The use and role of indigenous knowledge in small-scale agricultural systems in Africa: the case of farmers in northern Malawi.

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Abstract

This thesis examines the role and use of indigenous knowledge within small-scale agricultural systems in Africa and its relevance in development practice and theory. Using development programmes that have been implemented in the study area from the colonial to the recent times, many of which were largely underpinned by modernisation theory and practice, indigenous knowledge theory and practice is analysed for its role in development processes.

The roles of the private sector, NGOs and the government are analysed, based on a chronology of development programmes that were underpinned in many instances by the influences of the major development theories and the subsequent introduction of the structural adjustment programmes by the IMF and the World Bank. Particular emphasis is placed on farmers' responses to externally induced development programmes, designed by experts for farmers to adopt. In their assessment of these externally driven development programmes, there is a manifestation of the extent of the resilience of local knowledge to its displacement by Western knowledge. Scientifically proven technologies are assessed by farmers for their effectiveness under their farming practices that take into account a range of environmental, socio-cultural and economic factors. Indigenous knowledge is frequently found to be effective in resisting those changes that are undesirable and of little relevance at both farm and community levels. For farmers, knowledge that is useful and of practical use is adopted, or adapted, only when it is assessed, and, in many cases, this is only after trials have been successfully completed. Knowledge that is of little benefit to farmers is discarded irrespective of its type (indigenous or Western), or its source.

This study forms the basis for understanding the importance of indigenous knowledge in development practice arising from its existence at farm level and the fact that it is continuously being fined-tuned to suit specific conditions and situations, which are in turn affected by socio-cultural, economic and environmental factors. The findings of this study also show that there are many benefits from using indigenous knowledge in development practice that include the empowerment of local people through their participation in development programmes. Indigenous knowledge is also found to be

resilient and beneficial to farmers regardless of income level by reducing their costs of production, to be adaptable to different environmental and economic circumstances, and to provide for a more sustainable use of resources in farming. There is, however, a need for further studies in indigenous knowledge utilisation to enable researchers to keep pace with changes that occur at the local level if development theory and practice are to utilise indigenous knowledge fully and successfully.

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Declaration

This thesis is based on results of original research carried out by the author between October 2005 and September 2008. Where there is need for references to existing works, they are appropriately made. Any errors that remain or are omitted are the responsibility of the author.

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Definitions

Chiduli is an ant hill

Chihanya is the dry season

Chilanda is mashed cooked beans after removing the outer skin

Chipombola is *Cussiona arborea*

Chiuvi is mist

Chiwombe is to get soaked in water

Chizimyalupsya is the first heavy rains (>25mm) before the on set of the rainy season

Dambo is a river, stream, wetland or valley

Dankha is first or before

Dimba is a wetland garden

Futali is mashed sweet potatoes or pumpkins normally mixed with groundnut flower

Ganyu is piecework usually in form of defined task in exchange for cash

Ghaweme means good

Jungu is a pumpkin

Katondo is red soil or *latosols*

Khola is a kraal or house for livestock

Khonde is a garden adjacent to a dwelling house

Kuchelenga is to make half a ridge

Kusosa is a form of land clearing in a garden before ridging or tilling the land

Malawi is a country name or heat waves or flames

Masuku is a local name for *Uapaca kirkian*

Matutu are mounds

Mawoko means hands

Mchere is kitchen salt or inorganic fertiliser

*Mphangul*a is a garden converted from virgin land

Mukukwe is a conical shaped heap of maize

Munda is a garden

Munda ukulu is a main garden

*Munyoz*i is a local name for *Brachystegia*

Ndipo is ‘is when’ or so

Nduna are local leaders that assist village headmen or chiefs

Ngoma means maize

Ngoma zamankholo are maize crops from dropped seeds during harvest

Ninyengo yakupumulira means it is time for resting

Njota is a garden next to a river or stream, which is cultivated in the rainy season

Nkhulya means eat

Nthewele is a field laid with tree branches ready for burning

Sima is thick porridge made of maize, cassava, sorghum

Tikupanda means to plant

Usambazi is wealth

Vundira is humus

Wasukuluka is to become less fertile as a result of use

Zamankholo crops growing from seeds dropped unintentionally

Zikuti wayawaya is a sound made by shaking dry things like stones and seeds

Abbreviations

ADD	Agricultural Development Division
ADMARC	Agricultural Development and Marketing Corporation
ADRA	Adventist Development and Relief Agency
ATC	Agricultural Trading Company
CAP	Common Agricultural Policy
CBO	Community Based Organisation
CCAP	Church of Central Africa Presbyterian
EPA	Extension Planning Area
EU	European Union
FAO	Food and Agriculture Organisation
FMB	Farmers' Marketing Board
GDP	Gross Domestic Product
GNP	Gross National Product
GoM	Government of Malawi
HIPC	Heavily Indebted Poor Countries
IK	Indigenous knowledge
IMF	International Monetary Fund
K	Potassium
MAFS	Ministry of Agriculture and Food Security
MDG	Millennium Development Goal
MDI	Malawi Dairy Industries
MGDS	Malawi Growth and Development Strategy
MK	Malawi Kwacha
MZADD	Mzuzu Agricultural Development Division
N	Nitrogen
NGO	Non-Governmental Organisation
NIC	New Industrialising Countries
NRDP	National Rural Development Programme
P	Phosphorus
PRSP	Poverty Reduction Strategy Paper
SAP	Structural Adjustment Programme
UNDP	United Nations Development Programme

USD	United States Dollar

Chapter 1

Introduction

1.1 Overall aims of the thesis

The main aim of the research is to investigate the extent to which traditional (local or indigenous) ecological knowledges[1] are used and incorporated in and within small-scale agricultural systems in Africa, and to examine and analyse traditional ecological knowledges' role in the development process in rural African areas that are dominated by small-scale farmers. The main aim has been tackled using three objectives, which are the identification, documentation and critical analysis of the traditional knowledges used in agricultural production in the field area; the establishment and analysis of the extent to which environmental, economic and socio-cultural concerns impact on the evolution and use of such knowledges by smallholder farmers; and the investigation of tensions between scientific and indigenous knowledges in the management, protection and conservation of the environment that leads to sustainable development. Given that development has lagged behind in these areas, despite modernisation processes being put in place in the last fifty years to induce development, traditional ecological knowledge incorporation in the development process may significantly influence the rate of progress in rural areas of Africa. It is argued here that traditional ecological knowledge can be a viable alternative or complement to the current mainstream development theories and practices such as modernisation.

1.2 Justification of the topic

Africa has on average about 60% of its population still living in rural areas and engaged in small-scale farming (Morgan and Solarz, 1994; Dorward *et al,* 2004). This population needs to be engaged as social capital in the development process, if Africa as a continent is to move out of poverty. The involvement of this population of small-scale farmers in the development process, which requires their active participation, can be

[1] The use of knowledges in the plural is adopted from Briggs and Sharp (2004). This term recognises the plurality of different levels and types of knowledge held by individual members of communities. Hence there is no community knowledge as such, but a range of knowledges held by members of that community.

achieved, if the starting point, as well as the continued development process, is initiated by small-scale farmers so that they control their own destiny.

Traditional ecological knowledge is knowledge developed by small-scale farmers through their lived experience in their respective rural areas. It is, therefore, endogenous and thus less likely to be rejected as alien. The process of development based on its appropriate use then would not require external (development) experts either to define the problems of the rural people or to implement programmes and projects as has been the case in the past. Rural people are on the ground, they already know and may just require facilitation by (development) experts to engage in the development process. In such circumstances, development will utilise locally available resources resulting in reduced environmental damage, reduced cultural shock and probably a lower economic cost of development projects and programmes. In addition, these are major players in the economy as they produce the bulk of foodstuffs (Brohman, 1996:211). For Malawi, the World Bank (2008) notes that the smallholder sector contributes about 35 % of the gross domestic product (GDP). It is known by many development experts (Peters, 2002) that smallholder farmers have retained their use of traditional farming practices, thereby establishing the fact that indigenous knowledge has the potential for use and a role to play in development theory and practice that needs to be examined, analysed and tapped.

Development programmes and projects over the last fifty to sixty years have been influenced by modernisation theory and practice and in more recent years by neo-liberal theory and practice. Indigenous knowledge, and hence traditional ecological knowledge, was used briefly by British colonial regimes but was quickly replaced by modernisation theory and practice. This has, therefore, left knowledge gaps in the utilisation of indigenous knowledge (theory and practice) in the development process. This research topic, therefore, is chosen so as to fill the knowledge gap created by the preference for other development theories and practices in the development process. These other development theories and practices (for example, modernisation and neo-liberalism) have been critiqued as being biased towards an economic growth resulting in environmental degradation and the reduced attention paid to culture and cultural factors in the development process. Elliott (2002) notes that the legitimacy and universal acceptance of the ideas of progress and development that have characterised the modernist tradition in development theory for so long, have to a degree been overturned by the postmodern movement over recent years. The ideas of progress during that period were generally synonymous with economic growth (capacity to produce goods and services) and the modernisation of traditional societies. As far as issues of wealth distribution were concerned, including welfare and human rights, it was assumed that these would follow as outcomes of the linear process of economic development (Elliott, 2002). Many scholars, including Elliott (2002), note that by the end of 1960s, there was growing disillusion with the practice of development and with indicators of development that took no account of the distribution of national wealth. Indeed, the economic growth that actually took place in most developing countries seemed to go hand in hand with increases in absolute and relative poverty (Elliott, 2002). Various theories and alternative developments are now influencing development agendas that emphasise the move towards 'pro-poor' growth (see Potter *et al,* 1999). Indigenous knowledge, and therefore traditional ecological knowledge, is one such alternative that allows for the genuine participation by the local people in the development process, and addresses the problems relating to environmental degradation and an unequal distribution of wealth that may be inadequately addressed by other development approaches. After all, despite the continued use and application of other development approaches and practices, local people still retain traditional ecological knowledge (Peters, 2002; Beckford, 2002; Beckford *et al,* 2007), and thus it becomes imperative and intellectually challenging to unpack the factors that encourage its continued use by small-scale farmers in rural parts of Africa.

Furthermore, indigenous knowledge (IK) is at times regarded and misinterpreted as a myth (Tucker, 1999) which Western knowledge regards as backward and inferior, based on superstition and unfounded beliefs that are difficult to consider as rational. Most of this type of misrepresentation has been as a result of linguistically and culturally influenced barriers and by African intellectuals that have looked down upon such knowledges in the light of Western training (Sillitoe, 1998; Sardar, 1999). Chambers (1983) has described this as the conditioning of development experts and Tucker (1999) notes that, as a result of studying in the West, they are often socialised into the dominant paradigm of Western thinking. As a result, some cultures and societies find themselves over-determined by Western representations to the point that they can no longer recognize themselves in the discourses that claim to portray them. They are saturated with imposed meanings, ambitions and projects. Here the researcher is Western trained but grew up under traditional conditions in northern Malawi and thus tries to balance his Western training with the traditional training that he has had all his life, to try and deconstruct and reconstruct traditional ecological knowledges still in use in this part of the country. The language barrier and thus interpretation of these knowledges will not be compromised as the researcher is a fluent speaker of both English and Tumbuka (the common language spoken in the study area).

1.3 The background of Malawi

Malawi is a small poverty stricken country (12 million hectares) in the southern part of Africa. Agriculture is the mainstay of its economy with a population of about 13 million, per capita income of US $160 and a poverty headcount of 54% (World Bank, 2008). Its GDP is composed of 46% services, 35% agriculture and 19% industry. It had accumulated extensive external debt as a result of trying to develop through the modernisation process but qualified to have its debt cancelled under Heavily Indebted Poor Countries (HIPC) programme in 2006 (Malawi Nation Newspaper, 2007; World Bank, 2008). Despite this debt, Malawi has very little to show for the money that has gone into its development. The country, therefore, becomes an appropriate place to engage in development alternatives such as traditional ecological knowledges underpinned by theory and practice that can be discerned from the use and production of indigenous knowledge. It is, for example, a representative of most of the countries that are classified as poor by international financial institutions such as the World Bank and the International Monetary Fund (IMF). In addition to this classification, the proportion of small-scale farmers living in the rural areas is higher than the average of 60% for most Third World countries. In fact, in Malawi 85% of the population lives in the rural areas and most are considered to be small-scale farmers under the common name of smallholder farmers (Nkhonjera, 1980; Conroy, 2006). It, therefore, becomes a very attractive place to investigate traditional ecological knowledges where such a large population is still living in the rural areas and still relies on such types of knowledge for its livelihood.

Major development theories such as dependency and modernisation theories use class (proletariat and bourgeoisie), mode of production and economic growth to explain the process of development (see Brohman, 1996; Leys, 1996). Many rural areas in Africa are inadequately described when such tools are used to depict progress. This study, therefore, assumes a position that differs from the major development theories and practices, and describes rural Africa in the manner that the rural Africans look at themselves, and practice their everyday livelihood or way of life.

The study is conducted in the northern part of Malawi, where the population still utilises traditional ecological knowledge for its livelihood despite many years of government effort to promote modern farming techniques. Structural adjustment programmes (SAPs) under the international financial institutions, such as the IMF, have negatively impacted on government efforts to increase social and technical services to sustain modern techniques in farming, just as these SAPs have done in many developing countries (Lele, 1989). The northern part of Malawi is situated in a position that is similar to most parts of Malawi and other countries that have been affected by SAPs and have similar distributions of population in the rural areas. In addition, several projects have been implemented in the study area using a top-down development approach, which makes it an ideal site for examining and analysing the use and role of indigenous knowledge in development through the assessment and evaluation of their success or failure. The majority of its population (85%) lives in rural areas as active smallholder farmers cultivating an average of 4 hectares. Mzuzu has an annual rainfall of about 1200 mm in the rainy season (late November to late April) and has a dry season from late April and/or May to early November. The area, just like the region and the whole country, has two seasons. Therefore, the northern region and in particular Mzuzu (Zombwe Extension Planning Area) is representative of many rural areas of Malawi.

1.4 Structure of the thesis

After the introduction and justification of the topic in Chapter One, Chapter Two reviews the main development theories and practices that are, and have been used in the development process, to establish the strengths and weaknesses of each as revealed in other scholars' work. Knowledge gaps observed and noted in the process direct the rest of the thesis, which will try to address them. Chapter Three analyses the choice of methods and justifies the reasons for those adopted in the research. It also lays down the characteristics of the study area and its relevance for the study following the brief background of the study area given in this chapter. Chapter Four and Chapter Five outline agricultural development strategies in Malawi, giving the background of agricultural development from just before the decolonisation of the country and after the republic state was declared to the most recent times. This is followed by a general analysis of the farming systems practiced by small-scale farmers in Malawi and specifically in the study area. Chapter Six evaluates the traditional/local/indigenous ecological knowledges practiced in the study area, including the control of pests and diseases in crops and livestock. Chapter Seven describes, analyses and establishes the factors that affect the use and loss of traditional ecological knowledges. Chapter Eight establishes the nature of the tensions between scientific and local knowledges in the development process and the mechanisms practised by small-scale farmers and those recommended by development agents, who are trained as experts in planning and implementing development programmes. The Conclusions in Chapter 9 reflect and evaluate the potential of indigenous knowledge in contemporary agricultural systems and outline areas for further research, given the findings of this study.

Chapter 2
Literature Review

2.1 Introduction

It is argued by many scholars that the invention of agriculture brought about the need for increased labour specialization and the development of a state apparatus capable of organizing the defence of cultivated land against aggressors (Rodney 1972:125; Leys, 1996:4). With the establishment of agriculture, the process of social evolution greatly accelerated (Leys, 1996:4). This became the engine of growth for industrialisation and with it, what has been termed development in the West.

The term development has been difficult to define, theorise and put in practice (Fagan, 1999). For example, Tucker (1999) notes that dependency theorists and their contemporary critics have also singularly failed to address the question of the meaning of development and Munck (1999), for example, states that some thirty years of debate around practical experience of and attempts to theorise development have come to naught. Development experts and academics have developed development theories and practice based on the experience of the West in order to explain the development process. The intention in some cases has been to emulate development processes in the West to develop the global South. These efforts looked promising in the early nineteenth century and in the middle of the twentieth century. However, in the decade 1960 to 1970, it became clear that development was not being achieved as envisaged by experts and they began to disagree on the way forward to develop the global South. Success had been limited and a development impasse set in. It became clear to most experts that the development process would just not be achieved with expert-made solutions without active participation by the people of the global South. These warnings were made by Chambers (1983) when he stated that development programmes developed by experts were at times inappropriate and even irrelevant, and he suggested the need to listen to people with lived experience in the global South.

The chapter that follows will define and describe characteristics of theories and practices that have so far been developed and used in the development process. These theories include modernisation, dependency, neo-liberalism and post- and anti-development. The last two form part of the theory called alternative development.

Indigenous knowledge theory is part of the alternative paradigm and is the main focus of this research, as it forms the basis for true participation of the people of the global South. The role and use of traditional ecological knowledge in small-scale agriculture systems in Malawi with respect to farmers' practices, such as disease and pest control in crops and livestock, will be utilised to unpack indigenous theory and practice.

2.2 Modernisation

Modernisation theory highlights the positive role played by the developed world in modernizing and facilitating sustainable development in underdeveloped nations (Leys, 1996; Narman, 1999; Sardar, 1999) (particularly from 1945 onwards after Truman's bold programme to transfer technology to the 'South'). Economic rationality, based on Western intellectual and scientific evolutionism, underpins the development discourse in modernisation theory (Munck, 1999; Hove, 2004). The theory adopts the original assumption of orthodox development theory, that the process of development involves drawing the populations of the third world out of their traditional isolation into a modern social system that would be participative, pluralistic and democratic (Hansen, 1981; Forbes, 1986:57; Brohman, 1996:22; Leys, 1996:10; Munck, 1999; Potter *et al,* 2004:83,84). This is not a new phenomenon, as Buchanan (1885:108) wrote in the context of Malawi:

> "We have entered the Shire highlands (Malawi today) for the express purpose of developing the country, and civilizing and Christianising the natives; and we need not expect that they will be capable for many years to come of attributing to us motives beyond what they themselves ever dreamt of."

He further refers to Africa as a dark continent (Buchanan, 1885:2; Power, 2003:76, 139). Indeed, Stringer *et al,* (2008) in their critique that seeks to challenge the predominantly North-South flows of knowledge and resources also show that colonists dedicate human and financial resources towards bringing civilisation to primitive backward areas.

However, modernisation theory was an American response to what made societies unresponsive to the positive orthodoxy. It emerged from sociologists and political scientists in the United States of America in order to exercise its new role as a super power (Munck, 1993; Escobar, 1995:21; Leys, 1996:9; Tucker, 1999; Power, 2003:27, 80). They believed that, in the transition from traditional to modern forms of social organisation already completed in the West, the complex interactions between social change and economic development could be traced using structural-functional analysis and a typology of social structures. These were concerned with norms, structure and behaviour in terms of values and interests, plus roles and role networks and classes, not least in terms of motivation and perception.

In addition to the above, modernisation theory highlighted the process of development occurring through diffusion. The concept of 'growth poles' was adapted and re-conceptualised as centres from which technologies would diffuse to hinterlands (Hansen, 1981; Power, 2003:78; Potter *et al,* 2004:110). For example, development efforts were concentrated in urban areas, which were supposed to diffuse modernisation and modern social organisation to peripheral areas (Power, 2003:80). Since modernisation theory was developed at a time when there were two major political forces at the global scale (Power, 2003:31, 77), the socialist/communist (China and the Soviet Union) and the capitalist (most of the so-called West), democratization became an important element of modernisation theory. Aid provision from the West was tied to this democratization process, through the use of aid programmes, technical assistance and provision of scholarships to the global South, (Leys, 1996:10; Tevera, 1999) especially Africa partly to discourage socialist sympathies.

Modernisation as a theory therefore focused on economic growth, despite the fact that it was developed by political and social scientists that sought to incorporate social and political factors in explaining development failures (Tucker, 1999). It was based on the assumption that backwardness and traditionalism of societies were seen as barriers to progress. Thus modernisation defines needs, values and appropriate culture needed for development to take place (Munck, 1999; Sardar, 1999; Tucker, 1999; Power, 2003:75; Hove, 2004) and relied on the transfer of science and technology from the West to the global South. The problem of poverty was to be treated by technology transfer, by capital investment and by the release of productive forces. In this context, Western scientists speak for the global South (Blaikie, 2000; Briggs and Sharp, 2004 quotes Hooks, 1990 and Spivak, 1988; Hove, 2004). The development agenda is defined in the corridors of power in the 'North' and, in these, the voices of the 'South' are largely unheard (Briggs *et al,* 1999).

For modernists, production is a function of the factors of production of land, labour and capital (Power, 2003:30). The bourgeoisie accumulate capital and the proletariat become a factor of production that earns money by working (Hove, 2004). Restructuring, therefore, is at the expense of social conditions. Production ideas and social relations themselves perpetuate inequality. For the modernist, the important aspects are the types of forces in the production process, such as demand and supply, which influence prices leading to the ultimate goal of profit making or taking.

Modernisation approaches therefore envision development as a process of rapidly induced changes that cumulatively result in linear progress toward an end point, closely resembling the contemporary advanced capitalist world (Brohman, 1996:21; Munck, 1999). Most modernisation theorists regarded the middle and the upper classes as crucial to this process. Progressive members of these classes would play the role of a modernizing elite, as change agents who would be the bearers of modern entrepreneurial values (Brohman, 1996:22), hence the provision of scholarships (Leys, 1996:10; Narman, 1999; Tevera, 1999). These change agents were supposed to be involved in the process of democratisation. However, this process was silent on bottom-up approaches (Power, 2003:81), which are naturally associated with the process of democracy. For example, Briggs *et al* (1999) note that 'experts' consider that no worthwhile contribution can be made by the inhabitants of fragile environments, as they have little meaningful to offer; indeed, left to their own ways will only result in further degradation. For many in the 'North', lands have to be managed in a rational technocratic manner using knowledge rooted firmly in formal Western science and technology (Briggs *et al,* 1999; Blaikie, 2000).

The common indices used to measure progress along the road to development are factors thought to be responsible for growth among modern Western societies, such as, for example, the growth of formal rationality and of complex bureaucratic organisations, increased social differentiation and industrial specialisation (Brohman, 1996:21; Morse, 2008). Yet, the area where this modernisation process was to take place, especially Africa, still has a sense of community responsibility and individual rationality is influenced by communal values, as can be found in communal land ownership. For example, Escobar (1995:22) states that vernacular societies have developed ways of defining and treating poverty that accommodates visions of community, frugality, and sufficiency.

Modernisation theorists envisaged modern values being diffused through formal education and technology transfer to the elites of the periphery (Brohman, 1996:22; Leys, 1996:10; Power, 2003:80). In this context, the values, interests and norms to be promoted are those of Western culture. All developing countries needed to do was to emulate the most successful societies and cultures for them to move out of their 'traditional isolation' into a modern social system (Escobar, 1995:26; Brohman, 1996:19, 20; Munck, 1999; Power, 2003:79; Potter *et al,* 2004:84; Simon, 2007) that would be participative, pluralistic and democratic (Leys, 1996:65). In reality, it meant relegating indigenous values (Tucker, 1999; Power, 2003:76; Eriksen, 2007; Riseth, 2007) to the bottom of the spectrum of values, as progressive members of the elite classes play the role of change agents by becoming the bearers of modern values, especially those of entrepreneurship (Brohman, 1996:22). This contrasts with the awareness of the existence of complex interactions between social change and economic development of social and political scientists. Calls are now being made to recognise that such cultural values and knowledges may be important in the development of modernisation theory itself (Chambers, 1983, 1993; Bebbington, 1993; Blaikie, 2000; Briggs and Sharp, 2004; Eriksen, 2007).

In the development paradigm, former colonies were to adopt Western norms and values so that development would be induced through a top-down, centre-outward process of capitalist development via modernizing elites. The elite were sent to universities in the West to become leaders in the development process and trained in Western science and technology, which was considered superior to traditional local knowledges (Chambers, 1983, 1993). Indeed, Eriksen (2007) notes that post-colonial leaders were educated in rigid colonial government systems so that many colonial policies were retained as newly independent states pursued economic development. In effect, this translated into practice, so that the norms, values, interests, roles, role networks and classes that existed in the colonies and former colonies were inadequately utilised on the basis that Western culture was superior to traditional social organisation (Munck, 1999; Pieterse, 1999; Sardar, 1999; Power, 2003:75). Chambers (1983) alludes to this point when he states that development projects introduced by development experts were inappropriate and even irrelevant.

Development could, therefore, be conceived as the training of role models, resulting in a smooth transition from traditional societies to modern forms of organisation. However, the transition was often bumpy. It became clear that the process of political change accompanying modernisation in many Third World countries in the global South was far from smooth in the 1960s. It became disruptive and at times served as a source of political conflict (Brohman, 1966:22). The change agents had their own agendas in the development process. Brohman (1996:24) notes that development theorists are now urged to pay more attention to cultural and political structures and to incorporate both objective and subjective elements into their analysis.

The process was facilitated by the provision of development experts who analysed the problems and offered technical and scientific solutions to development problems *in situ* (Blaikie, 2000; Power, 2003:75). The questions that arose over time were whether the training was adequate for the conditions on the ground; were experts knowledgeable about local conditions; and whether the projects borne out of such assessment by development experts reflected local needs and ambitions (Townsend, 1993).

The transfer of science and technology was one of the most important aspects of modernisation theory (Sardar, 1999). It aimed at dealing with poverty and under production of resources (land, labour and capital) through the transfer of science and technology (Briggs *et al,* 1999; Briggs and Sharp, 2004). What had worked in the development of the Western economies was to be reproduced in the former colonies in Africa and elsewhere (Schuurman, 1993; Brohman, 1996:24; Sardar, 1999). Development assumed a linear relationship in terms of capital, land and labour and the manipulation of these using science and technological advances. Essentially, modernisation theory assumes that societies are made up of rational individuals, collectively making their way through evolution, heading in the same direction, and that differences between societies can be understood primarily as differences in development (Tucker, 1999; Power, 2003:75; Hove, 2004). The approach does little to eradicate poverty and nothing to resolve the degradation of the environment (Hove, 2004).

Modernisation theory in practice has not transformed African societies into 'modern' societies. The process of development that occurred in the West was not reproduced in Africa and elsewhere in the world, except perhaps for a few cases in Asia (Booth, 1993; O'Hearn, 1999). Santos (1999) notes that modernisation has resulted in an increased gap between the rich and the poor. The development experts analysed problems on the ground inadequately and the projects that arose from these analyses did not address the needs of the people concerned (Chambers, 1983, 2008; Townsend, 1993; Blaikie, 2000; Eriksen, 2007). Briggs *et al* (1999) use the case of Bedouin in Upper Egypt to illustrate the inappropriateness and inadequacy of modernisation theory in the analysis of development priorities and interests of local people. They cite the assumption made that *Acacia* and *Balanites* were the two key vegetation types and that *Tamarix* was irrelevant as misplaced, because all these vegetation types played important roles in the lives of the people in the country (Egypt) where the study was conducted. In a similar manner, the introduction of and dependency on cash crops, hybrid varieties and monocultures, including the uses of pesticides to increase agricultural production levels in Africa, has met little success (Lele, 1989). It appears that the real agenda connected with the introduction of these technologies was to induce mass-consumption that would generate egalitarian socioeconomic structures upon which democratic institutions were to be erected (Brohman, 1996:22).

The end result has been failure of modernisation theory to develop rural Africa. This raises questions; Rodney (1972) raises a few points that may form a basis for explaining part of the theory's failure to achieve development in Africa. He reports that Africa was placed in a position where it served its masters (colonial powers) as a source of raw materials. The resources were used to develop the West. Other failures can be attributed to failures to take into account socio-cultural and political factors as noted by Brohman

(1996:24). With such omissions, it then became difficult to reproduce the development that occurred in Europe in Africa.

Modernisation in practice took a turn and changed after the Second World War, especially following Truman's bold new programme to transfer technology to the 'South' so that it could follow in the path of the developed West (Power, 2003:71). Development meant absorbing deep-rooted Western and Eurocentric traditions, which cast a dominant shadow over development thinking. 'Development' then was visualised as a form of organised intervention in collective affairs according to a set standard of improvements (Booth, 1993; Escobar, 1995:6; Power, 2003:72). The 'darkened' past traditional social order was often counterpoised to the bright progressive future promised by scientific understanding, which meant that, by concentrating on the future as a realm of unrealised possibilities, there was a corresponding depreciation of the past (Power, 2003:74 cited Gay, 1973:92; Schuurman, 1993). For example, Hove (2004) states that earlier ascriptions of development converged around its association with a uni-linear, continuous process toward predetermined finite goals of modernization and industrialisation. Under such an approach, the backwardness and traditionalism of societies were seen as barriers to development. This also translated in practice into an uncritical transfer of science and technology from the 'North' to the 'South', so that development was to be created through the application of reasoned empirically based knowledge (Munck, 1999; Power, 2003:75). The highest form of knowledge was scientific and rational – science can shine the light of reason into all corners of the darkest underdeveloped corners of the world where they replace the backwardness of tradition (Munck, 1999; Power, 2003:75). For example, science improves the practice of agriculture and industrial organisation, harnessing natural forces for human interests. It also held the view that 'man' can conquer nature for the benefit of mankind. This led to the understanding that the West is superior to other societies and that there are stages of progress that all nations go through on the road to the 'modern'. In fact, reason then became imperialistic and racist, taking a specific form of consciousness for a universal, standardised form that all must aspire to reach.

This led to the belief that Western values and knowledge are superior (Chambers, 1983, 2008). Modernisation therefore is structured around a process of 'othering' of nonconformist cultures and societies that are not informed by this reasoning and these social norms, and so are banished to the lower echelons of humanity, defined as 'underdeveloped' or 'uncivilised' (Buchanan 1885:108; Munck, 1999; Tucker, 1999; Power, 2003:75). This led to such societies not being given a chance to participate in the development process. The government, government institutions and other development agents developed projects and programmes (Escobar, 1995:5) that were thought suitable, based on scientific interpretation of development problems in the areas concerned. This meant that all human beings were the same and that the needs of the society, be it men or women, were essentially the same. However, traditional societies are more complex than acknowledged; in fact, these societies are not as backward and irrational as they have been portrayed (Chambers, 1983, 2008; Briggs *et al,* 1999; Power, 2003:80).

Central to modernisation theory is a power relation that is skewed in favour of development experts and lending institutions, such as the World Bank and the IMF. In this power geometry, the local indigenous people frequently only get lip service paid in terms of participation in the development process (Power, 2003:182). Escobar (1995:22) states that modernization signified not only the rupture of vernacular relations, but also the setting in place of new mechanisms of control. Preference and control of development are in the hands of scientists/technicians, national decision makers and donors. This results in a persistent inability to grasp how local people understand and define such things as livelihoods, which are instead recast in a somewhat endogenous discourse encrypted by outsiders (Power, 2003:182). The end result is the exclusion of the local people from the development process, particularly women (Schuurman, 1993). This raises the question that probably development, though posing as a solution, might in fact be a large part of the problem (Tucker, 1999; Power, 2003:192). For example, many development practices have resulted in the impoverishment and marginalisation of indigenous peoples, women, peasant farmers and industrial workers, and in a deterioration of certain economic, social and ecological conditions (Townsend, 1993; Harrison, 2001; Power, 2003:194). For example, under socialist programmes in the 1970s, in Tanzania (known as Ujamaa) and Mozambique, known as villagisation, local people were moved into areas away from their homes and concentrated in what were considered 'good' farmlands to operate as consolidated and/or collectivised forms of peasant agriculture, and provided with resources and facilities such as schools and safe water to drink (Brohman, 1996:214, 221; Harrison, 2001). However, the villagisation process only managed to upset peasants' conditions of life and rarely presented a clear and secure improvement to their standard of living (Harrison, 2001). Indeed, Escobar (1995:22) points out that it is true that massive poverty in the modern sense appeared only when the spread of the market economy broke down community ties and deprived millions of people from access to land, water and other resources.

In addition, Western values have sometimes been emphasised at the expense of traditional and indigenous knowledge systems. People have not been central in this type of development process, emphasis has been on economic growth resulting in overlooking the survival needs of the people and the failure to consider implications of development policies at the level of individuals, households and communities (Power, 2003:199; Potter *et al,* 2004). There has been an assumption that people and communities are homogeneous and passive, rather than differentiated and dynamic. Possibly indigenous development theory offers a comprehensive alternative as it starts from the bottom going upwards in a real sense (if at all there is that direction in society).

2.3 Dependency theory

The failure of modernisation to explain adequately underdevelopment in the global South led to some scholars to develop a new theory to explain the lack of progress (Morse, 2008). Underdevelopment was linked to an unbalanced resource transfer from the global South to the West, leaving the global South without adequate resources for development. The theory explaining this trend was called dependency theory, and it became a global force in the 1960s and 1970s. It had its origins in the writing of Latin American and Caribbean radical scholars stemming from an aspiration to identify indigenous paths for the region's development (Munck, 1993, 1999; Tucker, 1999; Potter *et al,* 2004:108). They were convinced that the twin strands of modernisation and industrialisation were not suited to the region (Schuurman, 1993).

Dependency theory refers to thinking that emanates from, or at least relates to, conditions that are encountered in the global South or Third World (Munck, 1993;

Schuurman, 1993; Tucker, 1999). It is also strongly associated with the work of Andre Gunder Frank who maintained that development and underdevelopment are opposite sides of the same coin and that both are the necessary outcome and manifestation of the contradictions of capitalist system of development (Munck, 1993; Potter *et al,* 2004:109).

Rodney (1972) draws attention to the fact that historically Africa and other Third World Countries have been used as sources of cheap raw materials and markets for the industrialised West. In short, underdevelopment is a result of exploitation by the West (North) of the 'South' (Lanning and Mueller, 1979:22; Schuurman, 1993; Power, 2003:82). Power (2003:81) argues that the incorporation of each country into the world capitalist system caused exploitation, which involved stripping the colonies of their resources, reorganising their land systems and reconfiguring their labour relations. The economic surplus created in the developing countries was being transferred to the West (Schuurman, 1993; Potter *et al,* 2004:108). It was noted that during colonial periods, advanced nations entered into special partnerships with powerful elite groups (which they had created) and managed to extract surplus value out of the colonies (Rodney, 1972; Potter *et al,* 2004). This resulted in the low incomes of the majority, and a highly unequal income distribution (Leys, 1996:46).

Political and economic structures were transformed in order to serve the interests of the West under development programmes based on modernisation theory and practice (Rodney, 1972; Tucker, 1999). This appears to reflect rational thinking and allocation of resources by capitalism. Institutions are deliberately put in place to maximise profits from factors of production and the rewards such as profits duly paid to the West. For example, the economies of Third World Countries were structured so as to be systematically subordinate to the structures of the economies where capital was being accumulated (Leys, 1996:46). This gave rise to the process of surplus removal from such parts of the world, perpetuating and rigidifying in new ways their low level of productivity as their surplus was being taken away (Rodney, 1972; Leys, 1996:46).

The condition of developing countries therefore is not an outcome of inertia, misfortune, chance, climatic conditions or whatever, but a reflection of the manner of their incorporation into the global capitalist system (Rodney, 1972; Potter *et al,* 2004:109). Dependency theory therefore was considered as representing a holistic view because it described a chain of dependent relations, which has grown since the establishment of capitalism as a dominant world system, so its expansion is regarded as coterminous with colonialism and underdevelopment (Rodney, 1972; Potter *et al,* 2004:110). It explains the failure of development under modernisation theory and practice. It reveals the chain of exploitative relations of extraction and transmission of surplus value via a process of unequal exchange that extends from the peasant, through the market town, regional centre, national capital, to the international metropole (Rodney, 1972; Potter *et al,* 2004:110, 111). Indeed, modernisation theory and practice encouraged capitalist activity that involved accumulating capital where this could be done cheaply and investing it where the return to investment was highest (Leys, 1996:46). Dependency theory and practice provided an alternative to this grip by the West through the introduction of trade barriers, control of trans-national corporations and the formation of regional trading areas, along with the encouragement of local or indigenous production and development (Bebbington, 1993).

In addition, dependency theory stimulated the empirical study of the institutional and structural mechanisms of underdevelopment such as trans-national corporations, income distribution, fiscal and taxation policies, capital expenditure and aid programmes (Schuurman, 1993; Leys, 1996:46). It also highlighted imperialism, the existence of social class and questioned the assumption that the state is an instrument of popular will, or at least of the public interest, as interpreted by a minority on behalf of the public under modernisation theory and practice. This raised the consideration of the involvement of rural people especially in the Third World and in particular Africa, where they are the majority constituting about 60% or more of the population. However, it did not provide answers as to why some parts of the Third World cannot now take advantage of its cheap labour to develop. The failure of modernisation theory and dependency theory to achieve development in developing countries led to the development impasse which will now be examined.

2.4 Development impasse

In the 1980s the potency of modernisation and dependency discourses declined as approaches, which sought economic advancement, as there also developed a lack of consensus concerning such issues as declining standards of living in the periphery, despite the use of modernisation and dependency theory and practice in the development process (Munck, 1999). This lack of consensus was identified as the development impasse by such scholars as Booth in 1980s (Booth, 1985; 1993; Schuurman, 1993). International development theorists, students and practitioners alike have become increasingly concerned about its nature (Hove, 2004).

There was a growing awareness that the emphasis on economic growth in development process had not improved the living standards of the majority of the poor in the global South. In fact, this had resulted in an insupportable burden on the natural environment, and the demise of the socialist paradigm as the link between theory and development praxis (Schuurman, 1993). The global South continued to have major economic problems, although, in political terms, the on-going democratisation process would seem to allow for better conditions for the development process (Schuurman, 1993).

The dependency and modernisation theories were too general and became irrelevant to most important practical issues facing developing countries (Booth, 1993). For example, these theories seemed to neglect or even deny much of what is specifically human about human societies, such as action and interaction, history, culture and the social construction of reality. It therefore becomes apparent that the development impasse was a result of a generalized theoretical disorientation (Booth, 1993). Munck (1999) notes that thirty years of debate around the practical experience of, and attempts to theorize, development had, it seemed, come to naught.

The development impasse also led to the realisation that the world market is an overarching whole, which cannot be approached using development policies focused at the national level. In a similar vein, there was recognition of differentiation between the global South that could no longer be handled by global theories that assumed a homogeneous First and Third World. This became clear as a result of the economic performance of new industrialised countries such as Taiwan, Singapore and South Korea (Booth, 1993). The success of these Asian countries, especially concerning fiscal and monetary discipline including their successful engagement with the markets through manufacturing and trade, encouraged the birth of development processes that could be based on market forces. Neo-liberalism, the Washington Consensus and SAPs were promoted by some scholars and these will be discussed in the next section.

2.5 Neo-liberalism, the Washington Consensus and SAPs in development

Neo-liberalism drew on the 200-year old arguments of Adam Smith, who advocated the abolition of government intervention while promoting free trade in economic matters in his explanation as to why certain nations prospered and experienced growth (Power, 2003:154). Neo-liberalism likewise advocates free market operations with governments refraining from activities that result in reduced efficiency for players in the market system. Any effort by the state to improve the operation of the market by intervention only distorts it (Schuurman, 1993; Blaikie, 2000). Thus, deregulation is required to allow market forces to act as self-regulating, and to permit the privatisation of state-owned enterprises. Perrons (1999) observed that the profit motive underlies the decision-making strategies of major capitalist organisations. People investing outside areas in which they live are only interested in the rate of return they get on their money. All other income streams from their investment, such as payments to workers and suppliers reduce profits and every effort is made to minimise them (Slater, 1993; Douthwaite, 1999).

Neo-liberalism, therefore, is similar to modernisation theory in that it advocates economic growth as a way forward for human progress (Schuurman. 1993; Routledge, 1999; Power, 2003:192), while arguing that free markets without government interference are the most efficient means of allocating resources. Neo-liberalism focuses on three main areas, namely free trade in goods and services, free circulation of capital and freedom of investment (Power, 2003:222; Watson and Achinelli, 2008). The means of allocating resources through the market system and reduced government interference has been widely promoted by the World Bank, the IMF and most Western states, especially the USA (Schuurman, 1993; O'Hearn, 1999). This group, comprising the World Bank, the IMF and the USA, have at times been referred to as the Washington Consensus (Narman, 1999:171; Power, 2003).

As alluded to above, neo-liberalism came into being as a response to the failure of modernisation to tackle poverty in the global South. Blaikie (2000) notes that neo-liberalism has been rediscovered in response to particular global crises with a view to ensuring outcomes such as economic growth, which are claimed by its adherents (particularly the IMF and the World Bank) to benefit all people. The international debt crisis enabled economists to reorient themselves and realise that neo-liberal laws were valid and that the invisible hand of the market indeed allocates resources optimally (Schuurman, 1993; Lehmann, 1997; Blaikie, 2000; Potter *et al,* 2004:305). The World Bank and the IMF advocated SAPs from the mid-80s with the intention of supervising economic stabilization programmes in heavily indebted countries (Chambers, 1993:109, 2008:152; Brohman, 1996:133).

It is believed by its proponents that neo-liberalism will result in sustained economic growth, which is the way to progress that results in development. This will in return result in economic globalisation that would benefit everyone through free markets that would be the most efficient way of allocating resources (Gonzalez, 1999; Narman, 1999). Market forces without government interference should achieve the optimal allocation of resources. Freeing markets and creating more favourable macroeconomic conditions should spur investment and growth, as well as improving overall economic efficiency and productivity. If markets are allowed to allocate goods, capital and labour rationally without interference, the poor and others will inexorably reap higher incomes derived from increased efficiency and productivity through the operation of trickle-down forces (Brohman, 1996:160; Narman, 1999).

However, the government retains the function of providing infrastructure and the rule of the law, such as respect for property rights, and thus reducing waste and inefficiencies within the state apparatus (Slater, 1993). In effect, neo-liberalism rejects the old assumption under modernisation theory that government or the state can do everything and anything, which has marred many neo-Keynesian development strategies (Schuurman, 1993; Brohman, 1996:138; Lehmann, 1997). The aim of neo-liberalism has been to reduce private consumption through reduced government subsidies so that an increasing proportion of the national economy may be diverted toward investment that would allow the trickle-down mechanism to function (Brohman, 1996:133). At the global scale, therefore, there is room for the freedom of trade in goods and services (Brohman, 1996:133), the free circulation of capital and the ability to invest wherever one wants. To facilitate the flow of goods and services, currencies have been regularly devalued, deregulated or realigned with convertible monetary systems, or allowed to float to find their own 'market value' (Schuurman. 1993; Slater, 1993; Brohman, 1996:133; Potter *et al*, 2004:302).

Restraining expenditure by government under neo-liberalism reduces government budget deficits under SAPs, which in turn lowers government borrowing both internally (domestic) and externally. However, fiscal and monetary policies also affect the overall production and domestic expenditure levels of an economy through various multipliers and indirect effects (Lele, 1989; Brohman, 1996:138). The assumption that the market can meet all the development goals of all countries under all conditions then becomes problematic in real life situations. This point raises the question as to whether market forces are indeed sufficient for inducing development under all conditions and in all countries subjected to SAPs and neo-liberalism.

Following up on the above point, neo-liberalism seems to assume no variations in the socio-economic and spatial structures of the South (Lele, 1989; Brohman, 1996:139, 140; Blaikie, 2000). Yet variation is the norm rather than the exception, as endorsed by evolution theory by Darwin and Ecologists (Tucker, 1999). Under such conditions imperfect market conditions do exist. The presence of state-owned enterprises may therefore play a significant role in reducing price distortions and thus be less inefficient than the private sector (Lele, 1989; Brohman, 1996:139).

Neo-liberalism assumes that price incentives and getting the prices right are necessary and sufficient to sustain economic growth even in a world of pervasive imperfections, essentially stating that the markets can normally sustain economic growth better than government intervention. The South therefore should allow market forces to determine patterns of resource allocation, remove state intervention in both external and internal markets, provide incentives to foreign capital for investment and job creation, accept outward-oriented growth, according to the principles of comparative advantage as the basic engine of growth, and rely heavily on foreign experts to guide development to ensure efficient project selection (Brohman, 1996:148; Blaikie, 2000).

In practice, though, neo-liberalism results in sidelining local knowledge and reducing it both theoretically and practically to market information (Blaikie, 2000). Market forces override indigenous knowledge's appropriateness to the environment and individual or household needs. Local institutions are also subjected to the influence of market forces (Blaikie, 2000: Lele, 1989), especially under SAPs. SAPs, however, have not been able to improve aggregate supply at the local level (Lele, 1989), resulting in higher food and input prices (Slater, 1993; Hillocks, 2000; Gladwin *et al,* 2002). In the South, where poverty is still rife, goals that aim at overall economic growth seem to penalize the 'poor' or exclude them because of their inability to participate productively (Lele, 1989; Power, 2003).

Many countries in the global South have export sectors concentrated on a few traditional primary products (Lele, 1989; Morgan and Solarz, 1994; Brohman, 1996:134). Price movements in international commodity markets have affected the outward-oriented adjustment programmes of many poorer, smaller countries (Lele, 1989; Brohman, 1996:134). The capacity to attract investment capital has in large part been determined by internal socio-economic structures, such as the level of human resource development and the efficiency of the transportation and communication infrastructure, that are inadequate in much of the 'South'. Under liberalised market forces, investment will flow towards countries with comparative advantage and the 'South' is in most cases a loser. The governments in the 'South' can only change this situation through concerted state intervention (Lele, 1989; Brohman, 1996:134), as has been the experience of some countries in Asia such as Taiwan and South Korea.

There has been little attention to non-economic factors that have impacted negatively on some countries of the 'South' in neo-liberalism (Lele, 1989; Morgan and Solarz, 1994; Brohman, 1996:134), such as droughts leading to famine and diseases, which have thwarted the development endeavours of some countries. Market forces are insufficient and inadequate in allocating resources where such natural disasters have struck or occur frequently (Lele, 1989; Brohman, 1996:134). Pragmatic solutions based on real-world development processes should replace one-dimensional, dogmatic views (Lele, 1989; Brohman, 1996:134; Sardar, 1999; Blaikie, 2000). Brohman (1996:134) argues that idealistic models ought to be rejected in favour of realistic, achievable strategies based on the diverse empirical realities of the development experiences of different countries. For example, market forces may be important in influencing agricultural production, but in addition to market forces, other factors such as rural credit, agricultural extension programmes, transport and access to consumer goods are equally important stimulators, and these factors may have to be weighted at par with the liberalisation of market forces.

Market forces, in certain cases, especially where they involve the rural poor, may result in many farmers being driven off their land because they are unable to meet the new conditions heightened by competition with trans-national agribusiness and other larger producers (Lele, 1989; Brohman, 1996:136). The exclusion of the rural masses and their technologies in the development process promoted through neo-liberalism has led to calls for alternatives to development (Chambers, 1983; Briggs *et al,* 1999; Tucker, 1999) which are discussed below.

2.6 Alternative development (Post-, anti-, populist and indigenous)

Alternative development rhetoric can be traced to the early 1930s when the populist movement was able to influence the British Colonial Office to support the use of local farming practices and indigenous forms of knowledge (Brohman, 1996:204). The British got involved in community development through the provision of basic education and social welfare programmes in some colonial areas.

Alternative development permits the poor to acquire some economic and political power through fostering local institutions to enhance people's participation in the selection, design, and management of development projects at the community level (Booth, 1993; Long and Villarreal, 1993; Brohman, 1996:218). It therefore has a particular local geographical area focus, design and implementation. It concentrates on small-scale projects involving in most cases organizations composed of farmers or agricultural workers managed at the local level, and stressing basic needs provision and investment in human capital, such as education, and human nutrition (Brohman, 1996:218).

Local organisations and primary communities are thought to be critical to peoples' creative unfolding through which a host of non-material needs, such as self-identity and expression, liberty and participation, might be pursued. Therefore, non-material needs and quality of life considerations figure prominently alongside concerns for welfare (Brohman, 1996:218). In addition to these, deliberate attention is directed towards the fulfilment of basic needs such as food, shelter and clothing. Importance is attached to the local scale as well as to a broad, human-centred approach to development. However, the implementation procedures resemble that of the other development strategies, in that design and implementation is usually by outside groups (Long and Villarreal, 1993), typically a national development agency assisted by an international donor. Despite this, the theory and practices of alternative development assume that inequalities in both socio-economic and regional terms need not be a price of development in the short-term. There is no need for a trade-off or conflict between redistributive measures and other policies designed to accelerate growth (Brohman, 1996:217). This is in direct contrast to mainstream development theories and practice that implicitly assume that inequalities in both socio-economic and regional terms are a necessary price of growth.

Alternative development theory and practice has its shortcomings too. A large gap exists between the theory or rhetoric and actual practice (Brohman, 1996:220; Sinclair and Walker, 1999). Development programmes and projects are commonly administered in a top-down paternalistic manner that affords little opportunity for local organisations to participate meaningfully in decision-making (Brohman, 1996:220; Blaikie, 2000). This means that projects undermine indigenous forms of social organisation and democratic political practice, which is an indication that officials often fail to respond to local perceptions of development issues. One of the outcomes of such failures (by officials in responding to local perceptions of development) is the creation of problems in 'local' or indigenous institutions. Outside professionals bring in foreign ideas and methods that are imposed on local particularities in terms of social relations, cultural traditions, spatial organisation and environmental conditions (Brohman, 1996:221; Blaikie, 2000). In most cases, these imposed (development) notions are inappropriate to local conditions (Chambers *et al*, 1989; Lele, 1989; Brohman, 1996:221). In effect, beneficiaries are not assigned a role in the decision-making process, nor is their technological knowledge sought prior to designing project components (Chambers *et al*, 1989; Brohman, 1996:221; Sinclair and Walker, 1999 Blaikie, 2000).

Alternative development is aware of power relations in knowledge construction, development priorities, research agenda and goal setting; it accepts that truth is variable and negotiable, encourages local and authentic action so that people can speak and act for themselves, and lastly, it recognizes that development is a continually negotiated and subjectively defined process (Long and Villarreal, 1993; Blaikie, 2000). In reality, however, alternative development theory and practice have generated conventional development projects that have replicated many of the problems of the mainstream approaches (Brohman, 1996:221; 223; Blaikie, 2000). Moreover, many of the problems have been glossed over by the tendency of many analysts to romanticize and simplify alternative development theory and practice (Brohman, 1996:222; Briggs, 2005).

