4.00	3.78	4.00	3.78	4.00	3.75
Rye	3.00	2.66	3.00	2.92	3.00	2.92	3.00	2.83	3.00	2.83	3.00	2.83	3.00	2.83	3.00	2.81
Linseed	1.50	1.54	1.50	1.39	1.50	1.39	1.50	1.34	1.50	1.34	1.50	1.34	1.50	1.34	1.50	1.38
WOSRSA	3.22	3.04	2.96	2.80	2.96	2.80	3.16	2.83	3.16	2.83	3.16	2.83	3.16	2.83	3.22	2.97
SOSRSA	2.30	2.17	2.40	2.23	2.00	1.86	2.30	2.06	2.00	1.79	2.00	1.79	2.00	1.79	2.30	2.12
Swedes cul	35.00	35.97	29.75	27.63	29.75	27.63	29.75	26.62	29.75	26.62	29.75	26.62	29.75	26.62	32.38	29.88
Fmaize	10.00	10.28	4.00	3.71	4.00	3.71	8.00	7.16	4.00	3.58	4.00	3.58	4.00	3.58	8.00	7.38
FmaizeP	12.00	12.33	6.00	5.57	6.00	5.57	10.00	8.95	6.00	5.37	6.00	5.37	6.00	5.37	10.00	9.23
Fbeet	10.00	10.28	10.00	9.29	10.00	9.29	10.00	8.95	10.00	8.95	10.00	8.95	10.00	8.95	10.00	9.23
SWEDES Grazed	8.50	8.73	8.00	7.43	8.00	7.43	8.00	7.16	8.00	7.16	8.00	7.16	8.00	7.16	8.00	7.38
TURNIPS	5.50	5.65	5.00	4.64	5.00	4.64	5.00	4.47	5.00	4.47	5.00	4.47	5.00	4.47	5.00	4.62

	Yields Tonnes/ha															
	Southern England		Scotland		Scotland LFA		Wales		Northern Ireland		Wales LFA		NI LFA		Northern England	
	Conv	Sus	Conv	Sus	Conv	Sus	Conv	Sus	Conv	Sus	Conv	Sus	Conv	Sus	Conv	Sus
KALEAGEdrilled	8.00	8.22	7.50	6.96	7.50	6.96	7.50	6.71	7.50	6.71	7.50	6.71	7.50	6.71	7.50	6.92
KALEAGEBroad	8.00	8.22	7.50	6.96	7.50	6.96	7.50	6.71	7.50	6.71	7.50	6.71	7.50	6.71	7.50	6.92
RapeBroad	5.00	5.14	4.20	3.90	4.20	3.90	4.20	3.76	4.20	3.76	4.20	3.76	4.20	3.76	4.20	3.88
RapeDrilled	5.00	5.14	4.20	3.90	4.20	3.90	4.20	3.76	4.20	3.76	4.20	3.76	4.20	3.76	4.20	3.88
RapeDD	5.00	5.14	4.20	3.90	4.20	3.90	4.20	3.76	4.20	3.76	4.20	3.76	4.20	3.76	4.20	3.88
WOSR	3.22	3.31	2.96	2.80	2.96	2.80	3.16	2.98	3.16	2.98	3.16	2.98	3.16	2.98	3.22	3.04
PMCWBPP2	40.00	48.00	40.00	37.14	40.00	37.14	40.00	36.36	40.00	36.36	40.00	36.36	40.00	36.36	40.00	38.86
PTPOF2	57.00	68.40	57.00	52.93	57.00	52.93	57.00	51.82	57.00	51.82	57.00	51.82	57.00	51.82	57.00	55.37
PTPEXST2	54.00	64.80	54.00	50.14	54.00	50.14	54.00	49.09	54.00	49.09	54.00	49.09	54.00	49.09	54.00	52.46
POT SEED2	35.00	42.00	35.00	32.50	35.00	32.50	35.00	31.82	35.00	31.82	35.00	31.82	35.00	31.82	35.00	34.00
POT DUAL2	45.00	54.00	45.00	41.79	45.00	41.79	45.00	40.91	45.00	40.91	45.00	40.91	45.00	40.91	45.00	43.71

Appendix 27. Grassland Herbage Yields in the Models

Appendix 27.a. Herbage Yields in the Conventional Models (t DM/ha)

	N kg/ha					
Improved Pastures	0.00	150.00	300.00	450.00	600.00	750.00
Southern England	2.34	7.60	8.95	9.85	10.54	11.11
Northern England & Scotland	2.85	8.26	9.57	10.44	11.09	11.63
Wales and Northern Ireland	3.17	9.58	11.17	12.21	13.02	13.67
LFA	0.98	6.01	7.72	8.95	9.93	10.77

Semi Natural Lowland	Zero N	Hill Rough Grazing	Zero N
Northern England	1.71	*Agrostis*	2.50
Wales	1.90	*Nardus* Grassland	2.00
Southern England	1.40	*Molinia* Grassland	2.00

Appendix 27.b. Herbage Yields in the Sustainable Models (t DM/ha)

Improved Pastures	N kg/ha					
	0.00	150.00	300.00	450.00	600.00	750.00
Southern England	2.34	6.80	7.84	8.53	9.05	9.47
Northern England & Scotland	6.67	8.17	8.40	8.54	8.64	8.72
Wales and Northern Ireland	7.56	9.50	9.81	9.99	10.12	10.23
LFA	4.88	6.75	7.05	7.24	7.38	7.48

Semi Natural Lowland	Zero N	Hill Rough Grazing	Zero N
Northern England	4.00	Agrostis	2.5
Wales	4.53	*Nardus* Grassland	2
Southern England	1.40	*Molinia* Grassland	2

Appendix 27.c. The Herbage Yield Function Coefficients

Conventional	A	B	Rough Grazing Yield t/ha
Northern	0.4547575	0.2124815	1.7096559
Southern	0.3686986	0.2354579	1.4023287
West	0.5006412	0.2209581	1.9001699
LFA	-0.0103261	0.3626002	2.1666667
Sustainable	A	b	Rough Grazing Yield t/ha
Northern	0.8239886	0.0404765	4.0007353
Southern	0.3835294	0.2062708	1.4023287
West	0.8783625	0.0457069	4.5343366
LFA	0.6883297	0.0646413	2.1666667

Appendix 28. Average Fertiliser Rates used in the Models
Appendix 28.a. The Conventional Fertiliser Rates

Conventional Scenario	Southern England			Scotland			Scotland LFA			Wales			Northern Ireland			Wales LFA			Northern Ireland LFA			Northern England		
Activity	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
WW2	186	67	72	201	85	88	201	85	88	186	67	72	186	67	72	186	67	72	186	67	72	186	67	72
BWW2	186	67	72	201	85	88	201	85	88	186	67	72	186	67	72	186	67	72	186	67	72	186	67	72
MSBAR2	103	42	57	90	54	61	90	54	61	103	42	57	103	42	57	103	42	57	103	42	57	103	42	57
WB2	142	64	70	143	58	70	143	58	70	142	64	70	142	64	70	142	64	70	142	64	70	142	64	70
SBAR2	103	42	57	90	54	61	90	54	61	103	42	57	103	42	57	103	42	57	103	42	57	103	42	57
WO2	112	53	62	112	53	62	112	53	62	112	53	62	112	53	62	112	53	62	112	53	62	112	53	62
SO2	112	53	62	112	53	62	112	53	62	112	53	62	112	53	62	112	53	62	112	53	62	112	53	62
RYE2	118	40	55	118	40	55	118	40	55	118	40	55	118	40	55	118	40	55	118	40	55	118	40	55
TRIT2	118	40	55	118	40	55	118	40	55	118	40	55	118	40	55	118	40	55	118	40	55	118	40	55
WOSR2	214	55	56	159	65	56	159	65	56	214	55	56	214	55	56	214	55	56	214	55	56	214	55	56
SOSR2	134	51	42	134	51	42	134	51	42	134	51	42	134	51	42	134	51	42	134	51	42	134	51	42
LIN2	68	31	24	68	31	24	68	31	24	68	31	24	68	31	24	68	31	24	68	31	24	68	31	24
SFB2	0	40	40	0	40	40	0	40	40	0	40	40	0	40	40	0	40	40	0	40	40	0	40	40
WORSA140	140	60	60	140	60	60	140	60	60	140	60	60	140	60	60	140	60	60	140	60	60	140	60	60
SORSA85	85	40	40	85	40	40	85	40	40	85	40	40	85	40	40	85	40	40	85	40	40	85	40	40
SBEET2	127	80	144	112	49	135	112	49	135	127	80	144	127	80	144	127	80	144	127	80	144	127	80	144
PTEW200	179	222	199	179	222	199	179	222	199	179	222	199	179	222	199	179	222	199	179	222	199	179	222	199
PTMCW180	202	202	276	169	192	238	169	192	238	202	202	276	202	202	276	202	202	276	202	202	276	202	202	276
PMCWBPP2	180	150	220	180	150	220	180	150	220	180	150	220	180	150	220	180	150	220	180	150	220	180	150	220
PTPOF2	220	150	220	220	150	220	220	150	220	220	150	220	220	150	220	220	150	220	220	150	220	220	150	220
PTPEXST2	220	150	220	220	150	220	220	150	220	220	150	220	220	150	220	220	150	220	220	150	220	220	150	220
POT SEED2	109	188	174	109	188	174	109	188	174	109	188	174	109	188	174	109	188	174	109	188	174	109	188	174
POT DUAL2	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180
SWEDE2	75	200	125	75	200	125	75	200	125	75	200	125	75	200	125	75	200	125	75	200	125	75	200	125

Conventional Scenario	Southern England			Scotland			Scotland LFA			Wales			Northern Ireland			Wales LFA			Northern Ireland LFA			Northern England		
Activity	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
CAB2	225	75	175	225	75	175	225	75	175	225	75	175	225	75	175	225	75	175	225	75	175	225	75	175
CABWW2	225	75	175	225	75	175	225	75	175	225	75	175	225	75	175	225	75	175	225	75	175	225	75	175
VIN2	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25	0	25	25
GRAZING0	0	20	20	0	34	36	0	34	36	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20
GRAZING50	50	20	20	50	34	36	50	34	36	50	20	20	50	20	20	50	20	20	50	20	20	50	20	20
GRAZING75	75	30	30	75	34	36	75	34	36	75	30	30	75	30	30	75	30	30	75	30	30	75	30	30
GRAZING125	125	30	30	125	34	36	125	34	36	125	30	30	125	30	30	125	30	30	125	30	30	125	30	30
GRAZING150	150	40	40	150	34	36	150	34	36	150	40	40	150	40	40	150	40	40	150	40	40	150	40	40
GRAZING175	175	40	40	175	34	36	175	34	36	175	40	40	175	40	40	175	40	40	175	40	40	175	40	40
GRAZING200	200	40	40	200	34	36	200	34	36	200	40	40	200	40	40	200	40	40	200	40	40	200	40	40
GRAZING250	250	50	50	250	34	36	250	34	36	250	50	50	250	50	50	250	50	50	250	50	50	250	50	50
GRAZING300	300	50	50	300	34	36	300	34	36	300	50	50	300	50	50	300	50	50	300	50	50	300	50	50
GRAZING375	375	60	60	375	34	36	375	34	36	375	60	60	375	60	60	375	60	60	375	60	60	375	60	60
SILAGE125	125	40	60	125	53	71	125	53	71	125	40	60	125	40	60	125	40	60	125	40	60	125	40	60
SILAGE220	220	65	110	220	65	110	220	65	110	220	65	110	220	65	110	220	65	110	220	65	110	220	65	110
SILAGE275	275	90	150	275	90	150	275	90	150	275	90	150	275	90	150	275	90	150	275	90	150	275	90	150
SILAGE300	300	115	200	300	115	200	300	115	200	300	115	200	300	115	200	300	115	200	300	115	200	300	115	200
HAY0	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30	0	30	30
HAY50	50	30	30	50	30	30	50	30	30	50	30	30	50	30	30	50	30	30	50	30	30	50	30	30
HAY75	75	70	70	75	70	70	75	70	70	75	70	70	75	70	70	75	70	70	75	70	70	75	70	70
HAY125	125	40	60	125	40	60	125	40	60	125	40	60	125	40	60	125	40	60	125	40	60	125	40	60
HAY200	200	50	80	200	50	80	200	50	80	200	50	80	200	50	80	200	50	80	200	50	80	200	50	80
SWEDES	75	100	100	75	100	100	75	100	100	75	100	100	75	100	100	75	100	100	75	100	100	75	100	100
TURNIPS	75	100	100	75	100	100	75	100	100	75	100	100	75	100	100	75	100	100	75	100	100	75	100	100
KALEAGEdrill	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70
KALEAGEBr.	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70
RapeBroad	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70

Conventional Scenario	Southern England			Scotland			Scotland LFA			Wales			Northern Ireland			Wales LFA			Northern Ireland LFA			Northern England		
Activity	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
RapeDrilled	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70
RapeDD	140	70	70	140	70	70	140	70	70	140	70	70	140	70	70	140	70	70	140	70	70	140	70	70
Fbeet125	125	60	150	125	60	150	125	60	150	125	60	150	125	60	150	125	60	150	125	60	150	125	60	150
FRYE2	80	30	30	80	30	30	80	30	30	80	30	30	80	30	30	80	30	30	80	30	30	80	30	30
IRG2	200	50	50	200	50	50	200	50	50	200	50	50	200	50	50	200	50	50	200	50	50	200	50	50
TURNCC2	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70	100	70	70
FMAIZE2	62	70	111	62	70	111	62	70	111	62	70	111	62	70	111	62	70	111	62	70	111	62	70	111
FMAIZEP2	62	70	111	62	70	111	62	70	111	62	70	111	62	70	111	62	70	111	62	70	111	62	70	111
MUSTCC2	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20

Appendix 28.b. The Sustainable Fertiliser Rates

Sustainable Scenario	Southern England			Scotland			Scotland LFA			Wales			Northern Ireland			Wales LFA			Northern Ireland LFA			Northern England		
Activity	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
WW2	93	33.5	36	101	42.5	44	101	42.5	44	93	33.5	36	93	33.5	36	93	33.5	36	93	33.5	36	93	33.5	36
BWW2	121	33.5	36	101	42.5	44	111	42.5	44	93	33.5	36	93	33.5	36	93	33.5	36	93	33.5	36	93	33.5	36
MSBAR2	49.4	21	31.4	45	27	30.5	45	27	30.5	51.5	21	28.5	51.5	21	28.5	51.5	21	28.5	51.5	21	28.5	51.5	21	28.5
WB2	69.6	32	35	71.5	29	35	71.5	29	35	71	32	35	71	32	35	71	32	35	71	32	35	71	32	35
SBAR2	49.4	21	31.4	45	27	30.5	45	27	30.5	51.5	21	28.5	51.5	21	28.5	51.5	21	28.5	51.5	21	28.5	51.5	21	28.5
WO2	56	26.5	31	56	26.5	31	56	26.5	31	56	26.5	31	56	26.5	31	56	26.5	31	56	26.5	31	56	26.5	31
SO2	56	26.5	31	56	26.5	31	56	26.5	31	56	26.5	31	56	26.5	31	56	26.5	31	56	26.5	31	56	26.5	31
RYE2	59	20	27.5	59	20	27.5	59	20	27.5	59	20	27.5	59	20	27.5	59	20	27.5	59	20	27.5	59	20	27.5
TRIT2	59	20	27.5	59	20	27.5	59	20	27.5	59	20	27.5	59	20	27.5	59	20	27.5	59	20	27.5	59	20	27.5
WOSR2	107	27.5	28	79.5	32.5	28	79.5	32.5	28	107	27.5	28	107	27.5	28	107	27.5	28	107	27.5	28	107	27.5	28
SOSR2	67	25.5	21	67	25.5	21	67	25.5	21	67	25.5	21	67	25.5	21	67	25.5	21	67	25.5	21	67	25.5	21
LIN2	34	15.5	12	34	15.5	12	34	15.5	12	34	15.5	12	34	15.5	12	34	15.5	12	34	15.5	12	34	15.5	12
SFB2	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20	0	20	20
SETSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SETNR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WORSA140	70	30	30	70	30	30	70	30	30	70	30	30	70	30	30	70	30	30	70	30	30	70	30	30
SORSA85	42.5	20	20	42.5	20	20	42.5	20	20	42.5	20	20	42.5	20	20	42.5	20	20	42.5	20	20	42.5	20	20
SBEET2	63.5	40	72	56	24.5	67.5	56	24.5	67.5	63.5	40	72	63.5	40	72	63.5	40	72	63.5	40	72	63.5	40	72
PTEW200	89.5	111	99.5	89.5	111	99.5	89.5	111	99.5	89.5	111	99.5	89.5	111	99.5	89.5	111	99.5	89.5	111	99.5	89.5	111	99.5
PTMCW180	101	101	138	84.5	96	119	84.5	96	119	101	101	138	101	101	138	101	101	138	101	101	138	101	101	138
PMCWBPP2	90	75	110	90	75	110	90	75	110	90	75	110	90	75	110	90	75	110	90	75	110	90	75	110
PTPOF2	110	75	110	110	75	110	110	75	110	110	75	110	110	75	110	110	75	110	110	75	110	110	75	110
PTPEXST2	110	75	110	110	75	110	110	75	110	110	75	110	110	75	110	110	75	110	110	75	110	110	75	110
POT SEED2	54.5	94	87	54.5	94	87	54.5	94	87	54.5	94	87	54.5	94	87	54.5	94	87	54.5	94	87	54.5	94	87

Sustainable Scenario	Southern England			Scotland			Scotland LFA			Wales			Northern Ireland			Wales LFA			Northern Ireland LFA			Northern England		
Activity	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
POT DUAL2	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
SWEDE2	37.5	100	62.5	37.5	100	62.5	37.5	100	62.5	37.5	100	62.5	37.5	100	62.5	37.5	100	62.5	37.5	100	62.5	37.5	100	62.5
CAB2	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5
CABWW2	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5	113	37.5	87.5
VIN2	0	12.5	12.5	0	12.5	12.5	0	12.5	12.5	0	12.5	12.5	0	12.5	12.5	0	12.5	12.5	0	12.5	12.5	0	12.5	12.5
GRAZING0	0	10	10	0	17	18	0	17	18	0	10	10	0	10	10	0	10	10	0	10	10	0	10	10
GRAZING50	25	10	10	25	17	18	25	17	18	25	10	10	25	10	10	25	10	10	25	10	10	25	10	10
GRAZING75	37.5	15	15	37.5	17	18	37.5	17	18	37.5	15	15	37.5	15	15	37.5	15	15	37.5	15	15	37.5	15	15
GRAZING12	62.5	15	15	62.5	17	18	62.5	17	18	62.5	15	15	62.5	15	15	62.5	15	15	62.5	15	15	62.5	15	15
GRAZING15	75	20	20	75	17	18	75	17	18	75	20	20	75	20	20	75	20	20	75	20	20	75	20	20
GRAZING17	87.5	20	20	87.5	17	18	87.5	17	18	87.5	20	20	87.5	20	20	87.5	20	20	87.5	20	20	87.5	20	20
GRAZING200	100	20	20	100	17	18	100	17	18	100	20	20	100	20	20	100	20	20	100	20	20	100	20	20
GRAZING250	125	25	25	125	17	18	125	17	18	125	25	25	125	25	25	125	25	25	125	25	25	125	25	25
GRAZING300	150	25	25	150	17	18	150	17	18	150	25	25	150	25	25	150	25	25	150	25	25	150	25	25
GRAZING375	188	30	30	188	17	18	188	17	18	188	30	30	188	30	30	188	30	30	188	30	30	188	30	30
SILAGE125	62.5	20	30	62.5	26.5	35.5	62.5	26.5	35.5	62.5	20	30	62.5	20	30	62.5	20	30	62.5	20	30	62.5	20	30
SILAGE220	110	32.5	55	110	32.5	55	110	32.5	55	110	32.5	55	110	32.5	55	110	32.5	55	110	32.5	55	110	32.5	55
SILAGE275	138	45	75	138	45	75	138	45	75	138	45	75	138	45	75	138	45	75	138	45	75	138	45	75
SILAGE300	150	57.5	100	150	57.5	100	150	57.5	100	150	57.5	100	150	57.5	100	150	57.5	100	150	57.5	100	150	57.5	100
HAY0	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15	0	15	15
HAY50	25	15	15	25	15	15	25	15	15	25	15	15	25	15	15	25	15	15	25	15	15	25	15	15
HAY75	37.5	35	35	37.5	35	35	37.5	35	35	37.5	35	35	37.5	35	35	37.5	35	35	37.5	35	35	37.5	35	35
HAY125	62.5	20	30	62.5	20	30	62.5	20	30	62.5	20	30	62.5	20	30	62.5	20	30	62.5	20	30	62.5	20	30
HAY200	100	25	40	100	25	40	100	25	40	100	25	40	100	25	40	100	25	40	100	25	40	100	25	40
SWEDES	37.5	50	50	37.5	50	50	37.5	50	50	37.5	50	50	37.5	50	50	37.5	50	50	37.5	50	50	37.5	50	50
TURNIPS	37.5	50	50	37.5	50	50	37.5	50	50	37.5	50	50	37.5	50	50	37.5	50	50	37.5	50	50	37.5	50	50
KALEAGEdr.	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35

Sustainable Scenario	Southern England			Scotland			Scotland LFA			Wales			Northern Ireland			Wales LFA			Northern Ireland LFA			Northern England		
Activity	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
KALEAGEBr.	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35
RapeBroad	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35
RapeDrilled	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35
RapeDD	70	35	35	70	35	35	70	35	35	70	35	35	70	35	35	70	35	35	70	35	35	70	35	35
Fbeet125	62.5	30	75	62.5	30	75	62.5	30	75	62.5	30	75	62.5	30	75	62.5	30	75	62.5	30	75	62.5	30	75
FRYE2	40	15	15	40	15	15	40	15	15	40	15	15	40	15	15	40	15	15	40	15	15	40	15	15
IRG2	100	25	25	100	25	25	100	25	25	100	25	25	100	25	25	100	25	25	100	25	25	100	25	25
FRAPECC2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TURNCC2	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35	50	35	35
FMAIZE2	31	35	55.5	31	35	55.5	31	35	55.5	31	35	55.5	31	35	55.5	31	35	55.5	31	35	55.5	31	35	55.5
FMAIZEP2	31	35	55.5	31	35	55.5	31	35	55.5	31	35	55.5	31	35	55.5	31	35	55.5	31	35	55.5	31	35	55.5
MUSTCC2	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20

Appendix 29. Yield Function Co-efficients in the Models

Appendix 29.a. Yield Co-efficients used in the Conventional Models

	Southern England		Scotland		Scotland LFA		Wales		Northern Ireland		Wales LFA		Northern Ireland LFA		Northern England	
Crop	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Wheat	0.5513	0.1134	0.6031	0.1134	0.6031	0.1134	0.6031	0.1134	4.0095	0.0168	0.6031	0.1134	4.0095	0.0168	0.6031	0.1134
SBarley	0.4393	0.1310	0.5185	0.1310	0.5185	0.1310	0.5185	0.1310	2.6950	0.0230	0.4306	0.1310	2.6950	0.0230	0.4393	0.1310
Wbarley	0.5185	0.1310	0.5185	0.1205	0.5185	0.1205	0.5185	0.1205	0.5185	0.1205	0.5185	0.1205	0.5185	0.1205	0.5185	0.1205
Oats	0.3424	0.1310	0.3424	0.1267	0.3424	0.1267	0.3424	0.1267	0.3424	0.1267	0.3424	0.1267	0.3424	0.1267	0.3424	0.1267
Rye	0.2175	0.1267	0.2175	0.1267	0.2175	0.1267	0.2175	0.1267	0.2175	0.1267	0.2175	0.1267	0.2175	0.1267	0.2175	0.1267
Trit	0.3424	0.1253	0.3424	0.1253	0.3424	0.1253	0.3424	0.1253	0.3424	0.1253	0.3424	0.1253	0.3424	0.1253	0.3424	0.1253
Pots	1.3531	0.1146	1.3531	0.1146	1.3531	0.1146	1.3531	0.1146	1.3531	0.1146	1.3531	0.1146	1.3531	0.1146	1.3531	0.1146
Potsew	1.0828	0.1152	1.0828	0.1152	1.0828	0.1152	1.0828	0.1152	1.0828	0.1152	1.0828	0.1152	1.0828	0.1152	1.0828	0.1152
WOSR	0.2455	0.1210	0.2718	0.1114	0.2718	0.1114	0.2718	0.1114	0.2718	0.1114	0.2718	0.1114	0.2718	0.1114	0.2718	0.1114
Lin	-0.0835	0.1417	-0.0835	0.1417	-0.0835	0.1417	-0.0835	0.1417	-0.0835	0.1417	-0.0835	0.1417	-0.0835	0.1417	-0.0835	0.1417
SOSR	0.1383	0.1114	0.1383	0.1114	0.1383	0.1114	0.1383	0.1114	0.1383	0.1114	0.1383	0.1114	0.1383	0.1114	0.1383	0.1114
Sugar Beet	1.2175	0.1346	1.2175	0.1346	1.2175	0.1346	1.2175	0.1346	1.2175	0.1346	1.2175	0.1346	1.2175	0.1346	1.2175	0.1346
Cabbage	1.1383	0.1385	1.1383	0.1385	1.1383	0.1385	1.1383	0.1385	1.1383	0.1385	1.1383	0.1385	1.1383	0.1385	1.0652	0.1104
CabbageWW	1.5019	0.1104	1.2175	0.1104	1.2175	0.1104	1.2175	0.1104	1.2175	0.1104	1.2175	0.1104	1.2175	0.1104	1.5185	0.1104
Vining Peas	0.0414	0.1857	0.0414	0.1857	0.0414	0.1857	0.0414	0.1857	0.0414	0.1857	0.0414	0.1857	0.0414	0.1857	0.0414	0.1857
Kaleage	0.6154	0.1298	0.6154	0.1298	0.6154	0.1298	0.6154	0.1298	0.6154	0.1298	0.6154	0.1298	0.6154	0.1298	0.6154	0.1298
Forage Rape	0.3636	0.1298	0.3636	0.1298	0.3636	0.1298	0.3636	0.1298	0.3636	0.1298	0.3636	0.1298	0.3636	0.1298	0.3636	0.1298
Fodder Beet	0.7404	0.1238	0.7404	0.1238	0.7404	0.1238	0.7404	0.1238	0.7404	0.1238	0.7404	0.1238	0.7404	0.1238	0.7404	0.1238
Forage Maize	0.7404	0.1449	0.3424	0.1449	0.7404	0.1449	0.7404	0.1449	0.7404	0.1449	0.7404	0.1449	0.7404	0.1449	0.7404	0.1449
Forage MaizeP	0.8195	0.1449	0.5185	0.1449	0.8195	0.1449	0.8195	0.1449	0.8195	0.1449	0.8195	0.1449	0.8195	0.1449	0.8195	0.1449

	Southern England		Scotland		Scotland LFA		Wales		Northern Ireland		Wales LFA		Northern Ireland LFA		Northern England	
Crop	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Forage Rye	0.0925	0.1364	0.0925	0.1364	0.0925	0.1364	0.0925	0.1364	0.0925	0.1364	0.0925	0.1364	0.0925	0.1364	0.0925	0.1364
Spring Field Beans	0.3424	0.1621	0.3424	0.1621	0.3424	0.1621	0.3424	0.1621	0.3424	0.1621	0.3424	0.1621	0.3424	0.1621	0.3424	0.1621
Swedes	1.3314	0.1385	1.3314	0.1385	1.3314	0.1385	1.3314	0.1385	1.3314	0.1385	1.3314	0.1385	1.3314	0.1385	1.3314	0.1385

Appendix 29.b. Yield Co-efficients used in the Sustainable Models

	Southern England		Scotland		Scotland LFA		Wales		Northern Ireland		Wales LFA		Northern Ireland LFA		Northern England	
Crop	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Wheat	0.4479	0.1305	0.5038	0.1305	0.5038	0.1305	0.5038	0.1305	0.5038	0.1305	0.5038	0.1305	0.5038	0.1305	0.5038	0.1305
Sbarley	0.3936	0.1544	0.4728	0.1544	0.4728	0.1544	0.4728	0.1544	0.4728	0.1544	0.4728	0.1544	0.4728	0.1544	0.4728	0.1544
Wbarley	0.4479	0.1400	0.4728	0.1400	0.4728	0.1400	0.4728	0.1400	0.4728	0.1400	0.4728	0.1400	0.4728	0.1400	0.4728	0.1400
Oats	0.2967	0.1485	0.2967	0.1485	0.2967	0.1485	0.2967	0.1485	0.2967	0.1485	0.2967	0.1485	0.2967	0.1485	0.2967	0.1485
Rye	0.1717	0.1466	0.1717	0.1466	0.1717	0.1466	0.1717	0.1466	0.1717	0.1466	0.1717	0.1466	0.1717	0.1466	0.1717	0.1466
Trit	0.2967	0.1466	0.2967	0.1466	0.2967	0.1466	0.2967	0.1466	0.2967	0.1466	0.2967	0.1466	0.2967	0.1466	0.2967	0.1466
Pots	1.2562	0.1322	1.2562	0.1322	1.2562	0.1322	1.2562	0.1322	1.2562	0.1322	1.2562	0.1322	1.2562	0.1322	1.2562	0.1322
Potsew	0.9859	0.1330	0.9859	0.1330	0.9859	0.1330	0.9859	0.1330	0.9859	0.1330	0.9859	0.1330	0.9859	0.1330	0.9859	0.1330
WOSR	0.1486	0.1279	0.1749	0.1279	0.1749	0.1279	0.1749	0.1279	0.1749	0.1279	0.1749	0.1279	0.1749	0.1279	0.1749	0.1279
Lin	-0.1805	0.1695	-0.1805	0.1695	-0.1805	0.1695	-0.1805	0.1695	-0.1805	0.1695	-0.1805	0.1695	-0.1805	0.1695	-0.1805	0.1695
SOSR	0.1875	0.1279	0.1875	0.1279	0.1875	0.1279	0.1875	0.1279	0.1875	0.1279	0.1875	0.1279	0.1875	0.1279	0.1875	0.1279
Sugar Beet	1.1206	0.1485	1.1206	0.1485	1.1206	0.1485	1.1206	0.1485	1.1206	0.1485	1.1206	0.1485	1.1206	0.1485	1.1206	0.1485
Cabbage	1.0414	0.1266	1.0414	0.1266	1.0414	0.1266	1.0414	0.1266	1.0414	0.1266	1.0414	0.1266	1.0414	0.1266	1.0414	0.1266
CabbageWW	1.5137	0.1266	1.1206	0.1266	1.1206	0.1266	1.1206	0.1266	1.1206	0.1266	1.1206	0.1266	1.1206	0.1266	1.4838	0.1266
Vining Peas	0.0267	0.2367	-0.0555	0.2367	-0.0555	0.2367	-0.0555	0.2367	-0.0555	0.2367	-0.0555	0.2367	-0.0555	0.2367	-0.0555	0.2367
Kaleage	0.5185	0.1528	0.5185	0.1528	0.5185	0.1528	0.5185	0.1528	0.5185	0.1528	0.5185	0.1528	0.5185	0.1528	0.5185	0.1528
Forage Rape	0.2667	0.1528	0.2667	0.1528	0.2667	0.1528	0.2667	0.1528	0.2667	0.1528	0.2667	0.1528	0.2667	0.1528	0.2667	0.1528
Fodder Beet	0.6435	0.1446	0.6435	0.1446	0.6435	0.1446	0.6435	0.1446	0.6435	0.1446	0.6435	0.1446	0.6435	0.1446	0.6435	0.1446

	Southern England		Scotland		Scotland LFA		Wales		Northern Ireland		Wales LFA		Northern Ireland LFA		Northern England	
Crop	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
Forage Maize	0.6435	0.1741	0.3102	0.1741	0.6435	0.1741	0.6435	0.1741	0.6435	0.1741	0.6435	0.1741	0.6435	0.1741	0.6435	0.1741
Forage Maize P	0.7226	0.1741	0.4863	0.1741	0.7226	0.1741	0.7226	0.1741	0.7226	0.1741	0.7226	0.1741	0.7226	0.1741	0.7226	0.1741
Forage Rye	-0.0044	0.1621	-0.0044	0.1621	-0.0044	0.1621	-0.0044	0.1621	-0.0044	0.1621	-0.0044	0.1621	-0.0044	0.1621	-0.0044	0.1621
Spring Field Beans	0.3201	0.1996	0.3201	0.1996	0.3201	0.1996	0.3201	0.1996	0.3201	0.1996	0.3201	0.1996	0.3201	0.1996	0.3201	0.1996
Swedes	1.2345	0.1650	1.2345	0.1650	1.2345	0.1650	1.2345	0.1650	1.2345	0.1650	1.2345	0.1650	1.2345	0.1650	1.2345	0.1650

Appendix 30. Deriving the Pesticide Impact Scores

Chemical	DT (Dermal Toxicity) DT	C (Chronic Toxicity) C	SY (Systemicity) SY	F (Fish Toxicity) F	L (Leaching Potential) L	R (Surface Loss Potential) R	D (Bird Toxicity) D	S (Soil Half Life) S	Z (Bee Toxicity) Z	B (Beneficial Arthropod Toxicity) B	P (Soil Half Life/ Proxy for Plant Surface) P	kg ai /l	l/ha	Kg ai/ha	ha	EIQ Ecological	Total Ecological	EIQ Consumers	Total Consumer	EIQ Farm worker	Total Farm worker
Benzoximate	1	5	3	5	3	3	3	3	3	3	3	0.48		0.48		87	41.76	48	23	28	13
Bupirimate	3	3	3	5	3	1	3	1	3	3	1	0.25		0.25		31	7.75	12	3	48	12
Captan	3	5	3	3	3	3	5	1	5	3	1	0.80		0.80		47	37.6	18	14	78	62
Carbendazim	5	3	1	5	3	1	1	1	5	3	1	0.50		0.50		31	15.5	6	3	80	40
Chlorothalonil	3	5	3	3	3	1	1	1	1	3	1	0.50		0.50		17	8.5	18	9	78	39
Desmetryne	5	3	3	5	3	3	1	1	1	3	1	0.25		0.25		29	7.25	12	3	80	20
Diclofop-methyl	3	3	5	5	1	3	1	1	1	3	1	0.38		0.38		29	10.96	16	6	48	18
Dicofol	3	3	5	5	3	1	5	3	1	3	3	0.19		0.19		77	14.25	41	7	47	8.6
Diflubenzuron	1	3	3	5	3	1	3	3	1	3	3	0.48		0.48		59	28.32	30	14	18	8.6
Dipel (Bacillus thuringiensis)	3	3	3	3	3	3	3	1	3	1	1	0.50		0.50		33	16.5	12	6	48	24
Dithianon	1	3	3	3	3	1	5	3	3	1	3	0.75		0.75		91	68.25	30	23	18	14
Diuron	3	3	3	5	3	1	3	5	1	3	5	0.50		0.50		93	46.5	48	24	60	30
Fenpropimorph	3	3	3	5	3	5	3	3	3	3	1	0.75		0.75		60	45	21	16	48	36
Isoproturon	5	3	3	3	3	1	3	1	1	1	3	0.50		0.50		46	23	21	11	90	45

Chemical	DT (Dermal Toxicity) DT	C (Chronic Toxicity) C	SY (Systemicity) SY	F (Fish Toxicity) F	L (Leaching Potential) L	R (Surface Loss Potential) R	D (Bird Toxicity) D	S (Soil Half Life) S	Z (Bee Toxicity) Z	B (Beneficial Arthropod Toxicity) B	P (Soil Half Life/ Proxy for Plant Surface) P	kg ai /l	l/ha	Kg ai/ha	ha	EIQ Ecological	Total Ecological	EIQ Consumers	Total Consumer	EIQ Farm worker	Total Farm worker
Mecoprop	3	3	1	1	3	3	5	1	1	1	3	0.57		0.57		58	33.06	9	5	54	31
Phenmedipham	3	5	3	5	3	1	1	1	1	3	1	0.15		0.15		19	2.166	18	2	78	8.9
Primicarb	5	5	1	3	3	3	5	5	3	3	5	0.50		0.50		157	78.5	28	14	150	75
Propyzamid	3	5	3	5	3	1	1	3	1	3	3	0.40		0.40		41	16.4	48	19	84	34
Pyrethrum + pip.butoxide	5	3	5	5	3	5	1	3	5	3	3	0.0008		0.00075		97	0.073	48	0	90	0.1
Simazine	5	5	3	1	3	1	1	3	3	3	3	0.50		0.50		55	27.5	48	24	140	70
Tetradifon	3	3	5	1	3	1	3	3	1	1	3	0.08		0.08		53	4.24	48	4	54	4.3
Thiophanate-methyl	1	5	1	5	3	1	3	3	1	3	3	0.50		0.50		59	29.5	18	9	28	14
Thiram	3	3	1	5	3	5	3	1	3	3	1	0.6		0.6		51	30.6	6	4	48	29
Triadimefon	3	3	3	3	3	1	1	5	3	3	5	0.25		0.25		91	22.75	48	12	60	15
Trifluralin	3	3	5	3	3	5	1	3	3	3	3	0.48		0.48		69	33.12	48	23	54	26
Vinclozolin	3	5	3	3	3	3	5	3	1	3	3	0.50		0.50		81	40.5	48	24	84	42
Alphacypermethrin	3	5	5	5	3	1	1	3	5	5	3	0.10		0.10		79	7.9	78	8	84	8.4
Bentazone	3	3	1	3	5	3	3	3	3	3	3	0.48		0.48		81	38.88	14	7	54	26
Bromoxynil + Clopyralid	3	3	1	5	3	3	3	3	3	3	3	0.29		0.29		87	25.23	12	3	54	16
Bromoxynil + ioxynil + mecoprop	3	3	3	5	3	3	3	3	3	3	3	0.34		0.34		87	29.23	30	10	54	18

Chemical	DT (Dermal Toxicity) DT	C (Chronic Toxicity) C	SY (Systemicity) SY	F (Fish Toxicity) F	L (Leaching Potential) L	R (Surface Loss Potential) R	D (Bird Toxicity) D	S (Soil Half Life) S	Z (Bee Toxicity) Z	B (Beneficial Arthropod Toxicity) B	P (Soil Half Life/ Proxy for Plant Surface) P	Kg ai /l	l/ha	Kg ai/ha	ha	EIQ Ecological	Total Ecological	EIQ Consumers	Total Consumer	EIQ Farm worker	Total Farm worker
Chlorpyrifos	5	5	5	5	3	5	1	3	5	5	3	0.48		0.48		99	47.52	78	37	140	67
Cycocel	3	3	3	3	3	3	3	3	3	3	3	0.50		0.50		81	40.5	30	15	54	27
Cypermethrin	3	5	5	3	3	1	3	1	5	5	1	0.10		0.10		37	3.7	28	3	78	7.8
Deltamethrin + Heptenophos	5	5	5	5	5	1	3	1	5	5	1	0.43		0.43		39	16.58	30	13	130	55
Diflufenican + Isoproturon	3	3	3	3	3	3	3	3	3	3	3	0.12		0.12		81	9.72	30	4	54	6.5
Fenaxaprop-P-ethyl	3	3	3	3	3	3	3	3	3	3	3	0.055		0.055		81	4.455	30	2	54	3
Flamprop-M-isopropyl	5	3	3	3	3	1	5	3	1	1	3	0.2		0.2		73	14.6	30	6	90	18
Fluazifop-P-butyl	5	3	5	3	1	5	3	1	3	3	1	0.125		0.125		41	5.125	16	2	80	10
Fluroxypyr	3	3	1	1	3	1	5	3	3	3	3	0.2		0.2		91	18.2	12	2	54	11
Fluzinam	3	3	3	5	3	3	3	3	3	3	3	0.5		0.5		87	43.5	30	15	54	27
Glyphosate	3	3	1	1	3	3	3	5	3	3	5	0.36		0.36		121	43.56	18	6	60	22
Imazalil	3	5	3	3	3	1	3	5	5	5	5	0.15		0.15		153	22.95	78	12	90	14
Iprodione	5	1	3	3	3	3	3	3	3	1	3	0.255		0.255		79	20.15	12	3	40	10
Mancozeb	1	1	1	3	3	1	3	1	3	3	1	0.8		0.8		29	23.2	4	3	6	4.8
Manganese Sulphate	3	1	3	3	3	3	3	3	3	3	3	0.5		0.5		81	40.5	12	6	24	12
Mecoprop-P	3	3	1	1	3	3	5	3	1	1	3	0.57		0.57		73	41.61	12	7	54	31

Chemical	DT (Dermal Toxicity) DT	C (Chronic Toxicity) C	SY (Systemicity) SY	F (Fish Toxicity) F	L (Leaching Potential) L	R (Surface Loss Potential) R	D (Bird Toxicity) D	S (Soil Half Life) S	Z (Bee Toxicity) Z	B (Beneficial Arthropod Toxicity) B	P (Soil Half Life/ Proxy for Plant Surface) P	kg ai /l	l/ha	Kg ai/ha	ha	EIQ Ecological	Total Ecological	EIQ Consumers	Total Consumer	EIQ Farm worker	Total Farm worker
Metsulfuron-Methyl	5	1	1	1	5	1	3	1	1	1	1	0.2		0.2		19	3.8	6	1	30	6
Metazachlor	3	3	3	3	3	1	3	1	1	1	1	0.5		0.5		21	10.5	12	6	48	24
Paraquat + Monolinuron	3	5	3	3	3	3	5	3	3	3	3	0.264		0.264		99	26.14	48	13	84	22
Pencycuron + Imazalil	5	1	5	1	3	1	1	3	3	3	3	0.27		0.27		55	14.85	18	5	40	11
Prochloraz	3	3	3	3	1	3	3	1	3	3	1	0.45		0.45		35	15.75	10	5	48	22
Propiconazole	3	1	3	3	3	1	3	3	3	3	3	0.25		0.25		75	18.75	12	3	24	6
Terbutryn + Terbuthylazine	5	3	3	3	3	5	5	3	3	3	3	0.5		0.5		105	52.5	30	15	90	45
Terbutryn	5	3	3	3	1	5	3	3	1	3	3	0.5		0.5		69	34.5	28	14	90	45
Terbuthylazine	5	3	3	3	3	5	5	3	3	3	3	0.5		0.5		105	52.5	30	15	90	45
MCPA	3	3	3	3	3	3	5	3	3	3	3	0.5		0.5		99	49.5	30	15	54	27
MCPB	5	3	3	3	3	3	1	3	1	1	3	0.4		0.4		43	17.2	30	12	90	36
Atrazine	3	3	3	3	5	1	3	3	3	3	3	0.5		0.5		75	37.5	32	16	54	27
Metamitron	3	3	1	1	3	3	5	3	1	1	3	0.7		0.7		73	51.1	12	8	54	38
Sulphur	1	1	1	1	5	3	1	1	1	1	3	0.8		0.8		34	27.2	7	6	8	6.4
Carbofuran	3	5	1	5	5	1	5	3	5	5	3	0.05		0.05		115	5.75	20	1	84	4.2
Chlorfenvinphos	5	5	3	5	3	3	3	3	5	5	3	0.24		0.24		107	25.68	48	12	140	34

Chemical	DT (Dermal Toxicity) DT	C (Chronic Toxicity) C	SY (Systemicity) SY	F (Fish Toxicity) F	L (Leaching Potential) L	R (Surface Loss Potential) R	D (Bird Toxicity) D	S (Soil Half Life) S	Z (Bee Toxicity) Z	B (Beneficial Arthropod Toxicity) B	P (Soil Half Life/ Proxy for Plant Surface) P	kg ai /l	l/ha	Kg ai/ha	ha	EIQ Ecological	Total Ecological	EIQ Consumers	Total Consumer	EIQ Farm worker	Total Farm worker
Tridemorph	3	3	5	3	3	5	5	3	3	3	3	0.75		0.75		105	78.75	48	36	54	41
Propachlor	1	3	1	5	3	5	3	1	3	3	3	0.48		0.48		88	42.24	9	4	18	8.6
Tebuconazole	3	5	3	3	3	3	3	3	3	3	3	0.25		0.25		81	20.25	48	12	84	21
Paraquat	3	5	3	1	3	1	5	3	3	1	3	0.2		0.2		89	17.8	48	10	84	17
Chlorothalonil + carbendazim	5	3	1	5	3	1	1	1	5	3	1	0.55		0.55		31	17.05	6	3	80	44

Appendix 31. Representative Farm Plans 1997/98
Appendix 31.a. Summary of Pig and Poultry Group LP Results 1997/98

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Dairy Cows (No.)	Suckler Cows (No.)	Total LSU's	Breeding Pigs (No.)
1. Pigs and Poultry Central England	7220	906	53	11	0	35	59	547	0	0	0	97	202
Model	5680	1320	96	0	0	4	0	684	0	0	0	0	405
Difference	-1540	413	42	-11	0	-31	-59	137	0	0	0	-97	204
2. Pigs and Poultry Southern England and Wales	1306	1716	47	19	0	33	3	601	0	0	0	42	103
Model	3951	1094	45	43	0	12	0	491	0	0	0	18	88
Difference	2644	-622	-3	24	0	-21	-3	-111	0	0	0	-24	-15
3. Pigs and Poultry Scotland, Northern Ireland & the North of England	2169	1232	42	26	1	32	54	257	0	0	0	90	122
Model	3811	780	91	2	3	4	15	208	0	0	0	3	221
Difference	1643	-451	50	-24	2	-27	-38	-49	0	0	0	-88	99
Bias	915.8	-402.6	29.6	-3.7	0.5	-26.4	-33.4	-7.7	0.0	0.0	0.0	-69.5	14.5

Appendix 31.b. Summary of Cropping Group Farm LP Results 1997/98

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Dairy Cows (No.)	Suckler Cows (No.)	Total LSU's	Stocking/ forage ha
4. Cropping South East England	429	693	64	14	1	22	72	172	94	0	0	400	2.69
Model	665	631	44	24	1	31	102	178	171	0	0	102	2.61
Difference	236	-61	-20	10	1	9	31	7	77	0	0	-298	-0.08
5. Cropping Central and Northern England	335	556	51	11	0	38	73	106	119	0	10	277	1.73
Model	323	494	35	26	0	38	60	69	0	0	0	74	1.73
Difference	-11	-62	-15	14	0	1	-14	-38	-119	0	-10	-203	0.00
6. Cropping Scotland, Northern Ireland and Western England	202	649	54	24	1	20	72	105	85	4	24	332	1.80
Model	502	357	34	3	0	63	59	35	0	0	0	8	1.80
Difference	300	-292	-20	-21	-1	42	-13	-70	-85	-4	-24	-324	0.00
7. Small Cropping Farms Wales	289	589	49	17	1	34	70	105	78	1	7	105	1.58
Model	429	418	32	13	0	55	52	57	0	0	0	14	1.58
Difference	140	-170	-16	-4	-1	21	-18	-48	-78	-1	-7	-91	0.00
Bias	166.0	-146.4	-17.8	-0.3	-0.2	18.4	-3.3	-37.1	-51.3	-1.4	-10.4	-228.8	0.0

Appendix 31.c. Summary of Mainly Dairy Group LP Results 1997/98

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Dairy Cows (No.)	Suckler Cows (No.)	Total LSU's	Stocking/ forage ha
8.Mainly Dairy Wales and Northern Ireland	429	375	2	96	0	2	88	75	76	52	2	152	1.90
Model	748	632	10	88	0	1	28	279	0	110	0	136	1.90
Difference	319	257	8	-7	0	-1	-61	203	-76	57	-2	-16	0.00
9.Small Dairy Northern England	178	563	7	92	0	0	61	118	154	27	6	99	1.62
Model	810	642	0	98	0	2	58	296	0	94	0	96	1.62
Difference	632	79	-7	6	0	2	-3	178	-154	66	-6	-3	0.00
10.Large Dairy Scotland	410	638	4	88	1	7	90	150	237	98	0	255	1.81
Model	395	607	7	93	0	0	35	267	0	111	0	239	1.81
Difference	-15	-31	2	5	-1	-7	-55	117	-237	14	0	-16	0.00
11.Mainly Dairy South West England	256	830	32	51	8	9	82	229	21	68	0	372	1.90
Model	406	564	40	56	2	2	47	209	0	108	0	217	1.90
Difference	150	-265	8	5	-7	-7	-35	-20	-21	39	0	-155	0.00
12. Dairy and Sheep Southern England	180	656	23	73	2	2	56	100	475	72	22	271	1.77
Model	429	481	22	70	0	8	38	135	0	98	0	183	1.77
Difference	249	-175	-1	-3	-2	6	-18	35	-475	26	-22	-88	0.00
Bias	267.0	-27.1	2.2	1.1	-2.0	-1.3	-34.5	102.8	-192.6	40.4	-6.0	-55.8	0.0

Appendix 31.d. Summary of Specialist Dairy Group and Mixed Lowland Group LP Results 1997/98

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Dairy Cows (No.)	Suckler Cows (No.)	LSU	Stocking/ forage ha
13.Specialist Dairy Central and Southern England	488	920	0	97	2	0	84	73	108	73	1	113	1.78
Model	328	578	9	90	0	1	42	140	0	50	0	97	1.70
Difference	-160	-342	9	-7	-2	1	-42	66	-108	-23	-1	-16	0.08
14.Specialist Dairy Wales & North of England	487	948	7	83	5	5	94	199	76	99	58	187	2.07
Model	1141	694	0	98	0	2	103	199	0	178	0	182	2.07
Difference	654	-254	-7	15	-5	-3	9	-1	-76	80	-58	-5	0
15.Mixed Lowland North & West	144	482	19	75	1	5	56	91	210	3	19	219	1.68
Model	161	605	27	65	3	6	59	178	79	18	41	144	1.47
Difference	17	123	8	-10	2	0	2	86	-132	15	22	-75	-0.21
16.Mixed Lowland South	369	766	33	57	1	9	99	270	88	24	12	308	2.19
Model	185	577	20	71	2	7	82	136	141	27	43	184	1.94
Difference	-184	-189	-13	14	1	-2	-17	-134	54	3	31	-124	-0.25
Bias Dairy Specialist	239.8	-297.8	1.2	4.0	-3.9	-1.3	-16.5	33.9	-86.9	27.5	-29.3	-78.3	-0.9
Bias Lowland	-83.7	-33.3	-2.8	2.1	1.4	-0.7	-7.4	-24.1	-39.0	9.2	26.6	-99.6	-0.2

Appendix 31.e. Summary of Large LFA Group LP Results 1997/98

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Dairy Cows (No.)	Suckler Cows (No.)	Total LSU's	Stocking/ forage ha
17.Large Hill Sheep Wales & Northern Ireland	124	242	1	98	0	1	22	26	2288	3	69	466	0.84
Model	5	197	0	98	2	0	20	56	3921	0	36	546	0.56
Difference	-119	-45	0	0	2	-1	-2	30	1633	-3	-33	80	-0.28
18.Large LFA North of England	91	144	0	99	0	1	8	16	902	0	20	193	0.53
Model	68	208	1	95	2	2	17	50	2784	0	60	440	0.78
Difference	-23	65	1	-4	2	1	9	35	1882	0	41	247	0.25
19.Large LFA Scotland	98	295	1	85	0	14	24	47	2146	0	303	1376	1.27
Model	79	174	0	98	2	0	33	5	4038	0	322	903	0.85
Difference	-19	-121	-1	13	1	-14	9	-42	1892	0	19	-473	-0.42
Bias	-160.9	-100.4	-0.1	9.7	5.5	-13.8	16.7	23.2	5408.0	-2.2	26.6	-146.1	-7.1

Appendix 31.f. Summary of Small LFA Group LP Results 1997/98

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Dairy Cows (No.)	Suckler Cows (No.)	LSU	Stocking/ forage ha
20.Small LFA Beef Scotland	167	365	5	93	1	1	59	49	210	0	92	191	1.45
Model	110	312	3	94	0	4	44	0	88	0	62	143	1.18
Difference	-57	-53	-2	1	-1	3	-16	-49	-121	0	-31	-48	-0.27
21.Small LFA Farms South West England	71	248	1	92	1	7	38	71	1363	4	82	249	1.60
Model	163	431	3	95	1	1	43	45	468	0	24	252	1.60
Difference	91	183	3	3	0	-6	4	-26	-895	-4	-58	3	0.00
22.Small Hill Wales & Northern Ireland	224	270	6	90	1	4	43	49	512	3	40	165	1.24
Model	113	339	2	95	2	1	46	44	516	0	30	156	1.24
Difference	-111	69	-4	5	2	-3	3	-5	4	-3	-10	-9	0.00
23.Small LFA North & Central England	147	376	0	91	1	8	28	45	588	0	74	189	1.03
Model	95	305	5	92	3	1	43	30	458	0	55	178	1.03
Difference	-52	-71	5	1	2	-8	16	-15	-130	0	-19	-11	0.00
Bias	-32.2	31.9	0.4	2.7	0.8	-3.5	1.8	-23.7	-285.4	-1.8	-29.6	-16.4	1.4

Appendix 32. Lindo Print outs for the Conventional Farm Models for 1997/1998

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
	315201.8000		71507.4500		159203.0000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	3.3153	0.0000	0.8811	0.0000	0.4210	0.0000
CJAN	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CFEB	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CMAR	37.1420	0.0000	2.1320	0.0000	26.2179	0.0000
CAPR	81.7124	0.0000	15.1105	0.0000	23.9282	0.0000
CMAY	22.2852	0.0000	0.0000	4.4622	5.3147	0.0000
CJUN	22.2852	0.0000	0.0000	1.2340	0.0000	0.8534
CJUL	0.0000	5.6962	0.0000	7.8600	0.0000	7.8600
CAUG	318.8906	0.0000	35.9651	0.0000	230.4324	0.0000
CSEP	279.3975	0.0000	28.8041	0.0000	153.0157	0.0000
COCT	304.3471	0.0000	45.7933	0.0000	187.1400	0.0000
CNOV	0.0000	7.8600	1.7730	0.0000	0.0000	4.8428
CDEC	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
BHAY	0.0000	0.1714	1.6602	0.0000	1.7631	0.0000
UPolMan	0.0000	0.0000	0.0000	0.0000	63.5134	0.0000
Upigslur	7146.1011	0.0000	1576.8806	0.0000	1597.5211	0.0000
USLYCat	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UFYMCat	0.0000	0.0000	154.8632	0.0000	0.0000	0.0000
BUYN	0.0000	0.8843	0.0000	0.9385	1364.1062	0.0000
BUYP	0.0000	0.8632	0.0000	0.9161	174.2480	0.0000
BUYK	0.0000	0.4842	0.0000	0.5139	0.0000	6.1446
bwSTRAW	0.0000	0.0000	3.0706	0.0000	0.0000	0.0000
bBSTRAW	0.0000	10.5270	0.0000	11.1723	0.0000	10.8689
bOSTRAW	0.0000	10.5270	0.0000	11.1723	0.0000	10.8689
WW1	0.0000	335.7092	0.0000	236.9969	0.0000	316.0253
WW2	0.0000	336.0426	0.0000	148.8860	0.0000	152.6871
WW3	0.0000	237.2905	0.0000	139.1931	0.0000	21.6871
BWW1	0.0000	126.2139	0.0000	101.1411	0.0000	193.0097
BWW2	0.0000	126.6411	0.0000	0.0000	0.0000	8.5230
BWW3	10.6900	0.0000	0.0000	0.0000	0.0000	0.0000
MSBAR1	0.0000	384.3932	0.0000	264.8114	0.0000	338.7111
MSBAR2	0.0000	327.4694	0.0000	201.0786	0.0000	162.0636
MSBAR3	0.0000	280.7342	0.0000	148.7532	6.2200	0.0000
WB1	0.0000	89.0217	0.0000	114.0053	0.0000	314.6798
WB2	0.0000	79.2808	0.0000	186.4863	0.0000	148.4690
WB3	42.3700	0.0000	8.0800	0.0000	31.8115	0.0000
SBAR1	0.0000	264.6223	0.0000	330.9193	0.0000	390.8275
SBAR2	0.0000	218.7207	0.0000	279.5271	0.0000	229.9574
SBAR3	0.0000	198.9994	0.0000	257.4468	0.0000	78.3614
WO1	0.0000	65.2791	0.0000	77.0416	0.0000	268.1789
WO2	0.0000	20.0650	0.0000	34.7358	0.0000	119.0829
WO3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SO50	0.0000	180.2837	0.0000	238.5470	0.0000	376.3466
SO100	0.0000	139.7265	0.0000	201.7350	0.0000	251.5781
SO125	0.0000	114.3066	0.0000	160.6655	0.0000	78.2341
RYE1	0.0000	180.7142	0.0000	212.9951	0.0000	396.4076
RYE2	0.0000	148.6476	0.0000	177.0929	0.0000	257.9007
RYE3	0.0000	139.7403	0.0000	167.1201	0.0000	116.3559
TRIT150	0.0000	140.2611	0.0000	167.7033	0.0000	364.8325
TRIT180	0.0000	104.8921	0.0000	128.1035	0.0000	239.0865
TRIT200	0.0000	95.0783	0.0000	117.1159	0.0000	111.5186
WOSR150	0.0000	366.2651	0.0000	266.6166	0.0000	495.4454
WOSR185	0.0000	320.4885	0.0000	203.6070	0.0000	408.9999
WOSR225	0.0000	302.3404	0.0000	190.1582	0.0000	252.0844
SOSR90	0.0000	204.1367	0.0000	101.4316	0.0000	405.1504
SOSR110	0.0000	173.1641	0.0000	66.7541	0.0000	352.2294
SOSR130	0.0000	153.9117	0.0000	45.1988	0.0000	273.5099

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
	315201.8000		71507.4500		159203.0000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
LIN50	0.0000	505.5062	0.0000	428.9934	0.0000	766.8118
LIN80	0.0000	505.0791	0.0000	428.5152	0.0000	731.6619
LIN120	0.0000	471.3664	0.0000	390.7700	0.0000	656.7886
SFB20K	0.0000	147.5736	0.0000	275.0517	0.0000	604.7205
SFB40K	0.0000	79.3254	0.0000	198.6399	0.0000	500.3926
SFB60K	0.0000	67.4906	0.0000	185.3895	0.0000	454.0310
SETSC	0.0000	93.3814	0.0000	95.8044	0.0000	325.3106
SETNR	2.4300	0.0000	0.4300	0.0000	0.0000	230.5443
WORSA100	0.0000	277.7770	0.0000	75.5704	0.0000	227.8423
WORSA140	0.0000	244.8458	0.0000	28.6573	0.0000	156.7216
WORSA180	0.0000	218.7383	0.0000	4.8274	1.8300	0.0000
SORSA60	0.0000	245.2908	0.0000	50.5543	0.0000	226.1028
SORSA85	0.0000	231.2891	0.0000	34.8777	0.0000	112.6727
SORSA110	0.0000	201.8687	0.0000	1.9382	0.0000	16.8975
SBEET1	0.0000	291.5188	0.0000	198.0688	0.0000	372.1735
SBEET2	0.0000	182.9738	0.0000	76.5401	0.0000	186.3688
SBEET3	0.0000	114.6110	1.8100	0.0000	0.0000	48.5181
POTEW1	0.0000	1677.7684	0.0000	2493.9541	0.0000	2128.9912
POTEW2	0.0000	1370.1879	0.0000	2149.5820	0.0000	1380.9204
POTEW3	0.0000	1178.5387	0.0000	1935.0085	0.0000	691.4376
PTMCW140	0.0000	1872.7604	0.0000	2716.6804	0.0000	2158.1357
PTMCW180	0.0000	1616.4674	0.0000	2429.7307	0.0000	1255.5404
PTMCW220	0.0000	1387.7095	0.0000	2173.6099	0.0000	385.8058
PMCWBPP1	0.0000	1604.4690	0.0000	2406.7720	0.0000	1811.6678
PMCWBPP2	0.0000	1285.2725	0.0000	2049.3945	0.0000	834.0026
PMCWBPP3	0.0000	1086.4556	0.0000	1826.7959	0.0000	0.0000
PTPOF1	0.0000	1845.7738	0.0000	2724.3430	0.0000	2355.2888
PTPOF2	0.0000	1613.7654	0.0000	2464.5828	0.0000	1606.5095
PTPOF3	0.0000	1469.2471	0.0000	2302.7778	0.0000	962.1422
PTPEXST1	0.0000	1873.8285	0.0000	2714.5000	0.0000	2293.1873
PTPEXST2	0.0000	1585.6254	0.0000	2391.8230	0.0000	1495.6041
PTPEXST3	0.0000	1406.1025	0.0000	2190.8264	0.0000	827.7217
POTSEED1	0.0000	2144.8569	0.0000	2975.1372	0.0000	2498.4976
POTSEED2	0.0000	1818.3571	0.0000	2609.5828	0.0000	1655.2107
POTSEED3	0.0000	1614.9875	0.0000	2381.8872	0.0000	958.8694
POTDUAL1	0.0000	2442.1816	0.0000	3316.6211	0.0000	2973.1355
POTDUAL2	0.0000	2152.4575	0.0000	2992.2415	0.0000	2269.8267
POTDUAL3	0.0000	1971.9971	0.0000	2790.1951	0.0000	1696.9150
VIN1	0.0000	2321.4890	0.0000	3136.4023	0.0000	3248.2981
VIN2	0.0000	2300.3406	0.0000	3112.7241	0.0000	3199.2922
VIN3	0.0000	2282.4006	0.0000	3092.6384	0.0000	3154.1157
GR0	0.0000	0.0000	0.0000	20.6838	0.0000	465.3083
GR50	0.0000	77.8475	0.0000	2.9062	0.0000	157.4841
GR75	0.0000	66.2155	7.0000	0.0000	0.0000	88.5344
GR125	0.0000	47.4145	0.0000	43.9110	0.0000	74.9385
GR200	0.0000	28.6659	0.0000	36.9343	0.0000	32.3702
GR375	0.0000	0.0000	0.0000	25.9186	0.0000	0.0000
SILAGE12	0.0000	164.4038	0.0000	34.5471	0.0000	314.0942
SILAGE27	0.0000	0.0000	0.4709	0.0000	0.0000	165.9510
SILAGE30	0.0000	30.8279	0.0000	75.3695	0.8380	0.0000
HAY0	0.0000	256.4734	0.0000	229.1317	0.0000	368.6553
HAY50	0.0000	94.0016	0.0000	86.2478	0.0000	395.4399
HAY75	0.0000	69.6071	0.0000	64.6326	0.0000	191.0965
HAY125	0.0000	35.5392	0.0000	32.8118	0.0000	215.0070
HAY200	0.0000	0.0000	0.3091	0.0000	0.0000	125.0549
FMAIZE1	0.0000	483.4702	0.0000	284.2833	0.0000	1361.1471
FMAIZE2	0.0000	543.0028	0.0000	212.8191	0.0000	1106.9886
FMAIZE3	0.0000	405.0278	0.0000	141.5239	0.0000	852.8312
FMAIZEP1	0.0000	828.3396	0.0000	487.3057	0.0000	1808.9354

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
	315201.8000		71507.4500		159203.0000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FMAIZEP2	0.0000	880.0186	0.0000	401.5484	0.0000	1554.5884
FMAIZEP3	0.0000	734.2086	0.0000	315.9943	0.0000	1300.2427
SWEDESGR	0.0000	36.2127	0.0000	389.4109	0.0000	37.3891
TURNIPSG	0.0000	0.0000	0.0000	358.7884	1.0704	0.0000
KALEAGEd	0.0000	279.5328	0.0000	320.0628	0.0000	841.1763
KALEAGEB	0.0000	103.7958	0.0000	171.4545	0.0000	659.7305
RapeBroa	0.0000	6.9478	0.0000	131.5115	0.0000	395.3370
RapeDril	0.0000	0.0000	0.0000	125.6362	0.0000	388.1635
RapeDD	0.0000	74.3203	0.0000	188.4836	0.0000	501.4177
Fbeet1	0.0000	176.5064	0.0000	145.6202	0.0000	680.5465
Fbeet2	0.0000	96.4920	0.0000	0.0000	0.0000	339.0755
Fbeet3	0.0000	116.1824	0.0000	35.8350	0.0000	0.0000
LLB120	0.0000	15.6146	0.0000	11.8462	0.0000	21.6145
LLBE140	0.0000	16.9399	0.0000	6.3114	0.0000	17.6156
LLBE180	0.0000	21.0809	0.0000	3.3008	0.0000	16.5676
CBE140	0.0000	26.9447	0.0000	17.5320	0.0000	36.6047
CBE160	0.0000	26.9355	0.0000	14.4753	0.0000	32.3879
CBE180	0.0000	28.0079	0.0000	15.3025	0.0000	31.6419
WINFINMK	0.0000	0.0000	0.0000	0.0000	133.8040	0.0000
WINFINLK	0.0000	4.4648	0.0000	2.6960	0.0000	2.9913
WINFINBF	0.0000	21.2336	0.0000	24.0760	0.0000	18.9466
WINFINSK	0.0000	17.4567	0.0000	16.2251	0.0000	21.4191
AFLGR	0.0000	29.2275	0.0000	41.1486	0.0000	23.7654
GIMMERIN	0.0000	120.0471	0.0000	116.5022	0.0000	141.0219
INDOORLA	0.0000	44.9515	0.0000	71.5043	0.0000	56.0763
LLSUCKNJ	0.0000	222.3063	0.0000	183.6982	0.0000	374.9677
LLSUCKFA	0.0000	270.4591	0.0000	227.6597	0.0000	405.8062
LLSUCKMJ	0.0000	195.6335	0.0000	168.7402	0.0000	285.5968
LLSUCKAO	0.0000	199.1298	0.0000	168.9252	0.0000	291.4181
18MthST	0.0000	143.3775	9.6720	0.0000	0.0000	199.9910
18mthHF	0.0000	188.5717	0.0000	76.5843	0.0000	288.5903
24mthFr	0.0000	1.1460	0.0000	1.2831	0.0000	1.3676
24mthB	0.0000	0.0000	5.9228	0.0000	0.0000	0.0000
Owscsbst	0.0000	59.7868	0.0000	161.6699	0.0000	119.7641
Owscsbhf	0.0000	115.6419	0.0000	224.5929	0.0000	187.4896
Owscwbst	0.0000	76.6718	0.0000	184.7317	0.0000	135.4658
Owscwbhf	0.0000	208.9859	0.0000	333.1930	0.0000	299.8129
WFLFDBST	0.0000	104.7136	0.0000	247.8145	0.0000	149.8728
WFMFDBST	0.0000	133.8204	0.0000	274.1950	0.0000	182.6640
WFSCST	0.0000	68.6953	0.0000	203.3640	0.0000	107.0811
WFSCHF	0.0000	144.4669	0.0000	286.4121	0.0000	196.1897
BSDBXSTL	0.0000	87.6539	0.0000	133.7775	0.0000	266.9177
BSDBXSTM	0.0000	109.2433	0.0000	160.4919	0.0000	248.1851
OWSCSTWB	0.0000	118.4673	0.0000	170.2263	0.0000	269.5594
OWSCHFWB	0.0000	108.6377	0.0000	159.9954	0.0000	247.5531
OWSCSTSB	0.0000	118.4673	0.0000	170.2263	0.0000	269.5594
OWSCHFSB	0.0000	108.6377	0.0000	159.9954	0.0000	247.5531
OWMJST	0.0000	118.4673	0.0000	170.2263	0.0000	269.5594
OWMJHF	0.0000	108.6377	0.0000	159.9954	0.0000	247.5531
RYCSBMST	0.0000	198.6969	0.0000	231.0900	0.0000	257.3188
RYCSBLST	0.0000	217.8660	0.0000	252.5521	0.0000	280.1954
RYCABMST	0.0000	120.8598	0.0000	152.8844	0.0000	140.4561
RYCABLST	0.0000	136.0700	0.0000	169.9141	0.0000	158.6082
WFLFBST	0.0000	74.8491	0.0000	203.7976	0.0000	130.4392
SFLFBST	0.0000	171.8969	0.0000	184.7774	0.0000	330.8790
IBBFCF	0.0000	42.6547	0.0000	43.9027	0.0000	139.2916
IBBBXSF	0.0000	263.0396	0.0000	559.5717	0.0000	185.5875
IBBSCCF	0.0000	0.0000	15.1113	0.0000	0.0000	117.1147
IBBSCSF	0.0000	195.5115	0.0000	421.4934	0.0000	185.8854

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
	315201.8000		71507.4500		159203.0000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
BPIG3WKW	123.2272	0.0000	42.6504	0.0000	112.4787	0.0000
BPIG4WKW	282.0454	0.0000	45.0969	0.0000	108.1352	0.0000
BPIGOUT	0.0000	74.3389	0.0000	5.8573	0.0000	0.0000
FPIGPORK	0.0000	38.9776	0.0000	30.5218	0.0000	45.1805
FPIGCUT	0.0000	12.9300	0.0000	3.5768	0.0000	15.9382
FPIGBAC	2343.2280	0.0000	418.9765	0.0000	393.8173	0.0000
FPIGHEA	0.0000	9.2119	99.7688	0.0000	0.0000	10.3307
PULREAR	0.0000	3.9232	0.0000	7.9327	0.0000	7.5202
EGGCAGE	0.0000	15.2779	0.0000	19.2186	0.0000	17.3777
EGGRANGE	0.0000	0.0000	0.0000	11.1227	0.0000	9.9571
EBARN	0.0000	6.2893	0.0000	0.0000	2220.7493	0.0000
CHBROILE	0.0000	5.2173	0.0000	9.8739	0.0000	9.3275
TFFthen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
tfftstag	0.0000	2.0382	0.0000	1.5283	0.0000	1.2420
PPOUT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FCOSTS	35267.4688	0.0000	10914.7559	0.0000	23905.5801	0.0000
EEIQ	7702.1240	0.0000	2010.8794	0.0000	6604.9414	0.0000
CEIQ	11564.8643	0.0000	2597.4485	0.0000	8654.5391	0.0000
WEIQ	13760.3311	0.0000	2844.6340	0.0000	10597.0342	0.0000
TPest	180.4744	0.0000	39.0013	0.0000	140.1695	0.0000
Herb	60.5760	0.0000	22.0740	0.0000	56.9794	0.0000
Insectic	3.0884	0.0000	0.7492	0.0000	6.3035	0.0000
Fungicid	116.9169	0.0000	16.1781	0.0000	76.8866	0.0000
Growth	0.0000	83.9181	0.0000	126.6156	0.0000	136.2139
STBO	149820.0000	0.0000	39820.0000	0.0000	91890.0000	0.0000
LOSS	230592.2344	0.0000	36869.9297	0.0000	88408.2734	0.0000
TOTLAB	37953.8320	0.0000	8878.5186	0.0000	8676.3379	0.0000
SOILIND	98.3302	0.0000	49.2912	0.0000	70.1926	0.0000
LSU	0.0000	0.0000	18.1274	0.0000	2.6761	0.0000
MAIZEFOD	0.0000	0.0140	0.0000	0.0000	0.0000	0.0012
FOD	0.0000	0.0000	2658.2678	0.0000	3209.3354	0.0000
Weaner	0.0000	2.5208	0.0000	0.5576	0.0000	0.0000

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	103914.000		52558.1300		87101.2300		28611.7900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	2.4666	0.0000	0.0000	3010.6235	0.0000	713.9791	0.0998	0.0000
CJAN	0.0000	7.8700	0.0000	7.8700	0.0000	7.8700	0.0000	7.8700
CFEB	0.0000	7.8700	0.0000	7.8700	0.0000	7.8700	0.0000	7.8700
CMAR	97.5564	0.0000	325.4558	0.0000	0.0000	2.4065	64.4905	0.0000
CAPR	0.0000	3.8612	0.0000	1.3886	0.0000	7.8700	6.2555	0.0000
CMAY	0.0000	7.8700	0.0000	7.8700	0.0000	7.8700	0.0000	7.8700
CJUN	86.3584	0.0000	0.0000	7.8700	102.7717	0.0000	9.2104	0.0000
CJUL	0.0000	7.8700	0.0000	7.8700	0.0000	7.8700	0.0000	7.8700
CAUG	91.7543	0.0000	202.6125	0.0000	74.0004	0.0000	28.7875	0.0000
CSEP	410.8481	0.0000	675.6755	0.0000	289.1271	0.0000	149.8589	0.0000
COCT	34.7117	0.0000	214.7788	0.0000	152.1847	0.0000	92.7924	0.0000
CNOV	0.0000	1.8385	0.0000	7.8700	79.1733	0.0000	21.7295	0.0000
CDEC	23.8780	0.0000	0.0000	7.8700	71.7685	0.0000	0.0000	5.6997
BHAY	152.4369	0.0000	153.1773	0.0000	0.8198	0.0000	34.2235	0.0000
BBAR	57.0278	0.0000	0.0000	9.6724	0.0000	29.7388	0.0000	19.7764
SBAR	0.0000	0.0000	23.5530	0.0000	0.0000	15.3056	0.0000	3.7481
USLYCat	0.0000	10.7119	0.0000	14.5093	0.0000	1.8732	0.0000	16.3370
UFYMCat	304.2000	0.0000	304.2000	0.0000	39.9345	0.0000	58.0769	0.0000

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	103914.000		52558.1300		87101.2300		28611.7900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
BUYN	23645.1797	0.0000	12495.3896	0.0000	13677.4199	0.0000	4521.7759	0.0000
BUYP	8971.0635	0.0000	7068.1064	0.0000	6546.9785	0.0000	2327.0508	0.0000
BUYK	10446.4492	0.0000	6847.6382	0.0000	8101.3755	0.0000	2655.7446	0.0000
bHeifers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SSLambs	0.0000	0.0000	0.0000	3.6540	0.0000	17.0168	0.0000	0.0000
bSLambs	284.0557	0.0000	96.5960	0.0000	0.0000	0.0000	0.0000	8.8870
sGimmers	0.0000	0.0000	0.0000	7.5230	0.0000	0.0000	0.0000	18.2968
bGimmers	47.7560	0.0000	0.0000	0.0000	0.0000	35.0346	0.0000	0.0000
bwSTRAW	9.0000	0.0000	9.0000	0.0000	1.1815	0.0000	1.7183	0.0000
bBSTRAW	0.0000	5.0115	0.0000	5.7747	0.0000	9.7049	0.0000	8.9976
bOSTRAW	0.0000	5.0115	0.0000	5.7747	0.0000	9.7049	0.0000	8.9976
WW1	0.0000	184.0862	0.0000	210.6361	0.0000	292.2331	0.0000	309.3030
WW2	0.0000	193.5027	0.0000	215.8434	0.0000	285.6228	0.0000	328.1818
WW3	0.0000	222.4740	0.0000	252.7578	0.0000	425.7269	0.0000	383.8066
BWW1	0.0000	5.2069	4.1839	0.0000	20.4512	0.0000	7.7034	0.0000
BWW2	68.7900	0.0000	41.1561	0.0000	38.3588	0.0000	12.3066	0.0000
BWW3	0.0000	19.8705	0.0000	14.1751	0.0000	94.7444	0.0000	33.4661
MSBAR1	0.0000	130.5821	0.0000	234.6364	0.0000	139.4653	0.0000	141.2217
MSBAR2	0.0000	106.2214	0.0000	219.8988	0.0000	97.3385	0.0000	106.5950
MSBAR3	0.0000	104.6127	0.0000	215.4053	0.0000	114.0703	0.0000	90.0105
WB125	0.0000	19.6745	11.9755	0.0000	0.0000	1.7355	0.0000	5.1227
WB180	0.0000	34.7790	0.0000	26.2201	0.2637	0.0000	0.0000	45.9896
WB225	0.0000	72.8060	0.0000	83.4243	0.0000	160.9507	0.0000	140.2533
SBAR75	0.0000	146.4729	0.0000	104.8531	0.0000	8.4027	1.3982	0.0000
SBAR100	0.0000	151.6247	0.0000	121.9070	0.6662	0.0000	0.0000	15.1529
SBAR125	0.0000	179.7511	0.0000	149.9702	0.0000	54.5038	0.0000	54.6153
WO50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
WO100	0.0000	18.4021	0.0000	27.7794	0.0000	59.1387	0.0000	46.9398
WO125	0.0000	52.0692	0.0000	70.7680	0.0000	139.1933	0.0000	116.2133
SO50	0.0000	151.6448	0.0000	109.1674	0.0000	137.2773	0.0000	177.8298
SO100	0.0000	170.0469	0.0000	136.9468	0.0000	224.0734	0.0000	171.3656
SO125	0.0000	203.7139	0.0000	179.9459	0.0000	254.5894	0.0000	294.0584
RYE1	0.0000	87.2045	0.0000	82.6658	0.0000	111.2229	0.0000	120.6661
RYE2	0.0000	95.5586	0.0000	98.1555	0.0000	146.3873	0.0000	147.4823
RYE3	0.0000	111.4219	0.0000	114.8252	0.0000	177.9306	0.0000	174.4915
TRIT150	0.0000	50.5206	0.0000	44.3284	0.0000	58.5008	0.0000	64.3704
TRIT180	0.0000	55.8879	0.0000	54.1617	0.0000	85.8865	0.0000	82.8808
TRIT200	0.0000	70.9393	0.0000	72.5179	0.0000	119.7490	0.0000	112.3664
WOSR150	0.0000	117.9462	0.0000	220.2747	0.0000	225.1737	0.0000	271.5395
WOSR185	0.0000	137.2954	0.0000	280.4556	0.0000	347.9089	0.0000	381.1656
WOSR225	0.0000	172.9319	0.0000	296.3179	0.0000	340.1497	0.0000	396.1814
SOSR90	0.0000	152.8947	0.0000	238.9119	0.0000	201.7381	0.0000	305.0373
SOSR110	0.0000	195.8029	0.0000	270.0917	0.0000	292.7134	0.0000	382.7881
SOSR130	0.0000	249.3956	0.0000	355.0277	0.0000	411.5191	0.0000	490.2557
LIN50	0.0000	314.8603	0.0000	411.4049	0.0000	554.6982	0.0000	669.1091
LIN80	0.0000	320.0272	0.0000	419.3189	0.0000	573.8330	0.0000	683.1533
LIN120	0.0000	331.9193	0.0000	434.2614	0.0000	602.6335	0.0000	707.5183
SFB20K	0.0000	54.6450	18.9728	0.0000	0.0000	49.8094	0.0000	28.4887
SFB40K	0.0000	18.4823	17.6018	0.0000	0.0000	4.2427	5.4543	0.0000
SFB60K	31.7988	0.0000	16.8246	0.0000	16.7065	0.0000	5.1967	0.0000
SETSC	0.0000	38.9581	0.0000	6449.4707	0.0000	73.3562	0.0000	77.0750
SETNR	6.3300	0.0000	0.0000	6404.6753	77.1075	0.0000	20.6108	0.0000
WORSA100	0.0000	216.4725	6.9100	0.0000	0.0000	472.0444	0.0000	520.6740
WORSA140	0.0000	253.4370	0.0000	52.5862	0.0000	624.8383	0.0000	618.9594
WORSA180	0.0000	304.4237	0.0000	112.0333	0.0000	678.4543	0.0000	700.5562
SORSA60	0.0000	248.1887	0.0000	17.7790	0.0000	458.6001	0.0000	554.6741
SORSA85	0.0000	268.9863	0.0000	37.6100	0.0000	480.8737	0.0000	588.4600
SORSA110	0.0000	298.9849	0.0000	80.5481	0.0000	576.6989	0.0000	656.1772

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C)	103914.000		52558.1300		87101.2300		28611.7900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SBEET1	0.0000	80.4039	0.0000	133.2957	0.0000	266.1569	0.0000	236.4590
SBEET2	0.0000	37.6361	0.0000	163.8778	0.0000	289.3409	0.0000	288.3378
SBEET3	0.0000	35.6817	0.0000	101.0254	0.0000	242.7328	0.0000	203.0151
POTEW1	0.0000	2917.0449	0.0000	3886.3535	0.0000	2501.6191	0.0000	2801.8538
POTEW2	0.0000	2431.6504	0.0000	3349.5725	0.0000	2282.0432	0.0000	2538.4573
POTEW3	0.0000	2068.7217	0.0000	2945.4133	0.0000	2007.1509	0.0000	2265.7417
PTMCW140	0.0000	4409.9199	0.0000	4868.2036	0.0000	2893.3997	0.0000	3154.0085
PTMCW180	0.0000	3957.8384	0.0000	4452.4092	0.0000	2642.8054	0.0000	2983.5825
PTMCW220	0.0000	3708.6086	0.0000	4095.6257	0.0000	2632.2266	0.0000	2853.8098
PMCWBPP1	0.0000	3810.8757	0.0000	4208.2544	0.0000	2406.3784	0.0000	2692.0962
PMCWBPP2	0.0000	3299.0305	0.0000	3641.5386	0.0000	2152.9778	0.0000	2395.8955
PMCWBPP3	0.0000	3015.7075	0.0000	3329.4424	0.0000	2063.8516	0.0000	2275.1040
PTPOF1	0.0000	4348.1362	0.0000	4765.6997	0.0000	2609.6125	0.0000	3012.2256
PTPOF2	0.0000	3952.4387	0.0000	4328.7168	0.0000	2449.9575	0.0000	2813.8313
PTPOF3	0.0000	3744.6038	0.0000	4101.0508	0.0000	2425.3486	0.0000	2759.6362
PTPEXST1	0.0000	3416.4971	0.0000	3763.7749	0.0000	2108.0642	0.0000	2384.9421
PTPEXST2	0.0000	2888.0630	0.0000	3178.8962	0.0000	1852.9905	0.0000	2084.6616
PTPEXST3	0.0000	2597.5688	0.0000	2859.1311	0.0000	1768.9614	0.0000	1967.0192
POTSEED1	0.0000	1243.3230	0.0000	1379.0953	0.0000	694.9782	0.0000	786.5563
POTSEED2	0.0000	458.2160	0.0000	507.4361	0.0000	229.9953	0.0000	267.8205
POTSEED3	0.0000	0.0000	0.0000	0.0000	0.3067	0.0000	0.9001	0.0000
POTDUAL1	0.0000	2689.4004	0.0000	2983.3298	0.0000	1716.5034	0.0000	1892.6221
POTDUAL2	0.0000	2048.3567	0.0000	2272.7197	0.0000	1372.1194	0.0000	1498.8479
POTDUAL3	0.0000	1685.1095	0.0000	1871.6310	0.0000	1227.4309	0.0000	1318.3048
SWEDE1	0.0000	4434.3027	0.0000	4960.8335	0.0000	1086.4347	0.0000	708.3774
SWEDE2	0.0000	4342.4751	0.0000	5419.9351	0.0000	1885.7789	0.0000	1660.8324
SWEDE3	0.0000	4275.6846	0.0000	4817.9116	0.0000	964.8617	0.0000	520.5237
CAB1	0.0000	4400.4927	0.0000	6089.1230	0.0000	1124.1472	0.0000	701.5646
CAB2	0.0000	4271.3223	0.0000	6036.1797	0.0000	2812.4875	0.0000	2033.7311
CAB3	0.0000	4175.6782	0.0000	6003.5972	0.0000	883.7459	0.0000	399.7525
CABWW1	0.0000	161.9559	0.0000	210.6024	5.7434	0.0000	1.7042	0.0000
CABWW2	6.4831	0.0000	2.1800	0.0000	3.8740	0.0000	1.1495	0.0000
CABWW3	6.0269	0.0000	0.0000	43.7963	5.3458	0.0000	1.5862	0.0000
VIN1	0.0000	31.1913	0.0000	31.9095	0.0000	1320.8174	0.0000	1387.6366
VIN2	0.0000	14.0522	0.0000	14.3416	0.0000	1297.7865	0.0000	1362.1710
VIN3	0.0000	0.0000	0.0000	0.0000	0.0000	1279.1924	0.0000	1341.4427
GR0	0.0000	263.2022	0.0000	18.0133	0.0000	162.8865	0.7452	0.0000
GR50	0.0000	55.8962	37.6643	0.0000	0.0000	4.9371	7.9548	0.0000
GR75	0.0000	38.4509	0.0000	13.0266	3.9700	0.0000	0.0000	25.5222
GR125	0.0000	11.2568	0.0000	28.4698	0.0000	8.8160	0.0000	53.6963
GR200	26.1951	0.0000	0.0000	63.4317	0.0000	32.9635	0.0000	112.2822
GR375	0.0000	10.4678	0.0000	149.6556	0.0000	119.1622	0.0000	252.9479
SILAGE12	0.0000	243.6698	0.0000	44.9541	0.0000	176.7454	0.0000	12.8409
SILAGE27	10.7061	0.0000	4.2982	0.0000	0.6761	0.0000	0.0000	0.0000
SILAGE30	0.0000	57.6343	0.0000	72.8928	0.0000	209.6574	0.0000	109.2887
HAY0	0.0000	519.0246	0.0000	99.3650	0.0000	401.5219	0.0000	212.6647
HAY50	0.0000	401.3683	0.0000	24.4167	0.0000	226.5199	0.0000	52.4730
HAY75	0.0000	418.0662	0.0000	52.8210	0.0000	266.0818	0.0000	89.1830
HAY125	0.0000	394.2453	0.0000	41.6408	0.0000	236.7830	0.0000	61.2431
HAY200	0.0000	403.8574	0.0000	68.7068	0.0000	270.5927	0.0000	93.1996
FMAIZE1	0.0000	446.8272	0.0000	28.8725	0.0000	659.6443	0.0000	0.0000
FMAIZE2	0.0000	489.3410	0.0000	124.9084	0.0000	708.1058	0.0000	152.4878
FMAIZE3	0.0000	558.5865	0.0000	47.3808	0.0000	767.3651	0.0000	24.5748
FMAIZEP1	0.0000	516.2877	0.0000	181.9189	0.0000	922.0610	0.0000	233.5191
FMAIZEP2	0.0000	544.2244	0.0000	268.8687	0.0000	955.8025	0.0000	371.3277
FMAIZEP3	0.0000	604.2396	0.0000	185.5876	0.0000	1005.7402	0.0000	234.1198
SWEDESGR	0.0000	420.6747	0.0000	135.2761	0.0000	390.0490	0.0000	282.8719
TURNIPSG	0.0000	403.4353	0.0000	115.4111	0.0000	356.6640	0.0000	251.9202