The major problem of mainstream development theory and practice was non-recognition of variation and diversity in terms of culture, space, power and values (Booth, 1993; Munck, 1999). Alternative development similarly engaged in development programmes that assumed communities were homogeneous, tending to deny possibilities of divergent needs and interests along class, gender, ethnic or factional lines (Brohman, 1996:223). Participation therefore took place through representatives of communities which development experts believed empowered everyone. This analysis of social relations and structures by development experts was inadequate (Chambers, 1983, 2008; Sinclair and Walker, 1999; Blaikie, 2000). The result was that newly created local institutions, rather than representing instruments of progressive change, often became susceptible to co-option and manipulation by dominant classes and social groups (Brohman, 1996:223).

However, this alternative development approach does acknowledge some kind of social movement and the occasional vague notion of local people participation. There is a welcome re-centring of local knowledge and practices, which seek to ground global development in particular places and localities (Power, 2003:229), with the realisation of existence of diversity in needs and values, despite critics pointing out that there is an over-generalised and essentialised view of reality. Yet there is evidence that communities around the world, despite the much vaunted global reach and penetrative capabilities of capitalism, and development have never allowed their identities to be completely reshaped by these processes; neither did they simply surrender to development and global capitalism their indigenous models of economy or nature (Kolawole, 2001; Power, 2003:235 quotes Escobar, 2002).

2.7 The input and contribution of NGOs

A new approach, which is less economistic in its expression and more concerned to question the very identification of progress with growth and development, emphasises the environment, gender issues and calls for an end to the destruction of cultures and livelihoods through grassroots mobilisation (Lehmann, 1997; White, 1999). This new style in critique of development has been influenced or conditioned by the proliferation of non-governmental organisations (NGOs) and the growth of resources under their control (Lehmann, 1997; White, 1999). Their emphasis is to reduce the destruction of the environment, indigenous cultures and knowledge across the globe (Bebbington, 2004; Cameron, 2004).

There is re-discovery of humanity through NGOs (Lehmann, 1997) arising from the fact that poverty is persistent, despite the abundant human and material resources available to tackle it. The result has been the recognition of the fact that the state or government cannot 'do development' alone, and that its interest might be different from their people, and thus postmodern writing places its faith in social movements and NGOs. For example, Lehmann (1997) observes that there are question marks as to whether governments or elites have sufficient political or cultural implantation in their societies to enable them to exercise hegemony, which is assumed to be necessary for successful long-term domination. NGOs can fill in the areas where the government and the state are weak. For example, White (1999) notes that 1990 a World Bank's review of Poverty and Public Expenditure in Bangladesh repeatedly compared NGO activities favourably with those of the state, and recommended the expansion of NGOs to supplement government efforts. It is not surprising, therefore, that NGOs have begun to replace the state in functions like welfare and agricultural development (Chambers, 1993:110; Bebbington, 2004; Cameron, 2004), and seem to be concerned with the protection of the impoverished through projects and relief work. They often advocate the preservation of authenticity, tradition, and popular culture (Lehmann, 1997; Cameron, 2004). The state or government is left with a role to remove any hindrance it may constitute to the new harbingers of development; NGOs, civil society and, of course, the market (White, 1999).

However, although NGOs are treated as one homogenous component in terms of origin and scale, in some instances, they are diverse in structure and institutional context (Stringer *et al,* 2008). They range from those developed at the international scale, which can be referred to as international non-governmental organisations, to those formed at the local level or grassroots known as community based organisations (CBOs). Although their functions and roles may be similar in nature, the structures of these NGOs are different and therefore represent different levels of participation by the local communities along a gradient that is higher and stronger for CBOs, and lower and weaker for international non-government organisations.

Despite the difference in scale and origin, NGOs are seen to displace a development approach in which people are passive recipients of the ambiguous benefits of modernity (Escobar, 1995; Lane, 1995; Lehmann, 1997) by providing the local with a chance to initiate development as they see and want it through a process they term participation (White, 1999). However, the question is raised as to what extent do NGOs represent indigenous peoples' needs? And how genuine is the involvement of the locals in development under the term participation? There is now recognition of the fact that NGOs are also unsatisfactory in their effort to reach and represent the grassroots needs (Mitlin, 1997) and as such there are efforts to engage some local institutions called civil societies that are part of the informal institutions within the local communities in the development process.

There is now an appreciation by many experts of diversity and variations between communities, households and individuals that are supposed to be recognised and utilised in development process (White, 1999). However, some NGOs still treat the local people as if they are homogeneous by lumping them together, thereby losing the fact that there is diversity and differences that probably need redressing for progress to be achieved in the development process. For example, Cameron (2004) notes that in opposing top-down developmentalism, indigenous rights' discourses are in fact another form of developmentalism, where pastoralists, hunter-gatherers and other people from afar may be lumped together for the convenience of donors. Such classifications and groupings tend to invoke the image of knowledgeable and powerful experts (outsiders) helping the powerless and less discerning local folk (Long and Villarreal, 1993). Therefore, it is not surprising that Bebbington (2004) calls for caution in appraising NGOs, by stating that there is need to resist the normative temptation to be either gratuitously critical or excessively optimistic about them.

It has been argued by some experts that neo-liberal theories allowed for the overexploitation of resources that resulted in environmental degradation and the exclusion of locals from the development process (Narman, 1999). NGOs, thus, engage with grass-roots, that is, to fill the gaps left by neo-liberal policies in the development process, as NGOs are considered better placed to work at the grassroots level by the nature of their organisation and formulation (Mitlin, 1997; White, 1999; Reuben, 2002). The emphasis is placed on the need for grassroots development and a bottom-up approach. NGOs in this case have been devoted to poverty alleviation, such that their projects tend to be small-scale and commonly stress the need for local participation, the use of appropriate technology, local knowledge and resources (Brohman, 1996). In effect, NGOs, instead of imposing outside ideas and solutions, try to understand local needs and interests as defined by members of the communities themselves (Brohman, 1996; Howes, 1997).

However, NGOs from the West have pushed three specific issues in Africa with a clear European-American value basis, namely gender equality, human rights and the environment (Narman, 1999). Such issues are often alien to indigenous people. For example, Reuben (2002) notes that the inclusion of gender issues in NGOs in Tanzania led to resistance from many indigenous organisations, as gender is perceived to be an agenda from outside. The continued setting of development agenda by NGOs, therefore, appears to contradict the bottom-up approach which NGOs are considered to be better at than government or the state in the development process.

NGOs acknowledge the idea that grass-roots development efforts can be more effective, especially over the longer term, if they move away from a focus on fixed, externally defined goals towards a more flexible, enabling orientation, designed to develop the intellectual, moral, management and technical capabilities of local participants (Brohman, 1996). Although this has a positive aspect, it still represents an exogenous source of intervention. The fact that it is the outsiders that seem to know what is right for the local people, by bringing in management and the promotion of technical capabilities, undervalues the local knowledge on which development has to be based. The value of local knowledge in this case is valuable in the Western context. It is not surprising, therefore, that more often than not, local knowledge as well as development becomes romanticised. What becomes difficult for NGOs probably is to do what they understand, which is to allow for the locals to carry out the development process. For example, Landim (1987) notes that NGOs seem to promote development that is defined on the line of economic growth very similar to that of neo-liberalism.

Brohman (1996:264) cites Dube (1988:88) who remarked that the process of making the poor aware of important social and political issues (conscientization) helps the poor to understand the root causes of their problems, which may have quite radical implications. There is an identification of the poor in this case, that the poor need to know the root causes of poverty. The implication is that they (the poor) do not already know the root causes of their poverty. Indeed, Beckford and Barker (2007) show that agricultural policy in Jamaica brings cheap subsidized foreign grown produce into the island, with which local producers cannot compete. The foreign grown crops then act as barriers to the movement of local farmers out of poverty through local (agricultural) production. Such global phenomena that also include imports of cheap foods into low income countries, global trade agreements and the north benefitting from cheap food imported from the south pose a challenge as to how indigenous knowledge can prepare local people to fully understand these issues. Bebbington (1993) shows how mixed reactions can be to such global phenomena at the local level in Ecuador. He demonstrates resistance to modernisation in favour of traditional practices in certain quarters in Ecuador, while others such as the Indian federations have promoted the use of Green Revolution technologies as part of a strategy they still conceive as ‘indigenous’. Howes (1997) suggests that there is an expectation in some quarters that

NGOs can contribute to the emergence of a stronger civil society which will increase the chances of the multiple sources of poor people's deprivation to be addressed. Howes (1997) shows that the formulation of local institutions such as Village Development Committees and associated training by NGOs of such groups can be helpful in generating capacity to understand local issues as well as modern issues that can include global phenomena. Local knowledge can be seen to be embedded within such local institutions. Indeed, Cassini *et al* (2008), while working in Ethiopia demonstrate that LVIA, an NGO, put more emphasis in its second phase of intervention in boosting the income generating potential of households, by facilitating the establishment of cooperatives and informal groups, by training in management and specific skills and by building the capacities of local people. The World Bank (1999) also shows how local institutions of cotton growing farmers in Mali managed to influence a cotton buying company called *Compagnie Malienne des Textiles* to respond to farmers' demands for an increase in cotton prices. This was achieved an increased awareness of local farmers' power to negotiate, something brought about by local capacity building of the village associations.

However, Tucker (1999) argues that there is need to avoid the reasoning based on the postulation of an evolutionary scenario on which those left behind in the race of progress could, with the aid of the more advanced, catch up and also become modern and developed. Despite the concern raised by Tucker (1999) above, NGOs make every effort to empower local people of the global South to have the power to own resources or have access to resources to which they previously lacked access (see Bebbington, 1993). Therefore, for example, Schuurman (1993) states that, at present, political empowerment of the poor is the name of the game in the development paradigm.

Complexity and diversity commonly characterise the livelihood strategies of the poor; some may adopt specialised strategies, which rely on a single activity, but most are more versatile and opportunist (Brohman, 1996; Peters, 2002). This complexity and diversity of livelihood strategies of the poor may be one of the factors that present NGOs with problems in sustaining development programmes beyond a project life. Bebbington (2004) notes of some NGOs' disappearance in Bolivia, together with their initiatives, for example.

It is not surprising then that Brohman (1996:269) argues for the poor communities to be deciding for themselves, through their own local institutions and popular organisations, what mix of traditional and modern technologies best suits their particular needs. Development, to be sustainable and meaningful, must meet the needs of local people, because, if not, many people will be obliged by necessity to take more from the environment than is necessary (Brohman, 1996:311). Indigenous knowledge theory becomes the alternative choice for development process and is discussed next.

2.8 Indigenous knowledge for development

As we have seen, the use of centralized, technically oriented solutions to development has resulted in very little success in Africa (Chambers, 1993, 2008; Briggs *et al*, 1998, 1999; Pottier, 2003; Briggs and Sharp, 2004; Briggs 2005). There have been many attempts to explain why the smallholder farmer has been unable to take advantage of Western technologies that should have lifted the smallholder farmer out of poverty. Some solutions have pointed to the nature of the production system that is based on survival/subsistence (Harrison, 2001; FAO, 2003), and hence the smallholder farmer is unwilling to take risks in case the family does not meet its basic food needs as a result of deploying these new technologies (Lele, 1989; Chambers, 1993; Beckford, 2002). The farmers will therefore not risk taking up technologies that have not been proven by them to be effective.

Other scholars have attributed the lack of adoption of Western technologies by smallholder farmers to the lack of participation in the development stages of these technologies (Chambers, 1993; Sinclair and Walker, 1999). Sinclair and Walker (1999) go further in suggesting that the development of such technologies needs to be designed, implemented and evaluated with due regard to the knowledge already held by the farmers themselves. Other scholars, like Chambers (1983; 1993; 2008), have advocated putting farmers first in developing technologies. They have shown that farmers are more knowledgeable and better-informed than many agricultural professionals imagine, and so their input in development programmes is important. For example, farmers' mixed-cropping demonstrates their in-depth knowledge of crop performances in various niches such as wetlands and ant hills that cannot be ignored.

Sinclair and Walker (1999) note that, even though there has been this move towards having farmers participate in development processes, practice has lagged behind rhetoric. Other scholars, like Lele (1989), Morgan and Solarz (1994), Hillock (2000), including UNDP (2002), have made the point that smallholder farmers lack capital in the form of liquid cash to give them access to technologies like fertilisers and pesticides, and therefore there is a need for credit facilities to enable them to participate actively in the agricultural development process. Some economists have put the blame on farmers for not choosing those crops that have high economic returns if they are to fully benefit from Western types of development (Morgan and Solarz, 1994). Cash crops like tobacco, coffee, tea and sugarcane have been recommended to be grown by smallholder farmers to improve their income levels (Lele, 1989; Morgan and Solarz, 1994; Hillocks, 2000). The uptake of 'new' technologies has been mixed and it can hardly be said to be wholly successful (Chambers, 1993, 2008; Lele, 1989). Beckford (2002) suggests, therefore, that tropical small-scale farming should be recognised as a unique farming system. Smallholdings, scattered plots, the use of family labour and production mainly for subsistence priorities characterize it. Chambers (1993) has termed such agriculture as complex, diverse and risk-prone. It bears little resemblance to Western types of farming that are highly specialised (for example, mono-cropping), involving large scale production that is market-oriented and which fully utilises modern technologies, such as chemical fertilisers, pesticides and high yielding varieties to improve profit margins.

Smallholder farmers' traditional farming practices are a form of indigenous knowledge (IK), indigenous knowledge being a knowledge produced by local people based on lived experiences (Sinclair and Walker, 1999; Peters, 2002; Lado, 2004; Phuthego and Chanda, 2004). It is, therefore, assumed to be available and present within the local communities. However, there are differences in its exact definition, depending on the training associated with different disciplines such as anthropology, agriculture and environment. Some authors tend to define indigenous knowledge in terms of its association with culture, people's values and their ways of life. Such a definition excludes the fact that it is sometimes produced by incorporating external influence (Sinclair and Walker, 1999; Briggs *et al,* 2007). The exclusion of external forces in its production process implies that IK is primarily place-specific in nature. The production of IK is then just based on a given environment, culture or society and other social factors, such as beliefs (Rajasekaran, 1993; Kolawole, 2001; World Bank, 2003b). Homann and Rischkowsky (2001) elaborate this point by stating that indigenous knowledge is a social product which is closely linked, or even restricted, to its cultural and environmental context.

Such variations in IK definitions by experts render it difficult to be fully utilised in development practice (Agrawal, 1995). Its use and role is limited by its definition. In fact, the term indigenous has a connotation of being unchanging, as it excludes influences from external sources. This is further compromised by the fact that studies of IK are associated with societies that have not fully accepted Western ways of knowing and doing things even though some of such societies are in the West (Riseth, 2007).

However, since the process of IK production is mainly based on what local people can see with their own eyes (Chambers, 1983; Agrawal, 1995; Phuthego and Chanda, 2004), compared to Western knowledge that is produced using advanced technologies such as microscopes for example, it is viewed as static and backward (World Bank, 2003b). The use of science and technology legitimises Western science as being open, systematic, objective and analytical compared to IK, which is closed, non-systematic, holistic, and non-analytical, with advances being made which are based on experience rather than logic (Agrawal, 1995; Kolawole, 2001). Given its production process, IK's importance for use in development is considered to be inferior to that of Western scientific knowledge (World Bank, 2004; Eriksen, 2007; Riseth, 2007). As a result of this assumed inferiority of IK, experts are still divided over its usefulness in development, partly because of its epistemology and partly due to an assumed lack of rigour in the observations and 'experimentation' in its production process (Kolawole, 2001). This weakness is thus seen to generate findings of limited value and practical use for policy makers. Essentially, the methodological and epistemological grounds are different because these two forms of knowledge use different methods to investigate reality (Agrawal, 1995). In addition, Homann and Rischkowsky (2001) argue that the geographical and economic dominance of Western science make it difficult for development experts to work with other knowledge systems.

Such differences between IK and Western science result in presentations by some authors that create binary tensions between the two knowledges. They are represented by some experts almost as discrete entities, separated from each other so that they can hardly co-exist in one society (Briggs, 2005). Yet many scholars have demonstrated that these knowledges exist side by side and form part of each other's knowledge (Chambers, 1983; Sinclair and Walker, 1999; Peters, 2002). Indeed, indigenous knowledge has contributed to the advancement of science, as demonstrated by Chambers (1993:70), where farmers' observations, for example, discovered that the sprouting of potatoes in storage was inhibited by diffused light. Scientists learnt from farmers on this occasion and transferred the principles worldwide. Similarly, Western science has at times been found wanting. Farmers' practices of inter-cropping were once looked upon as simple, primitive and backward, but it is now recognised as a sophisticated way of crop management under particular ecological conditions (Chambers, 1983:85). As Dei (1993) points out, many indigenous communities have long recognised the need for environmental sustainability so that Dei argues for contemporary societies to learn from them. Nonetheless, there are some who still marginalise and disqualify non-Western knowledge systems (Chambers, 1983, 1993; Sillitoe, 1998; World Bank, 2003b; World Bank, 2006). Despite such positions, the World Bank (2004, 2007b) considers IK as an important input for agricultural growth in the global South. It is argued by some that the strength of IK lies in its continuous adaptations, 'experimentation' and observations by its producers (Chambers, 1993; Dei, 1993; Gata, 1993). It is not surprising that the World Bank in its World Development Report (2008) calls for an explicit farmers' input in crop variety development and selection (World Bank, 2007b). There is at least some realisation in such quarters that tensions between Western and IK are irrelevant, where the improvement of living standards is the major goal for development (Briggs, 2005).

Although 'experimentation' and observation under IK are commonly referred to as trial and error, there is evidence of it being as advanced as Western technologies in some cases, such as the knowledge of farmers in Nepal about the impact of rain-drop sizes on soil erosion. The farmers in Nepal understood the relationship between raindrop size and leaf size of the canopy before scientists had developed their understandings of the same (Sinclair and Walker, 1999). In fact, it had previously been disputed that different canopy types did indeed produce different sizes of rain-drops until advanced equipment was developed that measured raindrop size from different types of canopies. Similarly, Homann and Rischkowsky (2001) working in Namibia showed how the validation of environmental and organisational knowledge led to new scientific insights, in the same way as for farmers in Nepal. Farmers' knowledge of pastures' spatial distribution led to its better management during lean rainfall periods in Namibia. Furthermore, Eriksen (2007) and Riseth (2007) have shown that IK is to some extent based on scientifically-proven evidence, as demonstrated by the careful management of natural resources by reindeer farmers in Norway and the use of fire for management of forest resources in Zambia, respectively. Both of these studies show that by using IK, natural resources were well-managed without causing degradation, and in fact resulted in desirable species dominating the landscape. Indeed, the economic, social, environmental and cultural benefits of IK have been demonstrated by many authors (Bebbington, 1993; Sillitoe, 1998; Hillocks, 2000; Mtika, 2000; Orr *et al,* 2000; Dixon, 2001; Kolawole, 2001; Lado, 2004; Phuthego and Chanda, 2004; Riseth, 2007). The IK's production process generates knowledge that is both suitable for specific places and for individual households, because its production takes into consideration variations of each household's social, cultural, and economic endowment including the environment (World Bank, 2004). This is realised through the process of IK production that is primarily based on 'experimentation' and observation made at individual farmer level (Chambers, 1983).

However, the challenges for IK deployment in development are many. Firstly, there is the dichotomy with Western science as demonstrated by the above examples. Secondly, many scholars in the past have associated traditional farming practices (which are in effect primarily IK in nature) with low agricultural production levels that lead to economic stagnation (Bebbington, 1993; Morgan and Solarz, 1994). Roth (2001) alludes to this point when he argues that the introduction of Western technology to non-Western farmers was intended to increase production capacity and to improve the market position of the agricultural sector. Indeed, Bebbington (1993) argues that it is hard to find where traditional agricultural practices have resulted in economic prosperity. The result is that any use of IK in development is limited to where it can be verified by the use of Western technologies and science as useful and beneficial

(Sinclair and Walker, 1999; Briggs, 2005). Western science becomes the arbiter of all other knowledges. As if this is not enough, the production of IK is based on lived experience and observations of the surrounding environment which make it assume the position that it is place-specific so that its wider utilisation away from its production site is doubted (Briggs, 2005; Eriksen, 2007). Furthermore, the role and use of IK in development is seen by some experts as a threat, especially those who want to maintain authority in the design and implementation of programmes (Peters, 2002; Briggs, 2005). Pottier (2003) observes that the 'discovery' of indigenous knowledge demanded that development practitioners be receptive to the technology, skills and accumulated knowledge of the people everywhere. Yet IK is knowledge that experts cannot assume to be fully trained in, because it is produced by local people. Interestingly, its use and role in development creates a power shift from experts to local people. Furthermore, the recognition of IK as a useful tool in development programmes demands an equality of participation and partnership with the 'ignorant' farmer (Kapoor, 2005). Yet, Cleaver (1999) notes that there is an inherent difficulty in incorporating project concerns with participatory concerns, especially because a project by expert definition has a set of objectives, quantifiable costs and benefits associated with time-limited activities and budgets. However, there was recognition by some researchers of the need to allow for a degree of local autonomy necessary to sustain development beyond a project life (Pottier, 2003). In addition, development based on 'crisis narratives', which portrays IK as a 'culprit' in the management of natural resources that result in their degradation, becomes difficult to sustain with the deployment of the same in development practice (Briggs *et al,* 1999; Eriksen, 2007; Riseth, 2007). In fact, it appears that Western knowledge is threatened by the recognition of IK as a useful tool for development (Peters, 2002). Peters (2002) notes that it has been displaced from its pedestal and is now seen as one from among several types of competing knowledge systems. Clearly, there is a question of power relations here, where development is supposed to be planned by development experts who are knowledgeable and have the necessary scientific training (Chambers, 1983; Tevera, 1999; Riseth, 2007; Eriksen, 2007).

The World Bank (2004, 2005a, 2005b) observed that farmers are often overlooked in the process of the search for and development of knowledge, despite their extremely rich knowledge. In fact, some experts often pre-determine ignorance perhaps because they have little interest in externalizing farmers' knowledge, such that, despite the evidence and recognition of the potential role IK can play in development, there persists a notion that the producers of local knowledge, including farmers, wield little power (Ostberg, 1995; World Bank, 2004). The result has been insufficient practising of participatory and partnership concepts by experts (Kapoor, 2005). Farmers are assumed to have no voice worth listening to, and this is reinforced by excluding their knowledge in development programmes (Morgan and Solarz, 1994). The experts' objectives become dominant over those of farmers and are often biased towards the production of 'new' technologies which are high yielding for the benefit of publications, recognition and scientific progress (World Bank, 2004). The experts instil and consolidate the position that they produce knowledge, which benefits the farmers in a one-way transfer channel, that is from them to the farmers. Yet the World Bank (1998b) and Harrison (2001) demonstrate that there is recognition in some quarters that rural (local) people have the power to resist development projects that regard them as only beneficiaries. When farmers' inputs are ignored and the focus is on the inputs of experts, rather than the household, important natural, social, cultural and economic factors faced by the farmers on the ground can make the rejection of a development project a rational choice (see Ejigu, 2008).

The recognition of IK as useful in development has, at times, been romanticised (Peters, 2002). Roth (2001), Eriksen (2007) and Riseth (2007) by showing that indigenous knowledge demonstrates knowledge about the environment that results in the successful management of natural resources, all raise the notion that IK is out there ready to be tapped for use in development and without difficulties. However, just like Western science, local knowledge cannot be assumed to be understood as a system (Pottier, 2003). In fact, Peters (2002) argues that IK, just like Western science, has its own shortfalls when being applied in development processes. For example, IK can be inadequate in its understanding of the whole, such as a complete catchment area, while Western knowledge has been inadequate in understanding and appreciating local values and preferences (Townsend, 1993; Munck, 1999; Pieterse, 1999; Sardar, 1999; Blaikie, 2000; Peters, 2002; Power, 2003:75). Furthermore, Homann and Rischkowsky (2001) found that farmers' maps of local resources corresponded quite closely to those based on satellite images, but revealed a focus on the spatial and seasonal availability of the key resources, as opposed to broader pasture management regimes. Indeed, when farmers were asked to plan for the utilisation of these resources using their maps, the fencing put in place resulted in the over-use of resources culminating in their degradation. It is not surprising when Briggs (2005) argues that it cannot be assumed at all that IK will necessarily provide a sustainable answer to production challenges in poor rural communities. The practices based on local knowledge do not necessarily guarantee better land management, sustainable production or reduced land degradation (Osanude, 1994). In addition, knowledge held by communities is as diverse as the environments in which such communities are found and the objectives that are pursued, which may depend on several factors, including their resource endowment, family size and composition and formal or informal education (World Bank, 2004).

The theory and practice of IK has been 'dogged' by the so-called dichotomy between Western science and IK, power relations, romanticization, and a reluctance by experts to accept that IK can be applied and used beyond its production site. Yet the production of IK involves continuous innovation, modification and adaptation to suit local or specific conditions (World Bank, 2002). Surprisingly, there remains a scepticism about the usefulness of IK in development by experts (Lado, 2004; Beckford and Barker, 2007; Briggs *et al,* 2007).

Unlike development theories, such as modernisation and neo-liberalism, which assume that economic growth will empower the poor through trickle-down processes, the theory behind IK is that it offers empowerment to local people who are the subjects driving development rather than objects to be developed. IK then challenges[2] the development discourse as a system of knowledge, technologies, practices and power relationships that serves to order and regulate people as objects of development intervention (Bebbington *et al,* 2007). Indeed, they note that the World Bank has identified empowerment as one of the pillars of poverty reduction, while Kapoor (2005) notes the heroic nature of claims made for participatory approaches to development that include ensuring greater efficiency and effectiveness of investment and contributing to the

[2] For example, Eriksen (2007) in Zambia shows how IK related to wild fires challenges the development discourse that considered the bush fires as ecologically damaging to the environment. Also note that the discourse of IK and IK itself, including its promotion in development, have the same agency of challenging the development discourse (particularly that based on economic growth), and of recognising diversity and variety.

process of democratization and empowerment. It is argued by many scholars that IK is produced by local people using their lived experience within their environment, based on their own socio-economic assessment of their needs so that any IK developed has its own inherent value (see Briggs *et al,* 2007). If indeed it has inherent value, as the Bedouin have shown in the successful utilisation and management of their natural resources such as trees, and their effective choices and management of their cultivation sites as reported by Briggs *et al* (1998;1999), then IK provides for more than a multiplier effect in the development process. Indeed, the findings of Briggs *et al* (1998; 1999) clearly demonstrate the relevance and the incremental values that IK contributes to development practice and theory. The Bedouin determined suitable livestock feed through 'experimentation' and observing growth rates, lambing percentages and milk quality. Furthermore, there is an underlying assumption that, with IK, development experts and technocrats can become facilitators rather than developers of development agenda and projects (Chambers, 1983). When development experts become facilitators, there is a much greater ownership of development programmes by the local people, and hence this reflects what people want and aspire to, because they have a greater role in defining the development process and practice (see Chambers, 1983; Chambers *et al,* 1989).

The general agreement between some development experts is that the value of IK is based on the fact that it does not need others to generate technology, or to distil and distribute it for development to take place (Power, 2003:187; World Bank, 2003b). In addition, IK recognises diversity and variety in needs, spaces, power, environment and values, and eliminates the representation of local people and communities by development experts as some sort of uniform, homogeneous collective confined to a singular space (Power, 2003:189). It also eliminates the one-size-fits-all solution to development, that of economic growth. Livelihoods then become adequately and sufficiently addressed through the utilisation of IK, which in turn addresses the important question raised by Power (2003:191): will there come a time when there will be a return cargo of ideas, a South-North transfer of poverty concepts and definition? For example, the Dakar Manifesto (2000) calls for development to be based on solidarity among people, with a priority for basic human needs and stressing the importance of promoting home-grown solutions (very similar to IK) to development rather than a universal model (Power, 2003:216; Ejigu, 2008).

Indigenous knowledge is fundamentally a local knowledge owned by inhabitants, and therefore this is where participation in the development process should begin. As Escobar (1995:98) rightly puts it,

> "the remaking of development must start by examining local constructions, to the extent that they are the life and history of the people, that is, the conditions of and for change".

The relevance of Escobar's point to remake development is further explained by Jupp (2007) who argues that to have in-depth knowledge of communities ensures their participation in development programmes. Jupp (2007) demonstrates that there are linkages between participation, knowledge and empowerment so that such a process of representation, according to Jupp (2007), enables subjects to project their own voices and positions thereby empowering participants who are often seen as marginalised or disempowered.

Unlike some theorisations of IK as being static and frozen in time, there is now a general agreement amongst experts that IK is continuously adapting to changes (Adams *et al,* 1994; Adams and Mortimore, 1997; Sinclair and Walker, 1999; World Bank, 2004). Briggs *et al* (1999) note that the Bedouin do not see the development debate, as far as it affects them, in such stark bipolar terms; indeed, they accept that there are various knowledges and are more than prepared to appropriate those elements of knowledges, including formal science, that they see as being useful to their economic, social or political advantage. If IK was understood in the manner the Bedouin understand it, experts would not have come up with development projects that are inappropriate and/or irrelevant (see Chambers, 1983).

Development as understood by experts and technocrats has not worked in much of rural Africa. Harrison (2001) and Power (2003:182) allude to the point that in the development processes driven by the West there has been little participation by the local. Sinclair and Walker (1999) suggest that much local participation has been rhetoric as opposed to reality. Briggs *et al* (1999), Cleaver (1999), Harrison (2001), and Power

(2003:182), note that despite the lip service paid to public participation, preference is still given to control by scientists, technicians, national decision-makers and donors. To counteract this bias, IK has been romanticised unnecessarily (Adams *et al,* 1994; Power, 2003:187; Siebers, 2004).

Despite the change in the understanding of how development can be tackled in the global South, there are still no significant changes on the ground (World Bank 2004; Ejigu, 2008). Indeed, the World Bank (2004) acknowledges that the mere understanding of farmers' problems, and addressing their limitations, does not result in technology adoption. Full participation in design, evaluation and implementation is required for the successful adoption of technologies by farmers, for example, so that the incorporation of IK at these various stages (design, evaluation and implementation of development programmes) can ensure the involvement of the local people because successful implementation requires their input (Chambers, 1983). Yet, the reluctance to utilise indigenous knowledge fully in practice for development is still being ignored. Even the World Bank (2007b) argues in its World Development Report (2008) that the use of indigenous knowledge for agricultural production can be limited to the selection of high yielding varieties developed by experts. IK is still perceived as useful only when it complements Western scientific knowledge such as the selection of crop varieties suitable for farmers. Briggs and Sharp (2004) correctly note that there continues to be suspicion and wariness about the extent to which indigenous knowledges are capable of challenging currently accepted ideas of development by pushing formal science to the margins. Formal science represents such a powerful body of knowledge that many experts still pre-determine local knowledge as ignorance, largely because they have little interest in externalising farmers' knowledges (World Bank, 2004, 2006) unless they have potential commercial value, such as beneficial traits of crops that include disease resistance, for example.

However, it has now become clear for many experts that development as an uncontested human good, based on Western values, denies peoples of different cultures the opportunity to define the forms of their social life (Cleaver, 1999; Munck, 1999). When people define development themselves and on their own terms, responsibility for the process moves from development experts to indigenous (local) people in the manner they (local people) want it (and thus define it). The local people become responsible for their own destiny, and cease being objects to be studied, described and developed (Townsend, 1993; Tucker, 1999).

In most development programmes, the survival needs of people have often been overlooked and there has frequently been a failure to consider the implications of development policies at the various levels of individuals, households and communities (Cleaver, 1999; Power, 2003:199; World Bank, 2004). Bebbington *et al* (2007) note that even programmes supposedly produced through participatory processes, such as Poverty Reduction Strategy Papers (PRSPs) advocated by the IMF and the World Bank, usually end up endorsing neo-liberal programmes with equally damaging effects on communities and individuals, such as SAPs. IK, being individually-, household-, and community-derived knowledge, becomes an obvious alternative to currently accepted development theories and practices that fail to address the presence of such diversity of individual, household and community development needs. It is important to note that inequalities are manifested at the household level, where there are variations in levels of income, power and access to assets (Adams and Mortimore, 1997; Mtika, 2000; World Bank, 2004; Ejigu, 2008). Briggs *et al* (1999) associate this with the various levels of access and use of resources such as acacia trees in their study of Bedouin in the Eastern desert of Egypt. They note that from a single tree one household may have access to dead wood, while another may just have access to fallen leaves. They further note how variations in wealth between different households impacts on their access to resources.

It would seem that IK becomes an important tool in the ‘bottom-up’ development approach, which requires that development experts learn from the rural poor. They thus become facilitators and at times ‘learners’, rather the mantle-bearers for the development process. This calls for a real change in power relations. The expert dominant position must give way to an equal partnership with the rural poor. In this way, power is also transferred from the expert to the rural poor communities through active participation and decision-making (Brohman, 1996: 251-252; Jupp, 2007). Communities then not only share the benefits of projects but define the nature of the programmes fit for them. In fact, there is a wide understanding now that there are voices of resistance within rural communities to formal development from the ‘top’, even though there is a deliberate effort to ignore that voice (Kolawole, 2001; Briggs and Sharp 2004; Briggs, 2005). Pottier (2003) observes that local people exercise their power by choosing which externally driven development programmes are accepted or rejected. Indeed, Bebbington *et al* (2007) define power as the ability to make or receive any change or to resist it, that is, to make choices and pursue strategies within given limits, which varies over time and space. Harrison (2001), working in Mozambique and Tanzania, has shown that farmers resist development projects not by lobbying governments to change policies, nor by rebelling against the state in direct confrontation, but through sabotage and subterfuge, which is a form of exercising their power albeit discreetly. He also notes that farmers boiled seeds provided, so that they were destroyed in order for them to fail to germinate, or indeed planted them upside down. He further observes that there is lack of control of the peasantry for development by governments, either because of a lack of institutional capacity or indeed lack of personnel. Peters (2002) also observed that land ownership changes and agricultural programmes in Malawi, initiated by the colonial government, failed to take roots because of lack of personnel to enforce such changes. In fact, it was one of the major contributing factors that led to political changes that resulted in the fight for independence which was granted in 1964.

The question is how best to understand IK, as it is understood by its practitioners, and how best to use it to facilitate development, as understood by local people. It is no longer adequate for experts to collect and analyse data in order to develop technological fixes to others' problems for development purposes (Sillitoe, 1998). Prescriptions to solutions of problems faced by farmers that are developed without much of their input have been ineffective because local people are not used to the scientific understanding of issues and their language (Sillitoe, 1998; Harrison, 2001; Power, 2003:182). For example, the experts' analysis of crops at levels such as molecules and cells is alien to farmers. The development experts need to analyse the whole (plants, systems, animals and the environment) in a manner that is understood by the developers of local knowledge (Chambers, 1983; Chambers *et al,* 1989).

2.9 Summary and conclusion

The review of literature on development theory and practice has shown that modernisation creates attitudes that humans have authority over nature, thereby excluding humankind from nature itself. For development to take place, nature has to be manipulated using science and technology, sometimes/often with very little consideration for the environment. In this process, social values and expectations are those proven successful in the West, such as those of profit-making and maximising production. The weaknesses in modernisation theory and practice were used by dependency theory and practice scholars to highlight the major problem of underdevelopment that arose from the flow of resources away from the global South. The resultant failure to improve the living standards of the people in the global South led to the development impasse. The period of development impasse was considered by some authors as though development at one point went away.

The market place as an efficient allocator of resources for development purposes was rekindled with the introduction of neo-liberalism and SAPs. The efficient allocation of resources and massively reduced interference from the government was necessary for development. When the market also failed to induce development, social issues of development were introduced as embedded in alternative development. Development moved from being driven by technocrats with local people as objects to being driven by local people as partners. NGOs played an important role in making local people participants in development processes.

However, development has proven difficult to sustain in the global South. Indigenous knowledge theory and practice, which can be discerned as explaining and underpinning what has been happening with local knowledge during its production and use, or non-deployment in the development process, (being knowledge of the local people), has created a potential for being effective in the development process, firstly because it is assumed to be out there with local people and can thus be used for development, and secondly because it assumes the full participation of the local people. In addition, it is based on lived experience and may therefore not suffer from being looked at as knowledge introduced by outsiders.

This raises key research questions:

- What is the nature, role, use and content of indigenous knowledge in everyday agricultural practice?
- How do power relations within communities influence the acceptance and use of indigenous knowledge?
- To what extent is there an adequate understanding by policymakers and development workers of local people's perceptions and definitions of development?
- How can indigenous knowledge be used effectively in development theory and practice, and what are the key challenges to its effective deployment?

The study specifically will therefore examine and analyse the roles of stakeholders, like the government, NGOs and the private sector, in agricultural development, analyse the major information sources used by farmers in decision making, examine their use of resources (natural and social) in farming practices and establish their importance in development practice and theory, identify and analyse farmers' priorities underlying their farming practices in order to compare with those emphasised by experts and examine the social, cultural, economic and environmental context of their farming practices at household and community levels in order to establish the use and role of IK in development based on its application by farmers.

Chapter 3
Methods

3.1 The requirements of the study's objectives

The objectives of the study required field observations, major inputs from farmers about their farming activities throughout the agricultural calendar and from third parties supporting them, such as the government and its agents, private companies, NGOs and communities in general. The involvement of farmers in the study gave them the chance to be 'heard'. To establish the rationale and 'probably' the scientific basis of farmers' knowledge, their participation was necessary. It was also important to determine how indigenous knowledge is produced, mediated, transformed or re-worked and disseminated. The impact of seasonality of farming practices was considered very important, making it necessary for the study to be conducted over a period of eight months from June 2006 to February 2007, so that farmers' activities on all their plots that included upland gardens and wet lands (*dimba)* cultivated at different times could be adequately studied and analysed in detail. The period of the study ensured that most farming practices that involve land preparation up to the harvesting of annual crops grown on the uplands, as well as wet land farming systems, were included in the observations. A preliminary survey of the area was done to establish the methods that were appropriate for data collection adequate to answer the research questions (Lado, 2004). A mixture of methods was used in order to achieve the objectives of the study (see Johnston, 2005; Beckford *et al,* 2007). Primary methods of data collection included a questionnaire survey, personal interviews, participatory observation, farmers' participatory research methods (including focus group discussions), transect walks, field observations, random soil sampling and soil chemical analysis. Questionnaires and interview guide questions were pre-tested and necessary changes made so that the research questions could be adequately addressed.

3.1.1 Protocols

Conducting research that involves human participants requires ethical approval. In fulfilment of the University of Glasgow ethics approval process for research, an application was made and was granted. Similarly, in Malawi, permission was sought from the Head of Mzuzu Agricultural Development Division (ADD) to conduct research in the Zombwe Extension Planning Area (EPA). A meeting with the head of Mzuzu ADD was arranged and after introducing myself and explaining the purpose of the meeting, an application was made to conduct research in the study area. Permission was granted. A verbal authorisation was made and all government officials involved in the agricultural activities in the study area were notified of my presence and the purpose of the study.

Following the notification from the head of Mzuzu ADD, the extension worker in the study area notified some farmers of my presence in the area to conduct a study about their farming practices. This was followed by visits to village headmen in the area to seek permission to work with their villagers. Permission was granted. Farmers were then asked in advance to participate in interviews, questionnaire surveys and focus group discussions. Farmers were also asked for permission for the researcher to conduct transect walks on their farms, to collect soil samples and to participate in their farming practices. Some 128 farmers agreed to participate in the study.

Meetings were arranged with three NGOs and three private companies working in the study area to explain the purpose of my visits. During these meetings, permission was sought to gather data on their activities in the study area. Appointments were made for in-depth interviews with managers and sales representatives, concerning their activities in the study area, after they had agreed to participate in the study.

3.2 The study area

The study area is in northern Malawi and is Zombwe Extension Planning Area within Mzuzu Agricultural Development Division (Figure 3.1). The study was conducted in three areas of Zombwe EPA, Lupaso, Dunduzu-Msiki and Nkholongo, all of which have a rolling hill topography typical of the plateau lands of Malawi, and all of which are intersected by numerous streams (Figure 3.1 and Figure 3.2). The rolling hills and valleys create upland gardens on the slopes and watershed, and wetlands along the stream and river beds. The study area is 1300-1500m above sea level and covers an area 25 km in length by 15 km in width, although the whole Zombwe EPA has an area of about 40 km by about 30 km. The study area is located at a distance of about 8 km from the northern town of Mzuzu (Figure 3.1).

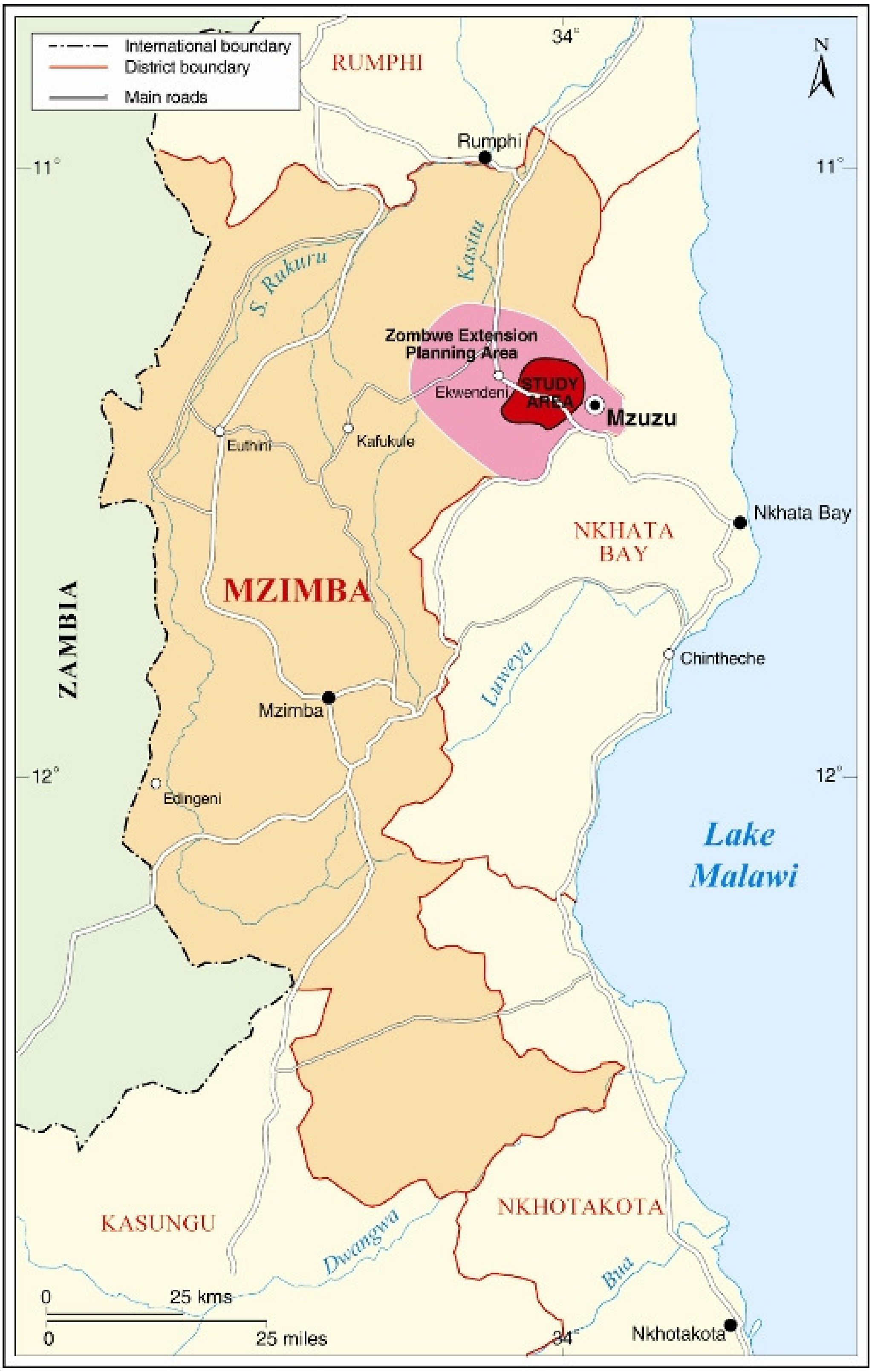

Figure 3.1 A Map showing the location of the study area

Figure 3.2 Birds' eye view of streams, cultivated areas and vegetation cover in the study area

The study area has an all-weather road that connects it to Mzuzu city and beyond (Figure 3.2), in addition to several feeder roads that are accessible throughout most of the year except on those days when it rains heavily. The area is predominantly cultivated by farmers holding land under customary land tenure that recognises private land ownership rights, inherited mainly through the patrilineal system (Ngwira, 2003).

3.2.1 Choice and justification of the study area

The study area has a fairly long history (>61 years) of agricultural development programmes that include the provision of agricultural services by the various governments that have held power over this period. The area has 33 villages with its population largely working as smallholder farmers cultivating various garden types that include rain-fed uplands and wetlands in the valleys. The smallholder setting of farming operations are typical of the whole country of Malawi (see Chirwa, 2004, 2005). The study area has an agrarian profile necessary for this study, and it is a reasonably representative sample of Malawi as a whole, and its surrounding neighbours that include Mozambique, Tanzania and Zambia (see Figure 3.3). Agriculture in the study area is organised at the household level, with the community at large playing supportive roles. The availability of agricultural services, the smallholder nature of farming activities based on local knowledges and the demography of the study area make it a suitable choice as a field laboratory to explore the interplay of government policies, experiences and interventions which affect local farming practices. The city (Mzuzu) that is close to the study area was the regional capital of the colonial government of Nyasaland (now Malawi).

The colonists who settled in Mzuzu in the late 1940s grew tea, tung and coffee on their estates. The area therefore has been exposed to modern farming technologies for over sixty years. This provides an opportunity to assess the development of indigenous knowledge alongside a long history of influence of the early introduction of modern technologies that were being used by these colonists in growing their crops close to the study area. It was expected that some farmers might have worked as paid labours on these estates, and, as such, may have either adopted or adapted some of the farming practices introduced by the colonial settlers. The adoption of such practices could have a significant influence on the development of indigenous knowledges in the study area.

Indeed, it is reasonable to assume that farmers may have incorporated modern technologies in their agricultural activities, generating ‘hybridised’ knowledges that would be interesting and important to examine.

Malawi is divided into eight Agriculture Development Divisions (ADDs) to facilitate agricultural production and productivity, the basis of its economy (Figure 3.3). The emphasis has been put on the promotion of modern farming practices to increase yields that result in increased volumes of export crops and self-sufficiency in food, both at national and household levels (Orr *et al,* 2000; Peters, 2002). Effort has been made by the government to train and produce professional agriculturists (agronomists, soil scientists, plant and animal breeders and entomologists, for example) of high calibre to promote modern methods of farming to achieve the government’s goals of food self-sufficiency and surpluses for export. Mzuzu is a headquarters of one of the eight ADDs and therefore the study area is well supplied with agricultural technical expertise necessary for the improvement of crop and livestock production. The availability of well-trained agricultural experts within the area of the study was assumed to be an important factor in the dissemination of modern technologies to the surrounding communities. The professional agricultural experts are responsible for disseminating knowledge and facilitating the adoption of modern farming technologies. This gives an opportunity to examine and analyse the interface between indigenous and Western knowledges.

Figure 3.3 A Map showing Agricultural Development Divisions in Malawi

Furthermore, the area had regional agricultural offices, established in the early 1950s, and it is thus appropriate to assume that modern technologies have been promoted by extension agents based in the study area for nearly 60 years. The length of time that these agricultural services have been provided to farmers is also assumed to have an impact on the development of farmers' knowledge and in particular indigenous knowledges in the study area. Farming practices developed by farmers for subsistence production have been considered by some experts as backward and static, as well as inefficient, insufficient and inappropriate for market-oriented production (see Chambers, 1983; Morgan and Solarz, 1994). This long period of undermining indigenous knowledge by experts might have significant impacts on knowledge production by farmers in the study area.

The study area still has small-scale farmers with landholdings of around four hectares or less, something that is widespread throughout the whole of Malawi (Chirwa, 2004; 2005; Langyintuo, 2004). This similarity in land holding sizes (of four hectares or less per household) to the rest of the nation rendered the study area a satisfactory representative sample from which to draw lessons and recommendations of use to the whole nation of Malawi, and possibly in other areas beyond with similar characteristics. In addition, farming practices under such small-sized land holdings are believed to be based on traditional ecological knowledges developed over a long period through experience specific to the local environment. Farmers who have small land holdings of this nature tend to operate under customary land tenure arrangements in Malawi and its neighbours (Kamoto and Milner, 2003). Such farmers tend to use, preserve, enlarge and then pass their farms onto their descendents after equipping them with an adequate knowledge on land resource management and utilisation (Lado, 2004).

Small-scale farmers found in most tropical areas have difficulty in accessing agricultural services because of long distances between farmers and the services, resulting in low adoption rates of modern farming technologies (Beckford *et al,* 2007). The presence of agricultural services, such as extension staff, agricultural division headquarters, NGOs and private companies providing agricultural services just eight kilometres away from the study area, was considered advantageous, as it removed one of the major limitations for adopting modern farming technologies. It was assumed that if farmers were still practising traditional methods of farming in the study area, it is as a result of other limiting factors, which needed to be established, assessed, analysed and evaluated.