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C)	103914.000		52558.1300		87101.2300		28611.7900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
KALEAGEd	0.0000	215.0796	0.0000	136.1742	0.0000	224.0236	0.0000	216.7563
KALEAGEB	0.0000	131.4182	0.0000	39.7711	0.0000	62.0093	0.0000	66.5508
RapeBroa	0.0000	160.2965	0.0000	54.1529	0.0000	76.6782	0.0000	97.9753
RapeDril	0.0000	156.9889	0.0000	50.3416	0.0000	70.2729	0.0000	92.0369
RapeDD	0.0000	209.2084	0.0000	110.5141	0.0000	171.3984	0.0000	185.7916
Fbeet1	0.0000	0.0000	0.7728	0.0000	0.0000	0.0000	0.0000	0.0000
Fbeet2	0.0000	3.6525	0.0000	37.4021	0.0000	65.2257	0.0000	56.0291
Fbeet3	0.0000	30.7728	0.0000	89.4322	0.0000	154.1493	0.0000	135.6904
FRYE1	0.0000	400.7943	0.0000	306.5996	0.0000	521.0662	0.0000	441.0675
FRYE2	0.0000	430.2012	0.0000	337.0901	0.0000	572.3083	0.0000	488.5747
FRYE3	0.0000	453.7154	0.0000	367.5806	0.0000	623.5504	0.0000	536.0819
IRG1	0.0000	416.2695	0.0000	351.3318	0.0000	536.8016	0.0000	528.3095
IRG2	0.0000	465.7445	0.0000	415.5362	0.0000	637.6967	0.0000	629.7549
IRG3	0.0000	509.4475	0.0000	477.8858	0.0000	730.8037	0.0000	729.1099
FRAPECC1	0.0000	0.0000	0.0000	89.7585	0.0000	0.0000	0.0000	48.4455
FRAPECC2	0.0000	0.0000	0.0000	89.7585	0.0000	0.0000	0.0000	48.4455
FRAPECC3	2.2724	0.0000	0.0000	89.7585	0.0000	0.0000	0.0000	48.4455
TURNCC1	0.0000	1093.1058	0.0000	631.9025	0.0000	113.0626	0.0000	153.2673
TURNCC2	0.0000	1136.6053	0.0000	682.0270	0.0000	197.3015	0.0000	231.3663
TURNCC3	0.0000	1180.1049	0.0000	732.1516	0.0000	281.5404	0.0000	309.4653
MUSTCC1	0.0000	1422.2402	0.0000	866.6406	0.0000	556.8970	0.0000	578.2645
MUSTCC2	0.0000	1411.6158	0.0000	854.3982	0.0000	536.3226	0.0000	559.1896
MUSTCC3	0.0000	1400.9916	0.0000	842.1558	0.0000	515.7480	0.0000	540.1147
LLB120	0.0000	28.0306	0.0000	28.8431	0.0000	34.5051	0.0000	38.7221
LLBE140	0.0000	13.1383	0.0000	15.6411	0.0000	15.0212	0.0000	17.0762
LLBE180	170.5572	0.0000	0.0000	5.2698	0.0000	0.0000	0.0000	0.0000
CBE140	0.0000	45.6349	0.0000	43.7355	0.0000	52.2456	0.0000	64.3292
CBE160	0.0000	32.9812	0.0000	30.8182	0.0000	30.8580	0.0000	44.3690
CBE180	0.0000	25.2942	0.0000	23.1190	0.0000	17.5420	0.0000	32.5644
WINFINMK	284.0557	0.0000	96.5960	0.0000	0.0000	11.5909	0.0000	43.8524
WINFINLK	0.0000	3.8530	0.0000	6.0972	0.0000	17.9628	0.0000	47.0649
WINFINBF	0.0000	11.9961	0.0000	20.4565	0.0000	41.3516	0.0000	58.8993
WINFINSK	0.0000	17.8531	0.0000	15.6255	0.0000	37.1495	0.0000	63.6487
AFLGR	0.0000	26.8798	0.0000	27.6609	0.0000	33.8834	0.0000	81.8324
GIMMERIN	0.0000	36.7254	0.0000	21.8396	0.0000	56.2777	0.0000	33.4133
INDOORLA	0.0000	40.0161	0.0000	42.4523	0.0000	65.2769	0.0000	79.2755
HREA26	0.0000	441.8481	0.0000	450.6207	0.0000	477.6136	0.0000	606.7046
HRA30	0.0000	459.2409	0.0000	470.6624	0.0000	458.5057	0.0000	637.9315
HRA36	0.0000	414.9514	0.0000	419.6275	0.0000	370.9772	0.0000	558.4141
HRS30	0.0000	425.6434	0.0000	431.9480	0.0000	418.9576	0.0000	577.6107
HRS36	0.0000	427.8219	0.0000	434.4583	0.0000	389.7430	0.0000	581.5220
Dsp5000	0.0000	445.5488	0.0000	435.9729	0.0000	497.8213	0.0000	611.6108
Dsum5000	0.0000	375.9189	0.0000	360.9507	0.0000	382.8545	0.0000	499.2745
DAut5000	0.0000	481.1302	0.0000	479.5527	0.0000	578.7382	0.0000	681.7668
DAll5000	0.0000	458.5786	0.0000	453.2441	0.0000	533.5645	0.0000	640.4936
Dsp8000	0.0000	22.1212	0.0000	17.1505	0.0000	8.3995	0.0000	19.4330
Dsum8000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAut8000	0.0000	34.7500	0.0000	35.8296	0.0000	52.0749	0.0000	52.1440
DAll8000	0.0000	14.0026	0.0000	11.4065	0.0000	9.4941	0.0000	13.6394
LLSUCKNJ	0.0000	126.6500	0.0000	127.4768	0.0000	221.2532	0.0000	228.4854
LLSUCKFA	0.0000	186.6098	0.0000	189.7194	0.0000	317.8695	0.0000	319.1420
LLSUCKMJ	0.0000	103.4667	0.0000	106.6166	0.0000	181.9831	0.0000	201.5120
LLSUCKAO	0.0000	76.9484	0.0000	77.2536	0.0000	144.8951	0.0000	156.3927
18MthST	0.0000	6.2530	0.0000	0.0000	7.2604	0.0000	0.0000	27.0597
18mthHF	0.0000	31.5624	0.0000	62.2872	0.0000	79.7133	0.0000	113.2230
24mthFr	0.0000	1.1025	0.0000	1.1522	0.0000	1.5846	0.0000	1.6920
24mthB	83.7824	0.0000	90.0000	0.0000	4.5546	0.0000	17.1825	0.0000
Owscsbst	0.0000	79.2761	0.0000	100.6241	0.0000	114.0209	0.0000	177.7564

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	103914.000		52558.1300		87101.2300		28611.7900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
Owscsbhf	0.0000	104.4710	0.0000	158.3016	0.0000	187.0601	0.0000	257.2361
Owscwbst	0.0000	98.4635	0.0000	121.2969	0.0000	141.7326	0.0000	208.8982
Owscwbhf	0.0000	199.3416	0.0000	258.1270	0.0000	323.5078	0.0000	404.5884
WFLFDBST	0.0000	121.4537	0.0000	193.9570	0.0000	173.9208	0.0000	233.5951
WFMFDBST	0.0000	107.2432	0.0000	183.4344	0.0000	189.2025	0.0000	249.6832
WFSCST	0.0000	128.6439	0.0000	186.8010	0.0000	221.2354	0.0000	283.9406
WFSCHF	0.0000	110.0396	0.0000	175.2873	0.0000	190.3266	0.0000	252.9298
BSDBXSTL	0.0000	137.7594	0.0000	80.0485	0.0000	97.3167	0.0000	140.6554
BSDBXSTM	0.0000	113.2568	0.0000	106.9674	0.0000	128.4154	0.0000	175.0590
OWSCSTWB	0.0000	125.2398	0.0000	114.8576	0.0000	139.6188	0.0000	186.7487
OWSCHFWB	0.0000	108.8693	0.0000	102.6595	0.0000	121.3733	0.0000	168.4423
OWSCSTSB	0.0000	125.2398	0.0000	114.8576	0.0000	139.6188	0.0000	186.7487
OWSCHFSB	0.0000	108.8693	0.0000	102.6595	0.0000	121.3733	0.0000	168.4423
OWMJST	0.0000	125.2398	0.0000	114.8576	0.0000	139.6188	0.0000	186.7487
OWMJHF	0.0000	108.8693	0.0000	102.6595	0.0000	121.3733	0.0000	168.4423
RYCSBMST	0.0000	147.7677	0.0000	157.4804	0.0000	257.5388	0.0000	268.6227
RYCSBLST	0.0000	166.2099	0.0000	176.7539	0.0000	284.0439	0.0000	296.9244
RYCABMST	6.2176	0.0000	0.0000	72.2957	0.0000	70.0370	0.0000	154.7526
RYCABLST	0.0000	14.6335	0.0000	87.5888	0.0000	91.0682	0.0000	177.2094
WFLFBST	0.0000	75.7193	0.0000	120.3995	0.0000	138.0195	0.0000	205.2143
SFLFBST	0.0000	262.1474	0.0000	140.2408	0.0000	325.2648	0.0000	199.9493
IBBFCF	0.0000	114.3041	0.0000	192.6121	0.0000	285.5579	0.0000	323.5652
IBBBXSF	0.0000	186.1689	0.0000	257.1389	0.0000	224.2279	0.0000	440.4755
IBBSCCF	0.0000	110.4577	0.0000	180.3785	0.0000	239.6551	0.0000	296.1862
IBBSCSF	0.0000	173.0518	0.0000	230.3538	0.0000	199.8542	0.0000	388.3916
CRFBFsl	0.0000	110.3783	0.0000	172.1553	0.0000	290.6843	0.0000	295.3997
CRMBBFsl	0.0000	114.3875	0.0000	176.3452	0.0000	296.4462	0.0000	301.5522
CRLBBFsl	0.0000	118.3966	0.0000	180.5351	0.0000	302.2082	0.0000	307.7047
CRFALstl	0.0000	136.0134	0.0000	204.7039	0.0000	354.3417	0.0000	348.7437
CRFBFhfl	0.0000	110.3783	0.0000	172.1553	0.0000	290.6843	0.0000	295.3997
CRMBBFhl	0.0000	114.3875	0.0000	176.3452	0.0000	296.4462	0.0000	301.5522
CRLBBFhl	0.0000	118.3966	0.0000	180.5351	0.0000	302.2082	0.0000	307.7047
CRFALhfl	0.0000	136.0134	0.0000	204.7039	0.0000	354.3417	0.0000	348.7437
FCOSTS	70774.2500	0.0000	69142.6250	0.0000	55909.5313	0.0000	24073.7012	0.0000
EEIQ	22526.8145	0.0000	17581.8418	0.0000	24632.5605	0.0000	8954.1045	0.0000
CEIQ	26272.2695	0.0000	23137.6055	0.0000	24355.6270	0.0000	9183.9941	0.0000
WEIQ	34584.3789	0.0000	35752.4375	0.0000	28880.5449	0.0000	11942.1475	0.0000
TPest	459.9547	0.0000	423.7324	0.0000	416.4124	0.0000	161.0780	0.0000
Herb	167.3567	0.0000	138.7007	0.0000	182.6617	0.0000	66.9975	0.0000
Insectic	14.6967	0.0000	8.9844	0.0000	14.3262	0.0000	6.1288	0.0000
Fungicid	278.5892	0.0000	276.5008	0.0000	220.0127	0.0000	88.1518	0.0000
Growth	0.0000	121.4213	0.0000	86.9894	0.0000	169.5884	0.0000	142.6790
STBO	0.0000	0.0623	135.4477	0.0000	25659.0879	0.0000	0.0000	0.3367
LOSS	115984.117	0.0000	46594.5859	0.0000	45351.0273	0.0000	13456.4268	0.0000
TOTLAB	27897.3672	0.0000	11163.7715	0.0000	6052.2324	0.0000	3827.5627	0.0000
SOILIND	355.9922	0.0000	387.4942	0.0000	480.9248	0.0000	182.2295	0.0000
LSU	102.3321	0.0000	73.9319	0.0000	8.3629	0.0000	13.7460	0.0000
MAIZEFOD	0.0000	0.0350	7092.1157	0.0000	0.0000	0.0371	0.0000	0.0027
FOD	37562.0352	0.0000	16159.0488	0.0000	2541.6248	0.0000	0.0000	0.0192
AW	1542.9160	0.0000	540.4688	0.0000	35.4448	0.0000	51.5476	0.0000
BSP	6.2176	0.0000	0.0000	27.9812	7.2604	0.0000	0.0000	0.0000
BSPFULL	83.7824	0.0000	90.0000	0.0000	4.5546	0.0000	17.1825	0.0000

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	60510.1100		49196.3900		55959.7000		80296.3800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	1.4841	0.0000	1.1099	0.0000	2.3795	0.0000	3.1785	0.0000
CJAN	0.0000	9.2300	0.0000	9.2300	0.0000	0.0000	0.0000	9.2300
CFEB	0.0000	2.9605	0.0000	9.2300	0.0000	6.7118	0.0000	9.2300
CMAR	102.0446	0.0000	125.4953	0.0000	178.9946	0.0000	0.0000	6.7118
CAPR	99.0376	0.0000	81.8443	0.0000	206.2319	0.0000	64.1956	0.0000
CMAY	190.9166	0.0000	138.7808	0.0000	410.2799	0.0000	170.1369	0.0000
CJUN	188.0478	0.0000	159.7400	0.0000	332.2211	0.0000	116.5244	0.0000
CJUL	143.7722	0.0000	137.7363	0.0000	249.5166	0.0000	13.3181	0.0000
CAUG	35.0204	0.0000	5.7005	0.0000	32.1423	0.0000	237.9005	0.0000
CSEP	0.0000	9.2300	0.0000	9.2300	0.0000	9.2300	106.9477	0.0000
COCT	0.0000	3.7512	42.5940	0.0000	0.0000	9.2300	158.0900	0.0000
CNOV	0.0000	9.2300	0.0000	6.7118	0.0000	9.2300	0.0000	9.2300
CDEC	0.0000	9.2300	0.0000	9.2300	0.0000	9.2300	0.0000	9.2300
BHAY	150.8442	0.0000	119.4607	0.0000	34.8484	0.0000	0.0000	0.0000
BBAR	0.0000	91.0697	0.0000	117.9610	0.0000	148.0425	0.0000	110.0167
SBAR	37.5386	0.0000	0.0000	0.0000	3.9829	0.0000	363.3204	0.0000
USLYCat	2110.6848	0.0000	1799.7870	0.0000	2142.7341	0.0000	2071.7642	0.0000
UFYMCat	135.7851	0.0000	15.0518	0.0000	664.8668	0.0000	566.4482	0.0000
BUYN	4839.2583	0.0000	7144.7451	0.0000	9050.6494	0.0000	17343.8555	0.0000
BUYP	482.5508	0.0000	1243.6581	0.0000	2976.3879	0.0000	4663.4819	0.0000
BUYK	0.0000	0.4943	0.0000	0.8907	0.0000	0.6377	0.0000	0.5218
bHeifers	0.0000	1719.2651	0.0000	3098.1860	0.0000	2218.1956	0.0000	1815.1229
SSLambs	0.0000	9.4340	0.0000	18.6712	0.0000	1.7593	0.0000	0.0000
bSLambs	0.0000	14.3159	0.0000	12.7700	0.0000	54.1679	0.0000	40.5657
sGimmers	0.0000	36.8589	0.0000	64.7318	0.0000	37.2227	0.0000	27.0371
bGimmers	0.0000	12.0381	0.0000	0.0000	0.0000	77.9214	0.0000	56.4806
bwSTRAW	4.0173	0.0000	0.4453	0.0000	19.6706	0.0000	16.7588	0.0000
bBSTRAW	0.0000	10.7454	0.0000	19.3637	0.0000	13.8637	0.0000	11.3445
bOSTRAW	0.0000	10.7454	0.0000	19.3637	0.0000	13.8637	0.0000	11.3445
WW1	0.0000	32.3261	0.0000	515.2037	0.0000	95.9828	0.0000	21.6805
WW2	0.0000	154.6115	0.0000	600.7084	0.0000	214.8689	0.0000	90.6494
WW3	0.0000	151.8168	0.0000	682.0883	0.0000	319.1947	0.0000	162.3916
BWW1	1.6200	0.0000	0.0000	0.0000	1.2800	0.0000	10.1800	0.0000
BWW2	0.0000	124.7759	0.0000	51.9162	0.0000	105.7694	0.0000	54.6215
BWW3	0.0000	89.1502	0.0000	98.5288	0.0000	192.8733	0.0000	112.7905
MSBAR1	0.0000	110.5076	0.0000	545.3201	0.0000	122.2094	0.0000	176.6253
MSBAR2	0.0000	220.0224	0.0000	742.3768	0.0000	293.2463	0.0000	293.3878
MSBAR3	0.0000	190.7309	0.0000	678.8210	0.0000	305.9361	0.0000	303.7005
WB125	6.7882	0.0000	0.0000	759.5907	7.9500	0.0000	0.0000	62.0538
WB180	0.0000	130.9797	0.0000	711.0910	0.0000	42.4071	69.4935	0.0000
WB225	0.0000	22.9777	0.0000	794.4600	0.0000	62.4381	0.0000	117.8493
SBAR75	0.0000	96.2957	0.0000	888.5239	0.0000	149.4539	0.0000	119.4096
SBAR100	0.0000	159.0898	0.0000	999.8373	0.0000	236.5781	0.0000	194.3785
SBAR125	0.0000	152.8306	0.0000	984.4186	0.0000	243.1113	0.0000	205.2898
WO50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
WO100	0.0000	15.6339	0.0000	5.9182	0.0000	26.1213	0.0000	23.1937
WO125	0.0000	58.7197	0.0000	73.6844	0.0000	96.7128	0.0000	71.6498
SO50	0.0000	147.3353	0.0000	805.5851	0.0000	141.9111	0.0000	25.5699
SO100	0.0000	137.4769	0.0000	839.0083	0.0000	154.1874	0.0000	62.8461
SO125	0.0000	223.1089	0.0000	909.6580	0.0000	261.1674	0.0000	115.3278
WOSR150	0.0000	345.0849	0.0000	945.1260	0.0000	309.3268	0.0000	327.4750
WOSR185	0.0000	376.9103	0.0000	967.1130	0.0000	398.1328	0.0000	356.3204
WOSR225	0.0000	417.0600	0.0000	1052.9169	0.0000	423.0136	0.0000	412.9189
SOSR90	0.0000	210.3017	0.0000	768.5759	0.0000	69.7112	0.0000	148.1875
SOSR110	0.0000	315.4986	0.0000	914.7404	0.0000	170.1645	0.0000	244.6216
SOSR130	0.0000	397.0988	0.0000	1087.9764	0.0000	276.1668	0.0000	352.8288
LIN50	0.0000	569.4113	0.0000	1319.5146	0.0000	480.4980	0.0000	422.8831
LIN80	0.0000	651.8889	0.0000	1467.9962	0.0000	587.0496	0.0000	510.0224
LIN120	0.0000	698.0330	0.0000	1539.5942	0.0000	657.5672	0.0000	563.7261

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	60510.1100		49196.3900		55959.7000		80296.3800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SFB20K	0.0000	350.0135	0.0000	928.9523	0.0000	263.7910	0.0000	235.7012
SFB40K	0.0000	319.8621	0.0000	851.2251	0.0000	247.1225	0.0000	213.9641
SFB60K	0.0000	342.0381	0.0000	887.1305	0.0000	279.5894	0.0000	239.1271
SETSC	0.0000	105.0467	0.0000	1491.7119	0.0000	141.3763	0.0000	103.9199
SETNR	1.0000	0.0000	0.0000	1321.2117	0.4200	0.0000	4.0000	0.0000
WORSA100	0.0000	292.9839	0.0000	1239.0016	0.0000	375.7541	0.0000	390.9158
WORSA140	0.0000	356.5474	0.0000	1324.4293	0.0000	498.2460	0.0000	452.4493
WORSA180	0.0000	407.7725	0.0000	1425.6188	0.0000	543.0870	0.0000	520.8374
SORSA60	0.0000	241.6499	0.0000	1217.9154	0.0000	251.7225	0.0000	297.5357
SORSA85	0.0000	315.9827	0.0000	1347.0668	0.0000	335.8344	0.0000	378.0841
SORSA110	0.0000	373.4850	0.0000	1440.6039	0.0000	435.9615	0.0000	443.1443
SBEET1	0.0000	224.0670	0.0000	704.5687	0.0000	235.9650	0.0000	191.3960
SBEET2	0.0000	161.5661	0.0000	554.7341	0.0000	190.6866	0.0000	141.4665
SBEET3	0.0000	142.9269	0.0000	497.7130	0.0000	188.9085	0.0000	131.9004
POTEW1	0.0000	1759.5431	0.0000	4021.1924	0.0000	1373.3263	0.0000	1598.3943
POTEW2	0.0000	1602.3860	0.0000	3632.5608	0.0000	1242.0652	0.0000	1462.3881
POTEW3	0.0000	1367.3556	0.0000	3143.3354	0.0000	977.6972	0.0000	1232.8920
PTMCW140	0.0000	1979.3149	0.0000	4509.9888	0.0000	1646.0471	0.0000	1802.2051
PTMCW180	0.0000	1879.7107	0.0000	4242.6494	0.0000	1471.7468	0.0000	1721.9727
PTMCW220	0.0000	1810.1630	0.0000	4038.9109	0.0000	1501.5604	0.0000	1670.7947
PMCWBPP1	0.0000	1697.3757	0.0000	3871.3479	0.0000	1322.8146	0.0000	1545.6893
PMCWBPP2	0.0000	1500.8412	0.0000	3409.2104	0.0000	1142.4755	0.0000	1368.8326
PMCWBPP3	0.0000	1433.9928	0.0000	3221.4959	0.0000	1101.8384	0.0000	1317.3384
PTPOF1	0.0000	1624.8765	0.0000	3972.8081	0.0000	1034.3325	0.0000	1382.9126
PTPOF2	0.0000	1507.5302	0.0000	3672.5686	0.0000	943.1420	0.0000	1284.2123
PTPOF3	0.0000	1496.7958	0.0000	3597.9250	0.0000	966.7973	0.0000	1288.5695
PTPEXST1	0.0000	1436.1650	0.0000	3346.7395	0.0000	1017.4861	0.0000	1282.5634
PTPEXST2	0.0000	1243.4906	0.0000	2887.1018	0.0000	845.1498	0.0000	1111.0464
PTPEXST3	0.0000	1185.8470	0.0000	2713.1963	0.0000	818.2731	0.0000	1070.0585
POTSEED1	0.0000	534.1960	0.0000	1213.2972	0.0000	519.2222	0.0000	492.8618
POTSEED2	0.0000	174.3427	0.0000	410.3735	0.0000	159.6921	0.0000	156.7680
POTSEED3	0.0000	0.0000	1.2100	0.0000	0.0000	0.0000	0.0000	0.0000
POTDUAL1	0.0000	1304.5906	0.0000	2881.7764	0.0000	1029.3541	0.0000	1223.0145
POTDUAL2	0.0000	1047.0712	0.0000	2286.4414	0.0000	786.1348	0.0000	988.3837
POTDUAL3	0.0000	947.2011	0.0000	2024.7007	0.0000	712.7405	0.0000	906.1462
GR0	5.1100	0.0000	13.6800	0.0000	14.1800	0.0000	0.0000	213.9297
GR50	36.9178	0.0000	0.0000	110.0241	72.6759	0.0000	60.7221	0.0000
GR75	0.0000	0.9996	0.0000	68.1694	7.3727	0.0000	0.0000	0.8102
GR125	8.2282	0.0000	0.0000	5.0638	0.0000	21.2873	14.8945	0.0000
GR150	0.0000	14.8992	0.0000	9.7628	0.0000	36.9003	0.0000	15.4248
GR175	0.0000	21.4158	0.7444	0.0000	0.0000	54.1985	0.0000	23.7674
GR200	0.0000	30.2341	27.0403	0.0000	0.0000	71.8581	0.0000	32.8276
GR250	0.0000	60.2113	0.0000	20.6326	0.0000	110.7619	0.0000	64.5914
GR300	0.0000	84.9412	0.0000	37.4632	0.0000	153.2502	0.0000	91.3932
GR375	0.0000	135.1820	0.0000	92.9410	0.0000	219.3907	0.0000	144.5542
SILAGE12	6.5949	0.0000	5.5708	0.0000	11.8566	0.0000	11.0557	0.0000
SILAGE27	14.6310	0.0000	12.4946	0.0000	26.0848	0.0000	24.3478	0.0000
SILAGE30	0.0000	71.6406	0.0000	137.1348	0.0000	83.8762	0.0000	70.1916
HAY0	0.0000	366.2905	0.0000	1060.2490	0.0000	261.2536	0.0000	396.9395
HAY50	0.0000	174.1679	0.0000	599.1273	0.0000	84.3087	0.0000	244.7462
HAY75	0.0000	194.1990	0.0000	612.6124	0.0000	121.0551	0.0000	275.5279
HAY125	0.0000	161.2500	0.0000	524.1979	0.0000	93.6143	0.0000	253.2550
HAY200	0.0000	185.2317	0.0000	538.3749	0.0000	138.4371	0.0000	289.9557
FMAIZE1	0.0000	46.8903	0.0000	177.9883	0.0000	1073.8296	0.0000	64.6594
FMAIZE2	0.0000	215.8776	0.0000	545.1093	0.0000	1106.0923	0.0000	253.2158
FMAIZE3	0.0000	0.0000	0.0000	0.0000	0.0000	1154.3562	2.9865	0.0000
FMAIZEP1	0.0000	300.9919	0.0000	527.4968	0.0000	1441.2578	0.0000	315.3580
FMAIZEP2	0.0000	449.8312	0.0000	846.8620	0.0000	1451.7068	0.0000	480.7873
FMAIZEP3	0.0000	221.1959	0.0000	271.5135	0.0000	1486.1570	0.0000	212.9274

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	60510.1100		49196.3900		55959.7000		80296.3800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SWEDESGR	0.0000	481.6036	0.0000	1665.9437	0.0000	494.5741	0.0000	616.8517
TURNIPSG	0.0000	444.6394	0.0000	1599.3328	0.0000	446.8829	0.0000	577.8266
KALEAGEd	0.0000	310.6547	0.0000	709.6141	0.0000	359.0859	0.0000	352.2580
KALEAGEB	0.0000	131.2708	0.0000	386.3571	0.0000	127.6449	0.0000	162.8726
RapeBroa	0.0000	214.0049	0.0000	733.1855	0.0000	162.1721	0.0000	282.2728
RapeDril	0.0000	206.9130	0.0000	720.4056	0.0000	153.0220	0.0000	274.7854
RapeDD	0.0000	318.8801	0.0000	922.1749	0.0000	297.4820	0.0000	392.9953
Fbeet1	0.0000	3.8828	0.0000	56.2788	0.0000	0.0000	0.0000	12.0879
Fbeet2	0.0000	0.0000	0.0000	0.0000	0.0000	12.9887	0.0000	0.0000
Fbeet3	0.0000	28.5535	0.0000	20.6037	0.0000	61.0954	0.0000	25.1446
IRG1	0.0000	415.2487	0.0000	1305.9521	0.0000	801.3738	0.0000	586.1858
IRG2	0.0000	518.9440	0.0000	1488.1417	0.0000	938.1733	0.0000	697.5562
IRG3	0.0000	616.5007	0.0000	1655.9307	0.0000	1069.5887	0.0000	804.1400
LLB120	0.0000	21.2449	0.0000	62.6981	0.0000	36.2901	0.0000	32.9122
LLBE140	0.0000	8.2814	0.0000	35.6751	0.0000	30.1682	0.0000	21.1607
LLBE180	0.0000	0.0000	0.0000	17.6661	0.0000	28.3462	0.0000	13.3172
CBE140	0.0000	42.9634	0.0000	91.8872	0.0000	37.7661	0.0000	33.5332
CBE160	0.0000	26.8195	0.0000	57.7717	0.0000	27.4090	0.0000	22.9325
CBE180	0.0000	17.5216	0.0000	37.8816	0.0000	23.0606	0.0000	17.9187
DBFEWE1	0.0000	12.5110	0.0000	13.2376	0.0000	26.7786	0.0000	5.8173
DBFEWE2	0.0000	9.9291	0.0000	22.4593	0.0000	31.3316	0.0000	2.9839
DBFEWE3	0.0000	7.1441	0.0000	0.0000	0.0000	26.2989	0.0000	0.0000
WINFINMK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	29.0158
WINFINLK	0.0000	7.0309	0.0000	9.6261	0.0000	6.5101	0.0000	29.2632
WINFINBF	0.0000	42.4627	0.0000	74.4914	0.0000	42.4300	0.0000	52.2811
WINFINSK	0.0000	20.5882	0.0000	36.7795	0.0000	19.3980	0.0000	42.9655
AFLGR	0.0000	25.2490	0.0000	75.9214	0.0000	47.1201	0.0000	78.9749
GIMMERIN	0.0000	0.0000	0.0000	0.6446	0.0000	0.0000	0.0000	0.0000
INDOORLA	0.0000	44.8917	0.0000	111.7433	0.0000	60.6559	0.0000	67.2901
HREA26	0.0000	1160.1539	0.0000	2588.1187	0.0000	1012.8597	0.0000	1053.9012
HRA30	0.0000	1197.4468	0.0000	2444.8274	0.0000	910.2681	0.0000	969.9518
HRA36	0.0000	1102.4827	0.0000	2266.6819	0.0000	782.7219	0.0000	865.5822
HRS30	0.0000	1125.4083	0.0000	2416.7502	0.0000	890.1658	0.0000	953.5022
HRS36	0.0000	1130.0795	0.0000	2291.8545	0.0000	800.7448	0.0000	880.3301
Dsp4000	0.0000	180.2666	0.0000	383.1662	0.0000	151.1349	0.0000	210.9068
Dsum4000	0.0000	126.5620	0.0000	207.0420	0.0000	47.1062	0.0000	124.5679
DAut4000	0.0000	279.9341	0.0000	561.6020	0.0000	288.0901	0.0000	323.6909
DAll4000	0.0000	255.7878	0.0000	508.1379	0.0000	264.1602	0.0000	299.5169
Dsp5000	0.0000	10.6895	0.1411	0.0000	23.6594	0.0000	0.0000	47.5964
Dsum5000	18.6278	0.0000	8.3878	0.0000	22.0190	0.0000	31.9259	0.0000
DAut5000	0.0000	104.8984	0.0000	166.8853	0.0000	115.0348	0.0000	155.3573
DAll5000	0.0000	55.6314	0.0000	77.4726	0.0000	49.8362	0.0000	100.6398
Dsp6000	17.2723	0.0000	7.8556	0.0000	20.6220	0.0000	0.7681	0.0000
Dsum6000	0.0000	33.5704	7.6928	0.0000	0.0000	21.4487	0.0000	56.8489
DAut6000	0.0000	32.4814	8.0117	0.0000	0.0000	59.8210	0.0000	83.4522
DAll6000	0.0000	2.1638	7.9172	0.0000	0.0000	18.8674	0.0000	48.6482
Dsp7000	15.4783	0.0000	7.0085	0.0000	18.3981	0.0000	26.6759	0.0000
Dsum7000	15.2130	0.0000	6.8365	0.0000	9.9629	0.0000	0.0000	7.9993
DAut7000	0.0000	47.9617	7.2221	0.0000	0.0000	108.3078	0.0000	96.4039
DAll7000	0.0000	3.7128	7.1098	0.0000	0.0000	49.1764	0.0000	46.7993
Dsp8000	14.1644	0.0000	6.3644	0.0000	16.7073	0.0000	24.2244	0.0000
Dsum8000	13.9622	0.0000	6.2463	0.0000	0.0000	52.3879	0.0000	23.5376
DAut8000	0.9045	0.0000	6.4221	0.0000	0.0000	79.7940	0.0000	50.3151
DAll8000	14.0804	0.0000	6.3280	0.0000	0.0000	16.6255	24.0858	0.0000
18MthST	0.0000	118.7001	0.0000	336.2861	3.6770	0.0000	18.2223	0.0000
18mthHF	0.0000	186.4216	0.0000	476.5042	106.7061	0.0000	77.5882	0.0000
24mthFr	0.0000	10.5314	0.0000	126.9243	0.0000	15.0863	0.0000	1.1512
24mthB	0.0000	9.2805	0.0000	124.2773	0.0000	13.8457	0.0000	0.0000
Owscsbst	0.0000	51.2370	0.0000	120.5952	0.0000	86.6800	0.0000	95.1873

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	60510.1100		49196.3900		55959.7000		80296.3800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
Owscsbhf	0.0000	107.5590	0.0000	241.2007	0.0000	77.4439	0.0000	88.2599
Owscwbst	0.0000	78.8490	0.0000	175.8282	0.0000	117.7676	0.0000	125.4531
Owscwbhf	0.0000	221.5872	0.0000	478.6500	0.0000	194.5820	0.0000	198.2068
WFLFDBST	0.0000	121.2062	0.0000	249.5297	0.0000	184.6191	0.0000	175.5743
WFMFDBST	0.0000	21.8714	0.0000	45.9256	0.0000	77.8383	0.0000	75.6477
WFSCST	0.0000	24.7826	0.0000	49.3789	0.0000	83.8309	0.0000	81.3241
WFSCHF	0.0000	112.5476	0.0000	237.8930	0.0000	103.1416	0.0000	100.5472
BSDBXSTL	0.0000	88.8418	0.0000	304.0175	0.0000	101.0249	0.0000	148.9506
BSDBXSTM	0.0000	6.9277	0.0000	97.2735	0.0000	21.8052	0.0000	62.5417
OWSCSTWB	0.0000	19.8965	0.0000	132.2951	0.0000	34.3374	0.0000	76.8697
OWSCHFWB	0.0000	91.0513	0.0000	275.0878	0.0000	41.4926	0.0000	81.4444
OWSCSTSB	0.0000	109.7350	0.0000	322.3980	0.0000	60.3620	0.0000	101.7030
OWSCHFSB	0.0000	91.0513	0.0000	275.0878	0.0000	41.4926	0.0000	81.4444
OWMJST	0.0000	109.7350	0.0000	322.3980	0.0000	60.3620	0.0000	101.7030
OWMJHF	0.0000	91.0513	0.0000	275.0878	0.0000	41.4926	0.0000	81.4444
RYCSBMST	0.0000	176.9839	0.0000	420.6982	0.0000	194.2524	0.0000	189.4463
RYCSBLST	0.0000	197.9083	0.0000	464.9753	0.0000	215.0045	0.0000	208.7018
RYCABMST	40.1731	0.0000	4.4532	0.0000	86.3231	0.0000	71.7777	0.0000
RYCABLST	0.0000	16.6031	0.0000	35.1329	0.0000	16.4663	0.0000	15.2788
WFLFBST	0.0000	179.4723	0.0000	368.8539	0.0000	243.9143	0.0000	237.0213
SFLFBST	0.0000	233.5355	0.0000	643.1046	0.0000	264.4580	0.0000	264.5461
IBBFCF	0.0000	103.9852	0.0000	191.8386	0.0000	146.4425	0.0000	123.4782
IBBBXSF	0.0000	533.0181	0.0000	956.3625	0.0000	634.8366	0.0000	708.8491
IBBSCCF	0.0000	22.2850	0.0000	64.9281	0.0000	16.3972	0.0000	22.4289
IBBSCSF	0.0000	395.0123	0.0000	745.8867	0.0000	419.9281	0.0000	495.9096
CRFBFs1	0.0000	362.4808	0.0000	578.7340	0.0000	446.5946	0.0000	360.9654
CRMBBFs1	0.0000	367.0296	0.0000	588.3594	0.0000	451.1060	0.0000	365.1514
CRLBBFs1	0.0000	371.5784	0.0000	597.9849	0.0000	455.6172	0.0000	369.3373
CRFALst1	0.0000	445.7795	0.0000	718.8431	0.0000	563.5693	0.0000	453.2233
CRFBFhf1	0.0000	362.4808	0.0000	578.7340	0.0000	446.5946	0.0000	360.9654
CRMBBFh1	0.0000	367.0296	0.0000	588.3594	0.0000	451.1060	0.0000	365.1514
CRLBBFh1	0.0000	371.5784	0.0000	597.9849	0.0000	455.6172	0.0000	369.3373
CRFALhf1	0.0000	445.7795	0.0000	718.8431	0.0000	563.5693	0.0000	453.2233
FCOSTS	28561.9121	0.0000	20993.9824	0.0000	48122.8672	0.0000	70280.6016	0.0000
EEIQ	4913.8271	0.0000	3092.1807	0.0000	7950.9409	0.0000	17764.8926	0.0000
CEIQ	4242.0757	0.0000	2080.7898	0.0000	6326.5474	0.0000	21276.6367	0.0000
WEIQ	5269.3301	0.0000	2633.8445	0.0000	7936.9224	0.0000	25595.3848	0.0000
TPest	76.6090	0.0000	40.0787	0.0000	117.6293	0.0000	349.4294	0.0000
Herb	57.6936	0.0000	38.0217	0.0000	97.4332	0.0000	176.0871	0.0000
Insectic	0.4790	0.0000	0.6171	0.0000	0.4561	0.0000	3.8154	0.0000
Fungicid	18.4525	0.0000	1.4399	0.0000	19.7528	0.0000	169.6287	0.0000
Growth	0.0000	67.6739	0.0000	594.0944	0.0000	47.6215	0.0000	25.4172
STBO	32360.0000	0.0000	35759.4023	0.0000	35460.0000	0.0000	44080.0000	0.0000
LOSS	35637.6172	0.0000	16591.1270	0.0000	43553.6133	0.0000	63149.4414	0.0000
TOTLAB	22546.0430	0.0000	18008.6797	0.0000	37926.5313	0.0000	41288.5508	0.0000
SOILIND	310.2946	0.0000	229.9473	0.0000	568.2615	0.0000	607.1816	0.0000
LSU	135.8155	0.0000	96.4386	0.0000	239.2277	0.0000	216.6124	0.0000
MAIZEFOD	0.0000	0.0170	0.0000	0.0905	0.0000	0.0000	31672.0039	0.0000
FOD	88395.1719	0.0000	75262.7813	0.0000	135765.187	0.0000	126688.015	0.0000
AW	339.9252	0.0000	200.4476	0.0000	812.8558	0.0000	718.1248	0.0000
BSP	40.1731	0.0000	4.4532	0.0000	90.0000	0.0000	90.0000	0.0000
BSPFULL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	75.5210
Quota	756504.437	0.0000	631633.687	0.0000	684309.500	0.0000	737450.562	0.0000

	12. Dairy and Sheep Southern England		13.Specialist Dairy Central and Southern England		14.Specialist Dairy Wales & North of England	
C)	63679.6200		20828.3800		102136.7000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	1.4013	0.0000	0.2541	0.0000	0.7712	0.0000
CJAN	0.0000	9.2300	0.0000	9.2300	0.0000	9.2300
CFEB	0.0000	9.2300	0.0000	9.2300	0.0000	9.2300
CMAR	32.5814	0.0000	75.0693	0.0000	150.5164	0.0000
CAPR	75.5107	0.0000	74.6887	0.0000	120.9199	0.0000
CMAY	195.3382	0.0000	175.9093	0.0000	213.0830	0.0000
CJUN	145.4679	0.0000	170.2561	0.0000	245.0115	0.0000
CJUL	70.6211	0.0000	131.3888	0.0000	273.4520	0.0000
CAUG	62.0754	0.0000	39.5838	0.0000	29.1353	0.0000
CSEP	0.0000	1.2642	4.7507	0.0000	0.0000	9.2300
COCT	0.0000	5.4476	0.0000	6.7118	21.6345	0.0000
CNOV	0.0000	9.2300	0.0000	9.2300	0.0000	9.2300
CDEC	0.0000	9.2300	0.0000	9.2300	0.0000	6.7118
BHAY	104.2970	0.0000	122.6757	0.0000	269.9031	0.0000
BBAR	0.0000	138.9765	0.0000	188.3603	0.0000	53.6656
SBAR	112.1734	0.0000	16.9921	0.0000	0.0000	0.0000
USLYCat	1878.8840	0.0000	1203.5654	0.0000	3432.6392	0.0000
UFYMCat	443.7031	0.0000	151.5714	0.0000	18.2000	0.0000
BUYN	11038.8184	0.0000	5390.1318	0.0000	19901.7480	0.0000
BUYP	2535.7539	0.0000	994.3239	0.0000	2066.6196	0.0000
BUYK	0.0000	0.6115	0.0000	1.1789	0.0000	0.4905
bHeifers	0.0000	2126.8560	0.0000	2020.5786	0.0000	1706.0552
SSLambs	0.0000	3.9388	0.0000	13.1809	0.0000	20.2737
bSLambs	0.0000	45.9882	0.0000	57.9774	0.0000	0.0000
sGimmers	0.0000	35.2939	0.0000	68.3982	0.0000	0.0000
bGimmers	0.0000	67.4970	0.0000	78.1043	0.0000	41.7399
bwSTRAW	13.1273	0.0000	4.4844	0.0000	0.5385	0.0000
bBSTRAW	0.0000	13.2929	0.0000	25.6289	0.0000	10.6628
bOSTRAW	0.0000	13.2929	0.0000	25.6289	0.0000	10.6628
WW1	0.0000	126.0930	0.0000	335.5241	0.0000	418.4751
WW2	0.0000	143.2011	0.0000	428.5945	0.0000	496.3287
WW3	0.0000	313.3701	0.0000	622.4478	0.0000	454.9556
BWW1	0.0000	17.6943	0.0000	0.0000	0.0000	16.8112
BWW2	7.6300	0.0000	0.0000	42.9365	0.0000	84.8574
BWW3	0.0000	178.5938	0.0000	215.1349	0.0000	0.0000
MSBAR1	0.0000	138.4640	0.0000	318.6454	0.0000	177.2794
MSBAR2	0.0000	275.6027	0.0000	580.4962	0.0000	282.9374
MSBAR3	0.0000	299.3859	0.0000	533.8410	0.0000	144.7885
WB125	0.0000	47.7704	6.0300	0.0000	0.0000	731.7653
WB180	22.3708	0.0000	0.0000	105.4767	0.0000	712.7730
WB225	0.0000	121.8503	0.0000	24.6427	0.0000	727.8014
SBAR75	0.0000	179.6215	0.0000	512.7587	0.0000	756.4031
SBAR100	0.0000	269.8658	0.0000	667.7739	0.0000	805.7280
SBAR125	0.0000	287.5584	0.0000	663.0813	0.0000	773.1068
WO50	3.2994	0.0000	0.0000	0.0000	0.0000	22.1998
WO100	0.0000	39.9763	0.0000	45.0007	0.0000	0.0000
WO125	0.0000	87.1851	0.0000	109.6849	0.0000	26.0183
SO50	0.0000	48.3722	0.0000	356.6205	0.0000	723.0818
SO100	0.0000	104.6171	0.0000	437.1525	0.0000	649.2992
SO125	0.0000	156.7944	0.0000	506.6144	0.0000	743.2411
WOSR150	0.0000	249.8451	0.0000	1018.3058	0.0000	1053.5612
WOSR185	0.0000	277.3256	0.0000	1023.5175	0.0000	1071.1373
WOSR225	0.0000	352.1563	0.0000	1157.5966	0.0000	1099.9591
SOSR90	0.0000	23.6029	0.0000	698.1439	0.0000	973.4510
SOSR110	0.0000	139.9237	0.0000	896.1220	0.0000	1072.2402
SOSR130	0.0000	268.7813	0.0000	1128.2201	0.0000	1139.1515
LIN50	0.0000	330.6748	0.0000	1407.2175	0.0000	1412.3209
LIN80	0.0000	432.8255	0.0000	1603.8038	0.0000	1493.9974
LIN120	0.0000	499.3714	0.0000	1703.4889	0.0000	1526.5898
SFB20K	0.0000	157.6910	0.0000	968.5798	0.0000	1144.7749
SFB40K	0.0000	139.5471	0.0000	875.6655	0.0000	1088.1384

C)	12. Dairy and Sheep Southern England 63679.6200		13.Specialist Dairy Central and Southern England 20828.3800		14.Specialist Dairy Wales & North of England 102136.7000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SFB60K	0.0000	170.3021	0.0000	924.9160	0.0000	1105.5111
SETSC	0.0000	130.7784	0.0000	236.9297	0.0000	181.9814
SETNR	11.6198	0.0000	0.3200	0.0000	0.0000	84.5680
WORSA100	0.0000	362.3441	0.0000	207.3738	0.7200	0.0000
WORSA140	0.0000	428.3858	0.0000	299.1362	0.0000	53.7318
WORSA180	0.0000	516.4812	0.0000	450.9192	0.0000	90.7950
SORSA60	0.0000	236.8088	0.0000	95.2699	0.0000	8.5053
SORSA85	0.0000	332.6938	0.0000	268.2531	0.0000	76.7857
SORSA110	0.0000	412.0859	0.0000	396.3494	0.0000	122.3292
SBEET1	0.0000	96.8295	0.0000	588.9613	0.0000	889.7454
SBEET2	0.0000	49.9773	0.0000	406.4910	0.0000	785.2333
SBEET3	0.0000	46.1070	0.0000	340.9993	0.0000	739.9758
POTEW1	0.0000	1636.8964	0.0000	4960.1167	0.0000	2717.2700
POTEW2	0.0000	1506.1637	0.0000	4490.6382	0.0000	2440.9138
POTEW3	0.0000	1255.0934	0.0000	3871.0955	0.0000	2132.6655
PTMCW140	0.0000	1849.9855	0.0000	5567.5645	0.0000	3041.2903
PTMCW180	0.0000	1779.8312	0.0000	5251.1367	0.0000	2842.1218
PTMCW220	0.0000	1741.1581	0.0000	5014.8691	0.0000	2683.5581
PMCWBPP1	0.0000	1586.0287	0.0000	4777.8936	0.0000	2612.3914
PMCWBPP2	0.0000	1408.1213	0.0000	4212.2100	0.0000	2294.0525
PMCWBPP3	0.0000	1366.0470	0.0000	3992.3984	0.0000	2150.9119
PTPOF1	0.0000	1326.5250	0.0000	4813.3364	0.0000	2805.5322
PTPOF2	0.0000	1234.9834	0.0000	4453.7588	0.0000	2587.6980
PTPOF3	0.0000	1255.1068	0.0000	4378.5137	0.0000	2513.8899
PTPEXST1	0.0000	1291.6055	0.0000	4106.4966	0.0000	2291.6345
PTPEXST2	0.0000	1121.1652	0.0000	3546.0190	0.0000	1972.0365
PTPEXST3	0.0000	1092.1561	0.0000	3345.6682	0.0000	1834.8571
POTSEED1	0.0000	509.4356	0.0000	1499.1246	0.0000	816.3570
POTSEED2	0.0000	157.5660	0.0000	502.1847	0.0000	282.8716
POTSEED3	0.0000	0.0000	0.0000	0.0000	0.9000	0.0000
POTDUAL1	0.0000	1287.8519	0.0000	3588.1277	0.0000	1900.8372
POTDUAL2	0.0000	1048.5759	0.0000	2856.0725	0.0000	1495.3715
POTDUAL3	0.0000	974.4216	0.0000	2544.4666	0.0000	1302.8805
GR0	15.0000	0.0000	1.8800	0.0000	2.9500	0.0000
GR50	44.4086	0.0000	13.5279	0.0000	0.0000	217.8320
GR75	0.0000	0.2244	13.2129	0.0000	0.0000	160.7183
GR125	15.0696	0.0000	10.2623	0.0000	0.0000	77.2245
GR150	0.0000	17.5885	0.0000	53.5210	0.0000	63.1691
GR175	0.0000	27.2570	0.0000	88.9710	0.0000	40.3703
GR200	0.0000	37.5725	0.0000	124.9103	0.0000	24.8662
GR250	0.0000	74.8782	0.0000	223.2962	0.0000	12.8019
GR300	0.0000	104.0782	0.0000	306.1576	61.0610	0.0000
GR375	0.0000	166.5044	0.0000	455.3889	0.0000	3.0329
SILAGE12	9.1890	0.0000	5.6406	0.0000	0.0000	84.2575
SILAGE27	19.7128	0.0000	12.6263	0.0000	23.8690	0.0000
SILAGE30	0.0000	77.1419	0.0000	198.5693	0.0000	71.1730
HAY0	0.0000	403.6325	0.0000	413.0733	0.0000	1130.3733
HAY50	0.0000	202.8438	0.0000	122.2049	0.0000	745.3456
HAY75	0.0000	235.4297	0.0000	195.9591	0.0000	732.0016
HAY125	0.0000	199.5416	0.0000	152.9501	0.0000	655.4959
HAY200	0.0000	233.9900	0.0000	244.3154	0.0000	635.4833
FMAIZE1	0.0000	480.1891	0.0000	749.1804	0.0000	181.1992
FMAIZE2	0.0000	448.3770	0.0000	687.8458	0.0000	439.0600
FMAIZE3	0.0000	454.9201	0.0000	700.4611	0.0000	0.0000
FMAIZEP1	0.0000	832.4876	0.0000	1428.4198	0.0000	277.2122
FMAIZEP2	0.0000	779.7600	0.0000	1326.7598	0.0000	498.5887
FMAIZEP3	0.0000	773.0593	0.0000	1313.8407	0.0000	36.4266
SWEDESGR	0.0000	498.2907	0.0000	1212.1249	0.0000	1333.9587
TURNIPSG	0.0000	452.5633	0.0000	1123.9614	0.0000	1297.2786
KALEAGEd	0.0000	399.0349	0.0000	769.3485	0.0000	540.1575
KALEAGEB	0.0000	177.1241	0.0000	341.4993	0.0000	362.1519

C)	12. Dairy and Sheep Southern England 63679.6200		13.Specialist Dairy Central and Southern England 20828.3800		14.Specialist Dairy Wales & North of England . 102136.7000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
RapeBroa	0.0000	67.9178	0.0000	130.9471	0.0000	729.0856
RapeDril	0.0000	59.1446	0.0000	114.0321	0.0000	722.0482
RapeDD	0.0000	197.6561	0.0000	381.0854	0.0000	833.1550
Fbeet1	0.0000	0.0000	0.0000	0.0000	0.0000	90.9472
Fbeet2	0.0000	12.4538	0.0000	24.0112	0.0000	16.1054
Fbeet3	0.0000	58.5797	0.0000	112.9429	0.0000	0.0000
IRG1	0.0000	789.3879	0.0000	1331.7954	0.0000	1131.5176
IRG2	0.0000	917.6406	0.0000	1587.4569	0.0000	1222.6049
IRG3	0.0000	1038.7882	0.0000	1835.0114	0.0000	1299.1641
LLB120	0.0000	16.9678	0.0000	59.0947	0.0000	32.3699
LLBE140	0.0000	6.7477	0.0000	25.8758	0.0000	13.5039
LLBE180	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CBE140	0.0000	30.8430	0.0000	85.6019	0.0000	62.6042
CBE160	0.0000	19.1497	0.0000	50.5380	0.0000	40.4822
CBE180	0.0000	13.6030	0.0000	31.3013	0.0000	27.0970
DBFEWE1	0.0000	18.8380	0.0000	49.7493	0.0000	34.5293
DBFEWE2	0.0000	23.5601	0.0000	44.5810	0.0000	29.9090
DBFEWE3	0.0000	17.5420	0.0000	37.7506	0.0000	25.0288
WINFINMK	0.0000	0.0000	0.0000	0.0000	0.0000	4.9228
WINFINLK	0.0000	5.1679	0.0000	13.1604	0.0000	11.2620
WINFINBF	0.0000	40.1158	0.0000	87.9288	0.0000	41.8706
WINFINSK	0.0000	22.7227	0.0000	45.5944	0.0000	30.8514
AFLGR	0.0000	48.8622	0.0000	79.4099	0.0000	117.1063
GIMMERIN	0.0000	0.0000	0.0000	0.0000	0.0000	88.7439
INDOORLA	0.0000	63.2287	0.0000	204.1625	0.0000	124.8647
HREA26	0.0000	1096.4728	0.0000	425.4401	0.0000	1763.7528
HRA30	0.0000	998.1057	0.0000	235.7861	0.0000	1800.7590
HRA36	0.0000	875.8114	12.5111	0.0000	0.0000	1706.5247
HRS30	0.0000	978.8310	0.0000	198.6241	0.0000	1729.2742
HRS36	0.0000	893.0921	0.0000	33.3176	0.0000	1733.9093
Dsp4000	0.0000	158.6466	0.0000	438.6423	0.0000	369.5692
Dsum4000	0.0000	57.5337	0.0000	211.9986	0.0000	263.7634
DAut4000	0.0000	292.7308	0.0000	683.9181	0.0000	462.5300
DAll4000	0.0000	267.2793	0.0000	613.8583	0.0000	428.5186
Dsp5000	19.3583	0.0000	4.4040	0.0000	0.0000	120.7078
Dsum5000	18.0161	0.0000	4.0986	0.0000	8.2728	0.0000
DAut5000	0.0000	120.7262	0.0000	189.4843	0.0000	206.2944
DAll5000	0.0000	56.5665	0.0000	67.8754	0.0000	157.9996
Dsp6000	16.8731	0.0000	3.8386	0.0000	19.3462	0.0000
Dsum6000	0.0000	20.4588	3.7590	0.0000	18.9451	0.0000
DAut6000	0.0000	61.7107	3.9148	0.0000	0.0000	40.6931
DAll6000	0.0000	20.8176	3.8687	0.0000	0.0000	11.4468
Dsp7000	15.0535	0.0000	3.4246	0.0000	17.2599	0.0000
Dsum7000	14.6840	0.0000	3.3406	0.0000	16.8362	0.0000
DAut7000	0.0000	102.1257	3.5290	0.0000	17.7858	0.0000
DAll7000	0.0000	43.8230	3.4741	0.0000	17.5092	0.0000
Dsp8000	13.6701	0.0000	3.1099	0.0000	15.6737	0.0000
Dsum8000	0.0000	37.6501	3.0522	0.0000	15.3829	0.0000
DAut8000	0.0000	68.7107	3.1381	0.0000	15.8158	0.0000
DAll8000	0.0000	6.5570	3.0921	0.0000	15.5840	0.0000
18MthST	0.0000	71.3696	0.0000	47.3832	0.0000	375.4619
18mthHF	41.2731	0.0000	0.0000	169.8152	0.0000	450.8996
24mthFr	0.0000	1.2258	18.1061	0.0000	0.0000	225.7709
24mthB	0.0000	0.0000	18.2357	0.0000	0.0000	224.0810
Owscsbst	0.0000	112.5526	0.0000	198.8059	0.0000	94.0196
Owscsbhf	0.0000	36.7412	0.0000	350.9245	0.0000	172.5351
Owscwbst	0.0000	142.8013	0.0000	268.9495	0.0000	126.8722
Owscwbhf	0.0000	151.9711	0.0000	637.6550	0.0000	314.8473
WFLFDBST	0.0000	209.1245	0.0000	351.1004	0.0000	367.0783
WFMFDBST	0.0000	104.6616	0.0000	124.0066	0.0000	266.5378
WFSCST	0.0000	110.1900	0.0000	198.8974	0.0000	297.9621

C)	12. Dairy and Sheep Southern England 63679.6200		13.Specialist Dairy Central and Southern England 20828.3800		14.Specialist Dairy Wales & North of England 102136.7000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
WFSCHF	0.0000	62.9188	0.0000	367.0020	0.0000	390.7475
BSDBXSTL	0.0000	186.2449	0.0000	240.7281	0.0000	297.2092
BSDBXSTM	0.0000	96.1087	0.0000	62.0907	0.0000	160.8447
OWSCSTWB	0.0000	111.2995	0.0000	85.4465	0.0000	183.8905
OWSCHFWB	0.0000	48.6836	0.0000	286.9754	0.0000	275.4544
OWSCSTSB	0.0000	70.0730	0.0000	325.0450	0.0000	305.2570
OWSCHFSB	0.0000	48.6836	0.0000	286.9754	0.0000	275.4544
OWMJST	0.0000	70.0730	0.0000	325.0450	0.0000	305.2570
OWMJHF	0.0000	48.6836	0.0000	286.9754	0.0000	275.4544
RYCSBMST	0.0000	233.7149	0.0000	340.7390	0.0000	354.7673
RYCSBLST	0.0000	254.2196	0.0000	396.5443	0.0000	383.0349
RYCABMST	90.0000	0.0000	8.5018	0.0000	5.3846	0.0000
RYCABLST	0.0000	16.2700	0.0000	44.2802	0.0000	22.4298
WFLFBST	0.0000	267.5221	0.0000	504.0096	0.0000	229.9828
SFLFBST	0.0000	373.0916	0.0000	487.5258	0.0000	572.7718
IBBFCF	0.0000	164.0438	0.0000	262.6496	0.0000	122.7166
IBBBXSF	0.0000	563.7420	0.0000	1287.8934	0.0000	550.9408
IBBSCCF	0.0000	41.7489	0.0000	91.0556	0.0000	71.2483
IBBSCSF	0.0000	361.2663	0.0000	993.5449	0.0000	458.2812
CRFBFs1	0.0000	394.5442	0.0000	750.9848	0.0000	321.6177
CRMBBFs1	0.0000	399.0017	0.0000	763.1163	0.0000	327.7629
CRLBBFs1	0.0000	403.4592	0.0000	775.2479	0.0000	333.9080
CRFALst1	0.0000	505.7781	0.0000	940.6852	0.0000	392.8573
CRFBFhf1	0.0000	394.5442	0.0000	750.9848	0.0000	321.6177
CRMBBFh1	0.0000	399.0017	0.0000	763.1163	0.0000	327.7629
CRLBBFh1	0.0000	403.4592	0.0000	775.2479	0.0000	333.9080
CRFALhf1	0.0000	505.7781	0.0000	940.6852	0.0000	392.8573
FCOSTS	51363.3203	0.0000	27839.5781	0.0000	44336.1133	0.0000
EEIQ	10698.0566	0.0000	3863.8955	0.0000	4816.8882	0.0000
CEIQ	10595.4766	0.0000	3242.4768	0.0000	3229.1804	0.0000
WEIQ	12823.2275	0.0000	4027.7168	0.0000	4103.2681	0.0000
Tpest	181.5094	0.0000	59.0443	0.0000	63.2594	0.0000
Herb	106.4655	0.0000	46.8034	0.0000	61.4054	0.0000
Insecticide	2.0672	0.0000	0.1809	0.0000	0.4590	0.0000
Fungicide	68.9618	0.0000	12.0600	0.0000	1.3950	0.0000
Growth	4.1243	0.0000	0.0000	231.5105	0.0000	522.0900
STBO	33070.0000	0.0000	4873.4717	0.0000	66042.2266	0.0000
LOSS	35635.9258	0.0000	8107.0801	0.0000	40859.0781	0.0000
TOTLAB	20042.2363	0.0000	8859.7813	0.0000	17802.1387	0.0000
SOILIND	523.7371	0.0000	241.8417	0.0000	326.1190	0.0000
LSU	182.9826	0.0000	97.1550	0.0000	181.9116	0.0000
MAIZEFOD	0.0000	0.0000	0.0000	0.0000	0.0000	0.1031
FOD	95938.9375	0.0000	65403.1914	0.0000	104598.3516	0.0000
AW	589.1295	0.0000	259.6416	0.0000	372.9770	0.0000
BSP	90.0000	0.0000	8.5018	0.0000	5.3846	0.0000
BSPFULL	0.0000	60.2976	36.3418	0.0000	0.0000	0.0000
Quota	605633.6875	0.0000	330316.1563	0.0000	1256500.7500	0.0000

C)	15.Mixed Lowland North & West 20894.3300		16.Mixed Lowland South 23904.0800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	2.5830	0.0000	1.8950	0.0000
CJAN	0.0000	6.7300	0.0000	4.4958
CFEB	0.0000	6.7300	0.0000	6.7300
CMAR	16.2051	0.0000	41.0387	0.0000
CAPR	46.7041	0.0000	54.8439	0.0000
CMAY	67.3157	0.0000	83.9650	0.0000
CJUN	68.2257	0.0000	72.2687	0.0000
CJUL	51.6735	0.0000	66.2664	0.0000
CAUG	57.2402	0.0000	0.0000	2.7071
CSEP	0.0000	4.8800	0.0000	6.7300
COCT	178.2097	0.0000	142.9915	0.0000
CNOV	0.0000	6.7300	0.0000	4.4071
CDEC	0.0000	6.7300	0.0000	6.7300
BHAY	191.8924	0.0000	225.9193	0.0000
BBAR	0.0000	17.0077	0.0000	11.8670
SBAR	138.8241	0.0000	68.0861	0.0000
USLYCat	58.2788	0.0000	87.7064	0.0000
UFYMCat	581.7372	0.0000	591.5618	0.0000
BUYN	11841.5381	0.0000	17544.8457	0.0000
BUYP	4198.6626	0.0000	5131.8789	0.0000
BUYK	3887.5879	0.0000	4744.5562	0.0000
bHeifers	0.0000	187.3243	0.0000	189.9364
SSLambs	0.0000	6.4251	0.0000	4.4831
bSLambs	431.2323	0.0000	305.3523	0.0000
sGimmers	0.0000	13.2282	0.0000	9.2299
bGimmers	22.0661	0.0000	39.5592	0.0000
bwSTRAW	23.7801	0.0000	24.3033	0.0000
bBSTRAW	0.0000	6.1466	0.0000	6.0186
bOSTRAW	0.0000	6.1466	0.0000	6.0186
WW1	0.0000	286.8563	0.0000	266.0699
WW2	0.0000	293.7319	0.0000	267.7293
WW3	0.0000	338.7360	0.0000	323.2281
BWW1	0.0000	77.6548	0.0000	74.7759
BWW2	0.0000	65.2739	0.0000	56.1451
BWW3	0.0000	101.7783	0.0000	106.5632
MSBAR1	0.0000	318.4412	0.0000	197.7219
MSBAR2	0.0000	390.5149	0.0000	268.1410
MSBAR3	0.0000	356.7654	0.0000	229.5307
WB125	0.0000	17.5207	0.0000	10.8671
WB180	34.4101	0.0000	25.7242	0.0000
WB225	0.0000	22.5324	0.0000	17.2905
SBAR75	0.0000	134.9059	0.0000	72.4275
SBAR100	0.0000	175.2628	0.0000	110.8026
SBAR125	0.0000	170.3006	0.0000	103.6100
WO50	0.0000	0.0000	0.0000	0.0000
WO100	0.0000	0.0819	0.0000	5.4143
WO125	0.0000	25.2775	0.0000	17.7850
SO50	0.0000	215.7399	0.0000	29.5277
SO100	0.0000	226.2744	0.0000	45.6720

C)	15.Mixed Lowland North & West 20894.3300		16.Mixed Lowland South 23904.0800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
SO125	0.0000	251.9250	0.0000	57.9040
WOSR150	0.0000	238.9583	0.0000	204.6731
WOSR185	0.0000	241.5639	0.0000	194.0833
WOSR225	0.0000	271.7594	0.0000	229.0366
SOSR90	0.0000	202.4670	0.0000	188.4909
SOSR110	0.0000	248.5603	0.0000	232.0432
SOSR130	0.0000	306.3575	0.0000	287.6538
LIN50	0.0000	411.9754	0.0000	475.7153
LIN80	0.0000	464.9317	0.0000	527.5470
LIN120	0.0000	484.6492	0.0000	545.1329
SFB20K	0.0000	261.8318	0.0000	297.1588
SFB40K	0.0000	222.4390	0.0000	255.1024
SFB60K	0.0000	234.0883	0.0000	265.9049
SETSC	0.0000	57.6291	0.0000	55.8703
SETNR	1.9900	0.0000	2.2200	0.0000
WORSA100	0.0000	115.7768	0.0000	265.9897
WORSA140	0.0000	142.6363	0.0000	281.3800
WORSA180	0.0000	176.3100	0.0000	317.9823
SORSA60	0.0000	132.4299	0.0000	304.1781
SORSA85	0.0000	178.1923	0.0000	348.2727
SORSA110	0.0000	208.5578	0.0000	376.5038
SBEET1	0.0000	101.3029	0.0000	108.2243
SBEET2	0.0000	30.5885	0.0000	33.4414
SBEET3	3.8900	0.0000	10.7800	0.0000
POTEW1	0.0000	1889.2423	0.0000	1976.5552
POTEW2	0.0000	1712.3816	0.0000	1787.6759
POTEW3	0.0000	1527.9960	0.0000	1597.3466
PTMCW140	0.0000	2127.1064	0.0000	2223.2805
PTMCW180	0.0000	2013.2444	0.0000	2098.7061
PTMCW220	0.0000	1926.8788	0.0000	2002.4612
PMCWBPP1	0.0000	1815.3660	0.0000	1898.5852
PMCWBPP2	0.0000	1616.1699	0.0000	1687.4565
PMCWBPP3	0.0000	1535.6143	0.0000	1598.5624
PTPOF1	0.0000	2027.2883	0.0000	2140.6631
PTPOF2	0.0000	1894.3473	0.0000	1997.2686
PTPOF3	0.0000	1858.9377	0.0000	1954.3604
PTPEXST1	0.0000	1607.1101	0.0000	1686.6395
PTPEXST2	0.0000	1405.2570	0.0000	1472.2451
PTPEXST3	0.0000	1326.9336	0.0000	1385.1232
POTSEED1	0.0000	530.0140	0.0000	556.3072
POTSEED2	0.0000	180.1519	0.0000	190.7278
POTSEED3	1.3000	0.0000	1.3500	0.0000
POTDUAL1	0.0000	1277.4344	0.0000	1329.8931
POTDUAL2	0.0000	1012.2620	0.0000	1050.6918
POTDUAL3	0.0000	891.3115	0.0000	920.0817
GR0	3.7000	0.0000	5.4500	0.0000
GR50	61.6157	0.0000	0.0000	2.3452
GR75	0.0000	7.0449	0.0000	3.0258
GR125	0.0000	10.8926	64.5426	0.0000
GR150	0.0000	23.5940	0.0000	9.8109
GR175	0.0000	29.5342	0.0000	13.3661
GR200	0.0000	35.5156	0.0000	17.1191

C)	15.Mixed Lowland North & West 20894.3300		16.Mixed Lowland South 23904.0800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
GR250	0.0000	57.6410	0.0000	35.2249
GR300	0.0000	74.1939	0.0000	47.0749
GR375	0.0000	108.0795	0.0000	76.3717
SILAGE12	0.0000	61.7300	0.0000	58.0127
SILAGE27	19.1543	0.0000	22.2804	0.0000
SILAGE30	0.0000	67.3365	0.0000	64.9633
HAY0	0.0000	250.9480	0.0000	288.1457
HAY50	0.0000	143.2953	0.0000	168.5384
HAY75	0.0000	168.9097	0.0000	191.7859
HAY125	0.0000	151.0415	0.0000	168.5160
HAY200	0.0000	173.2283	0.0000	185.3672
FMAIZE1	0.0000	66.3469	0.0000	192.3486
FMAIZE2	0.0000	168.5667	0.0000	204.1159
FMAIZE3	0.0000	86.0470	0.0000	229.2861
FMAIZEP1	0.0000	229.2483	0.0000	372.3183
FMAIZEP2	0.0000	321.7968	0.0000	376.7768
FMAIZEP3	0.0000	233.1532	0.0000	397.3191
SWEDESGR	3.4499	0.0000	2.4428	0.0000
TURNIPSG	0.0000	130.7120	0.0000	94.0569
KALEAGEd	0.0000	432.1708	0.0000	468.5874
KALEAGEB	0.0000	329.5601	0.0000	368.1137
RapeBroa	0.0000	344.8680	0.0000	296.0469
RapeDril	0.0000	340.8112	0.0000	292.0746
RapeDD	0.0000	404.8584	0.0000	354.7880
Fbeet1	0.0000	274.3817	0.0000	313.9324
Fbeet2	0.0000	301.3460	0.0000	349.6378
Fbeet3	0.0000	343.8800	0.0000	397.1096
IRG1	0.0000	204.4290	0.0000	221.2693
IRG2	0.0000	269.0909	0.0000	283.5834
IRG3	0.0000	329.3271	0.0000	340.8968
LLB120	0.0000	11.5822	0.0000	20.9720
LLBE140	0.0000	4.5721	0.0000	10.1096
LLBE180	78.8075	0.0000	141.2827	0.0000
CBE140	0.0000	24.3160	0.0000	32.7096
CBE160	0.0000	13.9957	0.0000	19.2971
CBE180	0.0000	8.7228	0.0000	11.2296
DBFEWE1	0.0000	8.4079	0.0000	19.4257
DBFEWE2	0.0000	4.4355	0.0000	15.5810
DBFEWE3	0.0000	0.1822	0.0000	11.5862
WINFINMK	431.2323	0.0000	305.3523	0.0000
WINFINLK	0.0000	3.9452	0.0000	3.2255
WINFINBF	0.0000	19.6486	0.0000	21.8416
WINFINSK	0.0000	13.3744	0.0000	14.4939
AFLGR	0.0000	32.4842	0.0000	29.6148
GIMMERIN	0.0000	13.1730	0.0000	15.1753
INDOORLA	0.0000	45.7808	0.0000	43.0336
LLSUCKNJ	0.0000	53.6327	0.0000	56.0035
LLSUCKFA	0.0000	110.0635	0.0000	113.4448
LLSUCKMJ	0.0000	41.4890	0.0000	32.7899
LLSUCKAO	41.0558	0.0000	42.5091	0.0000
18MthST	0.0000	126.0759	0.0000	152.0310
18mthHF	0.0000	144.7543	0.0000	111.1570

C)	15.Mixed Lowland North & West 20894.3300		16.Mixed Lowland South 23904.0800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
24mthFr	0.0000	1.1444	0.0000	1.1790
24mthB	90.0000	0.0000	90.0000	0.0000
Owscsbst	0.0000	105.5220	0.0000	132.3297
Owscsbhf	0.0000	119.3923	0.0000	93.3724
Owscwbst	0.0000	126.5288	0.0000	153.6100
Owscwbhf	0.0000	219.0570	0.0000	195.6597
WFLFDBST	0.0000	150.2619	0.0000	182.4196
WFMFDBST	0.0000	121.3914	0.0000	100.0384
WFSCST	0.0000	144.5194	0.0000	123.5628
WFSCHF	0.0000	123.8366	0.0000	102.7098
BSDBXSTL	0.0000	114.8245	0.0000	154.7203
BSDBXSTM	0.0000	97.1289	0.0000	79.3458
OWSCSTWB	0.0000	105.2946	0.0000	88.6285
OWSCHFWB	0.0000	92.7682	0.0000	74.9158
OWSCSTSB	0.0000	105.2946	0.0000	88.6285
OWSCHFSB	0.0000	92.7682	0.0000	74.9158
OWMJST	0.0000	105.2946	0.0000	88.6285
OWMJHF	0.0000	92.7682	0.0000	74.9158
RYCSBMST	0.0000	163.9853	0.0000	172.0744
RYCSBLST	0.0000	183.1275	0.0000	191.7966
RYCABMST	0.0000	37.2468	0.0000	30.7808
RYCABLST	0.0000	52.4357	0.0000	46.4299
WFLFBST	0.0000	234.4474	0.0000	216.1684
SFLFBST	0.0000	291.6857	0.0000	300.8406
IBBFCF	0.0000	113.1674	0.0000	119.9965
IBBBXSF	0.0000	320.9844	0.0000	268.3206
IBBSCCF	0.0000	94.7321	0.0000	105.8057
IBBSCSF	0.0000	284.3756	0.0000	238.2494
CRFBFs1	0.0000	179.2259	0.0000	138.6077
CRMBBFs1	0.0000	183.3872	0.0000	142.8952
CRLBBFs1	0.0000	187.5486	0.0000	147.1826
CRFALst1	0.0000	215.9586	0.0000	173.0863
CRFBFhf1	0.0000	179.2259	0.0000	138.6077
CRMBBFh1	0.0000	183.3872	0.0000	142.8952
CRLBBFh1	0.0000	187.5486	0.0000	147.1826
CRFALhf1	0.0000	215.9586	0.0000	173.0863
FCOSTS	55316.9258	0.0000	57112.9961	0.0000
EEIQ	12311.2646	0.0000	12500.8955	0.0000
CEIQ	12838.1035	0.0000	13184.2715	0.0000
WEIQ	14282.4199	0.0000	13970.2568	0.0000
TPest	211.8775	0.0000	206.6675	0.0000
Herb	138.6868	0.0000	149.0262	0.0000
Insectic	2.7845	0.0000	4.4786	0.0000
Fungicid	70.4062	0.0000	53.1628	0.0000
Growth	0.0000	147.0770	0.0000	0.8803
STBO	31660.0000	0.0000	2835.9543	0.0000
LOSS	52446.8555	0.0000	78929.6250	0.0000
TOTLAB	22996.0000	0.0000	17578.3496	0.0000
SOILIND	426.3079	0.0000	403.8074	0.0000
LSU	147.7054	0.0000	184.0437	0.0000
MAIZEFOD	27598.8691	0.0000	19542.5469	0.0000
FOD	72010.7578	0.0000	78170.1875	0.0000

C)	15.Mixed Lowland North & West 20894.3300		16.Mixed Lowland South 23904.0800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
AW	1882.5311	0.0000	1732.5757	0.0000
BSP	0.0000	0.0000	0.0000	0.0000
BSPFULL	90.0000	0.0000	90.0000	0.0000
Cereals	7203.7632	0.0000	1562.4894	0.0000
Potatoes	5465.4600	0.0000	5675.6704	0.0000
Cattle	47179.5508	0.0000	45684.9063	0.0000
Sheep	27751.1172	0.0000	25366.8262	0.0000
Pigs	0.0000	0.0000	0.0000	0.0000
Other Cr	9823.2090	0.0000	16620.8281	0.0000
Milk	17071.3516	0.0000	25623.9766	0.0000
Poultry	0.0000	0.0942	0.0000	1.1670
HREA26	0.0000	117.0919	0.0000	114.6534
HRA30	0.0000	56.5483	0.0000	55.3707
HRA36	4.4830	0.0000	6.7466	0.0000
HRS30	0.0000	51.9384	0.0000	50.8568
HRS36	0.0000	7.9905	0.0000	7.8241
Dsp5000	3.6953	0.0000	5.5612	0.0000
Dsum5000	3.4391	0.0000	5.1757	0.0000
DAut5000	3.8322	0.0000	5.7673	0.0000
DAll5000	3.7443	0.0000	5.6350	0.0000
Dsp6000	3.2210	0.0000	4.8474	0.0000
Dsum6000	0.0000	0.0000	0.0000	0.0000
DAut6000	0.0000	0.0000	0.0000	0.0000
DAll6000	0.0000	0.0000	0.0000	0.0000
Dsp7000	0.0000	0.0000	0.0000	0.0000
Dsum7000	0.0000	0.0000	0.0000	0.0000
DAut7000	0.0000	0.0000	0.0000	0.0000
DAll7000	0.0000	0.0000	0.0000	0.0000
BPIG3WKW	0.0000	0.0000	0.0000	0.0000
BPIG4WKW	0.0000	0.0000	0.0000	0.0000
BPIGOUT	0.0000	0.0000	0.0000	0.0000
FPIGPORK	0.0000	0.0000	0.0000	0.0000
FPIGCUT	0.0000	0.0000	0.0000	0.0000
FPIGBAC	0.0000	0.0000	0.0000	0.0000
FPIGHEA	0.0000	0.0000	0.0000	0.0000
PULREAR	0.0000	13.9923	0.0000	0.0000
EGGCAGE	0.0000	16.2376	0.0000	0.0000
EGGRANGE	0.0000	0.0000	0.0000	0.0000
EBARN	0.0000	0.0000	0.0000	0.0000
CHBROILE	0.0000	14.9132	0.0000	13.2940
TFFthen	0.0000	10.0723	0.0000	0.0000
tfftstag	0.0000	9.6646	0.0000	0.0000
PPOUT	0.0000	0.0000	0.0000	0.0000
UPolMan	0.0000	0.0000	0.0000	0.0000
Upigslur	0.0000	0.0000	0.0000	0.0000

C)	17.Large Hill Sheep Wales & Northern Ireland 4703.1140		18.Large LFA North of England 39699.9200		19.Large LFA Scotland 84458.9800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	0.3694	0.0000	0.0413	0.0000	0.0000	11162.1855
CJAN	0.0000	7.8600	0.0000	7.8600	0.0000	15.7200
CFEB	0.0000	7.8600	0.0000	7.8600	0.0000	15.7200
CMAR	0.0000	5.6962	0.0000	5.6962	0.0000	15.7200
CAPR	1887.9799	0.0000	1147.4138	0.0000	570.1313	0.0000
CMAY	895.5775	0.0000	553.7634	0.0000	0.0000	15.7200
CJUN	1123.7291	0.0000	635.1151	0.0000	0.0000	4.3449
CJUL	1198.1052	0.0000	662.3790	0.0000	103.8225	0.0000
CAUG	758.0613	0.0000	376.6430	0.0000	0.0000	15.7200
CSEP	636.9998	0.0000	283.8810	0.0000	0.0000	15.7200
COCT	42.1534	0.0000	14.4295	0.0000	0.0000	15.7200
CNOV	0.0000	7.8600	0.0000	7.8600	0.0000	15.7200
CDEC	0.0000	7.8600	0.0000	7.8600	0.0000	15.7200
BHAY	85.3952	0.0000	53.3762	0.0000	493.6570	0.0000
BBAR	40.2057	0.0000	0.0000	46.5055	78.3019	0.0000
SBAR	0.0000	83.7827	0.0000	19.7186	0.0000	16.3297
USLYCat	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UFYMCat	544.4131	0.0000	710.3618	0.0000	2483.8948	0.0000
BUYN	14111.0693	0.0000	5832.9893	0.0000	32207.6094	0.0000
BUYP	21261.4297	0.0000	12192.6943	0.0000	34992.5352	0.0000
BUYK	21167.7969	0.0000	11259.7646	0.0000	32498.0117	0.0000
bHeifers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SSLambs	0.0000	0.0000	0.0000	25.0180	0.0000	6.1690
bSLambs	0.0000	31.6513	0.0000	0.0000	0.0000	0.0000
sGimmers	0.0000	46.4066	0.0000	41.0143	0.0000	0.0000
bGimmers	0.0000	18.7578	0.0000	10.4934	0.0000	12.7009
bwSTRAW	35.6509	0.0000	69.0831	0.0000	331.4401	0.0000
bBSTRAW	0.0000	9.9583	0.0000	9.1502	0.0000	6.5144
bOSTRAW	0.0000	9.9583	0.0000	9.1502	0.0000	6.5144
WW1	0.0000	435.7180	0.0000	64.9324	0.0000	44.3300
WW2	0.0000	509.1536	0.0000	107.2959	0.0000	77.0882
WW3	0.0000	495.5441	0.0000	185.1010	0.0000	119.2104
BWW1	0.0000	5.7143	0.0000	0.0000	0.0000	0.0000
BWW2	0.0000	86.1509	0.0000	0.0000	0.0000	0.0000
BWW3	0.0000	54.9541	0.0000	38.5557	0.0000	0.0000
MSBAR1	0.0000	194.3646	0.0000	169.8659	0.0000	50.5043
MSBAR2	0.0000	209.3154	0.0000	178.6179	0.0000	119.5165
MSBAR3	0.0000	214.2315	0.0000	197.8525	0.0000	15.3334
WB125	1.2673	0.0000	4.1105	0.0000	0.0000	17.8780
WB180	0.0000	119.8528	0.0000	86.1936	0.0000	63.7325
WB225	0.0000	61.8962	0.0000	165.4269	0.0000	106.8269
SBAR75	0.0000	185.7917	0.0000	138.1859	3.5643	0.0000
SBAR100	0.0000	209.0444	0.0000	183.7184	0.0000	80.7554
SBAR125	0.0000	219.9191	0.0000	236.8987	0.0000	15.4756
WO50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
WO100	0.0000	33.5959	0.0000	66.0332	0.0000	33.6814
WO125	0.0000	69.4087	0.0000	147.9545	0.0000	83.6461
SO50	0.0000	525.8076	0.0000	169.5626	0.0000	200.4004
SO100	0.0000	559.4036	0.0000	235.5958	0.0000	195.1453

C)	17.Large Hill Sheep Wales & Northern Ireland 4703.1140		18.Large LFA North of England 39699.9200		19.Large LFA Scotland 84458.9800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SO125	0.0000	595.2271	0.0000	317.5279	0.0000	284.0576
RYE1	0.0000	59.6570	0.0000	82.0053	0.0000	88.0404
RYE2	0.0000	82.6432	0.0000	122.6951	0.0000	107.2330
RYE3	0.0000	102.2561	0.0000	155.3465	0.0000	126.7021
TRIT150	0.0000	18.7227	0.0000	41.9571	0.0000	46.9957
TRIT180	0.0000	38.0917	0.0000	76.7381	0.0000	60.1325
TRIT200	0.0000	59.4125	0.0000	111.1513	0.0000	81.4071
WOSR150	0.0000	223.6316	0.0000	201.3341	0.0000	273.4050
WOSR185	0.0000	300.1079	0.0000	313.7737	0.0000	357.8888
WOSR225	0.0000	297.4524	0.0000	358.9084	0.0000	340.7813
SOSR90	0.0000	125.1126	0.0000	108.7549	0.0000	251.4420
SOSR110	0.0000	235.1006	0.0000	273.1480	0.0000	307.4810
SOSR130	0.0000	220.1218	0.0000	318.6220	0.0000	385.1862
LIN50	0.0000	359.3494	0.0000	331.5423	0.0000	462.5865
LIN80	0.0000	371.5486	0.0000	354.3975	0.0000	472.6123
LIN120	0.0000	384.7769	0.0000	384.5949	0.0000	490.1631
SFB20K	0.0000	107.6148	0.0000	117.6440	0.0000	207.3436
SFB40K	0.0000	100.4795	0.0000	87.5833	0.0000	169.2044
SFB60K	0.0000	96.0491	0.0000	76.8245	0.0000	150.8475
SETSC	0.0000	90.9974	0.0000	84.2089	0.0000	331.1576
SETNR	0.9700	0.0000	12.6414	0.0000	0.0000	244.4366
WORSA100	0.0000	131.3445	0.0000	319.9825	0.0000	403.3662
WORSA140	0.0000	190.9770	0.0000	430.7027	0.0000	506.8696
WORSA180	0.0000	227.0927	0.0000	529.5508	0.0000	533.1619
SORSA60	0.0000	0.0000	0.0000	237.1166	0.0000	387.6170
SORSA85	0.0000	66.6834	0.0000	333.5219	0.0000	460.6214
SORSA110	0.0000	56.1337	0.0000	358.8690	0.0000	460.7994
SBEET1	0.0000	42.3465	0.0000	0.0000	0.0000	42.9534
SBEET2	0.0000	126.1273	0.0000	73.9183	0.0000	48.6436
SBEET3	0.0000	78.3009	0.0000	50.2328	0.0000	0.0000
POTEW1	0.0000	1428.4406	0.0000	1730.0446	0.0000	2047.1814
POTEW2	0.0000	1409.3146	0.0000	1600.9454	0.0000	1854.1731
POTEW3	0.0000	1338.6017	0.0000	1410.0669	0.0000	1641.2281
PTMCW140	0.0000	1682.0249	0.0000	1966.0834	0.0000	2360.4492
PTMCW180	0.0000	1703.7150	0.0000	1908.3931	0.0000	2144.0767
PTMCW220	0.0000	1661.4845	0.0000	1879.6232	0.0000	2114.5588
PMCWBPP1	0.0000	1355.3395	0.0000	1668.1992	0.0000	1966.8884
PMCWBPP2	0.0000	1324.0531	0.0000	1509.0907	0.0000	1750.0736
PMCWBPP3	0.0000	1310.1418	0.0000	1474.7666	0.0000	1661.1483
PTPOF1	0.0000	1340.8065	0.0000	1688.2587	0.0000	2203.7412
PTPOF2	0.0000	1335.0723	0.0000	1603.3477	0.0000	2058.1597
PTPOF3	0.0000	1343.6050	0.0000	1621.0189	0.0000	2017.7129
PTPEXST1	0.0000	1113.3982	0.0000	1426.7737	0.0000	1743.3252
PTPEXST2	0.0000	1084.4334	0.0000	1269.3818	0.0000	1523.4591
PTPEXST3	0.0000	1073.5437	0.0000	1241.9170	0.0000	1436.7532
POTSEED1	0.0000	148.7914	0.0000	469.9849	0.0000	574.9598
POTSEED2	0.0000	61.9742	0.0000	145.7430	0.0000	196.0096
POTSEED3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POTDUAL1	0.0000	932.2778	0.0000	1226.0149	0.0000	1381.8960
POTDUAL2	0.0000	879.3458	0.0000	998.3458	0.0000	1093.9269
POTDUAL3	0.0000	847.5228	0.0000	922.3674	0.0000	961.4231