The growth of the previously small settlement of Mzuzu into a city, with private companies, government offices and NGOs, provided smallholder farmers a chance to diversify into waged employment that could be either formal or informal, but which can influence knowledge production, by either removing them partially or wholly from farming operations, or giving them access to new agricultural knowledge from migrants. Mzuzu as a city also acts as a market outlet for farmers' produce, as well as a source of entrepreneurs who sell products to farmers. Eriksen (2007), working on experience from Zambia, has argued that the distance to the nearest market and the lack of transport inhibits potential local income from selling products, such as fruit and vegetables, which is a clear indication of the importance of access to markets and transport links in farmers' sustenance and livelihoods. With employment opportunities offered by the city, farmers acquire additional wage income in addition to that generated from farming. This income from non-agricultural employment and/or selling produce gives farmers the opportunity to afford external farm inputs, such as chemical fertilisers and pesticides, which might have an impact on indigenous knowledge production. The city provides the opportunity for farmers in the study area to engage in market-oriented production, which could change the subsistence nature of their production. The change of the nature of production from subsistence to market-oriented requires a change in knowledge, including that of farming, as argued by most advocates of modernisation (see Tevera, 1999). This change in farming practices, to producing for the market, is an important factor in influencing knowledge acquisition and development, thereby having an impact on indigenous knowledge production in the study area. In addition, the city acts as an attraction for immigrants from different areas of Malawi to work or do business. Such people settle within and around the areas surrounding the city, bringing knowledges from their places of origin, which can potentially be adopted by the farmers in the study area. There is evidence in literature which shows that knowledge can be gained through interactions that arise from new farmers settling in an area where there are already settlers (see Briggs *et al*, 2007).

The area has both rain-fed agricultural production and wetland (*dimba*) cultivation. The duality of the agricultural activities in the study area provided the researcher with the opportunity to study indigenous knowledge production and development, where these two farming techniques are practiced at the same household level. This dualism is rare where irrigation facilities are absent, as is the case with most small-scale farming systems in developing countries that are primarily based on rain-fed agricultural production systems (Beckford *et al,* 2007). It was assumed that the two farming systems may require the acquisition of different types of indigenous knowledges that are suitable for each of the farming niche. The fact that a single household practised both systems of farming provided the researcher with a rare opportunity to see how such knowledge is managed by farmers at several levels, the individual, family and the community.

3.2.2 Physical characteristics of the study area

Figure 3.4 Rolling hills and red *katondo* soils in the study area

The rolling hills of the Zombwe EPA are dominated by red *katondo* soils (Figure 3.4). The vegetation is largely woodland, with *Brachystegia species* and *Uapaca species* dominating the tree category, and *Hypernia species* being the dominant grass in open areas cleared of trees. The streams intersecting the hills are typically in narrow valleys of between 20m to 100m in width. These valleys have dark fertile soils whose dark colour is mainly from plant residues decomposing after being deposited by run-off water from the surrounding vegetation on the slopes. The major vegetation of these valleys is dominated by reeds, with scattered trees locally named as *katopi* (*Syzgium cordetum*) and bushes that tolerate high water tables and inundation (Figure 3.5). The farms made along the stream beds are known locally as *dimba* and are cultivated in the dry season, utilising residual moisture and the light rains that fall during this period, while those farms on the rolling hills are cultivated during the rainy season.

Figure 3.5 Reeds dominating vegetation in a *dimba* in the study area

The area has two seasons. The rainy season starts from late November and lasts up to the end of April or May (Figure 3.6 and Table 3.2). The annual rainfall of the study area is above 1200 mm (Table 3.1). The dry season begins at the end of April or early May and lasts until November.

Table 3.1 Annual total rainfall and annual mean temperature figures for Mzuzu

Year	Total rainfall (mm)	Mean Maximum Temperature (°C)	Mean Minimum Temperature (°C)	Year	Total rainfall	Mean Maximum Temperature (°C)	Mean Minimum Temperature (°C)
1969	917.8	24.4	12.4	1988	1654.7	24.5	13.2
1970	1217.7	24.3	11.4	1989	1048.6	24.3	13.3
1971	904.4	23.7	11.1	1990	1505.6	25.0	12.9
1972	1050.1	23.9	11.9	1991	740.3	24.6	13.3
1973	1260.5	24.0	10.7	1992	784.5	25.2	12.7
1974	1345.8	23.8	11.9	1993	932.9	24.7	13.2
1975	1475.9	23.7	11.8	1994	834.9	24.8	12.6
1976	887.9	23.8	12.2	1995	1380.4	25.1	12.6
1977	1300.7	24.4	12.5	1996	913.9	25.0	13.4
1978	1407.7	23.9	12.8	1997	1207.7	25.2	13.5
1979	1305.1	23.6	13.5	1998	1633.8	25.7	13.2
1980	894.3	23.8	13.0	1999	1153.5	24.6	13.4
1981	1265.7	24.0	11.9	2000	1115.8	23.5	13.6
1982	1169.8	23.9	12.6	2001	1244.9	25.3	13.2
1983	1383.7	25.0	13.1	2002	1359.2	24.8	13.5
1984	1518.4	24.3	12.9	2003	1410.9	25.3	13.6
1985	1568.2	23.9	12.6	2004	1003.6	24.9	13.6
1986	1041.0	24.2	12.8	2005	1047.6	25.6	13.2
1987	1185.9	25.3	12.8	2006		24.2 (6Months)	15.1 (6Months)

This type of categorising seasons ignores the variation in weather that is typical of the hilly upland plateau (1300m-1500m above sea level) in the study area. Records from the Meteorological Department over the past 37 years show that the area receives rain throughout the year (Figure 3.6 and Table 3.2). The study area experiences a cool season between the months of June to early August, during which the temperature can drop to below 8ºC, but not below 0ºC (Figure 3.8).

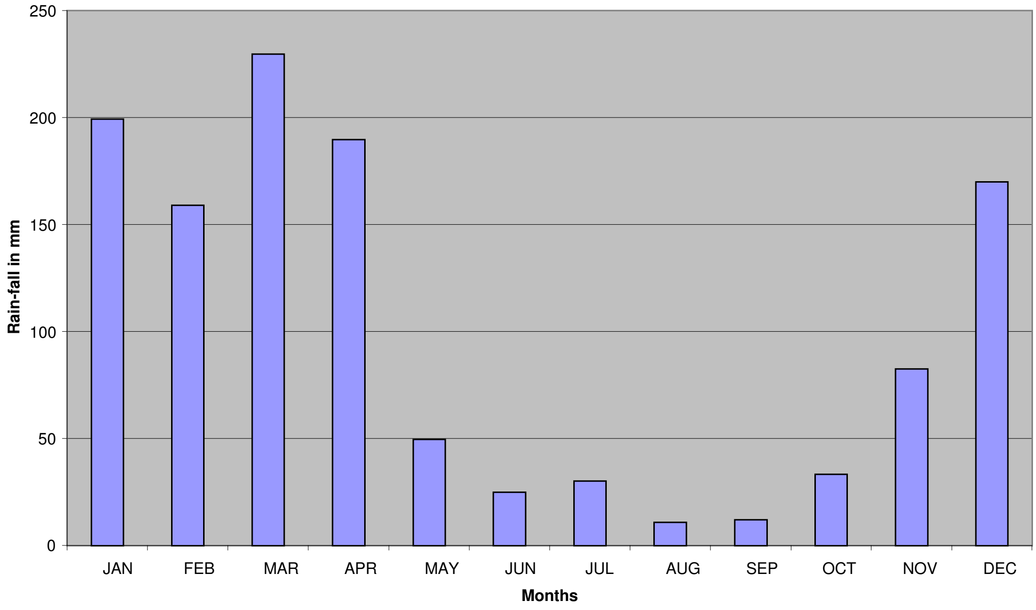

Figure 3.6 Mean monthly rainfall in mm 1969-2006 for Mzuzu

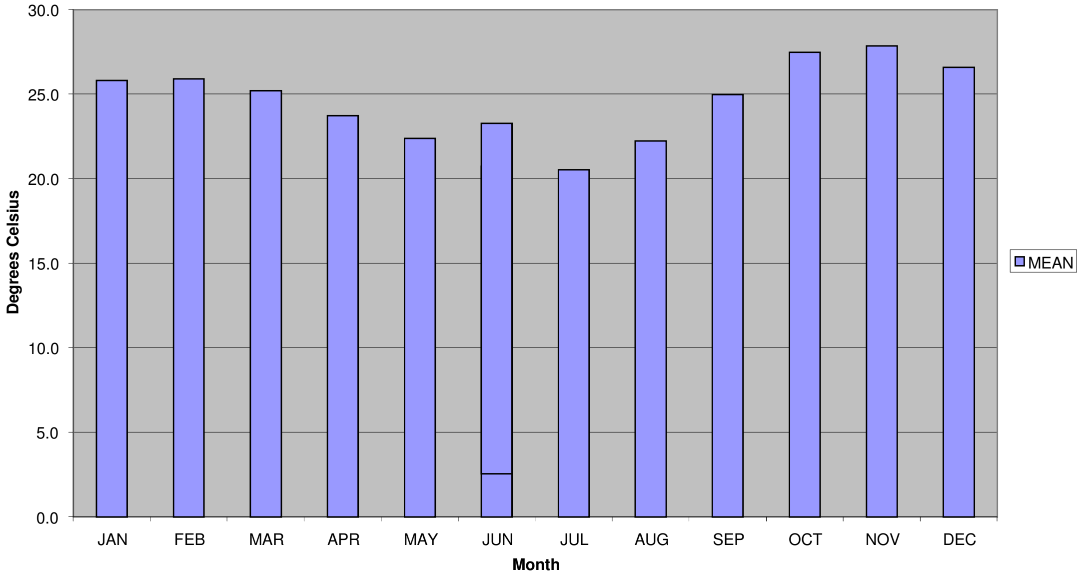

Figure 3.7 Mean Maximum Temperatures in ºC 1969-2006 for Mzuzu

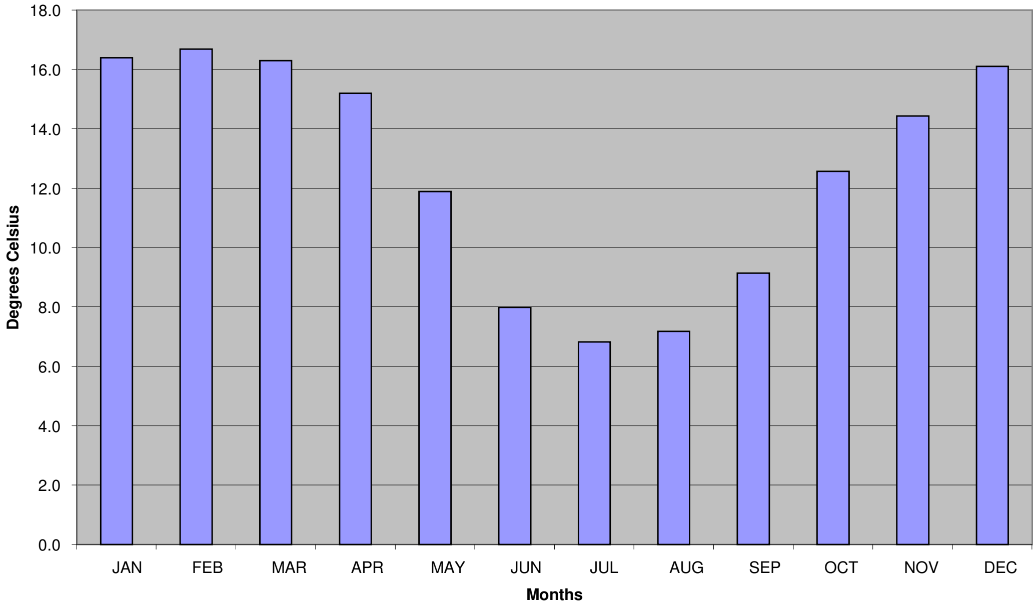

Figure 3.8 Mean Minimum Temperatures in ºC 1969-2006 for Mzuzu

The study area is suitable for most crops, except those that require very high temperatures of above 30ºC over the growing season like sorghum. The main crops grown in the area are tea, coffee, maize, millet, beans, vegetables of various types, oranges, avocado pears and sugarcane. The cool weather is also suitable for livestock production, especially exotic breeds from temperate regions, such as the Jersey, Friesian and Holstein cattle. In addition, local breeds of cattle, goats, pigeons, guinea fowls, rabbits and other small livestock types are kept. The cultivation practices and livestock kept in the study area have characteristics that fit the description of subsistence farming.

Table 3.2 Information on mean rainfall and mean temperature from 1969-2006

Month	Rainfall (mm)	Std. Deviation	Temperature(°C)	Std. Deviation
January	299.2	112.927	25.8	0.7678
February	159.0	69.8583	25.9	0.7688
March	229.7	112.9270	25.2	0.8358
April	189.8	115.5990	23.7	0.8440
May	49.5	44.7422	22.4	0.8644
June	25.0	23.5886	20.7	0.9702
July	30.1	29.1813	20.5	0.9682
August	10.9	11.4878	22.2	0.9023
September	12.1	26.2304	25.0	2.7152
October	33.3	37.2890	27.5	0.8283
November	82.6	92.3055	27.9	1.3736
December	170.0	69.9718	26.6	1.1735
N=37				
Mzuzu Airport rainfall and temperature figures where there is a weather station				

The number of villages, settlements and hamlets in the area was considered important, as it has a bearing on land ownership that is based on customary laws. The number of villages in the area also influences the population density of the area, which can be an important factor in amount of land allocated to farming practices. Indeed, the number of smallholder farmers (households) in the whole EPA was 58,772 in 1970, 64,186 in 1980 and 85,492 in 2008, representing a 45% growth over 38 years (National Statistical Office Records). Clearly, there is increasing pressure on land resources as a result of the growing numbers of farming families.

Table 3.3 Information on demography			
Characteristic	Mzuzu ADD	Mzimba district	Zombwe EPA
Mean household size	5.0	5.2	5.0
Number of households	N/A	224,118	85,492
Mean cultivated area (ha)	1.3		
Literacy	N/A	70%	N/A
Females		310,707	
Males		300,287	
Source: 1998 census (National Statistics Office Malawi)			

Zombwe EPA is in Mzuzu ADD which has a mean household size of 5.0 and a mean cultivated area of 1.3 hectares (Table 3.3). As a government administered area, it falls under Mzimba district which has a mean household size of 5.2, with a total of 224,118 households (Table 3.3). Zombwe EPA has a mean household size of 5.0 and a total of 85,492 households (Table 3.3). It has over 100 villages, which are headed by clan designated village headmen who inherit the chieftainship through a patrilineal system. The chief (village headman) is the head of administration of a village, assisted by known wise men in the community called *nduna.* Land allocation, disputes (marital or land-related), ceremonies like weddings, funerals and self-help development activities fall under his jurisdiction at this level. They can also be referred onto a Group Village Headman, who is the leader of 5-10 villages grouped together for administrative purposes. Although landholding is customary, that is, it is normally inherited through the patrilineal system, from father to son (see Ngwira, 2003), this is by no means fixed, as women can, and do, inherit land through the mother or through the father. The villages found in the study area are typical of Malawi, which have 5-40 houses (Figures 3.9; 3.10).

Table 3.4 Mzimba district population distribution by age		
Under 1	22,756	3.6%
1-4 years	81,741	13.4%
5-14 years	167,418	27.5%
15-64 years	316,018	51.9%
65 and over	23,061	3.6%
Total	608,744	100

Source: 1998 census (National Statistics Office Malawi)

The houses in the study area are mainly constructed using burnt bricks and mortar, which is an improvement over the old houses that were grass-thatched with walls made with poles of wood and plastered with mud. Corrugated iron sheets, nailed to poles or planks, are replacing the traditional grass-thatch roofs, and this might be the driving factor in making houses out of bricks and mortar. Houses made of bricks and mortar last longer than those made out of wood, which can be destroyed either by weevils and termites or can rot in moisture, especially as it rains throughout the year (Figure 3.6 and Table 3.2).

Figure 3.9 A village dominated by thatched brick houses in the study area

Figure 3.10 A village dominated by brick houses with corrugated iron sheets in the study area

The average household size is five for the Zombwe EPA, that includes the study area, which is composed of a husband and wife with three children or dependants. The population of Mzimba where Zombwe EPA is located is dominated by people aged between 15-64 years[3] (Table 3.4). The demographic data (Table 3.4) about Mzimba district, which is where the study area is located, show that there is abundant active labour that can carry out agricultural activities, with very few dependants of below 4 years (17%) or above 65 years (3.6%). It is important to note that for the purposes of this study age brackets adopted are those used by National Statistics Office in Malawi. A similar age cohort is also used by people in the study area, with people aged 5-13 years referred to as *twana* (children), 14-21 years as *majaha* (teen age), 22-50 as *madodana* ('young' adults) and 51-70 years are *madoda* ('mature' adults) while 71 years and above are called *madala* (old wise people). This age-based indigenous classification also relates to the level of local knowledge acquisition over time with knowledge acquired increasing with age. Much of the population is able to read and write (70%), probably reflecting the presence of many schools in the Zombwe EPA that include primary (>20), secondary (10), tertiary (2) and artisan (2). Household size is the key factor in driving the labour availability for farming practices. The timely completion of tasks by family labour is important when the major tool for farming is a hand-held hoe, yet the average farm size is 1.3 hectares (Table 3.3). In addition, households typically have more than one farm which may be scattered over distances that can be as far as 20 km apart.

3.3 Sampling frameworks

Four major categories of sampling frameworks were used in the study and these included government staff working for the Ministry of Agriculture; farmers who are defined as owning farms in which they cultivate crops; NGOs which, for the purpose of this study, are organisations that are either registered as NGOs with the Malawi government or organisations that are a branch of registered NGO, such as the Women's Guild; and private companies which are doing business in the study area. Each category of the samples is discussed below.

[3] The age 15-64 years is considered productive in agricultural activities (in Malawi) with other age brackets being referred to as dependants.

3.3.1 Sampling government staff

A meeting with the Head of Mzuzu ADD was arranged in advance and used to identify extension workers who were to be interviewed during the study. The programme manager, who is also the Head of the Mzuzu ADD, identified the three key personnel responsible for the study area, and these were then interviewed making random sampling unnecessary. Personnel who had worked on past programmes that have been phased out were identified and traced through the programme manager and other government officials. These two were also interviewed in order to learn more about the historical perspective of the agricultural interventions in the study area.

3.3.2 Sampling farmers

The interview with the government extension agent based in the study area as a technical field assistant confirmed that there was a list of villages (20) in which he performed his duties. Villages that were in the study area were identified. These were then subjected to stratification based on closeness to each other and then random sampling was used to select them. Random numbers were allocated and these were used to select villages that were studied. The assumption was that the closer the villagers were together, the more likely the farmers belonged to the same groups that were used to deliver extension programmes by extension agents. Extension messages can be altered for effective deliverance to audiences by extension workers depending on the type of groups they are dealing with based on past experiences. When farmers receive messages in the same group, any difference in their farming practices cannot be attributed with confidence to different groups to which the extension message was delivered, but are likely to be as a result of the farmers' preferences and perceptions. Preferences and perceptions can be important in knowledge production and technology adoption. Two locations were chosen based on advice given by the agricultural extension worker, who had divided the area into two agro-ecological regions for agricultural administration purposes, namely wet and dry Mzuzu, which are based on rainfall records and crops grown.

A total of 200 farmers was randomly selected from these villages for the administration of a questionnaire survey after assigning random numbers to the list of farmers provided by the extension agent, although only 128 farmers eventually participated in the survey, based on their willingness to take part, which reflected a participation rate of 128/200. The breakdown of farmers who participated in the survey, according to agro-ecological regions, was 111 from the wet Mzuzu area and 17[4] from the dry Mzuzu area. The 17 farmers from dry Mzuzu acted as a control in this study, because the area has different soil types and has a different local climate that makes certain crops, such as *Dwarf Cavendish* banana varieties, fail to survive and produce fruit.

3.3.3 Sampling NGOs

A preliminary survey was conducted to find out the number of NGOs which had offices in the city of Mzuzu. Five NGOs dealing with agricultural production were identified and interviewed to establish the areas in which they had development programmes. Only three organisations had agricultural-related programmes and activities being implemented in the study area. It was decided to include all three NGOs implementing programmes in the study area in the study. The small number of organisations made sampling unnecessary.

3.3.4 Sampling private companies

A further sample identified 15 private companies doing business in Mzuzu city related to agricultural production, but it was decided to select only those that dealt with chemicals, ranging from pesticides to herbicides, in addition to chemical fertilisers and seed distribution, because such programmes provided farmers with the main inputs used in their farming practices. Only three companies qualified under these criteria. It was assumed that companies that dealt with such products were likely to have links with farmers in the study area and thus played an important role in farmers' knowledge production.

3.4 Data collection in the field

To have an in-depth understanding of the study area a range of methods was used to gather primary data and information. These included structured questionnaires, personal interviews, participant and field observations, focus group discussions, transect walks, stratified random soil sampling and soil chemical analysis.

[4] Twelve farmers in wet Mzuzu have gardens in the dry Mzuzu hence the small sample of dry Mzuzu (as some are already captured in wet Mzuzu sample) which is a smaller area with less population compared to wet Mzuzu.

3.4.1 Questionnaire survey

The questionnaire survey generated contextual data about information, such as the crops grown, the livestock kept, traditional ecological knowledges, the factors affecting use and evolution of traditional knowledges, the tensions between scientific and local knowledges and demographic data that generated household characteristics that included household size, age, gender, and level of education (Appendix A). The questionnaire had both open-ended and closed questions.

The agricultural information gave detailed data associated with farming practices, including crops grown and their respective areas, the sizes and the number of the upland gardens cultivated by each household, the number of *dimba* cultivated per household, and the numbers and types of livestock kept by these households. Information on crop combinations (mixed stands) and farm sizes were gathered, which were considered as important indicators of underlying factors behind farmers' decision-making processes. Farm sizes and crop types determine labour needs, time of planting and ultimately show the nature of production orientation towards either the market or home consumption.

The traditional ecological knowledges were analysed with detailed information about factors that impinge on livestock and crop production processes such as diseases and pests. Farmers were asked to name and classify pests and diseases in different categories described as very important, important, neutral, not important and very unimportant. The categories gave the researcher an opportunity to be able to analyse farmers' perceptions, and to link these perceptions to knowledge generation by households. The ranking of pests and diseases was linked to the importance of control method by asking farmers to rank control methods in similar categories to that of pests and diseases (very important, important, neutral, not important and very unimportant). This was then used to determine how farmers felt about the efficacy of their control measures. Farmers were asked to list their sources of information about controlling pests and diseases, and were given the following options to choose from: Extension, Research, NGOs, Friends, Relatives, Parents, and Any other/specify. These options showed the extent of success or failure of intervention by various actors, and also revealed the level of knowledge production from within the community itself.

The tensions between local and scientific knowledges were teased out through having farmers define damage in crops, listing normal planting times and revealing objectives of their farming operations. Farmers were asked to rank objectives that included higher output, reduced environmental damage, higher profits, food security and higher quality in livestock production in specified categories of very important, important, neutral, not important and very unimportant. In crop production, farmers were asked to rank the objectives of increased yields, reduced environmental damage, higher profits, food security and blemish free into the categories of very important, important, neutral, not important and very unimportant. These were then compared with the rankings and objectives set by external agents involved in agricultural activities in the study area.

In administering the questionnaire, the major problem was time. It became clear that it took over an hour to administer the questionnaire if a farmer was eager to give answers in great detail. However, most farmers felt at ease only when the time used to answer the questionnaire was simultaneously being used for a productive activity such as harvesting crops or cooking food. This led to the researcher administering the questionnaire on the farms during operations that enabled farmers to fully engage in productive activities. This may seem strange, but farmers answering questions when they were most active and comfortable gave the researcher more detailed information underlying farmers' decision-making processes. In fact, it became possible for farmers to demonstrate in the field why certain decisions were made, for example, sometimes against the recommendations of agricultural experts.

The administration of the questionnaire with the sample of 128 farmers was arranged in advance through village headmen, extension workers, neighbours, or indeed by the researcher, so that farmers allocated time for the interviews (Lado, 2004; Phuthego and Chanda, 2004). In some instances, farmers arranged for additional days to discuss their farming practices, largely because some became encouraged by seeing a researcher interested in their farming practices, which were more typically considered by many agricultural experts as outdated, backward and not modern. The farmers in the study area knew the researcher in many ways and roles, as a person who grew up in the study area as a child, a friend, and an agricultural advisor having graduated from Bunda

College of Agriculture a constituent college of the University of Malawi that is responsible for training professional agriculturists.

These identities imposed interesting demands on the researcher in the course of the study. Farmers expected him to know the answers to some of the questions raised in the questionnaire survey (Tembo, 2003). For example, respondents found it embarrassing to be asked about the best time to plant maize. Some replied by asking when the researcher planted maize, which is a clear indication that the reasons for planting at any time of the rainy season must be well known to the researcher. Meanwhile, some farmers were older than the researcher and had worked with him on their farms and so wanted to know the extent to which he recalled, and used their training, in farming practices from childhood. The implication here was that, given the training in the childhood, he should be in a position to know the best time to plant maize in the study area, for example. If he did not know the best time to plant maize, then the respondents had failed in their job to impart knowledge adequately of the farming practices suitable for the area he grew up in. The questionnaire survey became a form of evaluation of the respondents' training of their apprentice. Clearly, multiple identities, such as the researcher had, created both positive and negative aspects during the administering of the questionnaire survey in the study area. This had also been noted by Tembo (2003), while he was conducting research in his home district of Karonga in Malawi, where respondents expected him to know the developmental problems facing the communities, having grown up in the area.

Arranging questionnaire times in advance reduced the likelihood of respondents being absent at the agreed time and location (Phuthego and Chanda, 2004). Although respondents had allocated time for the survey, it became clear in some instances that respondents had other things planned for the day. The culture of the people in the study area is that they find it offensive to let a visitor, such as the researcher, know that the allocated time has expired and that they needed to do something else, that was probably already programmed for the day. This had to be discerned by the researcher from the respondent's body language. For example, some respondents resorted to being very brief in answering questions that require a long explanation, a clear indication of impatience. The survey had to be quickly terminated then and another date arranged to complete the rest of the questionnaire.

Five respondents purchasing farm inputs such as herbicides were interviewed as they purchased the products. These five farmers were asked about the benefits and problems associated with the use of the purchased inputs and the level of assistance they received from traders, agricultural experts and private companies. It was assumed that interviewing farmers during such times put them in a position to talk in detail about the benefits and problems associated with inputs and associated supportive programmes. The farmers were pressed for time because of the nature of the place, which was different from administering a questionnaire on their farms. Interviews were short, ranging from ten to twenty minutes with these respondents. In fact, during the purchasing of chemicals, the data gathered from respondents were about advice sought on how to use the products, as well as the safety measures they needed to follow during the application and storage of inputs especially chemicals. They even sought advice as to the best time to apply herbicides for effective results to control weeds. This provided first-hand information as to how knowledge on chemicals used in agriculture was acquired by farmers. Although, in most cases, farmers indicated that they were advised by extension workers to buy the chemicals, such as actellic dust, they still wanted more information and guidance about the product they purchased from sales personnel.

3.4.2 Interviews

The personal interviews were used to gather information from private companies such as the Agricultural Trading Company, NGOs, and government extension workers. Personal interviews involved face-to-face discussion with respondents in order to increase response rates (Lado, 2004). For the NGOs, such as the Adventist Development and Relief Agency (ADRA), open-ended questions were used to generate information on the objectives of their programmes (Appendix A). Information and data about the activities and programmes of the NGOs in the study area, such as the type of advice given to farmers on farming practices, were gathered. It was important to get information on the objectives of the programmes and activities, and how they were being carried out in the field because such activities are a source of knowledge acquired by farmers in the study area. Data were gathered about the roles of programme recipients and providers to determine whether the programme providers were facilitators or dictators, because the nature of the roles played by experts is known to influence the programme delivery system and its effectiveness (Chambers *et al*, 1989; Tembo, 2003). Tembo (2003) argued that the way in which the development programmes are delivered by NGOs to participants dictates the nature of their knowledge acquisition.

The NGOs' interview guide therefore had three sections (Appendix A). The first section gathered data on the history of traditional ecological knowledges before the interventions were made by NGOs. It was assumed that NGOs conducted baseline surveys to determine the interventions necessary to be implemented in the study area. The common notion is to establish the shortcomings of farmers' practices that need modernisation for development to take place. Traditional farming practices are a major target for change in the process of modernisation, and, as such, are likely to be documented with the aim of replacing them with modern farming practices. Interventions by NGOs were expected to be justified, based on evidence acquired from a baseline survey.

The second section of the questionnaire guide addressed factors affecting the use and evolution of traditional ecological knowledges, especially those linked to the objectives of programmes implemented in the study area by respective NGOs. The section sought detailed information on the objectives of the programmes and the advice given to farmers with respect to pest and disease control, crops and livestock promoted by NGOs, the provision of extension programmes by NGOs, and the nature of collaboration (if available) with other organisations, such as the government departments and other NGOs.

The third section of the questionnaire guide addressed the tensions between scientific and traditional ecological knowledges, as underpinned by the objectives of the organisation, messages disseminated to farmers on crop and livestock management and the ranking of reasons, if any, for the disappearance of traditional methods of crop and livestock management. NGOs were asked to rank objectives in livestock production, such as higher output, reduced environmental damage, higher profits and higher quality. This was compared with the farmers' ranking of the same objectives. For crops, the objectives were increased yield, reduced environmental damage, higher profits, food security, higher quality, blemish-free and any other. These were ranked in similar manner to the objectives noted in livestock. These were also compared with farmers' rankings.

Since only three NGOs were working in the study area, arranging for the interviews was easy. The organisations' representatives set the dates and places to meet, the meetings were well-organised and the questions were answered to the satisfaction of the researcher. The characteristics of the three NGOs gave an insight into the development programmes implemented in the study area. The interventions put in place by NGOs were used to examine the roles which local people occupied in development programme initiation and implementation. The all-important questions were whether the local people were treated as subjects, objects or participants and partners in the quest to achieve development in the study area, and what was the role and use, if any, of their local knowledge in development programmes.

In the case of private companies, such as distributors of fertilisers and pesticides, data were gathered on the products used by farmers from the study area and how the companies engaged with farmers in terms of outreach programmes. Although most Mzuzu-based organisations were responsible for the whole region, some covered the study area, and so companies were asked if they had officials who provided advice on how to use products they sell. Data were gathered on advice that companies gave to farmers on usage and storage. The issue of health and safety was actively pursued in this study because these chemicals are dangerous and hazardous, and pose risks to farmers as well as the environment.

The respondents, who were company representatives, needed more time to discuss the issues raised, particularly the advice given to farmers on storage, use, handling and disposal of their products. In most cases, this arose because the respondents realised the potential of the research in terms of getting publicity for their work. The respondents wanted more of their activities recorded, so that once the research is published, it will become a form of a record of their activities reaching the academic world. Clearly, the private companies' primary objective was to sell their products, and the approach to farmers was to encourage them to buy the product on offer by emphasising their efficacy. However, they presented themselves to the researcher as providing an essential service to farmers, making sure that they earned a decent living from their efforts by utilising farming inputs sold by such companies. The data and information gathered were largely influenced by the need to show that they were professional in their trade as sales personnel.

The personal interviews were an opportunity to demonstrate how customers were handled. The interviews with sales representatives created an atmosphere of trust between the researcher, a fellow professional, and the respondents. Detailed results of sales were gathered, although for the sales personnel this was to show to the researcher a form of proof of their success in conducting business. This was evident, as the interviews were interrupted as soon as customers thought to be more important, such as those buying in bulk, came into the shops. This was declared directly, saying that an important customer had arrived and that they needed to give them maximum attention. The respondents made sure that their customers were attended to first, and this, at times, disturbed the flow of the conversation, leading to starting the interview all over again in some instances, and taking longer time than would have been the case otherwise. A single interview took a long time to complete, ranging from one to two hours. This did not bother the respondents, as the researcher provided company with whom to pass time away when customers were not present. The interviews in the work place gave the researcher an in-depth observation of the work done by the service providers.

Interviews with extension workers were used to gather data on how they disseminated technologies to farmers (Appendix A). Information and data were gathered on the type of meetings conducted, field visits, ways of contacting farmers and ways in which farmers contacted extension agents. Visits to plots used to demonstrate new technologies, such as hybrid crop varieties, were made by the researcher to see the technologies being promoted and disseminated to farmers in the study area. Data were gathered about official recommendations on crop varieties, types of inorganic fertilisers, crop planting dates, weeding regimes, livestock breeds and general farming practices that were considered suitable for the study area. The types of extension service and the nature of delivering programmes were discussed, generating data about typical visits to farmers' fields and the forms of message delivery systems, such as the use of farmers' groups. The sources of knowledge used by the extension workers themselves were recorded. Details of past extension programmes were obtained from archive records and from retired officers. The first African Regional Agriculture Officer in the North was traced by interviewing long-time serving extension staff who knew him. The retired Regional Officer provided information about the establishment of the regional office. This was important as the length of time that the modernisation programmes have been put in place through government agricultural programmes in the study area were seen to have a possible impact on farmers' knowledge acquisition and generation.

3.4.3 Participant and field observations

Participant observations were made by the researcher taking part in farming activities with farmers in the study area. The researcher made ridges, weeded and harvested crops with farmers. Data were gathered on how farmers handled and managed crops. Important details like grading during harvesting were discovered. Participatory observations were conducted throughout the research, particularly when various farming practices were being carried out. The participation of the researcher in farmers' activities demonstrated the researcher's interest in farming practices and established rapport with farmers, as observed by Beckford *et al* (2007) working in Jamaica. Participatory observation is useful where there is potential for respondents to conceal or even forget to mention traditional knowledges (Phuthego and Chanda, 2004). It has been shown in some studies that respondents give researchers what they think they want to hear, and not necessarily what they do (Peters, 2002; Tembo, 2003), and so participatory observation was used to circumvent such problems of intentional and unintentional hiding of respondents' practices.

Furthermore, the method generated data about farming practices which respondents were unable to elaborate verbally, but which could be learnt through observation, such as the grading of crops in the process of harvesting. Apart from giving the researcher the chance to see farmers practising their major occupational activities, it proved to be useful, as it allowed the researcher to learn and discover important issues. It transpired that farmers' responses to questionnaires were based, in some instances, on what they believed to be important to the researcher.

3.4.4 Focus group discussions

Two focus group discussions were arranged with farmers who opted in after they had been interviewed in the questionnaire survey. It was therefore not based on random sampling, which would have been the researcher's preference. Farmers were asked by the researcher to choose the day and place where the focus groups were to be conducted. The prior arrangement of focus group discussions alerted the farmers about the topics which the researcher wanted them to discuss, such as the cultivation of local versus hybrid varieties, knowledge transfer from parents to their children, the time of planting maize and the reasons why they did so, what they did and when, such as crop planting at different times in a growing season (Appendix A). The researcher acted as a facilitator and kept records of the conversation by taking detailed notes. The focus group was conducted in the local language, which is Tumbuka, to improve the level of participation by the members.

Recording discussions would have been ideal, but the farmers felt uncomfortable about this and it would likely have reduced their levels of participation. The fact that farmers arranged their own time and groups made the discussions very lively and open. The frank and candid debate was considered more useful than what might have been gained by taping the conversations; the trade-off was a necessary cost considered acceptable by the researcher. Tembo (2003) argues that data are generated in focus group discussions rather than being collected. The researcher wanted to encourage such data generation, rather than just to collect data, as it reflected the respondents' knowledge as closely as was possible. The findings then became relevant both to the respondents and the researcher. This was to ensure as much as possible that the research was about what farmers do and why they do it. The farmers told the researcher their story of events.

Field observations were made by the researcher travelling to farms in the study area. Four hundred farm plots (*dimba* and upland gardens) were visited and observations made at all stages of crop production. Detailed data about planting dates, pests, diseases, cropping pattern, fertiliser use and general crop management practices were gathered. Photographs were taken during such visits to record events observed. The allocation of tasks made by farmers, such as giving children a task to complete away from their parents, and then being allowed to leave the garden as soon as they had completed the task, were noted. The variations associated with tasks allocated were recorded, such as during the first weeding, children were given positions close to their parents and were kept under constant watch as to the way they carried out the weeding. Photographs of farmers, farming practices, landscapes and pests affecting crops were taken during field observations.

The placement of children, depending on the significance and nature of the farming practice, would not have become clear without field observation. Field observations during farming operations took more time, ranging from one hour to more than two hours in some instances. It was also energy demanding on the part of the researcher who sometimes had to walk some distance (up to 5km) to the next farm, even after using a car for part of the distance in some instances.

3.4.5 Transect walks and soil sampling

Transect walks (>400) were an integral part of the research work and involved diagonal walks across fields in straight lines. These were combined with the use of field observation (Lado, 2004) and were particularly useful in assessing the extent of crop damage from pests and diseases. Crops infested and affected by pests and diseases respectively were counted and the damage measured using a ruler in some cases. The extent of damage as a result of pests and diseases was calculated as percentages. The numbers of crops affected on a ridge were divided by the total number of plants on it, which was then converted into a percentage. It was a painstakingly slow process, as it involved careful examination of plants to establish both the extent of the damage and the diseases and pests responsible.

Authorisation from farmers to visit their gardens was sought in advance and this also involved explaining to them the purpose of the transect walk across their fields. Transect walks were conducted when farmers were in their fields. A diagonal path across the field was established after determining the shape of the field to be studied. Fields are of many shapes in the study area and careful observation and the establishment of boundaries were very important. Farmers were asked to show the researcher the boundaries of their farms before the transect walk was conducted. Farmers were then asked questions concerning the findings of the transect walks to give information on crop management practices. It was easy and safe to do the transect walks when farmers were in their gardens, as the researcher was then not considered as a trespasser. The presence of farmers during transect walks was useful because discussion and further probing could be conducted, based on field observations, which contributed to the relaxed and positive attitude of the respondents (Lado, 2004). However, the distances covered were long, in some cases three to five kilometres were covered to make sure that the comparisons were based on observations made on the same day. Pest infestation levels change on a daily basis because the pests feed on plants continuously, such that the nature of the damage incurred escalates over time, and this had to be accounted for in the planning and execution of transect walks. The walks were also used to confirm planting dates of crops. As soon as the planting rains fell, the researcher had to visit farms to record the actual dates of planting crops, particularly maize and beans. Where immediate verification of planting dates was not possible, transect walks allowed the researcher to measure the height of crops and to count the number of leaves of plants to deduce the planting dates. This was used in assessing and linking crop growth rates to factors such as soil fertility, attacks by pests, such as maize stalk-borer (*Busseola fusca)*, and disease progress in crops.

Farmers' knowledge of soil properties and fertility was compared with the established scientific ways of classifying and measuring soil types and fertility. Permission was sought to collect soil samples from farmers' gardens for analysis and soil samples were collected at random after stratifying the samples into ant hills and flat lands. Samples of soil were collected using a hoe from ant hills (30) and from adjacent flat lands 30 m away from ant hills (30). A hand-held hoe was used to dig soil for collection. The topsoil was gathered from a depth of 0-25 cm (see Funakawa *et al,* 2005), and subsoil was collected at a depth of 30cm. The choice was based on the depth of digging carried out by farmers during cultivation; farmers use a hand-held hoe and a measurement of cultivation revealed that the average depth of digging from such operations in upland gardens was between 15cm to 25cm. The 60 soil samples collected were then put in dry polythene bags and sealed for safe storage. Analysis was performed in the soil science laboratory at Bunda College of Agriculture.

3.4.6 Secondary data

Published research and documents about the study area were obtained from the archives and libraries of Bunda College and Mzuzu ADD. The National Statistical Office provided data on demographic factors of the study area. Data about agricultural programmes implemented in the study area were gathered from retired officers as well as files kept by officials in the Ministry, NGOs, and private companies. Animal populations of exotic breeds were obtained from documents compiled by technical experts responsible for these programmes. Labels of products were studied to get information about their ingredients. A detailed literature review was undertaken to establish the conceptual framework and theoretical underpinnings of development programmes carried out both worldwide and specifically in Malawi, including the study area, from the late nineteenth century to the recent times. Rainfall and temperature figures about the study area were obtained from the Meteorological Department in Malawi.

3.5 Data analysis

3.5.1 Quantitative and qualitative data analysis[5]

The quantitative data generated from questionnaires were inputted to a database and subjected to statistical analysis using SPSS (Gausi *et al,* 2004; Safalaoh and Sankhulani, 2004; Mwale *et al,* 2005). Generated descriptive statistics, such as means, modes, medians, ranges, frequencies and cross-tabulations, were used to determine relationships between factors such as the adoption and use of modern technologies by farmers. The generated statistics were also used to examine how indigenous knowledge was being transferred between different age groups and between the different sexes (male and female). Graphs were made from frequency tables and means from temperature and rainfall figures of the area obtained by the Meteorological Department from1969-2006. These (graphs and means) were then used to establish changes in the weather pattern of the study area over this period (1969-2006). The analyses were used to explain, examine and analyse indigenous knowledge production and changes resulting from the influence of weather over time.

[5] This section is short because it stems from questionnaires and other procedures covered in the previous sections within the methods chapter while a detailed laboratory analysis can be a complete stand alone section to be replicated without previous sections in the methods chapter being necessary pre-requisites

Farmers' preferences and decision making were determined by using rank and point score analysis. The points were added and the totals expressed were then converted to percentages. The importance of preferences was determined by ranking the highest percentages as the most preferred option with the lowest percentage as the least preferred option. Qualitative themes were determined after reading through the scripts of the focus group discussions. NVivo was used in analysing these to determine relations between the themes farmers considered in decision making concerning their farming practices (Tembo, 2003; Johnston, 2005; Bringer *et al,* 2006; Briggs *et al,* 2007).

3.5.2 Laboratory analysis

Laboratory analysis permitted the evaluation of indigenous knowledge about soil fertility using Western technology. The soil samples collected from farmers' gardens (N = 30) were analysed for pH, nitrogen and phosphorus content and soil texture (Kabuli and Phiri, 2005; Funakawa *et al,* 2005). It would have been useful to measure the soil moisture holding capacity of the soils, but it was a very expensive procedure, requiring both hiring the equipment and the services of its operator. However, because it is possible to calculate the water holding capacity of soils from its properties, it was decided that it would be cheaper and reasonably reliable for this study to deduce it from the soil properties analysis. A high clay content in soils increases water holding capacity, while a low clay content, combined with a high sand content, retains comparatively less moisture after the rains. A soil texture classification triangle was used to determine the soil texture of the samples.

Soil particle size analysis was done using a fertility kit method. Graduated 50 ml plastic tubes with caps were filled with 15 ml of soil, to which a dispersal solution called calgon was added. Shaking was done for two minutes to make sure the soil was thoroughly mixed with the solution. The resultant solution was allowed to settle for 30 seconds. The solution was gently poured into a second tube leaving the settled sand in the first tube. The second tube was left to settle for 30 minutes and the volume of the settled soil was silt. The clay proportion was determined by adding the volumes of sand and silt which were then subtracted from the total volume of soil (15 ml).

The soil pH was measured by placing 10 g of soil in a 50 ml centrifuge tube to which 25 ml of room temperature (25ºC) distilled water was added. The solution was shaken for 10 minutes, left to stand for 30 minutes, and then shaken again for two minutes. The pH meter was used to read the soil pH by inserting electrodes in the solution.

The nitrogen content of the soil was determined by using the digestion procedure for total nitrogen. This involved using 0.200 g of ground soil in a 50 ml digestion tube. A standard digestion solution (4.4 ml) was added quickly, and the content swirled for a few seconds (5-10) to ensure that no soil stuck to the bottom of the tube. This was then placed on a hot plate for digestion for two hours at 360ºC until the solution was clear in colour. The solution was cooled and then diluted to 50 ml. Samples of 0.500 ml were then placed in 20 ml glass vials to which 5 ml of N1 solution were added. After 10 minutes, 5 ml of N2 solution was added, and an hour was allowed for the colour to develop. The reading was done at 655 nm and this was directly converted to the percentage of nitrogen by dividing the figure read by 1000.

The phosphorus content of soils in farmers' gardens was determined using the Mehlich 3 procedure. Sieved soil weighing 2.5g was placed in a 50 ml centrifuge tube to which 25 ml of Mehlich 3 solution was added, and this was shaken for five minutes. Cotton wool was used to filter the solution until it became clear. The supernatant of 1 ml in volume was placed in a small container to which 8 ml of Murphy Riley working solution was added. After 30 minutes the absorbance was read at 860 nm. A standard curve was used to determine phosphorus as parts per million (ppm) which is equivalent to mg/l.

Chapter 4

Agricultural Development Strategies in Malawi

4.1 Introduction

This chapter presents a critical analysis of the application of modernisation theory and practice in the agricultural development of Malawi from the colonial times to the present in chronological order. The nature of agricultural development in the colonial days begins with the arrival of white settlers in Malawi. Their influence on local farmers is demonstrated and critically analysed. The agricultural development strategies introduced after independence up to the introduction of structural adjustment programmes (SAPs) are appraised for their impact on the economic growth of the country through the activities of local farmers and the estate sector. The analyses of failure of some of these programmes are followed by the examination of the current agricultural development strategies. The extent of their impact on economic growth and lessons from the introduction of SAPs are analysed. Effort is made to lay the foundation for the utilisation of indigenous knowledge in development.

4.2 Agricultural development in the colonial period

Agriculture has been the mainstay of the economy of Malawi from pre-colonial times to the present day, and is an important tool for poverty reduction and economic growth (see Chirwa, 2005; Woods, 1993). However, it is important to note that elements of modernisation and the application of science and technology in the agriculture sector can be traced as far back as the late 1800s. This was the time when white settlers first arrived in the country. The modernisation of, and the use of science and technology in, the agriculture sector were largely promoted by these white settlers in the absence of a formal government (Buchanan, 1885; Woods, 1993). Buchanan (1885) and Woods (1993) also show that these white settlers introduced new crops, such as coffee, tobacco and sugarcane, for the purposes of commercial-scale production. This marked the beginning of the estate sector of the economy and the growing of crops under monoculture conditions in the country. In addition, science and technology were applied in the processing of sugarcane into sugar. However, there existed a parallel small-scale farming sector with local people cultivating crops such as maize and beans in mixtures under a shifting cultivation system (Buchanan, 1885). Buchanan (1885) was amazed by the minimum tillage used by local farmers, with local farmers tilling the land at a very shallow depth, which he described as a mere scratching of the soil surface (less than 25cm deep). Farmers then planted maize on mounds called *matutu,* which were weeded once or twice in a growing season. Despite this, the yields were relatively high, as indicated by the maize growing to over 2m in height and bearing on average two ears (cobs), each containing three to four hundred grains. Although the crops performed well under shifting cultivation, as observed by Buchanan (1885:116-127), the use of cultivation sites for only a few years (two to three years), and the subsequent frequent abandonment of the cultivation sites by local farmers in favour of opening new sites on virgin lands, was considered by the white settlers to be an inefficient use of land as a resource. For them, vegetation was being destroyed and land resources were inadequately managed so that such practices were seen as inadequate for development. The settlers believed that local people were to be civilised in a number of ways, including the introduction of Christianity and the introduction of modern ways of farming (Buchanan, 1885). It is safe to construe that the modernisation process started with the introduction of modern farming practices by white settlers before the formation of the government and its associated development policies.

Woods (1993) demonstrates how Nyasaland was different in colonial Malawi's agriculture from its surrounding neighbours because the straitened economy and relatively autonomous colonial state created circumstances in which indigenous cultivators allied with expatriate planters in order to maximise their profits. With white settlers having first settled in the Southern region of Malawi to take advantage of the Shire to transport their produce for export, land pressure became a limiting factor by 1910 and a logical place in which to look for land was the Central Province. Woods (1993) demonstrates that A.F. Barron persuaded indigenous people to grow tobacco on their land under his guidance and the nature of this relationship thus exposed indigenous Malawians to the cultivation of cash crops without the restrictions that were experienced by many other indigenous people elsewhere in Africa. Furthermore, Woods (1993) notes that cash crops, such as coffee, failed miserably in the late 1890s due to drought and fluctuations in the product's price in the world economy. In addition, cotton varieties did not generate sufficient profits at large scale production levels so that tobacco, which planters started growing in 1904, became the key commercial crop. Persuading smallholder farmers to grow cash crops in Malawi was a very viable option for the white settlers because of the challenges they faced concerning unsuitable varieties of cotton for commercial production, the uncertainty of coffee prices on the world market, and the unpredictable weather made worse by the limited availability of productive land in the Southern Province. Indeed, the use of tenants to grow cash crops proved to be a very successful venture for the Blantyre and East African Company from the early 1900s (Woods, 1993).

Thomas (1975), McCracken (1983), Woods (1993) and Peters (2002) show how modernisation was utilised as a driving force for policy formulation and implementation after the colonial government was formed. During the colonial period, the major tool for the modernisation of agricultural production was the transfer of science and technology to local farmers with the aim of replacing traditional ways of farming. The cultivation practices of local farmers, such as the use of *matutu,* were considered to encourage soil erosion so that the government policy was to replace such practices with scientifically proven cultivation methods that effectively controlled soil erosion, such as contour ridges. The 'dust-bowl' phenomenon experienced in the USA provided a perfect reference point for government policy formulation on soil erosion control that justified the use of contour ridges in Malawi as a scientifically-proven solution to its control. Indeed, Thomas (1975) and Peters (2002) argued that the fears of a replication of the 'dust-bowl' phenomenon in the USA led to the colonial government imposing the use of contour ridges on Malawian farmers. However, there is little evidence in the literature to show that efforts were made to look for local solutions to the problems of soil erosion, let alone, the existence of the problem. Buchanan (1885) demonstrates that, at the time he was writing about agricultural activities in Malawi, local farmers left stumps and roots in their fields. These roots and stumps reduced the erosive effects of run-off on the soil in the immediate surrounding areas of most gardens, which were described as having tall grasses and trees that reduced the velocity of run-off and the impact of rain-drops (Sinclair and Walker, 1999). The policy to apply science and technology in smallholder agriculture by the settlers ignored the scientific underpinnings of local farmers' practices of cutting trees above the ground that left stumps with their root systems intact, a practice which was known to bind the soil and to limit the impacts of run-off (see Sinclair and Walker, 1999). Clearly, the process of modernisation in its early stages in Malawi ignored existing farmers' resource management practices which were based on their local knowledges.

The modernisation strategy and policy implemented by the government involved the use of science and technology on local farmers, sometimes by force, by coercing farmers to plant crops on ridges, for example. The understanding behind this undertaking by the government was that ridges reduced the loss of top soil that is richer in soil nutrients than the subsoil. The assumption was that the maintenance of soil fertility from planting on contour ridges could sustain high yields of crops, such as maize, over a long period of time, and certainly beyond the two to three years that farmers traditionally cultivated land before abandoning it. Modernisation and the application of science and technology targeted the elimination of shifting cultivation, a practice which experts were convinced was damaging to the environment, as it resulted in soil erosion and species extinction through deforestation (Buchanan, 1885; Eriksen, 2007).

For the effective deployment of modernisation in the agricultural sector, trained agricultural experts attempted to implement scientifically-proven methods of farming and management of land resources (Orr *et al,* 2000; Peters, 2002). This deployment was organised strategically in a way that maximised the efficient and effective delivery of services. The agriculture sector was given its own Ministry, organised with one national headquarters and three regional headquarters in the three regions of Malawi, the north, south and centre (personal communication with a retired officer). Experts were deployed in these regions at both district and local area levels, with the remit of promoting modern ways of farming to local farmers at the farm level. In addition to teaching farmers modern ways of farming, these experts forced farmers to adopt prescribed solutions to problems, such as the construction of bunds and storm drains to protect gardens from run-off. This practice of forcing farmers to adopt technologies became an important stimulus to the Malawian people in the fight for independence as a sign of the rejection of 'top-down' development (Peters, 2002). Clearly, modernisation, particularly in agricultural sector, was a process that was forced on the local people of Malawi and many resisted the process (Peters, 2002).

The modernisation of the agriculture sector was considered to be of paramount importance as a government instrument for policy formulation, and especially after a severe drought in the 1948-49 growing season, which resulted in the country experiencing food shortages (Thomas, 1975). The government took the view that the problems associated with food shortages as a result of this drought were to be solved through the application of science and technology. Based on scientific assessments, the problem was to be solved by increasing yields of the basic staple food crop. Experts concluded that maize was the most suitable crop to ensure food security in the country because it was considered to have a very high yield potential. A government policy to promote maize cultivation throughout the country was initiated (Milner, 2005). This strategy, however, was at odds with local farmers' practices of growing a wide range of crops (cassava, sorghum, millet, bananas and sweet potatoes) as a form of diversification strategy to ensure food security, and especially at the household level.

For farmers, crop diversification allowed them to meet balanced dietary requirements from their gardens. In addition, farmers were well aware that crops such as cassava and millet can be productive, compared to maize, under drought conditions, because they need relatively less moisture for growth. However, the Ministry's strategy and policy was to increase the maize yield per unit of land area, a reflection of its reliance on the efficient use of resources to maximise returns made on inputs, such as land, labour and chemical fertilisers. This was typically expressed as marginal returns on investment where the cost of the last profitable input equals the price of the unit output. This ignored the unpredictability of Mother Nature, however, on the basis that the application of science and technology could deal with such eventualities. The programme to increase maize yields per unit area had only a limited success (Thomas, 1975; Peters, 2002; Milner, 2005); the major limiting factor attributed to this failure was the unavailability of adequate resources necessary for this change in farming practices, including the shortage of trained agricultural experts available in the colonial days (Peters, 2002).

The agricultural modernisation policy created a two-tiered agricultural system; an estate sector that grew cash crops for export, and a smallholder sector that largely produced for subsistence purposes, and yet was left with the role of feeding the nation. Indeed, maize, the major food crop of the nation, was largely grown by smallholder farmers using unimproved local varieties, typically under conditions of shifting cultivation. The process of modernisation had failed to effect any significant change in local farmers' practices.

Shifting cultivation, as we have seen, was believed at that time by many experts to encourage soil erosion, as land was inevitably left bare and was poorly managed, as 'tired' fields were left fallow when farmers moved to cultivate newly cleared plots. It is therefore surprising that the policy of the government to ensure food security at national level was left under such a cultivation practice. For development experts and the government, leaving land to regenerate naturally after farming amounted to a lack of application of management skills, science and technology to an important natural resource by 'ignorant' farmers. This was considered by the Ministry to be an unscientific way of managing resources, which contributed directly to land degradation as a result of soil erosion; yet farmers understood that species diversity and soil fertility were recovered through the process of shifting cultivation that allowed the land to 'rest' and to recover its lost nutrients and species through the natural means of regeneration. Clearly, the practice of shifting cultivation allowed for natural regeneration, as observed by farmers over long periods of carrying out such practices, making indigenous knowledge relevant for development.

The process of modernisation in the colonial days had mixed results. It yielded positive results with those farmers who grew cash crops, probably because they already had the extensive knowledge of the application of science and technology in farming, while it was resisted by local farmers despite the effort made to enforce it by the government. The period after independence was used to implement policies and strategies that enabled local Malawian farmers to participate actively in economic development through the provision of subsidies and the engagement of some local farmers in the estate sector.

4.3 Agricultural development from 1964 to the 1980s

Agricultural development policies based on modernisation theory and practice were maintained by the government after independence in 1964 (Thomas, 1975). However, the Malawi government recognised that the agricultural sector was the basis for driving the economy and for creating the foundation for growth in all sectors of the economy, similar to that experienced in the West (Thomas, 1975; World Bank, 1998a; Dorward, *et al,* 2004). The government policy was thus to focus on developing the agricultural sector through the provision of improved infrastructure, research into technological advances, and the development of extension services to help increase maize yields for food security, as well as other export crops, such as tobacco. The faith in modernisation enabled experts to retain power over farmers in the design, planning and packaging of technologies to be adopted.

The policy and strategy of the government was that the economic growth of Malawi was to be facilitated by increased earnings of foreign currency from the export of cash crops and the benefits were to 'trickle' down to the population at large, including smallholder farmers (Thomas, 1975). Indeed, the 'new' government took the view that it would reduce reliance on foreign aid to fund development. Cash crops were promoted to generate foreign currency through their export, and maize remained the major staple food so that all other food crops such as millet, sorghum, cassava and sweet potatoes were discouraged. The importance of crop diversification in fostering economic growth was over-shadowed by perceived gains based on higher potential yields of maize as compared to these other crops (millet and sorghum).

The government maintained a policy of the growing of cash crops mainly in the estate sector. The use of the estate sector ensured protected land rights that led to a relatively capital intensive utilisation of resources, because land was used as collateral to finance crop production. However, maize continued to be grown under customary land ownership known as the smallholder sector. The dualism that had existed since the arrival of the early European settlers in the late 1800s and early 1900s was maintained (Buchanan, 1885; Thomas, 1975; McCracken, 1983; Peters, 2002).

The policy by the government to maintain the estate sector was based on the assumption that this sector would respond quickly and reliably to external economic opportunities offered by export markets, thereby generating the income necessary to fund development programmes (Thomas, 1975; McCracken, 1983). The strategy proved fruitful, as Malawi was able to achieve an impressive economic growth rate of 5% per annum for the first 15 years after independence from 1964-1979 (Thomas, 1975; Milner, 2005; Tsoka, 2006). The negative impact of this strategy on the smallholder sector and the general economy was not apparent until Malawi experienced a number of shocks in the late 1970s, including the oil price increase of 1973-4, and the political turmoil in Mozambique in 1975 that resulted in an influx of refugees into the country (Lele, 1989; World Bank, 1998a; Milner, 2005). Clearly, the modernisation processes aimed at attaining economic growth became vulnerable to external shocks, which led to reduced economic growth rates down to an average of 1.5% per annum between 1980 and 1994 (Tsoka, 2006). The poor economic growth rate was compounded by reduced agricultural commodity prices on the world market around the same time (Dorward *et al,* 2004). The modernisation strategy, largely focused on the estate sector, had failed to sustain the economic growth of the country based on cash crop export-led development. In addition, this policy proved to be a burden on the smallholder sector; in fact, it was a form of indirect taxation on smallholder farmers. Their produce was being bought at lower than the world market prices to fund the estate sector through soft loans' provision (Thomas, 1975; Lele, 1989; Chirwa, 2004, 2005; Blackie and Conroy, 2006). To reverse this situation, there was need for a provision in the government policy to remove the subsidy burden on the smallholder sector so that it could continue to contribute effectively to the development of the country.

The importance of the smallholder sector is in its contribution to Malawi's economy, demonstrated by being a significant source of livelihood for 71% of the 85% rural population (Chirwa, 2005). The continued high contribution of the smallholder sector to the economy made the government recognise its real role and importance in the economic growth of Malawi. The smallholder farmers' contributions to economic growth all this time were mainly based on traditional production systems that were not modernised, and which included the cultivation of local varieties of crops in mixed stands under the customary landholding system.

During this period (1964-1980s), as noted above, the smallholder sector accounted for about 85% of Malawi's population, most of whom live in the rural areas (Orr *et al*, 2000; Ellis *et al,* 2003), although a few practiced this type of farming in urban areas (Chirwa, 2005). To support this population, the government implemented a policy immediately after independence in 1964 to subsidise inputs, such as chemical fertilisers. This was a form of incentive to entice farmers to adopt modern farming technologies by lowering the prices of inputs, seen to be beyond their normal purchasing power. Participation by smallholder farmers was encouraged by the government setting prices for both inputs and outputs, prices that were considered attractive to the farmers. To support the input subsidy policy, extension agents, who were used by the colonial government to coerce farmers to adopt modern ways of farming, were now deployed to demonstrate the timely application and utilisation of technologies such as chemical fertilisers and hybrid crop varieties. It is important to note that after independence the extension agents were seen and used by the government more as 'promoters' of modernisation than as a force to 'ensure' its adoption.

However, Lele (1989), World Bank (1998a) and Chirwa (2005) point out that the government policy to increase food production, which was promoted by the provision of inputs and extension services, was considered necessary, with the specific intention to lower food prices for the growing urban population. There was a bias towards the urban areas as core centres for development based on the promotion of industrial activities. It was assumed by the government that the cheap food available to industrial workers would reduce their demand for higher wages, and lower wages would lead to increased profits for investors in industries, enabling them to expand their production that would result in urban areas becoming centres for driving the economic growth of the country. The benefits of increased urban economic activities would then trickle down to the rural population, either by the provision of employment opportunities for the rural poor as a result of the 'urban pull', or by creating markets for farmers' produce. Unfortunately, Chirwa (2004, 2005) points out that the strategy to achieve economic growth through such a process (of buying farmers' produce at lower than market prices) only resulted in the indirect taxation of the smallholder farmers; smallholder farmers were being exploited in the process of implementing modernisation in trying to achieve national economic growth (Harrison, 2001).

Although the urban centres were envisaged as market outlets for farmers' produce, Thomas (1975) and Kutengule *et al* (2004) show that the government also implemented a policy to provide additional market outlets for smallholder farmers. This was done by forming a Farmers Marketing Board (FMB), which not only bought produce from the smallholder sector, but also provided inputs to them. It had market outlets in the rural areas of the country for easy access by farmers, and, in addition to buying farmers' produce, it also provided for the marketing and the distribution of subsidised inputs that could be acquired either on loan through farmers' cooperatives, and later through farmers' clubs, or paid for in cash (Thomas, 1975). This arrangement sees the government as a 'major player' in the development process by providing the markets, as well as the infrastructure needs, for farmers. The FMB encouraged increased production because inputs were cheap, as a result of subsidies, and a market for crops was guaranteed. Economic growth was to be achieved by enabling and encouraging smallholder farmers to participate in the market at the expense of subsistence farming by encouraging production for the markets. 'Growth' became tied to the market place. Implicitly, there remained an assumption that the activities of smallholder farmers outside the market do not contribute to economic growth.

The government subsequently adopted a policy to broaden its participation in development programmes in the 1970s (Kutengule *et al,* 2004), and the strategy of the government therefore changed from the mere provision of inputs and output markets to an engagement in actual agricultural production and processing. The full utilisation of modern farming technologies could be encouraged through demonstrations by the marketing body engaging in farming operations. In order to attain this new additional objective, the Agricultural Development and Marketing Corporation (ADMARC) was formed in 1971 to replace the FMB (Kutengule *et al,* 2004). The new mandate enabled ADMARC not only to provide for the marketing of agricultural produce and inputs, but to provide infrastructure that facilitated the development of the smallholder sector (World Bank, 2003a, 2007a; Kutengule *et al*, 2004; Chirwa, 2005). The role of ADMARC, being a state-owned organisation, was therefore for generating both economic growth and food security, typically by the state promoting economic growth through the provision of markets and the necessary infrastructure for development.

Despite government support for agriculture-led economic growth under its modernisation strategy, agricultural production, especially that of domestic food, was still characterised by low productivity during the period from independence to 1989. The country still struggled to feed its population from its own production, such that, in some years, food requirements exceeded domestic production and the country had to import food to fill the gap (Thomas, 1975; World Bank 2003a; Dorward *et al,* 2004; Milner, 2005). Milner (2005) showed that over that period, only in four three-year periods (1969-71, 1972-74, 1974-76 and 1976-79) did Malawi as a country produce food surpluses above domestic demands.

Furthermore, Lonrho, a private company, started producing ethanol in 1982 as a bio-fuel (Liwimbi, no date), which could have helped local farmers to benefit directly from increased sugar cane production as a cash crop. In the study area, however, sugar-cane production did not increase to satisfy this demand (although smallholder sugar-cane producers around Dwangwa in Nkhotakota District did increase production), primarily because Lonrho were given sole production and processing rights by the then national President, Dr Hastings Banda. This arrangement was contrary to the clear recommendation of the UK ODA mission which had suggested that smallholders should be given priority to produce sugar-cane as a means of raising rural incomes. There could also have been the further benefit of ethanol being an alternative energy source for farmers themselves. Ethanol has continued to be used as a bio-fuel for blending with petrol in Malawi since the early 1980s, but it has never succeeded in becoming a bio-fuel useful to local rural Malawians.

In addition to the above problems, the economic growth strategy based on cash crop production for the export market, led by the estate sector, was found to be inadequate by the government and its development partners (the World Bank and the IMF) for continued progress. Smallholder farmers were excluded from such activities, particularly the selling of tobacco, the main cash crop in the country, directly in auction markets (Chirwa, 2004, 2005). This denied farmers wealth creation opportunities through the higher market prices offered by international buyers, thereby excluding the bulk of the population of the country (85%) from benefitting directly from the opportunity provided by the production of export crops. Clearly, development could not be achieved with the exclusion of the bulk of the population. Indeed, the majority of the smallholder population who were allowed to grow burley tobacco were only allowed to sell to ADMARC, or estate owners, a requirement disguised as ensuring 'quality' control. Yet it was a form of taxation enabled by the price difference between international buyers and the prices offered by the state-owned institution of ADMARC (Chirwa, 2005; Tsoka, 2006). In effect, this practice curtailed the 'trickle-down' effect which had been envisaged under government policy. This, once again, meant that farmers were indirectly being exploited and taxed by a government that should have been promoting farmers' economic progress (Chirwa, 2004; 2005).

The agriculture development policies after independence were successful in achieving economic growth of Malawi in the early part of this period, but were unable to cushion the effects of external shocks. The policies deployed during this period continued to enable the government indirectly to tax the smallholder sector. Yet, the smallholder sector was potentially a major contributor to the economic development of the country. The period after the introduction of SAPs was used to address this situation.

4.4 Agricultural development in the wake of structural adjustment

The introduction of structural adjustment programmes (SAPs) by the IMF during the 1980s meant that the government was forced to change its previous policies and its corresponding agricultural development strategies. The policies based on modernisation practice and theory gave way to theory and practice that recognised the primacy of market forces in directing economic growth. The SAPs were designed so that the government spent within its income thereby reducing budget deficits (Lele, 1989). The SAPs also advocated services' provision that did not distort the market, and promoted the creation of an environment for free market forces to operate that in theory would lead to economic recovery and growth. Under such circumstances, it was hard to sustain adequate funding for government-owned statutory organisations that included ADMARC.

The reduction of government intervention in the market place led to the revision of the policy on subsidies, so that the private sector could play a major role in national agricultural development as envisaged under market-led economic growth (Lele, 1989; Chirwa, 2005; Blackie and Conroy, 2006; Conroy, 2006). However, the government retained its role of providing free extension services to the smallholder sector, but did allow for the provision of additional extension services by both the private sector and NGOs. The smallholder sector was not helped either by the decision in 2002 by the UK Government to withdraw the support of the Commonwealth Development Corporation for that sector. The efforts to disseminate modern farming practices to farmers were now open to all players in the economy in the 1990s. This was the beginning of a consolidated effort to change ways of farming by providing knowledge that would replace traditional farming practices. The government realised, however, that some farmers could not acquire technologies, such as fertiliser inputs, at market prices. The government negotiated with the World Bank and the IMF for permission to implement a targeted input subsidy policy, specifically for those smallholder farmers who could not access inputs at market prices because of their low incomes (see Blackie and Conroy, 2006; Conroy, 2006). The World Bank and the IMF agreed to this arrangement, and since the 1990s, a limited subsidy programme on inputs, such as fertilisers and seeds, has been maintained to avoid a food crisis. This marked a major change in how the Malawi government did business with the West, the IMF and the World Bank. An estimated 260,000 or more vulnerable farm families benefited from subsidised seed and fertiliser as part of the government's target input programme (Langyintuo, 2004).

The World Bank in the 1990s noted that smallholder farmers were unable to benefit from the cultivation of burley tobacco, as they were only permitted to sell to second parties such as ADMARC and estate owners. A recommendation was made to the government to change its policy and to allow smallholder farmers to have access to the international tobacco markets in order to benefit from the higher prices offered there. The result was the liberalisation of the selling of burley tobacco; smallholder farmers were allowed to grow and sell the crop directly to international buyers at the Tobacco Auction Floors of Malawi, and so actively to participate in the economic benefits offered by the higher market prices for tobacco found there. This led to the recognition and realisation by the Malawi government that the key to overall growth in the economy could only be realised with the expansion of smallholder agriculture and its related activities via transport, marketing and other off-farm processing and services (World Bank, 1998a; Chirwa, 2005; Tchale *et al,* 2005).

After the elections in 2004, and following the severe droughts of 2001/2002 and 2004/2005, which saw a third of the population suffer from hunger, the government made subsidies for many smallholder farmers a major strategy once again to ensure food security in the country, despite opposition from the major international financing institutions, such as the IMF and the World Bank (see Blackie and Conroy, 2006). For the government, it was seen to be cheaper to subsidise production than to import food in times of need. The argument was that if developed countries in the West, including those belonging to the European Union (EU) under the Common Agricultural Policy (CAP), subsidise wealthy farmers, it was unrealistic to deny similar assistance to poor farmers in developing countries such as Malawi. This was a clear sign that development policies and strategies were to be 'home-grown' to be successful. This could be seen as a development from the IMF and the World Bank poverty reduction strategy papers that emphasised the use of home-grown solutions in the formulation of poverty reduction strategies in the early 2000s (see Tsoka, 2006). This is in line with Chambers' findings as far back as 1983, who noted that local experts understood better the grassroots problems than the one-day development 'tourists', and, therefore, could design programmes that suited local conditions. Once again, this is a signal for the need to utilise local knowledges.

Today the government recognises that the economic growth of the country can only be achieved by first being self-sufficient in food and then exporting the surplus. The surplus production of food can be secured by the policy implemented to subsidise inputs. The subsidies to smallholder farmers that have low incomes are provided through the use of coupons that are distributed with the help of the traditional institutions, such as village heads and their councillors, called *nduna*. Traditional institutions can be fully utilised for the economic growth of the country, by using them in the distribution of Western technologies, so that smallholder farmers who are unable to purchase chemical fertilisers and seed at market prices are identified by village headmen who are assisted in this task by committee members from the village. This is a full utilisation of local human resources, including traditional administrative skills, and this increases local participation in decisions that affect the lives of villagers. This subsidy programme is an arrangement that reflects changes in how the Malawi government now does business with international organisations such as the World Bank and the IMF. The government is emphasising a home-bred solution to poverty alleviation that would lead to economic growth; hence it has put in place a new development strategy.

This most recent development approach is outlined in the 2006-2011 Malawi Growth and Development Strategy (GoM, 2006). The strategy is similar to the one adopted by the government immediately after independence, in that it focuses on reducing poverty through economic growth, but still based on Western principles of development. It has six priority areas which are: agriculture and food security; infrastructure development; energy generation and supply; irrigation and water development; integrated rural development; and prevention and management of nutrition disorders and HIV/AIDS. It is assumed that these priority areas will assist Malawi in attaining the Millennium Development Goals (MDGs).

In this new initiative, the Ministry of Agriculture and Food Security (MAFS) has not been significantly altered in terms of its structure and organisation. One clear change, however, is in the provision of extension services stipulated in the new agricultural extension policy (GoM, 2000). In the past, extension services were provided to smallholder farmers, either as groups, such as farmers' clubs and blocks, or at the individual level by the extension worker paying visits to farmers' gardens. This latter was called the Training and Visit Scheme. With the new agricultural extension policy, agricultural advice to farmers is still based at the individual smallholder farmer level, but an extension worker at Field Assistant level will only provide the services when approached and requested by a smallholder farmer. This type of extension service delivery system has been termed a 'demand-driven' approach. It is believed that smallholder farmers will genuinely learn from extension services when they see the need for advice and ask for it. This is a change from the imposed position of the expert providing advice to farmers, to one of equal partners who need each other. The farmers are left to practice what they think is best under their own conditions. Development is therefore driven by the people themselves, with assistance provided only when needed.

The old model of development that looked at farmers as objects to be developed has given way to development by the people that respects farmers' preferences and choices. Farmers are now at least tacitly acknowledged as being rational in decision-making and reasonably well-informed. This creates an opportune time for making a greater utilisation of indigenous knowledge in development.

Meanwhile, the government has also maintained and promoted agricultural extension services provided by the private sector, such as by chemical companies and NGOs (for example, the World Vision International and the Adventist Development and Relief Agency). The new development strategy allows for all stakeholders to participate in the development of the country by initiating agricultural development programmes. The private sector and NGOs are encouraged to provide assistance and services to the whole agriculture sector. They are allowed to sell inputs at market prices, provide services and infrastructure, such as extension services and irrigation schemes, for example, that enable farmers to benefit from the new technologies which they introduce. However, closer observation of this development strategy reveals a deliberate intention to combine and mix all past development strategies that have the potential to provide for economic growth for Malawi.

4.5 Summary and conclusions

The contact which Malawi had with the Western world in the 1800s led to the country embarking on agricultural development strategies and policies based on Western ways of knowing that perceived local farming practices as inadequate for development. Successive governments placed emphasis on agricultural strategies and policies that would modernise agricultural production. Successive governments have deployed science and technology as a major tool for the improvement of agricultural production in the country, with the major objective being the economic growth. After independence, external agents, such as the IMF and the World Bank, played important roles in determining development strategies and policies, which the government utilised in the development process. The political relationship between the government and such external agents has been that of experts know best and the government must listen to them. In addition, the assumption has been that economic growth would trickle-down to the rest of the population with the result that participation by smallholder farmers in the design and implementation of agricultural programmes has been broadly missing.

Indeed, agricultural development strategies in Malawi, starting with the arrival of white settlers up to the present day, have all aimed at replacing traditional farming practices with modern ways of farming, through the application of science and technology to increase production and so alleviate poverty. The organisation of the Ministry of Agriculture and Food Security (MAFS) has changed from a crude spatially based management of the three regions of the country to being a farmer-centred institution. It has recognised that farmers are important partners in development, and, as such, their input is actively sought by the Ministry in the modernisation of the agricultural sector. However, the provision of agricultural services at grassroots levels is still undermined by a poor ratio of farmers to extension agents. In addition, the efforts that excluded farmers from technology development and the cultivation of cash crops have resulted in economic stagnation. The result has been no significant improvement in the living standards of rural Malawians. Furthermore, there has been very little change in the way farmers conduct their business. They still grow crops in mixed stands and cultivate cash crops only on a small scale, perhaps setting out a clear preference by farmers for their traditional farming practices. Their reliance on traditional ways of farming and doing business has led the government to work with them on the farmers' terms. The farmers are now full partners in development and not 'objects' to be managed and changed in order to achieve economic prosperity, creating an opportunity to utilise indigenous knowledge fully in development. The next chapter examines development programmes implemented by various stakeholders in the study area itself. These development programmes are analysed based on the assumptions underpinning their aims, objectives, justification and the associated impacts and effects on farmers in the study area.

Chapter 5
Approaches to Agricultural Development in the Study Area

5.1 Introduction

Approaches to agricultural development at the local level (Zombwe Extension Planning Area) have mirrored national policies and strategies discussed in Chapter Four since the late 1940s; economic growth was to be achieved through the application of science and Western technologies, which were to replace traditional ways of farming. In this, experts were to play a leading role in the development and implementation of these policies and strategies. The role of local people was to participate as objects that need to be developed through training. Experts demonstrated the successful application of science and Western technologies in the process of modernisation. However, the lack of farmers' input had all along (1950s to 2004) resulted in the failure of many of these development programmes. Slowly, farmer's participation was sought through the use of NGOs. The period after SAPs saw an increased involvement of the private sector in the implementation of many of the agricultural development programmes in the study area. This chapter explores the development programmes as they were introduced in the study area from the colonial days to the present day. It critically analyses events in chronological order to demonstrate the role of Western technologies in development practice, which undermined traditional practices, 'technologies', norms and values. In using the chronological order of events, it lays the foundation for justifying the utilisation of indigenous knowledge in development programmes.

5.2 Local approaches to agricultural development

The northern region of Malawi was not adequately incorporated into agricultural development strategies in the colonial days, simply because it was isolated from the rest of the country as a result of poor roads that were only passable in the dry season (Thomas, 1975). The region could only be reached with ease by using Lake Malawi. Lake Malawi is about 560 km in length enabling it to be used for accessing all the three regions of the country (see Figure 3.3).

The northern region had its first significant agricultural development programme in 1947 when the Colonial Development Corporation introduced tung trees (*Vernicia fordii*) for oil production in the study area (Peters, 2002; Singini, no date). There were no agricultural development policies and strategies prior to this period and local farmers practised subsistence farming.

As communications improved and the settlement of Europeans increased in the region, a regional agriculture office was opened in 1953 in Mzuzu to coordinate extension services. The strategy was to promote food production through increasing the yield of maize, the improvement of livestock and to promote cash crops suitable for cultivation in the study area, such as coffee and tea. Economic growth was to be achieved by maximising the production of food and cash crops, using science and technology, because traditional farming practices were considered inadequate by experts for economic growth. In fact, for development experts, including government extension workers, traditional farming not only retarded progress, but was retrogressive. In effect, for them, traditional farming 'pulled' the economy downwards (see Nkhonjera, 1980; Gausi *et al,* 2004).

Cash crops were introduced and grown under a leasehold scheme known as estates, which was considered by experts to be a secure land tenure system. Under leasehold arrangements introduced by white settlers, land could be used as collateral to raise capital for cash crop production. The need to raise capital to grow cash crops demanded the use of collateral leading to the growing of mostly cash crops on leased land. Since farmers own land under customary land tenure, it was difficult for them to raise capital to grow cash crops. The lack of collateral and its corresponding lack of capital under customary land tenure were responsible for the low uptake of cash crops by local farmers. Indeed, not many farmers grew such crops on a commercial scale. Cash crops remained largely to be cultivated in the estate sector for most of the colonial period and after independence.

Efforts to improve livestock production began in earnest in the 1950s. The government of the day introduced the Smallholder Poultry Improvement Programme in the 1950s with the main objective being to increase the egg and meat productivity of the indigenous chicken through crossbreeding (Safalaoh and Sankhulani, 2004). The indigenous poultry proved to be unsuitable for driving economic growth based on increasing output and surplus for the market. Indigenous chickens produced only an average of 40 eggs per annum and the birds weighed around 1kg (Gausi *et al,* 2004). There was a need to introduce breeds that could produce more eggs per annum and provide more meat per bird if economic growth was to be achieved. Increasing meat and egg production meant using science and technology to increase body weight, rate of growth and the number of eggs hens laid per annum through a breed improvement programme. The technical understanding of experts was that the low weight of local birds, slow growth rate and small body size explained the poor performance of the poultry sector in the rural areas of Mzuzu.

However, experts noted an additional problem that the mortality rates in local chickens were very high (90%) each year from Newcastle disease (Gausi *et al,* 2004). Science and technology offered a solution to this problem. Vaccination programmes were implemented, which were provided free of charge by the government, through veterinary assistants located in the various parts of the north, including the study area, to try and reduce the devastating impact of Newcastle disease on poultry production. No effort was made, however, to diagnose how local farmers dealt with the disease. The experts' diagnosis emphasised finding a solution without understanding the nature of the problem, so that the analysis only revealed the death toll of chickens as needing to be reduced. For experts, it was clear from the high death rate of chickens that the 'ignorant farmer' had failed to find a cure and a solution to Newcastle disease. The local farmers had nothing significant to offer in terms of local knowledge about the disease to experts with such high annual mortality rates of their flocks. For experts, the farmers needed help through the application of science and technology to control Newcastle disease. The introduction of vaccination programmes was thus considered a necessary top-down approach to solving a development-related problem. Yet, the farmers' flocks suffered such high death rates each year because those local chickens that survived were able to 'multiply'. The disease did not wipe out the flocks completely, enabling farmers to rebuild the population of their chickens. In fact, the 10% that survived was an indicator that there was some form of resistance or tolerance to the disease by local chickens.

After independence in 1964, the local development strategy retained largely the same top-down approach. Indeed, there was little effort made by experts to get inputs from the farmers who had the lived experience. The adoption of high yielding varieties of crops, such as maize, by local farmers was encouraged by experts. At the local level, field assistants transferred technologies developed at research stations to local farmers to improve the performance of hybrid varieties at the farm level. Demonstration plots were set up to show the local farmers how to grow crops using modern technologies. Indeed, through the government extension services, experts trained the 'ignorant' farmer.

The use of demonstration plots was based on the assumption that farmers would learn and adopt new technologies, 'only' if they could see the varieties perform well in their local areas. This was considered the best way to change the traditional ways of farming practiced by local farmers. In addition, since new technologies required learning new 'improved' methods of crop management, such as the application of chemical fertilisers in a timely manner, within the first week of emergence, field assistants located in the local area visited farmers in their gardens to ensure that those who used high yielding varieties were supported with relevant advice on time. Uptake of technologies by local farmers could be ensured with close supervision and persuasion by experts.

The workload was unbearable for the field assistants, however, and so a new strategy was put in place in the 1970s. The extension services were administered to groups of farmers who formed 'clubs', which were later called 'blocks'. This reduced the workload of extension agents as fewer visits were made to individual farmers' gardens. The groups acted as an inducement to technology adoption because farmers were assumed to feel more confident about adopting a new technology if fellow farmers did the same. However, there was an exception to this policy, such that those who needed individual help from the field assistant could still approach the agent on days when he or she was not engaged with clubs. It was assumed that knowledge could only be sourced from experts (extension agents, for example).

As expected, extension workers still placed emphasis on increasing the yield of maize per unit area, thereby ignoring alternative crops such as cassava and millet, which were important to farmers in the attainment of food security. Local farmers grew them in mixed stands in the same fields or even on the same ridge, depending on the farmers' experiences of the performance of such crops. These alternative crops, especially cassava, millet and sorghum, are resistant to drought, and, as such, complement maize in providing food security in the years that the country experiences less than normal rainfall or even a drought. However, the experts did not see much benefit in these crops, and paid little attention to them. Indeed, efforts were made to discourage the growing of these crops, particularly millet, because it was associated with land degradation through deforestation. Millet is always grown on virgin land and also on the flat, making it difficult to use ridges for the prevention of land degradation particularly from soil erosion.

This period from 1970 onwards also saw the government encouraging the cultivation of cash crops for income generation. The understanding by the government was that economic growth and improved standards of living were to be attained by increasing farmers' incomes. Yet again, there was no effort made to analyse the contribution that the local ways of living could contribute to economic growth. Indeed, local people's participation and their indigenous knowledges were irrelevant when the agenda was to improve their ways of living through the transfer of Western technology to replace traditional knowledges. The emphasis was to replace traditional ways of life and that included changing the crops that they grew. As such, coffee, a cash crop suitable for production on estates, was promoted for smallholder farmers to grow. However, farmers were unable to raise sufficient capital to grow this cash crop because of lack of collateral; customary land could not be used as collateral. On the other hand, the major cash crop of the country, tobacco, was not encouraged in the study area, as it was considered to be too cold for its profitable production. Farmers were not consulted as to how they could adapt this crop in the area. Other cash crops, such as fruits (oranges, guavas, macadamias, pineapples and bananas), were promoted to improve farm families' incomes. The satisfactory national economic growth in the country of 5% per annum between 1964 and 1975 reinforced this strategy at the local level. After all, the 5% annual economic growth at national level was based on increased food production mainly by smallholder farmers and increased cash crop production largely by the estate sector.

The policy to improve poultry production was maintained after independence with free extension services and vaccination programmes against diseases such as Newcastle, which continued up to the introduction of SAPs. Programmes to improve chickens were maintained with the hope of increasing the population of improved breeds (Black Australorp and hylines) owned by local farmers. The strategy seemed to have failed largely because farmers did not see the need to be engaged in this programme on a large scale, while mortality rates were very high despite the provision of veterinary services such as vaccination programmes. Science and technology had failed to 'conquer nature' as the disease prevailed. The situation on the ground became worse when the previous free vaccination of poultry became a cost to be paid for by farmers as a result of the introduction of SAPs. The costs of veterinary services were considered to be too high for most farmers. In addition, it became undesirable for farmers to incur the costs of veterinary services when they could replenish their stocks easily from friends and relatives at a cheaper cost than that of vaccines. Cassini *et al* (2008) similarly observed in Ethiopia that livestock farmers reduced the use of modern veterinary vaccinations, when they were required to pay for the full cost of the drugs, by reverting to the use of traditional medicines for their livestock treatment. Clearly, farmers have in place indigenous knowledge based contingencies, which have proven successful over time, to deal with eventualities such as endemic diseases of livestock. Such local knowledge based contingencies are used by farmers when the costs of modern technologies are perceived (by farmers) to be too high.

Efforts by the government at the local level to improve the living standards of its people through the use of science and technology continued. In 1975, for example, the National Rural Development Programme (NRDP) established a 'milk-shed' area in the northern region of Malawi, a name given to the programme to encourage commercial milk production through the rearing of improved dairy cows that were a cross between the local Zebu cows and exotic commercial high milk progeny bulls of Friesian or Holstein breeds. The crosses between the Zebu and the exotic breeds produced comparatively higher milk yields than the pure Zebu, thereby improving production at farm level, with a corresponding increase in income from milk sales for farmers in the study area. The milk-shed area covered Mzimba and Nkhata-Bay districts, and included the study area (see Figure 3.1). The goals of the programme were to provide the region with sufficient milk for the growing population of Mzuzu, the regional capital, to reduce imports of milk and milk by-products, and to generate alternative sources of income to farmers through increased milk sales (Kumwenda and Msiska, 1998).

However, unlike in crop production, where farmers were enticed to use hybrid varieties through subsidies and the strong persuasion of extension agents, farmers in animal production were asked to participate in the scheme on a much more voluntaristic basis. This was clearly a change from the 'norm', and the farmers' voices were heard, albeit the programme was still very top-down in approach. Those who chose to be involved were trained in dairy husbandry techniques in general, which included feed production, utilisation and conservation, and the rearing of dairy cows in particular (Nkhonjera, 1980). Those areas in which farmers were seen to have an inadequate knowledge about dairy farming were identified by the technical experts, and training programmes were put in place to impart the required knowledge to farmers in order for them successfully to manage the 'commercial' dairy production units under their control.

Introducing new technologies to farmers included training them so that the milk sold was a safe product for consumption. The farmers were then provided with '*khola*' (kraals) and milk parlours constructed by experts that were suitable for dairy cows and necessary for sustained increased milk production through the provision of a protective environment for the dairy animals (local farmers construct open air kraals for their zebu with exposure to rain that creates muddy conditions in the rainy season, which negatively affect milk quality, as well as reducing the milk yield of lactating animals). The cows provided were crosses between the local Zebu cows and the Friesian bulls for the first-time milk producers, and then the half-breed crosses were to be further improved through cross-breeding to three-quarter crosses, then seven-eighths and eventually over time, crosses would become closer to pure breed Friesian. The gradual improvement towards the pure exotic breed helped farmers to cope with the corresponding increased milk yields and the management practices that were necessary to sustain such high (milk) yields. In introducing the new technologies, there was a realisation on the part of development experts that farmers were not well equipped with appropriate knowledge from their rearing of the zebu to manage the high milk producing crosses and pure breeds successfully.

Development was to be achieved and recognised only when specific objectives were set by development experts. For the dairy programme, the objective was to improve milk yields per animal so that the annual per capita milk consumption of 3.2 kg per person could be raised to Africa's average of 15 kg/capita per year (Chagunda, 2002). Targets became important criteria for development. Although the Zebu pure breed produced less milk compared to the cross breeds, it had important characteristics, such as resistance and tolerance to the pests and diseases present in the study area. For experts, the 'ignorant' farmers had successfully bred and selected for some traits in the Zebu that were useful, and experts utilised this local knowledge to benefit their own breeding programmes by cross breeding so that the progeny were able to survive the challenging environments, while at the same time producing relatively higher milk yields for the livelihood benefit of the farmers.

It appears that lessons were learned by experts from the provision of extension services in crop production and these were adopted for use in dairy production. For example, the perceived benefits of organising farmers into groups were recognised by experts, and consequently dairy farmers were organised into groups called 'bulking groups', which were used for the supply of inputs such as pasture seeds. These groups also acted as fora for extension service provision and helped to initiate self-help programmes necessary for the development of the dairy industry, such as the co-management of communally-owned pastures for the purposes of maintaining high milk yields of the crossbreeds (Nkhonjera, 1980). Although farmers already had communal pastures on which they grazed their Zebu, experts felt there was still a need to impart knowledge about communal pastures to farmers in the study area for the purposes of further increasing milk yields through the systematic management of such pastures.

In a similar manner to crop production extension services, dairy assistants provided advice on general animal husbandry techniques, such as pasture management and feeding regimes. They also managed demonstration plots of pastures for training purposes, while veterinary assistants provided disease prevention and treatment services with the aim of improving and maintaining high milk yields through livestock disease and pest prevention and treatment programmes (Nkhonjera, 1980). The veterinary assistants trained and supervised farmers in other technologies, such as the spraying of animals with pesticides to control pests and diseases that are spread by vectors such as ticks, for example.

Special services to train farmers to detect when animals were on heat were provided, so that cows could be served by pure Friesian bulls that were kept in government established stations, such as at the Zombwe EPA headquarters, which is 30km away from the study area villages participating in the dairy production industry. Cows that were due to be serviced had to be driven by farmers on foot to Zombwe for mating with government-owned Friesian bulls, and it became clear that moving cattle this way was not conducive to the productive management of dairy animals, as they became stressed from the long journeys. It also increased the chances of spreading disease through such trekking, because the cows came into contact with local herds that had diseases and pests as they travelled to and from Zombwe. Above all, it was time-consuming and cumbersome for smallholder farmers to undertake this herding. Consequently, it became an unsuccessful dairy management exercise especially with incidences of ‘false heat’, a common condition which resulted in the journey being unproductive. These false conditions are deceptive, even to well-trained veterinary and extension staff, and provided farmers with very difficult decisions to make, considering the distance they had to move cows for servicing.

The false heat showed inadequacies in certain aspects of science and technology. However, improvements were made as a result of research. Artificial insemination was introduced in the early 1980s that ended the use of live bulls located at central stations for mating. The farmers were then trained to recognise cows which were on heat so that artificial insemination could be administered by an expert from Mzuzu Agricultural Development Division headquarters. The farmers, however, were still required to travel to the headquarters of Mzuzu Agricultural Development Division to report the need for artificial insemination. This, although cumbersome for the farmers, was easier than moving cows to central stations to be ‘serviced’ by government-owned bulls.

The use of science and technology in development required capital, and, as many farmers did not have sufficient capital, dairy cows were bought from loans made by the government, which were to be recovered through the income raised by milk sales. The loan package included pesticides, pasture seed and feed supplements, which were also to be repaid by selling milk. It was also a requirement that farmers grew pastures for the dairy animals so that milk yields were maintained at the expected high levels associated with the crossbreeds. The natural pastures that farmers used for Zebu were considered to be unsuitable for the exotic breeds, and the pasture regime introduced consisted of Napier grass (*Pennisetum purpureum*) and a rich protein source, such as Silver-leaf (*Desmodium uncinatum*), both of which were considered to be necessary for high milk-producing cows, and especially so when combined with feed supplements, such as urea blocks for the animals to lick. The introduction of cultivated pastures, although necessary for improving milk yields, increased the work load of farmers, most of whom also cultivated crops at the same time, particularly as they had previously used natural (indigenous) pastures which required little management. Fortunately, the Napier grass, which is also used to control soil erosion in road construction, has so far been confined to managed pastures and roadsides without spreading to become an invasive species. However, silver leaf has spread beyond pastures because the sticky seed pods are spread by being attached to animal skin and herders' clothes.

The milk produced required a market structure that could handle the programme successfully to benefit farmers. The government created an institution called the Malawi Milk Marketing Company, which acted as a milk outlet with an additional responsibility to recover the loans given to dairy farmers by deducting cash directly from the milk sales. The deductions were on a monthly basis, reducing the loan at a scale that still left the farmers with sufficient income for personal use, as well as for reinvestment in the dairy production business. The loan did not have a defined recovery period as such, because it could easily be fully repaid through the sales of bull-calves castrated and then fattened for sale as beef animals, or slaughtered and sold as beef. This beef production was a programme that grew out of the dairy herd; male calves were culled because of the need to reduce the chances of inbreeding that can occur when bulls mate with close relatives. Inbreeding normally results in low milk yields arising from natural genetic deformations that lead to such animals being susceptible to diseases. This was avoided through the castration of bull-calves (steers), a technical solution to a technical problem.

The Milk Marketing Company collected milk in bulk from several central stations, which had cooling and storage facilities at a cost borne by farmers. The collection was done once a day so that milk produced in the afternoon was put in a cooler overnight to remain fresh for collection in the following morning. The sale of milk through the Milk Marketing Company became inappropriate with the introduction of SAPs in the late 1980s that required minimum government intervention and the promotion of free markets. Thus, the Milk Marketing Company was sold and converted to a private company in direct response to the demands of the IMF and the World Bank. With the introduction of SAPs, development was planned and implemented according to the requirements and recommendations of the IMF and the World Bank, and it became a limited company in 1988 called Malawi Dairy Industries (Chagunda, 2002).

The privatisation of the Milk Marketing Company created problems for the dairy programme. There was now no direct link between farmers and this company, as it was now a privately-owned entity. Farmers were, therefore, not obliged to sell their milk through it, and many started marketing milk directly to consumers. The provision of loans for dairy cows was curtailed, as there was no direct means of loan recovery through milk sales. The new private company thought the risk of providing loans to farmers to be too high to be undertaken. In addition, privatisation made farmers more reluctant to join the dairy sector because there was a perceived reduced security in the industry after the privatisation of the milk marketing enterprise. Many farmers now felt there was no guarantee of steady prices for their milk that could sustain the loan repayment programme. Indeed, the farmers were well aware that in a free market, prices were prone to fluctuations based on the forces of supply and demand. Many farmers chose to abandon the dairy scheme after the privatisation of their milk outlet; clearly, local farmers showed experts that they too had power and they exercised it by opting out of the dairy scheme.

Expert solutions for problems ‘found’ in the local area continued to be made with the implementation of another strategy to improve further smallholder farmers’ income in

1981. This was in response to the assumption that eggs were in short supply in the area. The participation of local farmers in egg production would also lead to the improvement of the intake of animal protein in the local diet, and the availability of eggs within the area was thought to translate automatically into local residents consuming more eggs, thereby increasing animal protein intake.

In this programme, experts selected farmers to be trained in modern techniques of poultry production and management that included feeding programmes, egg collection and storage. The assumption again was that farmers were ignorant until they were trained. The farmers were given a poultry unit in the form of a package designed by experts. This package included hyline layers, which were 12-15 weeks old, battery cages and chicken feed, all of which were provided on loan. Knowledge adoption by farmers was ensured by the use of extension services, purposefully designed for the 'package' (by experts). In line with this assumption, extension services, specialised in poultry production with a specific emphasis on egg production, were put in place replicating the dairy sector management system. The training remained 'top-down' in nature and uni-directional. Despite past experience from earlier programmes, the distances between farmers and the training sites were still too far. For example, the unit had its major operations, such as the hatchery and training programmes, at Choma Livestock Centre, which is 10km from the Mzuzu Agricultural Development Division (MZADD) headquarters. A demonstration unit of how layers were to be managed from 12-15 weeks to the laying stage, that starts from 18-20 weeks, was established at Ekwaiweni, which is 18km south-west of MZADD headquarters. Furthermore, farmers were required to attend day and residential courses in poultry management techniques at Ekwaiweni demonstration centre, removing them from their everyday farming practices in their villages.

There was total control of the egg marketing processes by experts, leaving the farmers with very little room for 'home-grown' solutions to marketing. The eggs produced were collected, using a government-owned vehicle, from farmers on a weekly basis. These were then sold and supplied to a government egg marketing unit to manage the marketing of eggs. It also acted as an outlet for eggs to major commercial buyers and individual customers. As with the dairy industry, the loan was recovered from farmers by deductions from farmers' incomes generated from egg sales.

The introduction of SAPs once more resulted in reduced government support for farmers engaged in egg production in a similar manner that had affected the dairy industry and the programme to improve poultry production, as the funding for these programmes was reduced in line with conditions of SAPs. However, there was no effort to privatise the egg marketing unit, which simply collapsed. Farmers were left to sell eggs around their homes or to commercial-scale buyers. This exposed farmers to private businesses that were determined to make profits by buying eggs at below production costs. The introduction of SAPs was damaging to farmers who were conditioned to relying on government support, especially with its policies and strategies that suppressed the production of parallel traditional knowledges on introduced programmes. Farmers were unable to continue keeping layers at the levels reached by the programme, which was a minimum of 200 layers per farmer. The involvement of private companies and businessmen in the provision of services to the industry led to input prices rising in response to market forces. Farmers responded rationally to this scenario by keeping fewer than 100 layers, which they could afford to feed, and which was the reverse of the intended SAPs. Indeed, this study shows that 70% of the farmers stopped rearing layers altogether. During the time of this research (2006-2008), only 2 farmers, who had been involved in the initial programme, were still keeping layers. The one who maintained the use of battery cages had additional income from her retirement remuneration as a primary school teacher. The second farmer adopted the use of deep litter houses, which he considered cheaper to manage, instead of the original battery cages. Clearly, some farmers are industrious and can change and modify business management to suit their financial conditions. In addition, it demonstrates that some packages are adopted and maintained only with external support.

Further pressures associated with SAPs were being felt across the Ministry, including at the local level such as in the study area. The extension services remained unchanged, but gradually were unable to conduct regular visits to farmers as the government under SAP was unable to fund them adequately. The ordinary extension agents that were engaged in general crop and livestock matters slowly but steadily took over from the highly specialised poultry extension staff as they retired without replacement. Most government development programmes became difficult to sustain with the introduction of SAPs.

5.3 Chemical companies' roles and strategies in the study area

The introduction of SAPs increased the role which the private sector played in development activities in the agriculture sector. The study area experienced an increase in the role played by companies from the 1980s in a sector which was previously dominated by a government-owned company called the Farmers' Marketing Board (FMB), that later became the Agricultural Development and Marketing Corporation (ADMARC). Indeed, FMB and later ADMARC were the major sources of agricultural inputs that included pesticides and seeds for smallholder farmers in the study area. In line with a market-oriented approach, the private sector's priority was to supply inputs to farmers at competitive prices. The discussion will be based on the roles and strategies used by three private companies to engage farmers in the provision of their services.

The Wakonda Trading Company was established in 2005 by its local Malawian owner. The company supplies and sells fertilisers, seeds, sprayers and agro-chemicals in Mzuzu City and surrounding areas. Of major interest to this study were the agro-chemicals sold to smallholder farmers. This study found that most farmers bought the following pesticides:

- Actellic (pirimmphos-methyl-permethrin), sold as a liquid as well as a gas. It is used to control weevils in maize and beans in storage.
- Gastoxin (aluminium phosphide) which is a fumigant used to control weevils in crop storage.
- Methamodos (an organophosphate), used to control leaf miners, leaf eaters, cutworms, and bollworms. (It was observed that these are sold in large volumes in October and December).
- Cypermethrin (an emulsifiable concentrate – pyrethroid) used as a control against aphids and leaf miners.
- Karate (lambda-cyhalothrin), used as a control against red spiders.
- Dithane (uthane M-45) used to treat tomato blight.

The company has a policy of using well-trained staff to advise farmers on how to use those pesticides that are considered to be a potential health hazard to handlers. The expert, who is an agricultural adviser, trains farmers on the health, safety and hazards associated with the use of pesticides, in addition to their proper administration to crops in the field. Although the post fell vacant after the previous employee resigned in 2005, resulting in the cancellation of demonstrations on chemical application and safety, the company still advised farmers on general health and safety measures using sales personnel instead. Advice on how to administer pesticides is only given if farmers seek it whilst in the shop. Advice on health and safety measures, as well as the recommended application rates of pesticides, is not a compulsory requirement to all those who purchase pesticides. Clearly, there is a potential danger of some farmers purchasing chemicals about which they do not fully appreciate the health and environmental risks associated with them. The problem becomes particularly serious in the study area where farmers grow crops in wetlands next to running streams that others use as a source of domestic water. In fact, the situation is potentially 'grave' for aquatic species including those in Lake Malawi because most rivers eventually drain into it.

An important finding was made during the in-depth discussions with the manager of Wakonda Trading Company. It was established that during the manager's seven months' occupation of the post, no farmer had requested a chemical or pesticide to control maize stalk-borer. This point was very important as maize stalk-borer is prevalent in the area so that it was expected that some farmers would want to control it using pesticides. A second important finding was that many farmers bought pesticides and chemicals that were used in the production of high-value crops such as tomatoes, rape, Chinese cabbage and lettuce. These crops were not produced by smallholder farmers for home consumption only, but with an additional aim to sell on the commercial market. These findings applied to most farmers including those in the study area who confirmed the use of expensive pesticides on high-value crops such as tomatoes. It was observed that a major pesticide, actellic dust, applied to grain crops in storage, was, as expected, in high demand during the maize harvest period of the rain-fed crop. However, the interviews and the questionnaire administered to smallholder farmers in the study area revealed a very low level of use (<1%) amongst these farmers. This raised questions as to how farmers in the study area controlled pests, such as weevils, in crop storage. The farmers' farming practices including pesticides use are covered in Chapter Six.