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	4703.1140		39699.9200		84458.9800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SWEDE1	0.0000	1074.7477	0.0000	1031.6702	0.0000	1332.7729
SWEDE2	0.0000	1459.6014	0.0000	1509.9968	0.0000	2030.5098
SWEDE3	0.0000	1104.7687	0.0000	1014.9229	0.0000	1193.8690
GR0	806.3326	0.0000	531.0308	0.0000	828.2543	0.0000
GR50	122.8772	0.0000	0.0000	9.9109	0.0000	9.5889
GR75	0.0000	10.9809	0.0000	12.8922	0.0000	4.3760
GR125	0.0000	14.0390	0.0000	4.9421	166.9705	0.0000
GR200	0.0000	47.2319	0.0000	23.7684	0.0000	6.4191
GR375	0.0000	148.6275	0.0000	97.9594	0.0000	44.4781
SILAGE12	0.0000	102.6862	0.0000	98.6030	0.0000	39.2806
SILAGE27	25.6601	0.0000	19.9693	0.0000	49.4452	0.0000
SILAGE30	0.0000	79.1423	0.0000	73.3858	0.0000	60.0774
HAY0	0.0000	287.3733	0.0000	329.5072	0.0000	369.4624
HAY50	0.0000	142.6203	0.0000	183.7091	0.0000	261.3621
HAY75	0.0000	179.7257	0.0000	215.1455	0.0000	282.6345
HAY125	0.0000	141.3143	0.0000	175.8754	0.0000	253.3039
HAY200	0.0000	165.1193	0.0000	193.3773	0.0000	264.2828
FMAIZE1	0.0000	993.6338	0.0000	642.9509	0.0000	789.7675
FMAIZE2	0.0000	1051.3993	0.0000	718.1691	0.0000	969.4935
FMAIZE3	0.0000	1035.4309	0.0000	728.0776	0.0000	854.9367
FMAIZEP1	0.0000	1332.6730	0.0000	950.1516	0.0000	1013.7682
FMAIZEP2	0.0000	1425.8538	0.0000	1057.3960	0.0000	1188.6677
FMAIZEP3	0.0000	1370.0402	0.0000	1022.9244	0.0000	1071.0548
SWEDESGR	0.0000	34.2567	0.0000	31.4766	0.0000	22.4096
TURNIPSG	3.4998	0.0000	1.5453	0.0000	8.9542	0.0000
KALEAGEd	0.0000	293.8395	0.0000	254.0250	0.0000	190.5040
KALEAGEB	0.0000	127.5949	0.0000	101.2719	0.0000	81.7525
RapeBroa	0.0000	6.5725	0.0000	6.0391	0.0000	4.2995
RapeDril	13.7529	0.0000	10.7028	0.0000	8.8115	0.0000
RapeDD	0.0000	103.7659	0.0000	95.3449	0.0000	67.8801
Fbeet1	0.0000	191.5092	0.0000	98.2493	0.0000	84.5075
Fbeet2	0.0000	233.9819	0.0000	186.9280	0.0000	150.0474
Fbeet3	0.0000	278.1258	0.0000	287.7843	0.0000	223.3573
FRYE1	0.0000	735.9230	0.0000	414.2887	0.0000	606.7930
FRYE2	0.0000	756.9550	0.0000	464.5175	0.0000	641.1891
FRYE3	0.0000	777.9871	0.0000	510.9146	0.0000	675.5851
IRG1	0.0000	840.2942	0.0000	496.9650	0.0000	639.4396
IRG2	0.0000	872.4038	0.0000	590.3342	0.0000	703.4662
IRG3	0.0000	895.7028	0.0000	675.7202	0.0000	760.2800
HILLSTP1	0.0000	12.7517	0.0000	13.7134	0.0000	8.8460
HILLSTP2	0.0000	9.5753	0.0000	10.3919	0.0000	4.8226
HILLFLG1	2020.6962	0.0000	1470.4369	0.0000	0.0000	0.6803
HILLFLG2	1900.3672	0.0000	1313.2151	0.0000	4037.6570	0.0000
WINFINMK	0.0000	5.9335	0.0000	25.5052	0.0000	8.9289
WINFINLK	0.0000	11.6988	0.0000	30.4505	0.0000	13.4070
WINFINBF	0.0000	26.8970	0.0000	48.0171	0.0000	21.7031
WINFINSK	0.0000	30.6400	0.0000	47.8956	0.0000	30.8937
AFLGR	0.0000	25.4516	0.0000	53.1899	0.0000	29.0945
GIMMERIN	0.0000	0.0000	0.0000	0.0000	0.0000	41.6647
INDOORLA	0.0000	77.4243	0.0000	100.5911	0.0000	75.3952
HILLSU1	35.5345	0.0000	60.0831	0.0000	285.7803	0.0000

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	4703.1140		39699.9200		84458.9800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
HILLSU2	0.0000	85.8079	0.0000	93.6714	0.0000	57.8910
HILLSU3	0.0000	69.0814	0.0000	24.2209	36.6597	0.0000
18MthST	0.0000	167.7101	0.0000	152.6960	0.0000	134.9413
18mthHF	0.0000	188.4608	0.0000	199.3533	0.0000	144.7098
24mthFr	0.0000	1.1668	0.0000	1.2036	0.0000	1.2336
24mthB	90.0000	0.0000	23.6274	0.0000	90.0000	0.0000
Owscsbst	0.0000	38.1925	0.0000	19.7380	0.0000	55.8295
Owscsbhf	0.0000	73.5239	0.0000	61.5297	0.0000	62.1103
Owscwbst	0.0000	64.9665	0.0000	44.7998	0.0000	79.1619
Owscwbhf	0.0000	179.2221	0.0000	169.2184	0.0000	169.8941
OWSCSTSB	0.0000	87.9207	0.0000	102.7666	0.0000	90.9987
OWSCHFSB	0.0000	69.7347	0.0000	85.6360	0.0000	76.9901
OWMJST	0.0000	87.9207	0.0000	102.7666	0.0000	90.9987
OWMJHF	0.0000	69.7347	0.0000	85.6360	0.0000	76.9901
RYCSBMST	0.0000	215.0858	0.0000	172.3929	0.0000	190.0905
RYCSBLST	0.0000	234.6035	0.0000	192.5264	0.0000	210.7250
RYCABMST	0.0000	20.3317	66.3726	0.0000	0.0000	35.7234
RYCABLST	0.0000	35.8186	0.0000	15.9755	0.0000	52.0964
WFLFBST	0.0000	91.9776	0.0000	76.1982	0.0000	69.9637
SFLFBST	0.0000	133.7692	0.0000	133.8607	0.0000	100.7674
IBBFCF	0.0000	317.1879	0.0000	192.3340	0.0000	157.2868
IBBBXSF	0.0000	309.2976	0.0000	315.1094	0.0000	281.2782
IBBSCCF	0.0000	211.9747	0.0000	125.2823	0.0000	132.5842
IBBSCSF	0.0000	228.0528	0.0000	228.2790	0.0000	243.8715
CRFBFsl	0.0000	308.6244	0.0000	262.2296	0.0000	144.6964
CRMBBFsl	0.0000	312.8674	0.0000	266.6065	0.0000	149.1821
CRLBBFsl	0.0000	317.1104	0.0000	270.9833	0.0000	153.6679
CRFALstl	0.0000	385.6299	0.0000	329.6385	0.0000	183.0998
CRFBFhfl	0.0000	308.6244	0.0000	262.2296	0.0000	144.6964
CRMBBFhl	0.0000	312.8674	0.0000	266.6065	0.0000	149.1821
CRLBBFhl	0.0000	317.1104	0.0000	270.9833	0.0000	153.6679
CRFALhfl	0.0000	385.6299	0.0000	329.6385	0.0000	183.0998
FCOSTS	137153.3438	0.0000	91641.4297	0.0000	180755.3750	0.0000
EEIQ	34845.2109	0.0000	20451.6348	0.0000	40758.8477	0.0000
CEIQ	23265.5918	0.0000	13999.9482	0.0000	27063.7871	0.0000
WEIQ	27872.3047	0.0000	16388.7207	0.0000	32408.8359	0.0000
TPest	445.8641	0.0000	258.8937	0.0000	531.0323	0.0000
Herb	443.2915	0.0000	250.5493	0.0000	520.8384	0.0000
Insectic	0.0380	0.0000	0.1233	0.0000	3.0653	0.0000
Fungicid	2.5346	0.0000	8.2210	0.0000	7.1286	0.0000
Growth	0.0000	427.6982	0.0000	143.6049	0.0000	176.2430
STBO	67970.0000	0.0000	50400.0000	0.0000	30992.8359	0.0000
LOSS	115684.8516	0.0000	96208.5781	0.0000	224378.3750	0.0000
TOTLAB	54720.1875	0.0000	29243.2344	0.0000	5297.2769	0.0000
SOILIND	4149.5269	0.0000	2448.4526	0.0000	4412.5815	0.0000
LSU	545.9584	0.0000	440.3456	0.0000	903.0704	0.0000
MAIZEFOD	57762.0508	0.0000	44951.7031	0.0000	37008.3398	0.0000
FOD	76823.5313	0.0000	59785.7656	0.0000	148033.3594	0.0000
BSP	0.0000	0.0000	66.3726	0.0000	0.0000	0.0000
BSPFULL	90.0000	0.0000	23.6274	0.0000	90.0000	0.0000

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	14189.990		26589.880		14586.750		17229.380	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	0.0000	0.0000	0.0000	1563.7098	0.0000	337.5498	0.0000	2789.8699
CJAN	0.0000	0.0000	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CFEB	0.0000	0.0000	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CMAR	0.0000	0.0000	27.8009	0.0000	1.6977	0.0000	0.0000	7.8600
CAPR	0.0000	0.0000	340.3103	0.0000	333.7470	0.0000	303.1170	0.0000
CMAY	0.0000	0.0000	235.9055	0.0000	111.5366	0.0000	121.0960	0.0000
CJUN	0.0000	0.0000	154.2248	0.0000	93.9883	0.0000	123.2166	0.0000
CJUL	0.0000	0.0000	186.8583	0.0000	121.2692	0.0000	134.6094	0.0000
CAUG	0.0000	0.0000	0.8101	0.0000	48.4057	0.0000	16.6935	0.0000
CSEP	0.0000	0.0000	0.0000	7.8600	8.1456	0.0000	0.0000	7.8600
COCT	0.0000	0.0000	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CNOV	0.0000	0.0000	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CDEC	0.0000	0.0000	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
BHAY	2.0781	0.0000	30.7147	0.0000	35.2383	0.0000	47.1343	0.0000
BBAR	7.9575	0.0000	48.5592	0.0000	15.8206	0.0000	43.2174	0.0000
SBAR	0.0000	120.0210	0.0000	13.4069	0.0000	23.1889	0.0000	9.9842
USLYCat	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UFYMCat	720.2919	0.0000	991.7065	0.0000	504.0960	0.0000	673.6708	0.0000
BUYN	7354.8389	0.0000	12306.944	0.0000	10235.980	0.0000	12993.239	0.0000
BUYP	4267.3726	0.0000	3546.7791	0.0000	3040.6328	0.0000	4223.3608	0.0000
BUYK	3372.5967	0.0000	1715.8534	0.0000	1799.2839	0.0000	2962.2542	0.0000
bHeifers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SSLambs	0.0000	45.3413	0.0000	0.0000	0.0000	8.7602	0.0000	0.0000
bSLambs	0.0000	0.0000	0.0000	5.0648	0.0000	0.0000	0.0000	3.7718
sGimmers	0.0000	20.9327	0.0000	10.4276	0.0000	0.0000	0.0000	0.0000
bGimmers	0.0000	72.4170	0.0000	0.0000	0.0000	18.0358	0.0000	7.7655
bwSTRAW	31.8826	0.0000	33.1571	0.0000	19.6454	0.0000	30.2281	0.0000
bBSTRAW	0.0000	13.1115	0.0000	5.8997	0.0000	7.2765	0.0000	5.8094
bOSTRAW	0.0000	13.1115	0.0000	5.8997	0.0000	7.2765	0.0000	5.8094
WW1	0.0000	733.3088	0.0000	125.5751	0.0000	77.1185	8.2934	0.0000
WW2	0.0000	840.5272	0.0000	144.3592	0.0000	91.3037	0.0000	67.9451
WW3	0.0000	976.3168	0.0000	183.2575	0.0000	141.7420	0.0000	42.6407
BWW1	0.0000	0.0000	0.0000	61.3956	0.0000	8.5764	0.0000	0.0000
BWW2	0.0000	0.0000	0.0000	65.1378	0.0000	1.6710	0.0000	56.0331
BWW3	0.0000	113.0780	0.0000	94.6749	0.0000	41.2465	0.0000	3.5409
MSBAR1	0.0000	0.0000	0.0000	246.7824	0.0000	324.8615	0.0000	254.8380
MSBAR2	0.0000	120.9177	0.0000	233.8660	0.0000	314.2871	0.0000	240.1660
MSBAR3	0.0000	42.8030	0.0000	231.0324	0.0000	315.1863	0.0000	235.7720
WB125	0.0000	88.5328	5.4948	0.0000	2.3503	0.0000	0.0000	11.4828
WB180	3.8700	0.0000	0.0000	135.4756	0.0000	88.0278	0.0000	109.0248
WB225	0.0000	282.3083	0.0000	65.1419	0.0000	97.3523	0.0000	87.7633
SBAR75	0.0000	125.0483	0.0000	210.7345	0.0000	214.9196	0.0000	156.3287
SBAR100	0.0000	284.6793	0.0000	224.6487	0.0000	234.2456	0.0000	169.7148
SBAR125	0.0000	170.5765	0.0000	251.7878	0.0000	269.4041	0.0000	196.3029
WO50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
WO100	0.0000	105.4894	0.0000	37.5036	0.0000	39.7624	0.0000	28.0557
WO125	0.0000	229.6913	0.0000	71.2442	0.0000	96.9148	0.0000	71.3711
SO50	0.0000	820.6799	0.0000	265.6482	0.0000	301.4253	0.0000	206.4295
SO100	0.0000	881.4243	0.0000	303.1518	0.0000	341.1877	0.0000	234.4852
SO125	0.0000	1050.3840	0.0000	336.8923	0.0000	398.3520	0.0000	277.8110

C)	20.Small LFA Beef Scotland 14189.990		21.Small LFA Farms South West England 26589.880		22.Small Hill Wales & Northern Ireland 14586.750		23.Small LFA North & Central England 17229.380	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
RYE1	0.0000	93.3269	0.0000	88.6606	0.0000	93.5781	0.0000	82.9175
RYE2	0.0000	159.6031	0.0000	105.6037	0.0000	116.5859	0.0000	98.5806
RYE3	0.0000	209.4696	0.0000	123.0662	0.0000	138.9391	0.0000	115.3814
TRIT150	0.0000	46.1592	0.0000	50.9270	0.0000	49.7439	0.0000	44.4533
TRIT180	0.0000	105.4762	0.0000	62.3030	0.0000	66.2844	0.0000	54.4413
TRIT200	0.0000	157.4175	0.0000	81.4254	0.0000	90.5659	0.0000	72.9342
WOSR150	0.0000	187.5943	0.0000	231.5500	0.0000	243.2651	0.0000	260.1219
WOSR185	0.0000	344.4839	0.0000	285.2925	0.0000	332.0162	0.0000	320.6966
WOSR225	0.0000	384.6268	0.0000	306.7759	0.0000	347.0996	0.0000	336.8061
SOSR90	0.0000	70.6786	0.0000	195.8408	0.0000	195.8985	0.0000	215.8985
SOSR110	0.0000	214.9791	0.0000	229.5966	0.0000	336.9326	0.0000	247.4022
SOSR130	0.0000	384.1780	0.0000	316.2618	0.0000	347.8058	0.0000	332.8399
LIN50	0.0000	347.1520	0.0000	366.7072	0.0000	492.7975	0.0000	388.8519
LIN80	0.0000	384.9942	0.0000	375.5069	0.0000	504.9991	0.0000	396.8648
LIN120	0.0000	431.4838	0.0000	391.2244	0.0000	525.2371	0.0000	411.9294
SFB20K	0.0000	91.5557	0.0000	197.3939	0.0000	312.8810	0.0000	181.4093
SFB40K	0.0000	62.1277	0.0000	162.1032	0.0000	272.9676	0.0000	144.9115
SFB60K	0.0000	55.4331	0.0000	144.9989	0.0000	254.1808	0.0000	126.9522
SETSC	0.0000	110.1367	0.0000	70.7793	0.0000	83.5239	0.0000	69.3132
SETNR	3.8700	0.0000	0.3500	0.0000	0.2800	0.0000	0.6700	0.0000
WORSA1	0.0000	460.7911	0.0000	311.7779	0.0000	388.0532	0.0000	316.0292
WORSA2	0.0000	663.2143	0.0000	357.8636	0.0000	468.5987	0.0000	369.0200
WORSA3	0.0000	776.9082	0.0000	424.3521	0.0000	536.1498	0.0000	428.8943
SORSA1	0.0000	359.4709	0.0000	275.2786	0.0000	341.9985	0.0000	270.9977
SORSA2	0.0000	494.0499	0.0000	296.7427	0.0000	422.8422	0.0000	291.0342
SORSA3	0.0000	544.9384	0.0000	340.9500	0.0000	425.9102	0.0000	334.2544
SBEET1	0.0000	37.0531	0.0000	25.9480	0.0000	18.7539	0.0000	31.9585
SBEET2	0.0000	110.3757	0.0000	58.9553	0.0000	62.7923	0.0000	62.8510
SBEET3	0.0000	121.2590	0.5400	0.0000	0.4200	0.0000	0.0000	0.0000
POTEW1	0.0000	1814.1298	0.0000	1890.5648	0.0000	2155.7341	0.0000	1946.7583
POTEW2	0.0000	1711.5682	0.0000	1711.2367	0.0000	1956.3795	0.0000	1759.6210
POTEW3	0.0000	1461.1187	0.0000	1528.2933	0.0000	1744.3398	0.0000	1572.9020
PTMCW1	0.0000	2129.4829	0.0000	2127.2959	0.0000	2428.5112	0.0000	2189.1514
PTMCW2	0.0000	1995.8356	0.0000	2010.0321	0.0000	2302.0662	0.0000	2064.8879
PTMCW3	0.0000	2076.9177	0.0000	1920.0171	0.0000	2207.2754	0.0000	1968.4012
PMCWBPP1	0.0000	1755.0762	0.0000	1816.2227	0.0000	2071.8706	0.0000	1869.7684
PMCWBPP2	0.0000	1611.5042	0.0000	1615.2251	0.0000	1846.3164	0.0000	1661.0386
PMCWBPP3	0.0000	1614.8998	0.0000	1531.7997	0.0000	1757.3430	0.0000	1572.1577
PTPOF1	0.0000	1602.3502	0.0000	2040.7046	0.0000	2300.6929	0.0000	2114.0505
PTPOF2	0.0000	1550.0883	0.0000	1905.0437	0.0000	2151.7495	0.0000	1971.5790
PTPOF3	0.0000	1618.6449	0.0000	1866.0361	0.0000	2115.0859	0.0000	1927.6322
PTPEXST1	0.0000	1451.2698	0.0000	1611.4386	0.0000	1830.4514	0.0000	1662.7240
PTPEXST2	0.0000	1313.6416	0.0000	1407.4861	0.0000	1602.1752	0.0000	1450.6382
PTPEXST3	0.0000	1329.0382	0.0000	1325.9511	0.0000	1516.1086	0.0000	1363.3407
POTSEED1	0.0000	477.4820	0.0000	531.4811	0.0000	603.6289	0.0000	548.4377
POTSEED2	0.0000	133.6253	0.0000	181.6495	0.0000	204.1279	0.0000	188.4994
POTSEED3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POTDUAL1	0.0000	1341.7476	0.0000	1274.3185	0.0000	1461.8245	0.0000	1307.9534
POTDUAL2	0.0000	1118.1504	0.0000	1007.8792	0.0000	1160.3795	0.0000	1032.4511
POTDUAL3	0.0000	1073.2104	0.0000	884.3633	0.0000	1024.9651	0.0000	902.6398

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	14189.990		26589.880		14586.750		17229.380	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SWEDE1	0.0000	2914.1062	0.0000	1086.7457	0.0000	1710.0590	0.0000	1731.9111
SWEDE2	0.0000	3308.2795	0.0000	1322.9523	0.0000	2432.0669	0.0000	2191.8245
SWEDE3	0.0000	2993.6399	0.0000	955.2559	0.0000	1575.2949	0.0000	1589.1774
GR0	48.5864	0.0000	0.0000	7.1435	2.3689	0.0000	61.8000	0.0000
GR50	38.1974	0.0000	87.4003	0.0000	41.6735	0.0000	29.4098	0.0000
GR75	7.4450	0.0000	49.1899	0.0000	40.7032	0.0000	0.0000	1.0439
GR125	0.0000	20.0198	0.0000	0.2209	33.2587	0.0000	64.0706	0.0000
GR200	0.0000	64.4788	0.0000	18.1502	0.0000	24.7074	0.0000	4.5735
GR375	0.0000	194.3143	0.0000	75.3281	0.0000	99.5526	0.0000	48.4041
SILAGE12	12.8578	0.0000	0.0000	46.2643	0.0000	51.1183	0.0000	98.4328
SILAGE27	14.1034	0.0000	19.0699	0.0000	4.5157	0.0000	12.3195	0.0000
SILAGE30	0.0000	105.2267	0.0000	57.9052	0.0000	65.4464	0.0000	57.4221
HAY0	0.0000	145.9738	0.0000	253.3224	0.0000	245.3435	0.0000	285.6425
HAY50	0.0000	16.7365	0.0000	162.1957	0.0000	134.3519	0.0000	188.3977
HAY75	0.0000	79.4000	0.0000	183.0065	0.0000	160.3866	0.0000	207.1059
HAY125	0.0000	48.0718	0.0000	158.5719	0.0000	130.6979	0.0000	180.6729
HAY200	0.0000	100.4366	0.0000	170.8368	0.0000	146.3086	0.0000	190.1703
FMAIZE1	0.0000	526.6265	0.0000	213.3476	0.0000	484.4179	0.0000	406.7054
FMAIZE2	0.0000	1352.9937	0.0000	211.7869	0.0000	544.1222	0.0000	482.2785
FMAIZE3	0.0000	514.0897	0.0000	228.1674	0.0000	556.0167	0.0000	456.7455
FMAIZEP1	0.0000	810.8621	0.0000	364.9651	0.0000	733.2397	0.0000	597.0993
FMAIZEP2	0.0000	1609.9178	0.0000	353.6209	0.0000	816.3888	0.0000	667.3795
FMAIZEP3	0.0000	753.7202	0.0000	363.8064	0.0000	795.7949	0.0000	638.4949
SWEDESGR	0.0000	1054.4126	0.0000	165.4515	0.0000	25.0313	0.0000	19.9842
TURNIPSG	0.0000	1009.3090	0.0000	145.1566	2.3950	0.0000	2.8412	0.0000
KALEAGEd	0.0000	367.8465	0.0000	169.1208	0.0000	210.2647	0.0000	152.8048
KALEAGEB	0.0000	148.9629	0.0000	70.6315	0.0000	88.7901	0.0000	55.8235
RapeBroa	0.0000	297.0147	0.0000	27.4048	0.0000	4.8025	0.0000	3.8342
RapeDril	0.0000	288.3611	0.0000	23.5111	0.8047	0.0000	2.1954	0.0000
RapeDD	0.0000	424.9831	0.0000	84.9857	0.0000	75.8215	0.0000	60.5335
Fbeet1	0.0000	0.0000	1.5552	0.0000	0.0000	90.5830	0.0000	49.5973
Fbeet2	0.0000	56.1614	0.0000	36.0560	0.0000	163.1608	0.0000	103.7868
Fbeet3	0.0000	156.2916	0.0000	87.8627	0.0000	244.6532	0.0000	166.4975
FRYE1	0.0000	1026.9611	0.0000	320.3387	0.0000	351.7320	0.0000	299.3006
FRYE2	0.0000	1098.8652	0.0000	351.4890	0.0000	390.1521	0.0000	329.9740
FRYE3	0.0000	1165.4186	0.0000	382.6393	0.0000	428.5722	0.0000	360.6474
IRG1	0.0000	1194.2036	0.0000	356.0331	0.0000	396.8144	0.0000	327.2321
IRG2	0.0000	1339.2678	0.0000	415.5392	0.0000	471.0727	0.0000	383.3329
IRG3	0.0000	1479.9388	0.0000	469.4641	0.0000	538.9875	0.0000	432.3788
UPCLBE1	88.3184	0.0000	326.5579	0.0000	225.0172	0.0000	0.0000	0.9964
UPCLBE2	0.0000	11.0367	0.0000	9.3030	0.0000	10.7083	0.0000	10.4459
UPHBML	0.0000	0.0000	141.3855	0.0000	290.8824	0.0000	457.8759	0.0000
CBE1	0.0000	21.6617	0.0000	9.2298	0.0000	16.4235	0.0000	14.9692
CBE2	0.0000	18.7620	0.0000	7.9380	0.0000	14.9966	0.0000	13.6168
CBE3	0.0000	16.0299	0.0000	7.7715	0.0000	14.9479	0.0000	13.3770
WINFINMK	0.0000	47.7136	0.0000	2.3662	0.0000	12.3893	0.0000	38.0307
WINFINLK	0.0000	51.7901	0.0000	7.1153	0.0000	19.3401	0.0000	38.3821
WINFINBF	0.0000	88.9268	0.0000	20.6151	0.0000	33.8552	0.0000	41.4709
WINFINSK	0.0000	64.1079	0.0000	18.8005	0.0000	33.9618	0.0000	52.9182
AFLGR	0.0000	72.5047	0.0000	40.1785	0.0000	47.9662	0.0000	58.4576

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	14189.990		26589.880		14586.750		17229.380	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
GIMMERIN	0.0000	0.0000	0.0000	28.9529	0.0000	48.7437	0.0000	38.4275
INDOORLA	0.0000	110.6535	0.0000	71.3477	0.0000	85.3317	0.0000	82.1257
UPSUCKNJ	30.5273	0.0000	0.0000	46.8448	0.0000	34.1795	0.0000	21.8303
UPSUCKFA	0.0000	37.9815	0.0000	107.7501	0.0000	103.7850	0.0000	85.8498
UPSUCKMJ	4.0213	0.0000	0.0000	43.3561	0.0000	22.6006	8.6228	0.0000
UPSUCKAO	27.0034	0.0000	23.8544	0.0000	29.5704	0.0000	46.0327	0.0000
18MthST	0.0000	83.9268	108.6031	0.0000	0.0000	108.0848	0.0000	113.3391
18mthHF	59.6124	0.0000	0.0000	21.8635	65.3046	0.0000	86.2003	0.0000
24mthFr	0.0000	185.2775	0.0000	1.1341	0.0000	178.6335	0.0000	142.2867
24mthB	0.0000	183.8598	47.0923	0.0000	0.0000	177.3160	0.0000	141.1306
Owscsbst	0.0000	76.3766	0.0000	16.4339	0.0000	2.2928	3.7997	0.0000
Owscsbhf	0.0000	110.1270	0.0000	88.2551	0.0000	97.9530	0.0000	59.3592
Owscwbst	0.0000	114.4143	0.0000	40.1601	0.0000	27.1231	0.0000	20.7023
Owscwbhf	0.0000	243.7968	0.0000	189.6422	0.0000	207.1506	0.0000	159.2778
OWSCSTSB	0.0000	111.0049	0.0000	113.3253	0.0000	111.7599	0.0000	113.2069
OWSCHFSB	0.0000	72.7834	0.0000	95.2530	0.0000	96.3840	0.0000	100.4631
OWMJST	0.0000	111.0049	0.0000	113.3253	0.0000	111.7599	0.0000	113.2069
OWMJHF	0.0000	72.7834	0.0000	95.2530	0.0000	96.3840	0.0000	100.4631
RYCSBMST	0.0000	195.9006	0.0000	144.0895	0.0000	158.5681	0.0000	150.7113
RYCSBLST	0.0000	219.6134	0.0000	163.0593	0.0000	180.6049	0.0000	170.0485
RYCABMST	30.3876	0.0000	90.0000	0.0000	24.6954	0.0000	0.0000	9.5915
RYCABLST	0.0000	18.8155	0.0000	15.0522	0.0000	17.4857	0.0000	24.9351
WFLFBST	0.0000	175.6639	0.0000	127.7384	0.0000	119.6436	0.0000	82.1544
SFLFBST	0.0000	63.2367	0.0000	76.5096	0.0000	95.9220	0.0000	104.6857
IBBFCF	0.0000	365.1213	0.0000	87.4640	0.0000	216.6553	0.0000	165.4916
IBBBXSF	0.0000	595.3767	0.0000	444.2923	0.0000	313.4985	0.0000	187.6668
IBBSCCF	0.0000	210.6249	0.0000	63.9648	0.0000	182.2835	0.0000	149.6181
IBBSCSF	0.0000	416.7543	0.0000	373.0107	0.0000	254.2314	0.0000	168.8613
CRFBFs1	0.0000	342.8999	0.0000	152.9561	0.0000	204.7870	0.0000	143.9784
CRMBBFs1	0.0000	348.0548	0.0000	157.0800	0.0000	209.5776	0.0000	148.1821
CRLBBFs1	0.0000	353.2098	0.0000	161.2039	0.0000	214.3682	0.0000	152.3858
CRFALst1	0.0000	447.3090	0.0000	187.3058	0.0000	249.2229	0.0000	176.8011
CRFBFhf1	0.0000	342.8999	0.0000	152.9561	0.0000	204.7870	0.0000	143.9784
CRMBBFh1	0.0000	348.0548	0.0000	157.0800	0.0000	209.5776	0.0000	148.1821
CRLBBFh1	0.0000	353.2098	0.0000	161.2039	0.0000	214.3682	0.0000	152.3858
CRFALhf1	0.0000	447.3090	0.0000	187.3058	0.0000	249.2229	0.0000	176.8011
FCOSTS	40242.949	0.0000	63082.992	0.0000	37963.921	0.0000	49986.332	0.0000
EEIQ	6010.0908	0.0000	9272.2939	0.0000	8213.6563	0.0000	10298.310	0.0000
CEIQ	4351.8569	0.0000	6892.3335	0.0000	5716.4761	0.0000	7928.1436	0.0000
WEIQ	5447.3975	0.0000	8631.9668	0.0000	6655.8979	0.0000	9315.0117	0.0000
Tpest	82.7365	0.0000	129.5649	0.0000	110.0507	0.0000	147.7015	0.0000
Herb	74.8804	0.0000	117.4608	0.0000	105.1578	0.0000	121.4115	0.0000
Insectic	0.1161	0.0000	1.1092	0.0000	0.1881	0.0000	1.4099	0.0000
Fungicid	7.7400	0.0000	10.9949	0.0000	4.7048	0.0000	24.9630	0.0000
Growth	0.0000	641.9113	0.0000	162.4250	0.0000	210.0721	0.0000	140.3031
STBO	15470.000	0.0000	29500.000	0.0000	17261.742	0.0000	17442.371	0.0000
LOSS	22891.144	0.0000	52377.722	0.0000	24974.330	0.0000	39311.918	0.0000
TOTLAB	0.0000	1.0000	7434.8516	0.0000	5649.6914	0.0000	5492.0381	0.0000
SOILIND	533.1443	0.0000	673.0455	0.0000	515.6351	0.0000	699.3754	0.0000
LSU	142.9607	0.0000	251.5444	0.0000	155.8924	0.0000	177.8157	0.0000

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	14189.990		26589.880		14586.750		17229.380	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
MAIZEFOD	0.0000	0.0388	14273.294	0.0000	3379.8447	0.0000	9220.8369	0.0000
FOD	71146.726	0.0000	57093.179	0.0000	13519.378	0.0000	36883.347	0.0000
BSP	90.0000	0.0000	90.0000	0.0000	90.0000	0.0000	90.0000	0.0000
BSPFULL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix 33. The Lindo Print outs for the Conventional Farm Models for 1991/1992

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
C)	330423.5000		68292.7300		160854.1000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	5.1340	0.0000	0.9847	0.0000	0.8269	0.0000
CJAN	0.0000	0.0000	0.0000	4.3891	0.0000	6.9400
CFEB	0.0000	0.0000	0.0000	6.9400	0.0000	6.9400
CMAR	264.0985	0.0000	9.0670	0.0000	0.0000	3.9281
CAPR	0.0000	0.0000	18.6103	0.0000	10.4566	0.0000
CMAY	0.0000	0.0000	1.9819	0.0000	15.2526	0.0000
CJUN	119.4184	0.0000	4.5832	0.0000	22.8066	0.0000
CJUL	0.0000	0.0000	0.0000	0.6661	0.0000	6.9400
CAUG	0.0000	0.0000	0.0000	6.9400	0.0000	3.3948
CSEP	244.5709	0.0000	0.0000	6.9400	0.0000	1.6686
COCT	63.9651	0.0000	0.0000	6.9400	70.7891	0.0000
CNOV	0.6377	0.0000	15.1135	0.0000	74.5058	0.0000
CDEC	0.0000	0.0000	0.9231	0.0000	0.0000	3.0037
BHAY	0.0000	-60.0000	0.0000	23.7833	0.0000	56.3561
UPolMan	68.2851	0.0000	0.0000	0.0000	5.5042	0.0000
Upigslur	4616.3423	0.0000	1415.4158	0.0000	1376.7931	0.0000
USLYCat	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UFYMCat	379.8704	0.0000	313.6686	0.0000	143.7387	0.0000
BUYN	0.0000	-0.3600	0.0000	0.7947	2955.4299	0.0000
BUYP	0.0000	-0.3400	0.0000	0.7505	70.9893	0.0000
BUYK	0.0000	-0.1900	0.0000	0.4194	0.0000	4.4016
bwSTRAW	9.0000	0.0000	0.0000	0.0000	4.2526	0.0000
bBSTRAW	0.0000	-30.0000	0.0000	27.9544	0.0000	27.2752
bOSTRAW	0.0000	-10.0000	6.9218	0.0000	0.0000	0.0000
WW1	0.0000	577.7100	0.0000	186.5926	0.0000	220.3415
WW2	0.0000	577.3600	0.0000	87.8943	0.0000	94.0534
WW3	0.0000	681.3000	0.0000	77.0378	10.4864	0.0000
BWW1	0.0000	711.7700	0.0000	120.0261	0.0000	133.9544
BWW2	0.0000	711.3600	0.0000	4.3815	0.0000	0.0000
BWW3	10.6900	0.0000	0.0000	0.0000	0.0000	0.0000
MSBAR1	0.0000	406.2500	0.0000	360.7096	0.0000	293.9030
MSBAR2	0.0000	455.8000	0.0000	301.6598	0.0000	165.5148
MSBAR3	0.0000	496.4700	0.0000	253.1926	0.0000	49.1483
WB1	0.0000	474.4200	0.0000	122.0679	0.0000	285.9113
WB2	0.0000	484.2100	0.0000	199.6846	0.0000	161.8235
WB3	0.0000	563.9700	0.0000	0.0000	0.0000	54.6268
SBAR1	0.0000	401.3600	0.0000	301.5687	0.0000	242.1967
SBAR2	0.0000	451.3000	0.0000	242.0542	0.0000	113.2776
SBAR3	0.0000	472.7500	0.0000	216.4918	3.9762	0.0000
WO1	0.0000	317.0100	0.0000	80.2385	0.0000	194.6233
WO2	0.0000	361.2600	0.0000	36.1806	0.0000	83.4088
WO3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SO50	0.0000	329.2200	0.0000	288.8768	0.0000	313.8203
SO100	0.0000	368.9000	0.0000	250.5392	0.0000	227.0548
SO125	0.0000	393.7800	0.0000	207.7564	0.0000	95.2874
RYE1	0.0000	194.6500	0.0000	234.3121	0.0000	329.6924
RYE2	0.0000	222.6500	0.0000	200.9439	0.0000	234.0237

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
C)	330423.5000		68292.7300		160854.1000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
RYE3	0.0000	230.4300	0.0000	191.6723	0.0000	136.2163
TRIT150	0.0000	296.7100	0.0000	112.6851	0.0000	226.0781
TRIT180	0.0000	333.6500	0.0000	68.6630	0.0000	132.0065
TRIT200	0.0000	343.9100	0.0000	56.4359	0.0000	41.7566
WOSR150	0.0000	400.4200	0.0000	500.3979	0.0000	516.8865
WOSR185	0.0000	458.1000	0.0000	420.4351	0.0000	461.0717
WOSR225	0.0000	480.9600	0.0000	403.3599	0.0000	321.2187
SOSR90	0.0000	390.1300	0.0000	396.6972	0.0000	493.7133
SOSR110	0.0000	429.1500	0.0000	352.6895	0.0000	459.9728
SOSR130	0.0000	453.4100	0.0000	325.3284	0.0000	395.4553
LIN50	0.0000	313.2200	0.0000	567.5409	0.0000	649.5424
LIN80	0.0000	313.6000	0.0000	567.1123	0.0000	632.6487
LIN120	0.0000	343.4800	0.0000	533.4129	0.0000	582.4246
SFB20K	0.0000	486.5000	0.0000	259.7045	0.0000	351.6092
SFB40K	0.0000	594.7400	0.0000	137.6288	0.0000	217.3715
SFB60K	28.1659	0.0000	0.0000	116.4595	0.0000	176.8476
SETSC	0.0000	-55.0000	0.0000	144.1457	0.0000	509.6066
SETNR	0.0000	0.0000	0.0000	34.0776	0.0000	420.5679
WORSA100	0.0000	238.9900	0.0000	73.3030	0.0000	380.5494
WORSA140	0.0000	270.6000	0.0000	27.9419	0.0000	340.2745
WORSA180	0.0000	295.6600	0.0000	4.9005	0.0000	222.2096
SORSA60	0.0000	204.4600	0.0000	46.9964	0.0000	384.6858
SORSA85	0.0000	217.9000	0.0000	31.8385	0.0000	305.9622
SORSA110	0.0000	246.1300	0.0000	0.0000	0.0000	243.2937
SBEET1	0.0000	674.0000	0.0000	162.0458	0.0000	231.4074
SBEET2	0.0000	762.1700	0.0000	62.6056	0.0000	97.2533
SBEET3	0.0000	817.6800	1.8100	0.0000	8.0500	0.0000
POTEW1	0.0000	1510.9500	0.0000	2561.9402	0.0000	2695.7622
POTEW2	0.0000	1730.1801	0.0000	2314.6870	0.0000	2193.6577
POTEW3	0.0000	1866.7800	0.0000	2160.6262	0.0000	1712.1915
PTMCW140	0.0000	1899.7200	0.0000	2203.4509	0.0000	2173.0005
PTMCW180	0.0000	2132.1101	0.0000	1941.3555	0.0000	1503.2032
PTMCW220	0.0000	2339.6299	0.0000	1707.3096	0.0000	861.5059
PMCWBPP1	0.0000	2559.8301	0.0000	1400.2119	0.0000	1376.2577
PMCWBPP2	0.0000	2866.2200	0.0000	1054.6578	0.0000	622.8519
PMCWBPP3	0.0000	3057.0601	0.0000	839.4237	0.0000	0.0000
PTPOF1	0.0000	1747.0500	0.0000	2101.9634	0.0000	2194.1238
PTPOF2	0.0000	1969.7500	0.0000	1850.7969	0.0000	1621.0929
PTPOF3	0.0000	2108.4700	0.0000	1694.3451	0.0000	1142.9465
PTPEXST1	0.0000	2063.1499	0.0000	2108.1956	0.0000	2166.2302
PTPEXST2	0.0000	2339.7900	0.0000	1796.1940	0.0000	1547.1266
PTPEXST3	0.0000	2512.1101	0.0000	1601.8472	0.0000	1045.8888
POTSEED1	0.0000	1795.5000	0.0000	2636.4231	0.0000	2664.8220
POTSEED2	0.0000	2067.3401	0.0000	2329.8350	0.0000	2051.1416
POTSEED3	0.0000	2236.6699	0.0000	2138.8606	0.0000	1553.2823
POTDUAL1	0.0000	1510.2400	0.0000	2991.6130	0.0000	3080.4126
POTDUAL2	0.0000	1761.0601	0.0000	2708.7319	0.0000	2554.7666
POTDUAL3	0.0000	1917.2800	0.0000	2532.5432	0.0000	2136.0044
VIN1	0.0000	204.1300	0.0000	3218.6995	0.0000	3028.2517

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
C)	330423.5000		68292.7300		160854.1000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
VIN2	0.0000	221.9900	0.0000	3198.5564	0.0000	2991.5381
VIN3	0.0000	237.1500	0.0000	3181.4585	0.0000	2957.8752
GR0	0.0000	-23.9800	0.0000	107.3151	0.0000	221.1339
GR50	0.0000	-31.9500	0.0000	14.9463	0.0000	43.6053
GR75	0.0000	-31.9500	7.0000	0.0000	0.0000	0.0000
GR125	0.0000	-31.9500	0.0000	52.3119	0.0000	16.7480
GR200	0.0000	-31.9500	0.0000	32.0277	8.2186	0.0000
GR375	0.0000	-31.9500	8.2650	0.0000	0.0000	3.8980
SILAGE12	7.7747	0.0000	0.0000	325.3490	0.0000	148.5873
SILAGE27	0.0000	-31.9500	0.0000	215.5330	0.0000	91.2869
SILAGE30	0.0000	-31.9500	0.0000	291.1297	5.5494	0.0000
HAY0	0.0000	-35.9500	0.0000	359.2953	0.0000	202.3625
HAY50	0.0000	-36.9500	0.0000	137.0186	0.0000	194.3859
HAY75	0.0000	-37.9500	0.0000	102.7444	0.0000	49.7857
HAY125	0.0000	-38.9500	0.0000	52.0606	0.0000	62.8867
HAY200	8.7265	0.0000	1.0250	0.0000	2.5785	0.0000
FMAIZE1	0.0000	-309.5000	0.0000	94.4079	0.0000	931.1375
FMAIZE2	0.0000	-309.5000	0.0000	77.2017	0.0000	755.6408
FMAIZE3	0.0000	-309.5000	0.0000	60.0362	0.0000	580.1456
FMAIZEP1	0.0000	-516.5000	0.0000	41.2461	0.0000	1355.1104
FMAIZEP2	0.0000	-516.5000	0.0000	20.5986	0.0000	1179.3040
FMAIZEP3	0.0000	-516.5000	0.0000	0.0000	0.0000	1003.4999
SWEDESGR	0.0000	-112.9500	0.0000	0.0000	0.0000	20.2419
TURNIPSG	0.0000	-103.1500	0.0000	0.6302	0.5372	0.0000
KALEAGEd	0.0000	-279.5000	0.0000	36.9176	0.0000	751.1560
KALEAGEB	0.0000	-195.6000	0.0000	42.3127	0.0000	577.8604
RapeBroa	0.0000	-65.6800	0.0000	115.6053	0.0000	315.9384
RapeDril	0.0000	-62.4800	0.0000	115.8111	0.0000	309.3288
RapeDD	0.0000	-97.6800	0.0000	113.5476	0.0000	411.7777
Fbeet1	0.0000	-180.3700	0.0000	35.0605	0.0000	468.6671
Fbeet2	0.1328	0.0000	0.0000	0.0000	0.0000	232.3678
Fbeet3	0.0000	-180.3700	0.0000	8.6279	2.3737	0.0000
LLB120	0.0000	42.9100	0.0000	18.8197	0.0000	23.9847
LLBE140	0.0000	47.2200	0.0000	13.8755	0.0000	21.6071
LLBE180	0.0000	50.2900	0.0000	11.5584	0.0000	21.8002
CBE140	0.0000	43.4500	0.0000	21.5313	0.0000	23.1779
CBE160	0.0000	47.2500	0.0000	13.2055	0.0000	15.5480
CBE180	0.0000	50.6100	0.0000	9.6507	0.0000	11.4964
WINFINMK	16.6060	0.0000	0.0000	0.0000	363.8630	0.0000
WINFINLK	0.0000	9.7900	0.0000	11.0779	0.0000	8.5631
WINFINBF	0.0000	0.6500	0.0000	29.1433	0.0000	22.4894
WINFINSK	0.0000	1.4900	0.0000	22.9526	0.0000	22.5256
AFLGR	0.0000	14.6300	0.0000	9.6169	0.0000	8.0435
GIMMERIN	0.0000	-35.6600	0.0000	108.3408	0.0000	96.4391
INDOORLA	0.0000	5.5600	0.0000	54.5928	0.0000	47.8952
LLSUCKNJ	0.0000	273.4800	0.0000	236.5289	0.0000	340.7776
LLSUCKFA	0.0000	221.3600	0.0000	290.8404	0.0000	370.1050
LLSUCKMJ	0.0000	327.8500	0.0000	183.0121	0.0000	257.3826
LLSUCKAO	0.0000	330.2100	0.0000	200.5085	0.0000	273.9050

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
C)	330423.5000		68292.7300		160854.1000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
18MthST	0.0000	200.9500	29.3739	0.0000	9.9477	0.0000
18mthHF	0.0000	195.6000	0.0000	61.1491	0.0000	49.8100
24mthFr	0.0000	360.2500	0.0000	4.7613	32.5785	0.0000
24mthB	0.0000	361.6000	6.3926	0.0000	0.0000	29.5632
Owscsbst	0.0000	153.4500	0.0000	75.0184	0.0000	105.6757
Owscsbhf	0.0000	120.7500	0.0000	109.1993	0.0000	140.2826
Owscwbst	0.0000	127.7000	0.0000	106.2530	0.0000	136.4739
Owscwbhf	0.0000	13.1100	0.0000	232.5756	0.0000	263.4170
WFLFDBST	0.0000	111.0500	0.0000	91.4817	0.0000	115.2796
WFMFDBST	67.6123	0.0000	9.8681	0.0000	0.0000	24.5548
WFSCST	0.0000	148.1000	0.0000	45.8293	0.0000	70.2638
WFSCHF	0.0000	151.6000	0.0000	73.6926	0.0000	98.8245
BSDBXSTL	0.0000	43.8000	0.0000	156.0829	0.0000	228.6829
BSDBXSTM	0.0000	82.5900	0.0000	109.0958	0.0000	158.3809
OWSCSTWB	0.0000	56.1200	0.0000	138.9494	0.0000	192.7962
OWSCHFWB	0.0000	76.3200	0.0000	149.8842	0.0000	197.2802
OWSCSTSB	0.0000	56.1200	0.0000	174.8255	0.0000	228.7367
OWSCHFSB	0.0000	76.3200	0.0000	149.8842	0.0000	197.2802
OWMJST	0.0000	56.1200	0.0000	174.8255	0.0000	228.7367
OWMJHF	0.0000	76.3200	0.0000	149.8842	0.0000	197.2802
RYCSBMST	0.0000	107.2500	0.0000	312.4327	0.0000	334.9868
RYCSBLST	0.0000	176.7500	0.0000	233.5332	0.0000	255.5267
RYCABMST	0.0000	205.8000	0.0000	132.6601	0.0000	131.7962
RYCABLST	0.0000	203.1000	0.0000	134.0134	0.0000	134.8468
WFLFBST	0.0000	52.1000	0.0000	178.2236	0.0000	98.1477
SFLFBST	0.0000	48.2500	0.0000	278.9989	0.0000	208.5434
IBBFCF	0.0000	256.5000	23.5834	0.0000	0.0000	78.8661
IBBBXSF	0.0000	248.2000	0.0000	22.8216	0.0000	91.2260
IBBSCCF	22.3877	0.0000	0.0000	15.3275	0.0000	104.3120
IBBSCSF	0.0000	182.2500	0.0000	19.5743	0.0000	101.5815
BPIG3WKW	0.0000	428.1800	23.1776	0.0000	142.1276	0.0000
BPIG4WKW	295.6159	0.0000	63.2015	0.0000	146.2129	0.0000
BPIGOUT	0.0000	372.6100	0.0000	251.5876	0.0000	252.4378
FPIGPORK	0.0000	24.0100	0.0000	27.9706	0.0000	38.2701
FPIGCUT	0.0000	48.1400	0.0000	7.9785	0.0000	17.2664
FPIGBAC	1479.9004	0.0000	458.0116	0.0000	241.1954	0.0000
FPIGHEA	0.0000	37.5000	0.0000	32.3721	0.0000	40.0293
PULREAR	0.0000	4.0700	0.0000	9.9584	0.0000	9.0846
EGGCAGE	0.0000	2.8700	0.0000	18.8513	0.0000	17.0560
EGGRANGE	0.0000	7.9100	0.0000	9.4996	0.0000	8.4653
EBARN	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CHBROILE	0.0000	0.4100	0.0000	9.4767	0.0000	9.3367
TFFthen	0.0000	9.4200	0.0000	2.9824	0.0000	1.6206
tfflstag	13131.7490	0.0000	0.0000	1.9529	1058.4924	0.0000
PPOUT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FCOSTS	103600.0156	0.0000	16285.8604	0.0000	29948.6230	0.0000
EEIQ	5607.9141	0.0000	1258.6559	0.0000	5325.4727	0.0000
CEIQ	7029.6348	0.0000	1149.7301	0.0000	6836.8208	0.0000
WEIQ	12801.9932	0.0000	1174.6357	0.0000	7504.2192	0.0000

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
C)	330423.5000		68292.7300		160854.1000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
TPest	139.7206	0.0000	17.7380	0.0000	99.4835	0.0000
Herb	46.6172	0.0000	17.2131	0.0000	51.3247	0.0000
Insectic	1.8851	0.0000	0.5068	0.0000	8.6668	0.0000
Fungicid	91.3253	0.0000	0.0181	0.0000	39.5968	0.0000
Growth	0.0000	0.0000	0.0000	164.7711	0.0000	180.9087
STBO	149820.0000	0.0000	36200.0000	0.0000	91890.0000	0.0000
LOSS	326417.7500	0.0000	46651.7539	0.0000	100281.1563	0.0000
TOTLAB	45225.0039	0.0000	8101.1606	0.0000	7855.0654	0.0000
SOILIND	132.5876	0.0000	65.3093	0.0000	89.4859	0.0000
LSU	29.1097	0.0000	37.9557	0.0000	39.8061	0.0000
MAIZEFOD	1328.4771	0.0000	0.0000	0.0151	22790.9414	0.0000
FOD	55381.3945	0.0000	3336.4016	0.0000	30311.9531	0.0000
BSP	90.0000	0.0000	69.2180	0.0000	42.5262	0.0000
BSPFULL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Weaner	0.0000	0.0000	0.0000	0.0000	6206.8042	0.0000

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	81398.580		43074.360		82248.140		26262.610	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	1.7326	0.0000	0.0000	0.0000	1.9605	0.0000	0.0748	0.0000
CJAN	0.0000	0.0000	0.0000	0.0000	0.0000	6.8800	0.0000	6.8800
CFEB	0.0000	0.0000	0.0000	0.0000	0.0000	6.8800	0.0000	6.8800
CMAR	191.0558	0.0000	176.5272	0.0000	78.4114	0.0000	153.6171	0.0000
CAPR	0.0000	0.0000	18.4816	0.0000	5.0169	0.0000	0.0000	2.1851
CMAY	0.0000	0.0000	0.0000	0.0000	1.0589	0.0000	0.0000	3.7111
CJUN	56.3574	0.0000	0.0000	0.0000	204.6557	0.0000	31.6062	0.0000
CJUL	0.0000	0.0000	0.0000	0.0000	0.0000	6.8800	0.0000	6.8800
CAUG	234.5493	0.0000	341.4475	0.0000	87.7910	0.0000	223.7418	0.0000
CSEP	598.2161	0.0000	627.8457	0.0000	253.9682	0.0000	228.6877	0.0000
COCT	180.6475	0.0000	362.8921	0.0000	0.0000	6.8800	0.0000	5.9581
CNOV	31.1776	0.0000	0.0000	0.0000	0.0000	4.9743	33.0422	0.0000
CDEC	31.1776	0.0000	0.0000	0.0000	0.0000	0.0000	33.0422	0.0000
BHAY	0.0000	0.0000	0.0000	0.0000	0.0000	9.4842	0.0000	31.1521
BBAR	0.0000	2940.0000	0.0000	0.0000	0.0000	46.5271	0.0000	43.6540
SBAR	91.9116	0.0000	158.6686	0.0000	0.0000	2.9135	123.4820	0.0000
USLYCat	0.0000	0.0000	0.0000	0.0000	0.0000	13.2465	0.0000	30.0808
UFYMCat	305.8728	0.0000	304.2000	0.0000	679.8088	0.0000	89.5908	0.0000
BUYN	19501.1699	0.0000	16807.798	0.0000	25808.017	0.0000	7241.7271	0.0000
BUYP	9549.1709	0.0000	8913.4902	0.0000	10411.045	0.0000	4533.6597	0.0000
BUYK	10576.3672	0.0000	8986.4678	0.0000	11286.510	0.0000	4901.3115	0.0000
bHeifers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1098.3329
SSLambs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	11.6411
bSLambs	0.0000	0.0000	374.9950	0.0000	0.0000	13.1842	0.0000	0.0000
sGimmers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	21.9518
bGimmers	0.0000	1680.0000	0.0000	0.0000	0.0000	28.2518	0.0000	2.9933

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	81398.580		43074.360		82248.140		26262.610	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
bwSTRAW	9.0495	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bBSTRAW	0.0000	420.0000	0.0000	0.0000	0.0000	30.5716	0.0000	29.1938
bOSTRAW	0.0000	280.0000	9.0000	0.0000	20.1127	0.0000	2.6506	0.0000
WW1	0.0000	5755.1196	0.0000	0.0000	0.0000	190.8192	0.0000	181.7522
WW2	0.0000	5755.1196	0.0000	0.0000	0.0000	149.3221	0.0000	185.3819
WW3	0.0000	5755.1196	0.0000	0.0000	0.0000	265.3901	0.0000	224.5188
BWW1	0.0000	5755.1196	0.0000	0.0000	0.0562	0.0000	2.6790	0.0000
BWW2	68.7900	0.0000	45.0591	0.0000	58.7538	0.0000	17.3310	0.0000
BWW3	0.0000	5755.1196	7.1909	0.0000	0.0000	49.2741	0.0000	18.6614
MSBAR1	0.0000	5087.6001	0.0000	0.0000	0.0000	261.9474	0.0000	233.5701
MSBAR2	0.0000	5087.6001	0.0000	0.0000	0.0000	219.4372	0.0000	208.0556
MSBAR3	0.0000	5087.6001	0.0000	0.0000	0.0000	229.1995	0.0000	196.9662
WB125	22.9979	0.0000	37.9787	0.0000	0.0000	58.0530	0.0000	43.1570
WB180	0.0000	4574.9199	0.0000	0.0000	0.0000	36.0530	0.0000	69.5911
WB225	0.0000	4574.9199	0.0000	0.0000	0.0000	168.9814	0.0000	144.2628
SBAR75	0.0000	5381.6001	0.0000	0.0000	0.0000	28.7403	0.0000	0.0533
SBAR100	0.0000	5381.6001	0.0000	0.0000	12.8042	0.0000	22.6200	0.0000
SBAR125	0.0000	5381.6001	0.0000	0.0000	0.0000	40.5150	0.0000	26.8648
WO50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
WO100	0.0000	3100.7200	0.0000	0.0000	0.0000	37.8022	0.0000	34.4955
WO125	0.0000	3100.7200	0.0000	0.0000	0.0000	96.4851	0.0000	89.0562
SO50	0.0000	3038.0000	0.0000	0.0000	0.0000	194.8643	0.0000	228.6547
SO100	0.0000	3038.0000	0.0000	0.0000	0.0000	260.2630	0.0000	215.1566
SO125	0.0000	3038.0000	0.0000	0.0000	0.0000	269.4670	0.0000	317.7109
RYE1	0.0000	3183.5999	0.0000	0.0000	0.0000	151.1473	0.0000	145.7431
RYE2	0.0000	3183.5999	0.0000	0.0000	0.0000	177.1028	0.0000	169.4634
RYE3	0.0000	3183.5999	0.0000	0.0000	0.0000	201.5527	0.0000	192.2047
TRIT150	0.0000	3183.5999	0.0000	0.0000	0.0000	10.0187	0.0000	10.1273
TRIT180	0.0000	3183.5999	0.0000	0.0000	0.0000	20.4970	0.0000	18.9749
TRIT200	0.0000	3183.5999	0.0000	0.0000	0.0000	44.6365	0.0000	41.4179
WOSR150	0.0000	6029.8003	0.0000	0.0000	0.0000	611.5651	0.0000	575.2641
WOSR185	0.0000	6029.8003	0.0000	0.0000	0.0000	721.3655	0.0000	665.8841
WOSR225	0.0000	6029.8003	0.0000	0.0000	0.0000	663.4285	0.0000	647.0543
SOSR90	0.0000	2537.0801	0.0000	0.0000	0.0000	649.6290	0.0000	630.0519
SOSR110	0.0000	2537.0801	0.0000	0.0000	0.0000	701.5643	0.0000	677.7690
SOSR130	0.0000	2537.0801	0.0000	0.0000	0.0000	789.3073	0.0000	759.8951
LIN50	0.0000	5219.1997	0.0000	0.0000	0.0000	720.8533	0.0000	696.4396
LIN80	0.0000	5219.1997	0.0000	0.0000	0.0000	734.3337	0.0000	708.6669
LIN120	0.0000	5219.1997	0.0000	0.0000	0.0000	756.5615	0.0000	729.2997
SFB20K	0.0000	4627.2798	0.0000	0.0000	0.0000	119.2066	0.0000	90.6991
SFB40K	0.0000	4627.2798	16.8488	0.0000	0.0000	25.2257	5.6174	0.0000
SFB60K	36.7787	0.0000	15.5032	0.0000	21.6154	0.0000	5.9326	0.0000
SETSC	0.0000	1540.0000	0.0000	-84.1000	0.0000	95.1317	0.0000	530.1173
SETNR	0.0000	364.0000	0.0000	-84.1000	0.0000	0.0000	0.0000	445.0558
WORSA100	0.0000	5496.3999	0.0000	0.0000	0.0000	323.8983	0.0000	782.1544
WORSA140	0.0000	5496.3999	0.0000	0.0000	0.0000	449.7221	0.0000	861.4588
WORSA180	0.0000	5496.3999	0.0000	0.0000	0.0000	478.4078	0.0000	926.0533
SORSA60	0.0000	3237.0801	0.0000	0.0000	0.0000	306.9132	0.0000	769.2128
SORSA85	0.0000	3237.0801	0.0000	0.0000	0.0000	314.2480	0.0000	794.5306

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	81398.580		43074.360		82248.140		26262.610	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SORSA110	0.0000	3237.0801	0.0000	0.0000	0.0000	393.6496	0.0000	849.7833
SBEET1	0.0000	6379.2402	0.0000	0.0000	0.0000	149.4733	0.0000	180.0739
SBEET2	0.0000	6379.2402	0.0000	0.0000	0.0000	166.9732	0.0000	228.5364
SBEET3	0.0000	6379.2402	0.0000	0.0000	0.0000	126.6559	0.0000	174.6937
POTEW1	0.0000	31505.597	0.0000	-84.1000	0.0000	2285.4602	0.0000	1048.0664
POTEW2	0.0000	31505.597	0.0000	-84.1000	0.0000	2114.2849	0.0000	874.3464
POTEW3	0.0000	31505.597	0.0000	-84.1000	0.0000	1897.3942	0.0000	678.1289
PTMCW140	0.0000	33579.839	0.0000	-84.1000	0.0000	1809.6470	0.0000	1718.8898
PTMCW180	0.0000	33579.839	0.0000	-84.1000	0.0000	1516.7386	0.0000	1539.5613
PTMCW220	0.0000	33579.839	0.0000	-84.1000	0.0000	1465.8610	0.0000	1397.7991
PMCWBPP1	0.0000	32056.080	0.0000	-84.1000	0.0000	731.8619	0.0000	740.5612
PMCWBPP2	0.0000	32056.080	0.0000	-84.1000	0.0000	413.4152	0.0000	423.4289
PMCWBPP3	0.0000	32056.080	0.0000	-84.1000	0.0000	270.9966	0.0000	278.5532
PTPOF1	0.0000	26481.839	0.0000	-84.1000	0.0000	1347.6779	0.0000	1351.6427
PTPOF2	0.0000	26481.839	0.0000	-84.1000	0.0000	1125.7618	0.0000	1128.4695
PTPOF3	0.0000	26481.839	0.0000	-84.1000	0.0000	1048.5543	0.0000	1046.9043
PTPEXST1	0.0000	35889.839	0.0000	-84.1000	0.0000	788.2556	0.0000	789.0789
PTPEXST2	0.0000	35889.839	0.0000	-84.1000	0.0000	464.0937	0.0000	465.8505
PTPEXST3	0.0000	35889.839	0.0000	-84.1000	0.0000	323.2146	0.0000	321.9781
POTSEED1	0.0000	41760.878	0.0000	-84.1000	0.0000	608.6522	0.0000	605.1339
POTSEED2	0.0000	41760.878	0.0000	-84.1000	0.0000	203.8249	0.0000	204.2190
POTSEED3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POTDUAL1	0.0000	42628.878	0.0000	-84.1000	0.0000	1112.7380	0.0000	1096.1855
POTDUAL2	0.0000	42628.878	0.0000	-84.1000	0.0000	765.1255	0.0000	750.4214
POTDUAL3	0.0000	42628.878	0.0000	-84.1000	0.0000	605.4573	0.0000	588.5749
SWEDE1	0.0000	61475.679	0.0000	-84.1000	0.0000	1650.9950	0.0000	1562.2964
SWEDE2	0.0000	63340.757	0.0000	-84.1000	0.0000	2215.6238	0.0000	2116.1882
SWEDE3	0.0000	64839.597	0.0000	-84.1000	0.0000	1581.8578	0.0000	1489.2683
CAB1	0.0000	66368.679	0.0000	-84.1000	0.0000	1171.0657	0.0000	1099.9573
CAB2	0.0000	67433.804	0.0000	-84.1000	0.0000	2528.5776	0.0000	2032.7025
CAB3	0.0000	68289.476	0.0000	-84.1000	0.0000	980.4153	0.0000	911.6696
CABWW1	0.5617	0.0000	0.0000	-84.1000	2.1977	0.0000	1.7521	0.0000
CABWW2	6.0577	0.0000	2.1800	0.0000	5.4723	0.0000	1.5019	0.0000
CABWW3	5.8906	0.0000	0.0000	-84.1000	7.6000	0.0000	2.0859	0.0000
VIN1	0.0000	6104.2798	0.0000	0.0000	0.0000	1254.6294	0.0000	35.3780
VIN2	0.0000	6104.2798	0.0000	0.0000	0.0000	1234.4180	0.0000	15.8587
VIN3	0.0000	6104.2798	0.0000	0.0000	0.0000	1218.0159	0.0000	0.0000
GR0	0.0000	671.4400	0.0000	0.0000	0.0000	203.6675	0.0000	98.6598
GR50	0.0000	894.6000	27.4904	0.0000	0.0000	13.2387	7.1779	0.0000
GR75	0.0000	894.6000	0.0000	0.0000	3.9700	0.0000	0.0000	7.3895
GR125	11.6426	0.0000	0.0000	0.0000	41.9810	0.0000	0.0000	13.4835
GR200	0.0000	894.6000	0.0000	0.0000	0.0000	9.8754	0.0000	44.9099
GR375	0.0000	894.6000	0.0000	0.0000	0.0000	65.9789	0.0000	136.0423
SILAGE12	0.0000	894.6000	0.0000	0.0000	0.0000	218.9528	0.0000	148.4069
SILAGE27	3.6107	0.0000	7.1155	0.0000	15.1049	0.0000	0.0121	0.0000
SILAGE30	0.0000	894.6000	0.0000	0.0000	0.0000	91.7417	0.0000	90.6530
HAY0	0.0000	1006.6000	0.0000	0.0000	0.0000	280.2042	0.0000	204.2719
HAY50	0.0000	1034.6000	0.1024	0.0000	0.0000	31.1157	0.0000	14.5818
HAY75	0.0000	1062.6000	0.0000	0.0000	0.0000	46.2255	0.0000	34.8484

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	81398.580		43074.360		82248.140		26262.610	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
HAY125	0.0000	1090.6000	3.0710	0.0000	3.9145	0.0000	0.0000	0.0000
HAY200	0.0000	1118.6000	0.0000	0.0000	0.0000	4.0936	0.0000	14.4065
FMAIZE1	0.0000	19446.000	0.0000	0.0000	0.0000	720.2689	0.0000	17.8546
FMAIZE2	0.0000	21546.000	0.0000	0.0000	0.0000	755.9575	0.0000	169.0633
FMAIZE3	0.0000	23646.000	0.0000	0.0000	0.0000	801.7495	0.0000	0.0000
FMAIZEP1	0.0000	25242.000	0.0000	0.0000	0.0000	979.3812	0.0000	225.8132
FMAIZEP2	0.0000	27342.000	0.0000	0.0000	0.0000	1001.2965	0.0000	360.2554
FMAIZEP3	0.0000	29442.000	0.0000	0.0000	0.0000	1038.3665	0.0000	180.5756
SWEDESGR	0.0000	3162.5999	0.0000	0.0000	0.0000	379.9166	0.0000	568.1406
TURNIPSG	0.0000	2888.2000	0.0000	0.0000	0.0000	361.4756	0.0000	550.7798
KALEAGEd	0.0000	7826.0000	0.0000	0.0000	0.0000	340.3519	0.0000	353.7791
KALEAGEB	0.0000	5281.2002	0.0000	0.0000	0.0000	182.4751	0.0000	205.1499
RapeBroa	0.0000	1839.0400	0.0000	0.0000	0.0000	175.8955	0.0000	264.5863
RapeDril	0.0000	1749.4399	0.0000	0.0000	0.0000	169.8739	0.0000	258.9175
RapeDD	0.0000	2735.0400	0.0000	0.0000	0.0000	263.2076	0.0000	346.7841
Fbeet1	0.0000	5050.3599	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Fbeet2	0.0000	0.0000	0.0000	0.0000	0.0000	45.3813	0.0000	26.3661
Fbeet3	0.0000	5050.3599	0.0000	0.0000	0.0000	112.9364	0.0000	79.7247
FRYE1	0.0000	1876.0000	0.0000	0.0000	0.0000	457.3145	0.0000	393.5995
FRYE2	0.0000	1876.0000	0.0000	0.0000	0.0000	499.3710	0.0000	433.1927
FRYE3	0.0000	1876.0000	0.0000	0.0000	0.0000	541.4276	0.0000	472.7858
IRG1	0.0000	3024.0000	0.0000	0.0000	0.0000	467.0435	0.0000	430.2897
IRG2	0.0000	3024.0000	0.0000	0.0000	0.0000	548.7780	0.0000	509.6862
IRG3	0.0000	3024.0000	0.0000	0.0000	0.0000	623.2190	0.0000	583.4756
FRAPECC1	0.0000	2354.8000	3.0000	0.0000	0.0000	0.0000	0.0000	250.8570
FRAPECC2	0.0000	2354.8000	0.0000	0.0000	0.0000	0.0000	0.0000	250.8570
FRAPECC3	0.0000	2354.8000	0.0000	0.0000	0.0000	0.0000	0.0000	250.8570
TURNCC1	0.0000	2590.0000	0.0000	0.0000	0.0000	84.5836	0.0000	1543.4741
TURNCC2	0.0000	2590.0000	0.0000	0.0000	0.0000	153.3607	0.0000	1608.2227
TURNCC3	0.0000	2497.5000	0.0000	-7779.2500	0.0000	222.1378	0.0000	1672.9712
MUSTCC1	0.0000	1092.0000	0.0000	0.0000	0.0000	423.9104	0.0000	1626.2695
MUSTCC2	0.0000	1092.0000	0.0000	0.0000	0.0000	407.1631	0.0000	1610.5032
MUSTCC3	0.0000	1092.0000	0.0000	0.0000	0.0000	390.4157	0.0000	1594.7367
LLB120	0.0000	351.4000	0.0000	0.0000	0.0000	28.7766	0.0000	28.8967
LLBE140	0.0000	376.6000	0.0000	0.0000	0.0000	12.3040	0.0000	12.3779
LLBE180	0.0000	427.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CBE140	0.0000	203.5600	0.0000	0.0000	0.0000	44.3094	0.0000	38.2992
CBE160	0.0000	205.5200	0.0000	0.0000	0.0000	21.5873	0.0000	14.9508
CBE180	0.0000	208.8800	0.0000	0.0000	0.0000	7.9719	0.0000	0.4725
WINFINMK	0.0000	82.6000	374.9950	0.0000	0.0000	30.2175	0.0000	2.1085
WINFINLK	0.0000	82.6000	0.0000	0.0000	0.0000	44.3076	0.0000	1.6228
WINFINBF	0.0000	532.0000	0.0000	0.0000	0.0000	52.0335	0.0000	33.7892
WINFINSK	0.0000	61.6000	0.0000	0.0000	0.0000	57.3021	0.0000	12.1666
AFLGR	0.0000	61.6000	0.0000	0.0000	0.0000	40.9286	0.0000	16.0637
GIMMERIN	0.0000	100.8000	0.0000	0.0000	0.0000	29.3883	0.0000	0.0000
INDOORLA	0.0000	220.3600	0.0000	0.0000	0.0000	65.0433	0.0000	41.8431
HREA26	0.0000	5337.9199	0.0000	0.0000	0.0000	778.2373	0.0000	1009.5972
HRA30	0.0000	4644.9199	0.0000	0.0000	0.0000	710.1746	0.0000	967.6970
HRA36	0.0000	3356.9199	0.0000	0.0000	0.0000	624.1054	0.0000	887.1492

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	81398.580		43074.360		82248.140		26262.610	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
HRS30	0.0000	4343.9199	0.0000	0.0000	0.0000	693.1797	0.0000	942.5164
HRS36	0.0000	3538.9199	0.0000	0.0000	0.0000	638.0524	0.0000	901.9590
Dsp5000	0.0000	5376.0000	0.0000	0.0000	0.0000	452.5499	0.0000	445.7419
Dsum5000	0.0000	4704.0000	0.0000	0.0000	0.0000	323.9622	0.0000	324.2342
DAut5000	0.0000	6944.0000	0.0000	0.0000	0.0000	515.6006	0.0000	504.2736
DAll5000	0.0000	6272.0000	0.0000	0.0000	0.0000	470.4392	0.0000	461.7575
Dsp8000	0.0000	11424.000	0.0000	0.0000	0.0000	43.8944	0.0000	42.7664
Dsum8000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAut8000	0.0000	12768.000	0.0000	0.0000	0.0000	66.4959	0.0000	62.7225
DAll8000	0.0000	12096.000	0.0000	0.0000	0.0000	21.3344	0.0000	20.2064
LLSUCKNJ	0.0000	2492.0000	0.0000	0.0000	0.0000	275.3118	0.0000	302.5850
LLSUCKFA	0.0000	2455.5999	0.0000	0.0000	0.0000	364.0319	0.0000	351.3759
LLSUCKMJ	0.0000	2735.5999	0.0000	0.0000	0.0000	223.2048	0.0000	237.1626
LLSUCKAO	0.0000	2548.0000	0.0000	0.0000	0.0000	189.3650	0.0000	188.1411
18MthST	43.1836	0.0000	51.8781	0.0000	8.6503	0.0000	15.2246	0.0000
18mthHF	0.0000	1176.0000	0.0000	0.0000	102.5504	0.0000	0.0000	77.6477
24mthFr	0.0000	2004.7999	0.0000	0.0000	81.3497	0.0000	0.0000	7.2552
24mthB	0.0000	1920.7999	38.1219	0.0000	0.0000	39.0086	0.0000	4.1777
Owscsbst	0.0000	652.4000	0.0000	16.2800	0.0000	53.3627	0.0000	86.5116
Owscsbhf	0.0000	582.4000	0.0000	0.0000	0.0000	90.7681	0.0000	122.6876
Owscwbst	0.0000	694.4000	0.0000	0.0000	0.0000	98.9319	0.0000	131.0464
Owscwbhf	0.0000	618.8000	0.0000	0.0000	0.0000	248.7576	0.0000	275.3148
WFLFDBST	0.0000	771.4000	0.0000	0.0000	0.0000	140.9475	0.0000	130.0255
WFMFDBST	46.8164	0.0000	0.0000	0.0000	0.0000	6.5342	11.2816	0.0000
WFSCST	0.0000	686.0000	0.0000	0.0000	0.0000	69.6425	0.0000	60.9850
WFSCHF	0.0000	588.0000	0.0000	0.0000	0.0000	46.4444	0.0000	75.6167
BSDBXSTL	0.0000	616.0000	0.0000	0.0000	0.0000	197.4329	0.0000	142.2722
BSDBXSTM	0.0000	532.0000	0.0000	0.0000	0.0000	131.0215	0.0000	84.1647
OWSCSTWB	0.0000	532.0000	0.0000	0.0000	0.0000	169.4604	0.0000	120.0515
OWSCHFWB	0.0000	476.0000	0.0000	0.0000	0.0000	137.3629	0.0000	127.8425
OWSCSTSB	0.0000	532.0000	0.0000	0.0000	0.0000	175.9967	0.0000	163.1779
OWSCHFSB	0.0000	476.0000	0.0000	0.0000	0.0000	137.3629	0.0000	127.8425
OWMJST	0.0000	532.0000	0.0000	0.0000	0.0000	175.9967	0.0000	163.1779
OWMJHF	0.0000	476.0000	0.0000	0.0000	0.0000	137.3629	0.0000	127.8425
RYCSBMST	0.0000	2359.0000	0.0000	0.0000	0.0000	315.3563	0.0000	305.0553
RYCSBLST	0.0000	2331.0000	0.0000	0.0000	0.0000	216.8304	0.0000	210.4147
RYCABMST	0.4949	0.0000	0.0000	0.0000	8.5764	0.0000	0.0000	44.5810
RYCABLST	0.0000	2240.0000	0.0000	0.0000	0.0000	3.8093	0.0000	48.2415
WFLFBST	0.0000	669.2000	0.0000	0.0000	0.0000	59.4381	0.0000	91.2719
SFLFBST	0.0000	532.0000	0.0000	0.0000	0.0000	240.9120	0.0000	169.6141
IBBFCF	0.0000	2545.2000	0.0000	0.0000	0.0000	149.1185	0.0000	129.3239
IBBBXSF	0.0000	2329.5999	0.0000	0.0000	0.0000	87.7743	0.0000	132.3224
IBBSCCF	0.0000	835.8000	0.0000	0.0000	0.0000	177.8428	0.0000	159.2187
IBBSCSF	0.0000	721.0000	0.0000	0.0000	0.0000	140.5945	0.0000	170.3351
CRFBFs1	0.0000	5796.0000	0.0000	0.0000	0.0000	207.4462	0.0000	212.8450
CRMBBFs1	0.0000	5796.0000	0.0000	0.0000	0.0000	184.8724	0.0000	191.1530
CRLBBFs1	0.0000	5796.0000	0.0000	0.0000	0.0000	162.2986	0.0000	169.4610
CRFALst1	0.0000	6924.9600	0.0000	0.0000	0.0000	201.8757	0.0000	206.5820
CRFBFhf1	0.0000	5796.0000	0.0000	0.0000	0.0000	207.4462	0.0000	212.8450

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	81398.580		43074.360		82248.140		26262.610	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
CRMBBFh1	0.0000	5796.0000	0.0000	0.0000	0.0000	184.8724	0.0000	191.1530
CRLBBFh1	0.0000	5796.0000	0.0000	0.0000	0.0000	162.2986	0.0000	169.4610
CRFALhf1	0.0000	6924.9600	0.0000	0.0000	0.0000	201.8757	0.0000	206.5820
FCOSTS	59787.0156	0.0000	60287.773	0.0000	74151.960	0.0000	23269.511	0.0000
EEIQ	23917.7227	0.0000	20295.712	0.0000	24476.720	0.0000	12254.375	0.0000
CEIQ	30164.4941	0.0000	27440.595	0.0000	26301.173	0.0000	13199.329	0.0000
WEIQ	40173.4922	0.0000	37493.656	0.0000	34155.644	0.0000	18994.298	0.0000
TPest	525.0227	0.0000	465.0603	0.0000	467.1942	0.0000	236.5689	0.0000
Herb	175.2810	0.0000	153.0404	0.0000	189.2867	0.0000	80.8782	0.0000
Insectic	15.3866	0.0000	10.5451	0.0000	24.6741	0.0000	24.1365	0.0000
Fungicid	335.0429	0.0000	301.9974	0.0000	253.8214	0.0000	131.7543	0.0000
Growth	0.0000	0.0000	0.0000	0.0000	0.0000	200.0781	0.0000	169.8745
STBO	0.0000	-28.0000	0.0000	0.0000	28702.976	0.0000	2573.8250	0.0000
LOSS	93029.1641	0.0000	39214.300	0.0000	54674.609	0.0000	15006.174	0.0000
TOTLAB	22635.8984	0.0000	8139.9448	0.0000	19652.312	0.0000	5425.9219	0.0000
SOILIND	295.3357	0.0000	374.4836	0.0000	420.9418	0.0000	127.6179	0.0000
LSU	41.0315	0.0000	67.9682	0.0000	142.9349	0.0000	12.9420	0.0000
MAIZEFOD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0609	0.0000	0.0664
FOD	12668.0342	0.0000	36783.367	0.0000	69233.429	0.0000	53.0996	0.0000
BSP	90.0000	0.0000	90.0000	0.0000	90.0000	0.0000	26.5062	0.0000
BSPFULL	0.0000	0.0000	0.0000	0.0000	0.0000	38.3432	0.0000	0.0000

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	38135.890		110132.70		57203.860		117508.50	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	1.5300	0.0000	1.0514	0.0000	2.3400	0.0000	3.9108	0.0000
CJAN	0.0000	0.0000	133.9654	0.0000	0.0000	0.0000	0.0000	0.0000
CFEB	0.0000	5.9779	133.9654	0.0000	0.0000	8.2000	0.0000	0.0000
CMAR	110.4988	0.0000	241.2953	0.0000	161.1619	0.0000	472.0122	0.0000
CAPR	90.2393	0.0000	0.0000	0.0000	178.0863	0.0000	282.0988	0.0000
CMAY	215.9446	0.0000	0.0000	0.0000	324.2188	0.0000	646.3239	0.0000
CJUN	203.8774	0.0000	160.6047	0.0000	299.1973	0.0000	642.4564	0.0000
CJUL	160.9194	0.0000	0.0000	0.0000	318.6598	0.0000	519.3066	0.0000
CAUG	0.0000	8.2000	0.0000	0.0000	13.1597	0.0000	0.0000	0.0000
CSEP	0.0000	8.2000	0.0000	0.0000	0.0000	8.2000	0.0000	0.0000
COCT	0.0000	8.2000	0.0000	0.0000	0.0000	8.2000	59.8463	0.0000
CNOV	0.0000	8.2000	153.2807	0.0000	0.0000	8.2000	15.3714	0.0000
CDEC	0.0000	0.0000	135.8288	0.0000	0.0000	5.9779	0.0000	0.0357
BHAY	2.2991	0.0000	171.2144	0.0000	0.0000	0.5990	0.0000	0.0000
BBAR	27.2669	0.0000	94.9206	0.0000	51.4567	0.0000	74.1799	0.0000
SBAR	0.0000	29.9603	0.0000	0.0000	0.0000	36.5462	0.0000	0.0000
USLYCat	1955.2333	0.0000	983.5426	0.0000	2368.7722	0.0000	4818.5957	0.0000
UFYMCat	270.7518	0.0000	805.7986	0.0000	673.3057	0.0000	615.6812	0.0000
BUYN	8519.4902	0.0000	3723.2446	0.0000	16151.624	0.0000	52157.535	0.0000
BUYP	1397.5426	0.0000	240.7383	0.0000	2975.9602	0.0000	7992.1909	0.0000
BUYK	0.0000	0.3966	0.0000	0.1900	0.0000	0.3275	0.0000	0.1900

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	38135.890		110132.70		57203.860		117508.50	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
bHeifers	6.2465	0.0000	12.7799	0.0000	0.0000	177.7090	62.6117	0.0000
SSLambs	0.0000	0.0000	0.0000	0.0000	0.0000	4.5952	0.0000	0.0000
bSLambs	0.0000	2.2951	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
sGimmers	0.0000	0.0000	0.0000	0.0000	0.0000	5.4002	0.0000	0.0000
bGimmers	0.0000	0.0000	0.0000	60.0000	0.0000	0.0000	0.0000	60.0000
bwSTRAW	0.0000	0.0000	0.0000	10.0000	0.0000	0.0000	18.2154	0.0000
bBSTRAW	0.0000	33.1446	0.0000	15.0000	0.0000	25.3444	0.0000	15.0000
bOSTRAW	8.0104	0.0000	23.8402	0.0000	19.9203	0.0000	0.0000	10.0000
WW1	0.0000	273.0061	0.0000	205.5400	0.0000	186.0698	0.0000	205.5400
WW2	0.0000	381.9944	0.0000	205.5400	0.0000	211.1899	0.0000	205.5400
WW3	0.0000	273.6512	0.0000	205.5400	0.0000	216.8568	0.0000	205.5400
BWW1	0.0000	31.3986	0.0000	205.5400	0.1378	0.0000	0.0000	205.5400
BWW2	0.0000	143.0181	0.0000	205.5400	0.0000	14.4580	0.0000	205.5400
BWW3	0.0000	0.0000	0.0000	205.5400	0.0000	6.1199	0.0000	205.5400
MSBAR1	0.0000	293.4435	0.0000	180.4650	0.0000	229.9521	0.0000	181.7000
MSBAR2	0.0000	381.4358	0.0000	181.7000	0.0000	323.5156	0.0000	181.7000
MSBAR3	0.0000	269.9567	0.0000	181.7000	0.0000	241.9327	0.0000	181.7000
WB125	0.0000	230.8366	0.0000	163.3900	0.0000	86.9946	0.0000	163.3900
WB180	0.0000	409.9363	0.0000	163.3900	0.0000	66.6399	0.0000	163.3900
WB225	0.0000	134.5161	0.0000	163.3900	0.0000	11.1879	0.0000	163.3900
SBAR75	0.0000	164.3816	0.0000	192.2000	0.0000	52.2965	0.0000	192.2000
SBAR100	0.0000	180.6122	0.0000	192.2000	0.0000	65.0040	0.0000	192.2000
SBAR125	0.0000	102.6511	0.0000	192.2000	2.1248	0.0000	0.0000	192.2000
WO50	0.0000	26.1400	0.0000	110.7400	0.0000	27.1008	0.0000	110.7400
WO100	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
WO125	0.0000	18.2130	0.0000	110.7400	0.0000	28.1905	0.0000	110.7400
SO50	0.0000	669.8209	0.0000	108.5000	0.0000	503.4081	0.0000	108.5000
SO100	0.0000	595.4036	0.0000	108.5000	0.0000	450.4005	0.0000	108.5000
SO125	0.0000	675.2575	0.0000	108.5000	0.0000	515.1567	0.0000	108.5000
WOSR150	0.0000	757.0771	0.0000	215.3500	0.0000	538.8936	0.0000	215.3500
WOSR185	0.0000	747.3712	0.0000	215.3500	0.0000	583.4260	0.0000	215.3500
WOSR225	0.0000	752.2278	0.0000	215.3500	0.0000	536.1172	0.0000	215.3500
SOSR90	0.0000	765.8898	0.0000	90.6100	0.0000	470.7531	0.0000	90.5743
SOSR110	0.0000	838.5434	0.0000	90.6100	0.0000	497.3522	0.0000	90.5743
SOSR130	0.0000	869.9614	0.0000	90.6100	0.0000	531.9403	0.0000	90.5743
LIN50	0.0000	903.8143	0.0000	186.4000	0.0000	591.8074	0.0000	186.3643
LIN80	0.0000	971.6905	0.0000	186.4000	0.0000	647.8618	0.0000	186.3643
LIN120	0.0000	994.9100	0.0000	186.4000	0.0000	667.4908	0.0000	186.3643
SFB20K	0.0000	531.8885	0.0000	165.2600	0.0000	295.1092	0.0000	165.2600
SFB40K	0.0000	404.5897	0.0000	165.2600	0.0000	191.6429	0.0000	165.2600
SFB60K	0.0000	405.2767	0.0000	165.2600	0.0000	192.4963	0.0000	165.2600
SETSC	0.0000	1269.3562	0.0000	55.0000	0.0000	173.4873	0.0000	55.0000
SETNR	0.0000	1160.7682	0.0000	13.0000	0.0000	73.9187	0.0000	13.0000
WORSA100	0.0000	1010.0443	0.0000	0.0000	0.0000	47.8881	0.0000	0.0000
WORSA140	0.0000	1049.2636	0.0000	196.3000	0.0000	116.4305	0.0000	196.3000
WORSA180	0.0000	1072.0581	0.0000	196.3000	0.0000	99.9598	0.0000	196.3000
SORSA60	0.0000	1043.2142	0.0000	115.6100	0.0000	0.0000	0.0000	115.5743
SORSA85	0.0000	1096.7690	0.0000	115.6100	0.0000	26.5236	0.0000	115.5743
SORSA110	0.0000	1127.9348	0.0000	115.6100	0.0000	70.5931	0.0000	115.5743