The Agricultural Trading Company (ATC) is one of the major companies trading in fertilisers and chemicals in Malawi. The Mzuzu branch was opened in 1986 and the company sells products similar to those sold by the Wakonda Trading Company. ATC has a similar policy to the Wakonda Trading Company, as it also provides advice to farmers on how to use pesticides at the point of sale. However, the Mzuzu branch does not have follow-up visits for those farmers who purchase pesticides from their shop. Although the company is private, it is important to note that the manager stated that one of the main aims of selling chemicals was to improve the performance of the agriculture sector through correct chemical use, application at the right time and correct dosages. The company demonstrated that it cared for the success of farmers in their activities. This may well be a business ploy that shows the link between successful farming and corresponding increases in the purchases of inputs by farmers from the company. Again, the approach of the company was not clear on the health and environmental impacts of pesticides. The success of the business in selling its products was paramount.

During discussions, it became clear that this company has a very detailed knowledge of the farmers who come to purchase pesticides from the branch. The major farmers were described as tomato growers around Jenda, 150 kilometres away from Mzuzu, tobacco farmers from Mzimba north, and hybrid maize growers in Nkhata-Bay central. Mzimba and Nkhata-Bay are districts that form part of Mzuzu city. This company (ATC) revealed a similar observation made by the Wakonda Trading Company that the sales of pesticides used in the storage of grains peaked in June, which is the harvest period of rain-fed maize. It was also noted that carbaryl (naphthyl methyl carbamate) was mainly purchased by farmers in the Mzuzu area to control stalk-borer in maize. Farmers in Mzuzu, therefore, bought pesticides to control maize stalk-borer, but these farmers were not those in the study area. This therefore raised the question about what alternative pest control methods were being used by farmers in the study area.

The Chemical and Marketing Company was established in 1994. It has several outlets throughout the country and has a branch in Mzuzu. The company sells similar products to the other two companies listed above. This company has a policy to advise farmers on the appropriate use and application of pesticides as they purchase them, and the manager is responsible for this job. The arrangement appears to be effective and leads to farmers talking about their farming practices in some detail. For example, a smallholder farmer who wanted to know how to apply a herbicide in his maize field during the time the study was being conducted, reported that the advice received from extension staff was that herbicide use to control weeds was cheaper than utilising labour (in weeding maize fields), especially if a farmer used hired labour. The farmer's aim was, therefore, to try this new technology in his field and compare the results with the advice that was being given by the extension staff in his area. The question posed to the salesman is very important, as it shows that farmers want to try what extension agents promote. It also shows that before farmers adopt a technology promoted by extension workers, they seek further clarification from a wider group of known experts. Yet, even after wider consultation, farmers still try the technology and assess it themselves before accepting it as useful knowledge.

The research shows that the chemical companies' main objective is profit making and their approach to agricultural development is to sell products so that they achieve their objective. There is very little advice provided to farmers at the field (farm gate) level[6] as to how to apply these potentially poisonous products for the purpose of protection of the environment. Yet, pesticides are by their nature sufficiently toxic to cause serious health and environmental problems and farmers are wise to be cautious (Henning and Mangun, 1989:228; Maumbe and Swinton, 2003). In the Mzuzu area, it was clear that many farmers bought pesticides to use in *dimba* to control pests in high-value crops. The potential for these chemicals to transfer into water is, therefore, very high, as farmers apply the chemicals and wash the equipment used. The fact that pesticides are potentially dangerous by their very nature persuades the Wakonda Trading Company to make follow-up farm visits where appropriate. In addition, farmers seek advice on how to use these chemicals effectively in their fields. Thus there is a demand for technical advice at the farm level. Clearly, farmers are expecting to be advised on the use, health and safety measures concerning the application of pesticides in their farming practices.

[6] Advice on how to use pesticides is largely given at point of sale in the shops (except for Wakonda Trading Company before the resignation of the agricultural adviser) and not at the 'farm gate' yet these pesticides are hazardous both to farmers and the environment

5.4 Approaches adopted by NGOs

NGOs are increasingly involved in development programmes in several parts of Malawi, including the study area. Their main aim is to increase the participation of local communities in development programmes that will lead to improved living standards. Their approach to development is fundamentally bottom-up in nature. However, there are differences in the scale and nature of participation of local communities between the various NGOs. Some of those that were implementing programmes in the study area at the time of this research will be used to unpack the nature of their development programmes and the level of participation they created for the communities with which they worked. The discussion will be based on the roles and strategies they played and utilised respectively in implementing their programmes.

One of the NGOs present in the study area is the Adventist Development and Relief Agency (ADRA), which is an independent humanitarian agency established in 1984 by the Seventh-Day Adventist Church, for the purpose of providing individual and community development, and disaster relief (www.adra.org website). Its work is geared towards food security, economic development, emergency management and primary health care.

In line with the objectives of the NGO, ADRA's activities in the study area revolve around food security and income generation, particularly for the sick and orphans. The programmes are run by ADRA volunteers, and these volunteers are supposed to have in-depth knowledge of the area in which their programmes are to be implemented so that the involvement of ADRA in the community is effective. To achieve this, a needs assessment is done by Mzuzu-based 'volunteers' who know the area well. The organisation recognises the fact that the locals who opt to become volunteers are well-placed to know the problems faced by people in the area. The organisation's theory is that because these volunteers are part of the communities, and experience similar problems, they must have in-depth knowledge of the needs of their communities. It is thus assumed that solutions designed by them, or with their input, can alleviate poverty in a manner that meets the aspirations and needs of the local people as it ensures some form of their participation.

This study revealed that, indeed, these volunteers know the protocol involved in traditional settings well, such that they engaged and communicated with participating communities through the village heads. The village heads became the main contact persons in the activities of ADRA, and the village heads and volunteers worked together as partners to assist the needy by establishing gardens for the sick and orphans. Their knowledge of social settings in the study area was further demonstrated by their use of the available social capital. The volunteers understood the tradition of their society in-depth, that it takes care of its weak and the sick by providing free labour. This is a form of obligation that has to be fulfilled by those who are healthy and strong in the society. The volunteers used this knowledge to acquire labour through the village heads for cultivating gardens for the needy and the sick. The volunteers complemented this labour input from the communities by providing them with advice and training on how to acquire inputs. They particularly emphasised the use of those inputs that were locally found, such as manure to improve soil fertility for the improvement of crop yields. Their policy and strategy was to emphasise the deployment of local knowledges and local resources. ADRA acted as a facilitator for development programmes, something of a divergence from the uni-directional expert knowledge typical of more traditional development planning and implementation.

Volunteers also facilitated the formation of village committees, which worked with the village heads. The formation of these committees was an additional method deployed to give responsibility for the management of the programmes to the participating communities. Effort was made to ensure that the ownership of the programmes was given to the local people. By giving them the power (authority) and responsibility to manage themselves, it is believed that the programmes can continue even after ADRA pulls out of the area. ADRA has an exit strategy that allows for development programmes to be sustainable long after it has left the site.

The volunteers respect local knowledges so they allow the groups formed to practice their traditional cultivation practices, but make sure that what is produced meets the nutritional requirements of the sick and the orphans, as well as providing extra income. The volunteers do not see indigenous knowledge as a hindrance to progress; it is valued and utilised fully with the promotion of high nutrient crops, such as soya-beans *(Glysine max),* and the promotion of high-yielding maize varieties, such as hybrids, in line with government policy. Although ADRA is an international NGO, it does not impose conditions on the government or the communities with which it works. In fact, smallholder farmers involved in ADRA are advised to follow extension advice provided by government extension workers. Activities of ADRA in the area, therefore, mirror what is promoted under the local agricultural extension providers, yet fully applying local knowledges at the same time. For ADRA, there are no tensions between Western technology and indigenous knowledge. It has successfully used the complementarities existing between these knowledges for the benefit of the local people.

Unlike the government extension workers, who persuade farmers to plant crops based on their technical advice, ADRA let farmers plant crops when they choose. Farmers are considered to be knowledgeable of their local environment and so are given the liberty to make decisions freely. There are no fixed time-scales as to when to plant crops, either in *dimba* or upland gardens. However, it is interesting to note that in the 2004/2005 season, the volunteers noted that maize planted in early December in the orphan gardens was attacked and infested with stalk-borer. The infestation of early planted maize by stalk borer created an opportunity for farmers to stagger planting times in the following year based on this experience. The learning process from experience is encouraged by ADRA as a strategy to ensure food security in the areas in which ADRA implements its programmes. There is a feedback loop from which lessons are learnt, and local knowledge is an essential factor that is fully utilised in development programmes associated with food security. For example, soil is used as a pesticide by applying it to maize. This is done by filling the tip of the maize plant with soil to suffocate the pest in the stems of crops, an effective, cheap and environmentally friendly method of stalk-borer control. For ADRA, reducing the costs encountered by vulnerable households, by avoiding those associated with commercial farming inputs, such as pesticides and chemical fertilisers, is a key factor in raising the standards of living and quality of life. Indigenous knowledge is seen as a cost-cutting tool in its development endeavours, and local people are seen as subjects with whom to engage as partners. ADRA demonstrates that development is with and by the people, and, not just for the people, as designed and implemented by experts.

The second NGO involved in development programmes in the study area is the Women's Guild Lupaso, which is an organisation under the Synod[7] of the Livingstonia Church of the Central African Presbytery (CCAP). Just like ADRA, the Women's Guild Lupaso is a religious, as well as a social grouping, which promotes various women's activities that include food production to ensure families have adequate food for consumption all year round. The group observes that to serve God properly, its members and followers should have adequate food and income. The group recognises that one of the options available to them to attain their objectives is to engage in agricultural activities, and, as such, this NGO was launched in 1994.

The interest of the Women's Guild is agricultural development programmes that complement rain-fed agricultural production in the study area. For the Women's Guild, development is to be achieved through the application of technologies developed by experts. For example, experts' knowledge on how to grow high-value crops around *khonde* was sought. The experts concluded that the growing of crops around homes (*khonde*) required the availability and use of water in the dry season. The challenge was to design a technology that could effectively deliver this water as moisture to crops grown around *khonde* in the dry season. Due to the non-existence of cheap power to pump water from sources, such as streams, to *khonde* gardens, it was decided that a technology based on gravity-fed water raised on a platform was appropriate. A water bucket fitted with a perforated pipe was adopted to supply water to high-value crops, such as green vegetables, in the *khonde.* The use of perforated pipes to deliver water to crops is technically known as drip irrigation.

The Women's Guild's consultant saw that the technology had an added advantage, because labour was required only for land preparation, weeding, harvesting, and for filling the buckets. It was assumed that such an advantage would attract the participation of the local women as it addressed identified labour 'bottle-necks' that directly affected them. The understanding was that women were very busy most of the time looking after children and their extended families in addition to other domestic

[7] Synod is the name given to branches of the CCAP in Malawi, South Africa, Zambia and Zimbabwe whose head has a title of a General Secretary

chores. The underlying principle was that when a technology addressed the social needs of the local people, its potential for adoption was increased.

It was clear that once the buckets were filled, the farmers (women) were free to do other activities, as the water was supplied to plants through the perforated pipes by gravity and did not require them to control or monitor the delivery system. It only required refilling the bucket when the farmers felt there was time to do so. This technology, therefore, was chosen on the basis of its low labour demand and that it freed its users to engage in other activities.

The additional strategy behind this agricultural development programme is that food security is to be achieved through growing crops such as cassava *(Manihot esculanta)*, Irish potatoes *(Solanum tuberosum)*, sweet potatoes *(Ipomea batatas),* and yams *(Dioscorea species).* The choice of these crops is based on the fact that they do not necessarily require expensive inputs, such as chemical fertilisers, for their successful production. In addition, these crops are accepted by farmers as alternatives to the main staple food, maize (Thomas, 1975). Furthermore, the growing of more than one food crop is a common practice among smallholder farmers in the study area. The strategy is to use this local practice to its full advantage in this agricultural development programme.

Crops such as sweet potatoes can be prepared in several ways as dishes. For example, sweet potatoes can be consumed raw as a snack, but they can be cooked and eaten as mashed potatoes mixed with groundnut flour, which has been made from raw or roasted groundnuts. The dish is called *futali* or *nopi* in the local language (Tumbuka). The programme, therefore, encouraged the preparation of a variety of dishes for meals. The programme was purposefully designed to teach those women involved to make several types of dishes from these crops, ranging from main dishes to snacks, as alternatives to dishes based on maize. As well as being used as a main course, the dishes made from these crops are encouraged to be used for breakfast, taken with tea or any other beverage.

The programme, however, promoted these dishes as if they were new to people. The fact that farmers already prepared a variety of dishes from these crops was ignored. Development had to be seen to come from external sources and this was emphasised in the way the programme was implemented by training farmers in food preparation techniques that they already knew; for example, farmers were trained by experts to make *futali,* which farmers were already making for home consumption. There was a clear reliance on the 'top-down' approach to development in the transfer of science and technology. This reliance on top-down approaches to development was further demonstrated by the nature of their programme delivery systems. For example, to ensure that knowledge was passed from experts to local participants, the programme employed an agricultural adviser to provide technical advice on the growing of crops and the management of the irrigation system in addition to the programme coordinator. The interview with the programme coordinator revealed that the training and experience with Ministry of Agriculture and Food Security (MAFS) endorsed the belief that smallholder farmers needed to be taught, not once, but repeatedly, to adopt a technology. The programme was therefore designed to conduct training programmes in crop production and irrigation system management on a regular basis throughout the year, both at the synod's office and in the farmers' homes.

This type of approach to development, programme management and training has been demonstrated to be effective in transferring knowledge to farmers elsewhere (see Maumbe and Swinton, 2003). The Women's Guild merely transferred and adopted what worked elsewhere and applied it to their programme's administration. It is therefore not surprising that an agriculture adviser was employed to carry out demonstrations and teach farmers these 'new' technologies on a regular basis. Demonstrations are done to show how the technology works, based on the theory that farmers adopt practices that have been observed to work under conditions similar to their own farms or gardens. In fact, it is believed by some experts that when a technology is demonstrated in farmers' gardens, with their participation, there are increased chances of its uptake.

Indeed, farmers in the area have modified the irrigation system by replacing plastic buckets with ones designed to their specifications, particularly in terms of varying sizes, with the help of local tinsmiths. The buckets made from iron sheets have been found by farmers to be more durable as they do not break when accidentally dropped. This is very important for farmers with low incomes who need the equipment to last for a life-time to avoid recurrent costs of replacement. In this programme, farmers' choices and preferences have been accepted where they complement technologies recommended by experts. For example, the change in bucket type was not a threat to the success of the technology being promoted by the programme.

The third NGO working in the study area, is known as the Hospitaller Order of Saint John of God, an NGO, also based on Christian values, that utilises an holistic approach to provide care and pastoral services to the sick, the vulnerable and the disadvantaged, with the main aim of providing the best quality of life (www.sjog.ie/). The focus of attention is the person who is being served.

The organisation approach to agricultural development is to improve the production capabilities of the mentally ill patients, the vulnerable and those caring for them, in order for them to attain the best quality of life as stipulated in the NGO's mission statement (www.sjog.ie/). This is done through the provision of credit facilities to the needy for crop production. The organisation's view is that technologies necessary to improve the production capabilities of the needy are beyond their purchasing power, and there is a need for the provision of credit facilities. Seeds and chemical fertilisers are given on loan to those vulnerable. The loan is to be repaid after a single harvest from the sales of the expected surplus production. The surplus production is to be achieved through the deployment of the organisation's agricultural extension agents to provide technical advice to those involved in the programme. In order for these technical advisers to be effective in their delivery of their technical advice, they deploy a system of extension services dissemination that is normally referred to as a 'training and visit'. The training and visit system involves visiting smallholder farmers in their respective homes and gardens to provide them with advice and introduce technologies on site. The smallholder farmers are given advice on agronomy and husbandry practices that include the most appropriate time of planting and weeding crops.

The underlying assumption in the provision of extension services is that traditional farming practices lead to low yields, so proper farming techniques are introduced to farmers in order to increase yields, particularly with the provision of inputs such as chemical fertilisers. It is anticipated that, at the end of each growing season, the farmers' utilisation of proper advice on growing crops will lead to farmers having adequate food with surpluses for sale. The surplus sold is used for the paying back of the loans, but should leave 'enough' income for other household needs.

The approach has had mixed results. A few farmers have been unable to repay such loans. The reasons given by both farmers and extension agents include crop failure as a result of poor crop management, largely resulting from shortage of labour during the cropping season. Indeed, by definition, these families are vulnerable, having some sick members of the families so that the labour input in their farming operations are negatively affected or reduced. The caring for the sick demands that time has to be provided for them that competes with farming activities. The organisation anticipated this and had put in place arrangements to reschedule loans. Meetings were organised between the farmers in debt with the extension workers (technical assistant) for consultations. The normal procedure is to reschedule the loan to be repaid in a year when the production is high enough for both the provision of food and surplus for sale.

The NGOs in this study have different approaches to development. ADRA uses volunteers and utilises government extension services to promote its activities. It uses local practices, such as planting at a time farmers feel is appropriate, depending on weather, the time and amount of rain. ADRA also relies on the use of labour within the villages (social capital) to provide labour for crop production to achieve its major goal of food security. The burden of the operation is placed on the village heads and their subjects. The groups are trained to write proposals and to seek funding for some of their activities from other donor agencies. The NGO's approach is to involve several development agents in the process of improving participants' standards of living. It is thus a holistic approach.

The Women's Guild has a similar approach for its food security programme to that of Saint John of God. However, the Women's Guild gives the technology free of charge. It also allows for modifications to its technological packages, and promotes local initiatives and the use of locally found materials and inputs. For example, the farmers are allowed to adapt the technology through 'experimentation' and observation. In addition, the promotion of cassava, sweet potatoes and yams mirrors the 1990 government strategy to meet food security requirements for the rural people, probably because they adopted the government framework in developing their programmes. It may be that their agricultural experts, who are retired government employees, are applying techniques of administering development programmes that they are used to, or it might be the realisation that food security could only be achieved with diversification of food sources, which is a practice well-recognised and fully used by farmers. It is important to note that the programme encourages the preparation of different dishes for the three meal times of breakfast, lunch and supper. Such a programme can only be realised in an area where subsistence farming is the norm, as it allows for the growing of many different food crops by a farmer. The programme correctly encourages farmers to grow more than one crop, as opposed to crop specialisation that is common under monoculture.

Saint John of God uses modernisation theory and practice in its approach to agricultural development activities that promote food security and improve the quality of life of the local participants. It deals with poverty through the application and the transfer of science and technology, as understood in the developed world, probably because its base is in the developed world. Smallholder farmers are provided with scientifically proven technologies, such as seeds and chemical fertilisers, and advice. Farmers are left with no room to apply their own local knowledges. Smallholder farmers practise what is recommended by the technical assistants. The strict adherence to proven scientific methods of growing crops, such as early planting and applying chemical fertilisers, has been unhelpful at times. Mother Nature has proved to be unpredictable and the resultant weather patterns have led to farmers achieving lower yields than expected. It appears that if farmers who know their agro-ecology well are allowed to make decisions independently about their farming practices, such failures would be avoided. It is important to note that rain-fed farming systems and production decisions are greatly influenced by environmental factors such as the on-set of rainfall (Tchale *et al,* 2005). These crop failures have had serious negative impacts on farmers' lives because inputs are provided on loan to the vulnerable groups by the very nature of the programme, which in reality need free inputs to start with. These are families that have inadequate food year in and year out, and so the provision of inputs on loan has not been sufficient to lift them out of their vulnerable situation.

5.5 Summary and conclusions

The state at the local level followed the assumption that experts can design and implement development programmes for smallholder farmers. This often unfortunately had side-effects that resulted in farmers rejecting the packages necessary for development. The situation on the ground worsened when policies could not be sustained as a result of the introduction of SAPs by external agents, particularly the IMF and the World Bank. The promotion of market-led programmes ignored the subsistence nature of production practised by farmers. Market-led approaches increased input prices well above farmers' incomes, reducing their participation in the market place and the corresponding economic activities necessary for progress. The focus of development experts was on the consumer rather than the producer, yet under subsistence farming, the farmers are both the producer and the consumer. They sell the surplus and buy produce in lean periods. The outcome was that farmers' knowledge and their dual positions were ignored, often resulting in the failure of many of the development programmes that were initiated.

Agri-businesses were more concerned with their sale of products. Farmers were seen as clients that bought products which they needed. Advice was therefore mainly given only when actively sought by farmers. Of particular importance is the fact that the agri-business in effect was a tool used to promote modernisation at the expense of local knowledges in pursuit of economic progress. In line with SAPs, the private sector fulfilled the role of reducing government involvement in the provision of services that distort functions of the free-market system. In addition, the private sector increased the availability of science and technologies (pesticides and inorganic fertilisers) on the market for farmers to purchase, albeit these were beyond many farmers' purchasing power. Science and technology was to replace local knowledges in agricultural production including soil fertility management, disease and pest control in crops and livestock.

NGOs encouraged farmers to modernise and ignore local knowledges by introducing scientifically proven farming techniques. Only one NGO (ADRA) recognised the role and use of local knowledge in development programmes, particularly as an important tool for achieving economic progress by its cost cutting effects. It realised the benefits of local knowledge in cost cutting measures, where the local economy is not fully monetised and its people are still largely reliant on social capital.

It is important to note that although Women's Guild, Saint John of God and ADRA are Christian based organisations, the implementation of their programmes including extension work and provision of services cuts across faith-related boundaries despite the fact that their starting point in identifying the needy is largely through members of their respective churches of CCAP, Roman Catholic and Seventh Day Adventist. Furthermore, the study area is predominantly of Christian faith (about 90%) with few Muslims and animists. The provisions of development assistance through these churches reach all people in the study area that need it irrespective of the associated faith[8].

The impacts of these various development endeavours by stakeholders are further examined in the next chapter with respect to farming practices observed during the study. Smallholder farmers' practices are analysed in the light of the pressures they experience as result of the introduction of externally driven development programmes. The role which local knowledges play in their farming practices is examined.

[8] In Malawi about 70% of the population is of Christian faith according to National Statistics Office

Chapter 6

Indigenous Ecological Knowledges and Cultivation Practices

6.1 Introduction

Some of the literature would suggest that indigenous knowledge is developed and re-worked to suit the specific environment, needs and priorities of the farmers (Beckford *et al,* 2007; Briggs *et al,* 2007). This chapter examines various environments in which farmers cultivate crops. Their description of garden types and the reasons behind their nomenclature is analysed. The practices farmers use in cultivating such sites and their knowledge about soils and soil fertility is examined and compared with scientifically proven knowledges. Farmers' efforts to understand and manage soils are examined in detail, based on the use of inorganic fertilisers and organic matter from crop residues and natural vegetation. The role culture plays in indigenous knowledge development and the corresponding farmers' understanding of their environment is contextualised. Contextualisation of indigenous knowledge helps in understanding farmers' decision-making rationalities.

6.2 Garden types

All smallholder farmers included in this study have three types of gardens, which is a common feature in the study area. It is an accepted tradition that a household should have a *dimba,* which is a garden in a nearby wetland*;* a *khonde*, which is a garden close to the house; and a *munda ukulu,* which is a main garden where the bulk of food production is undertaken. The *munda ukulu* is normally located at distances from dwelling houses that range from as little as 100 metres to 20 km or further, mainly in areas considered to be very fertile. Many streams (>8) in the area make it possible for almost all farmers to have at least one *dimba* each; the village settings allow for each house to have a *khonde* garden, and a *munda ukulu* is a necessity in a situation where almost all food is produced and consumed by the grower. *Khonde* gardens are purposefully created by leaving spaces for cultivation between the houses in villages. Effort is made by farmers, therefore, to have these three types of gardens. Each name has a special meaning that is a description of the garden, relates to its geographical features, or refers to the purpose for which the crops are grown in such fields. The local common name for all types of gardens is *munda*, which denotes the main garden when the adjective *'ukulu'* is added to it, and therefore is called *munda ukulu* which means a big garden. Virgin land which is converted to farm land in its first year is called *nthewele* or *mphangula.*

A garden that is along a stream or river bank, which is inundated in the rainy season, is called a *dimba.* Such gardens are prepared in April to August and cultivated in the dry season from June to September, although some farmers extend this period by cultivating *dimba* from May up to the end of the dry season, which is late in the month of November. This is when the water table is low and the soil is not water-logged. Here is where the last annual crop is cultivated, such as maize, which is harvested in December just before inundation recurs as a result of the rains. Crops grown in these gardens rely on moisture residues and may be supplemented with water from the stream, using tools such as watering cans. A garden along a river bank that has good drainage and is cultivated in the rainy season is called *njota.* The major difference between *dimba* and *njota* is the time when crops are planted, which is during the rainy season in a *njota* and the dry season in a *dimba*. This is influenced and controlled by the soil moisture regime rather than soil fertility. The *dimba* is inundated in the rainy season and thus unsuitable for crops that need well-aerated soils, such as maize, while the *njota* remains free of inundation. Hence, its soils are well-aerated and remain suitable for crop production, especially maize, in a similar manner to upland gardens that are cultivated in the rainy season. These field types are also important in terms of the crops grown, their use and the cultivation practices followed by farmers. For example, *njota* are considered in the same way as *munda ukulu*, and, as such, food grown here, particularly maize, is mainly stored and used throughout the year, whereas maize grown in *dimba* is eaten as green maize soon after its maturity or is used soon after harvest in December, when it is dry enough to be processed into flour. Farmers' names given to field types are at times influenced by crop use in addition to names given based on location. The diverse environmental characteristics of cultivation sites play a major role in the names farmers give to their fields.

The classification of field types is also based on the physical position of the garden, as well as its size, making it complicated to understand to those unaware of the many factors farmers take into account in giving names to their fields. Indeed, when the area of the garden is quarter of a hectare or less, and is next to a dwelling house, it retains the name of *khonde.* However, a *khonde* garden that is bigger than half a hectare is referred to as a main garden, despite its location. It is important to note that despite this being referred to as a main garden, it is a necessary requirement for most farmers to have a main garden away from the *khonde* area for food security reasons. Farmers believe that a garden away from the houses has the advantage that crops grown here are less likely to be easily accessed because of the distance, and therefore are only used when they mature, become dry, are harvested and then put in storage. The distance between the main garden and the village then ensures that households are food secure for the whole year because food produced here is used only after it has been put in storage, which is when it is dry enough to store well up to the next harvest. For most seed crops, such as maize, this is when its moisture content is 14% of its total dry matter weight. The farmers achieve this moisture content not by drying and weighing the grains, as is the norm in Western scientific methods, but by the length of drying in the sun, then using touch and feel combining with the sounds grains make when shaken or twisting the cob. For farmers, dry grains make a special sound '*zikuti wayawaya'* that is distinct from those that are not fully dry. This sound is similar to stones shaken in a container. Farmers make the allusion that stones make such a sound when they are dry, so that grains making a similar 'noise' mean they are dry enough for storage.

Crops grown in *khonde* gardens are meant to supplement what is produced in the main gardens, and they are used as soon as they mature. For example, mature green maize is picked and eaten roasted or boiled in water immediately, with very little left over as dry maize suitable for use and storage in the dry season. Children are also allocated land to practice cultivation in *khonde* gardens, almost as a training ground for children to become productive farmers in the future. This is where they develop skills and practices such as land clearing, ridging, planting, weeding and harvesting necessary for farming in preparation for their adult lives. Children are allowed to cultivate whatever crops they choose on the sections of *khonde* allocated to them. *Khonde* gardens, therefore, have the highest total number of individual crops (14) grown by farmers as shown in Table 6.1, compared to main gardens (10) and *dimba* (9), a reflection of the 'experimentation', teaching and learning processes being carried out in these locations in addition to the provision of a wide variety of (perishable) food types.

Table 6.1 Information on types of gardens smallholder farmers cultivate and number of crops grown in each garden			
Garden type	Mean number of crops per garden type	Total number of different crops grown by farmers in the study area	Percentage of total crops grown
Munda ukulu	10	19	53
Khonde	14	19	74
Dimba	9	19	47
N=111			

The re-working and production of indigenous knowledge is continuous and involves 'experimentation' and making observations. The *khonde* gardens are intensively used for knowledge production because conducting 'experiments' and making observations is easy due to their closeness to dwelling houses. For example, one smallholder farmer dry-planted four maize seeds in November 2006 in his *khonde* garden which grew to be 30 cm taller at maturity than the maize planted a month later in the same field; they also averaged two to three maize cobs per plant, all of which were bigger than those planted a month later with the first rains in the same garden. The later-planted maize had only one cob per plant. This is very important to the farmers, as it demonstrates the yield potential of dry-planted maize. It was not surprising to hear from this particular farmer that a bigger area around the *khonde* was grown with dry-planted maize in the following season. The researcher was shown this crop when a third visit was made in February 2007. The rest of the maize crops in the *khonde* were smaller in size and height than those that were dry-planted, a reflection of the importance of early planting in this area that takes advantage of soil nutrients before they are leached down beyond a crop's roots by rain water later in the season.

The major problem with indigenous knowledge is that it is 'rarely' published and advertised by the producers. For example, the farmer conducting this 'trial' only alerted the researcher to his 'experiment' on the researcher's third visit, and perhaps then only because it was a success. It is, therefore, safe to assume that many crop and cultivation 'experiments' conducted by farmers may go unnoticed and are not exposed to outsiders, especially if and when they are considered unsuccessful.

Main gardens (*munda ukulu*) are located away from villages in most cases. They comprise a larger area in size, ranging from 1 hectare to 20 hectares with a mean size of 3.9 hectares as compared to *dimba* and *khonde,* which are normally less than a half a hectare. Up to ten food crops are grown in the main gardens under a mixed cropping pattern dominated by maize, but mixed with stands of beans, pumpkins, bananas, vegetables, cassava and mangoes, for example, making them a complex 'experimental' site for knowledge production. Very few farmers (only three) grow tobacco in their main gardens, despite it being a major cash and export crop in Malawi.

It is common practice for farmers to own more than one *munda ukulu*, as shown by the mode being 3 gardens and the mean being 2.9 (Table 6.2).

Table 6.2 Information on number of main gardens smallholder farmers own and/or cultivate

Number of main gardens	Number of farmers	Percentage
1	7	6.3
2	31	27.9
3	48	43.2
4	15	13.5
5	9	8.1
6	1	0.9
Mean number of gardens	2.92	
Median number of gardens	3.00	
Mode	*3*	

There are several reasons for farmers to have more than one main garden, including ensuring food security by having gardens in different areas of different soil types and microclimates; ensuring enough land is owned that will eventually be passed on to children; and the cultivation of land inherited from parents. In cases where gardens have been inherited from parents, the current farmers have not been able to select the sites according to their own preferences and soil fertility criteria. The act of choosing the site was done for them by parents, or even earlier generations, but it is reasonable to assume that parents based the choice of such gardens on soil fertility indicators that are now utilised by their children in selecting new garden sites. Such sites in different locations render themselves ideal for observation and comparison of crop performances both within one season and across many seasons that the crops have been grown, based on location, niche and local climate. These different gardens resemble trials conducted by researchers after a seed variety has been developed at a research station and is then grown on a wider scale in various parts of the country under a technical name called 'variety trials'. Variety trials are used to ascertain crop performances in the field, after proving either to be high yielding or resistant to diseases, depending on the objective of the research carried out on research stations. It is difficult to ignore some similarities between traditional knowledge and Western technologies' development and production procedures and processes.

The study area has predominantly red soils (latosols) which are considered to be relatively infertile because they have a low nitrogen content, a point also confirmed from the analysis done by the researcher in the 2006/2007 cropping season. There are, however, patches of soils that are considered to be more fertile by farmers using their own fertility indicators such as soil colour and vegetation, and these are sought and opened up as farmlands. Furthermore, farmers recognise that under their customs, land is passed on to children through inheritance of pieces of land cultivated by parents. Effort is made to open virgin land to establish ownership by cultivation for the purpose of subsequently passing that land to children. The more children a farmer has, the more land is opened up for passing to the children of the household later in life, particularly if they are male. Female children are expected to marry and inherit land through their husbands.

Those food crops, particularly maize, which are grown in *munda ukulu*, are rarely eaten when mature as green maize, while maize grown in *khonde* is eaten as green maize as soon as it is mature. Maize in *munda ukulu* is left to dry and is then harvested when the grain moisture content is suitable for storage, which is usually below 20% of individual grain weight or about 14% of its total dry matter. Farmers said that when maize is dry enough, it is lighter and easy to carry to granaries, and can be stored well up to the next harvest without mould infestation. To achieve this desirable moisture content, farmers cut the dry whole maize plant and create several circular upright heaps called maize bundles that stand on the stem base in gardens (Figure 6.1). Such maize heaps are known as *mukukwe,* and typically have a diameter of three to four metres. The maize cobs are removed by hand from the plants during the harvesting process when the cobs are considered to be sufficiently dry. This moisture content is usually achieved after the maize has been placed in the heap for about one month or more. The conical heaps are designed to allow air to pass through, collecting moisture which the heat from the sun then removes from the grains in the cob. The approximately uniform size of heaps in all gardens, therefore, is a reflection of the optimum quantity of maize plants that can be effectively dried under such conditions. A similar practice was common in Scotland in the early 20th century (see Black, 2006:81), where grain was dried in the open while standing on cut plant stalks placed in conical heaps. It is important to note that this is a practice associated with maize only in the main gardens. Maize in *khonde* gardens is harvested without making conical heaps and is allowed to dry while still in planting stations, reflecting the fact that it is consumed soon after harvest, and therefore it does not need to be thoroughly dried for storage.

Figure 6.1 Maize being dried in conical shaped heaps before being harvested.

Maize in the main gardens is rarely harvested whilst still green and this is achieved by the very nature of their location. Picking maize cobs while green in *khonde* is an activity that is largely done for pleasure because green maize is consumed as a snack so that it is often seen as a leisure activity that is particularly done, in most cases during morning or late afternoon hours. The long distances between the main gardens and the villages, therefore, require that effort is made to access maize in such gardens, and, as such, the leisure aspect is lost. There is a second aspect of *khonde* that is not related to green maize harvesting, however, but it is related to work output. Once the farmers have left the village for work, there is a reduced chance of being called to attend to minor events or to greet visitors, for example, and they can hence concentrate on their farming activities in the *munda ukulu*. For example, one farmer shrewdly said that producing enough food for the family requires avoiding social events during critical cultivation times, and this is achieved by being away working in *munda ukulu* that are located far from the dwelling houses. Indigenous knowledge is sophisticated in nature and is craftily and wisely used to ensure food security at household level as shown by the sometimes deliberate creation of considerable distances to *munda ukulu.*

Maize grown in the *munda ukulu* is reserved for use as flour upon drying and processing, and is then eaten cooked as a thick porridge called *sima.* Every effort is made to achieve household food security and the distance between the village and the *munda ukulu* plays a positive role in this respect. The fact that the *munda ukulu* are far from the village makes it possible to work without disturbance and this results in an improved work output from the labour input in activities like land preparation, ridging and weeding. Consequently, the yields of crops increase, mainly as a result of the timely completion of farming operations. The increase in output as a result of these timely operations is then enhanced through the avoidance of harvesting green maize, as happens in the *khonde,* which would reduce the harvest of dry matured maize for storage and consumption for the rest of the year after the harvest. It can be argued that food sufficiency is achieved through a deliberate strategy using the distance barrier between dwelling houses and *munda ukulu*. The food self-sufficiency ensured by these considerable distances between dwelling houses and *munda ukulu* contrasts with the Western ways of knowing that advocates the achievement of timely farming operations by 'amalgamating' of scattered gardens in order to reduce time for travelling between them.

Although there are advantages in having *munda ukulu* located away from dwelling houses, farmers pointed out that there are negative impacts associated with these long distances, especially during harvest. The transportation of crops from these gardens takes more time than it would if the distances were shorter. Farmers are aware of the side-effects of positioning gardens in such a manner, but the problems faced are solved using local solutions. Group labour is sometimes used in a reciprocal manner to ease the burden of harvesting and transportation of the crop to storage sites, which are located in the villages. Farmers harvest and carry the crop harvested using labour sourced from several households. This labour is used collectively in successive gardens of the group members, until each member has his or her maize crop harvested and transported to the storage areas. Those who have an adequate income employ paid labour to assist in this process. The fact that food security is assured in this manner encourages farmers to accept the cost associated with distance, in terms of transport, as a requirement for achieving self-sufficiency in food. The farmers' decisions are rational and based on well-informed choices.

The strategy of the Malawi Government since independence in 1964, and some NGOs in recent times, has been to advocate the growing of hybrid maize as a measure that will ensure food security, based on scientific evidence which shows that the yield of hybrid maize is higher than that of local maize. However, hybrid maize has yet to be accepted by farmers as providing adequate food security, because it is susceptible to weevil damage soon after harvest, and is therefore difficult to store over the lengthy periods up to the next harvest which are required for maintaining household food security. Farmers assess and evaluate Western technologies, such as hybrid maize, using local varieties as a control to see if their 'traits' fit in their normal farming practices that ensure food security. Interestingly, very few farmers (3) planted more hybrid than local maize, while many more (108), either planted local maize only (55), or combined local and hybrid maize (53).

To store hybrid maize for these periods, it must be protected from weevils by using pesticides, which has a clear financial cost. This is considered unnecessary by farmers, because local maize can be stored over the same period without pesticide use. Moreover, farmers consider that the cost of pesticides is too high and therefore restrictive and prohibitive. Yet it is doubtful that, even if the price of pesticides is reduced, or even eliminated, farmers would reduce the area put to local maize and increase the area put to hybrid maize. Women in the focus group discussion agreed that, in any case, flour made from local maize lasted longer than flour made from hybrid maize of the same volume. Another farmer said that the taste of *sima* made from local maize flour is superior to that made from hybrid maize. This produced a lively debate on taste that extended to the taste of both roasted and boiled green maize. It was agreed that local maize is sweeter than most hybrid maize varieties. This shows that farmers' decisions are made after considering and evaluating a range of factors. For farmers, the yield of crops such as maize is not the only factor; crop choice also involves taste and the amount of the final product, such as *sima,* which can be made from it.

The importance of farmers having sufficient food within each household is shown by the fact that, although many crops (19) are grown in the study area, the dominant ones are food crops (Table 6.3). In addition, crops that are considered as important foods, such as maize, beans, mangoes, pineapples, bananas, cassava, sweet potatoes, green vegetables and sugarcane, are grown by all farmers. The patterns of crops grown indicate that farmers are able to satisfy nearly all their dietary needs from their own production. Maize and cassava are a source of carbohydrates, beans are a source of proteins, green-vegetables are a source of vitamins, and fruits are a source of minerals and important vitamins such as vitamin A. Other crops, such as cassava and sweet potatoes, have leaves that are cooked as green vegetables and their tubers used as a source of carbohydrates by eating them raw, roasted or cooked. The piths of maize plants that have empty cobs (no grains in them) are eaten as a snack for their sugar content while green after producing a tassel. The production of a tassel is a sign that the sugar in the pith is suitable for consumption because its taste is seen to be pleasant at this time. Eating the pith before the formation of a tassel is avoided by farmers as it is not considered to be sufficiently sweet. Moreover, some farmers reported that those who have eaten immature maize piths have developed a strange fever. This may be true, or it might be a way to scare children so that they do not eat maize piths before cobs fully develop to a stage that farmers can distinguish empty cobs from those full of grains.

Table 6.3 Information on crops grown in the study area		
Name of the crops (in order of importance and nature of use)	Smallholder farmers growing the crops	
	Number of farmers growing the crop	Percentage of farmers growing the crop
Maize	111	100%
Beans	111	100%
Pumpkins	111	100%
Mangoes	111	100%
Pineapples	111	100%
Bananas	111	100%
Cassava	111	100%
Sweet potatoes	111	100%
Green vegetables	111	100%
Sugar cane	111	100%
Tomatoes	100	91%
Guavas	90	81%
Avocado pears	60	54%
Peas	60	54%
Oranges	30	27%
Yams	20	19%
Tobacco	3	3%
Ground nuts	2	2%
Millet	2	2%
N=111		

6.3 Farmers' soil knowledge systems

Farmers in the study area have a range of knowledges about the soils found across their three garden types. Farmers classify soils according to their fertility levels in order to deploy suitable and appropriate agricultural management practices. In assessing soil quality, all the farmers in the study classified them, firstly, in relation to the length of time of continuous cultivation of a given field; and, secondly, in relation to soil properties, primarily the soil's 'slippery' or coarse texture. The farmers' determination of soil texture resembles scientific ways of classification, which interestingly is also based on the feel method. Rubbing soil between the fingers to determine soil texture is both a scientific as well as an indigenous way of determining its properties. Soils in virgin gardens (*mphangula)*, irrespective of their actual properties, are considered to be rich in soil nutrients before cultivation is undertaken. Farmers recognise that the natural vegetation of virgin land provides the soil with dry matter, which decomposes to generate high levels of soil fertility. Indeed, all respondents said that a good garden site must have *vundira,* which is dry plant matter that is decomposing, similar to peat or compost, and in short could be termed as humus. It was established during focus group discussions that farmers deliberately choose garden sites that have dense vegetation because this indicates high soil fertility in the form of *vundira* (humus).

Farmers recognise that the denser the vegetation, the higher the dry matter available that forms *vundira.* However, farmers disaggregated dense vegetation and ranked that of *Brachystegia* woodlands to be superior to any other vegetation as an indicator of higher soil fertility, and therefore good and effective pointer for crop production, especially maize. One farmer specifically pointed out, without prompting, that he is cultivating a garden 10 kilometres away from the village because that was where *munyozi (Brachystegia spiciformis Benth),* a *Brachystegia* tree species, was found. Unsurprisingly, farmers are increasingly concerned that there is a growing shortage of available virgin land (where they also obtain other resources such as mushrooms, edible insects and wild plants for local medicines) in the study area; all have noted that virgin land has become scarcer with increased population densities, partly as a result of people renting houses in the area who work in the nearby city of Mzuzu. These are also renting gardens from farmers in the area who then have opened up new farmland replacing fields rented out and reducing forest areas further. The expansion into newly opened farmlands has resulted in more area being put under agricultural activities. There is general agreement that: '*Sono mizi njinandi malo ghamunda walero ghakusowa'*, a statement made by an elderly man at a focus group meeting, which can be translated as ‘there is very little virgin land left for conversion to farmland because of the increased number of villages in the area’. Indeed, even the agricultural extension worker in the study area has records that show that the population of farmers in the study area has more than doubled from its 1970 figure of 1000 households. In addition, a report by Langyintuo (2004) indicates that each field assistant in the country is responsible for 2900 farm families, implying there has been an increase in the farming families since 1970. Furthermore, satellite images of the study area show extensive cultivation or land cleared of its vegetation with very few areas of natural vegetation (see Figure 3.2).

Farmers said that because of the increased demand for land for cultivation from those wanting to rent it, they are forced to choose virgin land for conversion to farmland, but not necessarily based on the preferred indicators of soil fertility, such as the presence of black soils and *Brachystegia species*. Economic gains from renting can influence well-established local practices in choosing cultivation sites. Farmers are forced to choose land that is less fertile as a result of these external forces, and the cultivation of such sites becomes unsustainable and less beneficial, as the condition of low soil fertility demands the purchase and use of chemical fertilisers to improve crop yields. This is a cause for concern for farmers whose income was found to have an annual mean of US $457 during the study in the 2006/2007 cropping season.

Scientists have established that *Brachystegia* is a nitrogen-fixing plant. Farmers are generally not aware of this particular scientific finding, however, and certainly may not understand the process of nitrogen fixing in the soil by the *Brachystegia,* but they are well aware of the high soil fertility levels in those areas where the species is dominant. The characteristic *Brachystegia* has to fix nitrogen in the soil therefore explains the high fertility levels that farmers attach to it through their observation of the growth of crops on those soils that have had such trees on them before conversion to farmland. The ways of knowing are certainly different, but there is a common fact, that is true to both scientists and farmers, which is that the site is rich in soil nutrients, especially nitrogen; one conclusion is achieved by observing crops grown, while the other is through the use of Western science and technology. Local knowledge complements Western scientific ways of knowing. The presence of *Brachystegia* removes the need to take soil samples just for the sake of determining soil fertility levels in choosing farm sites, which is an expensive and time-consuming process that requires the services of technicians.

The farmers' knowledge associated with *Brachystegia* is likely to be gradually lost over time as a result of the natural habitat being slowly lost. It will be difficult for farmers to demonstrate to their children how to choose a good cultivation site for crops, particularly maize, in the absence of such a key soil fertility indicator. Indigenous knowledge is passed on between generations in several ways, but a key way is through observation. The old adage that 'seeing is believing' is borne out in this situation. Increasingly, future generations are less and less likely to see the species in its natural habitat; they will be less able to choose a suitable cultivation site based on the presence of *Brachystegia* and therefore in due course will not associate it with soil fertility. Although this may be the unavoidable outcome of the disappearance of *Brachystegia*, other soil fertility indicators, such as dark-coloured and black soils, may replace them as major soil fertility indicators. Farmers are already using this indicator in *dimba,* which is a sign that indigenous knowledge changes and evolves with varying environmental and ecological conditions. In short, indigenous knowledge is adaptable to changing times and circumstances.

In-depth group discussions revealed that farmers see *vundira* as 'providing food for crops'. It is, therefore, not surprising that most farmers (94%) had more than one *munda ukulu*, which had been achieved through the process of converting as many sites as possible, which had *Brachystegia,* into farmlands. It can be argued that this is an adaptation of the former practice of shifting cultivation that is now practiced by very few farmers in the study area. To maintain and improve soil fertility in cultivated fields, farmers' soil management practices revolve around the continued production of *vundira,* and, in gardens that are not *mphangula,* the incorporation of crop residues into the soil is used to maintain fertility. Hence, this maintains high crop yields for as long as this can be achieved after the natural benefits of *vundira* have been exhausted.

The plant food provided by *vundira* is called *mchere* in the local language, which is also the name given to kitchen salt. Farmers understand that plant food is depleted over time by crops, resulting in decreasing yields, for each additional year of cultivation.

Consequently, gardens ‘lose the strength’ to support crops over a period of time as a result of prolonged and continuous use. When the garden reaches such a state, the farmers describe this state as ‘*munda wasukuluka*.’ This translates as the soil in the garden has lost its fertility.

Focus group discussions showed that knowledge about virgin lands was widely shared amongst farmers across all ages and both genders. All members of the groups actively participated in the discussions, and it was clear that knowledge that has a direct impact on the yield of food crops, and by extension food security, is well shared amongst farmers. This is mostly referred to as survival strategies by many scholars such as Chambers (1983) and Beckford *et al* (2007).

Farmers allow children from the age of five onwards to cultivate in *khonde* as a learning process through practice and observation. Subsequently, at thirteen years of age or more, which is considered to be an age when children are about to be adults, farmers allow them to have their own independent gardens away from *khonde*. The farmers emphasise that children at this age need to have their own gardens, not only for training purposes, but also so that they stop consuming green maize from the *munda ukulu*. It seems that children are associated with increased consumption of green maize, which is considered to threaten food security as the amount of maize to be consumed as *sima* is correspondingly reduced. Because *sima* is the staple food for households in the study area, any use of maize that threatens its availability is a threat to household food security. Furthermore, the children’s gardens increase children’s knowledge of farming, because they can observe their own farming practices and compare these with those in their parents’ gardens. Children can then make informed choices. For farmers, the ability of the children to be independent and to be able to evaluate and assess farming practices on their own is a necessary process to go through, if they are to graduate as successful and responsible farmers. Indigenous knowledge becomes a tool for teaching and for the maintenance of desirable cultural norms, expectations and values within the society.

Farmers are also accompanied by children of all ages to the fields during almost all agricultural activities undertaken. Children make ridges, plant and weed maize in *munda ukulu* under the supervision of parents, for example. All this is done in order to give the children practical courses in farming. In the process, children acquire knowledge themselves through observation and practice. Children above thirteen are sometimes seen cultivating *munda ukulu* in the absence of parents, which is an indication that at this age they are considered to have acquired enough knowledge to carry out cultivation practices, such as weeding and banking, on their own. The responsibility of having part of a *khonde* garden, their own small gardens and participating in farming activities in the presence of parents and relatives, provides an opportunity for children to observe these operations and to learn through practice. Farmers are aware that without such practical lessons, children will not grow into successful farmers in the future. One farmer was especially frank and was of the opinion that children, who are not taught farming practices, become lazy and end up as thieves. This is a link that is very interesting, in terms of knowledge transfer in farming being associated with an impact on social behaviour, as this farmer linked excessive free time for children to the development of anti-social behaviour and laziness. Farming lessons are seen to become part of those processes that are used to make children acquire discipline and good manners. Furthermore, most farmers consider that those people who buy food for household consumption, especially maize in a year when everyone else has adequate surpluses from their own production, have received an inadequate farming training during childhood; such farmers are said to be lazy. Effort is, therefore, made to prepare children to be productive farmers in the future to avoid parents being scorned by fellow farmers as having failed to raise their children in a proper manner.

The act of the first weeding stage in maize cultivation is considered to be very important by farmers. Children between five and twelve years of age are frequently seen to be very close to where parents are weeding. The first weeding involves removing weeds from the ridge and placing them in the trough. Since weeds can be very close to the planting station itself, it is common for children to cut the crops in the process. To limit this damage, children are under close supervision. Parents instruct children to pull weeds out by hand that are either between maize plants in a planting station, or very close (2cm or less), instead of using a hoe, which can cause serious damage to the maize plants.

Farmers generally agreed that the length of time it takes a garden to become less productive, that is, to lose its ‘strength to support crops’, depends largely on soil texture. Farmers are, therefore, aware of the crucial difference between what they call ‘slippery’ soils and loose soils. They particularly noted that loose soils become less fertile more quickly with use than slippery soils, even when planted with similar crops. Many farmers (93%) plant bananas on ant hills which are considered to have ‘slippery’ soils. Banana clones planted on ant hills are said to produce bunches for up to fifty years or more, as shown by bananas planted in 1949 in the study area. Conversely, those bananas planted on the flat lands which have loose soils often die in the first year of planting unless manure is applied to the planting station. Furthermore, farmers also showed the researcher sites that have loose soils around villages, which have now been planted with cassava within ten years since the first opening of the land for cultivation, because the production of maize has become unsatisfactory on these soils, with 30% of plants producing cobs without grain. In contrast, ant hills within such locations are still being put to maize and produce cobs full of grain (Figure 6.2).

Figure 6.2 Full and empty maize cobs

Table 6.4 shows that farmers of all ages prefer to plant bananas on ant hills, probably a factor that can be considered to show the effectiveness of the training process children undergo before they become adults. Farmers under 21 years of age (75%) plant on ant hills by imitating their parents (>90%).

Table 6.4 Information on smallholder farmers banana planting sites by farmers' age						
Age category in years	Planting on flat	Percentage	Planting on ant hills	Percentage	Total	Percentage
<21	2	25	6	75.0	8	7.2
22-50	5	8.2	56	91.8	61	55.0
>51	1	2.4	41	97.6	42	37.8
Total	8	7.2	103	92.8	111	100

Farmers understand the loss of 'strength' of soil after use, by relating it to the similar effect that effort has on their ability to perform work. They get tired after working for a long period of time, and, in the same way soils also become 'tired' from continuous cultivation. The 'slippery' soils take a longer period of time to lose 'strength', in a similar manner that a strong person can endure a long period of hard work, while loose soils lose strength in a manner emulated by a weaker person who gets tired very quickly after working for a shorter period of time. The length of time taken for soils to lose 'strength' was emphasised by farmers by giving an example of 'slippery' soils, such as those found on ant hills. One farmer demonstrated this by showing an ant hill that has banana clones which were first planted in 1949. The banana plants were tall and were still growing vigorously; some had big bunches of fruits on them, a clear sign that the crops were still healthy and an indicator of maintained soil fertility. Many farmers emphasised this point further, by reporting that even the bananas that survived the first year on flat lands with 'loose soils' grow with less vigour and produce comparatively smaller bunches and fruits than those growing on ant hills. Farmers make detailed observations on a daily basis and they understand that bananas planted on the flat die because of lack of soil moisture soon after the rainy season is over and less nutrient availability in such soils. In order to retain moisture and introduce additional nutrients on these soils, farmers dig pits one metre deep and one metre wide, which are then filled with manure or plant matter that later decomposes to provide nutrients to bananas planted in these pits. The pits have an additional role of collecting rainwater, thereby retaining the moisture over longer periods of time than is normal for flat lands in the area. This generally sustains the growing bananas up to the next rainy season. Farmers understand that successful water retention is based on the pits' capacity to hold water, which results from the manure applied, which, in turn, retains soil moisture more effectively as a result of improved soil structure and texture.

Those farmers who cultivated a relatively smaller total land area, around 1-2 hectares, planted more maize on ant hills than bananas and pumpkins. They trade off space by making full use of the fertile soils on ant hills to increase their staple food crop which is maize. Some are forced, nonetheless, to plant bananas on ant hills, despite their limited farm size, because where termites (*Reticulitermes species)* are active on ant hills, they can destroy maize plants by attacking the stem just above the ground, thus killing the plant. However, termites are unable to destroy bananas because they have large, multilayered stems, and termites tend to feed on the outer layers that are dead and dry, so leaving the plant without damage.

Soil samples were collected from both ant hills and flat lands, and were analysed to compare the farmers' ways of understanding soil texture and fertility with those of Western science and technology. The samples were analysed for soil texture, pH, nitrogen content and available phosphorus. The results of the findings are presented in Table 6.5.

Table 6.5 Information on soil properties found on ant hills and flat lands

Soil properties	Minimum		Maximum		Mode		Mean		Median	
	Ant hill	Flat	Ant hill	Flat	Ant hill	Flat	Ant hill	Flat	Ant hill	Flat
pH	5.500	4.300	7.400	6.100	6.600	4.900	6.373	5.180	6.400	5.300
Nitrogen %	0.115	0.070	0.285	0.185	0.115	0.070	0.218	0.120	0.218	0.110
Phosphorus (ppm)	2.123	2.622	10.740	11.928	3.144	2.622	4.169	5.509	3.523	3.901
Clay%	40	30	83	47	67	40	68	40	70	40
Sand %	7	23	27	50	10	40	15	39	13	40
Silt%	10	7	23	27	20	20	17	20	17	20
N=30										

Soils from ant hills have a higher clay content, with a mean of 68% compared to 40% on the flat lands. The mean sand content was 15% in the soils from ant hills, which was less than half of the mean sand content (39%) in soils from the flat lands. The mean soil pH on flat lands was 5.2 and that of ant hill soils was 6.4. The mean nitrogen content of soils on ant hills was higher (0.22%) than the flat land soils (0.12%), but the mean available phosphorus in soils was higher on the flat lands (5.5ppm) than on ant hill soils (4.2ppm). The results confirm that the soils on ant hills have a higher soil fertility compared to those on the flat, confirming that 'slippery' soils are richer in soil nutrients than loose soils.

The differences in soil characteristics can be explained using Western science understandings. Soils that have a high clay content tend to bind phosphorus within them because of the adhesive properties of the clay. This explains the lower available phosphorus found on soils from ant hills compared to those found on flat lands. The high nitrogen content can be explained by the fact that ant hills are built by termites, and are produced by gathering plant residues on which the termites feed, and from which Nitrogen is released through the decomposition process, normally done by microbes such as bacteria in the soil. The process of gathering and decomposing plant residues by termites in ant hills, plus the metabolic wastes from termite digestive systems, therefore concentrates nitrogen in soils found on ant hills making it higher than those soils found on flat land.

The understanding of the significance of soil texture and fertility by farmers is comparable to that of Western science. Both groups understand the roles that soil particles play as soil texture determinants. They also understand that soil fertility is a function of the nutrients contained in soils; farmers are aware of the fact that soils without such nutrients are less fertile. Whereas Western science and technology analyses and establishes the exact content and nature of such material in soils, farmers establish the existence of such materials that make soils fertile by observing the vigour of crops grown on soil sites; for example, soils with a high nitrogen content make plants grow with vigour and produce a dark green colour in the leaves.

The significance of soil feel, which Western science sees as soil texture, is understood by farmers, primarily as an indicator of water holding capacity. Slippery soils are considered to hold moisture for longer periods of time after the end of the rainy season than the 'loose' coarser soils, which quickly become dry. This accords with the scientific fact that sandy soils lose water faster than clay soils. For example, pumpkins, and a few broad-leaved weeds, are frequently still green on ant hills in August and beyond, long after the end of rainy season (Figure 6.3). The characteristics and properties that farmers attach to 'slippery' soils, that they hold moisture for a long time after the last rains, is substantiated by the high clay content in ant hill soils.

Figure 6.3 Pumpkins on an ant hill are still green in the dry season.

Nearly all farmers (96%) planted pumpkins on both ant hills and flat lands, explaining that pumpkins were planted on ant hills to extend their growing time beyond the rainy season. It becomes clear that the importance of the moisture holding capacity of clayey, 'slippery' soils cannot easily be ignored in the farmers' cropping practices. For farmers, soil fertility and the water holding capacity of soils go hand in hand, to the extent that they are essentially of equal importance. Farmers' agricultural management practices therefore are designed to benefit from the essential soil properties of fertility and water retention capacity.

Pumpkins planted on 'loose' coarser soils die soon after the rainy season ends. The growing season of pumpkins on such soils, therefore, ends at the onset of the dry season at the end of April. Farmers' needs for green vegetables go beyond this time of the year; consequently, they utilise the fertility and water holding capacity of ant hills. The green vegetable and fresh crop production is further extended by the cultivation of *dimba* where residual moisture is available for crop production after the rainy season.

The soils in *dimba* and *njota* are much darker in colour, even black in some cases. These soils have characteristics similar to those soils found on the ant hills. They easily form a round ball when wet, are slippery when rubbed between fingers, and, most important of all, are very effective at retaining soil moisture, so necessary for plant growth. Farmers associate the dark colour of these soils with higher levels of soil fertility. Hence, *dimba* and *njota* are considered fertile because of their soil colour, and also because of the thick natural vegetation found on them, mainly composed of reeds and grass (see Figure 3.5). It was established during focus group discussions that reeds are a key indicator of high soil fertility levels where they are found in abundance, and especially so if their stems are bigger in circumference than average human fingers.

Significantly, farmers identify clear differences between *dimba* and *njota.* The soil characteristics are similar, and, in some cases, they may even be identical. The real difference is the level of the water table during the rainy season. Farmers explained that both *dimba* and *njota* experience flooding in the rainy season. However, *njota* behave almost identically to upland soils during the rainy season. The soils in *njota* retain adequate moisture for plant growth and quickly drain excessive moisture. This makes them suitable for crop production such as maize, as the crop does not become yellow, which would be the case if water was retained so reducing soil aeration processes. The amount of the retained moisture allows soil aeration and is, therefore, sufficient for crop production in the rainy season. However, soils in *dimba* retain excessive moisture in the rainy season, resulting in water-logging which is unsuitable for some crops, especially maize. Water-logging in most cases results in some crops turning yellow, wilting and dying. Drainage during the rainy season to achieve a moisture content suitable for crops becomes difficult to impossible because of the high water table. In fact, farmers noted that some *dimba* become inundated in the rainy season, sometimes for periods of up to three months. Thus, they become wetlands under these conditions, with shallow waters that make crop cultivation at such times impossible.

6.4 Indigenous soil improvement practices and fertiliser use

Farmers deploy agricultural management practices that can either improve soil fertility, or at least retain it for as long as they cultivate a site. Soil improvement practices and fertiliser use begin from the first year of cultivation of a given field. The processes of cultivating a virgin upland involve land clearing that includes cutting trees using hand held axes and slashing grass using home made *pangas* (cutting knives). When trees are cut down or felled, big branches that can be used as firewood are gathered and transported home or sold to people who manufacture bricks in the study area or elsewhere. The smaller branches are laid down along with the slashed grass. These are allowed to dry over a period of about two to three months or more, and then set on fire. The burning is done on a calm hot day to create optimum conditions necessary for effective burning and sterilisation of the soil. The farmers understand that by the end of two to three months of hot sunshine in the dry season, the branches and grass are dry enough to be fully burnt to ash. The ash created is then incorporated fully in the soil by tilling the land as a source of soil nutrients, especially potash.

All farmers agreed that the most suitable crop in the first year of cultivation of most *munda ukulu* is finger millet as the dominant crop in mixed stands. Indeed, two farmers who had converted virgin land to farmland in the year of the study planted it to finger millet. However, some farmers cultivate maize as the dominant crop in such mixed stands on virgin lands, especially when they have a pressing need for the major food crop. The main reason for preferring finger millet as a major crop in the mixture in the first year is that weeds are destroyed by burning. This is a very important factor for farmers since the weeding of finger millet is done by pulling weeds out of the soil by hand. Weeding for other crops such as maize is typically done using a hand-held hoe. The more weed seeds that are destroyed by burning, the fewer the weeds, and hence the less labour that has to be deployed, and the task of weeding becomes easier to undertake. In addition, ash is considered by farmers to be an effective plant food for finger millet, and so it tends to be grown only on newly converted farmlands that have been recently burnt. Ash contains potash, a necessary element for plant growth, and this explains the improved performance of millet under such conditions. A further reason put forward by farmers is that burning delays the subsequent appearance of weeds, such that the finger millet emerges on clean ground, at least when burning has been properly done. The crop, therefore, has limited competition from weeds for plant food, and especially so in its early growth stages when it is most vulnerable to such competition. This is then easily maintained through the growing season by weeding, when needed, especially because millet cannot be easily differentiated from other grasses in its early stages from emergence to about one month in age. Farmers noted that even when millet can be recognised, pulling out weeds that are at the same growth stage results in the potential destruction of the millet crop. Farmers avoid this crop destruction by 'sterilising' the planting sites using fire.

The preparation of branches and slashed grass for effective burning is considered a practice that requires special knowledge, skills and talent in laying the branches and grass so that all branches completely burn into ash by the end of the process. Farmers lay branches in positions determined by their size. The smaller branches, with diameters of up to 3 cm, are put around bigger branches with a diameter above 3 cm, so that the smaller branches generate adequate heat to burn the bigger branches; it is the subsequent burning of the bigger branches that generates sufficient heat that is effective in killing weeds. Some pointed out that this knowledge is accumulated with experience, associated with age as a result of doing this process many times. The experienced farmers said that to attain effective high temperatures, the environmental conditions at the time of setting the fire and the whole period of burning need to be calm, with little or virtually no breeze present. Experienced farmers have the ability to forecast and identify such days using local knowledge and understandings of weather and this forms part of the skill-set they have; calm hot days are characterised by *'malawi',* which is hot air seen in the form of waves rising from the surface of the earth, especially observed in cleared spaces such as gardens, roads or footpaths. Significantly, the temperature in the dry season, especially in the months of September and October, is above 27ºC, creating ideal conditions for effective burning. Although it rains throughout the year in the study area, the months of August, September and October experience relatively lower rainfall compared to the other months of the year. These climatic factors of low rainfall and high temperatures create ideal conditions for successful burning. The knowledge about when to set fire to the branches is based on the experience these experts have had with high temperatures in these months. Those who do not use such experts to burn branches fail to attain the killing effect of the resultant fire as insufficient heat is generated during burning, so that many weed seeds survive. The soil remains inadequately sterilised so that weeds appear in abundance as the millet emerges. This increased weed population creates a need for an increased labour demand during the weeding of the crop. An increase in weed population can result in the destruction of the emerging millet crop particularly when weeds are being uprooted. To avoid inadequate sterilisation, many farmers said that they seek assistance from experienced farmers in the form of reciprocal labour.

Where burning has been effective, weeds appear relatively late in the crop growth cycle and are easier, therefore, to differentiate from the finger millet, especially if they are of the grass family. Furthermore, farmers are of the view that burning loosens the soil, which then requires less effort in the process of uprooting weeds. This point was raised as a very important advantage of effective burning. Farmers try as much as possible to make their work as simple and easy as possible, and, in so doing, they save energy for other activities. This may not be surprising as they have many crops located across several gardens to attend to. This behaviour shows that farmers are rational in allocating scarce resources such as labour. They plan in advance in order to rationalise such resources.

Although the farmers in the study are aware of the cultivation practices associated with finger millet, only two farmers grew the crop in the year of the study. However, most of them had grown finger millet when their gardens had been virgin lands, and therefore they retained a memory of the advantages of burning and the resultant ash in such fields. In addition, farmers tend to share labour in groups during cultivation activities, such as weeding in particular. Therefore, although few farmers cultivate finger millet at the moment, because of the limited availability of virgin land, weeding the crop on established land involves many families in the form of reciprocal labour sharing. The reciprocal labour sharing and previous cultivation of the crop by many farmers may explain the wide and extensive knowledge that farmers showed during focus group discussions on finger millet cultivation and the soil fertility management practices associated with it, despite the fact that most of them were not cultivating the crop in their own gardens in the year in which the study was conducted. Knowledge therefore is learned, renewed, shared and maintained through activities and practice. Organised group labour ensures knowledge is not easily lost or forgotten.

After the first year of cultivation on virgin land, maize then becomes the first choice major crop, and maize dominates the crop mixed stands for as long as the soil can support yields that are reasonable for the farmer. This varies amongst the farmers, but when 30% of the cobs have no grain, most farmers consider this to be unacceptable. Their understanding of yield at this stage is in terms of empty cobs per given number of plants along a ridge. During harvest time farmers first use a number of *mukukwe* (see Figure 6.1) made in their *munda ukulu* to measure yield and later use baskets as they carry the crop for storage in granaries. Quantities are measured in volumes that farmers understand and relate to measuring instruments such as baskets and plates.

Farmers do not have weighing scales to measure yield in kilograms, such that the available alternative to measure food for consumption is the baskets used to carry maize after harvesting from gardens to granaries. This is a convenient way for farmers to measure food for consumption, because farmers have baskets that are used for other uses, such as grain storage, before taking grains to a maize mill. More important to farmers is that the baskets are also used to take maize for consumption from granaries, and, as such, are used as a measure of the amount of food baskets consumed per month for a given family. Consequently, farmers measure yields of maize in terms of bags produced, numbers of full baskets carried from a given field and the level of maize cobs in the grain stores. This is done by counting layers made of cobs across the surface area of the granary. This gives farmers a clear indication of the volume of maize they use each time that maize is collected for consumption from the granary, by counting the remaining layers. Each layer is then linked to a time-scale in terms of the months it can take to exhaust the contents of the granary. Farmers note that it is then easier to estimate when grain is likely to be used up.

Once 30% of cobs are without grain (see Figure 6.2), the garden is either immediately put to fallow or is planted with cassava for up to two years or more, before being put to fallow. However, farmers who are employed and have additional income are able to improve yields through the application of chemical fertilisers, and therefore prolong crop production beyond what would be possible without chemical fertilisers, which is typically understood by farmers to be 10 years on sandy soils, and up to twenty years or more on dark soils.

Farmers' understandings of soil fertility loss is conceptualised along the lines of food preparation practices, and particularly the application of kitchen salt to side dishes made of vegetables, meat and beans, which are usually served with *sima.* These side dishes, in most cases, are prepared to last for more than one meal because they take time to prepare, and a considerable amount of firewood is used in the process. Consequently, their preparation beyond a single meal is considered to be a rational decision in order to save labour and firewood. Salt is applied to these dishes to the required taste. However, the desire to take the side dishes while warm during all meals requires that water be added in order to heat up the side dishes. This additional water dilutes the salt content, and so it becomes necessary to add salt to the dish to maintain its previous taste.

Farmers use this understanding behind salt behaviour in the consumption of side dishes to interpret soil fertility loss in gardens. The starting point in understanding their reasoning can be seen in the name farmers give to chemical fertilisers. Fertiliser is called *mchere*; and *mchere* is also the name given to kitchen salt. The importance of kitchen salt is seen in its properties of improving the taste of food to which it is applied. The salt content of such food becomes diluted as a result of water addition when it is heated up, and this understanding is applied to represent the similar effect of rain in adding water to soils in cultivated gardens which dilutes soil nutrients. However, this is seen to be different from the leaching of soil nutrients by rainwater, as this results in soil nutrients being washed deeper into the ground. Farmers believe that not all soil fertility loss can be explained by crop nutrient uptake, soil erosion and leaching. For farmers, it is clear that leaching cannot occur in pots that do not leak, and yet salt which is added to side dishes still fades in taste over time with each application of additional water. This fact then provides farmers with an analogous explanation as to how soil nutrients are lost in their gardens. This has a bearing on how farmers understand soil fertility in a somewhat different manner that goes beyond soil properties and texture. It also has an important bearing on land management and improvement practices that they undertake to maintain soil fertility in their gardens. Significantly, it is also different from the main scientific interpretation of soil fertility loss, which is based on factors such as leaching, crop uptake and soil erosion, for example, of which the farmers are also aware.

The soil, therefore, is thought to show the properties of a non-living organism, while earlier on it showed the properties of living things, as it became ‘tired’ and ‘lost strength’ with continuous cultivation. The conceptualisation of soil, both as a living and a non-living entity, might be incomprehensible to Western scientific ways of knowing. Yet this is the smallholder farmers’ way of knowing and they move between these scenarios with ease. Both the living and the non-living nature of being are used to explain events that cannot adequately be explained by only one of these two when used independently. The farmers, therefore, try to be as holistic as possible in explaining their understanding of the nature and environments, in this case soil fertility, on their farms.

Farmers put gardens in uplands, particularly *munda ukulu* that have loose soils, to fallow for a minimum of one year after continuously cultivating them for a period of up to twenty years or more, depending on how many *munda* a given farmer has. Those with many *munda* ‘rest’ them for longer periods. For example, one farmer with four gardens has a *munda* that has been fallow for more than ten years (Figure 6.4).

Figure 6.4 A fallow for more than 10 years

Putting land to fallow is the least desirable option that farmers have for soil fertility maintenance, because it has a negative impact on food security, as it decreases the land area available for food production. Consequently, those with fewer gardens, and lower hectarages, are unable to put land to fallow for the longer periods of time necessary to replenish soil fertility. There is an additional reason for this reluctance by some; land left fallow is sometimes encroached on and used by relatives, and this can result in unnecessary and unpleasant family disputes. To avoid such disputes, cassava is often planted on land considered suitable for putting to fallow, as a means of retaining undisputable ownership of the land, but without being a significant drain on fertility. Indeed, cassava is thought to restore soil fertility in a similar manner to fallow. The crop is deliberately left to grow undisturbed with weeds, as minimum to zero weeding is done in the second year after planting. Weeds mature, die and decompose in the garden, replenishing soil fertility. This is possible because cassava can be left with weeds without yield being reduced. It is a crop that is harvested only when it is needed for consumption; otherwise it is stored in the garden as a living plant, while utilising only its leaves as a green vegetable. It can, therefore, be left in the field for periods of time that can extend over two years or more, replenishing soil nutrients.

As fallow is undesirable or even impossible for some farmers for soil fertility maintenance, they opt to use chemical fertilisers to improve crop yields. They explained that, although fertilisers are effective in raising crop yields, particularly of maize in their *munda ukulu,* which have low levels of soil nutrients, the cost is high and therefore restrictive, and especially so considering that almost all food produced is for household consumption. Thus, many farmers are obliged to engage in employment, partly to generate the funds to acquire chemical fertilisers. Some 48% of farmers are engaged in some form of employment, ranging from casual work, known as *ganyu,* to full employment. *Ganyu* refers to the selling of labour by doing paid piece-work. Most farmers said that money raised from employment is primarily for the purchase of chemical fertilisers.

Indeed, all farmers in the study area use at least two bags of fertilisers on some of their *munda ukulu*, because most farmers cannot afford to apply fertiliser to all their cultivated areas due to its high cost (65 USD per 50kg bag) and their corresponding very low incomes (mean of $457 per annum). Most fertiliser is accessed mainly through a government-subsidised input scheme using coupons as described in Chapter 4. Each farmer is entitled to fertiliser coupons that enable him/her to buy one 50kg bag of basal fertiliser and one 50kg bag of top dressing fertiliser. Those who have higher incomes and are employed use the recommended rate of fertilisation, which is at least four bags of basal dressing and two bags of top dressing per hectare. The use of fertiliser by farmers is also supported through social bonds and obligations. This study found that those who are unable to purchase chemical fertilisers, because of inadequate income, often engaged either in ‘unpaid’ labour in exchange for fertiliser, or simply begged from friends and relatives. There are social obligations within the society, as demonstrated in Chapter 5, where the needy are helped by those who are considered to be blessed with ‘abundant’ resources. Fertiliser, just like labour, was sourced ‘free’ of charge from friends and relatives, not necessarily as a future stock of capital to be drawn upon later, but a mere social obligation based on culture. The idea of the ‘genuine’ needy deserving assistance is a norm, value and expectation that is taught right from childhood, and which is followed to the letter. The village heads and their councillors, called *nduna,* ensure this is attained by ‘reprimanding’ those who fail to help but without any form of punishment. Giving to the needy is not enforced through punishment, but through persuasion and encouragement in an orderly manner that ensures little resentment from those with resources to give to others.

However, farmers are convinced beyond doubt that chemical fertilisers ‘burn’ the soil. Farmers apply chemical fertilisers to crops only reluctantly because they are aware of their side-effects. Focus group discussions showed that farmers’ past experiences with chemical fertiliser use have been characterised by mixed fortunes, and this has made them associate chemical fertilisers with the disturbance and destruction of the natural mechanisms of soil nutrient replenishment. Some farmers made it very clear that farms which had once been applied with chemical fertilisers have produced less than half of the yields realised without fertiliser use, when chemical fertilisers have not been applied in subsequent years. Meanwhile, those farms who have not been exposed to chemical fertilisers have maintained yields over subsequent years, with output loss of less than a layer in granaries each year, probably an indication that chemical fertilisers indeed have a negative impact on soil microbes that help in the fertility maintenance.

The observations which farmers have made show that once chemical fertiliser is applied to a field, yields of a given crop can only be maintained with the continued use of fertiliser in subsequent years of cultivation. However, gardens that have had no previous application of fertiliser are known to produce comparably higher yields of crops, especially of maize, than those gardens that have had only one chemical fertiliser application and none thereafter. This then is considered a burden for farmers, and they try as far as possible to maintain at least one garden where chemical fertiliser is not applied to crops. Many farmers recalled that in the past, particularly between the 1960s and 1970s, crops were grown without the application of chemical fertilisers and yields were adequate for meeting family food needs. Farmers compare the results of their crop performances over a long period of time, that, in some cases, can be beyond forty years. This is a demonstration of a high level of memory, which may explain farmers’ lesser use of written records about their farming practices.

Interestingly, it has been scientifically established that some chemical fertilisers, such as sulphate of ammonia, make soils acidic. The change in soil pH can affect and at times can upset the microbial activities in the soil that decompose dry matter (Taiwo and Oso, 2004). In Malawi, sulphate of ammonia fertiliser is now only recommended for application to irrigated rice, where its acidifying properties are beneficial to the crop; it has been withdrawn from being applied to upland maize and other crops grown in the mixed stands. It appears that the farmers' understandings of the side-effects of chemical fertilisers on soil are similar and in agreement with those of scientists. Some farmers argued that they observed this phenomenon long before scientists had linked chemical fertilisers to such side-effects.

Farmers have discovered another problem associated with chemical fertiliser, in particular, urea, which is yet to be verified using Western science and technology. They all agreed that urea makes beans' leaves wilt and drop off the plant, and eventually the plant dies. The common crop mixed stands of beans and maize, therefore, are now managed differently by those farmers who use urea. It is a normal practice to plant beans and maize in the same planting station (hole) along ridges about 90cm apart (the ridges are also about 90 cm apart). However, because of the problem of urea use for beans, to avoid the loss of bean yield, farmers now plant beans in different planting holes (stations) from maize. Urea fertiliser is then placed using a fertiliser cup in a hole made in the ground with a sharp stick 6-10 cm from the maize plant, and up to 30-60 cm away from the beans. At this distance, the side-effects of urea are not 'seen' on the bean plants. The distance is therefore considered safe and adequate, based on the lack of visual side-effects on the bean plants. Obvious visible effects on plants, such as wilting and eventual death of plants, are very important to farmers, as decisions are based primarily on what they are able to see.

As we have seen, farmers cultivate ant hills for long periods of time, close to fifty years in some instances, without applying chemical fertilisers to them; bananas planted on ant hills are cultivated typically without the application of chemical fertilisers (Figure 6.5). The soil fertility is maintained by leaving stems and leaves, from which banana bunches have been harvested, to decompose within and around the clones. Such practices are considered adequate to maintain soil fertility, as banana yields do not decrease for as long as these practices are maintained over their growing period.

Figure 6.5 Bananas on ant hill.

In *munda ukulu* and *khonde*, crop residues and weeds are buried under ridges constructed for planting crops in the subsequent year of cultivation. This practice is replicated each year of cultivation when ridging is done up to the time that the garden is put into fallow. The second weeding then involves rebuilding the ridges on which crops are planted, by taking soil from the troughs and placing it on the existing ridge using a hand held hoe. This buries weeds in the ridge that is being rebuilt. This practice is technically known as banking. Soil fertility, therefore, is maintained by weeds and crop residues which eventually decompose within the ridge, releasing plant nutrients in the soil. This annual incorporation of weeds and crop residues to maintain soil fertility resembles, for farmers, the need to add salt to side dishes to maintain their taste.

Some of the crop residues and weeds are gathered on particular sites, that are deliberately and carefully chosen, and then burnt. These sites are then used as pumpkin planting stations by making a hole in the ash where pumpkin seeds are placed. Ash is utilised as a fertiliser for pumpkins and is an important element in soil fertility improvement as it contains potash, an element which Western science and technology has associated with quality in many crops, such as tobacco, for example. Most farmers (94.6%) planted pumpkins on ash (Table 6.6) and the practice was undertaken across all age groups. The planting sites are chosen based on positions that limit the effects of pumpkins on reducing the growth of other crops that are smaller, such as beans, by reducing access to sunlight. Pumpkins have bigger leaves, especially compared to those of beans and maize, and they tend to grow very quickly from the third week after emergence compared to other crops. Farmers said that the choice of pumpkin planting sites involves consideration of these physical characteristics that include the large pumpkin leaves and their shading effect on other plants.

Table 6.6 Information on smallholder farmers' pumpkin planting sites by age

Age category in years	Planting without ash	Percentage	Planting on ash	Percentage	Total
<21	1	12.5%	7	87.5%	8
22-50	3	4.9%	58	95.1%	61
>51	2	4.8%	40	95.2%	42
Total	6	5.4%	105	94.6%	111

Planting pumpkins on ash is a deliberate strategy because ash improves the taste of pumpkins, a typical quality aspect associated with potassium, as well as improving the vigour of the plants during growth. It is not surprising, therefore, that farmers tend to plant pumpkins on ash. However, taste is not only related to using ash as a fertiliser; most farmers also consider that taste is a function of variety and type of pumpkin. However, within a given type and variety, such as Autumn King, which is locally known as *jungu*, it is believed that taste is improved when these are grown on sites that have ash.

Pumpkins are sometimes called runners, because they spread stems along the ground. Since the combination of big leaves and the growth by spreading along the ground are seen to inhibit the growth of other crops in the field, pumpkins are, therefore, planted around the periphery of the gardens, with just one or two plants per ant hill. More than ten pumpkins per hectare is considered very high for the successful growth of other crops in the field. The side-effect of pumpkins on other plants is not only understood in terms of competition for the light necessary for photosynthesis, but also their physical nature of almost growing over smaller crops. Farmers are careful and limit this effect of pumpkins on other crops by uprooting branches that grow over other plants and then laying them in the furrows.

The practice of using crop residues to maintain soil fertility is very widely used in *khonde* gardens. Crops, such as beans, after being harvested in *dimba* and *munda ukulu,* are processed at home. Their dry matter waste, including stems and bean pods from processing, are laid down along ridge troughs in *khonde* gardens to decompose. The processing of maize to make white flour for *sima* is done by pounding the grain using a mortar and a pestle after the husks and the cob have been removed. Pounding breaks the grain into the three parts, which are the endosperm, bran and the embryo (or germ). The endosperm is ground into white flour, while the bran and embryo become waste products of this process that are also put in ridge troughs around *khonde,* if they are not fed to livestock such as chickens or cattle. Even when they are fed to livestock, the remnants are later swept onto the ridge troughs in the *khonde* gardens.

It is important to note that maize flour can also be made from whole grain, and, in such circumstances, very little waste is left for feeding livestock and maintaining soil fertility. However, most farmers said that they prefer white flour, mainly because of the improved taste of *sima* prepared from it, in comparison to the *sima* made from whole grain flour. There is of course the added advantage that the waste products can be used to improve soil fertility or fed to livestock.

Farmers do not see the application of crop residues to *khonde* as anything special or remarkable. The *khonde* are near to the house where the processing of crops is done, and hence the waste is dumped as close as possible to the site. Hence, such activities have become part of everyday life, and farmers perform them without much attention paid to the reasons underlying their actions. However, during in-depth discussions and further probing, it was said that some crops, particularly maize, when grown with such dry matter decomposing in the soil, grow with vigour and produce bigger cobs, compared to similar crops grown without decomposing dry matter being available. Farmers have a clear understanding of the effects of decomposing dry matter on the growth of crops from long-term observations of crop performance in *khonde* gardens in particular.

Farmers who have livestock, such as goats, allow them to feed in *khonde* and *munda ukulu* in the dry season. The droppings from such animals add nutrients to soils, although they remove some through feeding. It is a common practice to apply manure from goats, chickens and cattle to *khonde* and *munda ukulu* to improve their fertility. Manure can be bought from those farmers who have livestock, or sometimes is given away free when kraals are cleaned out. Manure can pose a threat to animals' health, particularly in the rainy season. Disease vectors, such as houseflies, breed in such places and farmers are keen to reduce the breeding grounds of house flies by allowing fellow farmers to collect manure from kraals to apply in their gardens.

Soil improvement practices in *dimba* are complicated. Farmers largely avoid using chemical fertiliser in these areas, as was made clear in focus group discussions. The few that use chemical fertilisers in *dimba* tend to apply them to high-value crops, such as tomatoes and other vegetables that are sold for cash. Even under such conditions, farmers seem to be more eager to use chicken droppings than chemical fertilisers. *Dimba* soils are darker in colour, as compared to many upland soils that are red *katondo* soils (Figure 6.6). Dark coloured soils are considered more fertile than the red *katondo* soils, and hence the crops in *dimba* grow with more vigour compared to those on upland soils. The farmers note that maize in *dimba* rarely produce cobs without grain, even after cultivating in these sites for a long time, such as over twenty years. Farmers are also aware that top soils from upland gardens are deposited in *dimba,* and this replenishes soil nutrients so that the application of chemical fertilisers to these soils is a luxury farmers with low average incomes are unwilling to undertake. Farmers show that economic factors are considered in deciding to use chemical fertilisers by applying them only to crops that they sell.

Figure 6.6 Dark coloured *dimba* soil

To maintain soil fertility, farmers leave weeds to grow in *dimba* during the rainy season, even when they have perennial crops, such as bananas and sugarcane already growing there. The farmers simply slash grass that is around such crops, let it dry and then burn it away from the perennial crops, thereby adding potash to soils.

Farmers said that weeds left to grow during the rainy season have an additional purpose, that of slowing down rain water so that the sediment from upstream is deposited in the *dimba.* This helps to replenish fertility that is taken up by crops cultivated in *dimba*. Farmers are aware that farming activities in *dimba,* such as land preparation and tilling, loosen the soil and expose it to erosion by rain water. Tilling weakens stream banks, and drains made to lower the water-table can be unstable. Soil erosion widens stream and drain width as walls collapse, and this can have a direct impact of reducing the area for crop cultivation. This is certainly considered unacceptable by farmers, especially because some *dimba* tend to be narrow enough anyway, at between 10-20 metres in width, divided in the centre by a permanent stream (see Figure 3.2). Any increase in the width of the stream results in a reduced area for crops.

Farmers clear their *dimba* in the dry season from April onwards by slashing and burning, as described above. All plant matter that resists burning is buried under the soil to decompose for the release of soil nutrients. The farmers make no effort to create high temperatures from the fire for effective burning in *dimba,* as they do in the finger millet gardens, for example. The plant residues that do not burn completely are simply ploughed into the soil through tilling, as is the ash. This is not surprising, as a high, intensive heat is unlikely to be attained largely because the soils in *dimba* are wet at this time of the year from residual moisture, and the complete drying of dry matter is therefore difficult to achieve. Furthermore, waiting for the complete drying of these residues would result in the delayed planting of crops, such as maize, which takes 90-190 days to mature and to be dry enough to be harvested. This can result in such crops either being destroyed by the rains in the rainy season in December, or being heavily affected by mould infestation. Therefore, farmers are careful to start cultivation in sufficient time to allow maize crops to mature and to be harvested before the onset of the next rainy season. This may also be the explanation behind farmers' reluctance to plant finger millet in *dimba,* despite the ash being available as a fertiliser in each year of cultivation. Finger millet requires a longer growing time than maize to mature, to completely dry out and to be ready for harvesting.

Cultivation practices in *dimba* are different from *munda ukulu* and *khonde.* Crops are planted on the flat in *dimba,* by making a hole using a hoe and without making ridges (Figure 6.6). Planting is similar to the cultivation practice of finger millet production, which is planted by broadcasting the seed on the flat that is then immediately lightly tilled in using a light hoe. Planting without making ridges is also practiced on ant hills. It appears that farmers are aware of the moisture regime in the *dimba* being of particular importance for plant growth. For farmers, soil improvement in *dimba* is more a question of managing the moisture regime than the soil fertility itself. Farmers are aware that planting on ridges would increase the distance between soil moisture and the crop roots, as ridges have a function by their very nature and shape to drain excessive moisture that is unnecessary for plant growth. In *dimba,* this function of the ridge is unnecessary and can be problematic, as moisture available to plants is residual. Farmers place seeds in planting stations as close as possible to the source of the residual moisture so that the plant roots are able to access the soil moisture as the water table continues to lower from the effect of the dry season progression. Planting on the flat makes it easier for plant roots to grow up to the depth at which the residual moisture is available in the soil.

Furthermore, farmers have observed that when ridges are made in *dimba,* the soil is drained to the extent that the soil on top of the ridge becomes so dry that its dryness is readily observable by eye, even while the trough is wet. This makes it necessary to apply water to crops to supplement the residual moisture. Farmers' understandings of drainage are, therefore, related to the distance between the roots of crops and available soil moisture, which reflects their accumulated knowledge of water-table levels in the *dimba*. They are aware that crop roots have a finite depth of growth, and, beyond that depth, they are unable to reach the moisture in the soil necessary for growth. Consequently, plants wilt and require supplementary water supply. Farmers recognise that the water-table is important for crop cultivation in *dimba,* and it is therefore carefully managed in a manner that reflects its importance by cultivating on the flat. When the water level goes beyond the plant root zone, as a result of factors beyond the farmers' control, such as dry spells during some rainy seasons, farmers may apply water to plants.

The application of additional water to crops, however, in order to supplement residual moisture, is viewed as creating an unnecessary labour demand, which is to be avoided where possible. In addition, the dry season is a time when many traditional festivities, such as weddings, family visits and trading in surplus crops are done. These activities are typically planned at this time because there is adequate food from the rain-fed harvest, and also because overall farming activities are at their lowest level, being limited mainly to cultivation in *dimba.* In addition, these traditional festivals are viewed as important occasions and activities for which time and space should be created. Planting on the flat is one such option that makes the job easier by avoiding the need to apply additional water to crops, thereby creating more time for social activities.

Cultivating land that is around the average of three to four hectares per household, with an average family size of five, can be labour demanding. Farmers can become tired and exhausted from cultivation undertaken during the rainy season. In addition, the dry season marks the beginning of the major harvest period. Maize, the major food crop, is dry and ready for harvesting, transportation, processing and storage. This demands the same exhausted labour to harvest and transport the crop to granaries in the villages. *Munda ukulu* are, on average a kilometre away from villages, with a maximum distance of up to 20 kilometres, for example. It is not surprising that farmers try to save on labour by planting crops on the flat in *dimba,* apart from taking advantage of the moisture regime. In addition, many farmers consider part of the dry season as a holiday. They used the phrase '*chihanya ninyengo yakupumulira,'* which means that the dry season is a holiday period, meant for resting and celebrating the hard-earned harvests from the labour-demanding activities of the rainy season.

6.5 Summary and conclusions

Farmers are industrious and develop local knowledges that are applied to various environments with which they are faced in their everyday farming practices. These are re-worked to suit the specific environments, although the general principles can be widely applied across the various environments. Soil fertility management is of paramount importance in crop production and it has been perfected to achieve food security. Some of the techniques used to determine and manage soil fertility are comparable to Western scientific knowledges, such that there are complementarities between the two knowledges.

Soil improvement practices in *dimba* are influenced by other activities in the rainy season and during the dry season, and therefore may be given less attention. However, in upland gardens more attention to detail is paid to soil improvement practices, so as to achieve effective and efficient nutrient replenishment, probably because the major food production is carried out in such gardens. Farmers' landholdings in *dimba* are very small by the very nature of wetland size. It does not adequately provide for all household food needs, and hence *dimba* cultivation is seen only as supplementing household food requirements that are largely produced from *munda ukulu.* Farmers also realise the need to live a fuller life by giving themselves time to relax and be on holiday. It appears that development experts have paid very little attention to this fact, and, at times, consider farmers as lazy and unwilling to adopt technologies that can improve their income earnings.

Local knowledges have various uses and roles in society, such as their use in maintaining acceptable socio-cultural values, expectations and norms. This applicability of local knowledge in socio-cultural, economic and various environments makes it hard to sustain the view by some experts that it is backward and static. It further demonstrates that local knowledge is used by people who are well-informed and make rational decisions about their environment, lives and livelihoods, based on 'experimentation' and careful observations that resemble scientific ways of knowing. In addition, the teaching and inter-generational learning in the production of indigenous knowledge challenges the Western notion of the 'expert'. The next Chapter shows how this knowledge is used for the fulfilment of farmers' priorities and preferences.

Chapter 7

The Role of Indigenous Knowledge in Everyday Practice

7.1 Introduction

In this chapter, the agricultural management practices at farm level are critically analysed in terms of crops grown, farm size, number of gardens cultivated, the cultivation of wetlands (*dimba*) and the age of the household head. The role of indigenous knowledge in managing various ecological features is established and the role played by indigenous knowledge in solving problems faced by farmers is examined. In addition, there is an attempt made to understand the use of indigenous knowledge by farmers to generate new knowledge, either by deliberate 'experimentation' or through simple curiosity. The role and effects of cultural and socio-economic factors on farmers' management practices and decision-making are discussed and critically examined.

7.2 Agricultural management practices at the farm level

Table 7.1 shows the diversity of the households in the study area in terms of household size, landholdings, age and number of gardens and *dimba* cultivated. Of paramount importance for this section are the numbers of gardens per household, the number of *dimba* cultivated and the mean farm size. These factors impact on how farmers allocate resources such as labour at any given time in their fields, and agricultural management practices at the farm level generally may vary because of the influences of these factors.

Table 7.1 Information on household characteristics of the study area					
Characteristic	Minimum	Maximum	Mean	Mode	Std Deviation
Household size	1	12	4.7	5	2.520
Gardens per household	1	6	2.9	3	1.037
Dimba	0	3	1.0	1	0.436
Cultivated area in hectares	1	20	3.9	5	2.030
Age of head of household	13	83	45.5	26	16.9
N=111					

The mean household size of the study area is 4.7 with the most frequently observed family size (mode) of 5, cultivating upland gardens that can be as big as 20 hectares excluding the *dimba* and as many as 6. The population of the study area is dominated by an age group of 26 years, although the mean age is 45.5 years. The modal age of 26 and the mean age of 45.5 years are an indication that the population is dominated by young people who are a labour source necessary for agricultural production.

Figure 7.1 Calendar of farming operations in the study area in a year

Activity	January	February	March	April	May	June	July	August	September	October	November	December
Activities in upland gardens (*khonde* and *munda ukulu*)												
Land clearing	x						x	x	x	x	x	x
Ridging	x								x	x	x	x
Planting	x										x	x
Weeding	x	x	x									
Harvesting (fruits and crops)	x	x	x	xx	xx	xx	xx	xx	xx	x	x	x
Activities in dimba												
Land clearing				x	x	x	x	x				
Land tilling					x	x	x	x				
Planting						x	x	x	x	x		
Weeding						x	x	x	x			
Harvesting						x	x	x	x	x	x	x

The calendar for farming operations in the study area shows that operations in the upland gardens are continuous throughout the year, particularly with regard to harvesting that is carried out in every month (Figure 7.1). Harvesting is done throughout the year because of the amount of fruit and banana clones which farmers grow and which mature almost every month and thus need to be harvested. The 'xx' on the calendar shows the overlap of major harvesting periods, which occur when cassava and maize are harvested at the same period of time during the months of April to September. During these months between April and September maize in *munda ukulu* and *khonde* is mature while cassava is also considered as mature for a major harvest either for sale or processing into flour. Cassava is harvested throughout the year as a snack, while its leaves are eaten as a green vegetable boiled and taken with *sima*. However, the main harvesting period for cassava begins in the month of April, which coincides with the harvesting of green maize. The continuous harvesting of cassava as a snack is not only useful as food in its own right, but is also a way of tasting and testing when cassava is suitable for major harvesting for selling to customers or for the preparation of flour suitable for making *sima*. From the months of April to September, cassava has a low water content, as compared to the rest of the year, and hence is more suitable for trading and processing into flour. Farmers monitor the properties of the cassava throughout the year by continuously tasting the crop. For farmers, knowledge has to be verified in agricultural management practices, such as the crop management, in order for them to make informed decisions. From experience, farmers are aware that variations in rainfall events can shift the suitable harvesting time from the beginning of the month of April in a 'drier' year to late April in a 'very wet' year. Farmers know about seasonal rainfall differences and their impacts on crop physiology, so that their management practices are influenced accordingly by the resultant conditions of their crops. The calendar double 'xx' thus shows increased levels of harvesting activities of these two crops (maize and cassava) alongside fruit harvesting.

Unlike along the shore of Lake Malawi, where cassava is a staple food and thus harvested throughout the year for flour production, in the Mzuzu area, both cassava and maize are used in the preparation of *sima*, giving farmers a chance to diversify their diet according to their preferences for *sima* made from either maize or cassava. Although farmers in rural areas, especially in developing countries, have been criticised for being ignorant and backward, with their local knowledge labelled as static by some experts (see Chambers, 1983; 1993), here is an example of the importance of local knowledge in expressing and representing farmers' choices that make their lives fuller. It becomes unhelpful to portray smallholder farmers in rural areas as 'struggling' to make a living (see Beckford, 1985) when they innovatively and ingeniously utilise available resources as demonstrated by the use of cassava and maize to diversify their food sources. It is important to note that most of the cassava grown along the shores of Lake Malawi for *sima* preparation is a bitter variety which cannot be eaten as a snack because it contains high levels of cyanide (personal communication with Bunda College of Agriculture nutritionists). The variety is deliberately chosen because of its high poison content (bitterness) and is reserved for processing into flour for *sima* production. Its bitterness is a deterrent to those who would want to eat it as a snack, thereby reducing food security at the household level. The bitterness is diluted and dissolved by soaking cassava in water for 1-2 weeks, after which it is dried in the sunshine and pounded into flour having lost its bitterness and toxicity.

In the study area, because the major staple food is maize, the cassava that is grown is sweet and is eaten as a snack, as well as being used for flour processing. There is deliberate selection of cassava varieties based on taste. It is interesting to note the importance of indigenous knowledge essentially to differentiate a single crop (cassava), that has many cultivars, based on just one common factor which is taste (bitter or sweet) in different places that are far apart (30km or more). The knowledge about the taste of cassava can be transferred to areas beyond its production site. It is knowledge that can be utilised in the management of cassava to ensure food security at the household level throughout the whole of Malawi and possibly throughout the whole of Africa where cassava is produced.

Upland gardens are prepared from the months of July through to January (although occasionally some farmers might extend this period for reasons such as sickness, for example). This is a deliberate practice by farmers so as to spread the work effort over an extended period. There are two reasons for this. One is making the farmers' work easier to manage, and ensuring that other non-agricultural activities can be fitted in; and the other is that they then can plant maize over this extended time period so that they have a longer period in a year in which they have access to green maize. The farming calendar reveals the strategic nature of indigenous knowledge use by the farmers. Farmers are able to extend the availability of green maize that they like to eat because of its sweetness and also occasionally sell for cash.

Ridging begins in the month of September and lasts up to the month of January. Between the months of September and October, ridges are not completely made, but only half made, which in Tumbuka is called *kuchelenga.* One side of the ridge is made, or just a small ridge of crop residues and weeds are made. This is done by placing weeds and crop residues using a hoe into an old furrow that will eventually be buried in the process of making a ridge. Ridges are made by digging soil from old ridges thereby burying weeds and crop residues placed in the furrow, a process technically known as banking as noted in Chapter Six. Banking is done by some farmers at a time when planting time is deemed imminent, necessary and convenient, based on past experience. The time at which ridging is done by farmers is influenced by their past experiences as noted in Chapter Six. It is important to note that at the time *kuchelenga* is done some farmers may not have decided when to plant, but know what is going to be planted. What to plant is a decision made several months before land preparation, and each garden has a major crop that dominates the mixed stand. It is still the dry season in the months of September and October and so other factors may determine when to plant, including the actual onset of the rainy season, yet some farmers have already started preparing their gardens. Some farmers plan and execute farming operations in advance of planting time, especially *kuchelenga* and the making of half ridges, both of which are viewed to be advantageous because subsequent ridging then uses less effort and is therefore completed quickly. As noted above, weeds and crop residues are buried under the soil when ridges are being made so that placing weeds and crop residues in the furrow in advance of ridging removes a stage that can delay the process. In addition, placing weeds and crop residues in furrows clears the farms of standing plants, making operations like tilling and ridging easier to accomplish. It also reduces the weed infestation in the gardens, as the completion of the ridge close to the day of planting kills the weeds that emerge with the light rains that occur throughout the year in the study area (Figure 3.6).

Planting of maize, beans and other crops in the mixed stands begins in earnest in November after the ‘planting’ rains which generally occur towards the end of the month. Cassava is planted as a minor crop in fields dominated by other crops, particularly maize. When cassava is a minor crop, it is mainly consumed as the farmers visit their fields. To eat cassava, it has to be uprooted. Farmers have developed knowledge to plant the uprooted cassava stems immediately after uprooting them in spaces between the dominant crops in the mixed stand. Since the study area receives rain throughout the year, the planting of cassava is a continuous process, all year round. The stems are broken into 30 cm planting materials and inserted in the ridges of the main crop. The light rains throughout the year ensure its survival in the drier months. When ridging is conducted for new crops, the space occupied by cassava is left as a small mound, which in the second year forms part of the new ridge (Figure 7.2).

Figure 7.2 Cassava in small mounds in old furrows after maize harvest

Farmers noted that although weeding is indicated in the calendar as a major operation from the month of January onwards, such representation of weeding as an activity only depicts those operations conducted on the annual crops that are planted in the rainy season, while excluding the fact that weeding is done throughout the year. For many farmers, weeding is also done during frequent visits made to inspect crops. Such visits which are made on a regular basis are a form of inspection which enables farmers to see the conditions of their crops. Farmers also regularly visit virgin and/or fallow lands they own. Farmers pull out weeds that are close to them instinctively during such visits, including ferns in fallow and virgin lands because ferns are known to be difficult to weed when cultivation is subsequently undertaken. Weeds are destroyed and buried in the soil, before they can disperse their seeds, to provide nutrients to crops as they decompose.

The activities in *dimba* begin in earnest in the dry season from the end of the month of April. However, because perennial crops already exist here, the calendar ignores light weeding in the form of cutting grass around such crops. This cutting of grass using a *panga* is done as and when farmers consider that the weeds are a threat to crop survival.

The process consists of a continuous evaluation of the perceived competition between plants and weeds. Just like in upland gardens, farmers uproot weeds as they inspect their crops. Land tilling is a major activity after land preparation that involves cutting grass and burning it. Water channels are made to drain excess water and then the land is tilled by first using a big hoe for deep cultivation, and then a light hoe to break the soil into finer particles suitable as a bed for crop planting (Figure 7.3).