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	38135.890		110132.70		57203.860		117508.50	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SBEET1	0.0000	287.4208	0.0000	227.8300	0.0000	101.2177	0.0000	227.7936
SBEET2	0.0000	200.0857	0.0000	227.8300	0.0000	30.4453	0.0000	227.7936
SBEET3	0.0000	162.1908	0.0000	227.8300	0.0000	0.0000	0.0000	227.7936
POTEW1	0.0000	2236.4480	0.0000	1125.2000	0.0000	1770.8799	0.0000	1125.1449
POTEW2	0.0000	2050.6272	0.0000	1125.2000	0.0000	1620.7813	0.0000	1125.1449
POTEW3	0.0000	1825.2230	0.0000	1125.2000	0.0000	1433.8066	0.0000	1125.1449
PTMCW140	0.0000	1691.9846	0.0000	1199.2800	0.0000	1400.3676	0.0000	1199.2250
PTMCW180	0.0000	1487.7871	0.0000	1199.2800	0.0000	1145.8049	0.0000	1199.2250
PTMCW220	0.0000	1321.2379	0.0000	1199.2800	0.0000	1084.8527	0.0000	1199.2250
PMCWBPP1	0.0000	708.4192	0.0000	1144.8600	0.0000	527.0178	0.0000	1144.8049
PMCWBPP2	0.0000	371.5661	0.0000	1144.8600	0.0000	253.4724	0.0000	1144.8049
PMCWBPP3	0.0000	207.3455	0.0000	1144.8600	0.0000	120.7390	0.0000	1144.8049
PTPOF1	0.0000	1291.8014	0.0000	945.7800	0.0000	974.9979	0.0000	945.7250
PTPOF2	0.0000	1051.3602	0.0000	945.7800	0.0000	780.2448	0.0000	945.7250
PTPOF3	0.0000	952.8361	0.0000	945.7800	0.0000	701.2498	0.0000	945.7250
PTPEXST1	0.0000	780.8043	0.0000	1281.7800	0.0000	605.4843	0.0000	1281.7250
PTPEXST2	0.0000	440.0896	0.0000	1281.7800	0.0000	328.9405	0.0000	1281.7250
PTPEXST3	0.0000	279.1223	0.0000	1281.7800	0.0000	199.0122	0.0000	1281.7250
POTSEED1	0.0000	632.9414	0.0000	1491.4600	0.0000	514.1058	0.0000	1491.4049
POTSEED2	0.0000	217.9082	0.0000	1491.4600	0.0000	176.6579	0.0000	1491.4049
POTSEED3	0.0000	0.0000	1.2100	0.0000	0.0000	0.0000	3.5500	0.0000
POTDUAL1	0.0000	1132.4889	0.0000	1522.4600	0.0000	926.1780	0.0000	1522.4049
POTDUAL2	0.0000	775.2801	0.0000	1522.4600	0.0000	636.1362	0.0000	1522.4049
POTDUAL3	0.0000	602.3902	0.0000	1522.4600	0.0000	496.4387	0.0000	1522.4049
GR0	5.1100	0.0000	13.6800	0.0000	14.1800	0.0000	0.0000	23.9800
GR50	0.0000	20.2950	0.0000	31.9500	0.0000	15.1200	0.0000	31.9500
GR75	0.0000	11.4123	0.0000	31.9500	0.0000	4.4651	0.0000	31.9500
GR125	45.3648	0.0000	15.5413	0.0000	93.3878	0.0000	0.0000	31.9500
GR150	0.0000	8.0350	0.0000	31.9500	0.0000	2.5807	0.0000	31.9500
GR175	0.0000	9.9055	0.0000	31.9500	0.0000	6.6639	0.0000	31.9500
GR200	0.0000	14.1625	0.0000	31.9500	0.0000	11.0491	0.0000	31.9500
GR250	0.0000	33.2002	0.0000	31.9500	0.0000	23.4286	0.0000	31.9500
GR300	0.0000	49.1372	0.0000	31.9500	0.0000	39.4170	0.0000	31.9500
GR375	0.0000	84.5766	0.0000	31.9500	0.0000	65.5062	111.3594	0.0000
SILAGE12	7.7509	0.0000	14.1702	0.0000	0.0000	99.7346	23.7295	0.0000
SILAGE27	17.2434	0.0000	0.5873	0.0000	31.0961	0.0000	52.6006	0.0000
SILAGE30	0.0000	78.8873	0.0000	31.9500	0.0000	59.3584	0.0000	31.9500
HAY0	0.0000	372.4271	0.0000	35.9500	0.0000	271.6728	0.0000	35.9500
HAY50	0.0000	81.6043	0.0000	36.9500	0.0000	46.8971	0.0000	36.9500
HAY75	0.0000	76.3643	0.0000	37.9500	0.0000	46.1592	0.0000	37.9500
HAY125	0.0000	20.3224	0.0000	38.9500	0.0000	4.9190	0.0000	38.9500
HAY200	0.0000	9.9948	9.0495	0.0000	0.8935	0.0000	0.0000	39.9500
FMAIZE1	0.0000	80.1074	0.0000	309.5000	0.0000	448.7659	0.0000	309.5000
FMAIZE2	0.0000	246.3516	0.0000	309.5000	0.0000	446.2324	0.0000	309.5000
FMAIZE3	5.4209	0.0000	6.5017	0.0000	0.0000	459.2076	6.4405	0.0000
FMAIZEP1	0.0000	307.7314	0.0000	516.5000	0.0000	605.4210	0.0000	516.5000
FMAIZEP2	0.0000	452.3759	0.0000	516.5000	0.0000	581.7453	0.0000	516.5000
FMAIZEP3	0.0000	192.3473	0.0000	516.5000	0.0000	581.3321	0.0000	516.5000
SWEDESGR	0.0000	719.4116	0.0000	112.9500	0.0000	727.5354	0.0000	112.6071

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	38135.890		110132.70		57203.860		117508.50	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
TURNIPSG	0.0000	698.9535	0.0000	103.1500	0.0000	710.6421	0.0000	102.8071
KALEAGEd	0.0000	477.8790	0.0000	279.5000	0.0000	438.4759	0.0000	279.1571
KALEAGEB	0.0000	302.7318	0.0000	195.6000	0.0000	293.8485	0.0000	195.2572
RapeBroa	0.0000	404.5843	0.0000	65.6800	0.0000	435.0612	0.0000	65.3371
RapeDril	0.0000	397.9041	0.0000	62.4800	0.0000	429.5451	0.0000	62.1371
RapeDD	0.0000	501.4476	0.0000	97.6800	0.0000	515.0458	0.0000	97.3371
Fbeet1	0.0000	24.7156	0.0000	180.3700	0.0000	35.2465	0.0000	180.0271
Fbeet2	0.0000	0.0000	0.0000	0.0000	0.0000	0.6047	0.0000	180.0271
Fbeet3	0.0000	10.0579	0.0000	180.3700	0.0000	0.0000	0.0000	0.0000
IRG1	0.0000	496.6203	0.0000	108.0000	0.0000	334.4110	0.0000	107.9786
IRG2	0.0000	582.2401	0.0000	108.0000	0.0000	402.1053	0.0000	107.9786
IRG3	0.0000	662.6620	0.0000	108.0000	0.0000	463.7896	0.0000	107.9786
LLB120	0.0000	45.4311	0.0000	12.5500	0.0000	38.5268	0.0000	12.5400
LLBE140	0.0000	27.4031	0.0000	13.4500	0.0000	24.2337	0.0000	13.4400
LLBE180	0.0000	14.2235	0.0000	15.2500	0.0000	13.8575	0.0000	15.2400
CBE140	0.0000	43.4491	0.0000	7.1318	0.0000	38.0749	0.0000	7.2650
CBE160	0.0000	16.7660	0.0000	7.3400	0.0000	17.1698	0.0000	7.3350
CBE180	0.0000	1.5267	0.0000	7.4600	0.0000	5.4009	0.0000	7.4550
DBFEWE1	0.0000	45.7911	0.0000	18.1300	0.0000	43.0240	0.0000	18.1250
DBFEWE2	0.0000	50.8252	0.0000	18.1300	0.0000	41.8542	0.0000	18.1250
DBFEWE3	0.0000	28.4226	0.0000	18.1300	0.0000	29.3981	0.0000	18.1250
WINFINMK	0.0000	1.8897	0.0000	2.9500	0.0000	6.2373	0.0000	2.9439
WINFINLK	0.0000	2.6113	0.0000	2.9500	0.0000	6.5018	0.0000	2.9457
WINFINBF	0.0000	40.9107	0.0000	19.0000	0.0000	38.4639	0.0000	18.9939
WINFINSK	0.0000	10.6559	0.0000	2.2000	0.0000	10.1588	0.0000	2.1939
AFLGR	0.0000	21.2108	0.0000	2.2000	0.0000	32.2341	0.0000	2.2000
GIMMERIN	0.0000	3.0070	0.0000	3.6000	0.0000	0.0000	0.0000	2.2268
INDOORLA	0.0000	26.7200	0.0000	7.8700	0.0000	47.8647	0.0000	7.8700
HREA26	0.0000	37.3325	0.0000	190.6400	0.0000	157.9496	0.0000	190.5886
HRA30	0.0000	91.0540	0.0000	165.8900	0.0000	79.2951	0.0000	165.8386
HRA36	15.3275	0.0000	0.0000	119.8900	24.6234	0.0000	0.0000	119.8386
HRS30	0.0000	9.0113	0.0000	155.1400	0.0000	71.0471	0.0000	155.0886
HRS36	0.0000	30.9791	0.0000	126.3900	0.0000	11.2047	0.0000	126.3386
Dsp4000	0.0000	350.5614	0.0000	176.0000	0.0000	278.3261	0.0000	160.9179
Dsum4000	0.0000	236.4617	0.0000	152.0000	0.0000	186.6032	0.0000	136.9179
DAut4000	0.0000	421.7045	0.0000	232.0000	0.0000	342.4406	0.0000	216.9179
DAll4000	0.0000	389.1457	0.0000	232.0000	0.0000	317.5660	0.0000	216.9179
Dsp5000	0.0000	133.8626	0.0000	192.0000	0.0000	125.7922	0.0000	176.9179
Dsum5000	0.0000	1.5974	0.0000	168.0000	0.0000	20.6889	0.0000	152.9179
DAut5000	0.0000	195.9230	0.0000	248.0000	0.0000	183.2165	0.0000	232.9179
DAll5000	0.0000	149.5933	0.0000	224.0000	0.0000	143.7311	0.0000	208.9179
Dsp6000	0.0000	17.3671	0.0000	256.0000	0.0000	56.0009	0.0000	240.9179
Dsum6000	0.0000	8.7118	0.0000	288.0000	0.0000	44.1618	0.0000	272.9178
DAut6000	0.0000	53.6443	0.0000	304.0000	0.0000	92.9446	0.0000	288.9178
DAll6000	0.0000	24.0151	0.0000	288.0000	0.0000	67.2497	0.0000	272.9178
Dsp7000	11.3621	0.0000	0.0000	328.0000	7.9675	0.0000	0.0000	312.9178
Dsum7000	10.9061	0.0000	0.0000	361.6000	19.0079	0.0000	0.0000	346.5179
DAut7000	11.6047	0.0000	0.0000	395.2000	0.0000	63.3506	0.0000	380.1179
DAll7000	11.3883	0.0000	0.0000	372.8000	0.0000	26.6234	0.0000	357.7178

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	38135.890		110132.70		57203.860		117508.50	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
Dsp8000	10.3964	0.0000	0.0000	408.0000	18.1195	0.0000	55.3167	0.0000
Dsum8000	10.0314	0.0000	45.7427	0.0000	17.4834	0.0000	63.8995	0.0000
DAut8000	10.3964	0.0000	0.0000	456.0000	18.1195	0.0000	66.2020	0.0000
DAll8000	10.2106	0.0000	5.3770	0.0000	17.7958	0.0000	65.0285	0.0000
18MthST	54.5338	0.0000	0.0000	40.5000	81.7507	0.0000	90.0000	0.0000
18mthHF	0.0000	16.5962	0.0000	42.0000	69.5107	0.0000	83.3712	0.0000
24mthFr	0.0000	149.6423	0.0000	71.6000	0.0000	72.2929	0.0000	71.5571
24mthB	0.0000	145.8773	0.0000	68.6000	0.0000	102.4120	0.0000	68.5571
Owscsbst	0.0000	119.5402	0.0000	23.3000	0.0000	55.9916	0.0000	23.2643
Owscsbhf	0.0000	161.8694	0.0000	20.8000	0.0000	81.8811	0.0000	20.7643
Owscwbst	0.0000	178.3969	0.0000	24.8000	0.0000	98.7113	0.0000	24.7643
Owscwbhf	0.0000	334.0756	0.0000	22.1000	0.0000	212.1685	0.0000	22.0643
WFLFDBST	0.0000	163.3013	90.0000	0.0000	0.0000	91.3270	0.0000	27.5143
WFMFDBST	0.0000	128.1747	0.0000	24.0500	0.0000	66.7952	0.0000	24.0143
WFSCST	0.0000	129.8376	0.0000	24.5000	0.0000	67.2440	0.0000	24.4643
WFSCHF	0.0000	140.7028	148.4019	0.0000	0.0000	73.3056	0.0000	20.9643
BSDBXSTL	0.0000	163.1063	0.0000	22.0000	0.0000	108.9231	0.0000	22.0000
BSDBXSTM	0.0000	78.8363	0.0000	19.0000	0.0000	52.0730	0.0000	19.0000
OWSCSTWB	0.0000	121.9110	0.0000	19.0000	0.0000	82.7958	0.0000	19.0000
OWSCHFWB	0.0000	122.4048	0.0000	17.0000	0.0000	83.6617	0.0000	17.0000
OWSCSTSB	0.0000	170.0645	0.0000	19.0000	0.0000	118.2647	0.0000	19.0000
OWSCHFSB	0.0000	122.4048	0.0000	17.0000	0.0000	83.6617	0.0000	17.0000
OWMJST	0.0000	170.0645	0.0000	19.0000	0.0000	118.2647	0.0000	19.0000
OWMJHF	0.0000	122.4048	0.0000	17.0000	0.0000	83.6617	0.0000	17.0000
RYCSBMST	0.0000	362.5966	0.0000	84.2500	0.0000	298.3121	0.0000	84.2071
RYCSBLST	0.0000	256.8147	0.0000	83.2500	0.0000	220.2089	0.0000	83.2071
RYCABMST	25.5702	0.0000	0.0000	80.0000	47.9415	0.0000	8.7830	0.0000
RYCABLST	0.0000	4.0872	0.0000	80.0000	0.0000	3.0106	0.0000	79.9571
WFLFBST	0.0000	388.8969	0.0000	23.9000	0.0000	246.1071	0.0000	23.8643
SFLFBST	0.0000	346.9802	0.0000	19.0000	0.0000	306.5639	0.0000	18.9643
IBBFCF	0.0000	188.6760	0.0000	90.9000	0.0000	190.0356	0.0000	90.8643
IBBBXSF	0.0000	612.4788	0.0000	83.2000	0.0000	286.7274	0.0000	83.1643
IBBSCCF	0.0000	182.3511	0.0000	29.8500	0.0000	169.9262	0.0000	29.8143
IBBSCSF	0.0000	521.3919	0.0000	25.7500	0.0000	260.3942	0.0000	25.7143
CRFBFs1	0.0000	260.4995	0.0000	207.0000	0.0000	244.3910	0.0000	206.9525
CRMBBFs1	0.0000	236.2789	0.0000	207.0000	0.0000	226.5506	0.0000	206.9525
CRLBBFs1	0.0000	212.0584	0.0000	207.0000	0.0000	208.7101	0.0000	206.9525
CRFALst1	0.0000	256.9512	0.0000	247.3200	0.0000	249.0338	0.0000	247.2725
CRFBFhf1	0.0000	260.4995	0.0000	207.0000	0.0000	244.3910	0.0000	206.9525
CRMBBFh1	0.0000	236.2789	0.0000	207.0000	0.0000	226.5506	0.0000	206.9525
CRLBBFh1	0.0000	212.0584	0.0000	207.0000	0.0000	208.7101	0.0000	206.9525
CRFALhf1	0.0000	256.9512	0.0000	247.3200	0.0000	249.0338	0.0000	247.2725
FCOSTS	32431.193	0.0000	35358.664	0.0000	53875.043	0.0000	84304.492	0.0000
EEIQ	4255.7280	0.0000	3236.5837	0.0000	7492.6543	0.0000	11302.450	0.0000
CEIQ	2769.7063	0.0000	2155.6897	0.0000	5088.8301	0.0000	7545.6182	0.0000
WEIQ	3534.4893	0.0000	2695.8709	0.0000	6703.1694	0.0000	9546.9463	0.0000
Tpest	55.7572	0.0000	42.0942	0.0000	100.5269	0.0000	146.6672	0.0000
Herb	55.7572	0.0000	40.0372	0.0000	94.0132	0.0000	140.6322	0.0000
Insectic	0.0000	0.0000	0.6171	0.0000	1.8508	0.0000	1.8105	0.0000

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	38135.890		110132.70		57203.860		117508.50	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
Fungicid	0.0000	0.0000	1.4399	0.0000	4.6643	0.0000	4.2245	0.0000
Growth	0.0000	494.4143	0.0000	0.0000	0.0000	346.0974	0.0000	0.0000
STBO	22750.064	0.0000	0.0000	-1.0000	35460.000	0.0000	0.0000	-1.0000
LOSS	25389.392	0.0000	115774.71	0.0000	44250.472	0.0000	163509.56	0.0000
TOTLAB	20638.556	0.0000	17642.039	0.0000	32379.017	0.0000	58001.043	0.0000
SOILIND	295.5327	0.0000	224.0728	0.0000	524.9518	0.0000	713.4326	0.0000
LSU	153.6910	0.0000	115.4882	0.0000	252.5989	0.0000	368.8470	0.0000
MAIZEFOD	57488.050	0.0000	68950.265	0.0000	0.0000	0.0647	68300.617	0.0000
FOD	104099.24	0.0000	91703.851	0.0000	120045.27	0.0000	273202.46	0.0000
BSP	54.5338	0.0000	90.0000	0.0000	81.7507	0.0000	90.0000	0.0000
BSPFULL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Quota	645105.62	0.0000	408957.43	0.0000	760973.81	0.0000	2003574.0	0.0000

	12. Dairy and Sheep Southern England		13.Specialist Dairy Central and Southern England		14.Specialist Dairy Wales & North of England	
C)	77624.5000		37244.8100		78009.8800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	2.8279	0.0000	0.7380	0.0000	1.3486	0.0000
CJAN	0.0000	8.2000	0.0000	0.0000	0.0000	8.2000
CFEB	0.0000	8.2000	0.0000	5.9779	0.0000	8.2000
CMAR	286.6459	0.0000	94.3010	0.0000	185.4277	0.0000
CAPR	206.1129	0.0000	79.5450	0.0000	120.3795	0.0000
CMAY	310.1697	0.0000	195.2214	0.0000	295.1428	0.0000
CJUN	358.9747	0.0000	208.1423	0.0000	320.4057	0.0000
CJUL	408.5909	0.0000	168.1338	0.0000	262.2015	0.0000
CAUG	8.7152	0.0000	16.8062	0.0000	19.3032	0.0000
CSEP	0.0000	8.2000	0.0000	8.2000	0.0000	8.2000
COCT	78.5874	0.0000	0.0000	8.2000	15.4347	0.0000
CNOV	0.0000	7.1309	0.0000	8.2000	0.0000	8.2000
CDEC	0.0000	7.0470	0.0000	8.2000	0.0000	5.9779
BHAY	345.9110	0.0000	51.4077	0.0000	211.8129	0.0000
BBAR	0.0000	0.0000	0.0000	0.0000	0.0000	24.5830
SBAR	0.0000	0.0000	0.0000	25.2628	0.0000	0.0000
USLYCat	4373.1094	0.0000	1810.9777	0.0000	3406.9722	0.0000
UFYMCat	158.5491	0.0000	71.8866	0.0000	32.8871	0.0000
BUYN	35879.0508	0.0000	9534.0850	0.0000	18962.1992	0.0000
BUYP	4944.8608	0.0000	1631.1714	0.0000	2060.2688	0.0000
BUYK	0.0000	0.2297	0.0000	0.2700	0.0000	0.2676
bHeifers	56.8232	0.0000	23.5314	0.0000	44.2694	0.0000
SSLambs	0.0000	0.0000	0.0000	6.7367	0.0000	0.0000
bSLambs	0.0000	0.0134	0.0000	0.0000	0.0000	6.5555
sGimmers	0.0000	0.0000	0.0000	14.4359	0.0000	0.0000
bGimmers	0.0000	0.0000	0.0000	0.0000	0.0000	14.0474
bwSTRAW	4.6908	0.0000	0.0000	0.0000	0.0000	0.0000
bBSTRAW	0.0000	24.1269	0.0000	24.8149	0.0000	24.6531
bOSTRAW	0.0000	0.0000	2.1268	0.0000	0.9730	0.0000
WW1	0.0000	716.5925	0.0000	107.2435	0.0000	357.9142
WW2	0.0000	624.2353	0.0000	7.1022	0.0000	384.9459

	12. Dairy and Sheep Southern England		13.Specialist Dairy Central and Southern England		14.Specialist Dairy Wales & North of England	
C)	77624.5000		37244.8100		78009.8800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
WW3	0.0000	713.9451	0.0000	0.0000	0.0000	287.8857
BWW1	0.0000	572.7617	0.0000	147.5442	0.0000	103.7390
BWW2	0.0000	455.2359	0.0000	19.2588	0.0000	124.5708
BWW3	0.0000	551.0385	0.0000	0.0000	0.0000	0.0000
MSBAR1	0.0000	792.1948	0.0000	578.8243	0.0000	382.6969
MSBAR2	0.0000	843.2573	0.0000	635.8766	0.0000	439.9127
MSBAR3	0.0000	782.8262	0.0000	38.2039	0.0000	287.2813
WB125	0.0000	861.2437	0.0000	324.8279	0.0000	989.5475
WB180	0.0000	746.6071	0.0000	335.3394	0.0000	958.9899
WB225	0.0000	824.7964	0.0000	248.1869	0.0000	955.5343
SBAR75	0.0000	814.8964	0.0000	447.5235	0.0000	868.8842
SBAR100	0.0000	829.5599	0.0000	459.8239	0.0000	881.9296
SBAR125	0.0000	794.9550	0.0000	409.1955	0.0000	833.7227
WO50	0.0000	19.3056	0.0000	98.9626	0.0000	48.8066
WO100	0.0000	5.6575	0.0000	41.0406	0.0000	1.0732
WO125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SO50	0.0000	914.2134	0.0000	732.5649	0.0000	818.0704
SO100	0.0000	910.5867	0.0000	691.8616	0.0000	716.7988
SO125	0.0000	902.4511	0.0000	641.6323	0.0000	777.8231
WOSR150	0.0000	879.8447	0.0000	661.4058	0.0000	1017.0471
WOSR185	0.0000	828.2711	0.0000	561.5557	0.0000	1003.6049
WOSR225	0.0000	843.9164	0.0000	571.5745	0.0000	1001.4577
SOSR90	0.0000	888.4953	0.0000	714.6625	0.0000	1016.5585
SOSR110	0.0000	899.3250	0.0000	705.8107	0.0000	1062.8137
SOSR130	0.0000	927.9478	0.0000	726.0417	0.0000	1077.0857
LIN50	0.0000	961.7237	0.0000	877.0530	0.0000	1106.5127
LIN80	0.0000	1000.9043	0.0000	922.9052	0.0000	1152.2429
LIN120	0.0000	1004.5226	0.0000	910.6310	0.0000	1163.3365
SFB20K	0.0000	673.4941	0.0000	205.5623	0.0000	816.9211
SFB40K	0.0000	564.1777	0.0000	17.1727	0.0000	714.4923
SFB60K	0.0000	558.4020	0.0000	0.0000	0.0000	712.0850
SETSC	0.0000	209.3610	0.0000	136.6606	0.0000	165.1590
SETNR	0.0000	151.6187	0.0000	21.6592	0.0000	99.0426
WORSA100	0.0000	5.6915	0.0000	28.9386	0.0000	0.0000
WORSA140	0.0000	0.0000	0.0000	0.0000	0.0000	22.9528
WORSA180	0.0000	18.1654	0.0000	10.0553	0.0000	33.1664
SORSA60	0.0000	28.3109	0.0000	69.7345	0.0000	13.2951
SORSA85	0.0000	54.9028	0.0000	93.5629	0.0000	47.3669
SORSA110	0.0000	63.6653	0.0000	88.2491	0.0000	64.0734
SBEET1	0.0000	485.4829	0.0000	220.2883	0.0000	642.0673
SBEET2	0.0000	405.9097	0.0000	77.9678	0.0000	569.6671
SBEET3	0.0000	365.7081	0.0000	0.0000	0.0000	535.6138
POTEW1	0.0000	1985.5745	0.0000	3256.1770	0.0000	1829.7683
POTEW2	0.0000	1805.8641	0.0000	2923.6357	0.0000	1670.8860
POTEW3	0.0000	1630.4093	0.0000	2641.8040	0.0000	1497.9391
PTMCW140	0.0000	1518.0547	0.0000	2475.0359	0.0000	1391.6901
PTMCW180	0.0000	1323.3744	0.0000	2117.6160	0.0000	1218.3983
PTMCW220	0.0000	1158.6755	0.0000	1809.2003	0.0000	1074.3075
PMCWBPP1	0.0000	765.2814	0.0000	1238.9386	0.0000	642.9936
PMCWBPP2	0.0000	470.7666	0.0000	725.4398	0.0000	369.5111

	12. Dairy and Sheep Southern England		13.Specialist Dairy Central and Southern England		14.Specialist Dairy Wales & North of England	
C)	77624.5000		37244.8100		78009.8800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
PMCWBPP3	0.0000	313.7278	0.0000	436.6444	0.0000	229.9261
PTPOF1	0.0000	1316.8890	0.0000	2089.7400	0.0000	1135.9478
PTPOF2	0.0000	1095.8864	0.0000	1692.4022	0.0000	935.7259
PTPOF3	0.0000	987.8991	0.0000	1479.7877	0.0000	845.5778
PTPEXST1	0.0000	757.5565	0.0000	1254.5088	0.0000	668.7397
PTPEXST2	0.0000	456.7009	0.0000	726.6521	0.0000	390.7436
PTPEXST3	0.0000	298.9870	0.0000	432.7596	0.0000	252.1633
POTSEED1	0.0000	550.8334	0.0000	957.5551	0.0000	512.6809
POTSEED2	0.0000	196.9264	0.0000	350.4857	0.0000	179.8933
POTSEED3	2.6600	0.0000	0.0000	0.0000	0.9000	0.0000
POTDUAL1	0.0000	929.4075	0.0000	1547.8285	0.0000	891.1935
POTDUAL2	0.0000	616.3693	0.0000	1001.2242	0.0000	600.8471
POTDUAL3	0.0000	450.1134	0.0000	694.5348	0.0000	453.4623
GR0	15.0000	0.0000	1.8800	0.0000	2.9500	0.0000
GR50	0.0000	119.9123	0.0000	67.4421	0.0000	134.7495
GR75	0.0000	87.5655	0.0000	43.8847	0.0000	99.0756
GR125	0.0000	45.1712	0.0000	13.0287	0.0000	49.2958
GR150	0.0000	35.8717	0.0000	10.3019	0.0000	39.9383
GR175	0.0000	25.5771	0.0000	4.6035	0.0000	26.2961
GR200	0.0000	16.5246	35.0940	0.0000	0.0000	16.8105
GR250	0.0000	8.7598	0.0000	0.9218	0.0000	8.2929
GR300	39.1756	0.0000	0.0000	2.3082	41.9369	0.0000
GR375	53.5210	0.0000	0.0000	13.2700	9.5178	0.0000
SILAGE12	0.0000	39.3621	6.4673	0.0000	10.5055	0.0000
SILAGE27	37.9435	0.0000	14.6862	0.0000	23.6898	0.0000
SILAGE30	0.0000	47.7697	0.0000	52.9995	0.0000	49.4726
HAY0	0.0000	598.2528	0.0000	495.6407	0.0000	657.6810
HAY50	0.0000	362.9410	0.0000	257.0902	0.0000	365.5055
HAY75	0.0000	350.2198	0.0000	246.9222	0.0000	345.5858
HAY125	0.0000	299.0443	0.0000	200.4217	0.0000	286.1341
HAY200	0.0000	274.2701	0.0000	182.9680	0.0000	257.5206
FMAIZE1	0.0000	100.0636	0.0000	78.7784	0.0000	109.4156
FMAIZE2	0.0000	32.5365	0.0000	23.1843	0.0000	258.6407
FMAIZE3	0.0000	0.0000	5.3725	0.0000	0.0000	0.0000
FMAIZEP1	0.0000	169.6442	0.0000	205.6358	0.0000	198.7643
FMAIZEP2	0.0000	83.0363	0.0000	132.3683	0.0000	326.6373
FMAIZEP3	0.0000	38.4178	0.0000	97.9931	0.0000	54.4764
SWEDESGR	0.0000	643.0920	0.0000	562.9263	0.0000	752.3822
TURNIPSG	0.0000	631.2451	0.0000	548.9985	0.0000	738.5814
KALEAGEd	0.0000	324.6885	0.0000	319.0802	0.0000	422.5906
KALEAGEB	0.0000	223.2647	0.0000	199.8419	0.0000	304.4386
RapeBroa	0.0000	365.8118	0.0000	292.7054	0.0000	490.2718
RapeDril	0.0000	361.9435	0.0000	288.1576	0.0000	485.7654
RapeDD	0.0000	421.9032	0.0000	358.6489	0.0000	555.6145
Fbeet1	0.0000	54.4943	0.0000	30.7573	0.0000	57.3522
Fbeet2	0.0000	11.8880	0.0000	1.1524	0.0000	11.4887
Fbeet3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
IRG1	0.0000	557.6987	0.0000	533.3918	0.0000	698.1876
IRG2	0.0000	600.2563	0.0000	587.9276	0.0000	750.2921
IRG3	0.0000	635.3226	0.0000	636.6583	0.0000	794.8521

	12. Dairy and Sheep Southern England		13.Specialist Dairy Central and Southern England		14.Specialist Dairy Wales & North of England	
C)	77624.5000		37244.8100		78009.8800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
LLB120	0.0000	46.6255	0.0000	33.6182	0.0000	25.4297
LLBE140	0.0000	33.3438	0.0000	16.2948	0.0000	10.8745
LLBE180	0.0000	21.9622	0.0000	1.6761	0.0000	0.0000
CBE140	0.0000	58.6542	0.0000	38.1437	0.0000	36.0554
CBE160	0.0000	42.8581	0.0000	17.5933	0.0000	15.0981
CBE180	0.0000	33.8153	0.0000	5.5346	0.0000	2.1980
DBFEWE1	0.0000	56.0633	0.0000	50.6742	0.0000	46.7465
DBFEWE2	0.0000	51.1452	0.0000	44.4563	0.0000	40.1460
DBFEWE3	0.0000	45.7558	0.0000	38.0640	0.0000	33.6815
WINFINMK	0.0000	7.6010	0.0000	0.0000	0.0000	20.3692
WINFINLK	0.0000	8.7934	0.0000	1.8969	0.0000	33.1535
WINFINBF	0.0000	19.6536	0.0000	26.9897	0.0000	38.0326
WINFINSK	0.0000	15.8648	0.0000	9.3026	0.0000	43.8736
AFLGR	0.0000	44.8324	0.0000	36.3490	0.0000	60.8295
GIMMERIN	0.0000	32.8951	0.0000	26.2020	0.0000	46.4406
INDOORLA	0.0000	39.4242	0.0000	73.4931	0.0000	94.1257
HREA26	0.0000	470.5247	0.0000	286.4406	0.0000	348.4113
HRA30	0.0000	415.2191	0.0000	221.4209	0.0000	415.1996
HRA36	0.0000	359.6113	0.0000	156.0459	0.0000	354.7940
HRS30	0.0000	409.4770	0.0000	214.6703	0.0000	345.0895
HRS36	0.0000	367.4689	0.0000	165.2837	0.0000	379.2561
Dsp4000	0.0000	412.2038	0.0000	361.6848	0.0000	360.5975
Dsum4000	0.0000	333.0733	0.0000	280.6306	0.0000	280.0643
DAut4000	0.0000	445.5561	0.0000	409.0014	0.0000	407.3445
DAll4000	0.0000	418.5100	0.0000	381.9790	0.0000	380.4775
Dsp5000	0.0000	232.8952	0.0000	188.0349	0.0000	187.8574
Dsum5000	0.0000	139.2987	0.0000	92.8135	0.0000	93.2346
DAut5000	0.0000	259.0145	0.0000	228.2679	0.0000	227.5596
DAll5000	0.0000	231.8877	0.0000	195.4713	0.0000	195.0736
Dsp6000	0.0000	111.6121	0.0000	82.6024	0.0000	82.7132
Dsum6000	0.0000	90.0190	0.0000	76.1831	0.0000	74.7321
DAut6000	0.0000	120.8275	0.0000	108.3183	0.0000	104.1046
DAll6000	0.0000	103.3716	0.0000	85.5792	0.0000	82.8846
Dsp7000	8.1847	0.0000	16.7873	0.0000	26.8988	0.0000
Dsum7000	45.8760	0.0000	16.1065	0.0000	25.8444	0.0000
DAut7000	0.0000	25.1925	0.0000	30.5227	0.0000	30.2199
DAll7000	0.7500	0.0000	0.6758	0.0000	26.9593	0.0000
Dsp8000	43.7070	0.0000	15.3450	0.0000	24.6633	0.0000
Dsum8000	42.1531	0.0000	14.7994	0.0000	23.8161	0.0000
DAut8000	43.7070	0.0000	15.3450	0.0000	24.6633	0.0000
DAll8000	42.9148	0.0000	15.0668	0.0000	24.2323	0.0000
18MthST	0.0000	52.2234	0.0000	0.0000	0.0000	144.8147
18mthHF	0.0000	95.0947	0.0000	62.8677	0.0000	238.1245
24mthFr	0.0000	195.1447	0.0000	176.3475	0.0000	202.6685
24mthB	0.0000	193.5072	0.0000	174.0319	0.0000	200.3811
Owscsbst	0.0000	68.1834	0.0000	101.3827	0.0000	105.4893
Owscsbhf	0.0000	101.2484	0.0000	131.9254	0.0000	141.1844
Owscwbst	0.0000	113.0859	0.0000	148.4333	0.0000	149.5184
Owscwbhf	0.0000	242.3303	0.0000	272.6226	0.0000	274.1066
WFLFDBST	0.0000	82.8162	0.0000	136.9649	0.0000	122.8410

	12. Dairy and Sheep Southern England		13.Specialist Dairy Central and Southern England		14.Specialist Dairy Wales & North of England	
C)	77624.5000		37244.8100		78009.8800	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
WFMFDBST	0.0000	64.1944	0.0000	9.5908	0.0000	0.0000
WFSCST	0.0000	63.2028	0.0000	67.2470	0.0000	56.3168
WFSCHF	0.0000	80.7933	0.0000	97.6620	0.0000	89.5292
BSDBXSTL	0.0000	186.9847	0.0000	176.2310	0.0000	201.3132
BSDBXSTM	0.0000	110.3192	0.0000	100.1995	0.0000	121.8898
OWSCSTWB	0.0000	147.1976	0.0000	136.0339	0.0000	158.4319
OWSCHFWB	0.0000	147.3871	0.0000	159.2475	0.0000	180.6434
OWSCSTSB	0.0000	185.5446	0.0000	198.2209	0.0000	219.4395
OWSCHFSB	0.0000	147.3871	0.0000	159.2475	0.0000	180.6434
OWMJST	0.0000	185.5446	0.0000	198.2209	0.0000	219.4395
OWMJHF	0.0000	147.3871	0.0000	159.2475	0.0000	180.6434
RYCSBMST	0.0000	364.5561	0.0000	340.3009	0.0000	347.0487
RYCSBLST	0.0000	281.3730	0.0000	258.5990	0.0000	265.2130
RYCABMST	46.9080	0.0000	21.2682	0.0000	9.7299	0.0000
RYCABLST	0.0000	1.4466	0.0000	1.4167	0.0000	3.1701
WFLFBST	0.0000	382.1974	0.0000	410.5063	0.0000	290.2426
SFLFBST	0.0000	499.9688	0.0000	454.6425	0.0000	389.9433
IBBFCF	0.0000	55.9928	0.0000	92.6257	0.0000	67.5500
IBBBXSF	0.0000	411.9605	0.0000	507.3307	0.0000	497.4745
IBBSCCF	0.0000	98.1662	0.0000	107.7985	0.0000	93.0403
IBBSCSF	0.0000	373.9617	0.0000	432.0358	0.0000	424.4029
CRFBFs1	0.0000	131.7737	0.0000	175.2703	0.0000	184.2355
CRMBBFs1	0.0000	112.4857	0.0000	156.3807	0.0000	165.4495
CRLBBFs1	0.0000	93.1977	0.0000	137.4912	0.0000	146.6635
CRFALst1	0.0000	111.3004	0.0000	164.4530	0.0000	173.2770
CRFBFhf1	0.0000	131.7737	0.0000	175.2703	0.0000	184.2355
CRMBBFh1	0.0000	112.4857	0.0000	156.3807	0.0000	165.4495
CRLBBFh1	0.0000	93.1977	0.0000	137.4912	0.0000	146.6635
CRFALhf1	0.0000	111.3004	0.0000	164.4530	0.0000	173.2770
FCOSTS	58895.7578	0.0000	24260.9395	0.0000	38151.1328	0.0000
EEIQ	7975.3081	0.0000	3421.8743	0.0000	4830.3735	0.0000
CEIQ	5345.3003	0.0000	2223.9644	0.0000	3204.2971	0.0000
WEIQ	6781.9663	0.0000	2832.6709	0.0000	4090.2075	0.0000
TPest	103.4248	0.0000	44.8413	0.0000	62.8490	0.0000
Herb	98.9028	0.0000	44.8413	0.0000	61.3190	0.0000
Insectic	1.3566	0.0000	0.0000	0.0000	0.4590	0.0000
Fungicid	3.1654	0.0000	0.0000	113.2969	1.0710	0.0000
Growth	0.0000	696.8842	0.0000	471.3889	0.0000	599.7720
STBO	0.0000	0.2621	1394.8629	0.0000	28661.2285	0.0000
LOSS	105521.2578	0.0000	37047.1406	0.0000	61601.9961	0.0000
TOTLAB	39896.7617	0.0000	13113.5000	0.0000	22533.6758	0.0000
SOILIND	545.7288	0.0000	229.2209	0.0000	331.0258	0.0000
LSU	257.7828	0.0000	107.9500	0.0000	183.4020	0.0000
MAIZEFOD	0.0000	0.0145	56974.5977	0.0000	0.0000	0.0124
FOD	133123.9219	0.0000	75776.2188	0.0000	142489.7656	0.0000
BSP	0.0000	0.0000	0.0000	24.6322	0.0000	23.6587
BSPFULL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Quota	1763530.1250	0.0000	719435.8125	0.0000	1336918.0000	0.0000

	15.Mixed Lowland North & West		16.Mixed Lowland South			

C)	2946.4850		19132.2500	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	2.7379	0.0000	2.0760	0.0000
CJAN	0.0000	3.5061	0.0000	1.0836
CFEB	0.0000	6.0100	0.0000	6.0100
CMAR	57.2892	0.0000	3.6216	0.0000
CAPR	87.8103	0.0000	27.7318	0.0000
CMAY	0.0000	1.0270	4.6749	0.0000
CJUN	213.8477	0.0000	285.2314	0.0000
CJUL	0.0000	2.9987	0.0000	4.6367
CAUG	31.8133	0.0000	42.9016	0.0000
CSEP	0.0000	5.1220	0.0000	5.2449
COCT	93.7459	0.0000	192.0110	0.0000
CNOV	0.0000	6.0100	0.0000	5.8333
CDEC	0.0000	3.7662	0.0000	5.6316
BHAY	0.0000	19.0101	0.0000	9.6683
BBAR	0.0000	10.2181	49.2145	0.0000
SBAR	137.3845	0.0000	275.5417	0.0000
USLYCat	40.7125	0.0000	100.9792	0.0000
UFYMCat	683.3148	0.0000	660.4969	0.0000
BUYN	6188.7974	0.0000	14393.3281	0.0000
BUYP	3138.8811	0.0000	5074.4810	0.0000
BUYK	1492.7999	0.0000	4596.0376	0.0000
bHeifers	0.0000	66.6883	4.0093	0.0000
SSLambs	0.0000	2.7248	0.0000	0.0000
bSLambs	214.7844	0.0000	450.6287	0.0000
sGimmers	53.8993	0.0000	0.0000	0.0000
bGimmers	0.0000	5.8389	28.7162	0.0000
bwSTRAW	0.0000	0.0000	0.0000	0.0000
bBSTRAW	0.0000	21.2329	0.0000	20.7970
bOSTRAW	24.3130	0.0000	22.0041	0.0000
WW1	0.0000	167.7534	0.0000	183.7029
WW2	0.0000	151.8629	0.0000	152.3720
WW3	0.0000	177.6415	0.0000	184.8035
BWW1	0.0000	28.6909	0.0000	45.9428
BWW2	3.8900	0.0000	5.3318	0.0000
BWW3	0.0000	20.1355	0.0000	28.7727
MSBAR1	0.0000	310.4568	0.0000	244.4180
MSBAR2	0.0000	366.4005	0.0000	295.1435
MSBAR3	0.0000	326.6725	0.0000	239.0812
WB125	0.0000	30.2355	0.0000	38.8865
WB180	26.5614	0.0000	0.0000	78.4548
WB225	0.0000	11.5165	38.5470	0.0000
SBAR75	0.0000	74.5814	0.0000	104.4396
SBAR100	0.0000	98.2555	0.0000	123.4535
SBAR125	0.0000	78.1603	0.0000	99.5658
WO50	0.0000	10.6199	0.0000	13.2893
WO100	0.0000	0.0000	0.0000	2.8180
WO125	0.0000	14.9085	0.0000	0.0000
SO50	0.0000	158.8017	0.0000	147.2561
SO100	0.0000	157.4212	0.0000	146.4653
SO125	0.0000	171.3929	0.0000	141.3559
WOSR150	0.0000	437.4927	0.0000	402.7859
WOSR185	0.0000	415.4038	0.0000	363.6512
WOSR225	0.0000	429.4343	0.0000	382.4985

C)	15.Mixed Lowland North & West 2946.4850		16.Mixed Lowland South 19132.2500	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
SOSR90	0.0000	465.0264	0.0000	431.1973
SOSR110	0.0000	484.9014	0.0000	445.9319
SOSR130	0.0000	520.0871	0.0000	476.0147
LIN50	0.0000	526.1687	0.0000	490.9276
LIN80	0.0000	567.5063	0.0000	528.7781
LIN120	0.0000	578.2430	0.0000	535.9530
SFB20K	0.0000	270.6977	0.0000	239.6264
SFB40K	0.0000	180.8731	0.0000	147.6518
SFB60K	0.0000	179.8063	0.0000	145.0002
SETSC	0.0000	539.6967	0.0000	46.5322
SETNR	0.0000	488.6379	0.0000	0.0000
WORSA100	0.0000	606.0417	0.0000	62.9783
WORSA140	0.0000	619.8856	0.0000	63.8934
WORSA180	0.0000	640.5237	0.0000	85.3871
SORSA60	0.0000	640.1559	0.0000	103.2699
SORSA85	0.0000	672.8477	0.0000	132.0321
SORSA110	0.0000	690.1976	0.0000	145.4150
SBEET1	0.0000	134.9200	0.0000	95.5413
SBEET2	0.0000	72.8469	0.0000	30.7899
SBEET3	0.0000	44.6524	5.4482	0.0000
POTEW1	0.0000	1631.1498	0.0000	1682.1265
POTEW2	0.0000	1504.5680	0.0000	1546.5665
POTEW3	0.0000	1369.3495	0.0000	1410.4608
PTMCW140	0.0000	1244.2212	0.0000	1286.2405
PTMCW180	0.0000	1113.1277	0.0000	1145.3722
PTMCW220	0.0000	1007.8327	0.0000	1030.3651
PMCWBPP1	0.0000	584.0889	0.0000	631.5729
PMCWBPP2	0.0000	359.8446	0.0000	399.0938
PMCWBPP3	0.0000	253.8961	0.0000	285.1994
PTPOF1	0.0000	1040.6205	0.0000	1107.9377
PTPOF2	0.0000	880.3119	0.0000	938.8481
PTPOF3	0.0000	817.2514	0.0000	867.2440
PTPEXST1	0.0000	591.0499	0.0000	624.4915
PTPEXST2	0.0000	362.0293	0.0000	386.5221
PTPEXST3	0.0000	256.1797	0.0000	272.0245
POTSEED1	0.0000	426.7315	0.0000	441.0622
POTSEED2	0.0000	145.8262	0.0000	152.8266
POTSEED3	1.3000	0.0000	1.3500	0.0000
POTDUAL1	0.0000	757.1405	0.0000	768.0841
POTDUAL2	0.0000	513.1270	0.0000	515.6608
POTDUAL3	0.0000	395.4174	0.0000	389.8497
GR0	39.2792	0.0000	5.4500	0.0000
GR50	27.1085	0.0000	33.8452	0.0000
GR75	0.0000	12.5087	0.0000	7.2655
GR125	0.0000	27.8883	0.0000	15.6499
GR150	0.0000	42.2553	0.0000	26.6879
GR175	0.0000	50.8742	0.0000	32.7763
GR200	0.0000	59.4931	0.0000	38.8647
GR250	0.0000	83.2754	0.0000	57.6558
GR300	0.0000	101.5750	0.0000	71.4775
GR375	0.0000	135.3035	0.0000	99.0855
SILAGE12	7.7893	0.0000	11.5585	0.0000

C)	15.Mixed Lowland North & West 2946.4850		16.Mixed Lowland South 19132.2500	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
SILAGE27	0.0000	88.5906	4.1650	0.0000
SILAGE30	0.0000	153.2947	0.0000	59.3361
HAY0	0.0000	98.0595	0.0000	124.8397
HAY50	17.0582	0.0000	0.0000	10.6157
HAY75	0.0000	17.6279	0.0000	22.4896
HAY125	0.0000	0.9638	25.4893	0.0000
HAY200	0.0000	15.6793	0.0000	6.1345
FMAIZE1	0.0000	74.0933	0.0000	375.3095
FMAIZE2	0.0000	158.8314	0.0000	399.1140
FMAIZE3	0.0000	80.7431	0.0000	427.0042
FMAIZEP1	0.0000	228.2571	0.0000	569.4644
FMAIZEP2	0.0000	304.4710	0.0000	591.0410
FMAIZEP3	0.0000	220.9852	0.0000	617.5203
SWEDESGR	6.5234	0.0000	3.6050	0.0000
TURNIPSG	0.0000	122.7241	0.0000	24.7920
KALEAGEd	0.0000	423.5921	0.0000	427.9013
KALEAGEB	0.0000	328.3966	0.0000	340.6581
RapeBroa	0.0000	328.2131	0.0000	240.5435
RapeDril	0.0000	324.5823	0.0000	237.2160
RapeDD	0.0000	380.8600	0.0000	288.7925
Fbeet1	0.0000	206.6025	0.0000	283.8979
Fbeet2	0.0000	223.1803	0.0000	323.1283
Fbeet3	0.0000	253.4810	0.0000	365.9455
IRG1	0.0000	115.0061	0.0000	128.1602
IRG2	0.0000	169.2939	0.0000	176.3587
IRG3	0.0000	222.5198	0.0000	222.5478
LLB120	0.0000	13.2089	0.0000	21.4594
LLBE140	0.0000	5.8345	0.0000	9.9134
LLBE180	106.5479	0.0000	102.5579	0.0000
CBE140	0.0000	16.8581	0.0000	26.2543
CBE160	0.0000	6.4575	0.0000	12.6292
CBE180	0.0000	1.6901	0.0000	4.7825
DBFEWE1	0.0000	9.3143	0.0000	14.3860
DBFEWE2	0.0000	4.9161	0.0000	10.0290
DBFEWE3	0.0000	0.3727	0.0000	5.5473
WINFINMK	214.7844	0.0000	450.6287	0.0000
WINFINLK	0.0000	0.0108	0.0000	0.7546
WINFINBF	0.0000	19.7461	0.0000	15.7556
WINFINSK	0.0000	5.5785	0.0000	7.3264
AFLGR	0.0000	27.2282	0.0000	25.0567
GIMMERIN	83.7327	0.0000	0.0000	4.6394
INDOORLA	0.0000	28.9514	0.0000	26.1666
LLSUCKNJ	0.0000	60.8393	0.0000	56.9447
LLSUCKFA	0.0000	105.2093	0.0000	108.0294
LLSUCKMJ	0.0000	38.3603	0.0000	25.3171
LLSUCKAO	25.6034	0.0000	15.3925	0.0000
18MthST	0.0000	45.7737	0.0000	77.7574
18mthHF	0.0000	100.8979	0.0000	115.0335
24mthFr	0.0000	30.6873	0.0000	61.2829
24mthB	0.0000	28.9950	0.0000	59.8791
Owscsbst	0.0000	82.5541	0.0000	83.0846
Owscsbhf	0.0000	110.7851	0.0000	111.6285

C)	15.Mixed Lowland North & West 2946.4850		16.Mixed Lowland South 19132.2500	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
Owscwbst	0.0000	119.9368	0.0000	120.7783
Owscwbhf	0.0000	230.9157	0.0000	232.2916
WFLFDBST	0.0000	78.3417	0.0000	97.2524
WFMFDBST	0.0000	33.2972	0.0000	51.8903
WFSCST	0.0000	73.3799	0.0000	92.2100
WFSCHF	0.0000	76.3341	0.0000	77.5849
BSDBXSTL	0.0000	144.5841	0.0000	160.8211
BSDBXSTM	0.0000	104.1999	0.0000	120.0199
OWSCSTWB	0.0000	161.9991	0.0000	178.0983
OWSCHFWB	0.0000	87.0710	0.0000	85.1023
OWSCSTSB	0.0000	212.6978	0.0000	211.1759
OWSCHFSB	0.0000	87.0710	0.0000	85.1023
OWMJST	0.0000	212.6978	0.0000	211.1759
OWMJHF	0.0000	87.0710	0.0000	85.1023
RYCSBMST	0.0000	175.9516	0.0000	195.2154
RYCSBLST	0.0000	176.3730	0.0000	196.2552
RYCABMST	150.9573	0.0000	164.6283	0.0000
RYCABLST	0.0000	59.6739	0.0000	63.6387
WFLFBST	0.0000	0.0000	0.0000	32.9459
SFLFBST	0.0000	3.5633	0.0000	57.7664
IBBFCF	0.0000	53.4862	0.0000	61.4146
IBBBXSF	0.0000	277.6587	0.0000	308.5121
IBBSCCF	0.0000	85.7028	0.0000	99.2495
IBBSCSF	0.0000	261.5286	0.0000	292.1245
CRFBFs1	0.0000	127.4440	0.0000	106.1891
CRMBBFs1	0.0000	110.8469	0.0000	89.5516
CRLBBFs1	0.0000	94.2499	0.0000	72.9140
CRFALst1	0.0000	113.9481	0.0000	88.6438
CRFBFhf1	0.0000	127.4440	0.0000	106.1891
CRMBBFh1	0.0000	110.8469	0.0000	89.5516
CRLBBFh1	0.0000	94.2499	0.0000	72.9140
CRFALhf1	0.0000	113.9481	0.0000	88.6438
FCOSTS	46571.1445	0.0000	58022.4336	0.0000
EEIQ	11524.0947	0.0000	13599.4258	0.0000
CEIQ	11219.7959	0.0000	15231.0010	0.0000
WEIQ	12395.4678	0.0000	16949.3535	0.0000
TPest	195.8053	0.0000	246.5337	0.0000
Herb	127.3443	0.0000	147.5065	0.0000
Insectic	2.1211	0.0000	4.2768	0.0000
Fungicid	66.3787	0.0000	94.8038	0.0000
Growth	0.0000	112.7985	0.0000	95.8273
STBO	11306.6426	0.0000	0.0000	0.0998
LOSS	48457.2930	0.0000	82642.9844	0.0000
TOTLAB	21567.9063	0.0000	17488.2988	0.0000
SOILIND	448.1375	0.0000	407.2977	0.0000
LSU	164.2344	0.0000	184.2075	0.0000
MAIZEFOD	52187.4883	0.0000	30642.7480	0.0000
FOD	69409.3594	0.0000	122570.9922	0.0000
BSP	0.0000	17.7017	0.0000	0.0000
BSPFULL	0.0000	0.0000	0.0000	0.0000
HREA26	0.0000	114.6226	0.0000	110.4751
HRA30	0.0000	52.1930	0.0000	47.8330

C)	15.Mixed Lowland North & West 2946.4850		16.Mixed Lowland South 19132.2500	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
HRA36	3.1317	0.0000	4.5602	0.0000
HRS30	0.0000	49.8093	0.0000	47.1992
HRS36	0.0000	7.3751	0.0000	6.7590
Dsp5000	0.0000	4.1946	7.1332	0.0000
Dsum5000	4.0868	0.0000	6.4637	0.0000
DAut5000	0.0000	26.7812	7.3694	0.0000
DAll5000	4.5592	0.0000	7.1508	0.0000
Dsp6000	3.8810	0.0000	6.1608	0.0000
Dsum6000	0.0000	0.0000	0.0000	0.0000
DAut6000	0.0000	0.0000	0.0000	0.0000
DAll6000	0.0000	0.0000	0.0000	0.0000
Dsp7000	0.0000	0.0000	0.0000	0.0000
Dsum7000	0.0000	0.0000	0.0000	0.0000
DAut7000	0.0000	0.0000	0.0000	0.0000
DAll7000	0.0000	0.0000	0.0000	0.0000
BPIG3WKW	0.0000	0.0000	0.0000	0.0000
BPIG4WKW	0.0000	0.0000	0.0000	0.0000
BPIGOUT	0.0000	0.0000	0.0000	0.0000
FPIGPORK	0.0000	0.0000	0.0000	0.0000
FPIGCUT	0.0000	0.0000	0.0000	0.0000
FPIGBAC	0.0000	0.0000	0.0000	0.0000
FPIGHEA	0.0000	0.0000	0.0000	0.0000
PULREAR	0.0000	0.0000	0.0000	0.0000
EGGCAGE	0.0000	0.0000	0.0000	0.0000
EGGRANGE	0.0000	0.0000	0.0000	0.0000
EBARN	0.0000	0.0000	0.0000	0.0000
CHBROILE	0.0000	14.1060	0.0000	13.4960
TFFthen	0.0000	0.0000	0.0000	0.0000
tfftstag	0.0000	0.0000	0.0000	0.0000
PPOUT	0.0000	0.0000	0.0000	0.0000
UPolMan	0.0000	0.0000	0.0000	0.0000
Upigslur	0.0000	0.0000	0.0000	0.0000

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	7055.6120		42940.6300		25623.9200	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	3.8733	0.0000	1.0996	0.0000	0.0000	3541.9497
CJAN	0.0000	0.0000	0.0000	6.9400	0.0000	6.9400
CFEB	0.0000	0.0000	0.0000	6.9400	0.0000	6.9400
CMAR	268.7305	0.0000	494.0483	0.0000	0.0000	6.9400
CAPR	1416.8175	0.0000	897.9265	0.0000	54.4912	0.0000
CMAY	482.3553	0.0000	989.0561	0.0000	391.5558	0.0000
CJUN	1056.3394	0.0000	1063.9872	0.0000	749.9844	0.0000
CJUL	892.9578	0.0000	397.3535	0.0000	612.3836	0.0000
CAUG	527.7502	0.0000	366.2332	0.0000	0.0000	6.9400
CSEP	496.8926	0.0000	279.4422	0.0000	0.0000	6.9400
COCT	0.0000	0.0000	0.0000	5.0552	0.0000	6.9400
CNOV	0.0000	0.0000	0.0000	6.9400	0.0000	6.9400
CDEC	0.0000	0.0000	0.0000	6.9400	0.0000	6.9400
BHAY	508.9794	0.0000	29.4473	0.0000	0.0000	2.1634
BBAR	4.5155	0.0000	42.5112	0.0000	690.7174	0.0000
SBAR	0.0000	0.0000	0.0000	6.3000	637.7407	0.0000
USLYCat	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UFYMCat	3362.9709	0.0000	2033.8700	0.0000	2346.0171	0.0000
BUYN	3752.4006	0.0000	11696.2734	0.0000	33548.5742	0.0000
BUYP	15422.3096	0.0000	11041.1807	0.0000	38544.0039	0.0000
BUYK	6383.5645	0.0000	7421.7012	0.0000	40636.8984	0.0000
bHeifers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SSLambs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bSLambs	0.0000	0.0000	0.0000	1.6800	0.0000	0.0000
sGimmers	358.3742	0.0000	210.7182	0.0000	0.0000	0.0000
bGimmers	0.0000	0.0000	0.0000	3.6000	0.0000	0.0000
bwSTRAW	205.4389	0.0000	128.8605	0.0000	125.0443	0.0000
bBSTRAW	0.0000	0.0000	0.0000	20.3000	0.0000	21.8327
bOSTRAW	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
WW1	1.8110	0.0000	0.0000	14.7374	21.3300	0.0000
WW2	0.0000	0.0000	14.3360	0.0000	0.0000	2.3579
WW3	0.0000	0.0000	0.0000	20.7726	0.0000	14.7152
BWW1	0.0000	0.0000	0.0000	99.8665	0.0000	67.4780
BWW2	0.0000	0.0000	0.0000	73.1891	0.0000	59.1924
BWW3	0.0000	0.0000	0.0000	88.1217	0.0000	62.6202
MSBAR1	0.0000	0.0000	0.0000	415.8745	0.0000	267.4408
MSBAR2	0.0000	0.0000	0.0000	400.2852	0.0000	319.8557
MSBAR3	0.0000	0.0000	0.0000	393.3859	0.0000	219.3870
WB125	10.5116	0.0000	0.0000	83.4056	0.0000	127.5848
WB180	0.0000	0.0000	0.0000	105.6460	0.0000	149.4448
WB225	0.0000	0.0000	0.0000	121.8314	0.0000	168.8050
SBAR75	0.0000	0.0000	0.0000	190.0538	0.0000	67.9023
SBAR100	0.0000	0.0000	0.0000	187.7049	0.0000	129.7871
SBAR125	0.0000	0.0000	0.0000	202.9805	0.0000	52.8596
WO50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
WO100	0.0000	0.0000	0.0000	13.1504	0.0000	11.0910
WO125	0.0000	0.0000	0.0000	41.1008	0.0000	38.3382
SO50	0.0000	0.0000	0.0000	277.9431	0.0000	271.1211
SO100	0.0000	0.0000	0.0000	291.0935	0.0000	243.5682

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	7055.6120		42940.6300		25623.9200	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SO125	0.0000	0.0000	0.0000	319.0439	0.0000	309.4593
RYE1	0.0000	0.0000	0.0000	110.8581	0.0000	121.9083
RYE2	0.0000	0.0000	0.0000	120.1490	0.0000	129.8718
RYE3	0.0000	0.0000	0.0000	131.8613	0.0000	141.3132
TRIT150	0.0000	0.0000	0.0000	10.8281	0.0000	12.7121
TRIT180	0.0000	0.0000	0.0000	9.1490	0.0000	8.7003
TRIT200	0.0000	0.0000	0.0000	20.6413	0.0000	19.9016
WOSR150	0.0000	0.0000	0.0000	409.4207	0.0000	424.1078
WOSR185	0.0000	0.0000	0.0000	463.1421	0.0000	492.6734
WOSR225	0.0000	0.0000	0.0000	436.1335	0.0000	431.4545
SOSR90	0.0000	0.0000	0.0000	443.7988	0.0000	493.5832
SOSR110	0.0000	0.0000	0.0000	548.2866	0.0000	512.0427
SOSR130	0.0000	0.0000	0.0000	510.1544	0.0000	558.2079
LIN50	0.0000	0.0000	0.0000	474.6758	0.0000	524.2261
LIN80	0.0000	0.0000	0.0000	478.8132	0.0000	527.4464
LIN120	0.0000	0.0000	0.0000	489.1506	0.0000	537.4349
SFB20K	0.0000	0.0000	0.0000	238.6424	0.0000	207.8761
SFB40K	0.0000	0.0000	0.0000	169.1284	0.0000	131.2979
SFB60K	0.0000	0.0000	0.0000	128.7444	0.0000	86.5191
SETSC	0.0000	0.0000	0.0000	235.7715	0.0000	226.3786
SETNR	0.0000	0.0000	0.0000	174.9594	0.0000	163.4576
WORSA100	0.0000	0.0000	0.0000	560.1843	0.0000	580.6938
WORSA140	0.0000	0.0000	0.0000	603.3123	0.0000	655.3508
WORSA180	0.0000	0.0000	0.0000	635.5903	0.0000	654.8486
SORSA60	0.0000	0.0000	0.0000	541.3655	0.0000	605.7778
SORSA85	0.0000	0.0000	0.0000	594.2100	0.0000	660.9873
SORSA110	0.0000	0.0000	0.0000	582.1345	0.0000	645.3278
SBEET1	0.0000	0.0000	0.0000	31.8482	0.0000	53.9704
SBEET2	0.0000	0.0000	0.0000	53.6541	0.0000	49.3528
SBEET3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POTEW1	0.0000	0.0000	0.0000	1588.7616	0.0000	1765.8998
POTEW2	0.0000	0.0000	0.0000	1463.7284	0.0000	1623.5887
POTEW3	0.0000	0.0000	0.0000	1333.1810	0.0000	1470.9673
PTMCW140	0.0000	0.0000	0.0000	1212.9747	0.0000	1405.4910
PTMCW180	0.0000	0.0000	0.0000	1083.3198	0.0000	1177.8523
PTMCW220	0.0000	0.0000	0.0000	978.5352	0.0000	1121.3821
PMCWBPP1	0.0000	0.0000	0.0000	579.0424	0.0000	663.0265
PMCWBPP2	0.0000	0.0000	0.0000	360.2002	0.0000	418.9695
PMCWBPP3	0.0000	0.0000	0.0000	255.3984	0.0000	299.4029
PTPOF1	0.0000	0.0000	0.0000	1025.6394	0.0000	1163.1152
PTPOF2	0.0000	0.0000	0.0000	868.1896	0.0000	985.6047
PTPOF3	0.0000	0.0000	0.0000	804.4895	0.0000	910.4346
PTPEXST1	0.0000	0.0000	0.0000	580.8795	0.0000	655.5924
PTPEXST2	0.0000	0.0000	0.0000	357.1895	0.0000	405.7717
PTPEXST3	0.0000	0.0000	0.0000	252.2396	0.0000	285.5719
POTSEED1	0.0000	0.0000	0.0000	415.9869	0.0000	463.0280
POTSEED2	0.0000	0.0000	0.0000	142.8835	0.0000	160.4377
POTSEED3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POTDUAL1	0.0000	0.0000	0.0000	733.0563	0.0000	806.3363
POTDUAL2	0.0000	0.0000	0.0000	495.1122	0.0000	541.3418

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	7055.6120		42940.6300		25623.9200	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
POTDUAL3	0.0000	0.0000	0.0000	378.9284	0.0000	409.2651
SWEDE1	0.0000	0.0000	0.0000	337.7777	0.0000	910.4363
SWEDE2	0.0000	0.0000	0.0000	822.3601	0.0000	1459.6133
SWEDE3	0.0000	0.0000	0.0000	239.6336	0.0000	791.5408
GR0	920.1059	0.0000	462.6100	0.0000	898.3373	0.0000
GR50	0.0000	0.0000	0.0000	36.8078	0.0000	33.0759
GR75	0.0000	0.0000	0.0000	49.4653	0.0000	38.9478
GR125	0.0000	0.0000	0.0000	159.6857	0.0000	52.3096
GR200	0.0000	0.0000	0.0000	189.6370	0.0000	73.9991
GR375	0.0000	0.0000	0.0000	260.5085	0.0000	129.4044
SILAGE12	0.0000	0.0000	88.3900	0.0000	30.8607	0.0000
SILAGE27	0.0000	0.0000	0.0000	80.5827	109.4208	0.0000
SILAGE30	0.0000	0.0000	0.0000	132.7532	0.0000	54.1014
HAY0	0.0000	0.0000	0.0000	265.9359	0.0000	188.6177
HAY50	0.0000	0.0000	0.0000	128.4365	0.0000	50.7984
HAY75	0.0000	0.0000	0.0000	130.1273	0.0000	52.5713
HAY125	0.0000	0.0000	0.0000	90.8997	0.0000	12.8115
HAY200	34.7641	0.0000	0.0000	77.0822	6.0512	0.0000
FMAIZE1	0.0000	0.0000	0.0000	26.7858	0.0000	39.2850
FMAIZE2	0.0000	0.0000	0.0000	2.3861	0.0000	273.6563
FMAIZE3	0.0000	0.0000	10.4496	0.0000	0.0000	51.5129
FMAIZEP1	0.0000	0.0000	0.0000	132.5511	0.0000	0.0000
FMAIZEP2	0.0000	0.0000	0.0000	158.9766	0.0000	226.8843
FMAIZEP3	0.0000	0.0000	0.0000	86.1599	0.0000	0.0000
SWEDESGR	0.0000	0.0000	0.0000	346.3389	0.0000	226.0530
TURNIPSG	0.0000	0.0000	0.0000	335.9509	0.0000	224.5569
KALEAGEd	0.0000	0.0000	0.0000	229.0009	0.0000	99.9485
KALEAGEB	0.0000	0.0000	0.0000	140.0669	0.0000	87.1397
RapeBroa	0.0000	0.0000	0.0000	209.6890	0.0000	196.6225
RapeDril	0.0000	0.0000	0.0000	206.2970	0.0000	196.1340
RapeDD	0.0000	0.0000	0.0000	258.8730	0.0000	217.2274
Fbeet1	7.1675	0.0000	4.2144	0.0000	0.0000	0.0000
Fbeet2	0.0000	0.0000	0.0000	7.2884	0.0000	28.4928
Fbeet3	0.0000	0.0000	0.0000	33.9025	0.0000	69.0391
FRYE1	0.0000	0.0000	0.0000	308.6512	0.0000	404.6947
FRYE2	0.0000	0.0000	0.0000	332.3423	0.0000	423.8665
FRYE3	0.0000	0.0000	0.0000	356.0332	0.0000	453.4908
IRG1	0.0000	0.0000	0.0000	374.5453	0.0000	339.9161
IRG2	0.0000	0.0000	0.0000	425.3214	0.0000	384.5451
IRG3	0.0000	0.0000	0.0000	475.2045	0.0000	423.4652
HILLSTP1	0.0000	0.0000	0.0000	46.6580	0.0000	28.7537
HILLSTP2	1000.0000	0.0000	1000.0000	0.0000	617.0694	0.0000
HILLFLG1	0.0000	0.0000	0.0000	42.9230	0.0000	29.5324
HILLFLG2	0.0000	0.0000	0.0000	42.3482	0.0000	31.6938
WINFINMK	0.0000	0.0000	0.0000	17.0043	0.0000	23.6094
WINFINLK	0.0000	0.0000	0.0000	26.2458	0.0000	32.4142
WINFINBF	0.0000	0.0000	0.0000	29.1607	0.0000	31.6271
WINFINSK	0.0000	0.0000	0.0000	32.3307	0.0000	40.0505
AFLGR	0.0000	0.0000	0.0000	57.8216	0.0000	33.2513
GIMMERIN	358.3742	0.0000	210.7182	0.0000	0.0000	4.3966

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	7055.6120		42940.6300		25623.9200	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
INDOORLA	0.0000	0.0000	0.0000	76.3989	0.0000	72.3835
HILLSU1	311.5963	0.0000	202.0201	0.0000	163.6338	0.0000
HILLSU2	0.0000	0.0000	0.0000	106.6574	0.0000	149.8921
HILLSU3	0.0000	0.0000	0.0000	93.8254	0.0000	242.9145
18MthST	0.0000	0.0000	0.0000	0.0000	0.0000	14.9630
18mthHF	0.0000	0.0000	0.0000	60.2451	0.0000	48.5371
24mthFr	0.0000	0.0000	0.0000	1.5300	0.0000	1.4737
24mthB	0.0000	0.0000	0.0000	0.0000	45.0000	0.0000
Owscsbst	0.0000	0.0000	0.0000	60.6709	0.0000	7.9314
Owscsbhf	0.0000	0.0000	0.0000	87.6559	0.0000	37.8968
Owscwbst	0.0000	0.0000	0.0000	102.5650	0.0000	44.4052
Owscwbhf	0.0000	0.0000	0.0000	209.2020	0.0000	161.4722
OWSCSTSB	0.0000	0.0000	0.0000	92.5506	0.0000	45.4814
OWSCHFSB	0.0000	0.0000	0.0000	66.6656	0.0000	23.0222
OWMJST	0.0000	0.0000	0.0000	92.5506	0.0000	45.4814
OWMJHF	0.0000	0.0000	0.0000	66.6656	0.0000	23.0222
RYCSBMST	0.0000	0.0000	0.0000	210.3777	0.0000	247.2994
RYCSBLST	0.0000	0.0000	0.0000	141.3177	0.0000	196.8137
RYCABMST	371.7692	0.0000	197.6965	0.0000	321.8203	0.0000
RYCABLST	0.0000	0.0000	0.0000	1.2000	0.0000	2.9474
WFLFBST	0.0000	0.0000	0.0000	239.0830	0.0000	43.7876
SFLFBST	0.0000	0.0000	0.0000	5.8599	589.5089	0.0000
IBBFCF	0.0000	0.0000	0.0000	19.8997	0.0000	61.3782
IBBBXSF	0.0000	0.0000	0.0000	566.2819	0.0000	133.3155
IBBSCCF	0.0000	0.0000	0.0000	44.1473	0.0000	104.6167
IBBSCSF	0.0000	0.0000	0.0000	463.4614	0.0000	165.3829
CRFBFs1	0.0000	0.0000	0.0000	84.5233	0.0000	81.0531
CRMBBFs1	0.0000	0.0000	0.0000	68.5233	0.0000	63.5870
CRLBBFs1	0.0000	0.0000	0.0000	52.5233	0.0000	46.1208
CRFALst1	0.0000	0.0000	0.0000	69.7661	0.0000	62.4461
CRFBFhf1	0.0000	0.0000	0.0000	84.5233	0.0000	81.0531
CRMBBFh1	0.0000	5.6200	0.0000	68.5233	0.0000	63.5870
CRLBBFh1	0.0000	0.0000	0.0000	52.5233	0.0000	46.1208
CRFALhf1	0.0000	0.0000	0.0000	69.7661	0.0000	62.4461
FCOSTS	165117.4844	0.0000	106198.3906	0.0000	185913.3125	0.0000
EEIQ	28400.4922	0.0000	19831.1309	0.0000	34207.7188	0.0000
CEIQ	20445.1699	0.0000	15187.4082	0.0000	25415.1836	0.0000
WEIQ	25986.8027	0.0000	19308.4844	0.0000	32485.0762	0.0000
TPest	395.3256	0.0000	289.0664	0.0000	491.3224	0.0000
Herb	364.5909	0.0000	241.4719	0.0000	423.7063	0.0000
Insectic	4.2786	0.0000	4.5865	0.0000	3.6261	0.0000
Fungicid	26.4741	0.0000	43.1515	0.0000	64.2033	0.0000
Growth	0.0000	0.0000	0.0000	208.6778	0.0000	219.6632
STBO	67970.0000	0.0000	37952.3438	0.0000	0.0000	0.1516
LOSS	162458.5000	0.0000	141267.3125	0.0000	228051.2188	0.0000
TOTLAB	66177.2109	0.0000	39803.4961	0.0000	12550.4004	0.0000
SOILIND	4135.8052	0.0000	2407.0571	0.0000	4472.6465	0.0000
LSU	754.2355	0.0000	497.7843	0.0000	668.5888	0.0000
MAIZEFOD	69721.6406	0.0000	149494.7500	0.0000	0.0000	0.0093
FOD	92729.7813	0.0000	198828.0313	0.0000	413153.9375	0.0000

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	7055.6120		42940.6300		25623.9200	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
AW	5978.1826	0.0000	4669.9688	0.0000	5153.1367	0.0000
BSP	0.0000	0.0000	0.0000	26.5623	45.0000	0.0000
BSPFULL	0.0000	0.0000	0.0000	6.5285	45.0000	0.0000
Cereals	0.0000	0.0000	9245.4561	0.0000	12419.6064	0.0000
Potatoes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other Cr	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cattle	196120.6094	0.0000	117800.4297	0.0000	229992.3906	0.0000
Sheep	46250.3750	0.0000	50957.3828	0.0000	31853.1211	0.0000
Forage C	1292.7992	0.0000	3994.2944	0.0000	0.0000	0.9390
SAP	1000.0000	0.0000	1000.0000	0.0000	617.0694	0.0000

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	22297.060		39450.130		11206.900		15958.950	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	0.0000	5147.8608	0.0000	2459.3098	0.0048	0.0000	0.0000	2459.3098
CJAN	0.0000	6.9400	0.0000	6.9400	0.0000	0.0000	0.0000	6.9400
CFEB	0.0000	6.9400	0.0000	6.9400	0.0000	0.0000	0.0000	6.9400
CMAR	0.0000	6.9400	0.0000	6.9400	0.0000	0.0000	0.0000	6.9400
CAPR	75.6091	0.0000	470.0561	0.0000	366.0381	0.0000	363.4598	0.0000
CMAY	0.0000	1.3454	109.4477	0.0000	92.2813	0.0000	43.4461	0.0000
CJUN	0.0000	5.3754	42.4312	0.0000	83.3612	0.0000	46.5243	0.0000
CJUL	0.0000	3.5735	71.5915	0.0000	104.2950	0.0000	72.6665	0.0000
CAUG	0.0000	6.9400	0.0000	6.9400	46.6010	0.0000	3.5010	0.0000
CSEP	0.0000	6.9400	0.0000	6.9400	14.1578	0.0000	0.0000	6.9400
COCT	0.0000	6.9400	0.0000	6.9400	0.0000	0.0000	0.0000	6.9400
CNOV	0.0000	6.9400	13.3216	0.0000	22.2818	0.0000	0.0000	6.9400
CDEC	0.0000	6.9400	0.0000	6.9400	0.0000	0.0000	0.0000	6.9400
BHAY	21.5612	0.0000	68.4903	0.0000	36.7563	0.0000	58.5829	0.0000
BBAR	53.5291	0.0000	46.0442	0.0000	34.1807	0.0000	49.8666	0.0000
SBAR	0.0000	9.6873	0.0000	6.3000	0.0000	0.0000	0.0000	8.1217
USLYCat	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UFYMCat	745.4644	0.0000	931.6500	0.0000	488.5040	0.0000	630.1898	0.0000
BUYN	12726.403	0.0000	8766.9307	0.0000	9137.5010	0.0000	10472.843	0.0000
BUYP	4037.7961	0.0000	2794.9500	0.0000	2728.6484	0.0000	3583.7070	0.0000
BUYK	3045.9341	0.0000	0.0000	0.3691	1263.1366	0.0000	1693.1377	0.0000
BHeifers	0.0000	0.0000	0.0000	657.2000	0.0000	0.0000	0.0000	0.0000
SSLambs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.1658
BSLambs	0.0000	2.5833	0.0000	1.6800	0.0000	0.0000	0.0000	0.0000
SGimmers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bGimmers	0.0000	5.5356	0.0000	3.6000	0.0000	0.0000	0.0000	4.6410
bwSTRAW	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bBSTRAW	0.0000	21.1065	0.0000	20.3000	0.0000	0.0000	0.0000	20.7337
bOSTRAW	29.3311	0.0000	28.3989	0.0000	16.6753	0.0000	22.5379	0.0000
WW1	0.0000	11.4921	0.0000	35.3172	0.0000	0.0000	0.0000	5.0890
WW2	0.0000	0.0000	0.0000	5.7455	0.0000	0.0000	0.0000	58.0984
WW3	0.0000	17.8940	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BWW1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	25.3942
BWW2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	77.7870

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	22297.060		39450.130		11206.900		15958.950	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
BWW3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
MSBAR1	0.0000	285.0168	0.0000	0.0000	0.0000	0.0000	0.0000	374.1866
MSBAR2	0.0000	340.4217	0.0000	159.9410	0.0000	0.0000	0.0000	351.6388
MSBAR3	0.0000	226.6021	0.0000	127.8614	0.0000	0.0000	0.0000	339.2321
WB125	0.0000	260.4341	0.0000	248.5463	0.0000	0.0000	0.0000	163.3242
WB180	0.0000	189.1457	0.0000	335.2992	0.0000	0.0000	0.0000	242.6416
WB225	0.0000	302.2582	0.0000	219.3638	0.0000	0.0000	0.0000	202.1761
SBAR75	0.0000	198.3340	0.0000	316.5385	0.0000	0.0000	0.0000	247.1598
SBAR100	0.0000	262.3335	0.0000	290.8995	0.0000	0.0000	0.0000	242.4461
SBAR125	0.0000	181.5929	0.0000	284.6830	0.0000	-6.0400	0.0000	256.5870
WO50	0.0000	0.0000	0.0000	387.6255	0.0000	0.0000	0.0000	0.0000
WO100	0.0000	8.1001	0.0000	376.6701	0.0000	0.0000	0.0000	9.2441
WO125	0.0000	34.0833	0.0000	360.7157	0.0000	0.0000	0.0000	35.3902
SO50	0.0000	468.6955	0.0000	372.8907	0.0000	0.0000	0.0000	304.0665
SO100	0.0000	434.0213	0.0000	361.9353	0.0000	0.0000	0.0000	313.3106
SO125	0.0000	502.7788	0.0000	345.9809	0.0000	0.0000	0.0000	339.4567
RYE1	0.0000	160.4654	0.0000	573.3303	0.0000	0.0000	0.0000	128.5494
RYE2	0.0000	166.4926	0.0000	563.6348	0.0000	0.0000	0.0000	135.3061
RYE3	0.0000	177.4374	0.0000	561.7804	0.0000	0.0000	0.0000	146.3045
TRIT150	0.0000	39.5978	0.0000	439.2675	0.0000	0.0000	0.0000	14.3124
TRIT180	0.0000	32.3698	0.0000	414.8697	0.0000	0.0000	0.0000	8.5410
TRIT200	0.0000	43.0487	0.0000	853.7917	0.0000	0.0000	0.0000	19.2881
WOSR150	0.0000	452.5228	0.0000	674.5020	0.0000	0.0000	0.0000	435.8908
WOSR185	0.0000	526.9273	0.0000	817.8080	0.0000	0.0000	0.0000	478.2469
WOSR225	0.0000	442.4626	0.0000	810.8741	0.0000	0.0000	0.0000	462.8500
SOSR90	0.0000	595.8477	0.0000	604.0319	0.0000	0.0000	0.0000	454.9177
SOSR110	0.0000	605.8173	0.0000	578.7887	0.0000	0.0000	0.0000	453.9236
SOSR130	0.0000	649.7015	0.0000	620.9255	0.0000	0.0000	0.0000	523.0071
LIN50	0.0000	652.1015	0.0000	600.7053	0.0000	0.0000	0.0000	489.0335
LIN80	0.0000	651.8530	0.0000	600.4133	0.0000	0.0000	0.0000	493.1834
LIN120	0.0000	659.8893	0.0000	606.3212	0.0000	0.0000	0.0000	503.7816
SFB20K	0.0000	153.0423	0.0000	334.3489	0.0000	0.0000	0.0000	182.2294
SFB40K	0.0000	57.0584	0.0000	257.4525	0.0000	0.0000	0.0000	109.8505
SFB60K	0.0000	0.0000	0.0000	209.6862	0.0000	0.0000	0.0000	67.7677
SETSC	0.0000	269.4511	0.0000	61.5924	0.0000	0.0000	0.0000	164.2040
SETNR	0.0000	197.0255	0.0000	0.0000	0.0000	0.0000	0.0000	99.1605
WORSA100	0.0000	684.5989	0.0000	381.3021	0.0000	0.0000	0.0000	594.9111
WORSA140	0.0000	762.7944	0.0000	381.2817	0.0000	0.0000	0.0000	630.2354
WORSA180	0.0000	748.9875	0.0000	401.0513	0.0000	0.0000	0.0000	672.3719
SORSA60	0.0000	754.5298	0.0000	495.0258	0.0000	0.0000	0.0000	559.5090
SORSA85	0.0000	814.1022	0.0000	896.7927	0.0000	0.0000	0.0000	568.9349
SORSA110	0.0000	786.9239	0.0000	880.7196	0.0000	0.0000	0.0000	601.3248
SBEET1	0.0000	87.1725	0.0000	567.3964	0.0000	0.0000	0.0000	33.9977
SBEET2	0.0000	70.9664	0.0000	530.7831	0.0000	0.0000	0.0000	56.2394
SBEET3	0.0000	0.0000	0.5400	0.0000	0.4200	0.0000	0.0000	0.0000
POTEW1	0.0000	2179.9297	0.0000	1800.2300	0.0000	0.0000	0.0000	1647.7852
POTEW2	0.0000	1986.9095	0.0000	1638.4695	0.0000	0.0000	0.0000	1517.0587
POTEW3	0.0000	1800.7654	0.0000	1712.6998	0.0000	0.0000	0.0000	1381.2408
PTMCW140	0.0000	1727.4237	0.0000	1588.2272	0.0000	0.0000	0.0000	1257.9989
PTMCW180	0.0000	1430.6305	0.0000	1190.3340	0.0000	0.0000	0.0000	1122.4034

C)	20.Small LFA Beef Scotland 22297.060		21.Small LFA Farms South West England 39450.130		22.Small Hill Wales & Northern Ireland 11206.900		23.Small LFA North & Central England 15958.950	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
PTMCW220	0.0000	1343.3646	0.0000	1036.7306	0.0000	0.0000	0.0000	1012.6740
PMCWBPP1	0.0000	815.0070	0.0000	747.2553	0.0000	0.0000	0.0000	598.0143
PMCWBPP2	0.0000	499.5709	0.0000	654.2302	0.0000	0.0000	0.0000	369.8013
PMCWBPP3	0.0000	336.5234	0.0000	508.8150	0.0000	0.0000	0.0000	260.1941
PTPOF1	0.0000	1407.2739	0.0000	1193.9272	0.0000	0.0000	0.0000	1059.4591
PTPOF2	0.0000	1171.7727	0.0000	995.8742	0.0000	0.0000	0.0000	895.0405
PTPOF3	0.0000	1061.5464	0.0000	891.5710	0.0000	0.0000	0.0000	828.1248
PTPEXST1	0.0000	817.0145	0.0000	749.1674	0.0000	0.0000	0.0000	601.9160
PTPEXST2	0.0000	492.9984	0.0000	484.8741	0.0000	0.0000	0.0000	368.6052
PTPEXST3	0.0000	327.6512	0.0000	339.3210	0.0000	0.0000	0.0000	258.7884
POTSEED1	0.0000	595.6373	0.0000	480.2137	0.0000	0.0000	0.0000	433.6946
POTSEED2	0.0000	210.8141	0.0000	174.9969	0.0000	0.0000	0.0000	149.1307
POTSEED3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POTDUAL1	0.0000	999.8735	0.0000	748.4758	0.0000	0.0000	0.0000	763.8282
POTDUAL2	0.0000	658.5325	0.0000	477.3109	0.0000	0.0000	0.0000	515.7385
POTDUAL3	0.0000	479.8961	0.0000	327.9061	0.0000	0.0000	0.0000	394.2836
SWEDE1	0.0000	1655.5179	0.0000	1474.6245	0.0000	0.0000	0.0000	1480.3149
SWEDE2	0.0000	2290.3008	0.0000	1639.8085	0.0000	0.0000	0.0000	1820.6384
SWEDE3	0.0000	1508.4894	0.0000	1353.4198	0.0000	0.0000	0.0000	1379.5781
GR0	36.6200	0.0000	0.0000	16.1395	26.5400	0.0000	61.8000	0.0000
GR50	0.0000	7.7710	82.9920	0.0000	34.7954	0.0000	42.4114	0.0000
GR75	0.0000	3.0622	73.0180	0.0000	0.0000	0.0000	0.0000	1.9036
GR125	70.3106	0.0000	0.0000	3.6366	61.4646	0.0000	71.1286	0.0000
GR200	0.0000	4.9400	0.0000	11.9502	0.0000	0.0000	0.0000	11.7863
GR375	0.0000	33.4147	0.0000	49.8215	0.0000	0.0000	0.0000	53.0686
SILAGE12	0.0000	94.6248	0.0000	117.9732	0.0000	0.0000	0.0000	55.1597
SILAGE27	16.2263	0.0000	0.0000	97.9816	0.0000	0.0000	0.0000	12.2651
SILAGE30	0.0000	56.6739	0.0000	136.8439	0.0000	0.0000	0.0000	65.5133
HAY0	0.0000	155.3912	0.0000	193.6934	0.0000	0.0000	0.0000	214.3294
HAY50	0.0000	34.0626	0.0000	70.6305	0.0000	0.0000	0.0000	62.3253
HAY75	0.0000	40.3878	0.0000	57.0486	0.0000	0.0000	0.0000	61.4337
HAY125	0.0000	6.3047	0.0000	22.8629	0.0000	0.0000	0.0000	17.7191
HAY200	1.9031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FMAIZE1	0.0000	411.8895	0.0000	291.5562	0.0000	0.0000	0.0000	202.8732
FMAIZE2	0.0000	564.1209	0.0000	278.3758	0.0000	0.0000	0.0000	263.3096
FMAIZE3	0.0000	452.0737	0.0000	275.5806	0.0000	0.0000	0.0000	241.1288
FMAIZEP1	0.0000	603.6281	0.0000	457.3584	0.0000	0.0000	0.0000	388.5267
FMAIZEP2	0.0000	751.5252	0.0000	438.5150	0.0000	0.0000	0.0000	444.6381
FMAIZEP3	0.0000	636.7335	0.0000	432.1339	0.0000	0.0000	0.0000	419.7187
SWEDESGR	0.0000	11.0203	0.0000	10.3880	0.0000	0.0000	0.0000	10.7280
TURNIPSG	2.4734	0.0000	7.0500	0.0000	5.5500	0.0000	6.2600	0.0000
KALEAGEd	0.0000	169.1808	0.0000	239.3382	0.0000	0.0000	0.0000	165.6223
KALEAGEB	0.0000	74.8336	0.0000	150.4042	0.0000	0.0000	0.0000	73.7771
RapeBroa	0.0000	3.5985	0.0000	45.5575	0.0000	0.0000	0.0000	6.2563
RapeDril	0.3915	0.0000	0.0000	42.1655	0.0000	0.0000	0.0000	2.7532
RapeDD	0.0000	55.7762	0.0000	94.7415	0.0000	0.0000	0.0000	57.0503
Fbeet1	1.0051	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Fbeet2	0.0000	43.8936	0.0000	11.5147	0.0000	0.0000	0.0000	42.2747
Fbeet3	0.0000	94.7651	0.0000	32.1466	0.0000	0.0000	0.0000	91.5124
FRYE1	0.0000	428.9473	0.0000	436.0474	0.0000	0.0000	0.0000	187.0826

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	22297.060		39450.130		11206.900		15958.950	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FRYE2	0.0000	454.0803	0.0000	454.2016	0.0000	0.0000	0.0000	211.5492
FRYE3	0.0000	479.2133	0.0000	472.3558	0.0000	0.0000	0.0000	236.0157
IRG1	0.0000	458.3810	0.0000	454.1947	0.0000	0.0000	0.0000	228.0618
IRG2	0.0000	505.2896	0.0000	490.6193	0.0000	0.0000	0.0000	274.1182
IRG3	0.0000	546.9019	0.0000	522.9485	0.0000	0.0000	0.0000	315.2637
UPCLBE1	0.0000	0.3114	106.8604	0.0000	0.0000	0.0000	0.0000	1.5540
UPCLBE2	0.0000	9.8929	0.0000	9.2880	0.0000	0.0000	0.0000	10.7153
UPHBML	0.0000	0.4464	640.9091	0.0000	0.0000	0.0000	569.0912	0.0000
CBE1	0.0000	4.0258	0.0000	2.4910	0.0000	0.0000	0.0000	1.2987
CBE2	0.0000	1.9510	0.0000	1.4468	392.1280	0.0000	0.0000	0.2514
CBE3	387.0000	0.0000	0.0000	1.4230	162.8721	0.0000	0.0000	0.2560
WINFINMK	0.0000	10.2018	0.0000	10.6544	0.0000	0.0000	0.0000	10.6995
WINFINLK	0.0000	10.5559	0.0000	10.7085	0.0000	0.0000	0.0000	10.6269
WINFINBF	0.0000	21.3006	0.0000	20.4088	0.0000	0.0000	0.0000	22.6943
WINFINSK	0.0000	20.2157	0.0000	20.4632	0.0000	0.0000	0.0000	19.0077
AFLGR	0.0000	13.9747	0.0000	14.2809	0.0000	0.0000	0.0000	23.4476
GIMMERIN	0.0000	14.1785	0.0000	16.8129	0.0000	0.0000	0.0000	13.8018
INDOORLA	0.0000	46.1351	0.0000	48.1562	0.0000	0.0000	0.0000	51.8305
UPSUCKNJ	0.0000	64.2885	0.0000	67.2072	0.0000	0.0000	0.0000	61.2346
UPSUCKFA	0.0000	122.6596	0.0000	125.2680	0.0000	0.0000	0.0000	118.3616
UPSUCKMJ	0.0000	26.6055	0.0000	21.1614	0.0000	0.0000	0.0000	27.7584
UPSUCKAO	45.4747	0.0000	5.2208	0.0000	13.8906	0.0000	24.3329	0.0000
18MthST	78.6837	0.0000	90.0000	0.0000	62.8051	0.0000	90.0000	0.0000
18mthHF	0.0000	20.7724	0.0000	44.3605	0.0000	0.0000	0.0000	14.7202
24mthFr	0.0000	1.6703	0.0000	8.3005	0.0000	0.0000	0.0000	31.3677
24mthB	11.3163	0.0000	0.0000	6.7705	0.0000	0.0000	0.0000	29.7622
Owscsbst	0.0000	30.9225	0.0000	0.7816	0.0000	0.0000	0.0000	32.8737
Owscsbhf	0.0000	58.5430	0.0000	59.5766	0.0000	0.0000	0.0000	60.2005
Owscwbst	0.0000	65.5416	0.0000	32.4975	0.0000	0.0000	0.0000	67.6186
Owscwbhf	0.0000	175.3140	0.0000	170.9445	0.0000	0.0000	0.0000	175.9418
OWSCSTSB	0.0000	83.8439	0.0000	125.0423	0.0000	0.0000	0.0000	120.5338
OWSCHFSB	0.0000	53.0648	0.0000	93.5923	0.0000	0.0000	0.0000	94.0815
OWMJST	0.0000	83.8439	0.0000	125.0423	0.0000	0.0000	0.0000	120.5338
OWMJHF	0.0000	53.0648	0.0000	93.5923	0.0000	0.0000	0.0000	94.0815
RYCSBMST	0.0000	216.2584	0.0000	183.5328	0.0000	0.0000	0.0000	213.5187
RYCSBLST	0.0000	144.4241	0.0000	114.4728	0.0000	0.0000	0.0000	142.7355
RYCABMST	39.6022	0.0000	175.1944	0.0000	53.9415	0.0000	47.7810	0.0000
RYCABLST	0.0000	2.7871	0.0000	1.2000	0.0000	0.0000	0.0000	2.7468
WFLFBST	0.0000	46.9107	0.0000	132.8277	0.0000	0.0000	0.0000	157.8917
SFLFBST	0.0000	26.5530	0.0000	84.9733	0.0000	0.0000	0.0000	101.2329
IBBFCF	0.0000	74.4536	0.0000	86.5859	0.0000	0.0000	0.0000	96.1425
IBBBXSF	0.0000	103.6894	0.0000	51.7777	0.0000	0.0000	0.0000	169.4666
IBBSCCF	0.0000	99.6468	0.0000	122.3996	0.0000	0.0000	0.0000	128.2052
IBBSCSF	0.0000	129.4302	0.0000	110.8819	0.0000	0.0000	0.0000	190.9077
CRFBFs1	0.0000	88.7550	0.0000	112.6888	0.0000	0.0000	0.0000	103.3650
CRMBBFs1	0.0000	72.2388	0.0000	96.6888	0.0000	0.0000	0.0000	87.0874
CRLBBFs1	0.0000	55.7227	0.0000	80.6888	0.0000	0.0000	0.0000	70.8098
CRFALst1	0.0000	74.7015	0.0000	97.9315	0.0000	0.0000	0.0000	88.9862
CRFBFhf1	0.0000	88.7550	0.0000	112.6888	0.0000	0.0000	0.0000	103.3650
CRMBBFh1	0.0000	72.2388	0.0000	96.6888	0.0000	0.0000	0.0000	87.0874

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	22297.060		39450.130		11206.900		15958.950	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
CRLBBFh1	0.0000	55.7227	0.0000	80.6888	0.0000	0.0000	0.0000	70.8098
CRFALhf1	0.0000	74.7015	0.0000	97.9315	0.0000	0.0000	0.0000	88.9862
FCOSTS	37235.121	0.0000	52935.683	0.0000	32501.634	0.0000	40990.257	0.0000
EEIQ	6984.9478	0.0000	0.0000	0.0000	8494.8389	0.0000	10580.582	0.0000
CEIQ	4597.1548	0.0000	0.0000	0.0000	5558.2593	0.0000	6837.9844	0.0000
WEIQ	5359.8882	0.0000	0.0000	0.0000	5936.4717	0.0000	7507.1616	0.0000
TPest	91.2038	0.0000	0.0000	0.0000	111.4597	0.0000	138.5968	0.0000
Herb	90.6911	0.0000	0.0000	0.0000	111.3379	0.0000	138.5968	0.0000
Insectic	0.5126	0.0000	0.0000	0.0000	0.1176	0.0000	0.0000	0.0000
Fungicid	0.0000	62.8025	0.0000	0.0000	0.0042	0.0000	0.0000	0.0000
Growth	0.0000	378.0884	0.0000	4.6235	0.0000	0.0000	0.0000	228.4265
STBO	12153.216	0.0000	14066.087	0.0000	9060.1836	0.0000	4246.3882	0.0000
LOSS	36632.886	0.0000	72069.218	0.0000	28289.232	0.0000	44633.011	0.0000
TOTLAB	524.7275	0.0000	4905.5254	0.0000	5097.2690	0.0000	3675.4080	0.0000
SOILIND	487.9393	0.0000	686.3683	0.0000	499.6924	0.0000	721.6673	0.0000
LSU	186.9485	0.0000	260.8960	0.0000	159.1540	0.0000	187.0480	0.0000
MAIZEFOD	10868.664	0.0000	0.0000	0.0261	0.0000	0.0000	0.0000	0.0000
FOD	53656.054	0.0000	0.0000	0.0243	0.0000	0.0000	0.0000	0.0271
BSP	90.0000	0.0000	90.0000	0.0000	62.8051	0.0000	90.0000	0.0000
BSPFULL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	21.3111

Appendix 34. The MacSharry reforms of the Common Agricultural Policy and Changes in UK Agriculture 1992-1999

i. The MacSharry Reforms

The following section contains a brief outline of the MacSharry reforms and policy developments between 1991 and 1997, for a more detailed description and the background to the MacSharry reforms of the Common Agricultural Policy see Hubbard and Ritson (1997).According to Neville and Mordaunt (1993), the MacSharry reforms contained three essential features which are presented in Table A. 34.16, namely supply control, price reductions, and compensation payments.