Figure 7.3 Tilled land and dug water channels in *dimba* to drain water

For farmers, deep tilling is seen to lower the water table, while the breaking of these large soil chunks at a later stage is seen to reduce moisture loss by forming a physical barrier to moisture loss that was encouraged during the first tilling. Farmers know that a layer of fine soil is an effective barrier to moisture loss from evaporation in the hot months that follow. These forms of tilling are strategically timed, both to drain the soil of excess moisture, and then to protect it against further loss from subsequent crop production and evapo-transpiration. Fine soil on a tilled surface is also used in conventional Western farming techniques to reduce moisture loss, a process called harrowing accomplished using an implement called a harrow. Local knowledge in Mzuzu about moisture conservation resembles the practices of modern farming. This detailed water management regime demonstrates how deep the farmers' knowledge is about wetlands (*dimba*) and how their moisture contents can be managed. Furthermore, some farmers plant the banks of the water channels with sugarcane to strengthen and stabilise them so that they can last beyond a single rainy season (Figure 7.4). It is easier to do maintenance work in subsequent years once the water channels are constructed, rather than to dig new ones each dry season.

Figure 7.4 Sugarcane planted on banks of a water channel

Major planting in *dimba* begins in June, mainly with green vegetables, such as rape, which is followed by beans. Beans are planted so that the flowering avoids the lowest temperatures experienced in the months of June and July (Figure 3.8). Farmers have observed that very cold nights can kill bean flowers, so effort is made to avoid the loss of yield. Maize is then planted as the beans mature as a 'relay crop', so that it can be harvested when it is dry enough in December, just before the rains that can result in its destruction either by flooding or by mould infestation. This type of succession planting is seen to have advantages in reducing competition between plants, but also from fixing nitrogen by bean plants in the soil for the maize crop, despite the fact that in the uplands beans and maize are planted in the same planting stations. Farmers' observations over the years have made them manage these two crops differently in *dimba* and uplands. This is an interesting point that shows the high level of evaluation of practices under indigenous knowledge by farmers. They are able to compare upland crop management practices with those in *dimba* and make changes that suit these different environments. Indeed, in some cases such as these, indigenous knowledge is not static, but is dynamic. The knowledge about crop performance in these different environments is utilised by farmers so that effort put in their agricultural activities is rewarding. The knowledge about upland and *dimba* management practices is derived from past experiences that involve 'experimentation' and careful observations of the performance of crops. The farming practices are different in uplands farms to those in *dimba* based on the results of farmers' 'experimentation' and the corresponding observations.

Indeed, many farmers use the *dimba* to 'multiply' planting materials such as sweet potatoes and new varieties of crops, such as cassava that are introduced by friends and relatives. Farmers have in-depth knowledge of *dimba* environments. The moisture that is available throughout the year in the *dimba* ensures the survival of such plants. Consequently, the *dimba* become seedbeds for new varieties before being tried in the main gardens. As seeds are multiplied, the characteristics of these new crops are observed creating knowledge to enable farmers to manage them, confirming the fact that agricultural management practices of crops in the study area are evidence based on 'experimentation' and continual observation.

The harvesting of crops in the *dimba* begins as soon as the green vegetables are ready in the month of June and is completed with the harvesting of maize in the month of December. The months of January, February and March are a low activity time for *dimba* because they can be inundated as a result of the rains. Farmers make efforts through agricultural management practices to avoid crop destruction from water inundation. Cultivation of *dimba* is done so that crops mature and are harvested at times that reduce the destructive environmental factors, such as inundation, pests (including moulds) and low temperatures, affecting them.

7.3 Ensuring food security

The main priority of farmers is to ensure food security, not only at the household level but at the community level as well, something which is determined by the expectations and obligations of the extended family system (Table 7.2). There are variations between families, to the extent to which farmers produce beyond family consumption needs. There are some (12) who have always produced for the market in addition to meeting family requirements. 'Market-oriented' production is used to raise cash for the purchase of items that are not produced on the farm. In addition, a major driving force for surplus production for sale is the need to pay for their children's school fees, something mentioned by almost all farmers.

The desire to have adequate food for the family drives farmers to grow many food crops (see Table 6.1, 6.3). Table 7.2 shows that 107 farmers consider food security as 'very important' and only 2 farmers rated food security as only 'important'. No farmer ranked food security any lower than this. The importance of food security is also confirmed by 87 farmers who rank increased yield as 'very important' and 22 rank it as 'important'. There is no ambiguity about either the importance of food or secure yields on the part of all farmers. This point about food security has been demonstrated in the calendar of farming practices of the study area by the number of months farmers engage in crop production. Farmers are engaged in agricultural management activities that ensure food security throughout the year. They plant, weed, inspect and harvest food crops throughout the year. Crop management practices have been developed so that food is available all year round by either storing crops to last up to the next harvest as demonstrated in Chapter Six, or, in some cases, by growing crops that mature all year round, such as bananas and cassava.

Table 7.2 Information on smallholder farmers' objectives for producing and protecting crops from pests and diseases.								
Objectives	Very important	Important	Neutral	Not important	Very unimportant	Respondents	Total scores	Percentage %
Food security	107	2	0	0	0	109	543	99.6
Increase yield	87	22	0	0	0	109	523	96.0
Higher profit	12	60	32	2	1	107	400	73.4
Blemish-free	1	6	3	74	23	107	209	38.3
Scores	Very important = 5	Important = 4	Neutral = 3	Not important = 2	Very unimportant = 1			

All farmers interviewed said that they produce more food than is needed for household requirements. An example of one household serves as an illustration. The farmer produces over 200 banana clones, over 200 fruit trees and over a hectare of cassava and maize, all of which is more than enough for his household requirements. Consequently, the farmer sells the excess for cash which adds to his other income from repairing radios, televisions and building houses in the study area.

The small number of 12 respondents that are of the opinion that higher profits are 'very important' says something about the nature and culture behind subsistence farming in the area. All farmers prioritise the production of enough food for household consumption first, then any surplus production is sold for cash. However, food for household consumption is not just for the producing household. Farmers share production with friends and relatives. Food security is delivered only when all members of the community, and especially close family members, have adequate food, a point well utilised by ADRA as noted in Chapter Five. A farmer is expected to produce enough for his/her own household, but also a surplus for other members of the extended family, and friends that may fail to produce enough themselves on their own farms. The case study of one farmer, who has a garden next to a feeder road used by children going to school, is used here to demonstrate the social aspects of food production within the communities in the study area. As friends, school children and other people pass by when the farmer works on his garden, the farmer talks to them and typically uproots cassava for them to eat. This is a key social aspect of food production that is not fully appreciated when objectives such as profit-making are promoted by external agencies including development experts. However, this goes some way to explain the farmers' ranking of higher profit below food security; friendship and social capital mean sharing freely what is produced at the farm level.

Very few farmers (3) grow specific cash crops such as tobacco, which emphasises this point of ranking food security in its broadest sense higher than profit. For farmers in the study area, food has a social value beyond feeding the immediate family and friends. It ensures social bonding, and the value of food can be more than 'just food'. The role and use of local knowledges must be appraised with the realisation that communities have different values and norms so that poverty needs to be defined as reflected by the culture of the people concerned (see Escobar, 1995). Here, it has been demonstrated that the prioritisation of food security by farmers in Mzuzu is underpinned by cultural factors. Food security is a community responsibility which is defined by cultural expectations. Production levels are determined by household needs, extended families that may experience food shortages and festivals such as weddings, which are deliberately celebrated during the dry season when there is plenty of food from rain-fed crops and the weather is suitable for outdoor activities. Food production in the Mzuzu area is in line with observations made by Escobar (1995) that societies have developed ways of defining and treating poverty that accommodates visions of community, frugality and sufficiency. Indeed, farmers in Mzuzu produce food to accommodate the visions of the community including self-sufficiency at the household level.

The volatile prices of cash crops, such as tobacco, ensure the supremacy of food crops above cash crops in farmers' cropping strategies. For example, the prices of burley tobacco moved from an average of above one US dollar per kilogram to below 70 cents for a lengthy period in middle the 1990s to 2006 (see Mail and Guardian Online, 15/05/2008; Malawi Nation newspaper, 15/05/2008). Farmers are well aware of these price fluctuations and this discourages them from engaging in purely cash crop production. However, farmers in the study area did not raise the issue of prices of cash crops as an important factor in determining their priorities, even after probing them in relation to tobacco prices on the auction floors. The socially embedded value of food crops seems to eclipse the attraction of additional income from the production and sale of cash crops for many farmers in the study area. It also might be that the proximity of Mzuzu as an urban centre (market) creates alternative income sources from selling food crops, making them perform both as food as well as cash crops, an important factor for farmers because then they are able to achieve two of their objectives, food security and higher profit from the same crops. Indeed, all the farmers in this survey grow sugarcane as a food crop, as well as to provide cash when there is need, with only one farmer growing it for purely commercial purposes. His *dimba* is the only garden that has sugarcane as a dominant crop, occupying over 90% of the land area. Many farmers have sugarcane occupying only the banks of water channels with maize, beans and other crops, such as green vegetables, occupying the rest of the area in *dimba*.

While cash crops such as tobacco may have to be discarded if they become mouldy, for example, food crops such as beans that may be damaged by pests or diseases, can still be used, cooked as side dishes and eaten with *sima. Chilanda,* which is made from damaged beans, is prepared as a dish resembling mashed potatoes. Farmers, therefore, lose very little from blemished food crops because of their ability to use them, thus contributing to food security. Of course, if these were being produced as cash crops for the commercial standard market, they would be unsellable. However, such crops are sometimes sold amongst farmers for their own consumption; for example, one farmer said that he preferred to buy blemished beans because they are cheaper than blemish-free beans.

However, there is a small number of farmers who are committed to commercial-scale production, in addition to production for domestic consumption. There are 12 such farmers who rank higher profit as 'very important'. One exceptional case is the farmer producing broiler chickens for sale on a commercial scale. He produces 400 chickens which are sold every 6-8 weeks as broilers. He has developed traditional substitutes for commercial vitamin and mineral supplements, and treats chickens with his own locally-made medicines. He has also developed his own mixtures of vitamins A, B and C, and uses herbal medicines to prevent the common chicken disease in the area, Newcastle, from infecting his flock. There are efforts made by some farmers to move away from production only for home consumption to diversification for the market. Mzuzu provides them with an opportunity to do this, as it has a ready market for their produce.

Their local knowledge is utilised for the production oriented to the market. Some farmers (10) produce maize at a commercial scale for sale, and they specifically grow hybrid maize for sale, because of its high 'bulky' yield, but grow local maize for home consumption. Local knowledge is dynamic and fits several situations in fulfilling farmers' diverse objectives. In the first instance, it ignored market forces in favour of local values and norms in the production of food crops; and in this latter case it has been fully used to benefit from the market opportunities offered by Mzuzu as a market outlet for the production of broilers and hybrid commercial maize. Furthermore, the significance of diversity within the community is shown by the contribution to the wide variety of indigenous knowledge related to both crops and livestock.

Despite the fact that very few farmers prioritise production for the market, farmers consider that their farming is sufficiently secure and productive that only a few food items that they cannot produce themselves, such as bread, butter and sugar, are sourced off the farm. One farmer responded *'usambazi nkulya',* which means to be wealthy, one has to have food. It becomes safe to conclude that, although there are economic reasons for engaging in farming, farmers' understandings of production are based on being able to produce enough for domestic household consumption. It is food that is considered to be the wealth of the community and of the household. This is not surprising as, by their very nature, they are subsistence farmers, and most are only engaged in commercial production as an extension, or subsidiary activity, to subsistence farming.

It may not always be true, therefore, to assume that the lack of markets limits the extent to which small-scale farmers engage in commercial-scale production because this study shows that farmers produce mainly for home consumption as their overwhelming priority. For example, the growth of Mzuzu has increased the potential for commercial production, particularly for broilers and eggs. Yet, it is clear from this study that the presence of Mzuzu as a market outlet for farmers' produce has not significantly influenced many farmers to produce for it. It appears that sometimes, even where there are markets for products, not many farmers respond to the demand. Under subsistence farming systems, markets are typically regarded as places to dispose of food surpluses and to make sales that solve pressing cash needs, such as the payment of school fees, for example, and not necessarily to make profit as a major driving goal. The behaviour of local farmers in response to market forces is a challenge for development experts that they need to understand as they engage local people in development programmes that are based on modernisation and market-led economic progress.

The key characteristic not to produce purposefully for profit, of subsistence farming, is further observed from the fact that, despite the long list of crops grown (see Table 6.3), the most common crop sold during the dry season is sugarcane. Many pointed out that they sold sugarcane to purchase household items (for example, clothes) and other foodstuffs that they do not produce. Others noted that selling sugarcane was a measure to dispose of surpluses that would otherwise go to waste, for example, if left unused by end of the month of November. By this time, sugarcane is no longer suitable for consumption, as the canes become virtually tasteless because of the increased water uptake from *chizimyalupsya* rains that fall in October and/or November. Furthermore, if there was to be an increase in the production of sugarcane for commercial purposes, this would reduce the area put to other food crops, such as the staple maize, in *dimba,* something which is considered by most farmers as undesirable in the drive for food security.

The importance of food security is also demonstrated by the fact that farmers have established from their long experience in farming that *kusosa* and ridging are the only operations that can be spread over a long period of time, as critical timing is unnecessary and does not threaten crop output, as long as it is done in advance of the planting time. Planting and weeding by necessity cannot be spread over long periods of time, as the output of crops is negatively affected if and when such operations are delayed. Farmers are aware that weeds compete with crops for plant food in the soil and sunlight. They have noted that crops which are not weeded turn yellow and develop thin stems particularly if they are shaded. For farmers, weeds and shade increases the chance of reduced crop yields. Farmers make sure that an activity such as weeding is completed before damage to crop yields arises.

The importance of food security to farmers is further demonstrated by their planting at varying times, despite the fact that it has been demonstrated by agricultural extension staff, through field demonstration plots in the study area, that crops planted with the first 'planting' rains produce higher yields than those planted later. Thus, it would be realistic to expect higher yields from early planted crops, which then translates into increased food security at the household level. Utilising the full rainy season improves the chances of increased yields. This is a factor particularly emphasised in recent years by agricultural extension staff, as a precautionary measure following three droughts in the last fifteen years in Malawi. The droughts have resulted in food deficits at both national and household levels, although the study area has not experienced food shortages. Extension workers apply blanket recommendations across different ecological regions. Despite this, farmers in the study area plant at times that differ from those advised by agricultural extension staff, which suggests that, although knowledge can be acquired through extension services by word of mouth or demonstrations, its use varies from farmer to farmer depending on circumstances faced by individuals.

It is important to note that the first 'planting' rains fall at different times in different years, and, as such, there is no definite date attached. It is clear that, despite the likelihood of yield loss that occurs as a result of planting maize after the first rains, farmers' considerations of food security go beyond yield potential, and become a matter of what actually is harvested and stored. Farmers' understandings of food security are based on what eventually gets into their storage system, and it is this that determines the nature of their farming practices. The potential yield, as demonstrated under ideal conditions of demonstration plots managed by extension workers, is of little interest to farmers, especially if, by trying to achieve the potential yields, it means increasing the danger of facing an even lower output than is normally achieved using proven methods of production, such as planting after the first rains, especially around Christmas time. Farmers' management practices, including the application of fertiliser, crop varieties grown and weeding, are different from those carried out on demonstration plots. Demonstration plots are planted with hybrid varieties, kept weed free and receive recommended rates of fertilisers (4-8bags per hectare) which most farmers cannot afford, thereby putting their chances of realising the potential yield of hybrids out of reach. Hybrid crops, especially maize, are known to farmers to be susceptible to pests particularly those which attack the crop in storage, such as weevils. The destruction of crops in storage increases the chance of reducing food security at the household level. The knowledge which farmers have about demonstration plots in relation to potential yields is based on past experiences. It is safe to conclude that farmers' knowledge is grounded and based on past performances and results. When the past performance has resulted in high yields, it then becomes useful knowledge, which is retained for as long as it remains useful and productive. At such a point, Western technologies fail to displace it.

There is another reason advanced by farmers for planting maize at different times at the beginning of the rainy season. Many farmers explained that maize planted earlier than the Christmas period tends to be heavily infested with maize stalk-borer, and therefore the yields gained by early planting are reduced by stalk borer infestation. Indeed, transect walks by the researcher established that up to 40% of the crop planted earlier than the Christmas period showed signs of severe (50% of a leaf area or 60% of a stem affected) stalk-borer infestation (Figure 7.5). Farmers' knowledge is based on what they see and this is evaluated for its impact on yield. Stalk-borer infestation in maize is understood to reduce yields by as much as 30%, because a highly infested plant can fail to bear a cob. This is a significant point which farmers cannot ignore in the process of ensuring food security.

Figure 7.5 Evidence of maize stalk borer infestations in an early planted upland garden.

Farmers understand that, in order to be food secure, their farming practices need to protect crops from those diseases and pests that attack them either in the field or in storage. Farmers have a number of options, one of which is to apply chemical pesticides to protect crops. For many, it is easier and certainly cheaper to avoid pests in the fields by varying planting times, as demonstrated by their varying times of planting maize to escape its major pest (maize stalk-borer). Therefore, most farmers (59%) prefer to plant their main gardens around Christmas time, as past experience has shown that planting then generates minimum risk of stalk-borer infestation in their main staple crop. In high value crops, like tomatoes, pests and diseases are treated with the application of pesticides, as observed in Chapter Six.

Farmers in the study area cultivate a fairly large area (3.9 hectares) given that the labour force is raised from the family whose average size is 5. To manage such an area effectively (3.9 hectares) demands the spread of some activities over a longer period of time. Planting is therefore spread from the month of November to the month of January in response to low labour availability at the household level, although, as noted earlier, this has the advantage of increasing the length of time farmers have green maize available for consumption. The additional advantage is that this creates an opportunity for farmers to see the extent to which crops are attacked by pests and diseases with respect to different planting times. This is in line with observations made by many scholars engaged in studying indigenous knowledge that its production is dynamic and based on continuous 'experimentation' and observation (for example, Chambers, 1983). Indeed, the observations made become useful knowledge as to when it is best to plant crops in order to escape diseases and pests that attack them on a yearly basis. The knowledge generated, therefore, is used in a realistic and practical way to achieve food security in their farming practices. The relatively large area under cultivation (3.9 hectares) in the study area has an additional aspect to it; it is viewed by farmers as essential because it increases the chance of having enough food for household consumption. An old adage that 'size matters' comes into play in the case of cultivated areas. For farmers, although some crops may be damaged by infection and pest infestation that arise from the different planting times, enough is seen to be available as a result of their fairly large cultivated areas. If their farms were small, the risk of crop damage by pests and diseases would be seen to be too high to take and planting would be limited to proven safe periods, such as only after Christmas. Indeed, farmers with garden sizes around one hectare plant during this safe period, although it might be a factor related to the amount of labour available, as pointed out above. The landholding size and labour availability have implications for farming practices that have both negative and positive aspects, as demonstrated here. Landholding size is a major factor in influencing farming practices, especially as there is no mechanisation to accelerate the completion of activities.

There is another important geographical factor that influences the time of planting crops such as maize in upland gardens. Farmers' most fertile sites are ant hills. By their nature of a high clay content and steep slopes, the soil is not sufficiently moist after the first 'planting' rains. Rainwater runs off, limiting percolation. The ant hills' characteristics of delayed water uptake and resultant late soaking lead many farmers to plant only when they have acquired adequate moisture for seed emergence and this is normally only achieved after several days (7-10days) of rain above 25mm. Indeed, farmers said that *chiduli chiwombe dankha ndipo tikugoma*. This translates as the ant hill has to be adequately moist before planting. They know that planting before such rains results in the seed failing to emerge because of dry soil on its base, or the top surface being too hard and sealed off so that the shoot fails to break through the surface layer, especially if there is a break in the rain at the time of shoot emergence. Farmers noted that digging the planting stations have shown twisted shoots in the ground. This is a proven and tested outcome of ant hill management practice that cannot be ignored, so that farmers make strenuous efforts to ensure that planting crops is done according to this well-established knowledge repertoire. The drive to ensure food security by farmers in the study area has major impacts and implications for their agricultural management practices.

7.4 The role of indigenous knowledge in managing agro-ecological features

There is evidence that local knowledge is produced by farmers in some instances specifically to utilise particular agro-ecological features found in the study area. These include ant hills, flat lands and wetlands *(dimba)*, and farmers have developed detailed knowledge about those agricultural management practices necessary for the successful utilisation of these areas.

Farmers' knowledge of the physical characteristics of ant hills has led them to consider these sites as important for the cultivation of some of their crops. Farmers know that ant hills retain moisture beyond the end of rainy season, and so this characteristic has enabled farmers to extend their cultivation of crops throughout the period that moisture is still available to crops. Ant hills provide moisture for crops such as bananas and pumpkins during the dry season, when they otherwise would have wilted and died from lack of moisture if they had been planted elsewhere. Ant hills, therefore, have become a major banana planting site in the study area because of their moisture holding capacity.

Some farmers have adapted knowledge gained from managing ant hills for agricultural production on flat lands of *khonde* and *munda ukulu*. Their understanding of the moisture retention capacity of ant hills has been applied to moderate the soil moisture holding capacities of flat lands in their upland gardens. Pits are dug (up to 1m deep and up to 1m wide) and are filled with manure, plant matter such as weeds, and top soil. Farmers have observed over a long period that such management practices retain moisture for successful banana cultivation. They are aware that manure and humus gathered in these pits increases soil moisture retention properties, as well as raising soil fertility, thus imitating the physical characteristics of the ant hills. This has enabled some farmers to increase the areas under banana production beyond ant hills in the upland gardens.

It is interesting to note that many farmers have a detailed knowledge of the weather of the study area from as far back as the 1940s, which is the time at which they first settled in this area. One farmer noted that there have been some significant changes, recalling that each year in the months of June and July, up to late 1980s, masuku tree (*Uapaca kirkian*) leaves wilted, and died, from the effect of very cold weather, similar to frost. He recalled that in early morning hours, mainly between 4.00 and 6.00 am, when most farmers start their farming operations in the study area, he saw mist almost on a daily basis in the *dimba.* This mist is locally known as *chiuvi.* However, he noted that this is now a very rare phenomenon. Farmers now associate the lack of these rare, cold and misty conditions with the increase of mosquitoes in the study area. Farmers reported that the appearance of mosquitoes in the study area is associated with the probability that the area has become warmer, especially since the 1990s. Indeed, the meteorological records of the study area show that the maximum temperature of the coldest months of June and July since 1982 have been consistently above 20ºC, as compared to the previous 10-year period (1971-1981), which had a maximum that was below 20ºC (Table 7.3).

Table 7.3 Maximum temperatures in °C in the study area					
Year	June	July	Year	June	July
1971	19.8	20.1	1982	20.7	20.2
1972	19.7	19.6	1983	21.6	21.0
1973	19.3	19.5	1984	20.1	22.8
1974	20.4	19.1	1985	20.4	20.5
1975	19.4	20.4	1986	19.9	20.5
1976	19.7	19.6	1987	20.8	21.7
1977	20.7	19.9	1988	21.6	21.1
1978	19.3	18.8	1989	20.4	20.6
1979	19.2	19.5	1990	22.4	21.7
1980	19.7	18.7	1991	21.4	20.8
1981	19.8	19.9	1992	21.5	20.6

Farmers' recognition of the late 1990s as the beginning of the warmer period may represent the direct link they see between mosquito infestation and warm weather. Mosquitoes must have been establishing themselves in the area as it became warmer (1980s-1990s), so that their increased numbers in the 1990s act as a reminder of the change of weather in the study area. There is now scientific evidence that links the warm weather to the dry weather resulting from the warming of the Indian Ocean that has sent dry air over the African continent, particularly the eastern region that includes Malawi, reducing rainfall for the past 25-30 years (afro news, 2008).

Mosquitoes breed in warm wet weather conditions in water pools. Farmers have gained knowledge over time of ways to manage these water pools to limit the multiplication of mosquitoes around their homes. The pits, made by the removal of clay to mould bricks for building houses are planted with bananas (Figure 7.6), a practice which is common in all villages in the study area.

Figure 7.6 Bananas planted in a pit made from moulding bricks for house construction and decorated house with *dimba* soil (see section 7.7).

Before the banana clones multiply to fill the pit completely, the pits are first used as organic waste dumping sites. The waste dumped in these pits absorbs standing water, thus denying the mosquitoes breeding sites. The waste arises from the sweepings from around the houses. Indeed, almost every household has such a pit as a result of soil excavation.

The farmers' utilisation and management of physical features, such as ant hills, pits and wetlands, show the extent to which they have acquired ecological knowledge over the years about their area. This knowledge is diverse, ranging from farming to controlling diseases and pests that affect them. In the *dimba,* the water regime is controlled and managed for crops by digging water channels, which regulate the soil moisture available to crops, while the upland gardens purely rely on the moisture from rainfall. They have an in-depth knowledge of the soil moisture levels suitable for particular crops, aware that different crops vary in their moisture requirements. For example, farmers are aware that sugarcane flourishes under the inundation conditions typified during the rainy season, while crops such as maize are unable to survive and thus wilt. Consequently, maize is grown as a dry season crop in the *dimba*. In addition, farmers manage *dimba* differently from upland gardens, based on knowledge which they have accumulated over the years that they have cultivated these different sites. *Dimba* are tilled and crops are planted on the flat, which is different from the ridging undertaken in upland gardens. Farmers apply different management practices to these diverse environments. They have specialised knowledges for use in each type of garden. Furthermore, in *dimba,* soil erosion is controlled by allowing weeds to grow as a vegetation cover to control run-off in the rainy season, while in upland gardens, soil erosion is controlled by ridging across the slope.

Even during the dry seasons, water levels have to be managed to suit the varying needs of different crops. Water levels in *dimba* can pose a problem when they are too high, as they make crops such as maize become yellow as a result of water-logging; if too low, such crops wilt. Both scenarios reduce crop yields. Farmers have developed their own methods for dealing with the high water table in *dimba.* The water level management begins from the day that the land clearing is done right up to harvesting the crops. During land clearing, which involves cutting the grass and burning it, farmers observe their footprints carefully. They check to see whether water gathers in their footprint, and, if it does, they note the time it takes. Water gathering in footmarks within a few minutes after the footmark is made translates into too high a water table for crops such as maize, for which soil aeration is important for growth. Water gathering so quickly in farmers' footprints is a clear indication that maize and beans will turn yellow and wilt if planted without the soil being drained of such excess moisture. In these circumstances, channels are dug to depths up to 30cm deep to lower the water table to a level such that when footprints are made in the *dimba,* water only collects in them overnight. This indicates that the soil has been drained to a level of moisture that is suitable for the planting of maize and beans. Farmers have developed a further test for the suitability of soils in *dimba* for maize and bean cultivation. The soil must be loose enough not to form a round ball when effort is made to do so. This test, together with the footprint, helps farmers to decide when to plant crops in *dimba.* In addition, the soil should not leave water on their hands when rubbed between the fingers. An additional indicator of moisture suitable for maize and bean production is that the soil must not stick to the hoe when tilling. The tests done by farmers to determine moisture levels in *dimba* reflect an in-depth knowledge of soil moisture. For farmers to be confident that such soil moisture levels are unsuitable for maize and bean production is a reflection of the attention to detail embedded in their knowledge production that includes cross-checking knowledge using several other methods to measure the same property as shown by practices in *dimba*.

Farmers seem to have a clear mental record of what has happened in previous seasons. Based on this knowledge, farmers are able to anticipate what might happen in the current and/or the next growing seasons, so that the depths of water channels in *dimba* are dug at varying depths in response to this knowledge. Water channels are generally deeper (5-10cm) following a very wet rainy season and shallower following a drier rainy season. However, farmers noted that these water channel depths can be as shallow as those constructed following a rainy season with low rainfall (below 900mm), even if the wet season had very high rainfall (>1200mm), if they anticipated a very hot dry season. Indeed, meteorological data show that annual rainfall and temperature figures of the study area fluctuate over years. Farmers try to balance current water levels suitable for crops with the anticipated evaporation that may lower the water table to a level that crops will need water supplements. As the water table recedes and the soil becomes drier, water channels are closed by filling in with soil. This raises the water table to maintain soil moisture. Farmers are aware that if it becomes hotter, the water table can be lowered as a result of evaporation. This lowered water table level leads to crops requiring the application of additional water.

Farmers knowledge of water table levels is further demonstrated by different depths of water channels dug in *dimba.* In places with a high water table, the drains have a depth of 30cm at source, and up to 80cm at the mouth, while in places with a low water table, the depth at the mouth can be as shallow as 30 cm; the width is normally between 30cm and 60cm for all drains, yet the farmers do not use standardised measuring instruments in determining the widths and depths. Through the practice of cultivating many *dimba* over many years, knowledge has been steadily acquired as to the optimum depth of drains for different crops under differing water table levels, which are then dug by eye.

Farmers have a clear knowledge about stream characteristics and are aware of the importance of slope in drainage systems. For example, they know that the area around the source of a stream has less water and the amount increases with the distance from the source requiring a deeper drainage system for the successful cultivation of crops. They are also aware that as the gradient reduces the water level within the surrounding *dimba* rises closer to the surface. Water rises closer to soil surface in most streams in Mzuzu area as the distance increases from the source. This knowledge seems to be common to all farmers who dig drains in *dimba.* Indigenous knowledge plays a major role in the management of agro-ecological features found in the study area.

7.5 Indigenous knowledge in problem-solving

Farmers face many problems associated with their farming practices, and hence some farmers' management practices are deployed to solve the problems they experience. Farmers plant maize in *dimba* between the months of July and August, a period which is early enough so that maize matures and is harvested in December before being damaged by the onset of the rains in mid-November and December. Farmers have noted that the dry spells between rainy days, which can be as long as two to three days, and as short as half the day length (6 hours), are adequate to keep mould from developing on dry maize grains as they are being harvested. In a similar understanding of their weather conditions, beans are planted from June onwards so that the risk of frost, which has been known to occur during June and July, is over by the time the plants flower. Farmers know only too well that beans wilt and sometimes die as a result of being exposed to frost, and they are particularly vulnerable when they are flowering.

Farmers have been experiencing a shortage of sweet potato vines for planting in the rainy season. Sweet potatoes are planted in January for maximum yields, as farmers have observed that moles reduce yields of those sweet potatoes that are planted earlier than January by feeding on the maturing tubers. Farmers therefore make every effort to plant in the month of January each year. However, planting materials become scarce in January for a number of reasons. One major reason is that because many farmers plant at this time, this raises the demand for the planting materials (vines); and the second reason is the destruction of the vines by goats and children. The normal seed sources for sweet potatoes are overwintering plants in the previous season's fields. The sweet potato stock, which are vines or stems, grow from small tubers and roots that are left in the field, either because they are unsuitable for consumption, or, deliberately, to allow them to grow into planting materials for the following season. This has been a management practice adopted by farmers for a long time (since they settled in the study area). However, farmers have observed that children and goats like to feed on the small tubers and leaves respectively, making the multiplication of sweet potato stock in fields where sweet potatoes are allowed to overwinter both difficult and unsustainable.

Farmers have therefore now developed a further site for sweet potato stock production, which are the *dimba,* to supplement the planting materials that have successfully over-wintered in the upland gardens. Farmers have observed that sweet potatoes grow well on the residual moisture found in *dimba.* The success of potato growing in *dimba* has two advantages; the first is the increasing availability of planting materials for the month of January, and the second is the availability of sweet potatoes for consumption beyond the normal maturity period of the rain-fed crop in the dry season. Furthermore, some farmers are reusing waste water from domestic activities, and this waste water is available throughout the year, to promote the growth of those crops that require a steady source of moisture in the dry season, and this includes sweet potatoes.

Another example of farmers' abilities to solve their problems using local knowledge was demonstrated when some maize plants in the 2005/6 season were stunted in growth, despite adjacent plants growing to the normal height of over two metres. Farmers were initially unaware of what caused maize to be stunted. The stunted crop had thin stems that showed symptoms of phosphorus deficiency (purple colour), yet the plants had been both weeded and fertilised. It became clear to many farmers that the problem was not associated with their management practices. The plants did not have signs of being physically damaged on those parts that were above the ground, such as the stems and leaves. Farmers, therefore, excluded diseases such as maize streak as the cause of the stunted growth. Consequently, they uprooted the stunted plants and examined the roots carefully noting nodes on them and then examined the soil on which the plants were growing. They sifted through the soil and subsequently found thin white caterpillars that were not cut-worms (Figure 7.7).

Figure 7.7 White caterpillars (3) found in the soil where stunted maize is growing.

These caterpillars were thus established to be the cause of the stunted growth of maize plants, and they were physically destroyed each time they were found with the hope that they would not reappear the following season, the parents having been killed before multiplying. The ‘experiment’ to control the caterpillars by physically killing them arose from curiosity about the nature of these stunted crops and the need to generate a solution to this new problem. They now have a successful method of controlling these pests in addition to being aware of the symptoms that plants develop when they are affected by these caterpillars.

With regards to livestock, the knowledge gained from medical experts on how they treat medical conditions, particularly infections, has been adopted by farmers to treat their own livestock. To them, livestock are seen to be similar to humans in many respects, one being that they also get infected with similar types of diseases to those of humans. However, treatment by veterinary experts has become very expensive, and especially so after the introduction of SAPs. Nonetheless, some farmers (7.2%) have adopted the use of medicines such as penicillin to treat their livestock, such as Newcastle disease in chickens, in particular. However, because of expense, many farmers 'experiment' with other materials, such as soap (15.3%) and *Aloe vera* (35%), to treat diseases affecting their livestock. It is important to note that both penicillin and soap have positive health related impacts on livestock[9]. The assumption is that, as soap is slippery, whatever causes the disease in the body of the chicken will 'slip' out through diarrhoea induced by the use of soap. Although local knowledge has been useful in many ways so far, the use of medicine like penicillin and soap in livestock shows that at times this knowledge is indeed 'backward' and has some remnants of ignorance. The use of penicillin in livestock is likely to render it ineffective in treating diseases in human beings for which it is produced. Farmers and those who eat chicken treated with penicillin will be taking in small doses of the drug and parasites that can be cured using it will eventually become resistant.

Some of the recommendations made by agriculture extension workers, such as the growing of hybrid maize varieties in the study area, have created problems for farmers. Farmers have observed that these hybrid varieties are especially susceptible to weevil attack in storage, which destroys the maize before the next harvest season. This is a major problem for farmers as it increases food insecurity at the household level. Farmers have deployed local knowledge to reduce this damage to hybrid varieties by simply storing the maize for only a short period of time. This is achieved by farmers growing hybrid maize varieties in amounts that can be consumed before the weevils destroy it. Hybrid maize is consumed as soon as it is harvested and before it can be attacked by weevils, while local maize, which is resistant to weevil damage, is stored and used up to the next harvest. Farmers adapt knowledge to suit their livelihoods and are keen to avoid costs where necessary. Farmers do not reject knowledge when they can rework it for their own benefit in the quest to secure their livelihoods. Hybrid maize is found to be useful to some farmers, despite its shortfalls, and it is used to fill the gap of food insecurity that occasionally arises in some households before local maize varieties mature.

[9] Penicillin is an antibiotic that has similar properties as other antibiotics administered to livestock under veterinary medicines. The issue thus becomes a form of misuse of human medicine. Soap has mineral elements such as sodium, which is important as a nutrient to livestock and *Aloe vera* is an ingredient in some soaps with known curative properties and is rich in nutrients in its fresh form as a plant

Farmers' low incomes reduce their ability to acquire important farming inputs such as chemical fertilisers, and so they have used their own knowledge to address this problem. Farmers, who cannot afford chemical fertilisers, either because they are not gainfully employed or simply because they have inadequate financial resources, put fields that have become 'tired' to cassava. Growing cassava in 'tired' fields has two advantages for the farmers. The first is that land ownership is secured by having a crop in the field; and the second is that the land uses its natural means to recycle soil nutrients. Leaving land to fallow was a practice well established in the past in the form of shifting cultivation. Land was left fallow to regenerate itself naturally as plant species, bushes, grasses and trees increased. Farmers have observed that cassava cultivation has a similar effect to leaving land to fallow, and so it is used to restore soil fertility and it effectively reduces the need to apply chemical fertilisers to fields that would otherwise require chemical fertilisers' application. Some farmers, however, who have adequate land simply leave 'tired' lands to fallow and open virgin lands that require less use of chemical fertilisers.

There is an increase in land pressure in the study area as the Google aerial photo (see Figure 3.2) reveals very few uncultivated sites. Land is therefore perceived as being in short supply, requiring its tenure to be secured and so planting cassava as a fallow crop is a form of local knowledge that has evolved as a means to secure land ownership. Customary land tenure recognises individual landownership through the local administration by the village heads and *nduna.* This type of administration is fluid, based on trust and associated with use, especially between close relatives. The culture is that land is individually owned only as long as it is being used, and especially for crop cultivation. Claims of ownership within the same family are thus normally ensured through use. A member of the same family can therefore use land left to fallow with ease. A formal request would be lodged to a relation and normally granted. As long as the 'new' owner uses the land, it becomes culturally unacceptable for the previous owner to reclaim it. This was not much of a problem when land was in abundance because farmers simply opened new farmlands as demonstrated by farmers having up to six gardens each (see Table 6.2).

The use of cassava as a means to secure landownership is supplemented by the planting of exotic trees like pines (*Pinus patula*) along boundaries. Farmers therefore use the planting of cassava and exotic trees in combination as a form of land tenure protection. Cassava ensures land regeneration because it is a deep rooted crop and it can be left unweeded without yield reduction. Weeds die and rot, generating humus in the land, helping to restore its lost fertility. Farmers have discovered that cassava can be left growing in the field for as a long as they want without yield loss. The period that the cassava remains in the field means that land ownership is guaranteed because relatives will not ask to use land that has a crop on it. Village heads reported that they use several features to establish ownership in land disputes. These include crops in the field, exotic trees that are along boundaries and those in the garden (if any). The argument is based on the assumption that exotic trees can only be planted in the field by an owner of the land because they are a form of lifetime investment. Furthermore, if these were planted by a 'temporary' owner of the land, the genuine owner would have made the person uproot them or sought the intervention of the village heads at one point to rectify the anomaly. Cassava and exotic trees have, therefore, become a means to solve land tenure disputes, both by village heads and landowners. Local knowledge has either been used as a tool for solving problems farmers face, or has been used to avoid potential problems that could arise in the future.

7.6 Deliberate 'experimentation'

Apart from reasons discussed earlier, such as land size and unforeseen events like sickness and funerals, nearly all farmers (95.4%) in the study area deliberately spread the planting time of maize from late November to early January as a form of continuous 'experimentation' so that they can keep on evaluating the best planting times for maize in each growing season. It is important to be reminded that farming for the people in the study area is a life-long occupation. Farming has to remain productive for the whole of a farmer's life and into the next generation and beyond. Farmers' 'experimentation' is intensive, and particularly so in *khonde* gardens, where crop failure is not considered to be a serious risk to household food security because of its generally small-scale operation. In *khonde* gardens, farmers can afford to uproot crops damaged by pests and destroy them (Figure 7.8), because farmers spread their risks by having a number of gardens that in total give them a relatively large area under cultivation (3.9 hectares).

Figure 7.8 A farmer uprooting maize planted 'too' early (first week of November as a deliberate 'experiment' and destroyed by pests as a result).

Some farmers are more curious than others and are willing to 'experiment' in wider areas of their farming practices in order to generate new agricultural management practices. One farmer was curious to find out how dry planted maize would perform when planted on the flat, but without making ridges. His curiosity arose from the fact that he had noted that maize plants that grow from seed left by accident in the fields are greener, become taller and have bigger stems than maize planted in mid-December, which is the time farmers consider to be the best time to plant maize in the study area. The local name for maize growing from such seeds is *ngoma zamankholo*. He noted that such plants (*ngoma zamankholo*) have bigger cobs than those planted later and escaped maize stalk-borer, but unfortunately have fewer grains on their cobs. The farmer was curious to find out the outcome from deliberately imitating these conditions. He thus planted four seeds on the flat before the rains. The result was that the plants which emerged grew in a similar manner to those that emerged from seeds accidently dropped in the field during harvest time. The difference was only in the cob content; the plants that were planted had two or more cobs per plant each full of grains (while those accidentally dropped during harvesting period had few scattered grains on their cobs). New knowledge about maize cultivation has been produced.

Another farmer tried to grow wheat in the area. He planted a few ridges of wheat in a *dimba* (Figure 7.9). The purpose of raising the crop in the *dimba* was to assess its performance in the study area before he expanded production in the upland gardens. Farmers conduct 'experiments' in stages; first on a small-scale with few plants, as demonstrated by the maize trial above, and then they increase the size of the 'experiment' in terms of area to a number of ridges or a plot, as is the case with wheat here, before eventually conducting the 'experiment' at even larger scale in their *munda ukulu*. Farmers make their initial observations on small-scale 'experimental' 'plots' to generate knowledge about the management of the new crop that can later be applied when growing it on a larger scale.

Figure 7.9 Wheat being tried in *dimba*

Farmers also learn by chance from 'experiments' that occur naturally in the process of farming. One example of such opportunities relates to the natural variations in soil colour found in the study area. There are places which have different soil colours within very short distances and which are distinct from the red *katondo* soils (Figure 7.10). As a result of cultivating soil types of various colours and making observations on crop performances, farmers have increasingly developed knowledges of fertility that relate to soil colour. Such experiences are a form of 'experimentation' that generates knowledge of soil colour with respect to crop performance in terms of yield. The soils found in *dimba* have been found to be very productive by farmers and are cultivated in many cases without the application of chemical fertilisers. These experiences with the black soils of the *dimba* have made all farmers become aware that such soils possess a higher soil fertility level than all the other soil colours found in the study area. This knowledge is strategically used in choosing *dimba* sites. A good *dimba,* apart from having the ability to retain soil moisture for the crop growth period, must have black coloured soils in contrast to the red soils of upland gardens (Figures 7.3, 7.4, 7.10), as these black soils are associated with higher crop yields. This knowledge about the fertility of black soils has been further confirmed through observing the crops grown on soils of different colours in the study area and observing their yields. Farmers argued that pockets of black soils, within the dominant red soils, produce high yields even when they are found in upland gardens. When different soil colours are close to each other they present themselves to farmers as an ideal site for 'experimentation' and observation, for as long as they cultivate the site, generating in-depth knowledge of fertility based on soil colour. It is easier to assess the performance of crops in the different soils and associate the difference directly to soil colour, especially when such crops have received identical management practices, such as the application of chemical fertilisers and timely weeding.


Figure 7.10 Dark soils of *dimba* (left) versus upland *katondo* soils (right)

The 2005/2006 growing season provided the farmers with an opportunity to observe new pests and generate knowledge on how to control them. The infestation of maize roots by caterpillar based in the soil was solved by physically killing them, while the caterpillar that curled leaves proved difficult to control because of the large scale of the incidence, with three to four leaves per plant being affected. Although farmers knew that cutting off affected maize leaves destroyed the pests, the scale of the infestation required labour input which most farmers could not provide. When the heavy rains came, as noted in Chapter Six, leaf curling caterpillars were destroyed by the impact of the rain. These two pests enabled farmers to compare the impact of rain on pests that affect roots in the soil with those that affect leaves. Farmers now know that some pests, particularly those that attack plants above the ground, can be controlled by raindrop impact. Farmers did not deliberately design an 'experiment' to learn more about pests, but were given the opportunity by Mother Nature to observe the effects of the weather. Although 'experimentation' can be deliberate and purposeful, at times knowledge about crop management is produced by changes in environmental conditions over which farmers have no influence. However, the farmers are keen observers of environmental changes within their immediate surroundings so that they learn from such changes (a position that may not yet be fully appreciated by experts).

The pests that caused curling in maize plants were dark green caterpillars. The farmers found this out by opening the curled leaf, to reveal a larva that had pulled the ends of maize plant leaves together using silk-like structures. Farmers conduct deliberate 'experiments' on crop management practices, as shown by the trial of wheat in *dimba* and at times out of unforeseen or unplanned events, as demonstrated by pests in the 2005/2006 growing season.

7.7 Cultural and socio-economic factors

Knowledges produced by farmers are influenced by cultural and other socio-economic factors which they experience. In addition, there are household responsibilities which are associated with gender that impact on some farming practices generating gender-based knowledges. In general, women stay at home, while men are expected to travel far and wide in an effort to fend for the family. The result is that women tend to spend more time than men in gardens, planting and weeding crops, often with children (Figure 7.11).

Figure 7.11 A woman with her children planting maize in her family garden

However, in addition to general planting and weeding, women play a special role in the production of pumpkins. This role is associated with knowledge and skills, which are said to be possessed by women who have 'good hands'. Strenuous efforts are made to increase pumpkin yields from the few plants grown, and women do this by pruning flowers and young tender leaves, which are then prepared as a dish by boiling, to be eaten along with *sima.* The selection of such leaves is said to be crucial, such that it is only performed by women with 'good hands'. Farmers believe that this process increases pumpkin yields. The act of pruning is left to experienced 'special women', and women known to have 'good hands' from past performances, and these are asked by neighbours to assist in the pruning of pumpkin leaves and flowers. 'Good hands' is literally translated from the Tumbuka words: '*mawoko ghaweme'*. The skills are embedded in the individual and are inherited, so that they are not apparently transferable to an apprentice. One has simply got to be born with such skills. This is probably comparable to the Western understanding referred to as 'green fingers' in gardening.

It is important to note that pruning is a process well-understood scientifically to increase yields. This understanding is based on the fact that plant food produced by leaves through photosynthesis is then concentrated on the few selected plant parts. Farmers in the study area, however, do not seem to interpret the increased yield in pumpkins in this manner. They remove not only flowers, but leaves as well, which are important for plant food production through photosynthesis. Their knowledge seems to be based purely on past experiences and linked to the 'good hands' of women only. This is not suggesting that farmers do not know the advantages of pruning; they deliberately prune fruit trees to increase the yield and quality of such crops. Rather, their practice in relation to pumpkins is an indication of knowledge that is different and goes beyond scientific understanding of the advantages associated with pruning. For farmers, yield improvement appears to be embedded in both pruning and 'good hands'. It is the interaction of these two, rather than the associated benefits from photosynthesis alone, that accounts for the yield increase. It is evident from the practice of pruning and the utilisation of women with 'good hands' that, for farmers, both care and special skills are important for increased agricultural production.

Although the use of light coloured soils found in *dimba* to decorate houses is knowledge developed from ecological underpinnings, it has a cultural dimension. The collection of the light coloured soils in *dimba* is done by women and boys. However, the dilution of it with water, and its application to the walls of their houses, is done by women only.

The men and young boys, particularly under thirteen years of age, have been known to help in digging these soils. Boys under the age of thirteen are still considered to be in training in all aspects of life ranging from crop production to the management of homes, and as such are supervised by both women and men. After the age of thirteen, boys become the responsibility of males for training in aspects that are considered to be the male domain, such as opening up virgin lands and looking after goats and cattle; goats and cattle have to be driven to communally owned pastures for grazing that may be far from home, up to 3 km away or more, a practice culturally 'left' in the hands of males. It is important to note that women have been known to take animals for grazing in special cases, such as when males are away on other duties. Although grazing animals is largely a job for men, based on cultural beliefs and expectations, their culture allows for deviation from such expectation in special cases. Local knowledge, although influenced by culture, is fluid and creates complex relationships and expectations between the two sexes (male and female dichotomy) that is mutual and non-exclusive. Nonetheless, there appears to be a division of labour within the community 'fundamentally' based on gender, something which is widespread in this area as a cultural practice. Women are still expected to cook and perform duties like sweeping around houses, and men are expected to do jobs that require 'man' power, such as conversion of virgin land to farmland and land clearing in *dimba*. This might explain the observation made that women spend more time in gardens planting and weeding crops than men, as these two activities are considered easy and light work suitable for women and children[10]. It appears that farmers in the study area recognise the continuous nature of operations like planting and weeding, which demands patience and endurance - characteristics that are found in women. They have become very efficient at planting crops as a result of this culturally-based responsibility. Indigenous knowledge ensures that roles and responsibilities of each part of the society are played according to culture as well as other factors.

Observations made during this study show that knowledge can be acquired through exposure to other ways of doing things. Farmers who at some point have lived outside the study area have come across knowledge that is different from that held by those who

[10] It is important to note that men also plant and weed crops creating a complex division of labour that cannot be fully explained by the light nature of such work. However, if there are other tasks to be done, such as house-building, hunting and cattle-tending, then these take priority for men over weeding..

have lived all their life in the study area. For example, out of the 37% of farmers who plant maize early in *munda ukulu,* 25% have lived outside the study area at some point in time, as compared to the remaining 12% who have only ever lived in the study area. These farmers reported that they acquired the practice of early planting as a result of travelling and living outside the study area. Knowledge has been acquired through the experience of practices, such as planting maize soon after *chizimyalupsya* before the moisture necessary for plant seed germination is lost through evaporation, observed outside the study area. It might also be safe to assume that some farmers (probably the 12%) have acquired this knowledge from those who have lived elsewhere and now practice early planting in the study area.

Another important factor that is seen to influence knowledge production in the study areas is employment opportunities available in companies, NGOs and government offices based in Mzuzu City. This study has found that employment opportunities provided by the city of Mzuzu has a varied influence on knowledge produced by farmers in the study area. Those who have permanent jobs (14.4%), with a monthly waged income, said that they have the financial resources to buy chemical fertilisers, and hence they cultivate their lands for longer periods than if they did not use fertilisers. This opportunity, despite the negative effects of chemical fertilisers discussed earlier, and the increased population pressure as indicated in the increase in number of households from 1980s to the present times, has meant that some farmers have lost a knowledge of shifting cultivation methods. Shifting cultivation is no longer needed to restore fertility because it can be replenished artificially using chemical fertilisers. Indeed, many young farmers said that they have never been able to practice shifting cultivation, and thus have only a limited knowledge at best of the practice. It is only a matter of time before shifting cultivation practices become a completely forgotten knowledge in the study area, although they may be retained by the very few farmers who continue to migrate to places with virgin land outside the study area. This study found that four families have moved to new places, such as Choma, in the past five years in search of virgin land for cultivation, and some farmers (12) have second homes that they occupy during the rainy season in these distant areas where they have their new gardens.