Table A. 34.16. Essential features of the Macsharry reforms

Supply Control	Arable Set-Aside, Suckler Cow Quotas, Ewe Quotas
Price Reduction	Oilseeds, Peas and Beans (to world market prices), Cereals and Beef (towards world market prices).
Compensation	Arable Area Payments (limited nationally, regionally). Beef Headage Payments (limits imposed by individually and regionally).

ii. Policy Assumptions in the Historical Models

Thus the following assumptions were made in the 1991/1992 models in order to simulate a pre-MacSharry reform scenario.

Table A. 34.17. Institutional assumptions in the 1991/92 conventional farm models

	Institutional Assumptions	Price Assumptions
Arable Enterprises	No Area Payment Rates No Minimum Set-Aside Rate	Prices set as that quoted in SAC (1991).
Livestock	No Cost included for leasing of Suckler Cow or Ewe Quota 1000 head limit set on sheep annual premium in LFA's, 500 in lowlands	Prices set as that quoted in SAC (1991).

Appendix 35. The Farm Level Changes Predicted by the Conventional Models 1991/92 to 1997/98 Compared with Farm Business Survey Data 1991/92 and 1997/98

Appendix 35.a. Changes on Pigs and Poultry Farms 1991/92 to 1997/98

	Net Farm Income (£/ha)	Fixed Costs (£/ha)	Cereals %	Grass %	Fodder %	Other Crops %	Labour Costs %	Breeding Pigs (No.)
1. Pigs and Poultry Central England 1997 Data	7220	906	53	11	0	35	547	202
1997 Model	5680	1320	96	0	0	4	684	405
	-21%	46%	79%	-100%	...	-88%	25%	101%
1992 Data	11533	1294	61	10	0	29	347	147
1992 Model	5955	2682	19	30	0	51	815	296
	-48%	107%	-69%	205%	...	75%	135%	101%
Observed Change	-4313	-387	-8	2	0	6	200	55
Predicted Change	-274	-1362	76	-30	0	-46	-131	110
2. Pigs and Poultry Southern England and Wales 1997 Data	1306	1716	47	19	0	33	601	202
1997 Model	3951	1094	45	43	0	12	491	88
	202%	-36%	-6%	130%	...	-63%	-18%	-56%
1992 Data	8021	1906	66	27	0	7	353	103
1992 Model	3773	1347	0	90	0	10	448	86
	-53%	-29%	-100%	231%	...	38%	27%	-16%
Observed Change	-6715	-190	-18	-8	0	26	248	99
Predicted Change	178	-254	45	-47	0	2	43	1
3. Pigs and Poultry Scotland, Northern Ireland & the North of England 1997 Data	2169	1232	42	26	1	32	257	202
1997 Model	3811	780	91	2	3	4	208	221
	76%	-37%	119%	-92%	242%	-86%	-19%	9%
1992 Data	7738	1111	67	33	0	0	228	92
1992 Model	3851	905	35	39	7	19	188	288
	-50%	-19%	-48%	19%	...	...	-17%	213%
Observed Change	-5570	121	-25	-7	1	32	29	110
Predicted Change	-40	-125	56	-37	-4	-15	20	-68

Appendix 35.b. Changes on Cropping Farms 1991/92 to 1997/98

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Labour Costs £/ha	Ewes (No.)
4. Cropping South East England 1997 Data	429	693	64	14	0	22	172	94
1997 Model	665	1195	44	24	0	32	742	171
	55%	72%	-31%	69%	...	45%	332%	81%
1992 Data	204	614	69	21	0	9	191	0
1992 Model	521	527	59	10	0	32	145	0
	155%	-14%	-15%	-54%	...	235%	-24%	...
Observed Change	224	78	-5	-7	0	13	-19	94
Predicted Change	144	667	-15	14	0	1	597	171
5. Cropping Central and Northern England 1997 Data	335	556	51	11	0	38	106	119
1997 Model	323	494	35	26	0	38	69	0
	-3%	-11%	-30%	127%	...	2%	-35%	-100%
1992 Data	125	469	52	18	0	30	115	69
1992 Model	264	408	56	23	0	21	48	0
	111%	-13%	9%	26%	...	-31%	-58%	-100%
Observed Change	210	87	-1	-7	0	8	-8	50
Predicted Change	60	86	-21	3	0	17	21	0
6. Cropping Scotland, Northern Ireland and Western England 1997 Data	202	649	54	24	1	20	105	85
1997 Model	502	357	34	3	0	63	35	0
	148%	-45%	-37%	-89%	-100%	207%	-67%	-100%
1992 Data	157	484	57	23	0	20	113	127
1992 Model	474	541	41	37	0	21	113	0
	202%	12%	-28%	65%	...	9%	0%	-100%
Observed Change	45	166	-3	1	1	1	-8	-42
Predicted Change	28	-184	-7	-35	0	42	-78	0
7. Small Cropping Farms Wales 1997 Data	289	589	49	17	0	34	105	78
1997 Model	429	418	32	13	0	55	57	0
	48%	-29%	-34%	-24%	...	60%	-45%	-100%
1992 Data	45	538	51	21	0	29	121	378
1992 Model	394	430	64	11	0	25	81	0
	783%	-20%	26%	-48%	...	-12%	-33%	-100%
Observed Change	245	51	-2	-3	0	5	-16	-300
Predicted Change	35	-12	-32	2	0	30	-24	0

Appendix 35.c. Changes on the Mainly Dairy Farms 1991/92 to 1997/98

	Net Farm Income (£/ha)	Fixed Costs (£/ha)	Cereals %	Grass %	Fodder %	Other Crops %	Labour Costs (£ha)	Ewes (No.)	Dairy Cows (No.)
8.Mainly Dairy Wales and Northern Ireland 1997 Data	429	375	2	96	0	2	75	76	52
1997 Model	748	632	10	88	0	1	279	0	110
	74%	68%	425%	-8%	...	-36%	270%	...	109%
1992 Data	257	412	6	81	0	12	110	325	72
1992 Model	471	656	0	93	7	0	255	0	86
	84%	59%	-100%	15%	...	-100%	133%	...	20%
Observed Change	172	-37	-4	14	0	-10	-34	-249	-20
Predicted Change	277	-24	10	-5	-7	1	24	0	23
9.Small Dairy Northern England 1997 Data	178	563	7	92	0	0	118	154	27
1997 Model	810	642	0	98	0	2	296	0	94
	355%	14%	-100%	6%	...	587%	151%	...	243%
1992 Data	192	379	0	100	0	0	160	130	25
1992 Model	1813	873	0	87	11	2	290	0	51
	844%	130%	...	-13%	...	...	81%	...	105%
Observed Change	-14	184	7	-8	0	0	-42	24	2
Predicted Change	-1003	-230	0	11	-11	0	6	0	42
10.Large Dairy Scotland 1997 Data	410	638	4	88	1	7	150	237	98
1997 Model	395	607	7	93	0	0	267	0	111
	-4%	-5%	55%	6%	...	-96%	78%	...	14%
1992 Data	723	514	4	100	0	-4	198	94	136
1992 Model	403	608	2	98	0	0	228	0	98
	-44%	18%	-64%	-2%	...	...	15%	...	-28%
Observed Change	-313	124	0	-12	1	11	-48	143	-38
Predicted Change	-9	-1	5	-5	0	0	39	0	13
11.Mainly Dairy South West England 1997 Data	256	830	32	51	8	9	229	21	68
1997 Model	406	564	40	56	2	2	209	0	108
	59%	-32%	26%	10%	-82%	-77%	-9%	-100%	58%
1992 Data	362	698	27	60	4	8	204	20	104
1992 Model	594	720	0	95	3	2	293	0	250
	64%	3%	-100%	57%	-24%	-79%	44%	...	142%
Observed Change	-106	132	5	-9	4	0	25	1	-35
Predicted Change	-188	-155	40	-39	-2	0	-85	0	-143
12. Dairy and Sheep Southern England 1997 Data	180	656	23	73	2	2	100	475	72
1997 Model	429	481	22	70	0	8	135	0	98
	138%	-27%	-2%	-4%	-100%	247%	35%	-100%	36%
1992 Data	277	524	16	78	2	4	182	399	84
1992 Model	523	666	0	98	0	2	269	0	227
	89%	27%	-100%	26%	-100%	-51%	48%	-100%	172%
Observed Change	-96	132	7	-5	0	-1	-82	77	-12
Predicted Change	-94	-185	22	-28	0	6	-134	0	-130

Appendix 35.d. Changes on the Specialist Dairy and Mixed Lowland Farms 1991/92 to 1997/98

	Net Farm Income (£/ha)	Fixed Costs (£/ha)	Cereals %	Grass %	Fodder %	Other Crops %	Labour Costs (£/ha)	Ewes (No.)	Dairy Cows (No.)	Suckler Cows (No.)
13.Specialist Dairy Central and Southern England 1997 Data	488	920	0	97	2	0	73	108	73	...
1997 Model	328	578	9	90	0	1	140	0	50	...
	-33%	-37%	...	-7%	-100%	...	90%	-100%	-32%	...
1992 Data	537	1173	2	94	1	3	144	344	96	...
1992 Model	587	589	0	92	8	0	207	0	94	...
	9%	-50%	...	-3%	493%	...	43%	-100%	-2%	...
Observed Change	-49	-254	-2	3	1	-3	-71	-236	-23	...
Predicted Change	-259	-11	9	-2	-8	1	-67	0	-44	...
14.Specialist Dairy Wales & North of England 1997 Data	487	948	7	83	5	5	199	76	99	...
1997 Model	1141	694	0	98	0	2	199	0	178	...
	134%	-27%	...	18%	-100%	-63%	0%	-100%	81%	...
1992 Data	397	698	7	87	1	5	195	125	102	...
1992 Model	872	678	0	99	0	1	252	0	177	...
	119%	-3%	...	14%	-100%	-78%	29%	-100%	73%	...
Observed Change	90	250	0	-4	4	0	4	-49	-3	...
Predicted Change	270	16	0	-1	0	1	-53	0	1	...
15.Mixed Lowland North & West 1997 Data	144	482	19	75	1	5	91	210	3	19
1997 Model	161	605	27	65	3	6	178	79	18	41
	12%	25%	40%	-13%	217%	6%	94%	-63%	527%	218%
1992 Data	100	1088	25	74	1	1	862	170	10	16
1992 Model	22	538	22	72	5	1	170	144	19	11
	-78%	-51%	-10%	-3%	646%	56%	-80%	-15%	84%	67%
Observed Change	45	-606	-6	1	0	5	-771	40	-7	3
Predicted Change	140	67	4	-7	-2	5	8	-65	-1	30
16.Mixed Lowland South 1997 Data	369	766	33	57	0	10	270	88	24	12
1997 Model	177	554	19	68	2	11	130	141	27	43
	-52%	-28%	-42%	19%	...	10%	-52%	61%	14%	368%
1992 Data	230	765	23	74	1	2	245	0	0	0
1992 Model	137	550	32	60	3	5	127	108	19	17
	-40%	-28%	41%	-19%	429%	112%	-48%	...	...	...
Observed Change	139	1	10	-17	-1	7	25	88	24	12
Predicted Change	40	4	-13	9	-1	6	3	33	8	26

Appendix 35.e. Changes in Large LFA Farms 1991/92 to 1997/98

	Net Farm Income (£/ha)	Fixed Costs (£/ha)	Cereals %	Grass %	Fodder %	Other Crops %	Labour Costs (£/ha)	Ewes (No.)	Suckler Cows (No.)
17.Large Hill Sheep Wales & Northern Ireland 1997 Data	124	242	1	98	0	1	26	2288	69
1997 Model	5	197	0	98	2	0	56	3921	36
	-96%	-19%	-79%	0%	...	...	118%	71%	-48%
1992 Data	152	122	3	93	0	4	41	1731	50
1992 Model	7	237	1	98	1	0	68	1000	312
	-95%	95%	-57%	6%	...	...	67%	-42%	520%
Observed Change	-28	120	-2	5	0	-3	-15	556	19
Predicted Change	-2	-40	-1	0	1	0	-12	2921	-276
18.Large LFA North of England 1997 Data	91	144	0	99	0	1	16	902	20
1997 Model	68	208	1	95	2	2	50	2784	60
	-25%	45%	2263%	-4%	2540%	87%	219%	209%	208%
1992 Data	111	99	0	98	0	1	39	897	21
1992 Model	74	252	2	95	3	0	69	1000	202
	-33%	155%	...	-3%	...	...	74%	12%	882%
Observed Change	-20	45	0	0	0	0	-24	5	-1
Predicted Change	-6	-43	-2	0	0	2	-18	1784	-142
19.Large LFA Scotland 1997 Data	98	295	1	85	0	14	47	2146	303
1997 Model	79	174	0	98	2	0	5	4038	322
	-20%	-41%	-64%	15%	777%	...	-89%	88%	6%
1992 Data	59	129	2	98	0	0	69	875	131
1992 Model	24	186	2	98	0	0	12	617	164
	-60%	44%	2%	0%	...	...	-83%	-29%	25%
Observed Change	39	166	-1	-13	0	14	-22	1271	172
Predicted Change	55	-12	-2	0	2	0	-7	3421	159

Appendix 35.f. Changes in Small LFA Farms 1991/92 to 1997/98

	Net Farm Income (£/ha)	Fixed Costs (£/ha)	Cereals %	Grass %	Fodder %	Other Crops %	Labour Costs (£/ha)	Ewes (No.)	Suckler Cows (No.)
20.Small LFA Beef Scotland 1997 Data	167	365	5	93	1	1	49	210	92
1997 Model	110	312	3	94	0	3	0	88	62
	-34%	-14%	-38%	1%	-100%	152%	-100%	-58%	-33%
1992 Data	230	206	0	97	0	3	56	375	67
1992 Model	173	293	0	97	3	0	4	387	45
	-25%	42%	...	0%	...	...	-93%	3%	-32%
Observed Change	-63	159	5	-4	1	-2	-6	-165	26
Predicted Change	-63	19	3	-3	-3	3	-4	-299	16
21.Small LFA Farms South West England 1997 Data	71	248	0	92	0	8	71	1363	82
1997 Model	163	431	3	95	1	1	45	468	24
	128%	74%	...	3%	...	-93%	-36%	-66%	-71%
1992 Data	77	211	4	92	0	4	65	408	33
1992 Model	241	354	0	95	4	0	30	748	5
	215%	67%	-100%	4%	...	...	-54%	83%	-84%
Observed Change	-5	37	-4	0	0	4	6	955	49
Predicted Change	-79	77	3	0	-3	0	15	-280	19
22.Small Hill Wales & Northern Ireland 1997 Data	224	270	6	90	1	4	49	512	40
1997 Model	113	339	2	95	2	1	44	516	30
	-49%	25%	-67%	6%	219%	-86%	-10%	1%	-26%
1992 Data	64	190	5	88	0	7	57	434	37
1992 Model	87	292	0	95	4	0	40	555	14
	35%	54%	-100%	8%	892%	...	-31%	28%	-62%
Observed Change	160	80	1	2	0	-3	-8	77	3
Predicted Change	26	47	2	0	-2	0	4	-39	16
23.Small LFA North & Central England 1997 Data	147	376	0	91	1	8	45	588	74
1997 Model	95	305	5	92	3	0	30	458	55
	-35%	-19%	...	2%	296%	...	-33%	-22%	-26%
1992 Data	89	282	2	98	0	0	73	519	48
1992 Model	88	246	0	97	3	0	20	569	24
	-1%	-13%	...	-1%	832%	...	-72%	10%	-50%
Observed Change	58	94	-2	-7	0	9	-28	69	26
Predicted Change	7	60	5	-4	-1	0	10	-111	30

Appendix 36. The Farm Level Impacts of Moving to Sustainability
Appendix 36.a. Impacts of Sustainability on Pig Poultry Farms

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Total LSUs	Breeding Pigs (No.)	Rearing Pigs (No.)	Poultry Eggs (No.)	Lambs (No.)	Rearing Cattle (No.)
1. Pigs and Poultry Central England CFP	5680	1320	96	0	0	4	0	684	0	405	2343	0	0	0
SFP	1824	1117	30	28	10	33	0	602	29	336	1289	0	667	19
SFP as % of CFP	32%	85%	32%			745%		88%		83%	55%			
2. Pigs and Poultry Southern England and Wales CFP	3951	1094	45	43	0	12	0	491	18	88	519	0	0	31
SFP	1134	1056	7	51	8	33	0	536	20	61	235	0	185	30
SFP as % of CFP	29%	97%	16%	120%		269%		109%	111%	70%	45%			96%
3. Pigs and Poultry Scotland, Northern Ireland & the North of England CFP	3811	780	91	2	3	4	15	208	3	221	394	2221	134	0
SFP	1526	1119	35	34	10	22	0	601	31	203	780	0	507	26
SFP as % of CFP	40%	143%	38%	1673%	379%	502%	0%	289%	1155%	92%	198%	0%	379%	

CFP = Conventional Farm Plan SFP Sustainable Farm Plan.

Appendix 36.b. Impacts of Sustainability on Cropping Farms

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Suckler Cows (No.)	Rearing Lambs (No.)	Rearing Cattle (No.)	Total LSUs	Stocking Rate LSU/forage ha
4. Cropping South East England CFP	665	631	44	24	1	89	102	178	171	0	284	90	102	2.61
SFP	611	585	29	4	0	123	36	181	0	7	0	0	8	1.27
SFP as % of CFP	92%	93%	66%	17%	0%	139%	35%	101%	0%	0%	0%	0%	8%	48%
5. Cropping Central and Northern England CFP	323	494	35	26	0	101	60	69	0	0	97	90	74	1.73
SFP	330	351	32	8	3	122	26	29	0	9	546	0	22	1.21
SFP as % of CFP	102%	71%	92%	33%	565%	120%	44%	42%	0%	0%	565%	0%	30%	70%
6. Cropping Scotland, Northern Ireland and Western England CFP	502	357	34	3	0	136	59	35	0	0	0	0	8	1.88
SFP	538	359	33	2	0	138	30	40	0	0	0	6	6	1.42
SFP as % of CFP	107%	100%	95%	85%		101%	51%	116%	0%	0%	0%	0%	68%	79%
7. Small Cropping Farms Wales CFP	429	418	32	13	0	22	52	57	0	0	0	17	14	1.58
SFP	391	390	39	7	2	21	25	58	0	0	147	5	7	1.14
SFP as % of CFP	91%	93%	120%	56%		96%	48%	101%	0%	0%		29%	50%	72%

CFP = Conventional Farm Plan SFP Sustainable Farm Plan.

Appendix 36.c. Impacts of Sustainability on Mainly Dairy Farms

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Dairy Cows (No.)	Rearing Lambs (No.)	Rearing Cattle (No.)	Total LSUs	Stocking Rate LSU/forage ha
8.Mainly Dairy Wales and Northern Ireland CFP	748	632	10	88	0	1	28	279	0	110	0	40	136	1.9
SFP	229	568	0	97	0	2	13	248	0	55	0	90.000002	88	1.12
SFP as % of CFP	31%	90%		110%		179%	46%	89%		50%		224%	65%	59%
9.Small Dairy Northern England CFP	810	642	0	98	0	2	58	296	0	94	0	4	96	1.62
SFP	366	553	5	82	9	4	13	219	89	10	1	90	72	1.3
SFP as % of CFP	45%	86%		84%		183%	22%	74%		11%		2021%	75%	80%
10.Large Dairy Scotland CFP	395	607	7	93	0	0	35	267	0	111	0	197	239	1.81
SFP	397	578	0	99	0	1	11	246	0	130	0	90	132	0.94
SFP as % of CFP	100%	95%	0%	106%		405%	32%	92%		117%		46%	55%	52%
11.Mainly Dairy South West England CFP	406	564	40	56	2	2	47	209	0	108	0	168	217	1.9
SFP	235	500	5	87	1	7	15	211	441	50	139	171	240	1.38
SFP as % of CFP	58%	89%	11%	156%	37%	368%	32%	101%		46%		102%	111%	73%
12. Dairy and Sheep Southern England CFP	429	481	22	70	0	8	38	135	0	98	0	131	183	1.77
SFP	391	462	6	81	5	8	18	140	0	89	0	90	113	0.89
SFP as % of CFP	91%	96%	25%	117%		106%	48%	103%		91%		69%	62%	50%

CFP = Conventional Farm Plan SFP Sustainable Farm Plan.

Appendix 36.d. Impacts of Sustainability on Specialist Dairy and Mixed Lowland Farms

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Dairy Cows (No.)	Suckler Cows (No.)	Rearing Lambs (No.)	Rearing Cattle (No.)	Total LSUs	Stocking /forage ha
13.Specialist Dairy Central and Southern England CFP	328	578	9	90	0	1	42	140	0	50	0	0	45	97	1.70
SFP	300	674	0	90	9	1	8	162	0	62	0	0	24	90	1.42
SFP as % of CFP	91%	117%	0%	100%		100%	20%	116%		123%	0%		54%	92%	84%
14.Specialist Dairy North of England CFP	1141	694	0	98	0	2	103	199	0	178	0	0	5	182	2.07
SFP	396	727	7	88	0	5	15	177	0	91	0	0	26	130	1.65
SFP as % of CFP	35%	105%		90%		290%	14%	89%		51%	0%		477%	71%	80%
15.Mixed Lowland North & West CFP	161	605	27	65	3	6	59	178	79	0	41	431	131	148	1.51
SFP	212	406	2	81	9	8	13	89	279	0	0	587	133	155	1.58
SFP as % of CFP	132%	67%	9%	124%	334%	149%	21%	50%	354%	90%	0%	136%	101%	105%	105%
16.Mixed Lowland South CFP	185	577	20	71	2	7	82	136	141	0	43	305	133	184	1.94
SFP	197	496	7	79	11	2	39	169	468	0	0	858	103	168	1.43
SFP as % of CFP	107%	86%	35%	111%	609%	34%	48%	124%	331%		0%	281%	78%	92%	74%

CFP = Conventional Farm Plan SFP Sustainable Farm Plan.

Appendix 36.e. Impacts of Sustainability on Large LFA Farms

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Suckler Cows (No.)	Rearing Lambs (No.)	Rearing Cattle (No.)	Total LSUs	Stocking/ forage ha
17.Large Hill Sheep Wales & Northern Ireland CFP	5	197	0	98	2	0	20	56	3921	36	0	90	546	0.56
SFP	-47	311	0	98	1	1	5	75	2254	271	72	90	647	0.67
SFP as % of CFP	-964%	158%	0%	100%	61%	965%	23%	134%	57%	763%		100%	118%	119%
18.Large LFA North of England CFP	68	208	1	95	2	2	17	50	2784	60	0	90	440	0.78
SFP	91	228	2	95	3	0	2	44	3709	0	0	36	437	0.77
SFP as % of CFP	133%	109%	273%	100%	133%	11%	11%	87%	133%	0%		40%	99%	98%
19.Large LFA Scotland CFP	79	174	0	98	2	0	33	5	4038	322	0	90	903	0.85
SFP	104	156	0	98	2	0	1	4	4366	141	131	90	724	0.68
SFP as % of CFP	131%	89%	0%	100%	114%	424%	4%	78%	108%	44%		100%	80%	80%

CFP = Conventional Farm Plan SFP Sustainable Farm Plan.

Appendix 36.f. Impacts of Sustainability on Small LFA Farms

	Net Farm Income £/ha	Fixed Costs £/ha	Cereals %	Grass %	Fodder %	Other Crops %	Fertiliser Costs £/ha	Labour Costs £/ha	Ewes (No.)	Suckler Cows (No.)	Rearing Cattle (No.)	Total LSUs	Stocking /forage ha
20.Small LFA Beef Scotland CFP	110	312	3	94	0	4	44	0	88	62	90	143	1.18
SFP	170	306	0	98	2	4	9	0	276	72	45	149	1.16
SFP as % of CFP	154%	98%	0%	104%		100%	21%		313%	118%	50%	105%	98%
21.Small LFA Farms South West England CFP	163	431	3	95	1	1	43	45	468	24	246	252	1.60
SFP	143	379	0	95	4	1	10	41	489	76	90	208	1.28
SFP as % of CFP	88%	88%	0%	100%	453%	100%	23%	90%	104%	318%	37%	83%	80%
22.Small Hill Wales & Northern Ireland CFP	113	339	2	95	2	1	46	44	516	30	90	156	1.24
SFP	93	331	3	95	2	1	21	34	203	39	80	124	0.99
SFP as % of CFP	82%	98%	141%	100%	70%	100%	45%	77%	39%	132%	89%	79%	80%
23.Small LFA North & Central England CFP	95	305	5	92	3	1	43	30	458	55	90	178	1.03
SFP	86	276	4	92	4	1	4	19	589	24	66	143	0.82
SFP as % of CFP	90%	90%	83%	100%	129%	100%	9%	63%	129%	44%	74%	80%	80%

CFP = Conventional Farm Plan SFP Sustainable Farm Plan.

Appendix 37. Lindo Printout for the Sustainable Farm Models

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
C)	101190.1000		20522.5800		63728.0500	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	3.3357	0.0000	1.0083	0.0000	2.6175	0.0000
CJAN	65.3149	0.0000	8.4935	0.0000	31.9953	0.0000
CFEB	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CMAR	0.0000	7.8600	6.7667	0.0000	0.0000	7.8600
CAPR	0.0000	5.6962	0.0000	7.8600	0.0000	7.8600
CMAY	0.0000	7.8600	0.0000	1.6510	0.0000	0.7725
CJUN	2.8810	0.0000	0.0000	0.3672	19.9261	0.0000
CJUL	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CAUG	8.0793	0.0000	0.0000	7.8600	0.0000	1.3340
CSEP	45.9689	0.0000	0.0000	3.6781	0.0000	3.5897
COCT	125.0475	0.0000	28.6302	0.0000	59.3779	0.0000
CNOV	112.0369	0.0000	31.2562	0.0000	61.8063	0.0000
CDEC	105.3690	0.0000	13.7648	0.0000	49.5368	0.0000
BHAY	12.2765	0.0000	6.3879	0.0000	0.6797	0.0000
UPolMan	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Upigslur	4222.7002	0.0000	771.4819	0.0000	2556.5198	0.0000
USLYCat	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UFYMCat	65.5753	0.0000	173.8613	0.0000	87.7546	0.0000
BUYN	0.0000	0.8814	0.0000	0.8868	0.0000	0.8753
BUYP	0.0000	0.8604	0.0000	0.8657	0.0000	0.8545
BUYK	0.0000	0.4827	0.0000	0.4856	0.0000	0.4793
bwSTRAW	1.9401	0.0000	2.9519	0.0000	2.5963	0.0000
bBSTRAW	0.0000	10.4924	0.0000	10.5570	0.0000	10.4204
bOSTRAW	0.0000	10.4924	0.0000	10.5570	0.0000	10.4204
WW1	0.0000	163.9264	0.0000	206.7780	0.0000	289.5547
WW2	14.0000	0.0000	1.2749	0.0000	10.4400	0.0000
WW3	0.0000	32.8613	0.0000	91.0385	0.0000	159.1115
BWW1	0.0000	358.3432	0.0000	317.6382	0.0000	155.8120
BWW2	0.0000	148.1254	0.0000	86.0065	0.0000	0.0000
BWW3	0.0000	190.2693	0.0000	164.0460	0.0000	0.0000
MSBAR1	0.0000	192.1996	0.0000	325.7944	0.0000	202.3405
MSBAR2	0.0000	238.2631	0.0000	246.6107	4.0761	0.0000
MSBAR3	0.9769	0.0000	0.0000	165.9621	0.0000	12.2474
WB125	0.0000	784.2145	0.0000	154.8420	0.0000	259.0494
WB180	0.0000	773.7166	0.0000	154.7657	0.0000	106.3490
WB225	0.0000	760.1041	0.0000	26.7442	0.0000	124.6447
SBAR75	0.0000	623.3409	0.0000	130.4691	0.0000	252.1579
SBAR100	0.0000	630.7701	0.0000	66.6032	0.0000	88.9791
SBAR125	0.0000	599.0635	0.0000	29.5440	0.0000	132.1325
WO50	0.0000	299.9153	0.0000	101.6574	0.0000	430.2657
WO100	0.0000	211.6016	0.0000	48.8224	0.0000	318.0576
WO125	0.0000	198.6880	0.0000	0.0000	0.0000	329.5189
SO50	0.0000	101.2272	0.0000	163.5983	0.0000	315.5507
SO100	0.0000	12.9136	0.0000	110.7634	0.0000	229.3344
SO125	1.7908	0.0000	0.0000	61.9410	0.0000	187.3150

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
C)	101190.1000		20522.5800		63728.0500	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
RYE1	0.0000	460.7021	0.0000	263.2069	0.0000	590.2010
RYE2	0.0000	391.4854	0.0000	222.0436	0.0000	502.1098
RYE3	0.0000	398.7930	0.0000	201.0347	0.0000	528.5856
TRIT150	0.0000	408.8200	0.0000	211.1043	0.0000	538.5650
TRIT180	0.0000	331.6728	0.0000	165.2265	0.0000	440.3583
TRIT200	0.0000	339.8007	0.0000	141.7917	0.0000	469.8732
WOSR150	0.0000	498.1762	0.0000	442.2014	0.0000	352.0227
WOSR185	0.0000	364.0117	0.0000	206.3739	0.0000	277.9027
WOSR225	0.0000	406.8545	0.0000	355.9078	0.0000	261.1343
SOSR90	0.0000	88.5263	0.0000	266.4612	0.0000	88.1062
SOSR110	0.0000	114.2319	0.0000	228.5018	0.0000	132.8322
SOSR130	7.2831	0.0000	0.0000	177.5587	1.9965	0.0000
LIN50	0.0000	814.5681	0.0000	828.2709	0.0000	720.8334
LIN80	0.0000	751.8233	0.0000	734.1810	0.0000	656.7685
LIN120	0.0000	771.4216	0.0000	784.9411	0.0000	677.8916
SFB20K	0.0000	295.3463	0.0000	142.3173	0.0000	141.0427
SFB40K	0.0000	274.4719	0.0000	121.3542	0.0000	120.2673
SFB60K	0.0000	153.6311	2.6811	0.0000	0.1228	0.0000
SETSC	0.0000	200.8283	0.0000	105.9328	0.0000	380.3644
SETNR	0.0000	118.7413	0.0000	25.2258	0.0000	300.0917
WORSA100	0.0000	442.6190	0.0000	213.3536	0.0000	296.0125
WORSA140	0.0000	307.2088	0.0000	31.4596	0.0000	199.9983
WORSA180	0.0000	364.2412	0.0000	139.2656	0.0000	218.0066
SORSA60	0.0000	75.6888	0.0000	76.0104	0.0000	75.3296
SORSA85	0.0000	109.5831	0.0000	99.1705	0.0000	85.9290
SORSA110	2.4300	0.0000	0.4300	0.0000	1.8300	0.0000
SBEET1	0.0000	390.6649	0.0000	521.6825	0.0000	341.8409
SBEET2	0.0000	56.9629	1.3800	0.0000	0.1474	0.0000
SBEET3	0.0000	159.0106	0.0000	289.0439	0.0000	111.2858
POTEW1	0.0000	1540.1154	0.0000	2760.1741	0.0000	1665.5587
POTEW2	0.0000	126.9448	0.0000	0.0000	0.0000	508.2772
POTEW3	0.0000	869.4451	0.0000	2086.6538	0.0000	998.0708
PTMCW140	0.0000	1959.0308	0.0000	3013.0046	0.0000	1959.9634
PTMCW180	0.0000	1561.6571	0.0000	2613.9424	0.0000	1564.4755
PTMCW220	0.0000	1303.2946	0.0000	2354.4822	0.0000	1307.3387
PMCWBPP1	0.0000	1705.0985	0.0000	2758.3030	0.0000	1706.8904
PMCWBPP2	0.0000	1283.9639	0.0000	2335.3789	0.0000	1287.7542
PMCWBPP3	0.0000	1019.1141	0.0000	2069.4038	0.0000	1024.1610
PTPOF1	0.0000	1964.2081	0.0000	3016.9717	0.0000	1966.4923
PTPOF2	0.0000	1645.6834	0.0000	2697.0935	0.0000	1649.4789
PTPOF3	0.0000	1445.3711	0.0000	2495.9299	0.0000	1450.1171
PTPEXST1	0.0000	1959.3420	0.0000	3013.4270	0.0000	1960.1506
PTPEXST2	0.0000	1572.6792	0.0000	2625.1213	0.0000	1575.3225
PTPEXST3	0.0000	1329.5092	0.0000	2380.9177	0.0000	1333.3063
POTSEED1	0.0000	2477.8906	0.0000	3439.0469	0.0000	2482.9456
POTSEED2	0.0000	2078.6943	0.0000	3038.1541	0.0000	2085.6433
POTSEED3	0.0000	1827.6542	0.0000	2786.0474	0.0000	1835.7946

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
C)	101190.1000		20522.5800		63728.0500	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
POTDUAL1	0.0000	2140.2620	0.0000	3099.5601	0.0000	2147.3916
POTDUAL2	0.0000	1730.0052	0.0000	2687.5601	0.0000	1739.0817
POTDUAL3	0.0000	1472.0072	0.0000	2428.4658	0.0000	1482.3080
VIN1	0.0000	3367.2576	0.0000	3336.5195	0.0000	3189.0222
VIN2	0.0000	3209.3931	0.0000	3298.5906	0.0000	3031.9067
VIN3	0.0000	3309.1921	0.0000	3266.0627	0.0000	3131.2322
GR0	0.0000	91.2475	5.8655	0.0000	0.0000	62.6892
GR50	0.0000	75.9925	0.0000	155.8491	0.0000	23.1580
GR75	0.0000	78.0910	0.0000	157.9605	0.0000	25.2421
GR125	0.0000	23.8611	0.0000	48.2519	0.0000	6.1400
GR200	0.0000	14.4613	0.0000	29.1230	0.0000	3.4111
GR375	8.8915	0.0000	0.9507	0.0000	5.3817	0.0000
SILAGE12	0.0000	79.7081	0.0000	43.2714	0.0000	62.8828
SILAGE27	6.3853	0.0000	2.5010	0.0000	5.8152	0.0000
SILAGE30	0.0000	58.2479	0.0000	54.7148	0.0000	63.4509
HAY0	0.0000	213.0683	0.0000	298.7287	0.0000	50.4885
HAY50	0.0000	108.9416	0.0000	154.2835	0.0000	12.7505
HAY75	0.0000	91.7062	0.0000	129.6426	0.0000	8.9997
HAY125	0.0000	67.6969	0.0000	96.1497	0.0000	3.9827
HAY200	0.0000	42.5743	0.0000	60.3193	2.8221	0.0000
FMAIZE1	0.0000	491.6829	0.0000	726.2496	0.0000	672.5121
FMAIZE2	0.0000	465.1779	0.0000	691.0757	0.0000	652.2326
FMAIZE3	0.0000	448.1244	0.0000	668.4446	0.0000	639.1849
FMAIZEP1	0.0000	926.0699	0.0000	1163.3093	0.0000	1103.9147
FMAIZEP2	0.0000	899.5649	0.0000	1128.1354	0.0000	1083.6351
FMAIZEP3	0.0000	882.5115	0.0000	1105.5044	0.0000	1070.5874
SWEDESGR	0.0000	36.0940	0.0000	36.3161	0.0000	35.8460
TURNIPSG	3.9442	0.0000	0.5435	0.0000	1.7861	0.0000
KALEAGEd	0.0000	413.3173	0.0000	395.6813	0.0000	324.8416
KALEAGEB	0.0000	238.1564	0.0000	219.4427	0.0000	150.8842
RapeBroa	0.0000	36.7585	0.0000	6.9676	0.0000	9.8757
RapeDril	0.0000	29.8335	0.8998	0.0000	0.0000	2.9982
RapeDD	0.0000	103.9102	0.0000	74.5324	0.0000	76.5659
Fbeet1	0.0000	52.4702	0.0000	110.0531	0.0000	89.1065
Fbeet2	1.3892	0.0000	0.0389	0.0000	2.2672	0.0000
Fbeet3	0.0000	15.1911	0.0000	60.5813	0.0000	27.6728
LLB120	0.0000	65.2650	0.0000	54.6673	0.0000	64.6239
LLBE140	0.0000	50.4949	0.0000	41.8581	0.0000	54.7836
LLBE180	0.0000	39.6948	0.0000	31.9867	0.0000	48.7393
CBE140	0.0000	60.2569	0.0000	58.6688	0.0000	59.5469
CBE160	0.0000	48.3532	0.0000	46.4647	0.0000	47.1415
CBE180	0.0000	41.4548	0.0000	39.3191	0.0000	39.1647
WINFINMK	666.6699	0.0000	185.2771	0.0000	506.6583	0.0000
WINFINLK	0.0000	3.7764	0.0000	4.5101	0.0000	3.2398
WINFINBF	0.0000	16.0908	0.0000	16.1640	0.0000	15.8048
WINFINSK	0.0000	21.9070	0.0000	23.0906	0.0000	21.4418
AFLGR	0.0000	21.1056	0.0000	38.0091	0.0000	23.2089

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
C)	101190.1000		20522.5800		63728.0500	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
GIMMERIN	0.0000	163.2034	0.0000	169.0831	0.0000	162.1833
INDOORLA	0.0000	43.2649	0.0000	50.9456	0.0000	42.9212
LLSUCKNJ	0.0000	396.1225	0.0000	353.2571	0.0000	384.1866
LLSUCKFA	0.0000	482.6936	0.0000	431.5587	0.0000	468.0572
LLSUCKMJ	0.0000	338.6451	0.0000	308.4922	0.0000	330.4157
LLSUCKAO	0.0000	341.0316	0.0000	308.3218	0.0000	332.0769
18MthST	0.0000	24.5345	0.0000	31.5763	0.0000	63.7549
18mthHF	0.0000	192.7108	0.0000	131.4374	0.0000	169.6871
24mthFr	0.0000	1.8231	0.0000	1.8309	0.0000	1.8145
24mthB	19.4010	0.0000	7.5990	0.0000	25.9629	0.0000
Owscsbst	0.0000	72.6924	0.0000	131.6149	0.0000	129.2657
Owscsbhf	0.0000	223.7529	0.0000	221.5408	0.0000	218.4128
Owscwbst	0.0000	88.4143	0.0000	150.8529	0.0000	145.8354
Owscwbhf	0.0000	381.3203	0.0000	383.2292	0.0000	382.9113
WFLFDBST	0.0000	91.9334	0.0000	186.9603	0.0000	131.8110
WFMFDBST	0.0000	209.8401	0.0000	238.4294	0.0000	178.2287
WFSCST	0.0000	47.6604	0.0000	139.0489	0.0000	82.6588
WFSCHF	0.0000	228.0974	0.0000	256.7545	0.0000	196.4101
BSDBXSTL	0.0000	44.2778	0.0000	111.3787	0.0000	97.2708
BSDBXSTM	0.0000	154.4055	0.0000	147.7650	0.0000	145.6786
OWSCSTWB	0.0000	162.3835	0.0000	158.7649	0.0000	153.6143
OWSCHFWB	0.0000	155.3455	0.0000	148.7050	0.0000	146.6186
OWSCSTSB	0.0000	162.3835	0.0000	158.7649	0.0000	153.6143
OWSCHFSB	0.0000	155.3455	0.0000	148.7050	0.0000	146.6186
OWMJST	0.0000	162.3835	0.0000	158.7649	0.0000	153.6143
OWMJHF	0.0000	155.3455	0.0000	148.7050	0.0000	146.6186
RYCSBMST	0.0000	228.5632	0.0000	272.0455	0.0000	282.9651
RYCSBLST	0.0000	254.0409	0.0000	297.6315	0.0000	308.3220
RYCABMST	0.0000	160.1513	0.0000	154.2139	0.0000	211.1969
RYCABLST	0.0000	179.5673	0.0000	173.7123	0.0000	230.5207
WFLFBST	0.0000	200.8659	0.0000	221.1600	0.0000	199.9352
SFLFBST	0.0000	300.5740	0.0000	324.4542	0.0000	282.9498
IBBFCF	0.0000	0.0000	21.9196	0.0000	0.0000	47.2841
IBBBXSF	0.0000	351.5670	0.0000	498.4286	0.0000	392.1942
IBBSCCF	0.0000	9.0572	0.0000	4.8971	0.0000	55.5619
IBBSCSF	0.0000	329.1833	0.0000	420.9570	0.0000	355.3769
BPIG3WKW	0.0000	34.9266	0.0000	35.1337	0.0000	34.6952
BPIG4WKW	125.6395	0.0000	22.9542	0.0000	76.0650	0.0000
BPIGOUT	209.9757	0.0000	38.3623	0.0000	127.1241	0.0000
FPIGPORK	0.0000	62.6477	0.0000	63.6927	0.0000	61.4807
FPIGCUT	0.0000	13.0707	0.0000	13.7674	0.0000	12.2928
FPIGBAC	626.5185	0.0000	114.4641	0.0000	379.3087	0.0000
FPIGHEA	661.9818	0.0000	120.9432	0.0000	400.7790	0.0000
PULREAR	0.0000	6.1595	0.0000	6.1803	0.0000	6.1363
EGGCAGE	0.0000	24.2965	0.0000	24.8991	0.0000	24.9324
EGGRANGE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EBARN	0.0000	8.3328	0.0000	8.4376	0.0000	8.3042

	1. Pigs and Poultry Central England		2. Pigs and Poultry Southern England and Wales		3. Pigs and Poultry Scotland, Northern Ireland & the North of England	
C)	101190.1000		20522.5800		63728.0500	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
CHBROILE	0.0000	7.6411	0.0000	7.6688	0.0000	7.6102
TFFthen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
tfftstag	0.0000	0.5437	0.0000	0.5569	0.0000	0.5289
PPOUT	8.3990	0.0000	1.5345	0.0000	5.0850	0.0000
FCOSTS	28573.2383	0.0000	9413.1426	0.0000	21634.5215	0.0000
EEIQ	2345.3296	0.0000	809.1297	0.0000	1705.8584	0.0000
CEIQ	2382.3323	0.0000	867.4836	0.0000	1939.3828	0.0000
WEIQ	1806.6482	0.0000	920.1796	0.0000	1670.4319	0.0000
TPest	35.8973	0.0000	12.6283	0.0000	27.1997	0.0000
Herb	25.8233	0.0000	10.5953	0.0000	17.8893	0.0000
Insectic	1.0000	0.0000	0.1292	0.0000	1.2600	0.0000
Fungicid	8.9340	0.0000	1.8910	0.0000	7.9460	0.0000
Growth	0.0000	0.0000	0.0000	286.0799	0.0000	0.0000
STBO	96849.7969	0.0000	13358.2813	0.0000	63918.5078	0.0000
LOSS	55133.6289	0.0000	10072.8428	0.0000	33379.1641	0.0000
TOTLAB	33409.0703	0.0000	9693.9063	0.0000	25099.9844	0.0000
SOILIND	106.7336	0.0000	48.6936	0.0000	85.4999	0.0000
LSU	28.8542	0.0000	20.0870	0.0000	30.9035	0.0000
MAIZEFOD	12822.9609	0.0000	5022.5474	0.0000	21052.3730	0.0000
FOD	17054.5391	0.0000	6679.9883	0.0000	27999.6563	0.0000
BSP	0.0000	61.5025	21.9196	0.0000	0.0000	0.0000
BSPFULL	19.4010	0.0000	7.5990	0.0000	25.9629	0.0000
Weaner	0.0000	7.8345	0.0000	7.9911	0.0000	7.6596

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	95452.230		53647.300		93402.960		26087.890	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	1.6495	0.0000	0.0000	4550.3345	0.0585	0.0000	0.0000	338.5597
CJAN	0.0000	7.8700	0.0000	7.8700	0.0000	0.0000	0.0000	7.8700
CFEB	0.0000	7.8700	0.0000	7.8700	0.0000	0.0000	0.0000	7.8700
CMAR	502.5872	0.0000	0.0000	7.8700	0.0000	0.0000	66.8554	0.0000
CAPR	45.5890	0.0000	0.0000	7.8700	29.6485	0.0000	0.0000	7.8700
CMAY	0.0000	7.8700	0.0000	7.8700	0.0000	0.0000	0.0000	7.8700
CJUN	0.0000	5.6997	0.0000	7.8700	97.0750	0.0000	30.2740	0.0000
CJUL	0.0000	7.8700	0.0000	7.8700	0.0000	0.0000	0.0000	7.8700
CAUG	67.1004	0.0000	165.5705	0.0000	174.1676	0.0000	143.3550	0.0000
CSEP	526.6118	0.0000	181.5752	0.0000	213.6404	0.0000	105.9485	0.0000
COCT	346.8198	0.0000	255.2681	0.0000	139.9543	0.0000	37.3429	0.0000
CNOV	211.7418	0.0000	0.0000	3.3886	85.4849	0.0000	52.9919	0.0000
CDEC	19.2632	0.0000	0.0000	7.8700	86.1912	0.0000	52.9919	0.0000
BHAY	11.4045	0.0000	15.6386	0.0000	7.9215	0.0000	11.8028	0.0000
BBAR	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	95452.230		53647.300		93402.960		26087.890	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SBAR	78.4276	0.0000	58.5212	0.0000	98.8011	0.0000	27.2239	0.0000
USLYCat	0.0000	8.8791	0.0000	18.1257	0.0000	0.0000	0.0000	27.3358
UFYMCat	35.2504	0.0000	48.1682	0.0000	24.4847	0.0000	16.7350	0.0000
BUYN	6559.4072	0.0000	5901.8667	0.0000	7343.7397	0.0000	2261.0000	0.0000
BUYP	3933.4434	0.0000	2532.7124	0.0000	3007.7722	0.0000	1023.2371	0.0000
BUYK	5226.4800	0.0000	3235.4827	0.0000	3870.0693	0.0000	1311.4844	0.0000
bHeifers	0.0000	825.7734	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SSLambs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bSLambs	0.0000	0.0000	545.6084	0.0000	0.0000	0.0000	147.3235	0.0000
sGimmers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bGimmers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bwSTRAW	2.9285	0.0000	4.0017	0.0000	2.0341	0.0000	0.5941	0.0000
bBSTRAW	0.0000	5.1611	0.0000	5.1326	0.0000	0.0000	0.0000	8.3302
bOSTRAW	0.0000	10.3222	0.0000	10.2651	0.0000	0.0000	0.0000	16.6603
WW150	0.0000	211.4137	0.0000	350.2181	0.0000	0.0000	0.0000	370.6179
WW200	0.0000	165.5696	0.0000	210.4763	0.0000	0.0000	0.0000	330.4881
WW250	0.0000	284.2402	0.0000	324.3551	0.0000	0.0000	0.0000	709.8818
BWW1	0.0000	51.3985	0.0000	188.0598	0.0000	0.0000	0.0000	107.4350
BWW2	4.5572	0.0000	34.3404	0.0000	39.9024	0.0000	9.9693	0.0000
BWW3	0.0000	110.7112	0.0000	137.1910	0.0000	0.0000	0.0000	406.1142
MSBAR80	0.0000	100.0039	0.0000	92.0936	0.0000	0.0000	0.0000	40.8401
MSBAR100	0.0000	103.6553	0.0000	142.1028	0.0000	0.0000	10.0407	0.0000
MSBAR120	0.0000	106.3426	5.7422	0.0000	0.0000	0.0000	0.0000	102.4885
WB125	0.0000	11.4155	0.0000	119.7133	0.0000	0.0000	0.0000	71.8510
WB180	14.9714	0.0000	0.0000	60.3244	0.0000	0.0000	0.0000	110.0106
WB225	0.0000	62.1093	0.0000	80.9316	0.0000	0.0000	0.0000	299.9621
SBAR75	0.0000	65.7524	0.0000	50.8884	0.0000	0.0000	0.0000	7.8027
SBAR100	0.0000	79.9634	0.0000	94.1944	17.0924	0.0000	5.7140	0.0000
SBAR125	0.0000	105.3300	12.6739	0.0000	0.0000	0.0000	0.0000	72.9924
WO50	5.1823	0.0000	0.0000	167.6271	0.0000	0.0000	0.0000	254.4621
WO100	0.0000	23.6073	0.0000	129.2637	0.0000	0.0000	0.0000	301.6154
WO125	0.0000	49.9293	0.0000	141.8462	0.0000	0.0000	0.0000	442.1833
SO50	20.9227	0.0000	0.0000	104.1508	0.0000	0.0000	0.0000	241.8406
SO100	0.0000	23.6073	0.0000	65.7874	0.0000	0.0000	0.0000	234.3648
SO125	0.0000	49.9293	0.0000	78.3699	0.0000	0.0000	0.0000	429.5617
RYE1	0.0000	131.3649	0.0000	246.4617	0.0000	0.0000	0.0000	422.4578
RYE2	0.0000	157.4460	0.0000	219.8673	0.0000	0.0000	0.0000	495.9941
RYE3	0.0000	189.4892	0.0000	237.3473	0.0000	0.0000	0.0000	576.9682
TRIT150	0.0000	96.1147	0.0000	211.4063	0.0000	0.0000	0.0000	365.5628
TRIT180	0.0000	119.0062	0.0000	179.4535	0.0000	0.0000	0.0000	429.9193
TRIT200	0.0000	149.4082	0.0000	197.4878	0.0000	0.0000	0.0000	512.2762
WOSR150	0.0000	143.7757	0.0000	211.4780	0.0000	0.0000	0.0000	300.0151
WOSR185	0.0000	50.8191	0.0000	152.9847	0.0000	0.0000	0.0000	439.4899
WOSR225	0.0000	218.5798	0.0000	214.0905	0.0000	0.0000	0.0000	742.8856
SOSR90	24.9400	0.0000	0.0000	22.9282	18.4120	0.0000	0.0000	110.4438
SOSR110	0.0000	22.4227	0.0000	62.5850	0.0000	0.0000	0.0000	354.8687
SOSR130	0.0000	36.0613	0.0000	7.6897	0.4956	0.0000	0.0000	360.3680

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	95452.230		53647.300		93402.960		26087.890	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
LIN50	0.0000	205.3180	0.0000	324.6189	0.0000	0.0000	0.0000	602.2164
LIN80	0.0000	168.4168	0.0000	294.2316	0.0000	0.0000	0.0000	631.7997
LIN120	0.0000	229.5144	0.0000	319.4812	0.0000	0.0000	0.0000	733.2557
SFB20K	0.7612	0.0000	0.0000	82.6138	0.0000	0.0000	0.0000	28.0166
SFB40K	0.0000	16.8924	0.0000	75.0792	0.0000	0.0000	0.0000	15.7880
SFB60K	39.1624	0.0000	4.4165	0.0000	0.0000	0.0000	4.3350	0.0000
SETSC	0.0000	5735.2871	0.0000	30.9151	0.0000	0.0000	0.0000	62.0246
SETNR	0.0000	5693.0039	77.2398	0.0000	78.3276	0.0000	26.4182	0.0000
WORSA100	0.0000	56.0629	0.0000	287.6009	0.0000	0.0000	0.0000	550.9029
WORSA140	0.0000	18.1234	0.0000	247.8518	0.0000	0.0000	0.0000	740.7251
WORSA180	0.0000	136.3274	0.0000	296.0132	0.0000	0.0000	0.0000	1003.1863
SORSA60	6.3300	0.0000	0.0000	154.8538	0.0000	0.0000	0.0000	358.3841
SORSA85	0.0000	55.9566	0.0000	193.4866	0.0000	0.0000	0.0000	523.9403
SORSA110	0.0000	29.1501	0.0000	135.1756	0.0000	0.0000	0.0000	500.6685
SBEET80	0.0000	234.0825	0.0000	148.1783	0.0000	0.0000	0.0000	318.1251
SBEET100	20.5628	0.0000	12.1674	0.0000	0.0000	0.0000	0.0000	187.2540
SBEET120	0.0000	314.4168	0.0000	52.8666	0.0000	0.0000	0.0000	423.7428
POTEW180	0.0000	4662.3984	0.0000	3008.1323	0.0000	0.0000	0.0000	1143.6224
POTEW200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POTEW220	0.0000	3755.2317	0.0000	1612.0181	0.0000	0.0000	0.0000	698.6377
PTMCW140	0.0000	5249.9312	0.0000	3981.4412	0.0000	0.0000	0.0000	2987.7676
PTMCW180	0.0000	4778.8213	0.0000	3179.5964	0.0000	0.0000	0.0000	2754.8989
PTMCW220	0.0000	4552.4453	0.0000	2679.0073	0.0000	0.0000	0.0000	2709.5913
PMCWBPP1	0.0000	4678.3540	0.0000	3322.6772	0.0000	0.0000	0.0000	2543.9238
PMCWBPP2	0.0000	4119.9453	0.0000	2458.1914	0.0000	0.0000	0.0000	2238.3562
PMCWBPP3	0.0000	3836.6826	0.0000	1932.3956	0.0000	0.0000	0.0000	2143.6563
PTPOF1	0.0000	5716.9102	0.0000	4600.0630	0.0000	0.0000	0.0000	3384.5276
PTPOF2	0.0000	5361.1929	0.0000	3984.0535	0.0000	0.0000	0.0000	3278.9675
PTPOF3	0.0000	5207.0122	0.0000	3616.1267	0.0000	0.0000	0.0000	3327.8628
PTPEXST1	0.0000	5181.3042	0.0000	3940.7585	0.0000	0.0000	0.0000	2974.0464
PTPEXST2	0.0000	4687.9199	0.0000	3155.2891	0.0000	0.0000	0.0000	2762.9807
PTPEXST3	0.0000	4447.1602	0.0000	2680.7874	0.0000	0.0000	0.0000	2745.5227
POTSEED1	0.0000	5639.2246	0.0000	4528.7402	0.0000	0.0000	0.0000	3207.2527
POTSEED2	0.0000	5084.8955	0.0000	3705.4277	0.0000	0.0000	0.0000	2848.1838
POTSEED3	0.0000	4791.4009	0.0000	3203.1899	0.0000	0.0000	0.0000	2689.0154
POTDUAL1	0.0000	5173.8940	0.0000	3950.3340	0.0000	0.0000	0.0000	2918.9424
POTDUAL2	0.0000	4610.9678	0.0000	3110.2175	0.0000	0.0000	0.0000	2629.3428
POTDUAL3	0.0000	4316.0986	0.0000	2600.0659	0.0000	0.0000	0.0000	2545.1790
SWEDE1	0.0000	5134.0337	0.0000	5016.2729	0.0000	0.0000	0.0000	227.8001
SWEDE2	0.0000	4655.2041	0.0000	5023.3232	0.0000	0.0000	0.0000	732.0634
SWEDE3	0.0000	5021.7397	0.0000	4828.5571	0.0000	0.0000	0.7199	0.0000
CAB1	0.0000	5885.8545	0.0000	5577.3926	0.0000	0.0000	0.0000	1673.7766
CAB2	0.0000	4970.5728	0.0000	5565.5288	0.0000	0.0000	0.0000	1668.0336
CAB3	0.0000	5836.4683	0.0000	5421.8193	0.0000	0.0000	0.0000	1651.8695
CABWW1	1.1052	0.0000	0.0000	253.4745	1.0721	0.0000	1.8508	0.0000
CABWW2	5.7915	0.0000	2.1800	0.0000	5.3381	0.0000	1.0700	0.0000
CABWW3	5.6133	0.0000	0.0000	15.5573	8.8598	0.0000	1.6993	0.0000

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	95452.230		53647.300		93402.960		26087.890	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
VIN1	0.0000	477.2780	0.0000	105.0226	0.0000	0.0000	0.0000	79.2198
VIN2	0.0000	459.3859	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
VIN3	0.0000	445.1477	0.0000	69.0741	0.0000	0.0000	0.0000	20.8754
GWC1	0.0000	101.2324	0.0000	90.2139	0.0000	0.0000	0.0482	0.0000
GWC2	0.0000	56.5811	0.5400	0.0000	3.9700	0.0000	4.8445	0.0000
GWC3	0.0000	88.6883	0.0000	7.5962	0.0000	0.0000	0.0000	12.3286
GR1	0.0000	0.5458	11.3770	0.0000	0.0000	0.0000	0.0000	131.6631
GR2	6.4300	0.0000	0.0000	16.1605	0.0000	0.0000	0.0000	382.0180
GR3	0.0000	8.6619	0.0000	36.5149	0.0000	0.0000	0.0000	627.1844
SILAGE12	0.0000	70.4882	0.0000	93.2518	0.0000	0.0000	0.0000	240.9148
SILAGE27	0.0000	0.0000	1.8628	0.0000	0.0000	0.0000	0.0000	964.4350
SILAGE30	0.0000	183.9221	0.0000	134.3376	0.0000	0.0000	0.0000	1234.8788
HAY0	0.0000	241.5603	0.0000	199.2771	0.0000	0.0000	0.0000	0.0000
HAY50	0.0000	104.6941	0.0000	191.4026	0.0000	0.0000	0.0000	75.2877
HAY75	0.0000	155.5866	0.0000	207.9662	0.0000	0.0000	0.0000	152.9760
HAY125	0.0000	124.9219	0.0000	209.2861	0.0000	0.0000	0.0000	255.6622
HAY200	0.0000	146.2980	0.0000	229.4498	0.0000	0.0000	0.0000	438.1448
FMAIZE1	0.0000	130.5457	0.0000	368.7402	0.0000	0.0000	0.0000	140.6345
FMAIZE2	0.0000	0.0000	0.0000	384.2624	0.0000	0.0000	0.0000	232.1909
FMAIZE3	0.0000	197.5084	0.0000	355.5974	0.0000	0.0000	0.0000	214.2959
FMAIZEP1	0.0000	239.5847	0.0000	529.6648	0.0000	0.0000	0.0000	371.3682
FMAIZEP2	0.0000	65.2070	0.0000	531.0270	0.0000	0.0000	0.0000	433.0364
FMAIZEP3	0.0000	284.4938	0.0000	505.6537	0.0000	0.0000	0.0000	420.9724
SWEDESGR	0.0000	491.9639	0.0000	118.6738	0.0000	0.0000	0.0000	311.4626
TURNIPSG	0.0000	474.2097	0.0000	101.0178	0.0000	0.0000	0.0000	282.8069
KALEAGEd	0.0000	171.9597	0.0000	149.7437	0.0000	0.0000	0.0000	247.7408
KALEAGEB	0.0000	85.8005	0.0000	64.0606	0.0000	0.0000	0.0000	108.6771
RapeBroa	0.0000	164.5440	0.0000	30.5588	0.0000	0.0000	0.0000	115.9361
RapeDril	0.0000	161.1377	0.0000	27.1714	0.0000	0.0000	0.0000	110.4382
RapeDD	0.0000	206.2456	0.0000	72.0300	0.0000	0.0000	0.0000	265.2307
Fbeet1	0.0000	151.5862	0.0000	68.2720	0.0000	0.0000	0.0000	21.6962
Fbeet2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Fbeet3	0.0000	311.7658	0.0000	85.6655	0.0000	0.0000	0.0000	280.6984
FRYE1	0.0000	416.0308	0.0000	308.2877	0.0000	0.0000	0.0000	429.2248
FRYE2	0.0000	448.0077	0.0000	321.8376	0.0000	0.0000	0.0000	533.2034
FRYE3	0.0000	479.9846	0.0000	335.3876	0.0000	0.0000	0.0000	637.1820
IRG1	0.0000	389.9070	0.0000	263.1759	0.0000	0.0000	0.0000	608.3391
IRG2	0.0000	433.2960	0.0000	288.4576	0.0000	0.0000	0.0000	861.5262
IRG3	0.0000	484.2989	0.0000	316.7307	0.0000	0.0000	0.0000	1114.7848
FRAPECC1	0.0000	143.5857	0.0000	0.0000	0.0000	5547.2710	1.1786	0.0000
FRAPECC2	0.0000	143.5857	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FRAPECC3	0.0000	143.5857	4.3649	0.0000	0.0000	0.0000	0.0000	0.0000
TURNCC1	0.0000	224.1336	0.0000	346.0188	0.0000	0.0000	0.0000	1574.8735
TURNCC2	0.0000	289.3532	0.0000	368.2941	0.0000	0.0000	0.0000	1713.5101
TURNCC3	0.0000	354.5728	0.0000	390.5695	0.0000	89.3300	0.0000	1852.1467
MUSTCC1	0.0000	311.4564	0.0000	630.9626	0.0000	0.0000	0.0000	1888.7766
MUSTCC2	0.0000	276.0461	0.0000	620.0815	0.0000	0.0000	0.0000	1830.1232

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	95452.230		53647.300		93402.960		26087.890	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
MUSTCC3	0.0000	240.6358	0.0000	609.2005	0.0000	0.0000	0.0000	1771.4697
LLB120	0.0000	48.4398	0.0000	45.6238	0.0000	0.0000	0.0000	79.4298
LLBE140	0.0000	35.4429	0.0000	34.4348	0.0000	0.0000	0.0000	60.6870
LLBE180	0.0000	24.1502	0.0000	25.6479	0.0000	0.0000	0.0000	45.8093
CBE140	0.0000	50.3540	0.0000	41.5146	0.0000	0.0000	0.0000	82.4366
CBE160	0.0000	38.2105	0.0000	30.8081	0.0000	0.0000	0.0000	65.0599
CBE180	0.0000	30.8156	0.0000	24.9672	0.0000	0.0000	0.0000	55.5802
WINFINMK	0.0000	0.0000	545.6084	0.0000	0.0000	0.0000	147.3235	0.0000
WINFINLK	0.0000	3.8150	0.0000	1.6843	0.0000	0.0000	0.0000	3.7969
WINFINBF	0.0000	11.9059	0.0000	10.7787	0.0000	0.0000	0.0000	25.8848
WINFINSK	0.0000	17.8160	0.0000	16.3460	0.0000	0.0000	0.0000	21.0815
AFLGR	0.0000	26.2537	0.0000	3.3743	0.0000	0.0000	0.0000	13.4971
GIMMERIN	0.0000	37.8979	0.0000	21.7344	0.0000	0.0000	0.0000	42.7278
INDOORLA	0.0000	45.1534	0.0000	31.2674	0.0000	0.0000	0.0000	56.0447
HREA26	0.0000	633.3882	0.0000	540.8022	0.0000	0.0000	0.0000	848.6631
HRA30	0.0000	651.3002	0.0000	515.3960	0.0000	0.0000	0.0000	807.4289
HRA36	0.0000	605.6885	0.0000	468.1764	0.0000	0.0000	0.0000	730.7915
HRS30	0.0000	616.6998	0.0000	504.3610	0.0000	0.0000	0.0000	789.5190
HRS36	0.0000	618.9433	0.0000	474.8487	0.0000	0.0000	0.0000	741.6206
Dsp5000	0.0000	458.8507	0.0000	451.6658	0.0000	0.0000	0.0000	733.0539
Dsum5000	0.0000	387.1420	0.0000	375.7038	0.0000	0.0000	0.0000	609.7676
DAut5000	0.0000	495.4944	0.0000	488.1070	0.0000	0.0000	0.0000	792.1981
DAll5000	0.0000	472.2695	0.0000	465.0105	0.0000	0.0000	0.0000	754.7123
Dsp8000	0.0000	22.7816	0.0000	27.3052	0.0000	0.0000	0.0000	44.3164
Dsum8000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DAut8000	0.0000	35.7875	0.0000	40.2393	0.0000	0.0000	0.0000	65.3084
DAll8000	0.0000	14.4207	0.0000	18.9905	0.0000	0.0000	0.0000	30.8216
LLSUCKNJ	0.0000	33.5655	0.0000	63.5191	0.0000	0.0000	0.0000	131.7843
LLSUCKFA	0.0000	122.0087	0.0000	141.7923	0.0000	0.0000	0.0000	269.0537
LLSUCKMJ	0.0000	31.2737	0.0000	28.3112	0.0000	0.0000	0.0000	84.8739
LLSUCKAO	6.7789	0.0000	9.2631	0.0000	4.7086	0.0000	0.0000	38.9248
18MthST	0.0000	56.7185	0.0000	121.2314	0.0000	0.0000	0.0000	0.0000
18mthHF	0.0000	44.4852	0.0000	101.6287	0.0000	0.0000	0.0000	133.7034
24mthFr	0.0000	77.5687	0.0000	53.1188	0.0000	0.0000	0.0000	1.9993
24mthB	0.0000	76.3300	0.0000	51.8870	0.0000	0.0000	4.9512	0.0000
Owscsbst	0.0000	101.2427	0.0000	130.9573	0.0000	0.0000	0.0000	125.0855
Owscsbhf	0.0000	89.3457	0.0000	106.4478	0.0000	0.0000	0.0000	250.8253
Owscwbst	0.0000	121.0029	0.0000	146.8888	0.0000	0.0000	0.0000	150.9423
Owscwbhf	0.0000	187.0487	0.0000	199.8913	0.0000	0.0000	0.0000	402.4841
WFLFDBST	0.0000	111.9342	0.0000	179.4283	0.0000	0.0000	0.0000	110.6904
WFMFDBST	0.0000	65.7725	0.0000	101.8892	0.0000	0.0000	0.0000	190.1811
WFSCST	0.0000	84.9116	0.0000	98.3272	0.0000	0.0000	0.0000	218.0538
WFSCHF	0.0000	68.9104	0.0000	95.4222	0.0000	0.0000	0.0000	195.2459
BSDBXSTL	0.0000	88.2206	0.0000	115.2314	0.0000	0.0000	0.0000	95.8428
BSDBXSTM	0.0000	53.7388	0.0000	68.2619	0.0000	0.0000	0.0000	185.1298
OWSCSTWB	0.0000	58.7657	0.0000	73.2610	0.0000	0.0000	0.0000	193.2433
OWSCHFWB	0.0000	50.1260	0.0000	64.6691	0.0000	0.0000	0.0000	179.2987

	4. Cropping South East England		5. Cropping Central and Northern England		6. Cropping Scotland, Northern Ireland and Western England		7. Small Cropping Farms Wales	
C)	95452.230		53647.300		93402.960		26087.890	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
OWSCSTSB	0.0000	58.7657	0.0000	73.2610	0.0000	0.0000	0.0000	193.2433
OWSCHFSB	0.0000	50.1260	0.0000	64.6691	0.0000	0.0000	0.0000	179.2987
OWMJST	0.0000	58.7657	0.0000	73.2610	0.0000	0.0000	0.0000	193.2433
OWMJHF	0.0000	50.1260	0.0000	64.6691	0.0000	0.0000	0.0000	179.2987
RYCSBMST	0.0000	165.8044	0.0000	184.5021	0.0000	0.0000	0.0000	157.9755
RYCSBLST	0.0000	183.1146	0.0000	201.7167	0.0000	0.0000	0.0000	185.9149
RYCABMST	0.0000	0.0000	0.0000	66.6690	0.0000	0.0000	0.0000	108.5563
RYCABLST	0.0000	13.1917	0.0000	79.7879	0.0000	0.0000	0.0000	129.8481
WFLFBST	0.0000	80.3662	0.0000	75.7131	0.0000	0.0000	0.0000	191.0974
SFLFBST	0.0000	298.6459	0.0000	259.2400	0.0000	0.0000	0.0000	258.7327
IBBFCF	0.0000	58.3637	0.0000	148.0033	0.0000	0.0000	0.0000	331.1307
IBBBXSF	0.0000	170.2181	0.0000	52.1232	0.0000	0.0000	0.0000	9.3462
IBBSCCF	0.0000	54.4024	0.0000	148.2907	0.0000	0.0000	0.0000	330.9446
IBBSCSF	0.0000	156.7094	0.0000	97.8647	0.0000	0.0000	0.0000	83.5845
CRFBFsl	0.0000	91.8555	0.0000	110.9117	0.0000	0.0000	0.0000	263.8727
CRMBBFsl	0.0000	95.9844	0.0000	115.0177	0.0000	0.0000	0.0000	270.5368
CRLBBFsl	0.0000	100.1133	0.0000	119.1238	0.0000	0.0000	0.0000	277.2010
CRFALstl	0.0000	118.2560	0.0000	138.0116	0.0000	0.0000	0.0000	307.8560
CRFBFhfl	0.0000	91.8555	0.0000	110.9117	0.0000	0.0000	0.0000	263.8727
CRMBBFhl	0.0000	95.9844	0.0000	115.0177	0.0000	0.0000	0.0000	270.5368
CRLBBFhl	0.0000	100.1133	0.0000	119.1238	0.0000	0.0000	0.0000	277.2010
CRFALhfl	0.0000	118.2560	0.0000	138.0116	0.0000	0.0000	0.0000	307.8560
FCOSTS	63128.222	0.0000	52335.558	0.0000	55212.386	0.0000	22158.044	0.0000
EEIQ	12087.001	0.0000	12190.173	0.0000	13895.517	0.0000	5974.3760	0.0000
CEIQ	12314.646	0.0000	11956.666	0.0000	10954.098	0.0000	4879.7534	0.0000
WEIQ	13563.294	0.0000	10730.051	0.0000	9069.5693	0.0000	4982.0894	0.0000
TPest	192.6938	0.0000	156.9182	0.0000	168.1714	0.0000	76.1221	0.0000
Herb	155.9400	0.0000	121.5966	0.0000	131.0588	0.0000	57.8033	0.0000
Insectic	5.1900	0.0000	5.0000	0.0000	4.8663	0.0000	3.2084	0.0000
Fungicid	28.5800	0.0000	30.0000	0.0000	32.0000	0.0000	15.0569	0.0000
Growth	3.2649	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STBO	0.0000	0.0922	0.0000	0.0865	10902.012	0.0000	0.0000	0.7260
LOSS	108009.78	0.0000	41388.293	0.0000	58268.640	0.0000	11175.543	0.0000
TOTLAB	28268.060	0.0000	4740.9966	0.0000	7024.3281	0.0000	3854.4094	0.0000
SOILIND	254.1338	0.0000	468.8433	0.0000	477.2568	0.0000	184.8504	0.0000
LSU	8.1347	0.0000	22.0279	0.0000	5.6503	0.0000	6.9074	0.0000
MAIZEFOD	0.0000	0.0297	0.0000	0.0356	0.0000	0.0000	0.0000	0.0805
FOD	0.0000	0.0075	6064.2173	0.0000	0.0000	0.0000	0.0000	0.0801
BSP	0.0000	13.0871	0.0000	0.0000	0.0000	0.0000	0.0000	119.9985
BSPFULL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.9512	0.0000

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	18486.860		22241.230		56234.680		46415.830	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	1.3631	0.0000	0.0000	4951.4399	1.8207	0.0000	3.0745	0.0000
CJAN	0.0000	6.7118	170.3041	0.0000	0.0000	0.0000	0.0000	0.3740
CFEB	0.0000	9.2300	80.5085	0.0000	0.0000	6.7118	0.0000	9.2300
CMAR	74.2311	0.0000	147.2016	0.0000	186.6551	0.0000	482.5779	0.0000
CAPR	117.8564	0.0000	262.0888	0.0000	256.6162	0.0000	300.6250	0.0000
CMAY	144.3405	0.0000	178.4620	0.0000	456.9095	0.0000	0.0000	0.8101
CJUN	125.9853	0.0000	311.3815	0.0000	485.0634	0.0000	0.0000	5.4372
CJUL	143.1465	0.0000	206.1214	0.0000	204.7966	0.0000	0.0000	0.0905
CAUG	17.3175	0.0000	147.1938	0.0000	126.1018	0.0000	0.0000	9.2300
CSEP	0.0000	9.2300	92.1170	0.0000	0.0000	9.2300	51.9197	0.0000
COCT	0.0000	9.2300	157.9796	0.0000	0.0000	9.2300	190.2045	0.0000
CNOV	0.0000	9.2300	131.0349	0.0000	0.0000	9.2300	0.0000	9.2300
CDEC	0.2440	0.0000	90.8781	0.0000	0.0000	9.2300	0.0000	9.2300
BHAY	135.5622	0.0000	0.0000	0.3626	150.7069	0.0000	236.6983	0.0000
BBAR	0.0000	32.0703	27.3989	0.0000	4.5000	0.0000	80.3502	0.0000
SBAR	0.0000	44.4401	0.0000	32.5955	0.0000	85.8453	0.0000	29.9752
USLYCat	1278.6010	0.0000	231.4566	0.0000	3010.7085	0.0000	1154.4000	0.0000
UFYMCat	256.7790	0.0000	159.9635	0.0000	0.0000	10.9967	576.6315	0.0000
BUYN	2420.0000	0.0000	1209.6965	0.0000	3770.1235	0.0000	6268.6313	0.0000
BUYP	0.0000	1.0825	621.8300	0.0000	0.0000	0.8586	710.7162	0.0000
BUYK	0.0000	0.6073	0.0000	8.0252	0.0000	0.4817	0.0000	0.3694
bHeifers	0.0000	2112.1841	0.0000	1331.4755	0.0000	1675.3148	0.0000	1284.8929
SSLambs	0.0000	14.5276	0.0000	11.8055	0.0000	16.8885	0.0000	11.3240
bSLambs	0.0000	9.3137	0.0000	0.5084	0.0000	0.0000	1.1101	0.0000
sGimmers	0.0000	46.8642	0.0000	25.3520	0.0000	27.0517	0.0000	23.3141
bGimmers	0.0000	2.2207	23.8729	0.0000	0.0000	7.7187	33.7159	0.0000
bwSTRAW	9.1164	0.0000	5.6792	0.0000	0.0000	0.0000	20.4721	0.0000
bBSTRAW	0.0000	13.2012	0.0000	8.3217	0.0000	10.4707	0.0000	8.0306
bOSTRAW	0.0000	13.2012	0.0000	8.3217	0.0000	10.4707	0.0000	8.0306
WW1	0.0000	114.3569	0.0000	184.9287	0.0000	81.2381	0.0000	14.7653
WW2	0.0000	252.4628	0.0000	188.0540	0.0000	91.1399	0.0000	14.2579
WW3	0.0000	220.5258	0.0000	202.3388	0.0000	79.3417	0.0000	7.5253
BWW1	0.0000	3199.3594	0.0000	14.3109	0.0000	12.3985	0.0000	18.8630
BWW2	0.0000	3353.3079	0.0203	0.0000	0.0000	20.1110	0.0000	13.4289
BWW3	0.0000	3289.1846	0.9797	0.0000	0.0000	0.0000	3.0000	0.0000
MSBAR1	0.0000	52.6060	0.0000	133.4962	0.0000	604.4586	0.0000	238.4505
MSBAR2	0.2734	0.0000	0.0000	188.5989	0.0000	506.1207	0.0000	352.3387
MSBAR3	0.0000	58.3452	0.4300	0.0000	0.0000	567.1976	0.0000	197.3569
WB125	0.1266	0.0000	0.0000	106.1436	0.0000	50.6661	0.0000	51.3776
WB180	0.0000	192.5553	0.0000	150.8923	0.0000	18.9547	0.0000	29.6594
WB225	0.0000	38.7442	0.0000	44.9443	0.0000	0.0000	0.0000	18.0401
SBAR75	0.0000	66.0608	0.0000	106.7186	0.0000	188.2677	0.0000	39.4840
SBAR100	0.0000	13.4545	0.0000	160.1632	0.0000	54.6527	0.0000	149.8414
SBAR125	0.0000	73.2847	0.5700	0.0000	0.0000	133.3397	3.0000	0.0000
WO50	0.0000	199.6742	0.0000	51.5698	0.0000	43.7778	0.0000	73.7434
WO100	0.0000	187.8953	0.0000	11.4145	0.0000	0.0000	0.0000	45.3875
WO125	0.0000	253.6463	0.0000	35.8860	0.0000	34.9376	0.0000	63.9693
SO50	0.0000	258.1007	0.0000	40.1553	0.0000	105.9297	0.0000	28.3559
SO100	0.0000	187.6240	0.9624	0.0000	0.0000	23.6665	3.0000	0.0000
SO125	0.0000	312.0908	0.0000	24.4715	0.0000	97.1009	0.0000	18.5945

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	18486.860		22241.230		56234.680		46415.830	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
WOSR150	0.0000	350.1158	0.0000	97.7996	0.0000	216.0143	0.0000	74.6229
WOSR185	0.0000	346.8162	0.0000	52.7061	0.0000	184.2612	0.0000	11.6885
WOSR225	0.0000	498.5404	0.0000	159.3286	0.0000	219.2618	0.0000	82.0687
SOSR90	0.0000	0.0000	0.0000	0.0000	0.0000	1.3212	0.0000	2.9957
SOSR110	0.0000	178.1335	0.0000	94.5566	0.0000	74.1249	0.0000	67.3977
SOSR130	0.0000	79.1035	0.0000	69.1701	0.0000	0.0000	0.0000	0.0000
LIN50	0.0000	562.9189	0.0000	338.3688	0.0000	297.6790	0.0000	257.0638
LIN80	0.0000	549.4593	0.0000	329.2436	0.0000	268.4586	0.0000	225.7551
LIN120	0.0000	603.7554	0.0000	390.6962	0.0000	297.4509	0.0000	256.7117
SFB20K	0.0000	63.0478	0.0000	109.3131	0.0000	40.1616	0.0000	39.5690
SFB40K	0.0000	105.4378	0.0000	116.4496	0.0000	67.1641	0.0000	72.3491
SFB60K	0.8200	0.0000	0.0000	37.9032	1.2800	0.0000	4.1800	0.0000
SETSC	0.0000	135.8107	0.0000	343.0142	0.0000	112.8750	0.0000	72.5664
SETNR	0.5700	0.0000	0.0000	266.3817	0.4200	0.0000	4.0000	0.0000
WORSA100	0.0000	487.7365	0.0000	317.3874	0.0000	364.5638	0.0000	267.4252
WORSA140	0.0000	465.4810	0.0000	263.3332	0.0000	328.6310	0.0000	194.3287
WORSA180	0.0000	576.6071	0.0000	374.2252	0.0000	367.1487	0.0000	269.6070
SORSA60	0.0000	223.4120	0.0000	221.0848	0.0000	190.5033	0.0000	223.6115
SORSA85	0.0000	354.3748	0.0000	290.0189	0.0000	229.3037	0.0000	286.4280
SORSA110	0.0000	264.9566	0.0000	235.9759	0.0000	184.1660	0.0000	216.5792
SBEET1	0.0000	166.4893	0.0000	336.0492	0.0000	196.4762	0.0000	186.6079
SBEET2	0.4000	0.0000	1.0000	0.0000	0.0000	0.0000	3.0000	0.0000
SBEET3	0.0000	175.9954	0.0000	37.4399	0.0000	152.0927	0.0000	141.3828
POTEW1	0.0000	4874.8755	0.0000	5859.5503	0.0000	2816.1624	0.0000	3453.1187
POTEW2	0.0000	4041.8008	0.0000	4862.4282	0.0000	2165.5337	0.0000	2526.0625
POTEW3	0.0000	4736.4990	0.0000	4622.1045	0.0000	2658.9407	0.0000	3261.3218
PTMCW140	0.0000	5113.8110	0.0000	5805.6172	0.0000	2984.6204	0.0000	3612.9348
PTMCW180	0.0000	4412.4453	0.0000	4754.2656	0.0000	2346.0774	0.0000	2801.8469
PTMCW220	0.0000	4968.7603	0.0000	5284.1943	0.0000	2812.4688	0.0000	3436.9404
PMCWBPP1	0.0000	5213.5850	0.0000	4470.0449	0.0000	2557.3215	0.0000	2946.2073
PMCWBPP2	0.0000	4032.8450	0.0000	3251.6636	0.0000	2163.2017	0.0000	2489.4299
PMCWBPP3	0.0000	2852.1052	0.0000	2033.2698	0.0000	1769.0817	0.0000	2032.6654
PTPOF1	0.0000	3534.0378	0.0000	3132.7334	0.0000	1227.9811	0.0000	1712.1396
PTPOF2	0.0000	2188.2021	0.0000	1745.8745	0.0000	777.9464	0.0000	1188.6278
PTPOF3	0.0000	842.3843	0.0000	359.0290	0.0000	327.9005	0.0000	665.1164
PTPEXST1	0.0000	3268.1418	0.0000	2584.8459	0.0000	1087.6379	0.0000	1266.0657
PTPEXST2	0.0000	1634.0796	0.0000	921.2107	0.0000	543.8246	0.0000	633.0327
PTPEXST3	0.0000	0.0000	1.1530	0.0000	0.0000	0.0000	3.5500	0.0000
POTSEED1	0.0000	4010.8491	0.0000	3421.1848	0.0000	1987.5707	0.0000	1876.7457
POTSEED2	0.0000	2388.3625	0.0000	1980.5603	0.0000	1453.6763	0.0000	1261.7319
POTSEED3	0.0000	765.8758	0.0000	539.9223	0.0000	919.7930	0.0000	646.7178
POTDUAL1	0.0000	3644.1472	0.0000	3021.7844	0.0000	1425.9148	0.0000	1542.2391
POTDUAL2	0.0000	1999.9465	0.0000	1510.8988	0.0000	881.0236	0.0000	911.3481
POTDUAL3	0.0000	355.7462	0.0570	0.0000	0.0000	336.1323	0.0000	280.4443
GR0	21.2234	0.0000	14.0000	0.0000	14.1800	0.0000	0.0000	8.8239
GR50	0.0000	33.9436	13.6485	0.0000	0.0000	0.6582	86.0043	0.0000
GR75	0.0000	89.0657	0.0000	21.2520	0.0000	11.6525	0.0000	0.2117
GR125	29.7705	0.0000	8.6582	0.0000	82.0227	0.0000	84.5133	0.0000
GR150	15.4906	0.0000	0.0000	19.2273	0.0000	8.6445	0.0000	10.5049
GR175	0.0000	42.3570	0.0000	26.4962	0.0000	18.3982	0.0000	18.3272

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	18486.860		22241.230		56234.680		46415.830	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
GR200	0.0000	84.7139	0.0000	33.6658	0.0000	28.1957	0.0000	26.1494
GR250	0.0000	172.8368	0.0000	61.1744	0.0000	48.9436	0.0000	45.6964
GR300	0.0000	266.9069	0.0000	76.6253	0.0000	68.5824	0.0000	61.3409
GR375	0.0000	407.0331	0.0000	113.3282	0.0000	99.1716	0.0000	88.7100
SILAGE12	0.0000	21.2675	0.0000	104.5077	38.3848	0.0000	0.0500	0.0000
SILAGE27	12.2154	0.0000	0.0000	191.4581	5.5325	0.0000	0.0000	100.5790
SILAGE30	0.0000	106.6449	0.0000	188.3751	0.0000	55.8750	0.0000	168.3228
HAY0	0.0000	191.1700	13.5033	0.0000	0.0000	65.3640	0.0000	12.1739
HAY50	0.0000	122.1094	0.0000	136.3022	0.0000	44.2569	2.2690	0.0000
HAY75	0.0000	146.1672	0.0000	190.4374	0.0000	48.6972	0.0000	18.6634
HAY125	0.0000	215.3685	0.0000	88.0084	0.0000	62.9039	0.0000	21.7695
HAY200	0.0000	335.8404	0.0000	82.9250	0.0000	89.5554	0.0000	47.3495
FMAIZE1	0.0000	398.6750	0.0000	237.2931	0.0000	454.5767	0.0000	162.7083
FMAIZE2	0.0000	252.0711	0.0000	77.3830	0.0000	416.1508	0.0000	118.5928
FMAIZE3	0.0000	105.4671	2.7859	0.0000	0.0000	377.7249	0.0000	74.4773
FMAIZEP1	0.0000	771.2581	0.0000	472.8440	0.0000	690.6087	0.0000	376.1328
FMAIZEP2	0.0000	581.1680	0.0000	285.6918	0.0000	630.2433	0.0000	318.7905
FMAIZEP3	0.0000	391.0778	0.0000	98.5396	0.0000	569.8779	0.0000	261.4482
SWEDESGR	0.0000	507.8294	0.0000	845.4449	0.0000	591.6890	0.0000	135.3792
TURNIPSG	0.0000	462.4175	0.0000	816.8182	0.0000	555.6697	0.0000	107.7540
KALEAGEd	0.0000	548.7288	0.0000	949.6408	0.0000	510.0179	0.0000	330.7342
KALEAGEB	0.0000	328.3488	0.0000	810.7180	0.0000	335.2198	0.0000	196.6716
RapeBroa	0.0000	284.2551	0.0000	720.5403	0.0000	381.7869	0.0000	176.0332
RapeDril	0.0000	275.5424	0.0000	715.0480	0.0000	374.8762	0.0000	170.7331
RapeDD	0.0000	456.9378	0.0000	787.7798	0.0000	466.3903	0.0000	240.9203
Fbeet1	0.0000	278.8426	0.0000	505.0678	0.0000	181.7364	0.0000	97.3279
Fbeet2	0.0000	139.4207	0.0000	252.5339	0.0000	90.8688	0.0000	48.6640
Fbeet3	0.0000	0.0000	2.9716	0.0000	0.0000	0.0000	1.1134	0.0000
IRG1	0.0000	464.8740	0.0000	394.6276	0.0000	267.0585	0.0000	169.8046
IRG2	0.0000	541.7551	0.0000	460.6658	0.0000	282.4310	0.0000	185.3688
IRG3	0.0000	610.1506	0.0000	526.7040	0.0000	298.9127	0.0000	201.5429
LLB120	0.0000	34.5944	0.0000	29.1341	0.0000	15.0222	0.0000	6.2821
LLBE140	0.0000	14.3164	0.0000	12.5309	0.0000	15.2481	0.0000	1.8454
LLBE180	0.0000	0.0000	89.4288	0.0000	0.0000	19.1120	120.4138	0.0000
CBE140	0.0000	59.8530	0.0000	36.7924	0.0000	20.9834	0.0000	20.1305
CBE160	0.0000	36.0223	0.0000	19.9576	0.0000	13.5769	0.0000	13.3451
CBE180	0.0000	22.6789	0.0000	10.3708	0.0000	14.7078	0.0000	13.1835
DBFEWE1	0.0000	38.7624	0.0000	34.0583	0.0000	33.0547	0.0000	8.1482
DBFEWE2	0.0000	35.4702	0.0000	31.4465	0.0000	30.8935	0.0000	4.1441
DBFEWE3	0.0000	31.9646	0.0000	29.2392	0.0000	29.2686	321.0677	0.0000
WINFINMK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	139.1693	0.0000
WINFINLK	0.0000	6.4362	0.0000	6.6107	0.0000	7.0176	0.0000	6.5478
WINFINBF	0.0000	45.3027	0.0000	32.4982	0.0000	47.4851	0.0000	27.5970
WINFINSK	0.0000	25.3684	0.0000	14.9308	0.0000	16.4059	0.0000	18.2225
AFLGR	0.0000	56.2126	0.0000	44.4092	0.0000	53.5238	0.0000	43.3357
GIMMERIN	0.0000	0.0000	1.1672	0.0000	0.0000	0.0000	0.0000	4.2489
INDOORLA	0.0000	86.3400	0.0000	61.6542	0.0000	79.5929	0.0000	63.8693
HREA26	0.0000	70.8513	0.0000	97.3371	0.0000	122.6330	0.0000	133.3076
HRA30	0.0000	116.6671	0.0000	35.8833	0.0000	45.1497	0.0000	73.8813
HRA36	11.0759	0.0000	0.0000	19.0401	0.0000	23.9570	10.0000	0.0000

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	18486.860		22241.230		56234.680		46415.830	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
HRS30	0.0000	28.1650	0.0000	16.3243	0.0000	20.5854	0.0000	62.2370
HRS36	0.0000	33.9037	2.0050	0.0000	26.0803	0.0000	0.0000	10.4398
Dsp4000	0.0000	344.0114	0.0000	546.1317	0.0000	249.8823	0.0000	500.0419
Dsum4000	0.0000	262.8074	0.0000	460.5910	0.0000	159.1386	0.0000	409.7405
DAut4000	0.0000	459.0740	0.0000	620.0912	0.0000	344.9290	0.0000	564.3690
DAll4000	0.0000	420.1222	0.0000	589.8765	0.0000	320.9878	0.0000	537.1424
Dsp5000	0.0000	65.2098	0.0000	333.4546	0.0000	71.5405	0.0000	291.8119
Dsum5000	5.8882	0.0000	0.0000	235.2827	20.2524	0.0000	0.0000	189.1618
DAut5000	0.0000	171.6799	0.0000	401.1636	0.0000	161.1138	0.0000	350.0282
DAll5000	0.0000	112.1241	0.0000	362.4948	0.0000	113.5339	0.0000	315.0725
Dsp6000	5.4673	0.0000	0.0000	205.6589	15.1055	0.0000	0.0000	165.4936
Dsum6000	0.7692	0.0000	0.0000	208.8676	0.0000	30.7064	0.0000	160.6084
DAut6000	0.0000	10.3567	0.0000	252.9707	0.0000	66.2997	0.0000	203.9474
DAll6000	5.5100	0.0000	0.0000	229.2300	0.0000	37.2041	0.0000	183.4075
Dsp7000	4.9084	0.0000	0.0000	92.0103	16.9732	0.0000	0.0000	52.8275
Dsum7000	4.8253	0.0000	0.0000	77.9256	16.5619	0.0000	0.0000	31.0491
DAut7000	5.0742	0.0000	0.0000	167.0241	0.0000	49.8064	0.0000	117.9352
DAll7000	4.9941	0.0000	0.0000	132.7472	0.0000	7.1549	0.0000	87.2376
Dsp8000	4.4976	0.0000	0.9633	0.0000	15.4352	0.0000	12.5472	0.0000
Dsum8000	4.4345	0.0000	4.5018	0.0000	15.1527	0.0000	12.3176	0.0000
DAut8000	4.5392	0.0000	0.0000	34.8108	15.5724	0.0000	12.6587	0.0000
DAll8000	4.4713	0.0000	4.5599	0.0000	15.3481	0.0000	12.4764	0.0000
18MthST	0.0000	203.8902	0.0000	93.3878	0.0000	17.1565	0.0000	58.4468
18mthHF	0.0000	217.5011	0.0000	126.4504	0.0000	34.7510	80.6010	0.0000
24mthFr	0.0000	17.5256	23.7061	0.0000	0.0000	6.9054	25.3711	0.0000
24mthB	0.0000	15.3775	23.6204	0.0000	0.0000	5.5370	64.6289	0.0000
Owscsbst	0.0000	104.7479	0.0000	146.4286	0.0000	69.1582	0.0000	214.6562
Owscsbhf	0.0000	114.6521	0.0000	183.4803	0.0000	92.0402	0.0000	82.2838
Owscwbst	0.0000	139.1478	0.0000	169.9485	0.0000	96.3283	0.0000	237.4711
Owscwbhf	0.0000	320.1690	0.0000	331.3311	0.0000	227.2841	0.0000	226.6761
WFLFDBST	0.0000	202.8836	0.0000	203.0866	0.0000	153.0156	0.0000	269.2979
WFMFDBST	0.0000	59.4807	0.0000	102.0894	0.0000	47.7243	0.0000	171.0582
WFSCST	0.0000	55.1559	0.0000	97.6949	0.0000	49.2673	0.0000	166.6029
WFSCHF	0.0000	114.7771	0.0000	171.9574	0.0000	96.3701	0.0000	70.8665
BSDBXSTL	0.0000	98.0481	0.0000	80.5131	0.0000	62.4197	0.0000	176.2970
BSDBXSTM	14.0299	0.0000	42.6735	0.0000	90.0000	0.0000	0.0000	112.5916
OWSCSTWB	0.0000	11.3090	0.0000	13.6849	0.0000	6.8576	0.0000	119.1244
OWSCHFWB	0.0000	47.2657	0.0000	68.2150	0.0000	47.5240	0.0000	6.2054
OWSCSTSB	0.0000	67.9123	0.0000	83.9130	0.0000	63.6626	0.0000	19.0257
OWSCHFSB	0.0000	47.2657	0.0000	68.2150	0.0000	47.5240	0.0000	6.2054
OWMJST	0.0000	67.9123	0.0000	83.9130	0.0000	63.6626	0.0000	19.0257
OWMJHF	0.0000	47.2657	0.0000	68.2150	0.0000	47.5240	0.0000	6.2054
RYCSBMST	0.0000	287.8394	0.0000	157.9574	0.0000	180.9986	0.0000	236.3542
RYCSBLST	0.0000	317.8597	0.0000	179.7948	0.0000	200.1215	0.0000	257.7034
RYCABMST	49.8947	0.0000	0.0000	63.4128	0.0000	0.0000	0.0000	114.6775
RYCABLST	26.0754	0.0000	0.0000	80.0546	0.0000	14.5731	0.0000	130.9471
WFLFBST	0.0000	93.9552	0.0000	123.1165	0.0000	74.8168	0.0000	191.4704
SFLFBST	0.0000	310.1759	0.0000	49.8158	0.0000	110.6343	0.0000	191.9458
IBBFCF	0.0000	178.9200	0.0000	273.1605	0.0000	204.6376	0.0000	264.0401
IBBBXSF	0.0000	586.3590	0.0000	545.8456	0.0000	521.6035	0.0000	361.3693

	8.Mainly Dairy Wales and Northern Ireland		9.Small Dairy Northern England		10.Large Dairy Scotland		11.Mainly Dairy South West England	
C)	18486.860		22241.230		56234.680		46415.830	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
IBBSCCF	0.0000	79.1519	0.0000	220.1044	0.0000	86.5583	0.0000	214.4913
IBBSCSF	0.0000	450.5720	0.0000	478.8337	0.0000	382.6365	0.0000	297.9047
CRFBFs1	0.0000	372.4326	0.0000	339.2174	0.0000	348.4602	0.0000	230.9327
CRMBBFs1	0.0000	379.5931	0.0000	344.4261	0.0000	353.0215	0.0000	236.0249
CRLBBFs1	0.0000	386.7536	0.0000	349.6347	0.0000	357.5827	0.0000	241.1171
CRFALst1	0.0000	463.7636	0.0000	391.9348	0.0000	428.7285	0.0000	281.3371
CRFBFhf1	0.0000	372.4326	0.0000	339.2174	0.0000	348.4602	0.0000	230.9327
CRMBBFh1	0.0000	379.5931	0.0000	344.4261	0.0000	353.0215	0.0000	236.0249
CRLBBFh1	0.0000	386.7536	0.0000	349.6347	0.0000	357.5827	0.0000	241.1171
CRFALhf1	0.0000	463.7636	0.0000	391.9348	0.0000	428.7285	0.0000	281.3371
FCOSTS	25932.968	0.0000	20265.544	0.0000	47057.179	0.0000	57237.789	0.0000
EEIQ	175.8551	0.0000	724.5952	0.0000	100.4028	0.0000	1850.7250	0.0000
CEIQ	200.0186	0.0000	811.6706	0.0000	86.7712	0.0000	2063.6682	0.0000
WEIQ	251.3786	0.0000	753.8481	0.0000	204.2000	0.0000	2268.9949	0.0000
TPest	2.9147	0.0000	10.3078	0.0000	1.8268	0.0000	27.6473	0.0000
Herb	2.3398	0.0000	8.2646	0.0000	1.2892	0.0000	20.5649	0.0000
Insectic	0.0717	0.0000	0.6976	0.0000	0.0000	0.0000	1.3113	0.0000
Fungicid	0.5044	0.0000	1.3357	0.0000	0.5376	0.0000	5.7411	0.0000
Growth	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STBO	10670.368	0.0000	6820.0151	0.0000	35460.000	0.0000	40321.882	0.0000
LOSS	11482.912	0.0000	12123.992	0.0000	40808.484	0.0000	33173.078	0.0000
TOTLAB	20026.316	0.0000	13293.576	0.0000	34906.375	0.0000	41660.097	0.0000
SOILIND	307.4386	0.0000	219.3661	0.0000	540.2886	0.0000	733.8397	0.0000
LSU	88.0754	0.0000	72.2378	0.0000	132.1411	0.0000	240.1518	0.0000
MAIZEFOD	0.0000	0.0000	70074.515	0.0000	0.0000	0.0235	11304.831	0.0000
FOD	32626.316	0.0000	40818.984	0.0000	139041.81	0.0000	7051.8545	0.0000
BSP	90.0000	0.0000	42.6735	0.0000	90.0000	0.0000	0.0000	0.0000
BSPFULL	0.0000	0.0000	47.3265	0.0000	0.0000	0.0000	90.0000	0.0000
Quota	382075.81	0.0000	80199.781	0.0000	918708.31	0.0000	400000.00	0.0000

	12. Dairy and Sheep Southern England		13.Specialist Dairy Central and Southern England		14.Specialist Dairy Wales & North of England	
C)	57996.0100		19021.6600		35408.1900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	1.3747	0.0000	0.3977	0.0000	0.6792	0.0000
CJAN	0.0000	9.2300	0.0000	0.4726	0.0000	9.2300
CFEB	0.0000	9.2300	0.0000	9.2300	0.0000	9.2300
CMAR	153.1247	0.0000	84.4666	0.0000	177.4665	0.0000
CAPR	134.1507	0.0000	78.7896	0.0000	80.5799	0.0000
CMAY	88.6075	0.0000	187.1715	0.0000	244.2663	0.0000
CJUN	91.1200	0.0000	192.2596	0.0000	254.2694	0.0000
CJUL	129.6423	0.0000	117.2930	0.0000	120.0663	0.0000
CAUG	0.0000	4.1035	0.0000	6.2392	26.8835	0.0000
CSEP	0.0000	2.6082	0.0000	9.2300	0.0000	6.7118
COCT	87.3765	0.0000	0.0000	9.2300	38.6347	0.0000
CNOV	0.0000	9.2300	0.0000	9.2300	0.0000	9.2300

	12. Dairy and Sheep Southern England		13.Specialist Dairy Central and Southern England		14.Specialist Dairy Wales & North of England	
C)	57996.0100		19021.6600		35408.1900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
CDEC	0.0000	9.2300	0.0000	0.0000	0.0000	9.2300
BHAY	81.9702	0.0000	1.8478	0.0000	157.9984	0.0000
BBAR	0.0000	76.0566	0.0000	0.0000	0.0000	24.9406
SBAR	15.1120	0.0000	0.0000	116.9710	0.0000	79.5347
USLYCat	2062.1497	0.0000	1422.0623	0.0000	2106.0461	0.0000
UFYMCat	177.9255	0.0000	82.1800	0.0000	86.8285	0.0000
BUYN	5613.0000	0.0000	1265.1525	0.0000	3158.8979	0.0000
BUYP	830.6035	0.0000	0.0000	1.4511	0.0000	1.3373
BUYK	0.0000	0.4917	0.0000	0.8141	0.0000	0.7502
bHeifers	0.0000	1710.3453	0.0000	2831.4841	0.0000	847.8293
SSLambs	0.0000	22.2628	0.0000	41.5602	0.0000	35.0226
bSLambs	0.0000	0.0000	0.0000	2.6288	0.0000	4.4459
sGimmers	0.0000	45.8353	0.0000	72.5348	0.0000	69.5274
bGimmers	0.0000	0.0000	0.0000	18.4426	0.0000	11.7312
bwSTRAW	6.3169	0.0000	2.9176	0.0000	3.0827	0.0000
bBSTRAW	0.0000	10.6897	0.0000	17.6968	0.0000	16.3084
bOSTRAW	0.0000	10.6897	0.0000	17.6968	0.0000	16.3084
WW1	0.0000	21.9628	0.0000	598.4636	0.0000	690.2960
WW2	2.1789	0.0000	0.0000	518.9648	0.0000	432.7724
WW3	0.0000	125.0352	0.0000	550.1834	0.0000	673.3363
BWW1	0.0000	61.4095	0.0000	65.5248	0.0000	337.4183
BWW2	0.0000	62.9404	0.0000	49.2062	2.0000	0.0000
BWW3	0.0000	190.8999	0.0000	0.0000	0.0000	301.2780
MSBAR1	0.0000	91.2777	0.0000	113.9828	0.0000	245.6982
MSBAR2	0.0000	117.0558	0.0000	94.9959	0.0000	144.7664
MSBAR3	0.0000	115.8520	0.0000	0.0000	0.0000	174.0444
WB125	0.0000	96.4162	0.0000	399.4146	0.0000	150.8670
WB180	3.0000	0.0000	0.0000	0.0000	2.0000	0.0000
WB225	0.0000	161.0953	0.0000	324.1132	0.0000	96.6682
SBAR75	0.0000	48.9859	0.0000	511.2433	0.0000	116.7018
SBAR100	0.0000	77.8151	0.0000	501.4059	0.0000	4.8174
SBAR125	0.0000	83.6702	0.0000	428.3282	0.0000	37.4809
WO50	0.0000	20.1718	0.0000	57.8617	0.0000	121.2772
WO100	0.0000	53.7521	0.0000	47.3777	0.0000	64.8344
WO125	0.0000	74.2357	0.0000	0.0000	0.0000	99.3790
SO50	3.0000	0.0000	0.0000	76.6383	0.0000	125.3292
SO100	0.0000	33.5803	0.0000	66.1543	2.0000	0.0000
SO125	0.0000	54.0769	0.0000	18.8131	0.0000	103.4520
WOSR150	0.0000	293.5264	0.0000	462.7805	0.0000	415.3132
WOSR185	0.0000	202.2327	0.0000	200.4330	0.0000	330.0075
WOSR225	0.0000	423.1515	0.0000	478.9452	0.0000	426.6342
SOSR90	0.0000	27.4314	0.0000	149.0270	0.0000	152.0747
SOSR110	0.0000	76.8155	0.0000	166.8188	0.0000	310.1371
SOSR130	0.0000	100.4329	0.0000	139.9738	0.0000	142.9268
LIN50	0.0000	362.2745	0.0000	561.7933	0.0000	519.8635
LIN80	0.0000	323.5444	0.0000	459.5370	0.0000	478.1916
LIN120	0.0000	400.7191	0.0000	558.0679	0.0000	516.0363
SFB20K	0.0000	38.5220	0.0000	78.8814	0.0000	73.9914
SFB40K	0.0000	72.6432	0.0000	131.9171	0.0000	123.7394
SFB60K	4.6300	0.0000	0.0000	0.0000	1.0843	0.0000
SETSC	0.0000	98.0164	0.0000	172.6380	0.0000	145.2136

	12. Dairy and Sheep Southern England		13.Specialist Dairy Central and Southern England		14.Specialist Dairy Wales & North of England	
C)	57996.0100		19021.6600		35408.1900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SETNR	2.0000	0.0000	0.3200	0.0000	0.7200	0.0000
WORSA100	0.0000	404.4119	0.0000	251.5856	0.0000	213.9178
WORSA140	0.0000	329.5241	0.0000	50.0417	0.0000	134.5250
WORSA180	0.0000	487.8164	0.0000	252.4462	0.0000	211.6658
SORSA60	0.0000	205.5225	0.0000	16.5437	0.0000	15.9342
SORSA85	0.0000	284.3753	0.0000	109.0014	0.0000	137.2842
SORSA110	0.0000	246.9355	0.0000	0.0000	0.0000	0.0000
SBEET1	0.0000	310.9073	0.0000	607.6260	0.0000	243.7153
SBEET2	3.0000	0.0000	0.0000	0.0000	2.0000	0.0000
SBEET3	0.0000	338.3662	0.0000	517.1399	0.0000	158.2168
POTEW1	0.0000	5088.1650	0.0000	9080.5361	0.0000	4941.3203
POTEW2	0.0000	3064.3330	0.0000	5460.6812	0.0000	3895.5281
POTEW3	0.0000	4990.4722	0.0000	8763.1094	0.0000	4642.6953
PTMCW140	0.0000	5240.9380	0.0000	9326.9111	0.0000	5176.0190
PTMCW180	0.0000	3449.8333	0.0000	6102.9561	0.0000	4276.0449
PTMCW220	0.0000	5182.0396	0.0000	8982.5928	0.0000	4852.0566
PMCWBPP1	0.0000	3544.8501	0.0000	6446.9629	0.0000	4599.8140
PMCWBPP2	0.0000	3019.3308	0.0000	5433.1885	0.0000	3885.0615
PMCWBPP3	0.0000	2493.7991	0.0000	4419.3921	0.0000	3170.3091
PTPOF1	0.0000	1990.7487	0.0000	3746.4792	0.0000	2397.6624
PTPOF2	0.0000	1391.8905	0.0000	2587.7417	0.0000	1581.1418
PTPOF3	0.0000	793.0452	0.0000	1429.0265	0.0000	764.6422
PTPEXST1	0.0000	1472.5007	0.0000	2793.4963	0.0000	1971.2970
PTPEXST2	0.0000	736.2500	0.0000	1396.7476	0.0000	985.6591
PTPEXST3	2.6600	0.0000	0.0000	0.0000	0.9000	0.0000
POTSEED1	0.0000	2156.5034	0.0000	4110.8701	0.0000	3090.4336
POTSEED2	0.0000	1414.2316	0.0000	2747.6335	0.0000	2125.0942
POTSEED3	0.0000	671.9468	0.0000	1384.3748	0.0000	1159.7753
POTDUAL1	0.0000	1797.4186	0.0000	3383.8894	0.0000	2503.5813
POTDUAL2	0.0000	1053.6183	0.0000	1987.4216	0.0000	1516.8751
POTDUAL3	0.0000	309.8049	0.0000	590.9308	0.0000	530.1694
GR0	20.0610	0.0000	1.8800	0.0000	2.9500	0.0000
GR50	0.0000	24.4751	27.2271	0.0000	0.0000	0.0789
GR75	0.0000	71.9007	0.0000	18.5816	0.0000	17.2027
GR125	79.3852	0.0000	6.9999	0.0000	42.6882	0.0000
GR150	4.0844	0.0000	0.0000	14.9087	0.2279	0.0000
GR175	0.0000	32.7527	0.0000	31.2723	0.0000	15.0745
GR200	0.0000	65.5054	0.0000	47.8903	0.0000	28.9450
GR250	0.0000	138.0638	0.0000	82.8355	0.0000	59.3759
GR300	0.0000	211.1892	0.0000	116.3259	0.0000	90.0884
GR375	0.0000	324.2505	0.0000	168.1434	0.0000	137.9248
SILAGE12	0.0000	26.5609	9.7190	0.0000	19.2245	0.0000
SILAGE27	17.2644	0.0000	11.3240	0.0000	13.7051	0.0000
SILAGE30	0.0000	88.5490	0.0000	107.8066	0.0000	99.4537
HAY0	0.0000	163.8311	0.0000	155.6187	0.0000	126.3349
HAY50	0.0000	104.9739	0.0000	127.6819	0.0000	82.6380
HAY75	0.0000	140.4253	0.0000	139.5654	0.0000	91.8184
HAY125	0.0000	180.1454	0.0000	167.9552	0.0000	115.6004
HAY200	0.0000	277.4109	0.0000	216.9586	0.0000	157.1749
FMAIZE1	0.0000	78.9105	0.0000	149.0910	0.0000	481.8007
FMAIZE2	0.0000	18.3632	2.3387	0.0000	0.0000	382.8507

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C)	57996.0100		19021.6600		35408.1900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FMAIZE3	7.0361	0.0000	2.7058	0.0000	0.0000	283.9007
FMAIZEP1	0.0000	363.0039	0.0000	596.7841	0.0000	915.2197
FMAIZEP2	0.0000	284.8501	0.0000	416.0316	0.0000	789.4089
FMAIZEP3	0.0000	206.6962	0.0000	235.2791	0.0000	663.5980
SWEDESGR	0.0000	362.0749	0.0000	1108.0505	0.0000	646.0429
TURNIPSG	0.0000	325.3024	0.0000	1047.1736	0.0000	589.9421
KALEAGEd	0.0000	454.0407	0.0000	910.1339	0.0000	659.6653
KALEAGEB	0.0000	275.5876	0.0000	614.7039	0.0000	387.4134
RapeBroa	0.0000	160.8761	0.0000	450.6306	0.0000	332.9411
RapeDril	0.0000	153.8209	0.0000	438.9507	0.0000	322.1776
RapeDD	0.0000	298.1585	0.0000	593.6205	0.0000	464.7127
Fbeet1	0.0000	84.3174	0.0000	288.1855	0.0000	206.0873
Fbeet2	0.0000	42.1591	0.0000	144.0935	0.0000	103.0436
Fbeet3	0.0000	0.0000	0.9856	0.0000	0.0000	0.0000
IRG1	0.0000	359.1620	0.0000	586.0892	0.0000	474.4393
IRG2	0.0000	422.7744	0.0000	612.9100	0.0000	499.4292
IRG3	0.0000	479.1577	0.0000	641.1857	0.0000	524.4191
LLB120	0.0000	17.7288	0.0000	9.3080	0.0000	1.4327
LLBE140	0.0000	14.4302	0.0000	2.2018	0.0000	0.0000
LLBE180	0.0000	13.8796	0.0000	0.0000	0.0000	0.4237
CBE140	0.0000	41.0966	0.0000	28.7467	0.0000	41.1482
CBE160	0.0000	33.8753	0.0000	14.8790	0.0000	28.9574
CBE180	0.0000	33.4541	0.0000	15.6924	0.0000	29.5437
DBFEWE1	0.0000	44.1821	0.0000	50.9076	0.0000	36.0430
DBFEWE2	0.0000	41.8080	0.0000	46.4360	0.0000	31.8504
DBFEWE3	0.0000	39.9827	0.0000	42.8071	0.0000	27.3831
WINFINMK	0.0000	12.6513	0.0000	0.0000	0.0000	0.0000
WINFINLK	0.0000	18.9814	0.0000	8.7263	0.0000	8.4862
WINFINBF	0.0000	48.9277	0.0000	76.2929	0.0000	65.4368
WINFINSK	0.0000	34.4318	0.0000	30.1743	0.0000	32.0632
AFLGR	0.0000	66.2809	0.0000	71.9966	0.0000	68.9496
GIMMERIN	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
INDOORLA	0.0000	88.6291	0.0000	189.7457	0.0000	180.8624
HREA26	0.0000	125.1973	0.0000	207.2646	0.0000	87.5280
HRA30	0.0000	46.0938	0.0000	76.3085	0.0000	144.1276
HRA36	0.0000	24.4579	0.0000	40.4902	18.2436	0.0000
HRS30	0.0000	21.0159	0.0000	34.7919	0.0000	34.7944
HRS36	17.8634	0.0000	12.3186	0.0000	0.0000	41.8837
Dsp4000	0.0000	316.3779	0.0000	386.2635	0.0000	379.5422
Dsum4000	0.0000	217.6890	0.0000	223.6774	0.0000	227.9691
DAut4000	0.0000	412.4861	0.0000	546.1589	0.0000	528.9967
DAll4000	0.0000	384.3158	0.0000	497.3316	0.0000	481.6252
Dsp5000	0.0000	111.2297	0.0000	27.4445	0.0000	43.5371
Dsum5000	5.0858	0.0000	5.5176	0.0000	8.1714	0.0000
DAut5000	0.0000	201.1321	0.0000	176.5895	0.0000	182.9076
DAll5000	0.0000	152.1881	0.0000	95.9642	0.0000	107.1952
Dsp6000	0.0000	15.1159	5.1735	0.0000	7.6619	0.0000
Dsum6000	0.0000	37.9196	5.0678	0.0000	7.5052	0.0000
DAut6000	0.0000	80.6403	5.2745	0.0000	7.8115	0.0000
DAll6000	0.0000	50.6444	5.2130	0.0000	7.7204	0.0000
Dsp7000	12.7356	0.0000	4.6242	0.0000	6.8484	0.0000

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C)	57996.0100		19021.6600		35408.1900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
Dsum7000	12.4270	0.0000	4.5121	0.0000	6.6824	0.0000
DAut7000	0.0000	40.1069	4.7629	0.0000	7.0537	0.0000
DAll7000	12.9167	0.0000	4.6900	0.0000	6.9458	0.0000
Dsp8000	11.5816	0.0000	4.2052	0.0000	6.2278	0.0000
Dsum8000	11.3696	0.0000	4.1282	0.0000	6.1138	0.0000
DAut8000	11.6845	0.0000	4.2426	0.0000	6.2831	0.0000
DAll8000	11.5162	0.0000	4.1815	0.0000	6.1927	0.0000
18MthST	0.0000	80.7296	0.0000	80.7118	0.0000	213.2854
18mthHF	0.0000	90.7689	0.0000	154.1241	0.0000	303.0204
24mthFr	0.0000	1.5514	0.0000	43.0903	0.0000	2.5210
24mthB	0.0000	0.0000	0.0000	40.4026	25.6889	0.0000
Owscsbst	0.0000	66.6392	0.0000	192.3278	0.0000	155.5882
Owscsbhf	0.0000	79.0309	0.0000	307.0233	0.0000	265.7913
Owscwbst	0.0000	91.2131	0.0000	240.9044	0.0000	198.2702
Owscwbhf	0.0000	227.9557	0.0000	558.5792	0.0000	499.4420
WFLFDBST	0.0000	124.1341	0.0000	663.2717	0.0000	569.3239
WFMFDBST	0.0000	22.4020	0.0000	507.3987	0.0000	429.7154
WFSCST	0.0000	19.1137	0.0000	553.3721	0.0000	470.9471
WFSCHF	0.0000	69.6713	0.0000	675.1298	0.0000	591.4349
BSDBXSTL	0.0000	68.5596	0.0000	133.8518	0.0000	142.6528
BSDBXSTM	37.3593	0.0000	0.0000	18.9133	0.0000	34.1499
OWSCSTWB	0.0000	7.9228	0.0000	29.6159	0.0000	44.5339
OWSCHFWB	0.0000	39.8718	0.0000	180.6064	0.0000	188.2687
OWSCSTSB	0.0000	53.1646	0.0000	206.5504	0.0000	211.4250
OWSCHFSB	0.0000	39.8718	0.0000	180.6064	0.0000	188.2687
OWMJST	0.0000	53.1646	0.0000	206.5504	0.0000	211.4250
OWMJHF	0.0000	39.8718	0.0000	180.6064	0.0000	188.2687
RYCSBMST	0.0000	239.1824	0.0000	285.8694	0.0000	240.4039
RYCSBLST	0.0000	260.8636	0.0000	323.4288	0.0000	275.6350
RYCABMST	52.6407	0.0000	24.3136	0.0000	0.0000	0.0000
RYCABLST	0.0000	16.5227	0.0000	28.6231	0.0000	26.8487
WFLFBST	0.0000	51.4638	0.0000	163.2483	0.0000	108.4349
SFLFBST	0.0000	246.3411	0.0000	141.4577	0.0000	104.5980
IBBFCF	0.0000	102.1467	0.0000	378.5602	0.0000	315.0542
IBBBXSF	0.0000	470.8733	0.0000	1060.1656	0.0000	904.6409
IBBSCCF	0.0000	25.2677	0.0000	209.8895	0.0000	174.5462
IBBSCSF	0.0000	345.9691	0.0000	841.5018	0.0000	724.3361
CRFBFs1	0.0000	343.3633	0.0000	564.0856	0.0000	529.5472
CRMBBFs1	0.0000	348.5347	0.0000	573.0443	0.0000	537.9505
CRLBBFs1	0.0000	353.7061	0.0000	582.0031	0.0000	546.3539
CRFALst1	0.0000	421.7061	0.0000	691.0008	0.0000	645.4727
CRFBFhf1	0.0000	343.3633	0.0000	564.0856	0.0000	529.5472
CRMBBFh1	0.0000	348.5347	0.0000	573.0443	0.0000	537.9505
CRLBBFh1	0.0000	353.7061	0.0000	582.0031	0.0000	546.3539
CRFALhf1	0.0000	421.7061	0.0000	691.0008	0.0000	645.4727
FCOSTS	47732.5234	0.0000	32545.5781	0.0000	49229.2266	0.0000
EEIQ	1918.8800	0.0000	348.0526	0.0000	783.9194	0.0000
CEIQ	2072.6013	0.0000	241.9368	0.0000	1048.8416	0.0000
WEIQ	2301.9534	0.0000	264.9906	0.0000	981.2639	0.0000
TPest	29.7229	0.0000	4.4982	0.0000	12.9241	0.0000
Herb	23.7852	0.0000	4.3996	0.0000	9.6397	0.0000

	12. Dairy and Sheep Southern England		13.Specialist Dairy Central and Southern England		14.Specialist Dairy Wales & North of England	
C)	57996.0100		19021.6600		35408.1900	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
Insectic	0.6954	0.0000	0.0986	0.0000	0.4800	0.0000
Fungicid	5.2505	0.0000	0.0000	0.0000	2.8044	0.0000
Growth	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STBO	33070.0000	0.0000	1234.2386	0.0000	18884.5410	0.0000
LOSS	30620.0020	0.0000	11117.9326	0.0000	16465.4395	0.0000
TOTLAB	20709.9180	0.0000	10256.4941	0.0000	15808.7773	0.0000
SOILIND	505.9137	0.0000	245.6847	0.0000	313.8057	0.0000
LSU	113.4045	0.0000	89.7156	0.0000	130.0130	0.0000
MAIZEFOD	77396.8438	0.0000	64290.3906	0.0000	0.0000	0.0000
FOD	46111.7734	0.0000	67508.7813	0.0000	122088.9375	0.0000
BSP	90.0000	0.0000	24.3136	0.0000	0.0000	0.9249
BSPFULL	0.0000	48.0323	0.0000	0.0000	25.6889	0.0000
Quota	661198.8750	0.0000	416145.3750	0.0000	616303.1250	0.0000

	15.Mixed Lowland North & West		16.Mixed Lowland South	
C)	27496.6200		25577.6100	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	1.0776	0.0000	2.3550	0.0000
CJAN	268.4768	0.0000	410.1250	0.0000
CFEB	0.0000	6.7300	0.0000	6.7300
CMAR	29.9559	0.0000	0.0000	2.3677
CAPR	114.8225	0.0000	71.8607	0.0000
CMAY	0.0000	3.4505	55.2275	0.0000
CJUN	0.0000	1.4295	0.0000	0.5170
CJUL	0.0000	6.7300	0.0000	6.7300
CAUG	0.0000	6.7300	0.0000	6.7300
CSEP	0.0000	6.7300	0.0000	6.7300
COCT	22.4936	0.0000	0.0000	1.9953
CNOV	27.0775	0.0000	10.4821	0.0000
CDEC	27.4109	0.0000	22.6784	0.0000
BHAY	57.9412	0.0000	28.7009	0.0000
BBAR	83.9926	0.0000	99.5291	0.0000
SBAR	0.0000	10.8910	0.0000	8.0950
USLYCat	0.0000	0.0000	0.0000	0.0000
UFYMCat	449.5797	0.0000	347.1287	0.0000
BUYN	2870.6008	0.0000	8379.2871	0.0000
BUYP	1035.9371	0.0000	2532.7505	0.0000
BUYK	0.0000	0.6957	2377.0000	0.0000
bHeifers	0.0000	934.7967	0.0000	895.9108
SSLambs	0.0000	4.1144	0.0000	3.0581
bSLambs	587.0264	0.0000	857.7642	0.0000
sGimmers	0.0000	8.4708	0.0000	6.2961
bGimmers	78.0779	0.0000	131.0000	0.0000
bwSTRAW	15.9614	0.0000	12.3241	0.0000
bBSTRAW	0.0000	5.8425	0.0000	5.5994
bOSTRAW	0.0000	5.8425	0.0000	5.5994
WW1	0.0000	412.3167	0.0000	355.8752
WW2	0.0000	230.0276	0.0000	190.1882
WW3	0.0000	396.9804	0.0000	357.8528

	15.Mixed Lowland North & West		16.Mixed Lowland South	
C)	27496.6200		25577.6100	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
BWW1	0.0000	236.3706	0.0000	190.1809
BWW2	1.0000	0.0000	3.0000	0.0000
BWW3	0.0000	211.4709	0.0000	187.8396
MSBAR1	0.0000	210.8425	0.0000	20.7531
MSBAR2	0.0000	301.1920	0.0000	21.1240
MSBAR3	0.0000	170.3127	3.0000	0.0000
WB125	0.0000	78.6650	0.0000	38.0584
WB180	0.0000	6.5635	0.0000	62.2918
WB225	0.0000	54.9661	0.0000	163.8176
SBAR75	0.0000	34.5227	0.0000	18.5281
SBAR100	0.0000	113.9787	0.0000	20.8440
SBAR125	1.0000	0.0000	0.0000	3.5625
WO50	0.0000	91.3528	0.0000	7.6873
WO100	0.0000	64.3222	0.0000	10.9963
WO125	0.0000	75.9122	0.0000	3.8719
SO50	0.0000	22.6473	0.0000	3.8051
SO100	0.0000	56.5488	0.0000	7.1141
SO125	1.0000	0.0000	3.0000	0.0000
WOSR150	0.0000	60.6922	0.0000	119.7189
WOSR185	0.0000	4.7980	0.0000	0.0000
WOSR225	0.0000	58.5963	0.0000	129.0024
SOSR90	0.0000	76.8564	0.0000	95.9661
SOSR110	0.0000	126.8728	0.0000	105.8544
SOSR130	0.0000	68.4431	0.0000	95.2159
LIN50	0.0000	268.5381	0.0000	264.3951
LIN80	0.0000	241.1209	0.0000	218.6144
LIN120	0.0000	264.9362	0.0000	265.1683
SFB20K	0.0000	36.4749	0.0000	28.3683
SFB40K	0.0000	61.4881	0.0000	56.7106
SFB60K	1.8900	0.0000	1.7800	0.0000
SETSC	0.0000	48.6771	0.0000	51.5595
SETNR	6.4800	0.0000	2.2200	0.0000
WORSA100	0.0000	63.9822	0.0000	169.4457
WORSA140	0.0000	0.0000	0.0000	79.7075
WORSA180	0.0000	58.1021	0.0000	175.7300
SORSA60	0.0000	101.3528	0.0000	167.3792
SORSA85	0.0000	150.5340	0.0000	212.0376
SORSA110	0.0000	90.5568	0.0000	164.0524
SBEET1	0.0000	161.0083	0.0000	270.8401
SBEET2	1.0000	0.0000	3.0000	0.0000
SBEET3	0.0000	108.8656	0.0000	246.3979
POTEW1	0.0000	2861.7573	0.0000	4141.0635
POTEW2	0.0000	2087.9280	0.0000	2493.3328
POTEW3	0.0000	2677.2151	0.0000	4014.6846
PTMCW140	0.0000	2990.0552	0.0000	4298.3262
PTMCW180	0.0000	2308.3362	0.0000	2835.3206
PTMCW220	0.0000	2816.5491	0.0000	4179.1299
PMCWBPP1	0.0000	2441.0354	0.0000	2915.0598
PMCWBPP2	0.0000	2053.7048	0.0000	2463.5525
PMCWBPP3	0.0000	1666.3846	0.0000	2012.0350
PTPOF1	0.0000	1483.6776	0.0000	1865.7896
PTPOF2	0.0000	1041.1802	0.0000	1346.7661
PTPOF3	0.0000	598.6830	0.0000	827.7530
PTPEXST1	0.0000	1065.2250	0.0000	1256.9513

	15.Mixed Lowland North & West		16.Mixed Lowland South	
C)	27496.6200		25577.6100	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
PTPEXST2	0.0000	532.6124	0.0000	628.4754
PTPEXST3	1.3000	0.0000	1.3500	0.0000
POTSEED1	0.0000	1537.0927	0.0000	1735.5653
POTSEED2	0.0000	1021.7452	0.0000	1124.1782
POTSEED3	0.0000	506.3974	0.0000	512.7808
POTDUAL1	0.0000	1275.4297	0.0000	1448.8177
POTDUAL2	0.0000	746.3559	0.0000	820.5848
POTDUAL3	0.0000	217.2717	0.0000	192.3414
GR0	3.7000	0.0000	5.4500	0.0000
GR50	93.0311	0.0000	0.0000	59.1878
GR75	0.0000	8.7325	0.0000	70.0086
GR125	0.0000	9.8791	81.1478	0.0000
GR150	0.0000	15.4801	0.0000	5.3697
GR175	0.0000	21.2175	0.0000	6.8881
GR200	0.0000	26.9549	0.0000	8.4066
GR250	0.0000	39.0878	0.0000	17.4752
GR300	0.0000	50.5625	0.0000	23.7829
GR375	0.0000	68.4328	0.0000	37.6407
SILAGE12	2.5645	0.0000	0.0000	97.3236
SILAGE27	0.8105	0.0000	15.9773	0.0000
SILAGE30	0.0000	41.6221	0.0000	57.3175
HAY0	0.0000	2.3929	0.0000	191.5904
HAY50	4.2204	0.0000	0.0000	123.4987
HAY75	0.0000	4.7893	0.0000	137.2537
HAY125	0.0000	8.8351	0.0000	123.5894
HAY200	0.0000	22.8086	0.0000	131.6467
FMAIZE1	0.0000	70.9319	0.0000	66.4709
FMAIZE2	0.0000	35.4660	0.0000	33.2355
FMAIZE3	6.4773	0.0000	7.8315	0.0000
FMAIZEP1	0.0000	229.2821	0.0000	216.8575
FMAIZEP2	0.0000	184.5352	0.0000	174.5742
FMAIZEP3	0.0000	139.7883	0.0000	132.2910
SWEDESGR	5.0362	0.0000	7.0333	0.0000
TURNIPSG	0.0000	108.4076	0.0000	120.1991
KALEAGEd	0.0000	531.9230	0.0000	547.1956
KALEAGEB	0.0000	434.3887	0.0000	453.7185
RapeBroa	0.0000	414.1652	0.0000	391.8344
RapeDril	0.0000	410.3091	0.0000	388.1387
RapeDD	0.0000	461.3724	0.0000	437.0779
Fbeet1	0.0000	353.8083	0.0000	368.5521
Fbeet2	0.0000	313.5788	0.0000	338.6366
Fbeet3	0.0000	273.3492	0.0000	308.7207
IRG1	0.0000	143.5939	0.0000	171.5235
IRG2	0.0000	152.8757	0.0000	181.5110
IRG3	0.0000	162.5548	0.0000	188.2279
LLB120	0.0000	1.8676	0.0000	8.5600
LLBE140	0.0000	0.5052	0.0000	3.5494
LLBE180	278.8497	0.0000	467.8573	0.0000
CBE140	0.0000	12.4078	0.0000	38.3751
CBE160	0.0000	5.4136	0.0000	37.6298
CBE180	0.0000	3.5550	0.0000	41.5860
DBFEWE1	0.0000	16.7905	0.0000	26.5069
DBFEWE2	0.0000	12.4330	0.0000	23.6306
DBFEWE3	0.0000	7.9602	0.0000	20.6204

	15.Mixed Lowland North & West		16.Mixed Lowland South	
C)	27496.6200		25577.6100	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
WINFINMK	417.0275	0.0000	772.1537	0.0000
WINFINLK	169.9989	0.0000	85.6105	0.0000
WINFINBF	0.0000	17.0731	0.0000	17.9085
WINFINSK	0.0000	8.6516	0.0000	10.2641
AFLGR	0.0000	25.3324	0.0000	22.5932
GIMMERIN	0.0000	11.5413	0.0000	13.2688
INDOORLA	0.0000	39.0431	0.0000	36.4625
LLSUCKNJ	0.0000	0.0000	0.0000	0.0000
LLSUCKFA	0.0000	1.8917	0.0000	4.9642
LLSUCKMJ	0.0000	0.0000	0.0000	0.0000
LLSUCKAO	0.0000	0.0000	0.0000	0.0000
18MthST	0.0000	0.0000	0.0000	13.4791
18mthHF	43.0117	0.0000	12.7008	0.0000
24mthFr	25.1187	0.0000	0.0000	1.2359
24mthB	64.8813	0.0000	90.0000	0.0000
Owscsbst	0.0000	134.7919	0.0000	97.6211
Owscsbhf	0.0000	134.9624	0.0000	88.4360
Owscwbst	0.0000	151.9920	0.0000	114.1579
Owscwbhf	0.0000	252.3905	0.0000	203.5590
WFLFDBST	0.0000	170.7780	0.0000	138.1091
WFMFDBST	0.0000	130.4322	0.0000	89.7454
WFSCST	0.0000	150.8759	0.0000	109.5633
WFSCHF	0.0000	132.1257	0.0000	91.7684
BSDBXSTL	0.0000	75.1233	0.0000	71.5053
BSDBXSTM	0.0000	49.1332	0.0000	36.5409
OWSCSTWB	0.0000	54.3555	0.0000	41.6467
OWSCHFWB	0.0000	44.8015	0.0000	32.4414
OWSCSTSB	0.0000	54.3555	0.0000	41.6467
OWSCHFSB	0.0000	44.8015	0.0000	32.4414
OWMJST	0.0000	54.3555	0.0000	41.6467
OWMJHF	0.0000	44.8015	0.0000	32.4414
RYCSBMST	0.0000	136.4510	0.0000	122.5405
RYCSBLST	0.0000	154.0173	0.0000	139.8127
RYCABMST	0.0000	51.5609	0.0000	0.0000
RYCABLST	0.0000	64.9478	0.0000	13.1627
WFLFBST	0.0000	126.8480	0.0000	85.2073
SFLFBST	0.0000	122.9780	0.0000	174.5641
IBBFCF	0.0000	145.7620	0.0000	84.1510
IBBBXSF	0.0000	314.3110	0.0000	231.9792
IBBSCCF	0.0000	122.1978	0.0000	64.3338
IBBSCSF	0.0000	281.2632	0.0000	204.3465
CRFBFs1	0.0000	187.4679	0.0000	141.3509
CRMBBFs1	0.0000	191.6578	0.0000	145.4707
CRLBBFs1	0.0000	195.8477	0.0000	149.5905
CRFALst1	0.0000	220.7422	0.0000	172.5121
CRFBFhf1	0.0000	187.4679	0.0000	141.3509
CRMBBFh1	0.0000	191.6578	0.0000	145.4707
CRLBBFh1	0.0000	195.8477	0.0000	149.5905
CRFALhf1	0.0000	220.7422	0.0000	172.5121
FCOSTS	41036.3047	0.0000	42351.3477	0.0000
EEIQ	3126.1941	0.0000	4223.5293	0.0000
CEIQ	2221.4766	0.0000	3417.7131	0.0000
WEIQ	1906.3009	0.0000	2820.9368	0.0000
TPest	40.7273	0.0000	58.8718	0.0000

	15.Mixed Lowland North & West		16.Mixed Lowland South	
C)	27496.6200		25577.6100	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
Herb	38.1705	0.0000	53.3707	0.0000
Insectic	0.4000	0.0000	1.2000	0.0000
Fungicid	2.1468	0.0000	4.2711	0.0000
Growth	0.0000	0.0000	0.0000	0.0000
STBO	31660.0000	0.0000	13325.8613	0.0000
LOSS	33302.6250	0.0000	60227.9922	0.0000
TOTLAB	11530.0986	0.0000	21825.3438	0.0000
SOILIND	506.9749	0.0000	437.6776	0.0000
LSU	155.2256	0.0000	168.4455	0.0000
MAIZEFOD	94190.5313	0.0000	143965.7813	0.0000
FOD	23547.6328	0.0000	42673.9883	0.0000
AW	2823.4880	0.0000	4019.8425	0.0000
BSP	0.0000	47.4785	0.0000	54.9444
BSPFULL	90.0000	0.0000	90.0000	0.0000
Cereals	1873.4000	0.0000	6953.4302	0.0000
Potatoes	5748.6519	0.0000	7775.0547	0.0000
Cattle	42137.5000	0.0000	33907.9141	0.0000
Sheep	47048.6289	0.0000	60335.0273	0.0000
Pigs	0.0000	0.2897	0.0000	0.0198
Other Cr	9973.1084	0.0000	12673.7734	0.0000
Milk	0.0000	0.0000	0.0000	0.0000
Poultry	0.0000	0.4230	0.0000	0.3942
HREA26	0.0000	0.0000	0.0000	0.0000
HRA30	0.0000	0.0000	0.0000	0.0000
HRA36	0.0000	0.0000	0.0000	0.0000
HRS30	0.0000	49.3690	0.0000	0.0000
HRS36	0.0000	0.0000	0.0000	0.0000
Dsp5000	0.0000	0.0000	0.0000	0.0000
Dsum5000	0.0000	0.0000	0.0000	0.0000
DAut5000	0.0000	0.0000	0.0000	0.0000
DAll5000	0.0000	0.0000	0.0000	0.0000
Dsp6000	0.0000	0.0000	0.0000	0.0000
Dsum6000	0.0000	0.0000	0.0000	0.0000
DAut6000	0.0000	0.0000	0.0000	0.0000
DAll6000	0.0000	0.0000	0.0000	0.0000
Dsp7000	0.0000	0.0000	0.0000	0.0000
Dsum7000	0.0000	0.0000	0.0000	0.0000
DAut7000	0.0000	0.0000	0.0000	0.0000
DAll7000	0.0000	0.0000	0.0000	0.0000
BPIG3WKW	0.0000	0.0000	0.0000	0.0000
BPIG4WKW	0.0000	0.0000	0.0000	0.0000
BPIGOUT	0.0000	0.0000	0.0000	0.0000
FPIGPORK	0.0000	0.0000	0.0000	5.4092
FPIGCUT	0.0000	0.0000	0.0000	0.0000
FPIGBAC	0.0000	386.5825	0.0000	367.8810
FPIGHEA	0.0000	374.1885	0.0000	355.4694
PULREAR	0.0000	13.2281	0.0000	13.2829
EGGCAGE	0.0000	15.7113	0.0000	15.5982
EGGRANGE	0.0000	0.0000	0.0000	0.0000
EBARN	0.0000	0.0000	0.0000	0.0000
CHBROILE	0.0000	14.4942	0.0000	14.5202
TFFthen	0.0000	6.8704	0.0000	7.0324
tfftstag	0.0000	4.9733	0.0000	5.1603
PPOUT	0.0000	0.0000	0.0000	0.0000

	15.Mixed Lowland North & West		16.Mixed Lowland South	
C)	27496.6200		25577.6100	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST
UPolMan	0.0000	0.0000	0.0000	0.0000
Upigslur	0.0000	0.0000	0.0000	0.0000

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	-45347.7000		52793.1100		110601.2000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	3.8486	0.0000	0.0000	3127.4197	0.0000	15389.0195
CJAN	0.0000	15.7200	0.0000	15.7200	0.0000	15.7200
CFEB	0.0000	15.7200	0.0000	15.7200	0.0000	15.7200
CMAR	0.0000	5.4365	0.0000	15.7200	0.0000	15.7200
CAPR	1538.1659	0.0000	1177.2532	0.0000	528.6534	0.0000
CMAY	489.0189	0.0000	252.7294	0.0000	0.0000	15.7200
CJUN	760.4393	0.0000	479.8580	0.0000	0.0000	15.7200
CJUL	897.7879	0.0000	542.5823	0.0000	0.0000	15.7200
CAUG	682.2345	0.0000	435.7571	0.0000	0.0000	15.7200
CSEP	614.6276	0.0000	332.6163	0.0000	0.0000	15.7200
COCT	0.0000	5.9559	0.0000	15.7200	0.0000	15.7200
CNOV	0.0000	15.7200	0.0000	15.7200	0.0000	15.7200
CDEC	0.0000	15.7200	0.0000	15.7200	0.0000	15.7200
BHAY	1073.0114	0.0000	71.9442	0.0000	436.6754	0.0000
BBAR	96.1478	0.0000	0.0000	0.0179	71.3394	0.0000
SBAR	0.0000	5.4000	0.0000	8.4689	0.0000	0.0000
USLYCat	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UFYMCat	2136.2451	0.0000	121.9404	0.0000	1257.8271	0.0000
BUYN	4618.4688	0.0000	1396.9895	0.0000	0.0000	0.4247
BUYP	6408.7354	0.0000	943.9193	0.0000	3480.3628	0.0000
BUYK	0.0000	0.9724	607.6383	0.0000	0.0000	2.1409
bHeifers	0.0000	848.0000	0.0000	0.0000	0.0000	808.9377
SSLambs	0.0000	2.0400	0.0000	2.6756	0.0000	0.0000
bSLambs	72.2634	0.0000	0.0000	0.5305	131.2805	0.0000
sGimmers	0.0000	4.2000	0.0000	0.0000	0.0000	0.0000
bGimmers	0.0000	0.0000	0.0000	6.6008	0.0000	0.0000
bwSTRAW	214.0594	0.0000	4.3292	0.0000	151.8691	0.0000
bBSTRAW	0.0000	5.3000	0.0000	5.6430	0.0000	5.0559
bOSTRAW	0.0000	10.6000	0.0000	11.2859	0.0000	10.1117
WW1	0.0000	115.3135	0.0000	144.5311	0.0000	324.5513
WW2	0.0000	0.0000	8.3059	0.0000	0.0000	0.0000
WW3	0.0000	57.2393	0.0000	124.2312	0.0000	120.0089
BWW1	0.0000	177.8569	0.0000	356.9276	0.0000	268.5243
BWW2	0.0000	25.7895	0.0000	161.8609	0.0000	0.0000
BWW3	0.0000	94.9883	0.0000	311.4323	0.0000	22.7369
MSBAR1	0.0000	192.2577	0.0000	360.2408	0.0000	335.4693
MSBAR2	0.0000	237.2419	0.0000	420.9798	0.0000	234.7551
MSBAR3	0.0000	74.7819	0.0000	270.9185	0.0000	91.9874
WB1	0.0000	75.1637	0.0000	50.4974	0.0000	596.5344
WB2	0.0000	47.0129	2.9252	0.0000	0.0000	466.8584
WB3	0.0000	1.7531	0.0000	9.3700	0.0000	441.9447
SBAR1	0.0000	82.3367	0.0000	77.0001	0.0000	573.7244
SBAR2	0.0000	120.0808	0.0000	131.6271	0.0000	505.9037

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	-45347.7000		52793.1100		110601.2000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
SBAR3	0.0000	2.7495	0.0000	22.5707	0.0000	438.1942
WO1	0.0000	242.1736	0.0000	268.8615	0.0000	557.1795
WO2	0.0000	186.6608	0.0000	228.8341	0.0000	415.4167
WO3	0.0000	188.2179	0.0000	246.7998	0.0000	403.3510
SO1	0.0000	234.5930	0.0000	254.2486	0.0000	517.2828
SO2	0.0000	179.0904	0.0000	214.2316	0.0000	322.0015
SO3	0.0000	180.6373	0.0000	232.1870	0.0000	363.4543
RYE1	0.0000	343.8993	0.0000	371.1097	0.0000	714.9699
RYE2	0.0000	302.4031	0.0000	343.5396	0.0000	600.4917
RYE3	0.0000	309.4657	0.0000	364.9315	0.0000	606.1645
TRIT1	0.0000	309.1404	0.0000	335.7884	0.0000	660.8171
TRIT2	0.0000	262.0360	0.0000	302.5194	0.0000	535.7303
TRIT3	0.0000	269.9433	0.0000	324.7697	0.0000	544.5905
WOSR1	0.0000	315.0648	0.0000	563.3176	0.0000	922.5070
WOSR2	0.0000	255.4087	0.0000	516.7056	0.0000	837.9441
WOSR3	0.0000	294.1426	0.0000	571.8582	0.0000	824.0419
SOSR1	0.0000	146.5288	0.0000	304.6374	0.0000	899.4910
SOSR2	0.0000	259.1642	0.0000	432.3959	0.0000	914.6501
SOSR3	0.0000	113.8695	0.0000	293.3781	0.0000	811.0673
LIN1	0.0000	500.1574	0.0000	607.8728	0.0000	1206.9138
LIN2	0.0000	470.9525	0.0000	584.0777	0.0000	1155.8336
LIN3	0.0000	484.8876	0.0000	604.9022	0.0000	1161.7229
SFB20K	0.0000	350.1955	0.0000	82.0333	0.0000	627.5085
SFB40K	0.0000	333.5158	0.0000	75.0451	0.0000	598.6777
SFB60K	0.0000	251.0360	0.0000	0.0000	0.0000	503.3118
SETSC	0.0000	70.7691	0.0000	90.7882	0.0000	61.3332
SETNR	8.9962	0.0000	1.4500	0.0000	1.0700	0.0000
WORSA1	0.0000	472.0356	0.0000	635.6824	0.0000	92.9846
WORSA2	0.0000	442.5995	0.0000	620.3268	0.0000	14.4685
WORSA3	0.0000	456.7634	0.0000	650.0667	0.0000	0.0000
SORSA1	0.0000	332.9405	0.0000	407.2627	0.0000	106.3263
SORSA2	0.0000	410.1412	0.0000	497.6625	0.0000	152.9391
SORSA3	0.0000	296.1620	0.0000	390.3254	0.0000	26.0752
SBEET1	0.0000	189.8915	0.0000	294.5961	0.0000	886.5969
SBEET2	0.0000	0.0000	0.0000	135.3590	0.0000	582.5767
SBEET3	0.0000	30.6085	0.0000	204.1846	0.0000	616.6115
POTEW1	0.0000	1249.6304	0.0000	860.6391	0.0000	1132.5220
POTEW2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POTEW3	0.0000	419.0739	0.0000	335.1724	0.0000	385.5418
PTMCW1	0.0000	1592.5950	0.0000	1127.3060	0.0000	1464.9243
PTMCW2	0.0000	1110.4218	0.0000	843.8434	0.0000	1016.7883
PTMCW3	0.0000	794.8809	0.0000	682.3571	0.0000	692.5067
PMCWBPP1	0.0000	1241.1340	0.0000	860.1442	0.0000	1113.6138
PMCWBPP2	0.0000	732.5801	0.0000	543.5758	0.0000	640.0854
PMCWBPP3	0.0000	411.3647	0.0000	364.1407	0.0000	309.1050
PTPOF1	0.0000	1926.5963	0.0000	1343.9425	0.0000	1649.4253
PTPOF2	0.0000	1557.5487	0.0000	1130.9751	0.0000	1278.6613
PTPOF3	0.0000	1325.7220	0.0000	1018.4544	0.0000	1012.3101
PTPEXST1	0.0000	1582.0774	0.0000	1108.6788	0.0000	1371.9374
PTPEXST2	0.0000	1119.2968	0.0000	827.0980	0.0000	929.8508
PTPEXST3	0.0000	828.5208	0.0000	671.4259	0.0000	618.6444

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	-45347.7000		52793.1100		110601.2000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
POTSEED1	0.0000	1921.7039	0.0000	1358.7194	0.0000	1644.0894
POTSEED2	0.0000	1444.0521	0.0000	1054.3978	0.0000	1216.4548
POTSEED3	0.0000	1143.9954	0.0000	880.0771	0.0000	923.9543
POTDUAL1	0.0000	1590.1686	0.0000	1114.2223	0.0000	1388.4484
POTDUAL2	0.0000	1105.1991	0.0000	808.0734	0.0000	947.0341
POTDUAL3	0.0000	802.7422	0.0000	635.5251	0.0000	644.4957
SWEDE1	0.0000	203.0383	0.0000	173.0840	0.0000	259.7758
SWEDE2	0.0000	458.8463	0.0000	448.7424	0.0000	420.0988
SWEDE3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GWC1	832.2229	0.0000	371.6346	0.0000	751.5513	0.0000
GWC2	0.0000	3.1688	179.3654	0.0000	0.0000	26.2905
GWC3	0.0000	8.3239	0.0000	8.3516	243.0077	0.0000
GR1	122.2871	0.0000	0.0000	7.8965	50.1109	0.0000
GR2	0.0000	13.0018	0.0000	34.0872	0.0000	0.0000
GR3	0.0000	45.6821	0.0000	59.0328	0.0000	0.0000
SILAGE1	0.0000	0.0000	0.0000	0.0000	0.0000	23.7677
SILAGE2	0.0000	178.2288	0.0000	227.9233	0.0000	1.4499
SILAGE3	0.0000	209.2714	0.0000	284.4706	0.0000	0.0000
HAY0	0.0000	51.2227	0.0000	140.9546	0.0000	11.0689
HAY50	0.0000	16.1914	0.0000	99.2088	0.0000	46.5304
HAY75	0.0000	8.1106	0.0000	113.6289	0.0000	17.1417
HAY125	0.0000	6.3026	0.0000	109.4644	0.0000	20.7940
HAY200	0.0000	7.7701	0.0000	124.2996	0.0000	4.1476
FMAIZE1	0.0000	105.9297	0.0000	205.6522	0.0000	1163.8363
FMAIZE2	0.0000	50.0296	0.0000	185.1022	0.0000	1219.7993
FMAIZE3	0.0000	0.0000	0.0000	169.6051	0.0000	1028.4458
FMAIZEP1	0.0000	235.6753	0.0000	362.0869	0.0000	1331.4082
FMAIZEP2	0.0000	214.0538	0.0000	371.0412	0.0000	1375.5919
FMAIZEP3	0.0000	110.8443	0.0000	309.7711	0.0000	1187.2197
SWEDESGR	0.0000	18.2320	0.0000	19.4118	0.0000	17.3922
TURNIPSG	10.4938	0.0000	16.3190	0.0000	20.2600	0.0000
KALEAGEd	0.0000	261.6767	0.0000	199.7817	0.0000	247.6384
KALEAGEB	0.0000	173.1985	0.0000	105.5779	0.0000	163.2359
RapeBroa	0.0000	209.4276	0.0000	106.8603	0.0000	111.7192
RapeDril	0.0000	205.9297	0.0000	103.1359	0.0000	108.3824
RapeDD	0.0000	252.2516	0.0000	152.4555	0.0000	144.0768
Fbeet1	0.0000	166.4923	0.0000	98.4751	0.0000	162.9732
Fbeet2	0.0000	8.6089	0.0000	0.0000	0.0000	17.5971
Fbeet3	0.0000	83.3465	0.0000	101.7462	0.0000	0.0000
FRYE1	0.0000	272.6091	0.0000	303.4704	0.0000	1152.1195
FRYE2	0.0000	279.3083	0.0000	318.3679	0.0000	1140.9166
FRYE3	0.0000	286.0075	0.0000	333.2654	0.0000	1129.7136
IRG1	0.0000	285.6341	0.0000	334.6228	0.0000	1150.5905
IRG2	0.0000	303.6636	0.0000	365.9322	0.0000	1131.9188
IRG3	0.0000	321.1373	0.0000	397.7149	0.0000	1113.2473
HILLSTP1	0.0000	18.7238	0.0000	17.7700	0.0000	12.2767
HILLSTP2	0.0000	16.6558	0.0000	15.1643	0.0000	9.8195
HILLFLG1	0.0000	1.4498	2332.6514	0.0000	0.0000	1.7730
HILLFLG2	2253.5654	0.0000	1376.2028	0.0000	4365.8535	0.0000
WINFINMK	72.2634	0.0000	0.0000	0.0000	131.2805	0.0000
WINFINLK	0.0000	8.0954	0.0000	6.7525	0.0000	5.5486

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	-45347.7000		52793.1100		110601.2000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
WINFINBF	0.0000	15.6204	0.0000	16.7847	0.0000	12.2970
WINFINSK	0.0000	21.2875	0.0000	21.9351	0.0000	24.7012
AFLGR	0.0000	40.7929	0.0000	33.0197	0.0000	1.1634
GIMMERIN	0.0000	57.0097	0.0000	51.1869	0.0000	36.2739
INDOORLA	0.0000	103.8667	0.0000	89.5907	0.0000	63.1797
HILLSU1	271.0126	0.0000	0.0000	73.1774	141.0691	0.0000
HILLSU2	0.0000	108.0220	0.0000	178.7777	0.0000	110.2178
HILLSU3	0.0000	54.7611	0.0000	21.6704	0.0000	0.0000
18MthST	0.0000	168.6291	0.0000	220.1838	0.0000	107.4590
18mthHF	0.0000	158.2221	0.0000	215.3492	0.0000	105.0044
24mthFr	0.0000	1.2000	0.0000	1.2412	0.0000	1.2134
24mthB	90.0000	0.0000	36.0770	0.0000	90.0000	0.0000
Owscsbst	0.0000	114.0954	0.0000	51.1462	0.0000	81.4759
Owscsbhf	0.0000	138.1893	0.0000	148.1151	0.0000	163.4718
Owscwbst	0.0000	130.0144	0.0000	70.4464	0.0000	97.1692
Owscwbhf	0.0000	193.5227	0.0000	209.3767	0.0000	219.4988
OWSCSTSB	0.0000	158.9726	0.0000	179.4232	0.0000	105.9237
OWSCHFSB	0.0000	150.2126	0.0000	170.1541	0.0000	97.4602
OWMJST	0.0000	158.9726	0.0000	179.4232	0.0000	105.9237
OWMJHF	0.0000	150.2126	0.0000	170.1541	0.0000	97.4602
RYCSBMST	0.0000	151.5420	0.0000	191.3001	0.0000	114.3881
RYCSBLST	0.0000	168.3120	0.0000	208.6452	0.0000	131.3454
RYCABMST	0.0000	87.7575	0.0000	113.5141	0.0000	85.2461
RYCABLST	0.0000	100.5375	0.0000	126.7324	0.0000	98.1689
WFLFBST	0.0000	101.7943	0.0000	129.5754	0.0000	131.9583
SFLFBST	0.0000	167.1645	0.0000	167.5224	0.0000	119.5588
IBBFCF	0.0000	234.5215	0.0000	302.4219	0.0000	267.7377
IBBBXSF	0.0000	166.4681	0.0000	233.1403	0.0000	67.1515
IBBSCCF	0.0000	132.3130	0.0000	193.5360	0.0000	172.0308
IBBSCSF	0.0000	206.9703	0.0000	231.1422	0.0000	112.2093
CRFBFs1	0.0000	378.0516	0.0000	367.2996	0.0000	258.2859
CRMBBFs1	0.0000	382.0516	0.0000	371.4368	0.0000	262.3305
CRLBBFs1	0.0000	386.0516	0.0000	375.5740	0.0000	266.3752
CRFALst1	0.0000	314.9756	0.0000	306.9949	0.0000	192.2408
CRFBFhf1	0.0000	285.3116	0.0000	274.5596	0.0000	165.5459
CRMBBFh1	0.0000	289.3116	0.0000	278.6968	0.0000	169.5905
CRLBBFh1	0.0000	293.3116	0.0000	282.8340	0.0000	173.6352
CRFALhf1	0.0000	314.9756	0.0000	306.9949	0.0000	192.2408
FCOSTS	229791.9063	0.0000	107031.2344	0.0000	161699.9688	0.0000
EEIQ	4303.2451	0.0000	6478.4009	0.0000	7243.1694	0.0000
CEIQ	2631.9265	0.0000	4688.1724	0.0000	4518.0859	0.0000
WEIQ	1655.9852	0.0000	3026.6238	0.0000	2669.0757	0.0000
TPest	53.4442	0.0000	88.0717	0.0000	94.3816	0.0000
Herb	53.4442	0.0000	81.5859	0.0000	94.3816	0.0000
Insectic	0.0000	0.0000	0.2784	0.0000	0.0000	0.0000
Fungicid	0.0000	0.0000	6.1536	0.0000	0.0000	0.0000
Growth	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STBO	48640.5117	0.0000	8000.0977	0.0000	0.0000	0.0712
LOSS	195215.0781	0.0000	160619.7188	0.0000	259456.4219	0.0000
TOTLAB	73492.9531	0.0000	25315.4590	0.0000	4155.2163	0.0000
SOILIND	4104.0444	0.0000	2434.8643	0.0000	4525.0176	0.0000

	17.Large Hill Sheep Wales & Northern Ireland		18.Large LFA North of England		19.Large LFA Scotland	
C)	-45347.7000		52793.1100		110601.2000	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
LSU	646.5526	0.0000	436.8356	0.0000	724.1524	0.0000
MAIZEFOD	0.0000	0.0619	0.0000	0.0235	0.0000	0.0288
FOD	0.0000	0.1209	0.0000	0.0961	0.0000	0.0082
BSP	0.0000	0.0000	0.0000	0.0000	0.0000	101.5999
BSPFULL	90.0000	0.0000	36.0770	0.0000	90.0000	0.0000

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	21915.430		23334.650		11937.610		15576.090	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FTLAB	0.0000	8920.6699	0.0000	4016.0298	0.0000	1462.5354	0.0000	4016.0298
CJAN	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CFEB	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CMAR	0.0000	7.8600	0.0000	7.8600	0.0000	7.2114	0.0000	7.8600
CAPR	0.0000	7.8600	278.4474	0.0000	226.7112	0.0000	360.8115	0.0000
CMAY	0.0000	7.8600	182.0281	0.0000	93.1611	0.0000	0.0000	7.8600
CJUN	0.0000	7.8600	185.6894	0.0000	83.0028	0.0000	16.9545	0.0000
CJUL	0.0000	7.8600	208.9498	0.0000	99.6347	0.0000	44.2515	0.0000
CAUG	0.0000	7.8600	0.0000	7.8600	39.7606	0.0000	18.5201	0.0000
CSEP	0.0000	7.8600	0.0000	7.8600	13.2325	0.0000	0.0000	7.8600
COCT	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CNOV	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
CDEC	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600	0.0000	7.8600
BHAY	97.7063	0.0000	50.3301	0.0000	20.8821	0.0000	60.5943	0.0000
BBAR	33.9390	0.0000	47.9669	0.0000	17.0619	0.0000	77.2056	0.0000
SBAR	0.0000	11.1071	0.0000	9.2616	0.0000	8.4747	49.1275	0.0000
USLYCat	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UFYMCat	642.3644	0.0000	817.3868	0.0000	535.9590	0.0000	387.4774	0.0000
BUYN	1748.0824	0.0000	2542.9421	0.0000	5118.0000	0.0000	521.8011	0.0000
BUYP	1101.4628	0.0000	1408.6808	0.0000	1320.0834	0.0000	1145.2947	0.0000
BUYK	0.0000	3.1282	0.0000	3.8921	0.0000	5.0369	0.0000	2.0277
bHeifers	0.0000	0.0000	0.0000	916.6501	0.0000	902.6606	0.0000	0.0000
SSLambs	0.0000	0.0000	0.0000	3.4988	0.0000	3.2015	0.0000	0.0000
bSLambs	0.0000	4.1960	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
sGimmers	0.0000	8.6388	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
bGimmers	0.0000	0.0000	0.0000	7.2034	0.0000	6.5914	0.0000	0.0000
bwSTRAW	38.0745	0.0000	40.4404	0.0000	23.8091	0.0000	16.6475	0.0000
bBSTRAW	0.0000	5.9341	0.0000	5.7291	0.0000	5.6416	0.0000	5.3644
bOSTRAW	0.0000	11.8682	0.0000	11.4581	0.0000	11.2833	0.0000	10.7287
WW1	0.0000	743.0691	0.0000	783.4208	0.0000	279.1430	0.0000	122.7069
WW2	0.0000	658.7279	0.0000	676.9680	0.0000	49.7229	6.8551	0.0000
WW3	0.0000	595.5379	0.0000	597.0277	0.0000	86.9411	0.0000	22.6778
BWW1	0.0000	766.0587	0.0000	724.1031	0.0000	510.7298	0.0000	529.4243
BWW2	0.0000	667.2264	0.0000	600.9928	0.0000	231.0701	0.0000	373.1256
BWW3	0.0000	595.8776	0.0000	513.1151	0.0000	293.3357	0.0000	403.2599
MSBAR1	0.0000	4151.2314	0.0000	5766.0269	0.0000	537.3934	0.0000	561.4424
MSBAR2	0.0000	4073.6960	0.0000	5646.4580	0.0000	528.9578	0.0000	584.8149

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	21915.430		23334.650		11937.610		15576.090	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
MSBAR3	0.0000	3967.9587	0.0000	5525.3818	0.0000	309.7494	0.0000	407.3995
WB1	0.0000	221.4341	0.0000	180.7994	0.0000	210.2250	0.0000	120.9716
WB2	0.0000	0.0000	0.0000	117.6777	0.0000	100.8809	0.0000	90.4162
WB3	0.0000	66.7667	0.0000	0.0000	3.3186	0.0000	0.0000	9.4681
SBAR1	0.0000	4032.8167	0.0000	5890.2012	0.0000	234.9384	0.0000	124.5774
SBAR2	0.0000	3961.3152	0.0000	5799.1875	0.0000	220.3935	0.0000	140.9441
SBAR3	0.0000	3883.1589	0.0000	5721.8477	0.0000	40.6120	0.0000	13.6007
WO1	0.0000	414.9913	0.0000	175.1994	0.0000	414.1805	0.0000	262.4217
WO2	0.0000	312.2235	0.0000	85.5845	0.0000	298.9235	0.0000	190.8960
WO3	0.0000	296.4323	0.0000	0.0000	0.0000	241.6520	0.0000	172.6169
SO1	0.0000	3498.3335	0.0000	4747.8350	0.0000	406.1345	0.0000	266.8161
SO2	0.0000	3359.6755	0.0000	4658.2202	0.0000	290.8878	0.0000	195.2904
SO3	0.0000	3379.7744	0.0000	4572.6357	0.0000	233.6059	0.0000	177.0114
RYE1	0.0000	526.0892	0.0000	333.3606	0.0000	525.3798	0.0000	370.1943
RYE2	0.0000	444.4458	0.0000	261.0145	0.0000	431.5453	0.0000	314.5176
RYE3	0.0000	434.5543	0.0000	200.3949	0.0000	384.8723	0.0000	304.9058
TRIT1	0.0000	489.7737	0.0000	281.0254	0.0000	490.0631	0.0000	333.5557
TRIT2	0.0000	401.0160	0.0000	203.9438	0.0000	390.5304	0.0000	272.2787
TRIT3	0.0000	393.2620	0.0000	140.8875	0.0000	344.7157	0.0000	263.2461
WOSR1	0.0000	260.2449	0.0000	188.3735	0.0000	660.1338	0.0000	738.7832
WOSR2	0.0000	180.0725	0.0000	8.5768	0.0000	548.4328	0.0000	649.2601
WOSR3	0.0000	174.2113	0.0000	92.1974	0.0000	538.4830	0.0000	684.7373
SOSR1	0.0000	179.6527	0.0000	92.7483	0.0000	510.0300	0.0000	587.8287
SOSR2	0.0000	204.0310	0.0000	50.8117	0.0000	588.2790	0.0000	607.9852
SOSR3	0.0000	103.5329	0.5400	0.0000	0.0000	399.7864	0.0000	529.3197
LIN1	0.0000	507.1368	0.0000	393.5621	0.0000	894.1926	0.0000	881.8953
LIN2	0.0000	457.1936	0.0000	319.2963	0.0000	841.9017	0.0000	837.9692
LIN3	0.0000	467.1630	0.0000	344.0441	0.0000	834.2247	0.0000	852.1929
SFB1	0.0000	305.8000	0.0000	163.1313	0.0000	687.8663	0.0000	126.8993
SFB2	0.0000	267.5022	0.0000	117.2135	0.0000	630.5094	0.0000	98.7471
SFB3	0.0000	159.2318	0.0000	2.6724	0.0000	505.1046	0.0000	0.0000
SETSC	0.0000	49.8466	0.0000	67.4597	0.0000	69.1416	0.0000	63.2172
SETNR	0.1900	0.0000	0.3500	0.0000	0.2800	0.0000	0.6700	0.0000
WORSA1	0.0000	80.2699	0.0000	214.9529	0.0000	728.3642	0.0000	772.1675
WORSA2	0.0000	6.4567	0.0000	90.7431	0.0000	647.9156	0.0000	702.2351
WORSA3	0.0000	0.0000	0.0000	124.2938	0.0000	612.5565	0.0000	724.1834
SORSA1	0.0000	271.8810	0.0000	506.9464	0.0000	609.7921	0.0000	652.6670
SORSA2	0.0000	323.5168	0.0000	501.4158	0.0000	651.9643	0.0000	672.7672
SORSA3	0.0000	192.7135	0.0000	412.2650	0.0000	496.4253	0.0000	591.5455
SBEET1	0.0000	1597.0576	0.0000	2184.6304	0.0000	446.6234	0.0000	606.6773
SBEET2	0.0000	1263.2756	0.0000	1722.0746	0.0000	109.2952	0.0000	330.0105
SBEET3	0.0000	1285.0136	0.0000	1813.6982	0.4200	0.0000	0.0000	361.0649
POTEW1	0.0000	1026.4880	0.0000	2019.6576	0.0000	1029.1176	0.0000	1117.2537
POTEW2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POTEW3	0.0000	331.1630	0.0000	1279.7639	0.0000	117.8090	0.0000	488.8746
PTMCW1	0.0000	1306.0651	0.0000	2154.7444	0.0000	1177.4197	0.0000	1309.1229
PTMCW2	0.0000	868.4980	0.0000	1679.6144	0.0000	580.9072	0.0000	929.4214
PTMCW3	0.0000	539.9731	0.0000	1299.9104	0.0000	96.0898	0.0000	655.2914
PMCWBPP1	0.0000	1011.7185	0.0000	1999.6287	0.0000	1002.3107	0.0000	1098.9102

	20.Small LFA Beef Scotland		21.Small LFA Farms South West England		22.Small Hill Wales & Northern Ireland		23.Small LFA North & Central England	
C)	21915.430		23334.650		11937.610		15576.090	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
PMCWBPP2	0.0000	557.1782	0.0000	1550.2340	0.0000	444.4112	0.0000	717.9002
PMCWBPP3	0.0000	228.1379	0.0000	1208.1234	0.0000	12.0863	0.0000	455.5803
PTPOF1	0.0000	1440.7950	0.0000	2367.9778	0.0000	1443.7267	0.0000	1549.5504
PTPOF2	0.0000	1081.7136	0.0000	2000.7375	0.0000	982.1083	0.0000	1258.6115
PTPOF3	0.0000	814.5579	0.0000	1712.0803	0.0000	612.4702	0.0000	1054.6101
PTPEXST1	0.0000	1237.9596	0.0000	2193.7122	0.0000	1230.9183	0.0000	1318.5049
PTPEXST2	0.0000	816.0854	0.0000	1772.7936	0.0000	706.4698	0.0000	968.1804
PTPEXST3	0.0000	509.4390	0.0000	1450.3777	0.0000	297.3175	0.0000	726.8311
POTSEED1	0.0000	3888.9766	0.0000	5967.1426	0.0000	1516.0673	0.0000	1535.7112
POTSEED2	0.0000	3480.6633	0.0000	5570.4580	0.0000	1024.9181	0.0000	1188.0238
POTSEED3	0.0000	3191.3228	0.0000	5275.4771	0.0000	652.8121	0.0000	952.8534
POTDUAL1	0.0000	3657.6689	0.0000	5768.7729	0.0000	1286.2570	0.0000	1330.3771
POTDUAL2	0.0000	3244.0659	0.0000	5366.6553	0.0000	788.3411	0.0000	978.7369
POTDUAL3	0.0000	2952.7297	0.0000	5069.0576	0.0000	412.7648	0.0000	742.7294
SWEDE1	0.0000	271.2079	0.0000	1220.2131	0.0000	328.5835	0.0000	259.5597
SWEDE2	0.0000	418.9682	0.0000	671.7587	0.0000	526.4976	0.0000	235.2551
SWEDE3	0.0000	0.0000	0.0000	925.3911	0.0000	0.0000	0.0000	0.0000
GWC1	36.6200	0.0000	0.0000	29.2967	0.0000	40.8909	30.9142	0.0000
GWC2	0.0000	41.9356	0.0000	30.4425	0.0000	42.0192	0.0000	1.0729
GWC3	71.4063	0.0000	132.2314	0.0000	54.7672	0.0000	126.2285	0.0000
GR1	0.0000	9.8910	0.0000	12.0310	0.0000	14.3825	10.4574	0.0000
GR2	0.0000	33.8255	0.0000	4.5048	62.5391	0.0000	0.0000	9.1194
GR3	0.0000	58.2545	0.0000	12.7727	0.0000	7.1913	0.0000	24.9443
SILAGE12	0.0000	63.7392	0.0000	7.1334	0.0000	68.9101	0.0000	0.0000
SILAGE27	0.0000	18.0657	0.0000	38.5139	0.0000	65.6243	0.0000	105.5554
SILAGE30	17.7464	0.0000	23.4286	0.0000	5.2137	0.0000	0.0000	112.6599
HAY0	0.0000	42.4585	0.0000	107.7522	0.0000	60.4575	0.0000	116.7421
HAY50	0.0000	111.9267	0.0000	191.5757	0.0000	169.7092	0.0000	157.6210
HAY75	0.0000	71.7735	0.0000	135.2882	0.0000	91.4784	0.0000	136.5039
HAY125	0.0000	92.2015	0.0000	159.2081	0.0000	123.6055	0.0000	149.8500
HAY200	0.0000	85.6647	0.0000	144.1278	0.0000	100.5322	0.0000	150.9771
FMAIZE1	0.0000	456.7806	0.0000	226.9043	0.0000	637.7560	0.0000	493.1743
FMAIZE2	0.0000	401.8372	0.0000	28.8450	0.0000	518.9108	0.0000	456.2535
FMAIZE3	0.0000	327.3150	1.6719	0.0000	0.0000	400.4499	0.0000	400.3504
FMAIZEP1	0.0000	699.1488	0.0000	410.1181	0.0000	865.4477	0.0000	693.1075
FMAIZEP2	0.0000	643.2728	0.0000	189.4497	0.0000	748.8469	0.0000	650.1037
FMAIZEP3	0.0000	568.9868	0.0000	171.8383	0.0000	626.9039	0.0000	595.6146
SWEDESGR	0.0000	20.4134	0.0000	19.7080	0.0000	19.4072	0.0000	18.4534
TURNIPSG	3.0373	0.0000	5.1556	0.0000	1.7704	0.0000	6.4749	0.0000
KALEAGEd	0.0000	260.1039	0.0000	181.2867	0.0000	438.7272	0.0000	214.6139
KALEAGEB	0.0000	161.0396	0.0000	85.6457	0.0000	344.5459	0.0000	125.0613
RapeBroa	0.0000	3.9165	0.0000	3.7812	0.0000	200.4909	0.0000	23.2913
RapeDril	0.0000	0.0000	0.2225	0.0000	0.0000	196.7674	0.0000	19.7508
RapeDD	0.0000	51.8642	0.0000	50.0720	0.0000	248.1033	0.0000	66.6353
Fbeet1	0.0000	2513.4983	0.0000	3611.3911	0.0000	313.0097	0.0000	109.3479
Fbeet2	0.0000	2422.9668	0.0000	3357.0291	0.0000	148.8890	0.0000	21.6090
Fbeet3	0.0000	2342.5505	0.0000	3341.6694	0.4610	0.0000	0.0000	0.0000
FRYE1	0.0000	283.2710	0.0000	259.8028	0.0000	451.2895	0.0000	368.8991
FRYE2	0.0000	275.4754	0.0000	245.7364	0.0000	430.4349	0.0000	367.8531

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C)	21915.430		23334.650		11937.610		15576.090	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
FRYE3	0.0000	267.6799	0.0000	231.6700	0.0000	409.5802	0.0000	366.8070
IRG1	0.0000	303.1964	0.0000	282.3717	0.0000	474.1671	0.0000	405.0843
IRG2	0.0000	298.2149	0.0000	266.9485	0.0000	448.9978	0.0000	410.8510
IRG3	0.0000	293.3323	0.0000	251.5252	0.0000	423.8284	0.0000	416.6177
UPCLBE1	0.0000	7.0162	0.0000	3.4920	0.0000	3.3774	0.0000	0.3112
UPCLBE2	0.0000	14.5522	0.0000	10.9327	0.0000	10.7180	0.0000	7.9715
UPHBML	276.1165	0.0000	488.9213	0.0000	202.8548	0.0000	588.6302	0.0000
CBE1	0.0000	15.1758	0.0000	12.8409	0.0000	17.0759	0.0000	13.9469
CBE2	0.0000	13.2510	0.0000	12.1755	0.0000	16.4095	0.0000	13.1744
CBE3	0.0000	11.4538	0.0000	12.5872	0.0000	16.8046	0.0000	13.4212
WINFINMK	0.0000	0.0021	0.0000	2.4263	0.0000	3.5714	0.0000	1.4795
WINFINLK	0.0000	4.5653	0.0000	4.9042	0.0000	7.6984	0.0000	5.3481
WINFINBF	0.0000	24.8586	0.0000	25.3733	0.0000	24.7772	0.0000	20.6499
WINFINSK	0.0000	13.1611	0.0000	17.3437	0.0000	21.7629	0.0000	18.5032
AFLGR	0.0000	2.4851	0.0000	27.6275	0.0000	22.7526	0.0000	19.3603
GIMMERIN	0.0000	7.5633	0.0000	20.8544	0.0000	28.0584	0.0000	31.4615
INDOORLA	0.0000	58.3333	0.0000	71.1746	0.0000	74.2540	0.0000	67.6657
UPSUCKNJ	0.0000	29.0775	0.0000	16.9144	0.0000	32.9916	0.0000	63.0363
UPSUCKFA	0.0000	99.5481	0.0000	83.4237	0.0000	100.4119	0.0000	133.9839
UPSUCKMJ	36.5193	0.0000	12.8386	0.0000	0.5093	0.0000	0.0000	31.0965
UPSUCKAO	35.9406	0.0000	63.0766	0.0000	38.5678	0.0000	24.0907	0.0000
18MthST	0.0000	139.8949	0.0000	81.2287	0.0000	138.4103	0.0000	108.9184
18mthHF	45.1288	0.0000	90.0000	0.0000	80.4136	0.0000	66.4570	0.0000
24mthFr	0.0000	87.6971	0.0000	124.6845	0.0000	113.3702	0.0000	126.8487
24mthB	0.0000	82.0910	0.0000	119.1030	0.0000	107.7992	0.0000	121.2313
Owscsbst	0.0000	107.6630	0.0000	189.3873	0.0000	128.6810	0.0000	138.3107
Owscsbhf	0.0000	193.3763	0.0000	212.2773	0.0000	214.4912	0.0000	194.4541
Owscwbst	0.0000	124.9878	0.0000	211.0381	0.0000	145.9944	0.0000	157.6672
Owscwbhf	0.0000	232.2839	0.0000	253.9883	0.0000	246.3850	0.0000	236.2631
OWSCSTSB	0.0000	107.0406	0.0000	115.1780	0.0000	122.2937	0.0000	136.2410
OWSCHFSB	0.0000	91.9969	0.0000	100.6238	0.0000	113.0257	0.0000	127.2610
OWMJST	0.0000	107.0406	0.0000	115.1780	0.0000	122.2937	0.0000	136.2410
OWMJHF	0.0000	91.9969	0.0000	100.6238	0.0000	113.0257	0.0000	127.2610
RYCSBMST	0.0000	116.1027	0.0000	193.4351	0.0000	146.9309	0.0000	166.1504
RYCSBLST	0.0000	133.9362	0.0000	210.9247	0.0000	164.2738	0.0000	184.1425
RYCABMST	0.0000	75.1566	0.0000	129.2991	0.0000	101.3812	0.0000	118.0502
RYCABLST	0.0000	88.7471	0.0000	142.6274	0.0000	114.5978	0.0000	131.7615
WFLFBST	0.0000	165.4711	0.0000	211.4974	0.0000	194.7407	0.0000	175.4424
SFLFBST	0.0000	145.5808	0.0000	105.2468	0.0000	110.8887	0.0000	132.9950
IBBFCF	0.0000	313.0875	0.0000	319.3189	0.0000	378.8866	0.0000	285.0606
IBBBXSF	0.0000	90.9750	0.0000	452.2942	0.0000	271.4551	0.0000	266.0366
IBBSCCF	0.0000	180.0185	0.0000	183.0328	0.0000	246.9713	0.0000	162.2865
IBBSCSF	0.0000	130.0143	0.0000	415.7526	0.0000	283.0840	0.0000	270.8015
CRFBFs1	0.0000	288.3763	0.0000	307.1470	0.0000	351.5267	0.0000	294.3378
CRMBBFs1	0.0000	292.6300	0.0000	311.3186	0.0000	355.6633	0.0000	298.6292
CRLBBFs1	0.0000	296.8837	0.0000	315.4902	0.0000	359.8000	0.0000	302.9207
CRFALst1	0.0000	226.3640	0.0000	243.4778	0.0000	287.1510	0.0000	225.8616
CRFBFhf1	0.0000	191.5764	0.0000	210.3470	0.0000	254.7267	0.0000	197.5378
CRMBBFh1	0.0000	195.8300	0.0000	214.5186	0.0000	258.8633	0.0000	201.8292

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C)	21915.430		23334.650		11937.610		15576.090	
VARIABLE	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST	VALUE	REDUCED COST
CRLBBFhl	0.0000	200.0836	0.0000	218.6902	0.0000	263.0000	0.0000	206.1207
CRFALhfl	0.0000	226.3640	0.0000	243.4778	0.0000	287.1510	0.0000	225.8616
FCOSTS	39468.363	0.0000	55233.418	0.0000	38239.238	0.0000	46649.406	0.0000
EEIQ	1087.7944	0.0000	1988.5598	0.0000	993.8361	0.0000	2640.3831	0.0000
CEIQ	678.3523	0.0000	1245.2963	0.0000	878.4928	0.0000	2048.3811	0.0000
WEIQ	401.0937	0.0000	778.4573	0.0000	664.8036	0.0000	1329.0339	0.0000
TPest	14.1652	0.0000	25.7339	0.0000	14.2109	0.0000	36.7160	0.0000
Herb	14.1652	0.0000	25.7339	0.0000	12.8121	0.0000	32.3287	0.0000
Insecticide	0.0000	0.0000	0.0000	0.0000	0.1045	0.0000	0.2057	0.0000
Fungicide	0.0000	0.0000	0.0000	0.0000	1.3274	0.0000	4.1130	0.0000
Growth	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STBO	13783.311	0.0000	13521.005	0.0000	4062.0747	0.0000	0.0000	0.1329
LOSS	31427.474	0.0000	55579.523	0.0000	33724.753	0.0000	48688.125	0.0000
TOTLAB	0.0000	0.0000	6721.2012	0.0000	4366.2524	0.0000	3462.6255	0.0000
SOILIND	538.1992	0.0000	672.8094	0.0000	495.5529	0.0000	742.6465	0.0000
LSU	149.4196	0.0000	208.2688	0.0000	123.5039	0.0000	142.7415	0.0000
MAIZEFOD	0.0000	0.0023	15803.048	0.0000	3516.7715	0.0000	0.0000	0.0000
FOD	47881.339	0.0000	63212.195	0.0000	14067.085	0.0000	0.0000	0.0118
AW	1200.0051	0.0000	1987.0914	0.0000	1022.5097	0.0000	1995.9006	0.0000
BSP	45.1288	0.0000	90.0000	0.0000	80.4136	0.0000	66.4570	0.0000
BSPFULL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix 38. Calculating Output, Income and Employment Multipliers

Appendix 38.a. Output Multipliers

Type I and type II output multipliers are derived from the Leontief inverse, by summing the r_{ij}'s down each column. Thus a type I Output Multiplier is simply:

$$\text{Type I Output Multiplier for Sector } j = \sum_{i=1}^{n} r_{ij} \qquad \text{(A44.1.)}$$

As described in the previous section, moving the household rows and columns into the transactions matrix and treating them as another industrial sector the induced effects of increased household spending as well as direct and indirect effects can be calculated from the inverse of this matrix ($I-A^*$). Thus the type II output multipliers may be obtained from summing the columns of $(I-A^*)^{-1}$.

$$\text{Type II Output Multiplier for Sector } j = \sum_{i=1}^{n} r_{ij}^* \qquad \text{(A44.2.)}$$

Thus a type II output multiplier of 1.6 for agriculture would imply that for every £1000 increase in agricultural output, the total indirect and induced effects on output in other sectors of the economy would be £600.

Appendix 38.b. Income Multipliers

The effect on a sectors income of a change in output can be directly estimated from the regional input-output table. This is given by the payments to households, expressed as a proportion of sector output, known as the Direct Income Co-efficient (DIC).

$$\text{DIC for sector } j = {}^{H_j}\!/_{X_j} \qquad \text{(A44.3.)}$$

Where H_j is income from employment in sector j and X_j is the output of sector j. A direct income co-efficient of 0.43 would entail that wages and salaries would represent 43% of a sectors total input. Thus, a £1000 increase in output would lead to a £430 increase in regional incomes. Increased output in one sector will lead to increased output in sectors supplying it, and this will also lead to indirect increases in incomes in these sectors. The direct plus indirect incomes co-efficient may be obtained as follows:

$$\text{DIIC for sector } j = \sum_{i=1}^{n} r_{ij} DIC_i \qquad \text{(A44.4.)}$$

Thus for each sector i supplying sector j, the direct and indirect output required from sector i for a unit increase in final demand of sector j (r_{ij}) is derived by multiplying r_{ij} by the direct

income co-efficient (DIC_j), and summing over all producing sectors. The type I income multiplier thus measures the relationship between indirect and direct income effects so:

$$\text{Type I Income Multiplier for sector } j = {}^{DIIC_j}\!/_{DIC_j} \qquad \text{(A44.5.)}$$

As with the calculation of the output multipliers, the induced effects on incomes may be obtained by closing the input-output model and moving the household rows and columns into the transaction matrix. Thus the total effect on incomes (direct, indirect and induced) of a pound increase in output from sector j ($DIIIC_j$) is given as:

$$DIIIC \text{ for sector } j = r^{*}_{hj} \qquad \text{(A44.6.)}$$

Where r^{*}_{hj} is the appropriate element in the households row of the $(I-A^{*})^{-1}$ matrix. The type II income multiplier showing the relationship between the indirect plus induced and the direct effect would be calculated as follows:

$$\text{Type II Income Multiplier for sector } j = {}^{DIIIC_j}\!/_{DIC_j} \qquad \text{(A44.7.)}$$

For example a type II income multiplier of 1.4 for agriculture would mean that for every £1000 increase in farm income, there would be a further £400 increase indirectly through increased incomes in sectors supplying agriculture, and induced through increased household spending in these sectors.

Appendix 38.c. Employment Multipliers

The effects on employment arising from changes in output may be calculated in a similar fashion to incomes. The direct effect of a change in output upon employment in sector j (DEC_j) can be estimated from:

$$DEC_j = {}^{E_j}\!/_{X_j} \qquad \text{(A44.8.)}$$

where E_j is employment in sector j and X_j is output from sector j. A value of 26 for example will mean that for each £1 million increase in output for sector j, 26 jobs will be directly generated. To estimate the direct and indirect effects, the DEC_j is multiplied by the appropriate element of the $(I-A)^{-1}$ matrix which shows the direct and indirect requirements from industries in response to a unit change in final demand, which are then summed. Therefore:

$$DIEC_j = \sum_{i=1}^{n} r_{ij} DEC_i \qquad \text{(A44.9.)}$$

The type I employment multiplier may then be calculated as :

$$\text{Type I Employment Multiplier for Sector } j = DIEC_j / DEC_j \qquad \text{(A44.10.)}$$

To calculate the total effects upon employment, the direct, indirect and induced employment effect for sector j would be calculated as follows:

$$DIIEC_j = \sum_{i=1}^{n} r_{ij}^{*} DEC_i \qquad \text{(A44.11.)}$$

Thus the direct employment co-efficients (DEC_i) are multiplied by the appropriate elements of the $(I-A^{*})^{-1}$ index and summed over all supplying sectors. The type II employment multipliers therefore relate the total effect to the simple direct effect on employment for an increase in sector output:

$$\text{Type II Employment Multiplier for Sector } j = DIIEC_j / DEC_j \qquad \text{(A44.12.)}$$

Thus a type II employment multiplier for sector j of 2 would mean that for every job created in sector j, 1 other FTE would be created through indirect effects on sectors supplying its inputs and through increased household spending in these sectors.

Appendix 39. Deriving the Regional Matrices

Richardson (1972) describes the conversion of national to regional input output tables. The GRIT procedure involves correcting the co-efficients in the national table to account for the relative importance of each industry in a region. Two methods may be used namely the location quotient (LQ) method and the cross-industry location quotient (CILQ) method. They are most frequently calculated using employment data. Thus, for industry i and employment based LQ is defined as:

$$LQ_i = \frac{E_i^r \Big/ \sum_{i=1}^{n} E_i^r}{E_i^N \Big/ \sum_{i=1}^{n} E_i^N} \qquad \text{(A43.1.)}$$

Where E is the employment level, i denotes industry (i.....n), r is the region, N denotes the nation. The corresponding formula for an employment based CILQ is:

$$CILQ_{ij} = \frac{E_i^r / E_i^N}{E_j^i / E_j^N} \qquad \text{(A43.2.)}$$

The LQ method assumes that the regional demand and consumption patterns are the same as national patterns, and that there is no cross haulage of goods. These assumptions are relaxed in the CILQ method, and thus it is considered more appropriate. The direct co-efficients and import co-efficients used in the study will therefore depend on the value of the CILQ, and are calculated as shown in Table A. 39.18.

Table A. 39.18. The calculation of the direct coefficients and import coefficients for each region

Quotient Value (Q)	Direct Coefficient	Import Coefficient
0	0	National $a_{i,j}$ + National import coefficient
$0 < Q < 1$	$a_{i,j} * Q_{i,j}$	$a_{i,j} * (1 - Q_{i,j})$ + National import coefficient
≥ 1	National a_{ij}	National import co-efficient

The regional transaction matrix may be obtained by multiplying the direct co-efficients obtained by the regional output vector. The regional output for each industry is calculated using the following formula:

$$O_i^r = \frac{E_i^r}{E_i^N} O_i^N \qquad \text{(A43.3.)}$$

The LQ may be used to obtain the output passing into house hold consumption, if the LQ is more or equal to one, then local output, meets all local consumption, and the regional matrix would be the same as the national matrix. However, if the LQ is less than one, then the regional household coefficient is calculated by multiplying the national household coefficient by the LQ. The national other final demand element is multiplied by the LQ in order to obtain a value for the regional table.

Appendix 40. The National 'A' Matrix

National 'A' Matrix	Agriculture	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Agriculture	0.033297	0.000000	0.033412	0.000033	0.003950	0.000462	0.000000	0.000558	0.013530
Energy	0.003998	0.353118	0.019832	0.006637	0.019676	0.032333	0.011170	0.004397	0.044497
Manufacturing	0.376164	0.046058	0.223554	0.166047	0.098542	0.061896	0.053665	0.021607	0.119850
Construction	0.068918	0.000000	0.002917	0.255513	0.005601	0.001847	0.011072	0.006330	0.015524
Distribution	0.000000	0.019403	0.044889	0.032086	0.032705	0.038955	0.015139	0.004702	0.254044
Transport	0.000000	0.019928	0.026743	0.009389	0.095477	0.116736	0.064908	0.008256	0.041274
Business Services	0.053846	0.026210	0.080097	0.099977	0.135212	0.105843	0.300125	0.071461	0.061256
Other services	0.053846	0.005264	0.012975	0.004473	0.008239	0.013692	0.020295	0.038392	0.186224
Household	0.131828	0.125928	0.257390	0.185381	0.372879	0.331164	0.323200	0.561750	0.000000
Imports	0.232366	0.226712	0.107608	0.187823	0.141306	0.236113	0.141140	0.268399	0.171196

Appendix 41. Regional Employment Figures By Industry (Thousands)

Employment '000s	Agriculture	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Total
Northern England	6	9	195	52	194	45	109	306	916
North West	24	18	530	123	624	149	401	755	2624
Yorkshire & Humberside	23	20	419	98	437	108	284	566	1955
East Midlands	30	17	426	80	364	87	229	436	1669
West Midlands	26	22	563	92	469	109	329	574	2184
Eastern England	46	17	354	104	502	135	383	539	2080
London	4	11	282	116	814	278	1157	958	3620
South East	54	23	463	148	795	205	734	935	3357
South West	40	19	317	90	465	94	304	585	1914
Wales	19	8	220	51	217	41	116	336	1008
Scotland NW	5	2	9	8	17	7	9	47	104
Scotland SW	13	10	150	54	132	55	123	338	875
Scotland NE	11	20	59	32	65	23	61	125	396
Scotland SE	9	9	98	31	89	29	96	221	582
Northern Ireland	16	6	108	29	102	24	14	318	617
UK	326	210	4192	1107	5283	1390	4348	7040	23896

Appendix 42. Conventional and Sustainable Regional LQ (Location Quotients)

Appendix 42.a. Conventional LQ

LQ	Agriculture	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services
Northern England	0.5143	1.1414	1.2108	1.2323	0.9563	0.8446	0.6553	1.1326
North West England	0.6593	0.7966	1.1502	1.0131	1.0754	0.9795	0.8400	0.9766
Yorkshire & Humberside	0.8817	1.1414	1.2222	1.0810	1.0107	0.9480	0.7985	0.9829
East Midlands	1.3212	1.1402	1.4549	1.0367	0.9870	0.8954	0.7537	0.8868
West Midlands	0.8791	1.1380	1.4691	0.9053	0.9715	0.8592	0.8290	0.8918
Eastern England	1.6148	0.9122	0.9700	1.0799	1.0911	1.1192	1.0122	0.8800
London	0.0733	0.3414	0.4441	0.6898	1.0167	1.3232	1.7569	0.8986
South East of England	1.1721	0.7966	0.7858	0.9484	1.0709	1.0482	1.2024	0.9461
South West of England	1.5383	1.1380	0.9452	1.0131	1.0980	0.8420	0.8729	1.0376
Wales	1.3918	0.9104	1.2413	1.0993	0.9715	0.7046	0.6314	1.1326
Scotland NW	3.5980	1.6768	0.5090	1.5881	0.7324	1.1648	0.4584	1.5622
Scotland SW	1.0477	1.2890	0.9792	1.3367	0.6840	1.0794	0.7695	1.3125
Scotland NE	2.0168	5.6912	0.8515	1.7531	0.7464	1.0070	0.8390	1.0715
Scotland SE	1.1851	1.7235	0.9634	1.1426	0.6883	0.8548	0.9062	1.2898
Northern Ireland	1.9015	1.1077	0.9977	1.0141	0.7477	0.6691	0.1247	1.7494

Appendix 42.b. Sustainable LQ

LQ	Agriculture	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services
Northern England	0.5143	1.1414	1.2108	1.2323	0.9563	0.8446	0.6553	1.1326
North West England	0.6593	0.7966	1.1502	1.0131	1.0754	0.9795	0.8400	0.9766
Yorkshire & Humberside	0.8817	1.1414	1.2222	1.0810	1.0107	0.9480	0.7985	0.9829
East Midlands	1.3212	1.1402	1.4549	1.0367	0.9870	0.8954	0.7537	0.8868
West Midlands	0.8791	1.1380	1.4691	0.9053	0.9715	0.8592	0.8290	0.8918
Eastern England	1.6148	0.9122	0.9700	1.0799	1.0911	1.1192	1.0122	0.8800
London	0.0733	0.3414	0.4441	0.6898	1.0167	1.3232	1.7569	0.8986
South East of England	1.1721	0.7966	0.7858	0.9484	1.0709	1.0482	1.2024	0.9461
South West of England	1.5383	1.1380	0.9452	1.0131	1.0980	0.8420	0.8729	1.0376
Wales	1.3918	0.9104	1.2413	1.0993	0.9715	0.7046	0.6314	1.1326
Scotland NW	3.5980	1.6768	0.5090	1.5881	0.7324	1.1648	0.4584	1.5622
Scotland SW	1.0477	1.2890	0.9792	1.3367	0.6840	1.0794	0.7695	1.3125
Scotland NE	2.0168	5.6912	0.8515	1.7531	0.7464	1.0070	0.8390	1.0715
Scotland SE	1.1851	1.7235	0.9634	1.1426	0.6883	0.8548	0.9062	1.2898
Northern Ireland	1.9015	1.1077	0.9977	1.0141	0.7477	0.6691	0.1247	1.7494

Appendix 43. The Regional 'A' Matrices
Appendix 43.a. The Conventional Scenario 'A Matrices'

Northern England	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00761	0.00634	0.01322	0.01830	0.11115	0.05958	0.00000	0.00202	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00761	0.00634	0.00294	0.00185	0.00000	0.00051	0.00000	0.00261	0.00000	0.00031	0.00004	0.00000	0.00004	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00696	0.00001	0.00082	0.00010	0.00000	0.00012	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00424	0.00000	0.00050	0.00006	0.00000	0.00007	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01677	0.00002	0.00198	0.00023	0.00000	0.00028	0.00679
Energy	0.05968	0.02020	0.02564	0.01580	0.00000	0.00933	0.35312	0.01869	0.00615	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.43677	0.19878	0.24306	0.15334	0.11391	0.12640	0.04606	0.22355	0.16315	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.01010	0.00622	0.02069	0.02048	0.00400	0.01111	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01626	0.03545	0.02490	0.03270	0.03896	0.01514	0.00397	0.24294
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01475	0.01865	0.00644	0.08432	0.11674	0.06491	0.00616	0.03486
Business Services	0.04658	0.02539	0.00545	0.00094	0.00000	0.01270	0.01505	0.04335	0.05316	0.09266	0.08212	0.30012	0.04135	0.04014
Other services	0.04658	0.02539	0.00545	0.00094	0.00000	0.01270	0.00522	0.01214	0.00411	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.11147	0.08764	0.13832	0.14140	0.01984	0.08139	0.12593	0.25739	0.18538	0.35657	0.27969	0.21179	0.56175	0.00000

Yorkshire & Humberside	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00815	0.00600	0.00935	0.01261	0.11115	0.05927	0.00000	0.00145	0.00000	0.00021	0.00003	0.00000	0.00003	0.00072
Other Crops	0.00815	0.00600	0.00220	0.00125	0.00000	0.00058	0.00000	0.00188	0.00000	0.00027	0.00003	0.00000	0.00004	0.00093
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00502	0.00001	0.00072	0.00009	0.00000	0.00010	0.00248
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00306	0.00000	0.00044	0.00005	0.00000	0.00006	0.00151
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00059	0.00000	0.00008	0.00001	0.00000	0.00001	0.00029
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01210	0.00001	0.00173	0.00022	0.00000	0.00025	0.00599
Energy	0.05476	0.01855	0.01856	0.01115	0.00000	0.00853	0.35312	0.01852	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.41954	0.20610	0.18524	0.11509	0.11391	0.12929	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.00925	0.00653	0.01304	0.01698	0.00400	0.01214	0.00000	0.00258	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01718	0.03712	0.03000	0.03270	0.03896	0.01514	0.00470	0.25404
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01655	0.02074	0.00823	0.08956	0.11674	0.06491	0.00796	0.03913
Business Services	0.03451	0.02570	0.01032	0.00227	0.00000	0.01015	0.01834	0.05233	0.07385	0.10683	0.08915	0.30012	0.05805	0.04891
Other services	0.03451	0.02570	0.01032	0.00227	0.00000	0.01015	0.00453	0.01043	0.00407	0.00801	0.01369	0.02029	0.03839	0.18304
Household	0.09618	0.08615	0.12660	0.17287	0.01984	0.09492	0.12593	0.25739	0.18538	0.37288	0.31394	0.25807	0.55216	0.00000

North West of England	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00703	0.00598	0.01683	0.02005	0.09505	0.04908	0.00000	0.00116	0.00000	0.00015	0.00002	0.00000	0.00002	0.00054
Other Crops	0.00703	0.00598	0.00252	0.00160	0.00000	0.00059	0.00000	0.00150	0.00000	0.00019	0.00002	0.00000	0.00003	0.00070
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00399	0.00000	0.00050	0.00006	0.00000	0.00008	0.00186
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00243	0.00000	0.00031	0.00004	0.00000	0.00005	0.00113
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00047	0.00000	0.00006	0.00001	0.00000	0.00001	0.00022
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00961	0.00001	0.00122	0.00016	0.00000	0.00019	0.00448
Energy	0.06077	0.02027	0.02351	0.01395	0.00000	0.00635	0.35312	0.01373	0.00522	0.01457	0.02629	0.01059	0.00359	0.03545
Manufacturing	0.43384	0.20263	0.23090	0.14515	0.09709	0.10946	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.01027	0.00643	0.01743	0.02511	0.00543	0.01108	0.00000	0.00257	0.25551	0.00528	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01940	0.04197	0.03209	0.03270	0.03896	0.01514	0.00470	0.25404
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01993	0.02277	0.00908	0.08696	0.11674	0.06491	0.00826	0.04043
Business Services	0.03822	0.02621	0.00635	0.00113	0.00000	0.01013	0.02621	0.05849	0.08290	0.10561	0.09077	0.30012	0.06147	0.05146
Other services	0.03822	0.02621	0.00635	0.00113	0.00000	0.01013	0.00526	0.01102	0.00431	0.00748	0.01365	0.02029	0.03839	0.18186
Household	0.11877	0.08585	0.15602	0.14255	0.03279	0.09205	0.10031	0.25739	0.18538	0.37288	0.32438	0.27149	0.54860	0.00000

East Midlands	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00832	0.00585	0.00855	0.00394	0.09505	0.04588	0.00000	0.00183	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00832	0.00585	0.00193	0.00071	0.00000	0.00065	0.00000	0.00237	0.00000	0.00031	0.00004	0.00000	0.00004	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00632	0.00001	0.00082	0.00010	0.00000	0.00012	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00385	0.00000	0.00050	0.00006	0.00000	0.00007	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00074	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01523	0.00002	0.00198	0.00023	0.00000	0.00028	0.00679
Energy	0.05389	0.02051	0.01661	0.00628	0.00000	0.00671	0.35312	0.01554	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.41543	0.21099	0.17352	0.07053	0.09709	0.11509	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.00910	0.00666	0.00989	0.00733	0.00543	0.01954	0.00000	0.00208	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01680	0.03045	0.03055	0.03270	0.03896	0.01514	0.00470	0.25074
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01565	0.01646	0.00811	0.08661	0.11674	0.06491	0.00826	0.03696
Business Services	0.03230	0.02702	0.01257	0.00409	0.00000	0.01024	0.01732	0.04149	0.07268	0.10325	0.08909	0.30012	0.06073	0.04617
Other services	0.03230	0.02702	0.01257	0.00409	0.00000	0.01024	0.00409	0.00791	0.00383	0.00740	0.01356	0.02029	0.03839	0.16514
Household	0.09560	0.08448	0.13143	0.15285	0.03279	0.11113	0.12593	0.25739	0.18538	0.36804	0.29652	0.24359	0.49816	0.00000

Eastern England	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00441	0.00308	0.00628	0.00130	0.08654	0.04422	0.00000	0.00202	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00441	0.00308	0.00145	0.00031	0.00000	0.00072	0.00000	0.00261	0.00000	0.00031	0.00004	0.00000	0.00004	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00696	0.00001	0.00082	0.00010	0.00000	0.00012	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00424	0.00000	0.00050	0.00006	0.00000	0.00007	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01677	0.00002	0.00198	0.00023	0.00000	0.00028	0.00679
Energy	0.05469	0.01358	0.01573	0.00336	0.00000	0.00719	0.35312	0.01554	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.41015	0.08369	0.17708	0.04852	0.08852	0.12344	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.00924	0.00220	0.01018	0.02034	0.00535	0.02969	0.00000	0.00208	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01680	0.03045	0.03055	0.03270	0.03896	0.01514	0.00470	0.25074
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01565	0.01646	0.00811	0.08661	0.11674	0.06491	0.00826	0.03696
Business Services	0.03298	0.00869	0.01708	0.00391	0.00000	0.01658	0.01732	0.04149	0.07268	0.10325	0.08909	0.30012	0.06073	0.04617
Other services	0.03298	0.00869	0.01708	0.00391	0.00000	0.01658	0.00409	0.00791	0.00383	0.00740	0.01356	0.02029	0.03839	0.16514
Household	0.11801	0.04810	0.14792	0.19866	0.02905	0.12559	0.12593	0.25739	0.18538	0.36804	0.29652	0.24359	0.49816	0.00000

South East of England	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00448	0.00340	0.00675	0.00145	0.08654	0.04422	0.00000	0.00202	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00448	0.00340	0.00185	0.00038	0.00000	0.00072	0.00000	0.00261	0.00000	0.00031	0.00004	0.00000	0.00004	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00696	0.00001	0.00082	0.00010	0.00000	0.00012	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00424	0.00000	0.00050	0.00006	0.00000	0.00007	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01677	0.00002	0.00198	0.00023	0.00000	0.00028	0.00679
Energy	0.05588	0.01586	0.01919	0.00396	0.00000	0.00719	0.35312	0.01554	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.41524	0.09640	0.20779	0.05205	0.08852	0.12344	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.00944	0.00261	0.01205	0.01522	0.00535	0.02969	0.00000	0.00208	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01680	0.03045	0.03055	0.03270	0.03896	0.01514	0.00470	0.25074
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01565	0.01646	0.00811	0.08661	0.11674	0.06491	0.00826	0.03696
Business Services	0.03430	0.01119	0.01430	0.00340	0.00000	0.01658	0.01732	0.04149	0.07268	0.10325	0.08909	0.30012	0.06073	0.04617
Other services	0.03430	0.01119	0.01430	0.00340	0.00000	0.01658	0.00409	0.00791	0.00383	0.00740	0.01356	0.02029	0.03839	0.16514
Household	0.12009	0.05260	0.15208	0.18075	0.02905	0.12559	0.12593	0.25739	0.18538	0.36804	0.29652	0.24359	0.49816	0.00000

South West of England	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00703	0.00431	0.01558	0.00581	0.08654	0.05774	0.00000	0.00202	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00703	0.00431	0.00246	0.00078	0.00000	0.00053	0.00000	0.00261	0.00000	0.00031	0.00004	0.00000	0.00004	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00696	0.00001	0.00082	0.00010	0.00000	0.00012	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00424	0.00000	0.00050	0.00006	0.00000	0.00007	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01677	0.00002	0.00198	0.00023	0.00000	0.00028	0.00679
Energy	0.05334	0.02719	0.02242	0.00692	0.00000	0.00890	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.39848	0.10396	0.23335	0.07459	0.08852	0.12395	0.03826	0.22355	0.15493	0.08483	0.06190	0.05366	0.01968	0.11329
Construction	0.00901	0.00287	0.01899	0.00830	0.00535	0.01164	0.00000	0.00292	0.25551	0.00517	0.00185	0.01107	0.00618	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01872	0.04489	0.03209	0.03270	0.03896	0.01514	0.00470	0.25404
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01475	0.02382	0.00780	0.07322	0.11674	0.06261	0.00670	0.03475
Business Services	0.03306	0.01239	0.00671	0.00123	0.00000	0.01191	0.02011	0.07397	0.08615	0.10750	0.10584	0.30012	0.06012	0.05347
Other services	0.03306	0.01239	0.00671	0.00123	0.00000	0.01191	0.00480	0.01298	0.00447	0.00779	0.01369	0.02029	0.03839	0.18622
Household	0.09334	0.04809	0.18257	0.18534	0.02905	0.08539	0.12593	0.24329	0.18538	0.37288	0.27885	0.28214	0.56175	0.00000

West Midlands	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00713	0.00401	0.01321	0.00175	0.09505	0.04606	0.00000	0.00121	0.00000	0.00022	0.00003	0.00000	0.00003	0.00072
Other Crops	0.00713	0.00401	0.00246	0.00052	0.00000	0.00065	0.00000	0.00156	0.00000	0.00028	0.00004	0.00000	0.00004	0.00093
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00416	0.00001	0.00074	0.00010	0.00000	0.00011	0.00248
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00254	0.00000	0.00045	0.00006	0.00000	0.00007	0.00151
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00049	0.00000	0.00009	0.00001	0.00000	0.00001	0.00029
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01003	0.00002	0.00179	0.00023	0.00000	0.00028	0.00597
Energy	0.05250	0.03040	0.02474	0.00518	0.00000	0.00666	0.35312	0.01536	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.39825	0.10932	0.25686	0.05920	0.09709	0.11421	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.00887	0.00298	0.01613	0.00484	0.00543	0.01847	0.00000	0.00180	0.25551	0.00522	0.00185	0.01107	0.00633	0.01405
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01656	0.02968	0.03209	0.03270	0.03896	0.01514	0.00470	0.24680
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01505	0.01564	0.00891	0.08444	0.11674	0.06491	0.00795	0.03546
Business Services	0.03056	0.01431	0.00820	0.00236	0.00000	0.00957	0.01909	0.04520	0.09155	0.11538	0.10212	0.30012	0.06643	0.05078
Other services	0.03056	0.01431	0.00820	0.00236	0.00000	0.00957	0.00413	0.00788	0.00441	0.00756	0.01369	0.02029	0.03839	0.16608
Household	0.08920	0.04566	0.19037	0.14445	0.03279	0.10960	0.12593	0.25739	0.16783	0.36225	0.28454	0.26794	0.50098	0.00000

Scotland NW	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00647	0.00561	0.01155	0.00657	0.11115	0.04607	0.00000	0.00202	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00647	0.00561	0.00299	0.00152	0.00000	0.00071	0.00000	0.00261	0.00000	0.00031	0.00004	0.00000	0.00004	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00696	0.00001	0.00082	0.00010	0.00000	0.00012	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00424	0.00000	0.00050	0.00006	0.00000	0.00007	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01677	0.00002	0.00198	0.00023	0.00000	0.00028	0.00679
Energy	0.06443	0.02800	0.02883	0.01336	0.00000	0.00664	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.44347	0.14632	0.25695	0.12307	0.11391	0.11764	0.01398	0.22355	0.05322	0.06849	0.02705	0.05366	0.00704	0.06101
Construction	0.01093	0.00441	0.02918	0.00897	0.00400	0.02822	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00847	0.04489	0.01480	0.03270	0.02449	0.01514	0.00220	0.18606
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01384	0.02674	0.00689	0.09548	0.11674	0.06491	0.00616	0.04127
Business Services	0.05158	0.02148	0.00338	0.00095	0.00000	0.01559	0.00717	0.07214	0.02886	0.08463	0.04166	0.30012	0.02097	0.02808
Other services	0.05158	0.02148	0.00338	0.00095	0.00000	0.01559	0.00490	0.01298	0.00440	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.12489	0.07495	0.12051	0.14375	0.01984	0.14238	0.12593	0.13102	0.18538	0.27309	0.33116	0.14816	0.56175	0.00000

Scotland NE	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00724	0.00357	0.01136	0.00622	0.11115	0.04760	0.00000	0.00202	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00724	0.00357	0.00291	0.00145	0.00000	0.00070	0.00000	0.00261	0.00000	0.00031	0.00004	0.00000	0.00004	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00696	0.00001	0.00082	0.00010	0.00000	0.00012	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00424	0.00000	0.00050	0.00006	0.00000	0.00007	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01677	0.00002	0.00198	0.00023	0.00000	0.00028	0.00679
Energy	0.05050	0.02792	0.02797	0.01305	0.00000	0.00667	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.39287	0.08355	0.25193	0.12025	0.11391	0.11882	0.00689	0.22355	0.08065	0.09854	0.05234	0.05366	0.01717	0.10205
Construction	0.00854	0.00216	0.02768	0.00914	0.00400	0.02634	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00254	0.03935	0.01366	0.03270	0.02887	0.01347	0.00328	0.18962
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00353	0.02674	0.00539	0.09548	0.11674	0.06491	0.00776	0.04127
Business Services	0.03108	0.00919	0.00408	0.00104	0.00000	0.01439	0.00386	0.07892	0.04785	0.13521	0.08818	0.30012	0.05596	0.05139
Other services	0.03108	0.00919	0.00408	0.00104	0.00000	0.01439	0.00099	0.01298	0.00273	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.08003	0.03588	0.12495	0.15672	0.01984	0.13928	0.12593	0.21916	0.18538	0.27833	0.33116	0.27116	0.56175	0.00000

Scotland SW	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00656	0.00487	0.01501	0.00893	0.11115	0.05759	0.00000	0.00202	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00656	0.00487	0.00301	0.00198	0.00000	0.00067	0.00000	0.00261	0.00000	0.00031	0.00003	0.00000	0.00003	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00696	0.00001	0.00082	0.00009	0.00000	0.00009	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00424	0.00000	0.00050	0.00006	0.00000	0.00006	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01677	0.00001	0.00198	0.00022	0.00000	0.00022	0.00679
Energy	0.06095	0.02799	0.02959	0.01730	0.00000	0.00688	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.43148	0.12377	0.26499	0.15581	0.11391	0.12650	0.00689	0.22355	0.08065	0.09854	0.05234	0.05366	0.01717	0.10205
Construction	0.01036	0.00359	0.03164	0.01226	0.00400	0.01410	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00254	0.03935	0.01366	0.03270	0.02887	0.01347	0.00328	0.18962
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00353	0.02674	0.00539	0.09548	0.11674	0.06491	0.00776	0.04127
Business Services	0.04364	0.01702	0.00189	0.00073	0.00000	0.00657	0.00386	0.07892	0.04785	0.13521	0.08818	0.30012	0.05596	0.05139
Other services	0.04364	0.01702	0.00189	0.00073	0.00000	0.00657	0.00099	0.01298	0.00273	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.11191	0.06080	0.13695	0.11517	0.01984	0.11909	0.12593	0.21916	0.18538	0.27833	0.33116	0.27116	0.56175	0.00000

Scotland SE	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00741	0.00334	0.01229	0.00773	0.11115	0.05076	0.00000	0.00202	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00741	0.00334	0.00298	0.00175	0.00000	0.00069	0.00000	0.00261	0.00000	0.00031	0.00004	0.00000	0.00004	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00696	0.00001	0.00082	0.00010	0.00000	0.00011	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00424	0.00000	0.00050	0.00006	0.00000	0.00007	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01677	0.00002	0.00198	0.00023	0.00000	0.00026	0.00679
Energy	0.04861	0.02786	0.02882	0.01536	0.00000	0.00674	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.38462	0.07611	0.25637	0.13958	0.11391	0.12125	0.02574	0.22355	0.14000	0.09854	0.06190	0.05366	0.01614	0.11546
Construction	0.00822	0.00191	0.03001	0.01073	0.00400	0.02247	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00561	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00775	0.03207	0.01933	0.03270	0.03137	0.01150	0.00251	0.17485
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00988	0.02373	0.00702	0.09548	0.11674	0.06122	0.00547	0.03528
Business Services	0.03024	0.00784	0.00316	0.00086	0.00000	0.01192	0.01378	0.07534	0.07929	0.13521	0.10584	0.30012	0.05021	0.05551
Other services	0.03024	0.00784	0.00316	0.00086	0.00000	0.01192	0.00394	0.01298	0.00447	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.07583	0.03150	0.11714	0.13177	0.01984	0.13289	0.12593	0.24796	0.18538	0.25664	0.28306	0.29288	0.56175	0.00000

Northern Ireland	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00615	0.00474	0.01309	0.01906	0.11115	0.06348	0.00000	0.00202	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00615	0.00474	0.00276	0.00141	0.00000	0.00055	0.00000	0.00261	0.00000	0.00031	0.00003	0.00000	0.00003	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00696	0.00001	0.00082	0.00009	0.00000	0.00009	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00424	0.00000	0.00050	0.00006	0.00000	0.00006	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01677	0.00001	0.00198	0.00022	0.00000	0.00022	0.00679
Energy	0.06371	0.02974	0.02428	0.01195	0.00000	0.00594	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00278	0.04450
Manufacturing	0.43255	0.13027	0.24379	0.13204	0.11391	0.12111	0.04148	0.22355	0.16336	0.09854	0.06190	0.05366	0.01232	0.11958
Construction	0.01076	0.00361	0.02657	0.02633	0.00400	0.00970	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00367	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01310	0.03364	0.02366	0.03270	0.03896	0.01514	0.00201	0.18996
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01204	0.01794	0.00620	0.08544	0.11674	0.06491	0.00316	0.02762
Business Services	0.03283	0.01787	0.00347	0.00069	0.00000	0.00405	0.00295	0.01001	0.01229	0.02255	0.01973	0.30012	0.00509	0.00764
Other services	0.03283	0.01787	0.00347	0.00069	0.00000	0.00405	0.00526	0.01298	0.00447	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.12014	0.06054	0.17512	0.15040	0.01984	0.09851	0.12593	0.25680	0.18538	0.27881	0.22158	0.04030	0.56175	0.00000

Wales	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00512	0.00563	0.01512	0.02446	0.08654	0.06183	0.00000	0.00202	0.00000	0.00024	0.00003	0.00000	0.00003	0.00082
Other Crops	0.00512	0.00563	0.00292	0.00194	0.00000	0.00057	0.00000	0.00261	0.00000	0.00031	0.00004	0.00000	0.00004	0.00106
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00696	0.00001	0.00082	0.00010	0.00000	0.00012	0.00282
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00424	0.00000	0.00050	0.00006	0.00000	0.00007	0.00172
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00082	0.00000	0.00010	0.00001	0.00000	0.00001	0.00033
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01677	0.00002	0.00198	0.00023	0.00000	0.00028	0.00679
Energy	0.06743	0.02923	0.02489	0.01584	0.00000	0.00600	0.35312	0.01454	0.00550	0.01844	0.03233	0.01117	0.00353	0.04051
Manufacturing	0.43237	0.15729	0.24891	0.16774	0.08852	0.12071	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.01140	0.00468	0.02643	0.03195	0.00535	0.01147	0.00000	0.00258	0.25551	0.00560	0.00185	0.01107	0.00614	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01940	0.03513	0.02836	0.03270	0.03896	0.01514	0.00403	0.24680
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01542	0.01518	0.00602	0.06924	0.11674	0.06491	0.00514	0.02908
Business Services	0.04482	0.02286	0.00244	0.00042	0.00000	0.00516	0.01818	0.04074	0.05742	0.08788	0.09485	0.30012	0.03984	0.03868
Other services	0.04482	0.02286	0.00244	0.00042	0.00000	0.00516	0.00526	0.01184	0.00447	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.14112	0.07764	0.15825	0.13359	0.02905	0.10259	0.11464	0.25739	0.18538	0.36225	0.23333	0.20406	0.56175	0.00000

Appendix 43.b. The Sustainable Scenario 'A' Matrices

Northern England	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00449	0.00255	0.01829	0.02296	0.04517	0.05469	0.00000	0.00090	0.00000	0.00013	0.00002	0.00000	0.00002	0.00044
Other Crops	0.00449	0.00255	0.00331	0.00209	0.00000	0.00063	0.00000	0.00117	0.00000	0.00017	0.00002	0.00000	0.00002	0.00057
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00313	0.00000	0.00047	0.00006	0.00000	0.00006	0.00154
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00188	0.00000	0.00028	0.00004	0.00000	0.00003	0.00092
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00036	0.00000	0.00005	0.00001	0.00000	0.00001	0.00018
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00675	0.00001	0.00101	0.00013	0.00000	0.00012	0.00331
Energy	0.04829	0.03504	0.02362	0.01453	0.00000	0.00758	0.35312	0.01869	0.00615	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.30271	0.08683	0.19106	0.13041	0.04753	0.11141	0.04606	0.22355	0.16315	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.00929	0.00301	0.00886	0.02224	0.00660	0.01191	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01626	0.03545	0.02490	0.03270	0.03896	0.01514	0.00397	0.24294
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01475	0.01865	0.00644	0.08432	0.11674	0.06491	0.00616	0.03486
Business Services	0.04066	0.01427	0.00163	0.00195	0.00000	0.02116	0.01505	0.04335	0.05316	0.09266	0.08212	0.30012	0.04135	0.04014
Other services	0.04066	0.01427	0.00163	0.00195	0.00000	0.02116	0.00522	0.01214	0.00411	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.08215	0.03950	0.09461	0.11210	0.03279	0.10503	0.12593	0.25739	0.18538	0.35657	0.27969	0.21179	0.56175	0.00000

Yorkshire and Humberside	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00413	0.00195	0.01333	0.01406	0.04517	0.04617	0.00000	0.00153	0.00000	0.00022	0.00003	0.00000	0.00003	0.00076
Other Crops	0.00413	0.00195	0.00242	0.00124	0.00000	0.00111	0.00000	0.00198	0.00000	0.00028	0.00004	0.00000	0.00004	0.00098
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00532	0.00001	0.00076	0.00009	0.00000	0.00011	0.00263
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00319	0.00000	0.00046	0.00006	0.00000	0.00007	0.00158
Pigs and Poultry	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00062	0.00000	0.00009	0.00001	0.00000	0.00001	0.00031
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01147	0.00001	0.00164	0.00020	0.00000	0.00024	0.00568
Energy	0.04409	0.03607	0.01766	0.01038	0.00000	0.00801	0.35312	0.01852	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.27668	0.06822	0.14243	0.09161	0.04753	0.10902	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.00848	0.00214	0.01044	0.01598	0.00660	0.01103	0.00000	0.00258	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01718	0.03712	0.03000	0.03270	0.03896	0.01514	0.00470	0.25404
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01655	0.02074	0.00823	0.08956	0.11674	0.06491	0.00796	0.03913
Business Services	0.03163	0.00904	0.00191	0.00457	0.00000	0.01144	0.01834	0.05233	0.07385	0.10683	0.08915	0.30012	0.05805	0.04891
Other services	0.03163	0.00904	0.00191	0.00457	0.00000	0.01144	0.00453	0.01043	0.00407	0.00801	0.01369	0.02029	0.03839	0.18304
Household	0.07078	0.02773	0.07988	0.13424	0.03279	0.12873	0.12593	0.25739	0.18538	0.37288	0.31394	0.25807	0.55216	0.00000

North West of England	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00451	0.00293	0.01798	0.02035	0.04511	0.05453	0.00000	0.00121	0.00000	0.00015	0.00002	0.00000	0.00002	0.00056
Other Crops	0.00451	0.00293	0.00326	0.00189	0.00000	0.00095	0.00000	0.00157	0.00000	0.00020	0.00003	0.00000	0.00003	0.00073
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00423	0.00000	0.00053	0.00007	0.00000	0.00008	0.00197
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00253	0.00000	0.00032	0.00004	0.00000	0.00005	0.00118
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00049	0.00000	0.00006	0.00001	0.00000	0.00001	0.00023
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00911	0.00001	0.00115	0.00015	0.00000	0.00018	0.00424
Energy	0.04828	0.03225	0.02278	0.01384	0.00000	0.00772	0.35312	0.01373	0.00522	0.01457	0.02629	0.01059	0.00359	0.03545
Manufacturing	0.30317	0.09801	0.19390	0.12874	0.04747	0.11549	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.00928	0.00359	0.01685	0.02780	0.00659	0.01157	0.00000	0.00257	0.25551	0.00528	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01940	0.04197	0.03209	0.03270	0.03896	0.01514	0.00470	0.25404
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01993	0.02277	0.00908	0.08696	0.11674	0.06491	0.00826	0.04043
Business Services	0.03853	0.01499	0.00324	0.00236	0.00000	0.01821	0.02621	0.05849	0.08290	0.10561	0.09077	0.30012	0.06147	0.05146
Other services	0.03853	0.01499	0.00324	0.00236	0.00000	0.01821	0.00526	0.01102	0.00431	0.00748	0.01365	0.02029	0.03839	0.18186
Household	0.08736	0.05953	0.13456	0.18203	0.03142	0.10374	0.10031	0.25739	0.18538	0.37288	0.32438	0.27149	0.54860	0.00000

East Midlands	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00414	0.00201	0.00827	0.00531	0.04511	0.04738	0.00000	0.00192	0.00000	0.00025	0.00003	0.00000	0.00004	0.00086
Other Crops	0.00414	0.00201	0.00209	0.00086	0.00000	0.00066	0.00000	0.00249	0.00000	0.00032	0.00004	0.00000	0.00005	0.00111
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00670	0.00001	0.00087	0.00010	0.00000	0.00012	0.00299
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00402	0.00000	0.00052	0.00006	0.00000	0.00007	0.00179
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00078	0.00000	0.00010	0.00001	0.00000	0.00001	0.00035
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01444	0.00002	0.00188	0.00022	0.00000	0.00027	0.00644
Energy	0.04419	0.03559	0.01545	0.00779	0.00000	0.00387	0.35312	0.01554	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.27651	0.07058	0.13477	0.06882	0.04747	0.08947	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.00850	0.00223	0.00885	0.00785	0.00659	0.00986	0.00000	0.00208	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01680	0.03045	0.03055	0.03270	0.03896	0.01514	0.00470	0.25074
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01565	0.01646	0.00811	0.08661	0.11674	0.06491	0.00826	0.03696
Business Services	0.03128	0.00943	0.00198	0.00489	0.00000	0.00326	0.01732	0.04149	0.07268	0.10325	0.08909	0.30012	0.06073	0.04617
Other services	0.03128	0.00943	0.00198	0.00489	0.00000	0.00326	0.00409	0.00791	0.00383	0.00740	0.01356	0.02029	0.03839	0.16514
Household	0.07177	0.02913	0.09334	0.13387	0.03142	0.09387	0.12593	0.25739	0.18538	0.36804	0.29652	0.24359	0.49816	0.00000

Eastern England	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00794	0.00360	0.00631	0.00706	0.04518	0.00000	0.00000	0.00212	0.00000	0.00025	0.00003	0.00000	0.00004	0.00086
Other Crops	0.00794	0.00360	0.00182	0.00105	0.00000	0.00000	0.00000	0.00274	0.00000	0.00032	0.00004	0.00000	0.00005	0.00111
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00737	0.00001	0.00087	0.00010	0.00000	0.00012	0.00299
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00442	0.00000	0.00052	0.00006	0.00000	0.00007	0.00179
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00086	0.00000	0.00010	0.00001	0.00000	0.00001	0.00035
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01590	0.00002	0.00188	0.00022	0.00000	0.00027	0.00644
Energy	0.08583	0.02082	0.01289	0.00869	0.00000	0.00000	0.35312	0.01554	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.46881	0.12178	0.11826	0.08059	0.04755	0.00000	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.01651	0.00372	0.01375	0.00932	0.00660	0.00000	0.00000	0.00208	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01680	0.03045	0.03055	0.03270	0.03896	0.01514	0.00470	0.25074
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01565	0.01646	0.00811	0.08661	0.11674	0.06491	0.00826	0.03696
Business Services	0.06007	0.01431	0.00437	0.00285	0.00000	0.00000	0.01732	0.04149	0.07268	0.10325	0.08909	0.30012	0.06073	0.04617
Other services	0.06007	0.01431	0.00437	0.00285	0.00000	0.00000	0.00409	0.00791	0.00383	0.00740	0.01356	0.02029	0.03839	0.16514
Household	0.27501	0.09065	0.09892	0.19801	0.03314	0.00000	0.12593	0.25739	0.18538	0.36804	0.29652	0.24359	0.49816	0.00000

South East of England	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00746	0.00362	0.00932	0.00676	0.04518	0.00000	0.00000	0.00212	0.00000	0.00025	0.00003	0.00000	0.00004	0.00086
Other Crops	0.00746	0.00362	0.00274	0.00094	0.00000	0.00000	0.00000	0.00274	0.00000	0.00032	0.00004	0.00000	0.00005	0.00111
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00737	0.00001	0.00087	0.00010	0.00000	0.00012	0.00299
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00442	0.00000	0.00052	0.00006	0.00000	0.00007	0.00179
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00086	0.00000	0.00010	0.00001	0.00000	0.00001	0.00035
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01590	0.00002	0.00188	0.00022	0.00000	0.00027	0.00644
Energy	0.08028	0.02103	0.02001	0.00731	0.00000	0.00000	0.35312	0.01554	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.44618	0.12265	0.17358	0.07020	0.04755	0.00000	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.01544	0.00380	0.00651	0.00669	0.00660	0.00000	0.00000	0.00208	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01680	0.03045	0.03055	0.03270	0.03896	0.01514	0.00470	0.25074
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01565	0.01646	0.00811	0.08661	0.11674	0.06491	0.00826	0.03696
Business Services	0.05992	0.01493	0.00213	0.00253	0.00000	0.00000	0.01732	0.04149	0.07268	0.10325	0.08909	0.30012	0.06073	0.04617
Other services	0.05992	0.01493	0.00213	0.00253	0.00000	0.00000	0.00409	0.00791	0.00383	0.00740	0.01356	0.02029	0.03839	0.16514
Household	0.24466	0.08972	0.10993	0.16076	0.03314	0.00000	0.12593	0.25739	0.18538	0.36804	0.29652	0.24359	0.49816	0.00000

South West of England	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00406	0.00337	0.01657	0.01686	0.04518	0.05147	0.00000	0.00127	0.00000	0.00023	0.00003	0.00000	0.00003	0.00075
Other Crops	0.00406	0.00337	0.00263	0.00103	0.00000	0.00061	0.00000	0.00164	0.00000	0.00029	0.00004	0.00000	0.00005	0.00098
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00441	0.00001	0.00079	0.00010	0.00000	0.00012	0.00262
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00265	0.00000	0.00047	0.00006	0.00000	0.00007	0.00157
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00051	0.00000	0.00009	0.00001	0.00000	0.00001	0.00031
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00951	0.00002	0.00170	0.00022	0.00000	0.00026	0.00566
Energy	0.04352	0.02867	0.01904	0.00772	0.00000	0.00681	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.27086	0.09272	0.16176	0.08188	0.04755	0.10400	0.03826	0.22355	0.15493	0.08483	0.06190	0.05366	0.01968	0.11329
Construction	0.00837	0.00311	0.00634	0.01136	0.00660	0.01115	0.00000	0.00292	0.25551	0.00517	0.00185	0.01107	0.00618	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01872	0.04489	0.03209	0.03270	0.03896	0.01514	0.00470	0.25404
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01475	0.02382	0.00780	0.07322	0.11674	0.06261	0.00670	0.03475
Business Services	0.02948	0.01373	0.00146	0.00206	0.00000	0.01811	0.02011	0.07397	0.08615	0.10750	0.10584	0.30012	0.06012	0.05347
Other services	0.02948	0.01373	0.00146	0.00206	0.00000	0.01811	0.00480	0.01298	0.00447	0.00779	0.01369	0.02029	0.03839	0.18622
Household	0.07847	0.04968	0.09726	0.15051	0.03314	0.09918	0.12593	0.24329	0.18538	0.37288	0.27885	0.28214	0.56175	0.00000

West Midlands	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00420	0.00327	0.01256	0.00645	0.04511	0.04738	0.00000	0.00127	0.00000	0.00023	0.00003	0.00000	0.00003	0.00075
Other Crops	0.00420	0.00327	0.00299	0.00097	0.00000	0.00066	0.00000	0.00164	0.00000	0.00029	0.00004	0.00000	0.00005	0.00098
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00441	0.00001	0.00079	0.00010	0.00000	0.00012	0.00262
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00265	0.00000	0.00047	0.00006	0.00000	0.00007	0.00157
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00051	0.00000	0.00009	0.00001	0.00000	0.00001	0.00031
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00951	0.00002	0.00170	0.00022	0.00000	0.00026	0.00566
Energy	0.04477	0.02701	0.02098	0.00718	0.00000	0.00387	0.35312	0.01536	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.27935	0.08841	0.18825	0.07089	0.04747	0.08947	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.00861	0.00289	0.00284	0.00729	0.00659	0.00986	0.00000	0.00180	0.25551	0.00522	0.00185	0.01107	0.00633	0.01405
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01656	0.02968	0.03209	0.03270	0.03896	0.01514	0.00470	0.24680
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01505	0.01564	0.00891	0.08444	0.11674	0.06491	0.00795	0.03546
Business Services	0.03338	0.01254	0.00084	0.00218	0.00000	0.00326	0.01909	0.04520	0.09155	0.11538	0.10212	0.30012	0.06643	0.05078
Other services	0.03338	0.01254	0.00084	0.00218	0.00000	0.00326	0.00413	0.00788	0.00441	0.00756	0.01369	0.02029	0.03839	0.16608
Household	0.08942	0.04834	0.12480	0.16469	0.03142	0.09387	0.12593	0.25739	0.16783	0.36225	0.28454	0.26794	0.50098	0.00000

Scotland NW	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00454	0.00530	0.00964	0.01337	0.04517	0.05359	0.00000	0.00212	0.00000	0.00025	0.00003	0.00000	0.00004	0.00086
Other Crops	0.00454	0.00530	0.00277	0.00169	0.00000	0.00093	0.00000	0.00274	0.00000	0.00032	0.00004	0.00000	0.00005	0.00111
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00737	0.00001	0.00087	0.00010	0.00000	0.00012	0.00299
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00442	0.00000	0.00052	0.00006	0.00000	0.00007	0.00179
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00086	0.00000	0.00010	0.00001	0.00000	0.00001	0.00035
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01590	0.00002	0.00188	0.00022	0.00000	0.00027	0.00644
Energy	0.05438	0.02825	0.02187	0.01261	0.00000	0.01086	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.33926	0.13924	0.20646	0.12446	0.04753	0.12498	0.01398	0.22355	0.05322	0.06849	0.02705	0.05366	0.00704	0.06101
Construction	0.00981	0.00427	0.02848	0.01709	0.00660	0.01148	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00847	0.04489	0.01480	0.03270	0.02449	0.01514	0.00220	0.18606
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01384	0.02674	0.00689	0.09548	0.11674	0.06491	0.00616	0.04127
Business Services	0.04222	0.02061	0.00480	0.00109	0.00000	0.00404	0.00717	0.07214	0.02886	0.08463	0.04166	0.30012	0.02097	0.02808
Other services	0.04222	0.02061	0.00480	0.00109	0.00000	0.00404	0.00490	0.01298	0.00440	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.11294	0.07232	0.12759	0.16366	0.03279	0.11921	0.12593	0.13102	0.18538	0.27309	0.33116	0.14816	0.56175	0.00000

Scotland NE	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00388	0.00293	0.01334	0.02089	0.04517	0.05359	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Other Crops	0.00388	0.00293	0.00284	0.00175	0.00000	0.00093	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Energy	0.04149	0.02861	0.02027	0.01253	0.00000	0.01086	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.26160	0.07176	0.17478	0.12280	0.04753	0.12498	0.00689	0.22355	0.08065	0.09854	0.05234	0.05366	0.01717	0.10205
Construction	0.00798	0.00207	0.02183	0.01873	0.00660	0.01148	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00254	0.03935	0.01366	0.03270	0.02887	0.01347	0.00328	0.18962
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00353	0.02674	0.00539	0.09548	0.11674	0.06491	0.00776	0.04127
Business Services	0.02851	0.00842	0.00125	0.00163	0.00000	0.00404	0.00386	0.07892	0.04785	0.13521	0.08818	0.30012	0.05596	0.05139
Other services	0.02851	0.00842	0.00125	0.00163	0.00000	0.00404	0.00099	0.01298	0.00273	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.07887	0.03296	0.08670	0.13890	0.03279	0.11921	0.12593	0.21916	0.18538	0.27833	0.33116	0.27116	0.56175	0.00000

Scotland SW	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00411	0.00319	0.01227	0.02506	0.04517	0.05359	0.00000	0.00212	0.00000	0.00025	0.00003	0.00000	0.00003	0.00086
Other Crops	0.00411	0.00319	0.00288	0.00234	0.00000	0.00093	0.00000	0.00274	0.00000	0.00032	0.00004	0.00000	0.00004	0.00111
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00737	0.00001	0.00087	0.00010	0.00000	0.00010	0.00299
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00442	0.00000	0.00052	0.00006	0.00000	0.00006	0.00179
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00086	0.00000	0.00010	0.00001	0.00000	0.00001	0.00035
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01590	0.00001	0.00188	0.00021	0.00000	0.00021	0.00644
Energy	0.04386	0.02968	0.02060	0.01625	0.00000	0.01086	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.27347	0.08985	0.18383	0.16028	0.04753	0.12498	0.00689	0.22355	0.08065	0.09854	0.05234	0.05366	0.01717	0.10205
Construction	0.00843	0.00308	0.03225	0.02618	0.00660	0.01148	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00633	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00254	0.03935	0.01366	0.03270	0.02887	0.01347	0.00328	0.18962
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00353	0.02674	0.00539	0.09548	0.11674	0.06491	0.00776	0.04127
Business Services	0.03255	0.01391	0.00126	0.00116	0.00000	0.00404	0.00386	0.07892	0.04785	0.13521	0.08818	0.30012	0.05596	0.05139
Other services	0.03255	0.01391	0.00126	0.00116	0.00000	0.00404	0.00099	0.01298	0.00273	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.08468	0.04221	0.09213	0.11022	0.03279	0.11921	0.12593	0.21916	0.18538	0.27833	0.33116	0.27116	0.56175	0.00000

Scotland SE	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00383	0.00290	0.01233	0.02319	0.04517	0.05359	0.00000	0.00212	0.00000	0.00025	0.00003	0.00000	0.00003	0.00086
Other Crops	0.00383	0.00290	0.00280	0.00205	0.00000	0.00093	0.00000	0.00274	0.00000	0.00032	0.00004	0.00000	0.00004	0.00111
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00737	0.00001	0.00087	0.00010	0.00000	0.00011	0.00299
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00442	0.00000	0.00052	0.00006	0.00000	0.00007	0.00179
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00086	0.00000	0.00010	0.00001	0.00000	0.00001	0.00035
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01590	0.00002	0.00188	0.00022	0.00000	0.00024	0.00644
Energy	0.04094	0.02847	0.01998	0.01433	0.00000	0.01086	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00440	0.04450
Manufacturing	0.25853	0.06883	0.17552	0.14188	0.04753	0.12498	0.02574	0.22355	0.14000	0.09854	0.06190	0.05366	0.01614	0.11546
Construction	0.00787	0.00191	0.02688	0.02232	0.00660	0.01148	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00561	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00775	0.03207	0.01933	0.03270	0.03137	0.01150	0.00251	0.17485
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00988	0.02373	0.00702	0.09548	0.11674	0.06122	0.00547	0.03528
Business Services	0.02829	0.00763	0.00151	0.00134	0.00000	0.00404	0.01378	0.07534	0.07929	0.13521	0.10584	0.30012	0.05021	0.05551
Other services	0.02829	0.00763	0.00151	0.00134	0.00000	0.00404	0.00394	0.01298	0.00447	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.07726	0.03161	0.08632	0.11572	0.03279	0.11921	0.12593	0.24796	0.18538	0.25664	0.28306	0.29288	0.56175	0.00000

Northern Ireland	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00442	0.00345	0.01628	0.02367	0.04517	0.06029	0.00000	0.00212	0.00000	0.00025	0.00003	0.00000	0.00003	0.00086
Other Crops	0.00442	0.00345	0.00311	0.00154	0.00000	0.00065	0.00000	0.00274	0.00000	0.00032	0.00004	0.00000	0.00004	0.00111
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00737	0.00001	0.00087	0.00010	0.00000	0.00010	0.00299
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00442	0.00000	0.00052	0.00006	0.00000	0.00006	0.00179
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00086	0.00000	0.00010	0.00001	0.00000	0.00001	0.00035
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01590	0.00001	0.00188	0.00021	0.00000	0.00021	0.00644
Energy	0.04786	0.03365	0.02090	0.01066	0.00000	0.00457	0.35312	0.01983	0.00664	0.01968	0.03233	0.01117	0.00278	0.04450
Manufacturing	0.29844	0.10902	0.20484	0.11459	0.04753	0.11144	0.04148	0.22355	0.16336	0.09854	0.06190	0.05366	0.01232	0.11958
Construction	0.00920	0.00364	0.02800	0.02400	0.00660	0.01153	0.00000	0.00292	0.25551	0.00560	0.00185	0.01107	0.00367	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01310	0.03364	0.02366	0.03270	0.03896	0.01514	0.00201	0.18996
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01204	0.01794	0.00620	0.08544	0.11674	0.06491	0.00316	0.02762
Business Services	0.03706	0.01721	0.00097	0.00160	0.00000	0.00396	0.00295	0.01001	0.01229	0.02255	0.01973	0.30012	0.00509	0.00764
Other services	0.03706	0.01721	0.00097	0.00160	0.00000	0.00396	0.00526	0.01298	0.00447	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.09847	0.05215	0.15399	0.14664	0.03279	0.11298	0.12593	0.25680	0.18538	0.27881	0.22158	0.04030	0.56175	0.00000

Wales	Cereals	Other Crops	Beef	Sheep	P & P	Milk	Energy	Manufacturing	Construction	Distribution	Transport	Business Services	Other services	Household
Cereals	0.00495	0.00368	0.01748	0.02360	0.04518	0.06029	0.00000	0.00212	0.00000	0.00025	0.00003	0.00000	0.00004	0.00086
Other Crops	0.00495	0.00368	0.00322	0.00171	0.00000	0.00065	0.00000	0.00274	0.00000	0.00032	0.00004	0.00000	0.00005	0.00111
Beef	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00737	0.00001	0.00087	0.00010	0.00000	0.00012	0.00299
Sheep	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00442	0.00000	0.00052	0.00006	0.00000	0.00007	0.00179
P & P	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00086	0.00000	0.00010	0.00001	0.00000	0.00001	0.00035
Milk	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01590	0.00002	0.00188	0.00022	0.00000	0.00027	0.00644
Energy	0.05358	0.03495	0.02129	0.01161	0.00000	0.00457	0.35312	0.01454	0.00550	0.01844	0.03233	0.01117	0.00353	0.04051
Manufacturing	0.32715	0.11764	0.20659	0.12365	0.04755	0.11144	0.04606	0.22355	0.16605	0.09854	0.06190	0.05366	0.02161	0.11985
Construction	0.01030	0.00406	0.02474	0.02428	0.00660	0.01153	0.00000	0.00258	0.25551	0.00560	0.00185	0.01107	0.00614	0.01552
Distribution	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01940	0.03513	0.02836	0.03270	0.03896	0.01514	0.00403	0.24680
Transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01542	0.01518	0.00602	0.06924	0.11674	0.06491	0.00514	0.02908
Business Services	0.04761	0.01954	0.00100	0.00161	0.00000	0.00396	0.01818	0.04074	0.05742	0.08788	0.09485	0.30012	0.03984	0.03868
Other services	0.04761	0.01954	0.00100	0.00161	0.00000	0.00396	0.00526	0.01184	0.00447	0.00824	0.01369	0.02029	0.03839	0.18622
Household	0.10910	0.05536	0.13670	0.13806	0.03314	0.11298	0.11464	0.25739	0.18538	0.36225	0.23333	0.20406	0.56175	0.00000

Appendix 44. The Estimated Type I and II Output, Income and Employment Multipliers

Appendix 44.a. The Conventional Agriculture Multipliers

Cereals	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	2.00610	3.14099	1.14054	4.94662	3.77841	6.32180
Yorkshire & Humberside	1.93989	3.06115	1.15111	5.51800	1.85823	2.70741
North West England	1.99090	3.22520	1.99090	4.95743	1.34410	1.68615
East Midlands	1.90227	2.89380	1.14075	5.01773	1.62693	2.18643
Eastern England	1.88544	2.93842	1.88544	4.31465	1.47426	2.02128
South East England	1.90086	2.97294	1.10332	4.31620	1.82612	2.84038
South West England	1.93160	3.02076	1.15836	5.52192	2.04097	3.04542
West Midlands	1.85717	2.80636	1.14917	5.13974	1.60046	2.14419
Scotland North West	2.06130	2.79921	1.11180	3.24304	4.74070	6.61909
Scotland North East	1.89625	2.72709	1.17512	5.19864	2.34877	3.32644
Scotland South West	2.02145	3.03916	1.13849	4.55233	4.13921	6.51002
Scotland South East	1.87326	2.72221	1.18955	5.59970	1.66733	2.16310
Northern Ireland	1.90713	2.72404	1.14326	3.71123	2.06505	2.79468
Wales	1.99031	3.16410	1.13139	4.09097	2.23561	3.42738
Mean	1.94028	2.94539	1.25780	4.72344	2.33901	3.41384

Other Crops	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.47117	2.11752	1.05017	3.58310	2.34109	3.78961
Yorkshire & Humberside	1.48425	2.19611	1.04116	3.91123	1.47058	2.00970
North West England	1.48616	2.19541	1.48616	3.94079	1.18169	1.37824
East Midlands	1.48801	2.13634	1.04419	3.71291	1.36355	1.72939
Eastern England	1.19836	1.49930	1.19836	3.02554	1.05777	1.13755
South East England	1.23241	1.57451	1.06266	3.14431	1.10944	1.26432
South West England	1.28750	1.68165	1.07558	3.87876	1.31317	1.67666
West Midlands	1.28986	1.65277	1.06196	3.83893	1.20145	1.40934
Scotland North West	1.38773	1.72994	1.04493	2.50593	2.35607	3.22717
Scotland North East	1.23275	1.48507	1.09016	3.52101	1.32575	1.62267
Scotland South West	1.33451	1.73500	1.06058	3.29766	2.00142	2.93438
Scotland South East	1.21586	1.45269	1.10572	3.75980	1.15225	1.29056
Northern Ireland	1.32434	1.65477	1.06329	2.97916	1.39068	1.68580
Wales	1.40232	1.94001	1.05457	3.40627	1.51324	2.05917
Mean	1.34537	1.78936	1.10282	3.46467	1.48415	1.94390

Beef	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.52954	2.35452	1.04059	2.89788	2.32008	4.16892
Yorkshire & Humberside	1.41676	2.18724	1.03239	2.88055	1.37359	1.95712
North West England	1.51661	2.45354	1.51661	2.86470	1.17898	1.43862
East Midlands	1.38287	2.08460	1.03765	2.58311	1.26911	1.66509
Eastern England	1.39682	2.16729	1.39682	2.51873	1.36992	2.02789
South East England	1.44888	2.26862	1.03597	2.60603	1.42759	2.24280
South West England	1.53865	2.57860	1.02908	2.69555	1.57425	2.53331
West Midlands	1.53542	2.53638	1.01786	2.53968	1.36249	1.93587
Scotland North West	1.57473	2.07762	1.02943	2.29040	2.79550	4.07563
Scotland North East	1.56809	2.28602	1.03633	2.87727	1.79048	2.63529
Scotland South West	1.60311	2.37480	1.03475	2.82081	2.62791	4.42561
Scotland South East	1.58363	2.31754	1.04205	3.13342	1.41406	1.84265
Northern Ireland	1.50203	2.21805	1.02905	2.23165	1.54880	2.18831
Wales	1.53717	2.40274	1.03621	2.69013	1.60835	2.48717
Mean	1.50959	2.30768	1.09391	2.68785	1.69008	2.54459

Sheep	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.36008	2.06122	1.02421	2.40913	1.86480	3.43609
Yorkshire & Humberside	1.27628	2.07350	1.01446	2.18286	1.23738	1.84116
North West England	1.36197	2.11878	1.36197	2.53256	1.12810	1.33783
East Midlands	1.15896	1.75326	1.01974	1.88104	1.10981	1.44516
Eastern England	1.13855	1.85913	1.13855	1.75400	1.04285	1.25311
South East England	1.13398	1.79612	1.01845	1.77115	1.04751	1.29290
South West England	1.17504	1.93174	1.01746	1.93212	1.18384	1.88169
West Midlands	1.12372	1.66911	1.01435	1.82379	1.08442	1.39684
Scotland North West	1.26680	1.70995	1.01505	1.69201	1.83026	2.95831
Scotland North East	1.26255	1.87881	1.01766	1.96912	1.36312	2.08830
Scotland South West	1.34295	1.88931	1.02520	2.37491	1.93050	3.20327
Scotland South East	1.30579	1.89308	1.02279	2.22911	1.21666	1.55963
Northern Ireland	1.31047	1.85234	1.02062	1.96644	1.33424	1.81821
Wales	1.41234	2.10680	1.02616	2.55693	1.46154	2.16664
Mean	1.25925	1.89951	1.05262	2.07680	1.34536	1.97708

Pigs and Poultry	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.41653	1.75631	1.03327	8.32251	1.92757	2.68903
Yorkshire & Humberside	1.41062	1.76874	1.02430	8.54546	1.37876	1.64998
North West England	1.36052	1.73317	1.36052	5.42119	1.18410	1.28737
East Midlands	1.34590	1.67100	1.01774	4.79648	1.26480	1.44825
Eastern England	1.31497	1.61516	1.31497	4.99675	1.30479	1.54399
South East England	1.31636	1.61828	1.02214	5.02481	1.21789	1.44576
South West England	1.33201	1.65966	1.02148	5.33752	1.35607	1.65825
West Midlands	1.34071	1.66322	1.01219	4.75072	1.26296	1.44771
Scotland North West	1.43157	1.63512	1.02102	5.63234	2.20867	2.72682
Scotland North East	1.41595	1.70064	1.02690	7.18681	1.56484	1.89985
Scotland South West	1.43002	1.73548	1.02821	7.70878	2.08017	2.79175
Scotland South East	1.41150	1.70940	1.02919	7.51127	1.33642	1.51039
Northern Ireland	1.39396	1.64431	1.03015	6.88877	1.43883	1.66243
Wales	1.32468	1.63033	1.02319	5.17473	1.37499	1.68531
Mean	1.37466	1.68149	1.06895	6.23558	1.49292	1.81763

Milk	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.40291	1.94943	1.16628	3.26260	2.02790	3.25270
Yorkshire & Humberside	1.39889	2.02822	1.10413	3.13820	1.37440	1.85102
North West England	1.34451	1.92559	1.34451	3.01121	1.15274	1.31377
East Midlands	1.35332	1.95171	1.10733	2.60508	1.26386	1.60152
Eastern England	1.40375	2.09343	1.40375	2.65547	2.35458	4.25228
South East England	1.40454	2.09529	1.10499	2.65919	1.48901	2.26065
South West England	1.40404	2.00304	1.14984	3.31953	1.45686	2.00927
West Midlands	1.34550	1.93689	1.07477	2.60640	1.26033	1.59910
Scotland North West	1.40030	1.90759	1.06005	1.95551	2.32888	3.62019
Scotland North East	1.39745	2.05244	1.07856	2.35492	1.59870	2.36945
Scotland South West	1.39281	1.98032	1.09633	2.46956	2.07483	3.44346
Scotland South East	1.39515	2.04390	1.08934	2.44159	1.32050	1.69937
Northern Ireland	1.34692	1.77483	1.12447	2.37103	1.39444	1.77664
Wales	1.36620	1.93403	1.13464	2.72238	1.43513	2.01166
Mean	1.38259	1.97691	1.14564	2.68376	1.60944	2.36151

Energy	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.78971	2.60271	2.31806	3.13670	3.16001	6.56487
Yorkshire & Humberside	1.80703	2.70639	2.31973	3.38042	3.29977	7.18979
North West England	1.84448	2.64751	1.84448	3.81877	3.62614	7.18918
East Midlands	1.79569	2.61386	2.24855	3.14325	3.21670	6.66846
Eastern England	1.79613	2.61570	1.79613	3.14714	3.73778	8.29527
South East England	1.79618	2.61598	2.26744	3.14751	4.10249	9.44681
South West England	1.79797	2.68885	2.32167	3.34791	3.29733	7.17667
West Midlands	1.79918	2.62775	2.26552	3.17819	3.24517	6.74810
Scotland North West	1.66123	2.19550	2.24441	2.32862	2.36856	4.40341
Scotland North East	1.59227	2.19023	2.26814	2.37778	1.86077	4.28253
Scotland South West	1.59229	2.19037	2.32955	2.37754	2.96088	14.08659
Scotland South East	1.70517	2.39572	2.25303	2.74260	2.62576	5.41410
Northern Ireland	1.71663	2.30276	2.19030	2.54051	2.64066	4.82242
Wales	1.80545	2.55288	2.36140	3.20667	3.30886	6.46230
Mean	1.74996	2.49616	2.21631	2.99097	3.10363	7.05361

Manufacturing	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.63179	2.92185	2.87046	2.43515	1.77632	2.97057
Yorkshire & Humberside	1.64182	3.06131	2.83448	2.61035	1.83930	3.19645
North West England	1.65101	3.08356	1.65101	2.65499	1.93920	3.34421
East Midlands	1.58956	2.84892	2.74906	2.36707	1.76607	2.94048
Eastern England	1.59515	2.86088	1.59515	2.37794	2.09824	3.96521
South East England	1.59577	2.86214	2.78767	2.37876	2.34767	4.70806
South West England	1.73986	3.19362	2.84155	2.82775	1.99266	3.39197
West Midlands	1.57745	2.84596	2.76636	2.38055	1.74833	2.93375
Scotland North West	1.72116	2.34460	3.46443	2.61177	1.92901	2.45388
Scotland North East	1.74125	2.89297	2.71288	2.63156	1.97344	3.00450
Scotland South West	1.74261	2.89421	2.86706	2.63047	1.85187	2.78443
Scotland South East	1.71648	2.95869	2.63959	2.50556	1.96052	3.06926
Northern Ireland	1.53484	2.47615	2.64275	2.00070	1.63576	2.41026
Wales	1.60530	2.84090	2.93660	2.36109	1.77043	2.92274
Mean	1.64886	2.86327	2.66850	2.48384	1.90206	3.14970

Distribution	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.57606	3.13705	1.22252	2.12696	1.31081	1.87153
Yorkshire & Humberside	1.61470	3.41768	1.23378	2.28866	1.33839	2.00727
North West England	1.59663	3.38386	1.59663	2.28642	1.33924	2.01939
East Midlands	1.59615	3.22110	1.21423	2.13602	1.32789	1.91588
Eastern England	1.59685	3.22461	1.59685	2.13871	1.33313	1.89494
South East England	1.59698	3.22520	1.21581	2.13898	1.35588	1.94207
South West England	1.57758	3.34426	1.24565	2.24217	1.32206	1.98189
West Midlands	1.61648	3.25935	1.21625	2.19067	1.34184	1.93756
Scotland North West	1.51001	2.42708	1.20535	1.84314	1.27927	1.57885
Scotland North East	1.67839	2.99972	1.23072	2.37729	1.37664	1.83563
Scotland South West	1.67868	3.00020	1.23627	2.37691	1.40688	1.92803
Scotland South East	1.68493	2.95777	1.24265	2.48057	1.38278	1.82361
Northern Ireland	1.41836	2.33271	1.21182	1.78997	1.21085	1.50277
Wales	1.53938	3.03388	1.21742	2.02920	1.29392	1.83473
Mean	1.59151	3.06889	1.27757	2.17469	1.32997	1.86244

Transport	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.57475	2.90218	1.51786	2.30593	1.61267	2.54135
Yorkshire & Humberside	1.59360	3.18977	1.53249	2.40655	1.63981	2.79310
North West England	1.58538	3.21007	1.58538	2.38925	1.64873	2.85294
East Midlands	1.58792	2.99151	1.51905	2.29006	1.63367	2.62285
Eastern England	1.58842	2.99421	1.58842	2.29257	1.58054	2.41630
South East England	1.58848	2.99464	1.52085	2.29281	1.64684	2.56061
South West England	1.63393	3.14375	1.56379	2.56230	1.69117	2.78944
West Midlands	1.61591	3.02043	1.54135	2.38425	1.66924	2.66115
Scotland North West	1.39431	2.41807	1.39756	1.69675	1.40697	2.05832
Scotland North East	1.55400	2.94295	1.47036	2.10022	1.59001	2.52970
Scotland South West	1.55410	2.94329	1.47566	2.09996	1.54805	2.46018
Scotland South East	1.61643	2.91331	1.52167	2.29145	1.66396	2.53874
Northern Ireland	1.42658	2.20489	1.41298	1.91718	1.42859	1.91254
Wales	1.59805	2.74149	1.54409	2.41034	1.64532	2.45119
Mean	1.56513	2.90076	1.51368	2.24569	1.60040	2.51346

Business Services	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.82762	3.11409	2.52847	2.95120	1.73900	2.42134
Yorkshire & Humberside	1.83356	3.45585	2.54279	2.97546	1.74716	2.63581
North West England	1.83277	3.50920	1.83277	2.94560	1.75340	2.69542
East Midlands	1.82831	3.25284	2.50934	2.82927	1.74292	2.50404
Eastern England	1.82883	3.25558	1.82883	2.83234	1.67254	2.27104
South East England	1.82889	3.25601	2.52006	2.83264	1.63020	2.14615
South West England	1.83900	3.56812	2.55348	2.90032	1.75343	2.70700
West Midlands	1.83160	3.37302	2.49949	2.77878	1.74625	2.57154
Scotland North West	1.80719	2.54010	2.53596	2.71503	1.72330	2.07682
Scotland North East	1.82646	3.26435	2.43990	2.65534	1.73903	2.47655
Scotland South West	1.82658	3.26473	2.46576	2.65502	1.78416	2.62082
Scotland South East	1.82218	3.34336	2.40910	2.59769	1.73550	2.51341
Northern Ireland	1.79678	2.16825	2.66078	5.03080	1.71111	1.88622
Wales	1.82724	3.03133	2.54970	2.90220	1.74102	2.38439
Mean	1.82550	3.17120	2.41975	2.97155	1.72993	2.42218

Other services	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.19343	3.12383	1.11824	1.66961	1.11336	1.72706
Yorkshire & Humberside	1.23075	3.31075	1.12018	1.78304	1.13522	1.81816
North West England	1.23635	3.29731	1.23635	1.79208	1.14051	1.83466
East Midlands	1.23460	2.99043	1.12167	1.70517	1.13760	1.69991
Eastern England	1.23478	2.99296	1.23478	1.70665	1.15668	1.75500
South East England	1.23481	2.99342	1.12377	1.70681	1.15971	1.72959
South West England	1.23168	3.35267	1.11901	1.78679	1.13667	1.83776
West Midlands	1.24557	3.03618	1.11824	1.72648	1.14395	1.71860
Scotland North West	1.12330	2.56381	1.10831	1.40746	1.07822	1.49469
Scotland North East	1.21492	3.02958	1.10995	1.61761	1.12712	1.68502
Scotland South West	1.21480	3.02976	1.11431	1.61738	1.10807	1.58194
Scotland South East	1.19735	3.00703	1.11202	1.61122	1.11813	1.67283
Northern Ireland	1.08921	2.55094	1.09098	1.42028	1.05985	1.47287
Wales	1.18652	3.06169	1.11557	1.64182	1.11093	1.71148
Mean	1.2049	3.0243	1.1317	1.6566	1.1233	1.6957

Appendix 44.b. The Sustainable Agriculture Multipliers

Cereals	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.7223	2.5390	1.1592	4.8720	2.9583	4.7110
Yorkshire & Humberside	1.6587	2.4581	1.1752	5.3510	1.6005	2.1931
North West England	1.7400	2.6649	1.1751	5.0515	1.2697	1.5328
East Midlands	1.6421	2.3592	1.1347	4.8397	1.4576	1.8637
Eastern England	2.1419	3.8727	1.0292	3.0497	1.6817	2.6202
South East England	2.0917	3.6923	1.0315	3.1697	2.1345	3.7005
South West England	1.6612	2.4767	1.1617	4.9364	1.7375	2.4765
West Midlands	1.6529	2.4474	1.1169	4.2955	1.4990	1.9804
Scotland North West	1.8273	2.4410	1.1218	2.9836	3.7885	5.2773
Scotland North East	1.6160	2.2523	1.1570	4.1006	1.9829	2.7584
Scotland South West	1.6709	2.3722	1.1686	4.1492	3.0424	4.6484
Scotland South East	1.6243	2.3015	1.1838	4.3876	1.5133	1.9334
Northern Ireland	1.6760	2.3064	1.1750	3.4964	1.8343	2.3961
Wales	1.7999	2.7391	1.1588	4.2373	2.0217	2.9602
Mean	1.7518	2.6373	1.1392	4.2086	2.0373	2.9323

Other Crops	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.2573	1.5677	1.0511	3.8502	1.6410	2.3070
Yorkshire & Humberside	1.2145	1.4741	1.0860	4.4341	1.1711	1.3635
North West England	1.2833	1.7114	1.0466	3.4311	1.0996	1.2213
East Midlands	1.2148	1.4567	1.0875	4.0213	1.1354	1.2724
Eastern England	1.2941	1.8004	1.0590	2.7062	1.0916	1.2341
South East England	1.2979	1.8042	1.0556	2.7342	1.1483	1.3889
South West England	1.2686	1.6523	1.0450	3.6684	1.2902	1.6379
West Midlands	1.2417	1.5751	1.0506	3.3339	1.1775	1.3795
Scotland North West	1.3704	1.6983	1.0421	2.4897	2.2333	3.0288
Scotland North East	1.2033	1.4233	1.0320	3.3927	1.2903	1.5584
Scotland South West	1.2605	1.5540	1.0686	3.4843	1.7404	2.4127
Scotland South East	1.2014	1.4275	1.0917	3.5794	1.1489	1.2892
Northern Ireland	1.2912	1.5794	1.0645	3.0182	1.3455	1.6023
Wales	1.3299	1.7387	1.0667	3.6344	1.4032	1.8117
Mean	1.2664	1.6045	1.0605	3.4127	1.3512	1.6791

Beef	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.4041	1.9857	1.0243	3.0124	1.9350	3.1830
Yorkshire & Humberside	1.3170	1.8331	1.0491	3.0610	1.2629	1.6455
North West England	1.4415	2.2365	1.0245	2.8189	1.1570	1.3831
East Midlands	1.2811	1.7744	1.0506	2.5599	1.1838	1.4632
Eastern England	1.2673	1.7734	1.0639	2.4793	1.2369	1.6915
South East England	1.3539	1.9567	1.0559	2.6570	1.2966	1.9194
South West England	1.3594	1.9592	1.0333	2.9297	1.3661	1.9097
West Midlands	1.3671	2.0277	1.0268	2.5588	1.2530	1.6533
Scotland North West	1.4722	1.9558	1.0276	2.0816	2.4281	3.6015
Scotland North East	1.3915	1.8743	1.0000	2.8310	1.5564	2.1449
Scotland South West	1.4356	1.9690	1.0491	2.9003	2.1396	3.3610
Scotland South East	1.4149	1.9401	1.0569	3.0453	1.3112	1.6370
Northern Ireland	1.4340	2.0546	1.0323	2.2014	1.4663	2.0194
Wales	1.4561	2.1917	1.0407	2.6484	1.5054	2.2403
Mean	1.3854	1.9666	1.0382	2.6989	1.5070	2.1323

Sheep	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.3243	1.8969	1.0123	2.5030	1.7470	2.9757
Yorkshire & Humberside	1.2396	1.8762	1.0175	2.2466	1.2076	1.6795
North West England	1.3393	2.2048	1.0109	2.2688	1.1245	1.3707
East Midlands	1.1634	1.6988	1.0211	1.9373	1.1141	1.4174
Eastern England	1.1871	1.9390	1.0192	1.8401	1.0403	1.2028
South East England	1.1609	1.7781	1.0229	1.8600	1.0429	1.2283
South West England	1.2127	1.8742	1.0129	2.0877	1.2219	1.8213
West Midlands	1.1580	1.7876	1.0000	1.0000	1.0000	1.0000
Scotland North West	1.2921	1.7923	1.0129	1.6783	1.8563	3.0698
Scotland North East	1.2987	1.8701	1.0000	2.0909	1.4262	2.1225
Scotland South West	1.3978	1.9562	1.0246	2.5382	2.0311	3.3098
Scotland South East	1.3550	1.9209	1.0255	2.4475	1.2719	1.6229
Northern Ireland	1.2831	1.7968	1.0204	1.9133	1.3082	1.7660
Wales	1.3156	1.9524	1.0241	2.2701	1.3536	1.9899
Mean	1.2663	1.8817	1.0160	2.0487	1.3390	1.8983

Pigs and Poultry	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.1661	1.3715	1.0082	3.0695	1.3546	1.7954
Yorkshire & Humberside	1.1660	1.3877	1.0139	3.2038	1.1503	1.3146
North West England	1.1702	1.3932	1.0122	3.3866	1.0879	1.1514
East Midlands	1.1624	1.3595	1.0175	3.0392	1.1245	1.2362
Eastern England	1.1853	1.4334	1.0222	3.6272	1.1840	1.3904
South East England	1.1831	1.4253	1.0216	3.5408	1.1333	1.3224
South West England	1.1698	1.3940	1.0114	3.2136	1.1793	1.3825
West Midlands	1.1627	1.3646	1.0124	3.1065	1.1302	1.2526
Scotland North West	1.1748	1.3154	1.0125	2.3553	1.4630	1.8042
Scotland North East	1.1640	1.3439	1.0000	2.7891	1.2281	1.4474
Scotland South West	1.1694	1.3564	1.0161	2.8576	1.4080	1.8363
Scotland South East	1.1676	1.3593	1.0175	2.9257	1.1418	1.2607
Northern Ireland	1.1603	1.3198	1.0177	2.6569	1.1788	1.3209
Wales	1.1703	1.3798	1.0195	3.1108	1.1949	1.4042
Mean	1.1694	1.3717	1.0145	3.0630	1.2114	1.4228

Milk	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.3726	1.9679	1.0473	2.7777	1.9855	3.2630
Yorkshire & Humberside	1.3281	2.0128	1.0657	2.5200	1.3087	1.8163
North West England	1.3802	2.0301	1.0685	2.9893	1.1778	1.3626
East Midlands	1.2569	1.7189	1.1084	2.3838	1.1918	1.4534
Eastern England	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
South East England	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
South West England	1.3547	1.9658	1.0704	2.9269	1.4179	1.9717
West Midlands	1.2571	1.7265	1.0769	2.4174	1.2017	1.4862
Scotland North West	1.3622	1.7819	1.0636	1.9333	2.0364	3.0546
Scotland North East	1.3465	1.8850	1.0000	2.2962	1.4999	2.1562
Scotland South West	1.3573	1.9124	1.0818	2.3332	1.9288	3.2001
Scotland South East	1.3553	1.9245	1.0889	2.3899	1.2897	1.6428
Northern Ireland	1.3125	1.7532	1.0950	2.1302	1.3584	1.7511
Wales	1.3304	1.8967	1.1061	2.4670	1.3879	1.9536
Mean	1.2867	1.7554	1.0623	2.2546	1.4132	1.9366

Energy	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.7866	2.5879	2.2260	3.1182	3.1572	6.5324
Yorkshire & Humberside	1.8068	2.7042	2.2449	3.3762	3.3050	7.1981
North West England	1.8444	2.6471	2.3767	3.8179	3.6323	7.2018
East Midlands	1.7953	2.6106	2.1794	3.1356	3.2207	6.6682
Eastern England	1.7954	2.6093	2.4871	3.1319	3.7433	8.2867
South East England	1.7955	2.6094	2.4361	3.1316	4.1073	9.4306
South West England	1.7961	2.6804	2.2484	3.3355	3.2946	7.1555
West Midlands	1.7990	2.6257	2.2139	3.1736	3.2495	6.7510
Scotland North West	1.6612	2.1948	2.2053	2.3272	2.3708	4.4087
Scotland North East	1.5915	2.1764	2.2157	2.3609	1.8588	4.2364
Scotland South West	1.5922	2.1892	2.2367	2.3750	2.9653	14.1061
Scotland South East	1.7050	2.3941	2.2128	2.7388	2.6283	5.4159
Northern Ireland	1.7165	2.3019	2.1181	2.5392	2.6439	4.8295
Wales	1.8052	2.5514	2.2631	3.2037	3.3144	6.4722
Mean	1.7493	2.4916	2.2617	2.9832	3.1065	7.0495

Manufacturing	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.5932	2.8488	2.5282	2.3907	1.7501	2.9106
Yorkshire & Humberside	1.6385	3.0519	2.5266	2.6017	1.8336	3.1790
North West England	1.6501	3.0815	2.7234	2.6535	1.9329	3.3296
East Midlands	1.5852	2.8342	2.4474	2.3503	1.7579	2.9168
Eastern England	1.5866	2.8313	3.0629	2.3433	2.0894	3.9188
South East England	1.5872	2.8318	2.9701	2.3428	2.3308	4.6409
South West England	1.7126	3.1417	2.5639	2.7902	1.9609	3.3299
West Midlands	1.5750	2.8376	2.5444	2.3714	1.7408	2.9142
Scotland North West	1.7187	2.3393	3.2167	2.6014	1.9233	2.4433
Scotland North East	1.6780	2.7779	2.4860	2.5510	1.9159	2.8968
Scotland South West	1.7392	2.8845	2.5462	2.6183	1.8460	2.7696
Scotland South East	1.7134	2.9489	2.4741	2.4939	1.9495	3.0461
Northern Ireland	1.5324	2.4715	2.4265	1.9971	1.6316	2.4007
Wales	1.6024	2.8338	2.6676	2.3547	1.7658	2.9092
Mean	1.6366	2.8368	2.6560	2.4615	1.8878	3.1147

Distribution	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.5683	3.1060	1.2116	2.1132	1.3101	1.8657
Yorkshire & Humberside	1.6139	3.4127	1.2239	2.2855	1.3393	2.0088
North West England	1.5964	3.3828	1.2440	2.2859	1.3402	2.0217
East Midlands	1.5952	3.2139	1.2058	2.1302	1.3286	1.9158
Eastern England	1.5950	3.2107	1.2244	2.1273	1.3340	1.8939
South East England	1.5951	3.2109	1.2214	2.1271	1.3566	1.9403
South West England	1.5738	3.3271	1.2356	2.2336	1.3217	1.9784
West Midlands	1.6158	3.2546	1.2100	2.1870	1.3426	1.9380
Scotland North West	1.5096	2.4253	1.1988	1.8415	1.2800	1.5800
Scotland North East	1.6646	2.9520	1.2223	2.3510	1.3734	1.8223
Scotland South West	1.6779	2.9962	1.2247	2.3729	1.4081	1.9297
Scotland South East	1.6843	2.9538	1.2364	2.4760	1.3835	1.8241
Northern Ireland	1.4179	2.3310	1.2040	1.7888	1.2113	1.5038
Wales	1.5388	3.0307	1.2089	2.0272	1.2948	1.8364
Mean	1.5890	3.0577	1.2194	2.1677	1.3303	1.8614

Transport	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.5709	2.8797	1.5058	2.2933	1.6128	2.5339
Yorkshire & Humberside	1.5932	3.1861	1.5215	2.4037	1.6416	2.7961
North West England	1.5853	3.2093	1.5280	2.3888	1.6505	2.8572
East Midlands	1.5874	2.9863	1.5087	2.2849	1.6352	2.6235
Eastern England	1.5875	2.9841	1.5331	2.2822	1.5821	2.4157
South East England	1.5876	2.9842	1.5293	2.2821	1.6484	2.5591
South West England	1.6314	3.1304	1.5526	2.5534	1.6914	2.7849
West Midlands	1.6156	3.0171	1.5342	2.3809	1.6710	2.6627
Scotland North West	1.3942	2.4167	1.3916	1.6957	1.4079	2.0603
Scotland North East	1.5484	2.9054	1.4625	2.0828	1.5882	2.5098
Scotland South West	1.5538	2.9401	1.4647	2.0973	1.5496	2.4630
Scotland South East	1.6161	2.9102	1.5149	2.2882	1.6656	2.5402
Northern Ireland	1.4263	2.2038	1.4056	1.9162	1.4295	1.9144
Wales	1.5977	2.7394	1.5343	2.4082	1.6472	2.4544
Mean	1.5640	2.8923	1.4991	2.2398	1.6015	2.5125

Business Services	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.8239	3.0924	2.4725	2.9351	1.7371	2.4106
Yorkshire & Humberside	1.8332	3.4522	2.4916	2.9721	1.7464	2.6316
North West England	1.8327	3.5084	2.5362	2.9450	1.7526	2.6919
East Midlands	1.8279	3.2476	2.4498	2.8230	1.7420	2.4987
Eastern England	1.8280	3.2455	2.6001	2.8199	1.6718	2.2659
South East England	1.8281	3.2456	2.5771	2.8197	1.6295	2.1412
South West England	1.8364	3.5534	2.5154	2.8906	1.7513	2.6961
West Midlands	1.8314	3.3695	2.4678	2.7751	1.7454	2.5665
Scotland North West	1.8070	2.5389	2.4753	2.7130	1.7226	2.0749
Scotland North East	1.8206	3.2255	2.4012	2.6333	1.7356	2.4553
Scotland South West	1.8263	3.2615	2.4134	2.6517	1.7834	2.6170
Scotland South East	1.8219	3.3399	2.3825	2.5942	1.7346	2.5085
Northern Ireland	1.7965	2.1675	2.6111	5.0272	1.7104	1.8850
Wales	1.8270	3.0292	2.5085	2.8998	1.7403	2.3816
Mean	1.8243	3.1626	2.4930	2.9643	1.7288	2.4161

Other services	Type I Output Multipliers	Type II Output Multipliers	Type I Income Multipliers	Type II Income Multipliers	Type I Employment Multipliers	Type II Employment Multipliers
Northern England	1.1918	3.0971	1.1096	1.6621	1.1129	1.7191
Yorkshire & Humberside	1.2306	3.3066	1.1109	1.7812	1.1351	1.8153
North West England	1.2363	3.2964	1.1199	1.7918	1.1404	1.8324
East Midlands	1.2344	2.9848	1.1081	1.7019	1.1374	1.6965
Eastern England	1.2344	2.9822	1.1450	1.7002	1.1565	1.7507
South East England	1.2344	2.9824	1.1397	1.7001	1.1595	1.7250
South West England	1.2308	3.3381	1.1147	1.7819	1.1363	1.8313
West Midlands	1.2454	3.0325	1.1124	1.7244	1.1438	1.7155
Scotland North West	1.1232	2.5622	1.1005	1.4067	1.0781	1.4932
Scotland North East	1.2125	2.9876	1.1037	1.6061	1.1263	1.6713
Scotland South West	1.2147	3.0262	1.1059	1.6157	1.1080	1.5801
Scotland South East	1.1972	3.0035	1.1077	1.6093	1.1180	1.6699
Northern Ireland	1.0891	2.5494	1.0881	1.4197	1.0598	1.4716
Wales	1.1864	3.0589	1.1097	1.6407	1.1108	1.7094
Mean	1.2044	3.0148	1.1126	1.6530	1.1231	1.6915

Appendix 45. The Projected Changes in the Wider Economy

Appendix 45.a. The Income and Employment Coefficients

Conventional Agriculture

Cereals	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.11147	0.12714	0.55140	0.00001	0.00002	0.00004
Yorkshire & Humberside	0.09618	0.11071	0.53072	0.00002	0.00004	0.00005
North West England	0.11877	0.23646	0.58880	0.00005	0.00007	0.00009
East Midlands	0.09560	0.10905	0.47969	0.00003	0.00004	0.00005
Eastern England	0.11801	0.22250	0.50918	0.00004	0.00005	0.00007
South East England	0.12009	0.13250	0.51833	0.00003	0.00006	0.00009
South West England	0.09334	0.10812	0.51543	0.00002	0.00003	0.00005
West Midlands	0.08920	0.10251	0.45849	0.00002	0.00004	0.00005
Scotland North West	0.12489	0.13885	0.40501	0.00001	0.00002	0.00003
Scotland North East	0.08003	0.09404	0.41604	0.00001	0.00003	0.00004
Scotland South West	0.11191	0.12741	0.50947	0.00001	0.00006	0.00009
Scotland South East	0.07583	0.09020	0.42460	0.00002	0.00004	0.00005
Northern Ireland	0.12014	0.13736	0.44588	0.00001	0.00003	0.00004
Wales	0.14112	0.15966	0.57732	0.00001	0.00003	0.00005
Mean	0.09977	0.12643	0.46202	0.00002	0.00004	0.00005

Other Crops	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.08764	0.09204	0.31404	0.00001	0.00001	0.00002
Yorkshire & Humberside	0.08615	0.08969	0.33694	0.00002	0.00003	0.00004
North West England	0.08585	0.12759	0.33833	0.00005	0.00006	0.00007
East Midlands	0.08448	0.08821	0.31365	0.00003	0.00003	0.00004
Eastern England	0.04810	0.05764	0.14552	0.00007	0.00007	0.00008
South East England	0.05260	0.05590	0.16540	0.00007	0.00008	0.00009
South West England	0.04809	0.05172	0.18653	0.00002	0.00002	0.00003
West Midlands	0.04566	0.04849	0.17530	0.00002	0.00003	0.00003
Scotland North West	0.07495	0.07832	0.18782	0.00001	0.00001	0.00002
Scotland North East	0.03588	0.03912	0.12635	0.00001	0.00002	0.00002
Scotland South West	0.06080	0.06448	0.20048	0.00001	0.00003	0.00004
Scotland South East	0.03150	0.03484	0.11845	0.00002	0.00003	0.00003
Northern Ireland	0.06054	0.06437	0.18035	0.00001	0.00002	0.00002
Wales	0.07764	0.08188	0.26446	0.00001	0.00002	0.00003
Mean	0.05866	0.06495	0.20357	0.00002	0.00003	0.00004

Beef	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.13832	0.14393	0.40082	0.00001	0.00001	0.00003
Yorkshire & Humberside	0.12660	0.13070	0.36469	0.00002	0.00003	0.00004
North West England	0.15602	0.23662	0.44694	0.00005	0.00006	0.00008
East Midlands	0.13143	0.13637	0.33949	0.00003	0.00003	0.00004
Eastern England	0.14792	0.20662	0.37257	0.00002	0.00003	0.00004
South East England	0.15208	0.15755	0.39633	0.00003	0.00004	0.00007
South West England	0.18257	0.18788	0.49214	0.00002	0.00002	0.00004
West Midlands	0.19037	0.19377	0.48349	0.00002	0.00003	0.00005
Scotland North West	0.12051	0.12406	0.27602	0.00001	0.00001	0.00002
Scotland North East	0.12495	0.12949	0.35950	0.00001	0.00002	0.00003
Scotland South West	0.13695	0.14171	0.38631	0.00001	0.00004	0.00006
Scotland South East	0.11714	0.12207	0.36706	0.00002	0.00003	0.00004
Northern Ireland	0.17512	0.18021	0.39081	0.00001	0.00002	0.00003
Wales	0.15825	0.16398	0.42572	0.00001	0.00002	0.00003
Mean	0.13722	0.15033	0.36679	0.00002	0.00003	0.00004

Sheep	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.14140	0.14482	0.34065	0.00001	0.00001	0.00002
Yorkshire & Humberside	0.17287	0.17537	0.37734	0.00002	0.00002	0.00004
North West England	0.14255	0.19415	0.36102	0.00005	0.00006	0.00007
East Midlands	0.15285	0.15587	0.28752	0.00003	0.00003	0.00004
Eastern England	0.19866	0.22618	0.34844	0.00006	0.00007	0.00008
South East England	0.18075	0.18409	0.32014	0.00008	0.00009	0.00011
South West England	0.18534	0.18858	0.35810	0.00002	0.00002	0.00003
West Midlands	0.14445	0.14652	0.26344	0.00002	0.00003	0.00003
Scotland North West	0.14375	0.14591	0.24323	0.00001	0.00001	0.00001
Scotland North East	0.15672	0.15949	0.30860	0.00001	0.00002	0.00002
Scotland South West	0.11517	0.11807	0.27351	0.00001	0.00003	0.00004
Scotland South East	0.13177	0.13477	0.29373	0.00002	0.00003	0.00004
Northern Ireland	0.15040	0.15351	0.29576	0.00001	0.00002	0.00003
Wales	0.13359	0.13708	0.34157	0.00001	0.00002	0.00003
Mean	0.14335	0.15096	0.2942	0.00002	0.00003	0.00004

Pigs and Poultry	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.01984	0.02050	0.16508	0.00001	0.00001	0.00002
Yorkshire & Humberside	0.01984	0.02032	0.16951	0.00002	0.00003	0.00003
North West England	0.03279	0.04461	0.17777	0.00005	0.00006	0.00007
East Midlands	0.03279	0.03337	0.15728	0.00003	0.00003	0.00004
Eastern England	0.02905	0.03820	0.14516	0.00002	0.00003	0.00004
South East England	0.02905	0.02969	0.14598	0.00004	0.00005	0.00006
South West England	0.02905	0.02967	0.15506	0.00002	0.00002	0.00003
West Midlands	0.03279	0.03319	0.15578	0.00002	0.00003	0.00004
Scotland North West	0.01984	0.02025	0.11172	0.00001	0.00001	0.00001
Scotland North East	0.01984	0.02037	0.14256	0.00001	0.00002	0.00002
Scotland South West	0.01984	0.02040	0.15291	0.00001	0.00003	0.00004
Scotland South East	0.01984	0.02042	0.14899	0.00002	0.00003	0.00004
Northern Ireland	0.01984	0.02043	0.13665	0.00001	0.00002	0.00002
Wales	0.02905	0.02972	0.15033	0.00001	0.00002	0.00002
Mean	0.02356	0.02541	0.14099	0.00002	0.00003	0.00003

Milk	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.08139	0.09492	0.26553	0.00001	0.00001	0.00002
Yorkshire & Humberside	0.09492	0.10480	0.29788	0.00002	0.00003	0.00004
North West England	0.09205	0.12377	0.27719	0.00005	0.00006	0.00007
East Midlands	0.11113	0.12305	0.28949	0.00003	0.00003	0.00004
Eastern England	0.12559	0.17630	0.33350	0.00001	0.00002	0.00003
South East England	0.12559	0.13878	0.33397	0.00003	0.00004	0.00006
South West England	0.08539	0.09819	0.28347	0.00002	0.00002	0.00003
West Midlands	0.10960	0.11780	0.28566	0.00002	0.00003	0.00004
Scotland North West	0.14238	0.15093	0.27843	0.00001	0.00001	0.00002
Scotland North East	0.13928	0.15022	0.32799	0.00001	0.00002	0.00003
Scotland South West	0.11909	0.13057	0.29411	0.00001	0.00003	0.00005
Scotland South East	0.13289	0.14477	0.32447	0.00002	0.00003	0.00004
Northern Ireland	0.09851	0.11077	0.23356	0.00001	0.00002	0.00002
Wales	0.10259	0.11640	0.27929	0.00001	0.00002	0.00003
Mean	0.10403	0.11875	0.27364	0.00002	0.00002	0.00003

Energy	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.12593	0.29191	0.39500	0.00000	0.00001	0.00002
Yorkshire & Humberside	0.12593	0.29212	0.42569	0.00000	0.00001	0.00002
North West England	0.10031	0.18502	0.38307	0.00000	0.00001	0.00002
East Midlands	0.12593	0.28316	0.39582	0.00000	0.00001	0.00002
Eastern England	0.12593	0.22618	0.39631	0.00000	0.00001	0.00003
South East England	0.12593	0.28553	0.39636	0.00000	0.00002	0.00004
South West England	0.12593	0.29236	0.42160	0.00000	0.00001	0.00002
West Midlands	0.12593	0.28529	0.40022	0.00000	0.00001	0.00002
Scotland North West	0.12593	0.28264	0.29324	0.00000	0.00001	0.00001
Scotland North East	0.12593	0.28562	0.29943	0.00000	0.00001	0.00001
Scotland South West	0.12593	0.29336	0.29940	0.00000	0.00000	0.00002
Scotland South East	0.12593	0.28372	0.34537	0.00000	0.00001	0.00002
Northern Ireland	0.12593	0.27582	0.31992	0.00000	0.00001	0.00002
Wales	0.11464	0.27072	0.36762	0.00000	0.00001	0.00002
Mean	0.11507	0.25556	0.3426	0.0	0.00001	0.00002

Manufacturing	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.25739	0.73883	0.62678	0.00002	0.00003	0.00005
Yorkshire & Humberside	0.25739	0.72957	0.67188	0.00002	0.00003	0.00005
North West England	0.25739	0.42495	0.68337	0.00002	0.00003	0.00005
East Midlands	0.25739	0.70758	0.60926	0.00002	0.00003	0.00004
Eastern England	0.25739	0.41058	0.61206	0.00001	0.00003	0.00005
South East England	0.25739	0.71752	0.61227	0.00002	0.00004	0.00008
South West England	0.24329	0.69133	0.68798	0.00002	0.00003	0.00005
West Midlands	0.25739	0.71204	0.61273	0.00002	0.00003	0.00004
Scotland North West	0.13102	0.45390	0.34219	0.00002	0.00003	0.00004
Scotland North East	0.21916	0.59455	0.57673	0.00002	0.00003	0.00005
Scotland South West	0.21916	0.62834	0.57649	0.00004	0.00007	0.00011
Scotland South East	0.24796	0.65452	0.62129	0.00002	0.00003	0.00005
Northern Ireland	0.25680	0.67866	0.51378	0.00002	0.00002	0.00004
Wales	0.25739	0.75585	0.60772	0.00002	0.00003	0.00004
Mean	0.2251	0.59321	0.55697	0.00002	0.00003	0.00005

Distribution	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.35657	0.43592	0.75842	0.00004	0.00005	0.00007
Yorkshire & Humberside	0.37288	0.46005	0.85340	0.00004	0.00005	0.00008
North West England	0.37288	0.59535	0.85256	0.00004	0.00005	0.00008
East Midlands	0.36804	0.44688	0.78613	0.00004	0.00005	0.00008
Eastern England	0.36804	0.58770	0.78712	0.00005	0.00007	0.00010
South East England	0.36804	0.44746	0.78722	0.00009	0.00012	0.00017
South West England	0.37288	0.46448	0.83606	0.00004	0.00005	0.00008
West Midlands	0.36225	0.44058	0.79356	0.00004	0.00005	0.00008
Scotland North West	0.27309	0.32917	0.50335	0.00004	0.00005	0.00006
Scotland North East	0.27833	0.34254	0.66166	0.00004	0.00005	0.00007
Scotland South West	0.27833	0.34409	0.66155	0.00008	0.00011	0.00015
Scotland South East	0.25664	0.31891	0.63660	0.00004	0.00005	0.00007
Northern Ireland	0.27881	0.33787	0.49907	0.00004	0.00005	0.00006
Wales	0.36225	0.44101	0.73507	0.00004	0.00005	0.00007
Mean	0.31127	0.39947	0.67678	0.00004	0.00006	0.00008

Transport	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.27969	0.42453	0.64495	0.00002	0.00003	0.00005
Yorkshire & Humberside	0.31394	0.48111	0.75551	0.00002	0.00003	0.00006
North West England	0.32438	0.51426	0.77502	0.00002	0.00003	0.00006
East Midlands	0.29652	0.45042	0.67904	0.00002	0.00003	0.00005
Eastern England	0.29652	0.47099	0.67979	0.00003	0.00005	0.00008
South East England	0.29652	0.45096	0.67986	0.00005	0.00008	0.00012
South West England	0.27885	0.43607	0.71450	0.00002	0.00003	0.00006
West Midlands	0.28454	0.43858	0.67842	0.00002	0.00003	0.00005
Scotland North West	0.33116	0.46282	0.56190	0.00002	0.00003	0.00004
Scotland North East	0.33116	0.48693	0.69552	0.00002	0.00003	0.00005
Scotland South West	0.33116	0.48869	0.69543	0.00005	0.00007	0.00012
Scotland South East	0.28306	0.43073	0.64863	0.00002	0.00003	0.00005
Northern Ireland	0.22158	0.31309	0.42482	0.00002	0.00003	0.00004
Wales	0.23333	0.36028	0.56239	0.00002	0.00003	0.00005
Mean	0.27349	0.41396	0.61305	0.00002	0.00004	0.00006

Business Services	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.21179	0.53552	0.62504	0.00003	0.00005	0.00006
Yorkshire & Humberside	0.25807	0.65621	0.76787	0.00003	0.00005	0.00007
North West England	0.27149	0.49758	0.79970	0.00003	0.00005	0.00007
East Midlands	0.24359	0.61124	0.68917	0.00003	0.00005	0.00007
Eastern England	0.24359	0.44548	0.68992	0.00004	0.00007	0.00010
South East England	0.24359	0.61385	0.68999	0.00009	0.00014	0.00018
South West England	0.28214	0.72043	0.81829	0.00003	0.00005	0.00007
West Midlands	0.26794	0.66972	0.74455	0.00003	0.00005	0.00007
Scotland North West	0.14816	0.37574	0.40227	0.00003	0.00005	0.00006
Scotland North East	0.27116	0.66161	0.72003	0.00003	0.00005	0.00007
Scotland South West	0.27116	0.66862	0.71994	0.00005	0.00010	0.00014
Scotland South East	0.29288	0.70558	0.76081	0.00003	0.00005	0.00007
Northern Ireland	0.04030	0.10724	0.20276	0.00003	0.00005	0.00005
Wales	0.20406	0.52029	0.59223	0.00003	0.00005	0.00006
Mean	0.21666	0.51927	0.61484	0.00003	0.00006	0.00008

Other services	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.56175	0.62817	0.93790	0.00004	0.00005	0.00008
Yorkshire & Humberside	0.55216	0.61851	0.98452	0.00004	0.00005	0.00008
North West England	0.54860	0.67826	0.98313	0.00004	0.00005	0.00008
East Midlands	0.49816	0.55877	0.84945	0.00004	0.00005	0.00008
Eastern England	0.49816	0.61512	0.85019	0.00005	0.00006	0.00010
South East England	0.49816	0.55982	0.85026	0.00010	0.00011	0.00016
South West England	0.56175	0.62860	1.00373	0.00004	0.00005	0.00008
West Midlands	0.50098	0.56021	0.86492	0.00004	0.00005	0.00008
Scotland North West	0.56175	0.62259	0.79064	0.00004	0.00005	0.00007
Scotland North East	0.56175	0.62352	0.90869	0.00004	0.00005	0.00007
Scotland South West	0.56175	0.62597	0.90857	0.00012	0.00013	0.00019
Scotland South East	0.56175	0.62468	0.90510	0.00004	0.00005	0.00007
Northern Ireland	0.56175	0.61286	0.79784	0.00004	0.00005	0.00007
Wales	0.56175	0.62667	0.92229	0.00004	0.00005	0.00008
Mean	0.50601	0.57225	0.83715	0.00005	0.00006	0.00009

Cereals	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.08215	0.09523	0.40023	0.00001	0.00002	0.00003
Yorkshire & Humberside	0.07078	0.08318	0.37872	0.00002	0.00003	0.00004
North West England	0.08736	0.10265	0.44130	0.00005	0.00007	0.00008
East Midlands	0.07177	0.08143	0.34734	0.00003	0.00004	0.00005
Eastern England	0.27501	0.28303	0.83870	0.00003	0.00006	0.00009
South East England	0.24466	0.25237	0.77551	0.00003	0.00007	0.00012
South West England	0.07847	0.09116	0.38737	0.00002	0.00003	0.00004
West Midlands	0.08942	0.09987	0.38409	0.00002	0.00004	0.00005
Scotland North West	0.11294	0.12670	0.33698	0.00001	0.00002	0.00003
Scotland North East	0.07887	0.09125	0.32342	0.00001	0.00002	0.00003
Scotland South West	0.08468	0.09897	0.35137	0.00001	0.00004	0.00006
Scotland South East	0.07726	0.09146	0.33898	0.00002	0.00003	0.00004
Northern Ireland	0.09847	0.11570	0.34429	0.00001	0.00003	0.00003
Wales	0.10910	0.12642	0.46229	0.00001	0.00003	0.00004
Mean	0.10406	0.11596	0.40737	0.00002	0.00004	0.00005

Other Crops	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.03950	0.04152	0.15210	0.00001	0.00001	0.00002
Yorkshire & Humberside	0.02773	0.03012	0.12297	0.00002	0.00002	0.00003
North West England	0.05953	0.06230	0.20424	0.00005	0.00006	0.00006
East Midlands	0.02913	0.03168	0.11714	0.00003	0.00003	0.00003
Eastern England	0.09065	0.09600	0.24531	0.00007	0.00007	0.00008
South East England	0.08972	0.09470	0.24530	0.00007	0.00007	0.00009
South West England	0.04968	0.05192	0.18226	0.00002	0.00002	0.00003
West Midlands	0.04834	0.05078	0.16115	0.00002	0.00003	0.00003
Scotland North West	0.07232	0.07537	0.18006	0.00001	0.00001	0.00002
Scotland North East	0.03296	0.03402	0.11183	0.00001	0.00001	0.00002
Scotland South West	0.04221	0.04511	0.14708	0.00001	0.00002	0.00003
Scotland South East	0.03161	0.03451	0.11316	0.00002	0.00003	0.00003
Northern Ireland	0.05215	0.05551	0.15739	0.00001	0.00002	0.00002
Wales	0.05536	0.05906	0.20122	0.00001	0.00002	0.00003
Mean	0.04806	0.05084	0.15608	0.00002	0.00003	0.00003

Beef	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.09461	0.09691	0.28500	0.00001	0.00001	0.00002
Yorkshire & Humberside	0.07988	0.08380	0.24451	0.00002	0.00002	0.00003
North West England	0.13456	0.13786	0.37932	0.00005	0.00006	0.00007
East Midlands	0.09334	0.09806	0.23894	0.00003	0.00003	0.00004
Eastern England	0.09892	0.10525	0.24526	0.00002	0.00003	0.00004
South East England	0.10993	0.11608	0.29208	0.00003	0.00004	0.00006
South West England	0.09726	0.10050	0.28494	0.00002	0.00002	0.00003
West Midlands	0.12480	0.12815	0.31934	0.00002	0.00003	0.00004
Scotland North West	0.12759	0.13111	0.26559	0.00001	0.00001	0.00002
Scotland North East	0.08670	0.08670	0.24544	0.00001	0.00002	0.00002
Scotland South West	0.09213	0.09666	0.26721	0.00001	0.00003	0.00005
Scotland South East	0.08632	0.09124	0.26288	0.00002	0.00003	0.00004
Northern Ireland	0.15399	0.15897	0.33899	0.00001	0.00002	0.00003
Wales	0.13670	0.14226	0.36204	0.00001	0.00002	0.00003
Mean	0.10112	0.1049	0.26877	0.00002	0.00002	0.00003

Sheep	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.11210	0.11349	0.28060	0.00001	0.00001	0.00002
Yorkshire & Humberside	0.13424	0.13659	0.30158	0.00002	0.00002	0.00003
North West England	0.18203	0.18400	0.41297	0.00005	0.00006	0.00007
East Midlands	0.13387	0.13670	0.25934	0.00003	0.00003	0.00004
Eastern England	0.19801	0.20180	0.36435	0.00009	0.00009	0.00010
South East England	0.16076	0.16445	0.29901	0.00010	0.00011	0.00013
South West England	0.15051	0.15245	0.31421	0.00002	0.00002	0.00003
West Midlands	0.16469	0.16670	0.30439	0.00002	0.00003	0.00004
Scotland North West	0.16366	0.16577	0.27466	0.00001	0.00001	0.00002
Scotland North East	0.13890	0.13890	0.29042	0.00001	0.00002	0.00002
Scotland South West	0.11022	0.11293	0.27976	0.00001	0.00003	0.00005
Scotland South East	0.11572	0.11867	0.28323	0.00002	0.00003	0.00004
Northern Ireland	0.14664	0.14963	0.28057	0.00001	0.00002	0.00002
Wales	0.13806	0.14139	0.31341	0.00001	0.00002	0.00003
Mean	0.13663	0.1389	0.2839	0.00003	0.00003	0.00004

Pigs and Poultry	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.03279	0.03306	0.10064	0.00001	0.00001	0.00001
Yorkshire & Humberside	0.03279	0.03325	0.10505	0.00002	0.00002	0.00003
North West England	0.03142	0.03181	0.10641	0.00005	0.00006	0.00006
East Midlands	0.03142	0.03197	0.09549	0.00003	0.00003	0.00003
Eastern England	0.03314	0.03388	0.12022	0.00002	0.00003	0.00003
South East England	0.03314	0.03386	0.11735	0.00004	0.00004	0.00005
South West England	0.03314	0.03352	0.10651	0.00002	0.00002	0.00002
West Midlands	0.03142	0.03181	0.09761	0.00002	0.00003	0.00003
Scotland North West	0.03279	0.03320	0.07723	0.00001	0.00001	0.00001
Scotland North East	0.03279	0.03279	0.09145	0.00001	0.00001	0.00002
Scotland South West	0.03279	0.03332	0.09370	0.00001	0.00002	0.00003
Scotland South East	0.03279	0.03336	0.09593	0.00002	0.00003	0.00003
Northern Ireland	0.03279	0.03337	0.08711	0.00001	0.00002	0.00002
Wales	0.03314	0.03379	0.10310	0.00001	0.00002	0.00002
Mean	0.03042	0.03087	0.09319	0.00002	0.00002	0.00003

Milk	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.10503	0.11000	0.29174	0.00001	0.00001	0.00002
Yorkshire & Humberside	0.12873	0.13718	0.32440	0.00002	0.00003	0.00004
North West England	0.10374	0.11085	0.31010	0.00005	0.00006	0.00007
East Midlands	0.09387	0.10405	0.22378	0.00003	0.00003	0.00004
Eastern England	0.00000	0.01364	0.00000	0.00001	0.00001	0.00001
South East England	0.00000	0.01325	0.00000	0.00003	0.00003	0.00003
South West England	0.09918	0.10617	0.29031	0.00002	0.00002	0.00003
West Midlands	0.09387	0.10109	0.22692	0.00002	0.00003	0.00003
Scotland North West	0.11921	0.12679	0.23046	0.00001	0.00001	0.00002
Scotland North East	0.11921	0.11921	0.27372	0.00001	0.00002	0.00002
Scotland South West	0.11921	0.12896	0.27814	0.00001	0.00003	0.00004
Scotland South East	0.11921	0.12981	0.28489	0.00002	0.00003	0.00004
Northern Ireland	0.11298	0.12371	0.24067	0.00001	0.00002	0.00002
Wales	0.11298	0.12497	0.27871	0.00001	0.00002	0.00003
Mean	0.08848	0.09665	0.21692	0.00002	0.00002	0.00003

Energy	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.12593	0.28031	0.39266	0.00000	0.00001	0.00002
Yorkshire & Humberside	0.12593	0.28270	0.42516	0.00000	0.00001	0.00002
North West England	0.10031	0.23841	0.38299	0.00000	0.00001	0.00002
East Midlands	0.12593	0.27445	0.39486	0.00000	0.00001	0.00002
Eastern England	0.12593	0.31319	0.39439	0.00000	0.00001	0.00003
South East England	0.12593	0.30678	0.39436	0.00000	0.00002	0.00004
South West England	0.12593	0.28314	0.42004	0.00000	0.00001	0.00002
West Midlands	0.12593	0.27880	0.39964	0.00000	0.00001	0.00002
Scotland North West	0.12593	0.27771	0.29306	0.00000	0.00001	0.00001
Scotland North East	0.12593	0.27901	0.29731	0.00000	0.00001	0.00001
Scotland South West	0.12593	0.28166	0.29908	0.00000	0.00000	0.00002
Scotland South East	0.12593	0.27865	0.34490	0.00000	0.00001	0.00002
Northern Ireland	0.12593	0.26673	0.31976	0.00000	0.00001	0.00002
Wales	0.11464	0.25944	0.36728	0.00000	0.00001	0.00002
Mean	0.11507	0.26007	0.3417	0.0	0.00001	0.00002

Manufacturing	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.25739	0.65074	0.61535	0.00002	0.00003	0.00004
Yorkshire & Humberside	0.25739	0.65032	0.66965	0.00002	0.00003	0.00005
North West England	0.25739	0.70097	0.68299	0.00002	0.00003	0.00005
East Midlands	0.25739	0.62994	0.60494	0.00002	0.00003	0.00004
Eastern England	0.25739	0.78836	0.60315	0.00001	0.00003	0.00005
South East England	0.25739	0.76447	0.60302	0.00002	0.00004	0.00008
South West England	0.24329	0.62379	0.67884	0.00002	0.00003	0.00005
West Midlands	0.25739	0.65492	0.61038	0.00002	0.00003	0.00004
Scotland North West	0.13102	0.42144	0.34083	0.00002	0.00003	0.00004
Scotland North East	0.21916	0.54482	0.55907	0.00002	0.00003	0.00004
Scotland South West	0.21916	0.55801	0.57382	0.00004	0.00007	0.00011
Scotland South East	0.24796	0.61348	0.61839	0.00002	0.00003	0.00005
Northern Ireland	0.25680	0.62314	0.51286	0.00002	0.00002	0.00004
Wales	0.25739	0.68662	0.60608	0.00002	0.00003	0.00004
Mean	0.2251	0.59407	0.55196	0.00002	0.00003	0.00005

Distribution	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.35657	0.43203	0.75353	0.00004	0.00005	0.00007
Yorkshire & Humberside	0.37288	0.45637	0.85222	0.00004	0.00005	0.00008
North West England	0.37288	0.46386	0.85237	0.00004	0.00005	0.00008
East Midlands	0.36804	0.44377	0.78401	0.00004	0.00005	0.00008
Eastern England	0.36804	0.45062	0.78293	0.00005	0.00007	0.00010
South East England	0.36804	0.44951	0.78286	0.00009	0.00012	0.00017
South West England	0.37288	0.46072	0.83285	0.00004	0.00005	0.00008
West Midlands	0.36225	0.43832	0.79223	0.00004	0.00005	0.00008
Scotland North West	0.27309	0.32739	0.50289	0.00004	0.00005	0.00006
Scotland North East	0.27833	0.34020	0.65433	0.00004	0.00005	0.00007
Scotland South West	0.27833	0.34085	0.66045	0.00008	0.00011	0.00015
Scotland South East	0.25664	0.31730	0.63543	0.00004	0.00005	0.00007
Northern Ireland	0.27881	0.33569	0.49873	0.00004	0.00005	0.00006
Wales	0.36225	0.43793	0.73433	0.00004	0.00005	0.00007
Mean	0.31127	0.37964	0.67461	0.00004	0.00006	0.00008

Transport	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.27969	0.42117	0.64141	0.00002	0.00003	0.00005
Yorkshire & Humberside	0.31394	0.47765	0.75463	0.00002	0.00003	0.00006
North West England	0.32438	0.49564	0.77488	0.00002	0.00003	0.00006
East Midlands	0.29652	0.44735	0.67750	0.00002	0.00003	0.00005
Eastern England	0.29652	0.45459	0.67673	0.00003	0.00005	0.00008
South East England	0.29652	0.45346	0.67668	0.00005	0.00008	0.00012
South West England	0.27885	0.43296	0.71202	0.00002	0.00003	0.00006
West Midlands	0.28454	0.43654	0.67747	0.00002	0.00003	0.00005
Scotland North West	0.33116	0.46086	0.56156	0.00002	0.00003	0.00004
Scotland North East	0.33116	0.48432	0.68976	0.00002	0.00003	0.00005
Scotland South West	0.33116	0.48507	0.69457	0.00005	0.00007	0.00012
Scotland South East	0.28306	0.42882	0.64770	0.00002	0.00003	0.00005
Northern Ireland	0.22158	0.31147	0.42459	0.00002	0.00003	0.00004
Wales	0.23333	0.35799	0.56190	0.00002	0.00003	0.00005
Mean	0.27349	0.40986	0.61143	0.00002	0.00004	0.00006

Business Services	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.21179	0.52367	0.62163	0.00003	0.00005	0.00006
Yorkshire & Humberside	0.25807	0.64300	0.76699	0.00003	0.00005	0.00007
North West England	0.27149	0.68855	0.79955	0.00003	0.00005	0.00007
East Midlands	0.24359	0.59674	0.68764	0.00003	0.00005	0.00007
Eastern England	0.24359	0.63334	0.68688	0.00004	0.00007	0.00010
South East England	0.24359	0.62773	0.68683	0.00009	0.00014	0.00018
South West England	0.28214	0.70967	0.81555	0.00003	0.00005	0.00007
West Midlands	0.26794	0.66123	0.74356	0.00003	0.00005	0.00007
Scotland North West	0.14816	0.36675	0.40197	0.00003	0.00005	0.00006
Scotland North East	0.27116	0.65111	0.71406	0.00003	0.00005	0.00007
Scotland South West	0.27116	0.65443	0.71904	0.00005	0.00010	0.00014
Scotland South East	0.29288	0.69778	0.75979	0.00003	0.00005	0.00007
Northern Ireland	0.04030	0.10523	0.20261	0.00003	0.00005	0.00005
Wales	0.20406	0.51188	0.59173	0.00003	0.00005	0.00006
Mean	0.21666	0.53807	0.61319	0.00003	0.00006	0.00008

Other services	DICj	DIICj	DIIICj = r*hj	DECj	DIECj	DIIECj
Northern England	0.56175	0.62331	0.93369	0.00004	0.00005	0.00008
Yorkshire & Humberside	0.55216	0.61341	0.98352	0.00004	0.00005	0.00008
North West England	0.54860	0.61439	0.98297	0.00004	0.00005	0.00008
East Midlands	0.49816	0.55202	0.84780	0.00004	0.00005	0.00008
Eastern England	0.49816	0.57042	0.84695	0.00006	0.00006	0.00010
South East England	0.49816	0.56774	0.84690	0.00010	0.00011	0.00016
South West England	0.56175	0.62619	1.00098	0.00004	0.00005	0.00008
West Midlands	0.50098	0.55727	0.86387	0.00004	0.00005	0.00008
Scotland North West	0.56175	0.61821	0.79023	0.00004	0.00005	0.00007
Scotland North East	0.56175	0.62001	0.90225	0.00004	0.00005	0.00007
Scotland South West	0.56175	0.62124	0.90760	0.00012	0.00013	0.00019
Scotland South East	0.56175	0.62227	0.90405	0.00004	0.00005	0.00007
Northern Ireland	0.56175	0.61122	0.79754	0.00004	0.00005	0.00007
Wales	0.56175	0.62337	0.92166	0.00004	0.00005	0.00008
Mean	0.50601	0.56274	0.83533	0.00005	0.00006	0.00009

Appendix 45.b. The Wider Output Effects of Moving to Sustainability

Cereals	Changes in output (£)	Type I Output effects (£)	Type II Output effects (£)
Northern England	-£8,948,744	-£17,952,046	-£28,107,956
Yorkshire & Humberside	-£36,400,070	-£70,612,264	-£111,425,935
North West England	-£13,274,588	-£26,428,339	-£42,813,236
East Midlands	-£42,133,166	-£80,148,676	-£121,924,995
Eastern England	-£354,363,967	-£668,130,706	-£1,041,268,906
South East England	-£168,642,685	-£320,566,529	-£501,364,589
South West England	-£54,516,459	-£105,303,903	-£164,680,989
West Midlands	-£35,788,832	-£66,466,089	-£100,436,364
Scotland North West	-£18,751,520	-£38,652,464	-£52,489,461
Scotland North East	-£46,486,535	-£88,150,251	-£126,772,813
Scotland South West	-£14,157,568	-£28,618,821	-£43,027,132
Scotland South East	-£22,186,879	-£41,561,743	-£60,397,337
Northern Ireland	-£9,166,724	-£17,482,172	-£24,970,508
Wales	-£12,644,567	-£25,166,635	-£40,008,667
Total	(£837,462,304)	(£1,595,240,638)	(£2,459,688,888)

Other Crops	Changes in output (£)	Type I Output effects (£)	Type II Output effects (£)
Northern England	-£1,243,353	-£1,829,182	-£2,632,828
Yorkshire & Humberside	-£53,966,756	-£80,100,096	-£118,516,856
North West England	£1,918,948	£2,851,858	£4,212,869
East Midlands	-£77,649,519	-£115,543,426	-£165,885,587
Eastern England	£332,222,588	£398,123,650	£498,102,765
South East England	£144,513,542	£178,099,934	£227,538,421
South West England	-£14,926,298	-£19,217,620	-£25,100,835
West Midlands	-£22,203,069	-£28,638,772	-£36,696,604
Scotland North West	-£16,792,308	-£23,303,217	-£29,049,629
Scotland North East	-£28,542,801	-£35,186,038	-£42,388,033
Scotland South West	-£6,610,637	-£8,821,933	-£11,469,424
Scotland South East	-£14,035,140	-£17,064,696	-£20,388,677
Northern Ireland	£1,519,805	£2,012,744	£2,514,926
Wales	-£10,541,517	-£14,782,570	-£20,450,604
Total	£233,663,485	£236,600,636	£259,789,904

Beef	Changes in output (£)	Type I Output effects (£)	Type II Output effects (£)
Northern England	-£24,441,245	-£37,383,740	-£57,547,333
Yorkshire & Humberside	-£45,216,155	-£64,060,352	-£98,898,490
North West England	-£17,940,690	-£27,208,988	-£44,018,249
East Midlands	-£79,066,782	-£109,338,713	-£164,822,270
Eastern England	-£167,453,507	-£233,901,884	-£362,920,631
South East England	-£63,940,649	-£92,642,381	-£145,057,208
South West England	£145,889,815	£224,473,949	£376,190,851
West Midlands	£46,862,672	£71,954,061	£118,861,351
Scotland North West	£33,202,840	£52,285,453	£68,982,855
Scotland North East	£31,312,349	£49,100,541	£71,580,523
Scotland South West	-£65,347,116	-£104,758,605	-£155,186,559
Scotland South East	£3,629,246	£5,747,369	£8,410,924
Northern Ireland	£59,541,919	£89,434,015	£132,066,721
Wales	£120,452,059	£185,155,768	£289,414,685
Total	(£22,515,244)	£8,856,493	£37,057,170

Sheep	Changes in output (£)	Type I Output effects (£)	Type II Output effects (£)
Northern England	£65,094,441	£88,533,747	£134,173,849
Yorkshire & Humberside	£132,660,304	£169,311,398	£275,071,039
North West England	£33,914,128	£46,190,194	£71,856,438
East Midlands	£255,445,858	£296,050,446	£447,862,153
Eastern England	-£149,688,622	-£170,428,365	-£278,290,376
South East England	£87,395,166	£99,103,994	£156,972,545
South West England	£171,039,000	£200,976,955	£330,402,635
West Midlands	£215,053,948	£241,660,480	£358,949,069
Scotland North West	£162,587,243	£205,966,162	£278,016,456
Scotland North East	£88,911,996	£112,255,476	£167,048,915
Scotland South West	£88,917,876	£119,412,014	£167,993,041
Scotland South East	£31,361,935	£40,952,082	£59,370,684
Northern Ireland	-£59,750,972	-£78,302,105	-£110,678,976
Wales	-£62,477,008	-£88,238,505	-£131,626,366
Total	£1,060,465,293	£1,283,443,973	£1,927,121,106

Pigs and Poultry	Changes in output (£)	Type I Output effects (£)	Type II Output effects (£)
Northern England	£959,846	£1,359,648	£1,685,785
Yorkshire & Humberside	-£17,856,281	-£25,188,458	-£31,583,160
North West England	£2,408,054	£3,276,195	£4,173,565
East Midlands	-£54,190,818	-£72,935,190	-£90,552,835
Eastern England	-£80,286,534	-£105,574,228	-£129,675,424
South East England	-£79,701,733	-£104,916,118	-£128,979,803
South West England	-£104,769,797	-£139,554,112	-£173,882,619
West Midlands	-£66,554,998	-£89,231,070	-£110,695,484
Scotland North West	-£2,295,291	-£3,285,871	-£3,753,084
Scotland North East	-£17,538,194	-£24,833,229	-£29,826,117
Scotland South West	-£3,347,149	-£4,786,499	-£5,808,904
Scotland South East	-£2,243,482	-£3,166,671	-£3,835,002
Northern Ireland	-£9,571,545	-£13,342,365	-£15,738,597
Wales	-£36,661,591	-£48,565,017	-£59,770,446
Total	(£471,649,513)	(£630,742,985)	(£778,242,125)

Milk	Changes in output (£)	Type I Output effects (£)	Type II Output effects (£)
Northern England	-£277,821,971	-£389,758,806	-£541,595,519
Yorkshire & Humberside	-£139,981,296	-£195,819,028	-£283,913,081
North West England	-£13,436,697	-£18,065,834	-£25,873,605
East Midlands	-£109,534,368	-£148,235,042	-£213,778,903
Eastern England	-£54,259,250	-£76,166,304	-£113,588,141
South East England	-£125,658,835	-£176,492,644	-£263,292,247
South West England	-£725,829,415	-£1,019,093,202	-£1,453,863,839
West Midlands	-£185,899,681	-£250,127,597	-£360,067,750
Scotland North West	-£99,783,279	-£139,726,980	-£190,345,249
Scotland North East	-£52,641,695	-£73,564,155	-£108,044,097
Scotland South West	£31,558,715	£43,955,274	£62,496,250
Scotland South East	-£13,018,524	-£18,162,737	-£26,608,623
Northern Ireland	-£294,223,342	-£396,294,083	-£522,196,743
Wales	-£317,569,227	-£433,861,762	-£614,188,994
Total	(£2,378,098,865)	(£3,291,412,900)	(£4,654,860,541)

Appendix 45.c. The Wider Income Effects of Moving to Sustainable Agriculture

Cereals	DICj (Direct Income Effects)	DIIC Effects	DIIICj	Indirect Income effects	Induced Income effects
Northern England	-£997,515	-£1,137,708	-£4,934,330	-£140,193	-£3,796,622
Yorkshire & Humberside	-£3,500,925	-£4,029,954	-£19,318,094	-£529,029	-£15,288,140
North West England	-£1,576,632	-£3,138,912	-£7,816,050	-£1,562,280	-£4,677,138
East Midlands	-£4,027,892	-£4,594,811	-£20,210,872	-£566,919	-£15,616,061
Eastern England	-£41,819,094	-£78,847,240	-£180,434,860	-£37,028,146	-£101,587,620
South East England	-£20,252,391	-£22,344,784	-£87,413,375	-£2,092,393	-£65,068,591
South West England	-£5,088,716	-£5,894,581	-£28,099,487	-£805,865	-£22,204,906
West Midlands	-£3,192,510	-£3,668,727	-£16,408,686	-£476,217	-£12,739,959
Scotland North West	-£2,341,817	-£2,603,643	-£7,594,616	-£261,826	-£4,990,972
Scotland North East	-£3,720,262	-£4,371,757	-£19,340,295	-£651,495	-£14,968,538
Scotland South West	-£1,584,417	-£1,803,836	-£7,212,794	-£219,420	-£5,408,958
Scotland South East	-£1,682,329	-£2,001,209	-£9,420,547	-£318,879	-£7,419,338
Northern Ireland	-£1,101,325	-£1,259,100	-£4,087,269	-£157,776	-£2,828,168
Wales	-£1,784,417	-£2,018,863	-£7,299,998	-£234,446	-£5,281,134
Total	(£92,670,242)	(£137,715,125)	(£419,591,273)	(£45,044,884)	(£281,876,145)

Other Crops	DICj (Direct Income Effects)	DIIC Effects	DIIICj	Indirect Income effects	Induced Income effects
Northern England	-£108,972	-£114,439	-£390,458	-£5,467	-£276,019
Yorkshire & Humberside	-£4,649,071	-£4,840,444	-£18,183,579	-£191,373	-£13,343,135
North West England	£164,749	£244,842	£649,240	£80,094	£404,398
East Midlands	-£6,559,524	-£6,849,382	-£24,354,921	-£289,859	-£17,505,539
Eastern England	£15,979,273	£19,148,989	£48,345,942	£3,169,715	£29,196,953
South East England	£7,601,922	£8,078,294	£23,902,828	£476,373	£15,824,534
South West England	-£717,796	-£772,049	-£2,784,160	-£54,253	-£2,012,111
West Midlands	-£1,013,870	-£1,076,690	-£3,892,180	-£62,819	-£2,815,491
Scotland North West	-£1,258,614	-£1,315,158	-£3,153,993	-£56,544	-£1,838,835
Scotland North East	-£1,024,253	-£1,116,602	-£3,606,408	-£92,349	-£2,489,805
Scotland South West	-£401,902	-£426,249	-£1,325,333	-£24,348	-£899,083
Scotland South East	-£442,172	-£488,919	-£1,662,476	-£46,748	-£1,173,556
Northern Ireland	£92,006	£97,829	£274,100	£5,823	£176,271
Wales	-£818,432	-£863,096	-£2,787,801	-£44,664	-£1,924,706
Total	£6,843,344	£9,706,926	£11,030,801	£2,863,581	£1,323,876

Beef	DICj (Direct Income Effects)	DIIC Effects	DIIICj	Indirect Income effects	Induced Income effects
Northern England	-£3,380,622	-£3,517,841	-£9,796,642	-£137,219	-£6,278,801
Yorkshire & Humberside	-£5,724,498	-£5,909,911	-£16,489,731	-£185,413	-£10,579,819
North West England	-£2,799,065	-£4,245,084	-£8,018,484	-£1,446,019	-£3,773,399
East Midlands	-£10,391,453	-£10,782,667	-£26,842,265	-£391,214	-£16,059,598
Eastern England	-£24,769,745	-£34,598,798	-£62,388,358	-£9,829,053	-£27,789,561
South East England	-£9,724,297	-£10,074,060	-£25,341,848	-£349,764	-£15,267,787
South West England	£26,635,831	£27,410,286	£71,798,187	£774,454	£44,387,901
West Midlands	£8,921,452	£9,080,782	£22,657,663	£159,330	£13,576,880
Scotland North West	£4,001,310	£4,119,088	£9,164,587	£117,778	£5,045,499
Scotland North East	£3,912,348	£4,054,480	£11,256,879	£142,132	£7,202,399
Scotland South West	-£8,949,285	-£9,260,304	-£25,244,213	-£311,019	-£15,983,908
Scotland South East	£425,148	£443,025	£1,332,167	£17,877	£889,142
Northern Ireland	£10,427,104	£10,729,985	£23,269,696	£302,881	£12,539,711
Wales	£19,062,040	£19,752,296	£51,279,353	£690,256	£31,527,057
Total	£7,646,268	(£2,798,723)	£16,636,991	(£10,444,993)	£19,435,716

Sheep	DICj (Direct Income Effects)	DIIC Effects	DIIICj	Indirect Income effects	Induced Income effects
Northern England	£9,204,422	£9,427,253	£22,174,607	£222,831	£12,747,353
Yorkshire & Humberside	£22,932,564	£23,264,250	£50,058,588	£331,686	£26,794,338
North West England	£4,834,432	£6,584,375	£12,243,510	£1,749,943	£5,659,136
East Midlands	£39,044,683	£39,815,337	£73,444,644	£770,654	£33,629,308
Eastern England	-£29,736,419	-£33,856,476	-£52,157,798	-£4,120,057	-£18,301,322
South East England	£15,796,891	£16,088,382	£27,978,648	£291,491	£11,890,266
South West England	£31,700,548	£32,254,161	£61,249,136	£553,613	£28,994,975
West Midlands	£31,063,919	£31,509,737	£56,653,993	£445,818	£25,144,256
Scotland North West	£23,372,102	£23,723,755	£39,545,741	£351,653	£15,821,986
Scotland North East	£13,934,057	£14,180,137	£27,437,881	£246,080	£13,257,744
Scotland South West	£10,240,236	£10,498,277	£24,319,642	£258,042	£13,821,364
Scotland South East	£4,132,590	£4,226,783	£9,211,990	£94,194	£4,985,206
Northern Ireland	-£8,986,758	-£9,172,083	-£17,671,878	-£185,325	-£8,499,795
Wales	-£8,346,005	-£8,564,307	-£21,340,155	-£218,301	-£12,775,848
Total	£159,187,262	£159,979,581	£313,148,549	£792,322	£153,168,967

Pigs and Poultry	DICj (Direct Income Effects)	DIIC Effects	DIIICj	Indirect Income effects	Induced Income effects
Northern England	£19,039	£19,673	£158,456	£633	£138,783
Yorkshire & Humberside	-£354,196	-£362,804	-£3,026,767	-£8,608	-£2,663,963
North West England	£78,962	£107,430	£428,070	£28,467	£320,641
East Midlands	-£1,776,969	-£1,808,490	-£8,523,200	-£31,521	-£6,714,711
Eastern England	-£2,332,394	-£3,067,023	-£11,654,384	-£734,630	-£8,587,361
South East England	-£2,315,405	-£2,366,658	-£11,634,461	-£51,253	-£9,267,803
South West England	-£3,043,654	-£3,109,036	-£16,245,550	-£65,382	-£13,136,514
West Midlands	-£2,182,402	-£2,209,003	-£10,367,972	-£26,601	-£8,158,968
Scotland North West	-£45,529	-£46,486	-£256,436	-£957	-£209,950
Scotland North East	-£347,887	-£357,245	-£2,500,195	-£9,359	-£2,142,950
Scotland South West	-£66,394	-£68,267	-£511,816	-£1,873	-£443,549
Scotland South East	-£44,502	-£45,801	-£334,263	-£1,299	-£288,462
Northern Ireland	-£189,861	-£195,584	-£1,307,906	-£5,724	-£1,112,322
Wales	-£1,065,051	-£1,089,749	-£5,511,348	-£24,698	-£4,421,599
Total	(£13,666,243)	(£14,599,043)	(£71,287,772)	(£932,805)	(£56,688,728)

Milk	DICj (Direct Income Effects)	DIIC Effects	DIIICj	Indirect Income effects	Induced Income effects
Northern England	-£22,611,102	-£26,370,822	-£73,771,075	-£3,759,720	-£47,400,253
Yorkshire & Humberside	-£13,286,938	-£14,670,545	-£41,697,039	-£1,383,607	-£27,026,493
North West England	-£1,236,885	-£1,663,009	-£3,724,523	-£426,125	-£2,061,514
East Midlands	-£12,172,113	-£13,478,486	-£31,709,317	-£1,306,373	-£18,230,831
Eastern England	-£6,814,500	-£9,565,839	-£18,095,719	-£2,751,339	-£8,529,879
South East England	-£15,781,680	-£17,438,545	-£41,966,414	-£1,656,866	-£24,527,868
South West England	-£61,981,706	-£71,269,275	-£205,749,940	-£9,287,568	-£134,480,665
West Midlands	-£20,374,632	-£21,898,142	-£53,104,472	-£1,523,510	-£31,206,330
Scotland North West	-£14,207,275	-£15,060,459	-£27,782,496	-£853,184	-£12,722,036
Scotland North East	-£7,331,840	-£7,907,813	-£17,265,873	-£575,973	-£9,358,060
Scotland South West	£3,758,410	£4,120,467	£9,281,605	£362,057	£5,161,137
Scotland South East	-£1,730,092	-£1,884,666	-£4,224,176	-£154,574	-£2,339,511
Northern Ireland	-£28,983,135	-£32,590,768	-£68,719,932	-£3,607,633	-£36,129,164
Wales	-£32,579,262	-£36,965,893	-£88,693,266	-£4,386,631	-£51,727,373
Total	(£235,332,750)	(£266,643,795)	(£667,222,637)	(£31,311,046)	(£400,578,840)

Appendix 45.d. The Employment Effects

Cereals	DECj (Direct Employment Effects)	DIECj	DIIECj	Indirect Employment Effects	Induced Employment Effects
Northern England	-56	-212	-355	-156	-143
Yorkshire & Humberside	-699	-1298	-1892	-600	-593
North West England	-714	-960	-1204	-246	-244
East Midlands	-1059	-1722	-2315	-664	-592
Eastern England	-12717	-18747	-25704	-6031	-6956
South East England	-5492	-10030	-15601	-4537	-5571
South West England	-865	-1766	-2635	-901	-869
West Midlands	-888	-1421	-1903	-533	-483
Scotland North West	-94	-447	-624	-353	-177
Scotland North East	-538	-1263	-1789	-725	-526
Scotland South West	-190	-786	-1237	-596	-450
Scotland South East	-516	-860	-1115	-344	-256
Northern Ireland	-128	-265	-359	-137	-94
Wales	-177	-395	-605	-218	-210
Total	-24133	-40172	-57338	-16041	-17164

Other Crops	DECj (Direct Employment Effects)	DIECj	DIIECj	Indirect Employment Effects	Induced Employment Effects
Northern England	-8	-18	-30	-10	-11
Yorkshire & Humberside	-1036	-1523	-2082	-487	-558
North West England	103	122	142	19	20
East Midlands	-1951	-2661	-3374	-709	-714
Eastern England	23362	24712	26575	1350	1864
South East England	9836	10912	12435	1076	1523
South West England	-237	-311	-397	-74	-86
West Midlands	-551	-662	-776	-111	-114
Scotland North West	-84	-199	-273	-115	-74
Scotland North East	-330	-438	-536	-108	-98
Scotland South West	-89	-178	-260	-89	-83
Scotland South East	-326	-376	-421	-50	-45
Northern Ireland	21	30	36	8	6
Wales	-147	-223	-303	-76	-80
Total	28563	29187	30736	624	1550

Beef	DECj (Direct Employment Effects)	DIECj	DIIECj	Indirect Employment Effects	Induced Employment Effects
Northern England	-154	-356	-640	-203	-284
Yorkshire & Humberside	-868	-1192	-1699	-324	-506
North West England	-965	-1138	-1389	-173	-251
East Midlands	-1987	-2522	-3308	-535	-787
Eastern England	-3656	-5008	-7413	-1352	-2405
South East England	-1981	-2828	-4443	-847	-1615
South West England	2315	3645	5865	1330	2220
West Midlands	1162	1584	2250	421	667
Scotland North West	167	467	680	300	214
Scotland North East	362	649	955	286	306
Scotland South West	-877	-2304	-3881	-1428	-1576
Scotland South East	84	119	155	35	36
Northern Ireland	834	1292	1825	458	533
Wales	1682	2706	4184	1023	1478
Total	-3882	-4886	-6859	-1009	-1970

Sheep	DECj (Direct Employment Effects)	DIECj	DIIECj	Indirect Employment Effects	Induced Employment Effects
Northern England	409	762	1405	354	642
Yorkshire & Humberside	2546	3151	4688	604	1537
North West England	1825	2059	2442	234	383
East Midlands	6419	7124	9276	705	2153
Eastern England	-9564	-9974	-11984	-410	-2011
South East England	7266	7612	9395	345	1783
South West England	2714	3213	5108	499	1894
West Midlands	5334	5785	7451	450	1667
Scotland North West	818	1496	2419	679	922
Scotland North East	1028	1402	2148	373	746
Scotland South West	1193	2303	3822	1110	1519
Scotland South East	729	887	1137	158	250
Northern Ireland	-837	-1117	-1522	-280	-405
Wales	-873	-1275	-1891	-403	-615
Total	19007	23428	33894	4418	10465

Pigs and Poultry	DECj (Direct Employment Effects)	DIECj	DIIECj	Indirect Employment Effects	Induced Employment Effects
Northern England	6	12	16	6	5
Yorkshire & Humberside	-343	-473	-566	-130	-93
North West England	130	153	167	24	13
East Midlands	-1362	-1722	-1972	-361	-250
Eastern England	-1878	-2451	-2900	-572	-449
South East England	-3254	-3963	-4704	-709	-741
South West England	-1663	-2255	-2757	-592	-502
West Midlands	-1651	-2085	-2390	-434	-305
Scotland North West	-12	-25	-31	-14	-6
Scotland North East	-203	-317	-385	-115	-68
Scotland South West	-45	-93	-125	-49	-32
Scotland South East	-52	-70	-79	-18	-9
Northern Ireland	-134	-193	-223	-59	-30
Wales	-512	-704	-863	-192	-159
Total	-10973	-14186	-16812	-3215	-2626

Milk	DECj (Direct Employment Effects)	DIECj	DIIECj	Indirect Employment Effects	Induced Employment Effects
Northern England	-1745	-3539	-5676	-1794	-2137
Yorkshire & Humberside	-2687	-3693	-4974	-1006	-1281
North West England	-723	-833	-950	-110	-116
East Midlands	-2752	-3479	-4408	-726	-929
Eastern England	-368	-866	-1563	-498	-698
South East England	-3466	-5161	-7835	-1695	-2675
South West England	-11519	-16781	-23144	-5262	-6363
West Midlands	-4611	-5812	-7374	-1200	-1562
Scotland North West	-502	-1169	-1817	-667	-648
Scotland North East	-609	-974	-1443	-365	-469
Scotland South West	423	879	1458	455	580
Scotland South East	-303	-400	-514	-97	-115
Northern Ireland	-4121	-5747	-7322	-1626	-1575
Wales	-4435	-6365	-8922	-1930	-2557
Total	-37418	-53940	-74484	-16521	-20545

Appendix 45.e. Changes in the Multipliers arising from Sustainability

Cereals	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.2838	-0.6020	0.0187	-0.0746	-0.8201	-1.6108
Yorkshire & Humberside	-0.2812	-0.6031	0.0241	-0.1670	-0.2577	-0.5143
North West England	-0.2509	-0.5603	-0.8158	0.0941	-0.0744	-0.1534
East Midlands	-0.2602	-0.5346	-0.0061	-0.1780	-0.1693	-0.3227
Eastern England	0.2564	0.9342	-0.8563	-1.2649	0.2075	0.5989
South East England	0.1908	0.7193	-0.0718	-1.1465	0.3084	0.8601
South West England	-0.2704	-0.5440	0.0033	-0.5855	-0.3035	-0.5689
West Midlands	-0.2043	-0.3589	-0.0322	-0.8442	-0.1015	-0.1638
Scotland North West	-0.2340	-0.3583	0.0100	-0.2594	-0.9522	-1.3418
Scotland North East	-0.2803	-0.4748	-0.0181	-1.0980	-0.3659	-0.5681
Scotland South West	-0.3505	-0.6669	0.0302	-0.4031	-1.0968	-1.8616
Scotland South East	-0.2490	-0.4207	-0.0057	-1.2121	-0.1541	-0.2297
Northern Ireland	-0.2311	-0.4177	0.0317	-0.2148	-0.2307	-0.3986
Wales	-0.1905	-0.4250	0.0274	0.1463	-0.2139	-0.4672
Mean	-0.1759	-0.2875	-0.1107	-0.4805	-0.2816	-0.4495

Other Crops	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.2139	-0.5498	0.0009	0.2671	-0.7001	-1.4826
Yorkshire & Humberside	-0.2697	-0.7220	0.0448	0.5229	-0.2995	-0.6462
North West England	-0.2028	-0.4840	-0.4396	-0.5097	-0.0821	-0.1569
East Midlands	-0.2732	-0.6797	0.0433	0.3084	-0.2281	-0.4570
Eastern England	0.0958	0.3011	-0.1394	-0.3193	0.0338	0.0965
South East England	0.0655	0.2297	-0.0071	-0.4101	0.0388	0.1246
South West England	-0.0189	-0.0294	-0.0306	-0.2104	-0.0230	-0.0388
West Midlands	-0.0481	-0.0777	-0.0114	-0.5050	-0.0240	-0.0299
Scotland North West	-0.0173	-0.0317	-0.0029	-0.0163	-0.1228	-0.1984
Scotland North East	-0.0295	-0.0618	-0.0582	-0.1283	-0.0355	-0.0642
Scotland South West	-0.0741	-0.1810	0.0080	0.1866	-0.2610	-0.5217
Scotland South East	-0.0144	-0.0252	-0.0141	-0.1804	-0.0033	-0.0014
Northern Ireland	-0.0331	-0.0753	0.0012	0.0390	-0.0452	-0.0835
Wales	-0.0724	-0.2013	0.0121	0.2282	-0.1100	-0.2475
Mean	-0.0790	-0.1849	-0.0423	-0.0520	-0.1330	-0.2648

Beef	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.1255	-0.3689	-0.0163	0.1145	-0.3851	-0.9859
Yorkshire & Humberside	-0.0997	-0.3541	0.0167	0.1804	-0.1107	-0.3116
North West England	-0.0751	-0.2171	-0.4921	-0.0458	-0.0220	-0.0555
East Midlands	-0.1018	-0.3102	0.0129	-0.0232	-0.0853	-0.2018
Eastern England	-0.1296	-0.3939	-0.3329	-0.0394	-0.1330	-0.3364
South East England	-0.0950	-0.3119	0.0199	0.0510	-0.1310	-0.3234
South West England	-0.1793	-0.6194	0.0042	0.2342	-0.2081	-0.6236
West Midlands	-0.1683	-0.5087	0.0090	0.0191	-0.1094	-0.2825
Scotland North West	-0.1025	-0.1218	-0.0019	-0.2088	-0.3674	-0.4742
Scotland North East	-0.1766	-0.4117	-0.0363	-0.0462	-0.2341	-0.4904
Scotland South West	-0.1675	-0.4058	0.0143	0.0795	-0.4883	-1.0646
Scotland South East	-0.1687	-0.3774	0.0149	-0.0881	-0.1029	-0.2057
Northern Ireland	-0.0681	-0.1634	0.0033	-0.0303	-0.0825	-0.1689
Wales	-0.0811	-0.2111	0.0045	-0.0418	-0.1030	-0.2468
Mean	-0.1159	-0.3184	-0.052	0.0103	-0.1709	-0.3848

Sheep	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.0358	-0.1644	-0.0119	0.0939	-0.1178	-0.4604
Yorkshire & Humberside	-0.0367	-0.1973	0.0031	0.0637	-0.0297	-0.1616
North West England	-0.0227	0.0860	-0.3511	-0.2638	-0.0036	0.0329
East Midlands	0.0044	-0.0544	0.0014	0.0562	0.0043	-0.0278
Eastern England	0.0486	0.0799	-0.1194	0.0861	-0.0025	-0.0503
South East England	0.0269	-0.0181	0.0045	0.0888	-0.0046	-0.0646
South West England	0.0377	-0.0576	-0.0046	0.1556	0.0380	-0.0604
West Midlands	0.0342	0.1185	-0.0144	-0.8238	-0.0844	-0.3968
Scotland North West	0.0253	0.0823	-0.0022	-0.0137	0.0261	0.1115
Scotland North East	0.0362	-0.0087	-0.0177	0.1217	0.0631	0.0342
Scotland South West	0.0548	0.0669	-0.0006	0.1633	0.1006	0.1065
Scotland South East	0.0492	0.0278	0.0027	0.2184	0.0553	0.0633
Northern Ireland	-0.0274	-0.0555	-0.0003	-0.0531	-0.0260	-0.0522
Wales	-0.0967	-0.1544	-0.0020	-0.2868	-0.1079	-0.1768
Mean	0.0065	-0.0166	-0.0342	-0.0262	-0.0059	-0.0735

Pigs and Poultry	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.2504	-0.3848	-0.0251	-5.2530	-0.5729	-0.8937
Yorkshire & Humberside	-0.2447	-0.3810	-0.0104	-5.3416	-0.2285	-0.3354
North West England	-0.1904	-0.3400	-0.3483	-2.0346	-0.0962	-0.1360
East Midlands	-0.1835	-0.3115	-0.0002	-1.7573	-0.1403	-0.2121
Eastern England	-0.1297	-0.1818	-0.2927	-1.3695	-0.1208	-0.1536
South East England	-0.1333	-0.1930	-0.0005	-1.4840	-0.0846	-0.1234
South West England	-0.1622	-0.2656	-0.0101	-2.1239	-0.1768	-0.2757
West Midlands	-0.1780	-0.2986	0.0002	-1.6442	-0.1328	-0.1951
Scotland North West	-0.2568	-0.3197	-0.0085	-3.2770	-0.7456	-0.9226
Scotland North East	-0.2520	-0.3567	-0.0269	-4.3978	-0.3368	-0.4525
Scotland South West	-0.2606	-0.3790	-0.0121	-4.8512	-0.6721	-0.9554
Scotland South East	-0.2439	-0.3501	-0.0117	-4.5856	-0.1946	-0.2497
Northern Ireland	-0.2336	-0.3245	-0.0125	-4.2319	-0.2600	-0.3415
Wales	-0.1544	-0.2506	-0.0036	-2.0639	-0.1801	-0.2811
Mean	-0.1916	-0.2891	-0.0508	-2.961	-0.2628	-0.3685

Milk	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.0303	0.0185	-0.1190	-0.4849	-0.0424	0.0103
Yorkshire & Humberside	-0.0708	-0.0154	-0.0385	-0.6182	-0.0657	-0.0347
North West England	0.0357	0.1045	-0.2760	-0.0219	0.0250	0.0489
East Midlands	-0.0964	-0.2328	0.0011	-0.2212	-0.0721	-0.1481
Eastern England	-0.4037	-1.0934	-0.4037	-1.6555	-1.3546	-3.2523
South East England	-0.4045	-1.0953	-0.1050	-1.6592	-0.4890	-1.2607
South West England	-0.0493	-0.0372	-0.0795	-0.3926	-0.0390	-0.0376
West Midlands	-0.0884	-0.2104	0.0022	-0.1890	-0.0586	-0.1129
Scotland North West	-0.0381	-0.1257	0.0036	-0.0222	-0.2924	-0.5656
Scotland North East	-0.0510	-0.1674	-0.0786	-0.0587	-0.0988	-0.2132
Scotland South West	-0.0355	-0.0679	-0.0145	-0.1363	-0.1461	-0.2434
Scotland South East	-0.0399	-0.1194	-0.0004	-0.0517	-0.0308	-0.0566
Northern Ireland	-0.0344	-0.0217	-0.0294	-0.2408	-0.0360	-0.0255
Wales	-0.0358	-0.0374	-0.0285	-0.2554	-0.0473	-0.0580
Mean	-0.0895	-0.2067	-0.0777	-0.4005	-0.1832	-0.3966

Energy	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.0031	-0.0149	-0.0921	-0.0185	-0.0028	-0.0325
Yorkshire & Humberside	-0.0003	-0.0022	-0.0748	-0.0042	0.0053	0.0083
North West England	-0.0001	-0.0004	0.5322	-0.0008	0.0062	0.0126
East Midlands	-0.0004	-0.0033	-0.0691	-0.0077	0.0040	-0.0003
Eastern England	-0.0007	-0.0064	0.6909	-0.0153	0.0055	-0.0085
South East England	-0.0007	-0.0066	0.1687	-0.0159	0.0048	-0.0162
South West England	-0.0019	-0.0085	-0.0733	-0.0124	-0.0027	-0.0211
West Midlands	-0.0002	-0.0021	-0.0516	-0.0046	0.0043	0.0029
Scotland North West	-0.0001	-0.0007	-0.0391	-0.0014	0.0022	0.0053
Scotland North East	-0.0008	-0.0138	-0.0525	-0.0169	-0.0020	-0.0462
Scotland South West	0.0000	-0.0012	-0.0929	-0.0025	0.0044	0.0195
Scotland South East	-0.0001	-0.0016	-0.0403	-0.0038	0.0025	0.0017
Northern Ireland	-0.0002	-0.0008	-0.0722	-0.0013	0.0033	0.0071
Wales	-0.0002	-0.0015	-0.0983	-0.0029	0.0055	0.0099
Mean	-0.0006	-0.0043	0.0424	-0.0072	0.0027	-0.0038

Manufacturing	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.0386	-0.0730	-0.3422	-0.0444	-0.0262	-0.0600
Yorkshire & Humberside	-0.0033	-0.0094	-0.3079	-0.0087	-0.0057	-0.0175
North West England	-0.0009	-0.0020	1.0724	-0.0015	-0.0063	-0.0147
East Midlands	-0.0044	-0.0147	-0.3017	-0.0168	-0.0081	-0.0237
Eastern England	-0.0085	-0.0296	1.4677	-0.0346	-0.0089	-0.0464
South East England	-0.0086	-0.0304	0.1824	-0.0360	-0.0169	-0.0672
South West England	-0.0273	-0.0519	-0.2776	-0.0375	-0.0318	-0.0620
West Midlands	-0.0025	-0.0083	-0.2219	-0.0091	-0.0075	-0.0196
Scotland North West	-0.0025	-0.0053	-0.2477	-0.0104	-0.0057	-0.0106
Scotland North East	-0.0633	-0.1151	-0.2269	-0.0806	-0.0576	-0.1077
Scotland South West	-0.0034	-0.0097	-0.3209	-0.0122	-0.0059	-0.0148
Scotland South East	-0.0031	-0.0098	-0.1655	-0.0117	-0.0110	-0.0231
Northern Ireland	-0.0024	-0.0047	-0.2162	-0.0036	-0.0042	-0.0095
Wales	-0.0029	-0.0071	-0.2690	-0.0064	-0.0046	-0.0136
Mean	-0.0114	-0.0247	-0.0117	-0.0209	-0.0134	-0.0327

Distribution	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.0077	-0.0311	-0.0109	-0.0137	-0.0007	-0.0058
Yorkshire & Humberside	-0.0008	-0.0050	-0.0099	-0.0032	0.0010	0.0015
North West England	-0.0002	-0.0010	-0.3526	-0.0005	0.0010	0.0023
East Midlands	-0.0010	-0.0072	-0.0085	-0.0058	0.0007	-0.0001
Eastern England	-0.0019	-0.0139	-0.3725	-0.0114	0.0009	-0.0010
South East England	-0.0019	-0.0143	0.0056	-0.0118	0.0007	-0.0018
South West England	-0.0038	-0.0172	-0.0101	-0.0086	-0.0003	-0.0034
West Midlands	-0.0007	-0.0047	-0.0062	-0.0037	0.0007	0.0005
Scotland North West	-0.0004	-0.0018	-0.0065	-0.0017	0.0007	0.0011
Scotland North East	-0.0138	-0.0477	-0.0084	-0.0263	-0.0032	-0.0133
Scotland South West	-0.0007	-0.0040	-0.0116	-0.0040	0.0012	0.0017
Scotland South East	-0.0007	-0.0040	-0.0063	-0.0046	0.0007	0.0005
Northern Ireland	-0.0005	-0.0017	-0.0078	-0.0012	0.0005	0.0010
Wales	-0.0006	-0.0032	-0.0085	-0.0020	0.0009	0.0017
Mean	-0.0023	-0.0105	-0.0543	-0.0066	0.0003	-0.001

Transport	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.0039	-0.0224	-0.0120	-0.0126	0.0001	-0.0074
Yorkshire & Humberside	-0.0004	-0.0037	-0.0110	-0.0028	0.0018	0.0030
North West England	-0.0001	-0.0008	-0.0574	-0.0005	0.0018	0.0042
East Midlands	-0.0005	-0.0053	-0.0104	-0.0052	0.0015	0.0007
Eastern England	-0.0009	-0.0102	-0.0553	-0.0103	0.0015	-0.0006
South East England	-0.0009	-0.0104	0.0084	-0.0107	0.0016	-0.0015
South West England	-0.0025	-0.0134	-0.0111	-0.0089	0.0003	-0.0045
West Midlands	-0.0003	-0.0034	-0.0072	-0.0033	0.0017	0.0015
Scotland North West	-0.0001	-0.0013	-0.0059	-0.0010	0.0009	0.0020
Scotland North East	-0.0056	-0.0375	-0.0079	-0.0174	-0.0018	-0.0199
Scotland South West	-0.0003	-0.0031	-0.0109	-0.0026	0.0016	0.0028
Scotland South East	-0.0003	-0.0031	-0.0067	-0.0033	0.0016	0.0015
Northern Ireland	-0.0002	-0.0011	-0.0073	-0.0010	0.0009	0.0018
Wales	-0.0003	-0.0021	-0.0098	-0.0021	0.0019	0.0032
Mean	-0.0011	-0.0079	-0.0136	-0.0054	0.001	-0.0009

Business Services	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.0037	-0.0217	-0.0559	-0.0161	-0.0019	-0.0108
Yorkshire & Humberside	-0.0003	-0.0037	-0.0512	-0.0034	-0.0007	-0.0042
North West England	-0.0001	-0.0008	0.7034	-0.0006	-0.0008	-0.0036
East Midlands	-0.0004	-0.0052	-0.0595	-0.0063	-0.0009	-0.0053
Eastern England	-0.0008	-0.0101	0.7712	-0.0125	-0.0007	-0.0052
South East England	-0.0008	-0.0104	0.0570	-0.0130	-0.0007	-0.0049
South West England	-0.0026	-0.0148	-0.0381	-0.0097	-0.0021	-0.0109
West Midlands	-0.0002	-0.0035	-0.0317	-0.0037	-0.0009	-0.0051
Scotland North West	-0.0002	-0.0012	-0.0607	-0.0020	-0.0007	-0.0019
Scotland North East	-0.0058	-0.0389	-0.0387	-0.0220	-0.0034	-0.0212
Scotland South West	-0.0003	-0.0033	-0.0523	-0.0033	-0.0008	-0.0038
Scotland South East	-0.0003	-0.0035	-0.0266	-0.0035	-0.0009	-0.0049
Northern Ireland	-0.0002	-0.0007	-0.0497	-0.0036	-0.0007	-0.0012
Wales	-0.0003	-0.0021	-0.0412	-0.0024	-0.0007	-0.0028
Mean	-0.0011	-0.008	0.0684	-0.0068	-0.0011	-0.0057

Other services	Change in Type I Output Multipliers	Change in Type II Output Multipliers	Change in Type I Income Multipliers	Change in Type II Income Multipliers	Change in Type I Employment Multipliers	Change in Type II Employment Multipliers
Northern England	-0.0016	-0.0268	-0.0087	-0.0075	-0.0004	-0.0079
Yorkshire & Humberside	-0.0002	-0.0042	-0.0092	-0.0018	-0.0001	-0.0028
North West England	0.0000	-0.0009	-0.1164	-0.0003	-0.0001	-0.0023
East Midlands	-0.0002	-0.0056	-0.0136	-0.0033	-0.0002	-0.0034
Eastern England	-0.0004	-0.0107	-0.0897	-0.0065	-0.0002	-0.0043
South East England	-0.0004	-0.0110	0.0159	-0.0068	-0.0002	-0.0046
South West England	-0.0009	-0.0146	-0.0043	-0.0049	-0.0004	-0.0065
West Midlands	-0.0001	-0.0037	-0.0059	-0.0021	-0.0002	-0.0031
Scotland North West	-0.0001	-0.0016	-0.0078	-0.0007	-0.0001	-0.0015
Scotland North East	-0.0024	-0.0420	-0.0062	-0.0115	-0.0008	-0.0137
Scotland South West	-0.0001	-0.0035	-0.0084	-0.0017	-0.0001	-0.0018
Scotland South East	-0.0001	-0.0036	-0.0043	-0.0019	-0.0002	-0.0029
Northern Ireland	-0.0001	-0.0015	-0.0029	-0.0005	0.0000	-0.0013
Wales	-0.0001	-0.0028	-0.0059	-0.0011	-0.0001	-0.0021
Mean	-0.0004	-0.0088	-0.0178	-0.0034	-0.0002	-0.0039