Knowledge is also developed as a result of expectations set by the community. Children are expected to be competent farmers in their adulthood. This is the expectation which the parents and the community at large have set for their children. The communities and parents deploy reciprocal labour and training at household level to generate knowledge on where and when to plant crops, on proper weeding practices, and how to select suitable virgin land to convert to farmland, using vegetation and soil colour as indicators of suitability of land for cultivation to pass on to their children. Children have to comply with the expectations that are set and use the knowledge acquired to assist them in the attainment of the objectives determined by the community, particularly that of food security at the household level. Children are first warned, then punished by parents, if they do not take part in these training programmes at household level, either by smacking them or denying them a meal for each lesson missed. Parents of children who grow up into lazy farmers are frowned upon by the community. This sort of community coordinated effort, to maintain a high standard of farming practices, has been effective in developing and maintaining agricultural management practices that are proven to be effective in the study area.

The community-led knowledge development processes and expectations have other side-effects. Although farmers in the study area are aware of the benefits of producing for the market, it appears the community's expectation to have adequate food produced at the household level might be preventing some of them from practising full-time commercial-scale production, which may require them to buy in food for their households. Given community pressure, they opt to produce for home consumption first, with production for the market becoming only an extension over and above home consumption demands. Based on this community influence some farmers view the market as a place where they acquire food only when their production has been insufficient. Their belief is that the market is unreliable in conquering 'hunger' at the household level so that markets are viewed by most farmers as a source of food for those people who either do not produce enough or those who have no farms. Consequently, farmers' notions of food security and wealth are based on self-sufficiency in food production and not directly related to income generation to buy in food.

It is clear that these communities are not fully monetised yet. It may well be a reflection of the fact that farmers are confident of producing for the market only when they have adequate food. It then becomes a rational decision, as there is a reduced risk of the family going hungry when venturing into production for the market. The farmers' knowledge of the market might also have been generated from unsatisfactory past performance of the market, either as low prices for their produce, or having been unreliable in providing the staple food when needed. Farmers, therefore, generally do not trust markets to satisfy their number one priority, which is food security. Indeed, how can they rely on the market when culture expects them to be self-sufficient in food by producing enough both at family and community levels?

However, where market forces have worked to the advantage of farmers, they have not hesitated to produce for sale. For example, one farmer is producing broilers for sale, while another is producing eggs on a commercial scale. The benefits of the market have encouraged the broiler farmer to be innovative by producing home-made feeds to boost growth, weight and maturity. It may be safe to assume that if the market was weak for broilers, the farmer would not have risked such innovative ideas, and such new knowledge would not have been generated. It is clear that market forces can have different impacts on the same community.

The market has resulted in some farmers protecting their knowledge so that it can be sold. The above mentioned chicken farmer has developed knowledge in the form of ingredients such as those used as vitamins and in traditional medicine, which is not disclosed to buyers. The reluctance to disclose the herbs used in the production of vitamins and traditional medicine is a type of protectionism, associated with profit seeking. It resembles patenting rights. The farmer wants to keep the knowledge to himself and his family so that other farmers who seek treatment for their chickens have to pay a high price to reward his invention. The farmer uses this knowledge to generate additional income by selling the products formulated and through the provision of advice to other commercial farmers in the study area and beyond. This knowledge has developed to serve the economic needs of this farmer, but it also demonstrates that indigenous knowledge can be useful in the market place. Most important of all, this farmer's stance to protect information on ingredients used to produce vitamins and traditional medicine is a challenge to the expectations by farmers, which is to share knowledge freely within their communities.

Although there is a general assumption by many scholars that formal education changes societies' ways of living and expectations leading to the adoption of modern technologies that result in increased income generation necessary for the improvement of their living standards, this has not led to the uptake of modern ways of farming in the study area. To this effect, education has been used by experts as a tool for encouraging the adoption of modern farming techniques by farmers that can lead to market-oriented production. However, there is evidence in this study that formal education has had limited impact on knowledge development in the study area. Farmers still plant crops based on their local knowledge, preferring to plant around Christmas (Table 7.4), although the literacy rate of the study area is 98%. In addition, crop production within the community is mainly for home consumption. Agricultural lessons at school deliberately emphasise modern ways of farming that can lead to production for the market with the promotion of farming as a business. This study has shown that there is very little sign of knowledge gained from these lessons being applied by farmers on their farms, least of all those lessons related to farming as a business. It appears farmers' knowledge in the study area is not particularly influenced by education. Indeed, children who are currently in school practice what they are taught by parents, using *khonde* as their demonstration and training grounds for farming practices.

Table 7.4 Information on farmers' maize planting time by level of education

Education level	Number of farmers planting by indicated time periods				
	November	1st week of December	Around Christmas	Planting with first rains	Total
No education	1	0	1	0	2
Primary	1	13	36	4	54
Secondary	8	13	24	1	46
Tertiary	0	1	2	0	3
Artisan	2	2	2	0	6
Total	12	29	65	5	111

Pearson chi-square is 16.399 and p is 0.174

Practical courses about farming under informal education that is available to farmers and their children are responsible for most of the knowledge farmers have developed and use. Indeed, local knowledges acquired through informal education are widely accepted, and, as such, are widely used within the community. Farmers' well-tested knowledges are deemed relevant, and are passed on through generations; they are unlikely to be easily displaced by 'new' knowledges produced and promoted through formal education or from agricultural extension staff.

Incomes of farmers have in some ways influenced knowledge production in the study area. The farmers in the study area have very low incomes (mean of US $457) leading them to develop knowledge to enable them to manage crops and livestock with low use of external inputs such as pesticides and chemical fertiliser, creating 'an opportunity' for the potential production of environmentally friendly products. Farmers are aware of the benefits of modern technologies but are unable to access them because of their low incomes. In livestock, they use traditional medicine such as *Aloe vera* (35%) to control diseases; they use mixed stands, fallows and cassava to restore soil fertility in their gardens; and as noted above, some migrate to areas where they can find fertile soils to cultivate.

7.8 Summary and conclusions

Agricultural management practices at the farm level are influenced by changes associated with the rainy and dry seasons. Farmers have developed knowledges to manage their gardens and *dimba* in relation to these changes in the seasons. The source of moisture for their crop production plays a major role in decision-making. The upland gardens that depend on seasonal rainfall are managed to optimise the moisture made available by rain. In *dimba,* moisture is managed and regulated to suit crop needs by tilling the land without making ridges so that crops are planted on the flat. Their agricultural calendar is designed to make their farming operations as efficient as possible so that they can slot in non-agricultural activities.

Farmers prioritise production for home consumption. There aim is largely to be self-sufficient both at the household and community levels. To this effect, food crops are produced that meet their dietary requirements with very few farmers producing cash crops. They share produce with friends and relatives to ensure that the communities have adequate food. For farmers, wealth is largely defined in terms of food security as opposed to income generated.

Farmers have detailed knowledge of their environment that includes agro-ecological features. This in-depth knowledge of agro-ecological features is not only used as a management tool for their farming practices, but also to control human disease vectors. Each agro-ecological feature is managed to optimise agricultural production.

Indigenous knowledge has been developed to solve problems farmers face in their everyday farming practices. 'Experimentation' and curiosity combined with detailed observations play a major role in solving problems faced by farmers. 'Experiments' are designed to find solutions, although, in some cases, the environment provides already designed 'experiments' that only require careful observations to be made. However, knowledge production by farmers is influenced by many factors. Cultural factors underpin knowledge development. The markets, income levels, community expectations, gender and knowledge sources are becoming important factors in farmers' knowledge production processes.

Chapter 8

Spaces for Indigenous and Scientific Knowledges in Development and Environmental Management

8.1 Introduction

In Malawi and Africa in general, the international and governments' development processes continue to be based on economic policies that aim at modernizing society and transforming the productive sectors of the economy, particularly the agricultural sector, on the basis of the precedent of Western societies (World Bank, 2000). This can result in the perception of farmers' indigenous knowledge as being inadequate for economic growth and development. Farmers therefore 'need' development promoted by external experts to change their farming practices to suit a predetermined market-oriented economic model. However, the power relations between development experts and farmers are complex in reality, and these power relations can change over time and space. This chapter unpacks the complex nature, the role, the limitations and the position of indigenous knowledge in development and environmental management.

8.2 The relevance of indigenous knowledge in development

Indigenous knowledge sometimes is seen to be at odds with the government, international institutions such as IMF and World Bank and some NGOs because it has been misrepresented by some development experts (see Chambers, 1983). Development experts emphasise the adoption of Western technologies in order to achieve 'economic' progress. The holistic nature of indigenous knowledge, that includes assessing scientifically proven technologies before adoption, is sometimes interpreted as an indication of farmers' ignorance and backwardness. The core of the relevance of indigenous knowledge lies in questioning the fundamental view that Western technologies are suitable for use at the grassroots level for development if only communities have resources such as cash, are trained, have back-up extension services, and projects have been designed with communities' inputs so that their concerns have been addressed. Indeed, as demonstrated in this study, the government uses agricultural extension workers, research stations and some NGOs and companies to promote modernisation processes, involving the use of science and technology by, for example, showcasing hybrid crop performances based on increased yields and time of planting. The demonstration plots receive recommended fertiliser regimes developed under research conditions for maximising yields that may be far from the realities of farmers' fields. The demonstration plots tend to be monoculture stands of maize, which are kept free of weeds throughout the growing season. However, farmers using indigenous knowledge frequently maintain weeds in their gardens, especially towards the end of the season, are unable to apply the recommended rate of fertilisation, because of either low income or the 'belief' that fertiliser 'burns' the soil, and consider that some Western technologies, such as hybrid maize, are inappropriate because of being susceptible to weevil damage. The inappropriateness of such technologies (for example, the susceptibility of hybrid maize) is accepted by experts, and they have prescribed solutions to address their inadequacy, such as the use of pesticides for the protection of these varieties in storage. Unfortunately, the solution is considered to be expensive by many farmers, especially compared to alternatives such as the growing of local maize that is resistant to weevils. Most important of all, based on lived experience, farmers' indigenous knowledge advocates a mixed type of cropping, which means maize is grown with other crops in the same garden, and at times even on the same planting station, as is sometimes the case with beans. For farmers, having a mixed cropping pattern saves labour and makes it possible to have more than one food crop in a garden, so reducing the need to buy in additional food requirements. They find this to be a prudent way of using their scarce resources in a rational manner, particularly land, labour and time. In a sense, this resembles the technical efficiency advocated by experts in their promotion of technologies that are 'efficient' users of resources, such as hybrid maize. In addition, indigenous knowledge has been developed so that farming is not just an occupation, similar to formal waged employment, but has aspects of leisure built into it which gives farmers the time and space to live their 'fuller' lives, in contrast to the more commonly documented position that farmers struggle to survive and so need help in the form of Western technologies to improve their living conditions. The indigenous knowledge produced creates the time and space for normal life that includes having celebrations and festivals.

Furthermore, farmers use indigenous knowledge to alleviate poverty. Farmers in the study area generally use less fertiliser than the recommended application rates in their crops in part because of their low annual income ($457), but also because they have developed their own methods for managing and improving soil fertility. As we have seen, cassava is now used to replenish lost soil fertility hence reducing the use of expensive fertilisers, even though the Government of Malawi has maintained a targeted input subsidy programme since early 1990's to address the income needs of the lowest quartile, despite the introduction of structural adjustment programmes that required the elimination of subsidies as one of the measures to reduce government expenditure. At the farm level, and in particular in livestock production, farmers have alternatives to Western drugs and use locally available plants such as *Aloe vera* as remedies for curing and preventing diseases and pests, including the endemic Newcastle disease in chickens, for example. These indigenous knowledge based remedies and mechanisms to deal with the problems which farmers face in the study area have a positive impact on reducing the impact of poverty on individuals and communities alike. For example, local knowledge based reciprocal labour is used to help farmers who are in need, as demonstrated by the activities of ADRA in Chapter 5 in the study area. The findings of this study that local knowledge can be a tool used for alleviating poverty are similar to those made by Ellis *et al* (2003), also for Malawi, who showed that farmers' ownership of resources, such as livestock and access to resources that can be put to productive use, act as the building blocks by which the poor can construct their own route out of poverty. Indeed, Mtika (2000) also shows how local level community knowledge is used by the poor in accessing food through shared labour in agricultural production in Malawi. Furthermore in this study, one livestock farmer has utilised local knowledge to become a high income earner through the successful use of local remedies in his poultry production and by selling such remedies to fellow poultry farmers in the study area.

The emphasis on yields by development experts is based on the assumption that as more of the crop is produced per unit of land, there will be a greater surplus to be sold, thereby alleviating poverty as well as ensuring food security. Development experts believe that food security for farmers under subsistence farming conditions can only be achieved by increased yields per unit of land and/or labour (see Tchale *et al,* 2005). Farmers agree with the experts in terms of increased yields per unit of input as being necessary for household food security, but, for them, mixed cropping meets this objective very well. Farmers manage their gardens to optimise yields by, first of all, choosing farmland based on well-known soil fertility indicators, and then, secondly, by maintaining soil fertility through the application of chemical fertilisers, organic manure from livestock and by incorporating weeds deliberately left in the field towards the end of the growing season for them to decompose and release nutrients for the uptake of crops in the following year. Farmers' understandings of yields as being important for food security is further demonstrated when they put land to fallow when yields from such fields become too low to justify the effort of cultivating them.

However, farmers' understandings of food security are holistic in nature rather than reductionist. Increased yields are only one part of a story that also includes taste, suitability for storage, variety of food for balanced diets and being able to select and produce seed of their own choice in the gardens. For farmers, mixed cropping provides them with almost all their food requirements from a single field by planting several crops on a single ridge, a pattern that is typically replicated in the whole garden. Cassava, mixed with maize, beans and pumpkins, provides the farmers with green vegetables from cassava, pumpkins and bean leaves. Cassava is used as a snack, as well as being processed into flour for *sima*, which tastes differently from that made out of maize flour. Consequently, crops that have a number of usable parts, such as cassava and beans, are a must in farmers' crop mixed stands. Such mixed stands of crops are not fully appreciated when yield is seen only as a function of produce per unit area and that ignores the use over time of plant parts that are rarely included in yield measurements, such as leaves.

Farmers also use their own measuring instruments to assess their food situation from the time of planting, through the growing season, and into harvesting, storage and finally utilisation. Yet, the assessment and evaluation tools used by farmers to measure food security, and therefore progress, are considered inadequate for development by development experts who measure yield in terms of kilograms and evaluate profits as a measure of success embedded in technical efficiency. Farmers are seen by development experts to be in a state of permanent crisis of low yields and making little or no profits. The fact that farmers make rational choices about their production levels seems to be irrelevant for some development experts, who adopt a 'one size fits all' solution to farmers' so-called problems.

Farmers' understandings of crop cultivation practices are frequently misunderstood by agricultural experts. For the agricultural experts, crop damage caused by weevils on hybrid maize can be controlled by using pesticides. This is considered to be an advanced way of tackling the problem of weevils, a technically identified problem which can be solved by using a technical solution, and, in so doing, food surpluses will be achieved, resulting in the excess being sold for cash. Farmers and scientists agree that both food surpluses and food sales for cash are important for economic development. However, farmers adopt a different strategy to achieve food surpluses and security. Farmers grow local maize that is known to be resistant to weevil damage, so that it is suitable for storage up to the next growing season and they plant hybrid maize in small areas, which then is consumed before weevils are able to damage the crop. This local knowledge of using local maize as an insurance against damage in storage, and planting a limited land area to hybrid maize to avoid maize weevil infestation, is not considered sufficient for economic growth, hence the promotion of the idea of increased land areas being put over to hybrid maize cultivation by development experts in the study area. For experts, maize is a commodity that can generate money, a form of wealth that is measurable and recognised when commodities' values are expressed as a price, and indeed, contribute to national wealth as expressed in the Gross Domestic Product figures. Farmers, however, consider wealth to be an attribute which is more than just money and encompasses social aspects that include norms and values such as having to produce enough food. Communities expect households to be self-sufficient in food through production. Those who fail to produce enough food are said to be lazy and are frowned upon, although the communities can supplement their production. Farmers' choices and strategies are different from those of development experts, despite having the shared main goal of achieving food security and surpluses for sale.

Farmers have developed local monitoring techniques to help in the management of their resources including food stocks that are sometimes different from those (techniques and/or tools) used by experts. Locally developed monitoring techniques and tools give farmers knowledge about the condition of their resources so that, in the case of farmers in the study area, yield is measured using baskets harvested, or the level of maize stored in the granaries after harvest, although development experts measure yield in kilograms per hectare, even though this does not really make much sense to farmers. None of the farmers interviewed owned weighing scales and hence they have developed the use of baskets and levels of produce stored in granaries as a measure of production levels. This has become a form of local knowledge passed on between generations; farmers know how long a given basket full of maize will last per given household size. Such simple measurement tools used by farmers are considered to be of low technology levels, not modern and so these are labelled as inappropriate and backward by some experts, yet such tools adequately inform farmers of the level of use of produce over time. Kilograms per hectare may be valid to development experts, but clearly farmers have a problem accepting this when they have a knowledge that serves their purpose just as well.

To reduce the time wasted in travelling to fields, farmers have *khonde* gardens. They are planted early, and they can be weeded easily because of their proximity to the dwelling houses. Farmers are aware of the advantages of having a garden close to a dwelling house in a manner similar to development experts in that they consider dispersed gardens, and increased distances to gardens, as an inefficient way of using time and resources. However, farmers recognise that if gardens are close to dwelling houses, food security is compromised, a socially embedded aspect rarely considered as relevant by experts trained to achieve output-oriented production and management of resources. Farmers know that crops such as maize can be depleted before the harvest by being consumed as green maize, and farming operations in the *khonde* can be disturbed by visitors, something which is less likely with increased distance between dwelling houses and *munda ukulu*.

Just as the distance from the home to gardens is evaluated differently by farmers compared to development experts, farmers' evaluations of labour use are also different from what is expected by development experts. Labour supply is moderated by community expectations and obligations that do not necessarily respond to experts' expected economic rationality based on monetisation. For example, a farmer who is sick or bereaved during harvest time expects neighbours to harvest the crop for him or her at no direct monetary cost. Development experts, of course, expect payment to be made for such labour use. On the contrary, farmers feel it is part of the community responsibility that can even be punishable as an offence if such expectations and obligations are not met by individuals by not supporting those in need. Such community shared responsibilities defy the norm based on market-oriented production that requires the payment of services in cash for profit making purposes. It is, therefore, not surprising that such services are rarely included in the calculation of wealth, both at individual as well as national levels. Yet this form of wealth is valuable at such levels. It is a form of social capital that individuals draw upon in time of need without direct cash payment. Just as food is considered as wealth, social capital has long been recognised also as a form of wealth which is highly prized. Indigenous knowledge is produced to accommodate such issues hence its relevance both at farm as well as community level. This makes it relevant and challenges the wisdom of economic progress based on modernisation and profit making in many ways.

8.3 The dynamism of indigenous knowledge

Western technologies have specifications that experts insist upon if such technologies are to be adopted and implemented by farmers. Experts recognise that technologies are developed to maximise benefits and the process of adaptation can reduce them. The assumption in the application of Western technologies ignores deficiencies that may exist within such technologies. For example, chemical fertilisers are expensive so that the benefits are realised when production is largely market-oriented. The intended end users of such technologies are branded ignorant if outputs are below expectations, based on tried outcomes of the developed technologies even when failure is as a result of inherent technological deficiencies. However, indigenous knowledge is used by many farmers to adapt some Western technologies with a deliberate intention to accommodate conditions that exist at the local levels associated with environmental, economic, social and cultural realities that are deemed necessary and useful for consideration and incorporation.

Indigenous knowledge just like Western science and technology accepts deficiencies within itself that demand continuous 'experimentation' and adaptation. Indeed, as shown in this study, farmers do not stick to recommended monocultures for which chemical fertilisers are designed to increase output, but they apply fertilisers to their crops in mixed stands. However, they have modified their planting patterns on ridges based on the observed effects of the technology on their crop mixed stands. When urea is applied to maize, farmers plant beans away from maize plants in separate planting stations, which is a modification from their normal practice. Farmers change their practices to suit modern technologies when there are sufficient reasons to do so. Realising that maize yields are high when urea is applied, farmers opt for the planting pattern and spacing that yields positive results for both maize and beans in mixed stands. The mixed stand of crops is maintained while the cropping pattern is changed; hence farmers resist the complete move from their crop mix but accommodate changes within their accepted and proven farming practices. Some of these modifications are then interpreted by development experts as showing that local knowledge is static and does not respond to changes in technology, a point that was emphasised by the government extension agent in the study area who insisted on the wholesale uptake by farmers of government recommended monocultures particularly for the staple food maize. The expectation is that change is only in one direction, with the adoption of proven modern technologies. The farmers challenge the accepted wisdom to adopt technologies and they adapt them to suit their conditions, despite not being given sufficient space and recognition by experts for modifications based on their ability to 'experiment' and evaluate. Although there persists a notion that farmers are ignorant and recipients of new technologies who are unable to generate their own technologies to lift themselves out of poverty, the use of urea fertiliser and changes in the cropping pattern, while maintaining the crop mixed stands, shows that indigenous knowledge generation incorporates Western technologies using well tested innovative ideas. This study shows that farmers are not ignorant and their knowledge is dynamic, not static but relevant.

Farmers ensure that indigenous knowledge continues to evolve and adapt to changes by training their children from childhood to 'experiment' continually and to make observations. This process of 'experimentation' and observation also generates knowledge. As part of this process, farmers ensure that their children have their own gardens where they can grow crops as part of the learning process of becoming successful future farmers by practising. The fact that children grow their own crops and practice different cropping practices shows that ‘experimentation’ under indigenous knowledge starts at a young age of about 5-6 years using young minds that are creative and can take risks without jeopardising family food needs. When children, as well as parents, ‘experiment’ continuously throughout their lives, the notion of knowledge being static and backward is hard to justify. Continuous ‘experiments’, by nature, update knowledge to meet current and changing conditions (environment, economic or socio-cultural). *In situ* ways of knowledge production can therefore be superior to *ex situ,* implying that indigenous knowledge can be superior in particular circumstances and locations to knowledge developed elsewhere. This is the case in biological conservation practices, where adaptations to changing conditions are best realised through *in situ* conservation. In addition, farmers cannot rely only on past performance, because of the nature of farming itself. It is difficult to observe changes without continuous ‘experimentation’ and observations, where seasonal variations are the norm, such as in the African climate, and especially so with frequent droughts and changes for dates of the onset of the rainy season. Fluctuating starts of the rainy season are important in agricultural production because they influence planting times and the consequent pest and disease incidences. Furthermore, such changes can only be seen after a growing season in which the ‘experiment’ was conducted. In addition, the nature of agricultural production demands continuous and continual ‘experimentation’ because adequate data to evaluate the outcome of an ‘experiment’ can only be generated over more than one season. The process, therefore, by its nature, becomes a continuous learning process based on both the past and the present performances. This inherent ‘nature’ of risks and uncertainties in agricultural activities is managed by farmers using continuous ‘experimentation’ and observations.

Efforts are made by farmers to reduce waste from agricultural production. Indigenous knowledge is thus produced to ensure that almost all of what they produce is utilised. Farmers in the study area use beans damaged by weevils or disease in storage or in the field to make a special dish called *Chilanda,* after drying the beans, complementing the practice of incorporating crop residues into soil for soil fertility management.

8.4 Positioning indigenous knowledge

Despite indigenous knowledge being based on ‘experimentation’ and observations, development experts can be generally dismissive of it in relation to Western technologies, and, the interest in indigenous knowledge by some experts is not to narrow this gap but to maintain, or even widen it. Where the benefits of indigenous knowledge are very clear, such as the use of ash to control weevils in beans, the direction of interest seeks to find what indigenous knowledge can contribute to science including in terms of advancement and publications. Researchers at Lunyangwa Research Station in Mzuzu have been trying to establish and isolate the active ingredient in ash that is responsible for the protection of beans from weevils, and whilst they certainly agree with farmers that ash protects beans from weevil attack during storage, the main aim of the research is the scientific validation of the use of ash as indigenous knowledge used to control pests in beans. The validation process is essential and can be more beneficial to both scientists and farmers, particularly if the farmers are recognised as the owners of knowledge. Recognising farmers as owners of such knowledge can protect them from those who may obtain patenting rights on knowledge produced by farmers. The exclusion of farmers in this research amounts to an extraction of knowledge that is thought to be useful for development so that indigenous knowledge becomes important only as it complements scientific advances. The interest is scientific advancement that unfortunately excludes local farmers who are the producers of the knowledge. The local knowledge about ash has attracted experts to apply and adapt it to Western ways of knowing without the recognition of its developers, a clear reflection of power being contested that favours Western trained experts in silencing the ‘voices’ of the farmers. The understanding of how knowledge is developed, even though it may be useful in the development process, is ignored, yet it confirms that farmers are active developers of knowledge, and, as such, they can become active participants in the development process. Indeed, there is a realisation in some quarters that development can only be successful when both experts and the ‘grassroots’ become equal partners in the process, which is attainable if there is recognition, appreciation and application of knowledges held by both parties so that in the study area practice lags behind rhetoric. Sinclair and Walker (1999) made similar observations while working in Nepal on agro-forestry programmes where development experts paid lip service only to the involvement of farmers as equal partners. Farmers continued to be excluded from the planning stages of development programmes and became recipients of externally driven programmes.

The extraction of knowledge from farmers, is of only partial use for development because the partner that developed the knowledge in the first place is largely excluded from becoming an 'active participant'. Unfortunately, when this knowledge goes back to the farmers, it may be seen as new knowledge that has to be promoted through extension work, when it would have been easier to maintain the farmers' participation during the whole 'experimentation' and development process. The use of ash in bean storage demonstrates that indigenous knowledge contributes to Western scientific knowledge production, which is a position inadequately appreciated when the binary tension between indigenous and Western knowledge is discussed. The debate on tensions between Western and indigenous knowledges by experts is conducted as if these two knowledges have nothing in common particularly when differences are emphasised that sometimes ignore similarities. Agrawal (1995) examines some of the contradictions and ironies involved in this debate, while exploring a number of possible ways out of the dilemma that includes similarities between these two knowledges that can reduce these tensions.

Given the many similarities between Western and indigenous knowledge, the need for indigenous knowledge to complement Western science in certain aspects becomes irrelevant. Indigenous knowledge is complete and useful on its own, so that it can exist side by side with Western knowledge. What is of paramount importance is to understand the processes under which indigenous knowledge is useful. This study shows that development experts need not only look at what indigenous knowledge can contribute to Western knowledge, but also should see how practical and useful it is to farmers on a day-to-day basis. It then becomes useful to understand the spaces and power of indigenous and Western scientific knowledges in development practice. The binary tension between the two knowledges then can be 'ignored' in favour of advancing areas where both knowledges contribute effectively to the development process.

8.5 Spaces and power of knowledges (IK and Western scientific) in development

The results of this study suggest that spaces of farmers and development experts have not been adequately conceptualised as both being interactive and yet exclusive at the same time. It has been a normal position for development experts and scientists to assume supremacy over farmers in knowledge production and the consequent dominating power that follows from this, hence the promotion of market-oriented economic growth through top-down development approaches by the Malawi government and some of its partners. Such approaches to development confirm in the minds of experts the need to empower farmers through training and exposing them to Western technology and scientific ways of knowing and acting.

However, there are different spaces, power relations, rationalities and preferences between smallholder farmers and development experts, as demonstrated in this study and by many other scholars such as Long and Villarreal (1993), Beckford *et al* (2007) and Simon (2007). Local power is expressed in resistances to teachings and advice. Farmers stick to their practices, apply recommended measures by government extension workers based in the study area to specific crops deemed appropriate or develop modifications to the recommendations advocated by experts. In some cases, resistance by farmers, as in this study, is a viable option to avoid costs instead of seeking surpluses, the latter being advocated by extension workers. Farmers choose what is appropriate for them, thereby exercising their power. Farmers in the study area grow high-value crops for sale, such as vegetables to which they apply pesticides as recommended by experts, and yet plant crops mainly for home consumption that do not require the use of pesticides, such as cassava and local maize, to reduce the overall cost of production. In livestock, they use local shrubs and roots to control diseases thereby avoiding cash expenditure on vaccinations and other Western drugs, which are typically either beyond their income or simply do not make a difference to their farming. To farmers, local shrubs, herbs and roots are as effective as Western drugs in pest and disease control. Indeed, the physical destruction of pests in crops is as effective in the control of leaf curling caterpillars in maize as is the use of pesticides. Their local knowledge enables them to reduce dependence on resources over which farmers have no control, such as pesticides, thereby reducing the power exercised by experts. Farmers are aware that to maintain their power over their lives, they must retain and use resources over which they have full control.

There is clear space and power conflict between farmers and development experts in such situations, because the expectation of development experts is that farmers should adopt Western technologies. This would mean, however, that farmers would have to move out of their current space into the domain inhabited by experts, a move that involves purchasing inputs even when there are alternatives that are free in cash terms. Farmers in the study area resist this as far as possible by using both technologies, Indigenous and Western, the latter when they have cash, and local shrubs, herbs and roots at other times so that they then move in and out of the market at will without loss of power to experts. Markets can demand products that may require the use of experts' knowledge to produce, such as blemish free products, and this would make farmers dependent on experts' advice, a situation farmers make efforts to resist.

The desire by farmers to exercise control over their production is further demonstrated by the manner in which they control pests. Actellic dust is widely available in shops and is promoted by experts as an effective control for weevils in maize. Farmers, however, have adopted an alternative strategy that avoids damage by weevils by the use of maize varieties that are resistant to them, rather than opting to purchase actellic to apply to the introduced high yielding hybrid maize varieties. The scientists assume that, since actellic dust is cheap, technically feasible, relatively risk-free and socially acceptable, the farmers will adopt the technology (see Ostberg, 1995; World Bank, 2004). The farmers certainly accept the technology as suitable and relevant, but use it only when absolutely necessary. Assumptions that farmers will adopt technologies, if known constraints are addressed, if their cooperation is sought, and most important of all, if farmers are trained, may be insufficient in this power game. Farmers assess and evaluate options available to them and continuously carry out 'experiments' to develop their own technologies, in order to maintain their own control over their production processes.

Interestingly, farmers in the study area saw promoted programmes, such as those for milk and egg production, as irrelevant as packages for adoption. The egg production programme was accepted by very few farmers because of costs and farmers' lack of control of key resources, and factors like parent chickens, price of eggs and price of feed. Farmers are rational in their choices by ensuring control over their farming practices. If experts assume to have control over local farmers, there is a need to rethink this position. Power, control and spaces of farmers and experts are carefully analysed by farmers to enable them to have an edge over the 'outsider' experts.

The assumption made by researchers, educators and project managers that farmers are ignorant stakeholders, who could learn from them, by assuming that knowledge development and transfer is a one-way channel from the research station to the farmer, is both inadequate and inappropriate for knowledge development and power relations. Experts may dispute this process of knowledge development by farmers, based on results established through scientific research and trials, but the farmers also continually do the same ('experiment'). A farmer in the study area dry planted maize on the flat because such maize had more cobs than that planted on ridges. Yet, the official advice is to plant maize on ridges. Here, advice given by agricultural experts is challenged by the results of the farmer's 'experiment'. Farmers use real, tangible evidence to question the relevance of some Western technologies, significantly undermining the power usually assumed to be associated with experts.

Farmers' scepticism concerning scientists and development experts may have arisen from the changing positions of some scientific evidence, as in the case of shifting cultivation, which was seen in the past to be environmentally unfriendly. In the study area, experts still discourage this practice today, even though there is now scientific evidence that shifting cultivation can allow for the regeneration of plant species, for example. Farmers were aware of these facts from observations of land after it had been put to fallow. The change in scientific understandings of shifting cultivation to that long-accepted view of farmers challenges the power which experts have over their knowledge in the eyes of the farmers. Fallow land in the study area is re-grown with wild plants and does not look much different from adjacent virgin land. Where there are clear observable results that farmers learn from, such as shifting cultivation, farmers become sceptical about scientific knowledge more generally, and particularly that which discounts their practices. It is a small step for farmers to position Western scientific knowledge at the same level as indigenous knowledge or even lower. This study suggests that the debate amongst development experts, that indigenous knowledge is backward and static, is probably going on in parallel with farmers doing the same with Western scientific knowledge.

Furthermore, some farmers in the area have also ‘moved on’ and no longer practice shifting cultivation. The relegation of shifting cultivation to a practice that can no longer be sustained is not based on grounds advocated by scientists of being environmentally unfriendly; on the contrary, for farmers, shifting cultivation can no longer give the same benefits as it used to, and especially in relation to replenishing soil fertility because there is now much more population pressure on land. In addition, land left fallow can be lost to neighbours. To avoid loss of land tenure rights, farmers use cassava as a means of replenishing lost soil fertility on land that previously would have been left to regenerate naturally. Shifting cultivation, therefore, has outlived its usefulness and farmers have accordingly changed to other practises.

This example of shifting cultivation shows that farmers’ knowledge is not static (see also World Bank, 2004; Briggs *et al,* 2007). Farmers continuously carry out research which may not be appreciated by scientists, but which enables them to develop knowledges that are used in securing livelihoods and which ensure that they do not lose power over their resources. These local innovations, such as dry planting maize on the flat and the use of urea fertiliser in maize and bean mixed combinations, do not directly depend on outside intervention, although they do incorporate outside knowledges. The farmers’ use of urea is a result of outside intervention by experts’ introduction of urea, while the utilisation of cassava as a fallow crop is an internal development. These examples show that farmers have a space to work in that can be independent of experts.

Although farmers have their own spaces, they still seek assistance from experts when there is need. It is when farmers seek advice from development experts that the opportunity is created for scientific and indigenous knowledge to operate in the same space. Probably at this point, the power pendulum favours the experts, but clearly it oscillates between both groups. This study has found that farmers seek assistance from experts when they are faced with difficult problems, such as new pests or diseases, and when they have had no previous experience of them, or when the experience before was damaging enough to warrant consulting experts. When farmers feel that their resources are inadequate to solve their problems, they seek additional resources from elsewhere, which includes expert advice. For example, maize plants suffered from two unfamiliar pests in 2005/2006 and again in 2006/2007. These pests, a leaf curling worm and a root eating worm, were new to farmers and so many farmers actively sought advice from the extension workers. It is important to note that farmers were already physically destroying these pests, so retaining their own power, and advice was sought on their terms. Farmers wish to retain control over their own farming practices, even if, at times they are ignored by experts. In many instances, scientists assume that they operate within the same spaces as farmers. However, this study shows there are only a few occasions where farmers and development experts occupy the same spaces for fruitful advice and knowledge dissemination, as demonstrated by the presence of a pest in maize that was new to farmers. But such spaces for participation by experts are often created by the needs assessment by farmers rather than by experts' imposition.

This study shows that scientists and farmers have separate powers and spaces in which they operate. The space of experts is dominated by economic and scientific understandings of development that have their main focus on economic progress, which tends to underestimate the concerns and aspirations of smallholder farmers as unimportant. So when scientists claim power through scientific knowledge, they may be right, but they do not always recognise that power is within their space, and does not necessarily directly influence the farmers, as is believed in most cases, because farmers retain their aspirations and concerns that see wealth as more than just economic progress. As noted earlier, wealth is defined by farmers in a holistic manner that includes community concerns which address food security and social well-being, in addition to income generation. Yet, failure of development programmes in the past has always not been directly linked to these power relations. Frequently, the failure of development programmes has been associated with ignorance and/or risk avoidance practices of the smallholder farmer (see Legesse, 2002; World Bank, 2004), instead of the differences in spaces occupied by scientists and development experts from those occupied by farmers. Development experts have assumed a role of empowering farmers for development to take place through the transfer of Western technology and scientific knowledge to farmers, yet they hardly occupy the same space to allow for this technology transfer to take place. There is an assumption that knowledge in agricultural activities is transferred to farmers through extension services, without the full appreciation of the fact that the power which scientists and experts possess only affects farmers when they need assistance from them, in a manner that is similar to a patient going to meet a doctor, as demonstrated in maize stunted growth. Sachs (2005) alludes to this relationship between experts and farmers when he argues that economists should utilise a diagnosis of problems in a manner similar to which medical experts diagnose patients.

Development and progress are still constructed as technical and professional tasks for experts, which exclude the grassroots, who are seen as non-professional in their trade. In such a discourse, the farmers' knowledge, power and space are considered to be of lesser importance to that of Western science and technology, and hence development experts attach a low value to the farmers' space, and, by extension, to indigenous knowledge. The development experts' power and space is assumed to be the dominant factor necessary for development, and is placed above indigenous knowledge and farmers' spaces. This arguably is the major cause of failure by past development programmes because there is a real gap created between indigenous and scientific knowledge in the process. This gap is sometimes reduced, when development experts and farmers interact, especially when there is some form of agreement between the two parties, either out of need or coercion. For there to be a reduction in the gap, so that power relations between farmers and development experts occupy the same spaces and exert influence on each other, effort has to be made by both parties. For example, farmers in Malawi adopted the planting of crops on ridges as opposed to *matutu* because the colonists enforced the practice by either imprisoning offenders or having offenders pay a fine (see Thomas, 1975; Peters, 2002), while this study has demonstrated that when farmers realise the need for development experts' knowledge, as shown in the case of new maize pests, they actively seek advice from agricultural extension agents. Long and Villarreal (1993) observed that the life worlds of researchers, extension workers and farmers are partially sealed from each other, and the findings of this study confirm this. The fact of farmers' actively seeking advice is wrongly assumed to mean a subordination to that power exerted by experts. Similar findings were made by Cleaver (1999), who has argued that there is a sophisticated analysis amongst people of the structural instruments of their subordination and blindness amongst development agencies, for example. The farmers' willingness to attend development experts' organised meetings is sometimes interpreted as subordination by farmers to the superior knowledge development experts have. However, in this study, this is more of a reflection of local culture that leads to farmers to attend such meetings, as farmers are reluctant to reject invitations to meetings or to view demonstration plots, because doing so is perceived to be bad behaviour within the community (see Mtika, 2000). For farmers, attending a meeting is not a problem, and, at times, is a form of passing time because they have the choice to reject the recommendations that are made in such meetings anyway.

Scientists and development experts assume that farmers need the knowledge which development experts have in order for farmers to make progress, that is, they represent the starting point for development. However, in reality, it is only when farmers see the need for assistance from development experts that the power of scientists reaches that space occupied by farmers. Whether it is effective or not, then, depends on the resultant interactions, and what the farmer values as important economic and socio-cultural gains, and even this is usually only after 'experimentation', observation and evaluation by the farmer. Indeed, Mohan and Stokke (2000) argue that looking at the 'local' and the 'outsider' creates discreet entities, separable from each other in space. Ostberg (1995) noted that farmers withdrew from what they did not want, and when withdrawal was inadequate, they took physical action to make their point known. Similarly, some farmers in this study have taken action by not planting at the time recommended by extension workers, for example.

8.6 The limitations of scientific and indigenous knowledges

Development as a discourse in some quarters has been undertaken as if there are no problems associated with the application and use of Western technologies (Agrawal, 1995). Where inadequacies of Western technologies have been noted, indigenous knowledge has been at times romanticised by experts as offering a way out of the impasse (see Briggs, 2005). However, both of these knowledge systems in isolation have significant limitations that can only be remedied with synergy resulting from using them both in development programmes. The case of the farmer who has developed alternative vitamins for chickens, and sells this knowledge to other farmers, shows that farmers exposed to similar conditions still can develop different knowledges. Since farmers hold different knowledges at the grassroots level, the powers they have within their spaces are therefore different. The unevenly held knowledge can be a limiting factor, firstly because it creates a dominant position for those who have superior knowledge over others; and, secondly, because it challenges the notion and assumption by development experts that indigenous knowledge is out there, needing to be tapped for development.

The use of penicillin, which is an antibiotic normally prescribed for human beings, in controlling diseases in livestock demonstrates the misuse of medicine by farmers in the study area. Clearly, when the use of penicillin is seen as 'new' indigenous knowledge, it represents a serious limitation of this (indigenous) knowledge. Indigenous knowledge then becomes backward and a sign of ignorance. In addition, indigenous knowledge appears to be inadequate in dealing with global phenomenon such as world trade agreements because of its nature of having limited exposure to such events. Rarely are local people adequately represented in such forums to enable them to develop indigenous knowledge to deal with such global events.

This study has already shown that indigenous knowledge is not evenly held across farmers within a community because factors such as gender, past experience and having lived outside the study area impact on indigenous knowledge production. What is also significant in indigenous knowledge production in the study area is the level of 'experimentation' undertaken by individuals. Farmers conduct many 'experiments' with crops and livestock, particularly regarding the time of planting of crops to escape pest damage and to achieve higher yields. For example, farmers who had lived outside the study area for some time plant maize earlier than those who had not lived outside the study area, and their level of 'experimentation' is partly influenced by knowledge gathered from elsewhere. Those with only a limited experience of living elsewhere have a more limited exposure to ideas and their 'experiments' are limited to the extent of this exposure, which are derived from the practices observed from childhood and from what extension workers have promoted and demonstrated.

While the fact that not all farmers have the same knowledge is also true with development experts, which is rarely acknowledged in the literature, it becomes more of a limiting factor to farmers because of limited resources for exchange of knowledge. They do not have extensive sources as compared to experts who might have access to journals, conferences and the internet. Learning is rather largely restricted to what can be physically observed. There is very little evidence provided in this study of knowledge gained by farmers from direct interaction with agricultural research workers, particularly from Lunyangwa Research station, the nearest research station but which is still 15km from the study area. In addition, knowledge generated by farmers is becoming more difficult now to share freely because of the need to pay for it. The farmer who sells locally made vitamins demonstrates this point clearly. In the past, such ingredients would be revealed to fellow farmers so that they could obtain them themselves from the wild (virgin forests), and yet now the farmer keeps the ingredients as a protected secret to enable him to sell the knowledge in the form of a product or commodity.

Since knowledge can be seen as a commodity and can be sold, indigenous knowledge at the farmer level is turning into a potentially big business. This could be a significant development that has a potential to reduce farmer to farmer extension, which is considered more effective compared to the official use of extension agents (see World Bank, 2004). This study also shows that farmers rely on their colleagues for important information concerning farming. The case of the commercial poultry farmer, who has developed alternatives to Western medication and vitamin supplements used in poultry production, shows that sometimes knowledge is not shared even at a price. The farmer sells the remedies and does not disclose the ingredients to clients who are farmers in the study area. As noted earlier, he is protecting this knowledge in a manner similar to patenting rights, and the knowledge he has developed is now being sold as a remedy, rather than as a knowledge being freely shared. Indigenous knowledge can become a commodity to be sold and traded just like any other. It is important to note that there has been the sale of herbal medicine, which is a form of indigenous knowledge, for a long time in the study area and elsewhere in Africa, even though this has at times been offered free of charge as a token showing mercy for the sick (see Maumbe and Swinton, 2003).

The study has shown that many farmers continuously ‘experiment’ and carry out observations throughout the growing seasons. For farmers, it is not enough to find a solution to a given problem; many want to anticipate problems and be ahead in finding solutions before the problem arises. Farmers cannot afford to stand still in knowledge generation through ‘experimentation’, especially when their livelihood is based on farming. This is advantageous in that knowledge is continuously generated ahead of problems, but it certainly is sometimes a drain on resources, which can be avoided by farmers coordinating and sharing areas of emphasis for research just like Western experts do through reports and journals. They can conduct meetings to share research findings after each growing season and this may reduce wasting resources in areas that farmers have adequate knowledge and capacity.

The fact that farmers produce knowledge that is directly useful and relevant to them, as is the case in the soil fertility improvement practices, creates an empowerment consistent with some current development thinking (see Mohan and Stokke, 2000; Briggs, 2005). There is a danger, however, that indigenous knowledges become romanticised, despite the fact that farmers are aware of the limits of their knowledge (hence the continuous and continual ‘experimentation’ year in year out). In the eyes of many, one major limitation of farmers’ ‘experimentation’ is a lack of written record-keeping. This weakens the farmers’ ability to refer back to what was previously observed, as this knowledge is only held in memory which can then be lost, either through being forgotten or the death of the person holding the knowledge. This may be considered less important in the eyes of the farmers, as they are forward-looking and accept that knowledge is not static and is liable to being lost, as well as to being changed continuously over time. But this does mean that it lacks incremental gains, as no proper records can lead to farmers repeating ‘experiments’ that could have been avoided if written records had been kept.

This study has shown the fairly low levels of incomes of farmers in the study area, which can partly explain the low levels of external input use. However, for those who have higher incomes, the low input use appears to be advantageous, because it results in increased savings. The use of indigenous knowledge therefore has two implications.

The first is that those with limited financial resources can survive with a low external input use; and the second is that those who have higher incomes also survive on low input use and potentially can make higher profit margins. However, a major limitation of low input use is shown by Bebbington (1993), who argues that there are few experiences where low-input agriculture has proven economically viable. When the sole objective is to make profits, indigenous knowledge has mixed performance results.

The farmers in the study area use indigenous means of food production that typically use very few external inputs compared to conventional farming systems. Farming practices using indigenous knowledge can be used by development experts to raise economic benefits to farmers if they can be harnessed as an ecologically friendly way of producing food. This could be marketed as prime products that can fetch a high value on the market bearing a naturally produced product with a special symbol. The natural produce then becomes a brand to be marketed as a high-value product. This would be using indigenous knowledge in combination with scientific knowledge and technology as knowledge systems of equal importance complementing each other to the economic advantage of farmers. Unfortunately, the standards of environmentally friendly products, such as organic farming, are too high for some smallholder farmers to obtain a 'recognised' worldwide certification. This high level of standards, as depicted in organic products, suggests an element of experts trying to retain dominance over environmentally-friendly production systems that are a common feature under local knowledge systems of the global South based on reduced external input use and the reliance on natural processes of soil fertility maintenance. The limitation recognised in this study is an indication of the lack of power of indigenous knowledge at the global scale, as a result of the dominance of Western ideologies with their corresponding silencing effects as noted by Agrawal (1995) and Mohan and Stokke (2000).

The study in Mzuzu also shows that reliance on scientific knowledge has not fully worked either. Development strategies, such as the milk-shed and egg production, did not benefit farmers in the study area. The trick is to use both knowledge systems in a manner that benefits the farmers most, and avoids swinging from one untenable position, that the scientist knows best, to an equally untenable one, where farmers know best (Cleaver, 1999; Mohan and Stokke, 2000). For example, farmers in the study area, have noted change in the taste of the pith of maize when chemical fertilisers have been applied. This has resulted in farmers avoiding the consumption of maize pith when chemical fertilisers have been used. The farmers have therefore lost the food component of the pith although they gain in terms of grain yields. Chemical fertilisers can change the taste of crops, which is a limiting factor for farmers despite increasing the yields. The study findings point to the importance of using both knowledge (Indigenous and Western) in development processes.

8.7 Indigenous knowledge and development in practice

The interviews with many development experts in the study area, as demonstrated in Chapters Four and Five, show that experts are still unwilling to give up power in determining the development agenda that affects the rural 'poor'. The position of development experts is shown by extension staffs in the study area who provide scientifically-based recommendations for farmers, such as the early planting of maize, despite observed and experienced infestation of pests in such crops. Extension workers consider early planting practices to be necessary for the achievement of high yields, as opposed to the farmers' knowledge from lived experience in the area. Farmers' knowledge still tends to be ignored, even when it is based on empirical evidence. The experts' argument is that those problems faced by farmers, such as pests and diseases, can be treated with the use of science and technology.

During the discussions with extension workers, they suggested that farmers were planting much earlier than before as a result of that advice. However, the study showed that many farmers (59%) still plant late to avoid maize stalk-borer. There is a knowledge gap between the experts and the farmers, and the fact that it is assumed that extension agents are more knowledgeable than farmers makes the situation on the ground even more challenging. Interestingly, most farmers (99.3%) ranked extension services as third in importance as a source of information, while the most important was information generated by individual farmers themselves through observations and 'experimentation' (Table 8.1).

Table 8.1 Information on importance of sources of information for farmers in study area							
Source of information	Very important	Important	Neutral	Not important	Very unimportant	Scores	Percentages
Farmers' own knowledge from 'experiments' and observations	107	3	0	0	0	427	99.3%
From friends/relatives	11	93	3	0	0	329	74.8%
From extension services	14	77	7	1	1	302	68.6%
Scale runs from 4 = very important to 0 = very unimportant							
N = 111							

Table 8.1 shows farmers' own knowledge is very important with a score of 427 (99.3%) as a source of information used in decision-making. The second important source of information for farmers in the study area is friends and relatives with a score of 329 (74.8%) and the extension services are least in importance with a score of 302 (68.6%). It is important to note that one farmer ranked the extension services as not important and another (one) farmer ranked them as low as very unimportant. Farmers' most trusted source of knowledge is their own individually produced knowledge. If experts based their understandings on the evidence which farmers use, this would create an opportunity for development experts to engage farmers in knowledge production effectively by learning from them.

Farmers are wary of second-hand information, even from experts, without first being tested and experienced so that where their experience is clearly showing advantages over experts' recommendations, changing their ways of practice becomes impossible. The extension agents' position that change has occurred, such that the farmers now plant maize early, portrays the notion that experts are not prepared to learn from farmers. Chambers (1983:23) has referred to this as narrow professionalism that leads to diagnosis and prescriptions, which underestimates the extent of a given problem by recognizing and confronting only part of the problem, in this case low yields as a result of late maize planting. As shown here, experts fail to see life from the perspective of the rural people themselves. Specialisation, despite being advantageous, makes it hard for observers to understand linkages by looking for and finding what fits their ideas (see Chambers, 1983). Specialisation creates intensive knowledge in one subject area, such that, in the process, it becomes difficult to relate issues that are outside the training undertaken. Unfortunately, the real world scenario is messy with unpredictable interrelations that are not adequately covered in training. Indeed, the training which extension workers receive conditions them to think that their ways of knowing are always better than those of farmers despite contrary empirical evidence in many cases. There is a position being contested here between knowledge gathered by training and that found in practice.

Furthermore, experts believe that indigenous knowledge is static and thus inadequate for development. For example, banana planting on ant hills has been practised by farmers continuously since 1949 in the study area, and the knowledge about this has largely remained unchanged since its introduction. To that extent, the argument that scientists consider indigenous knowledge to be static has a case. What probably has not been fully understood is why such knowledge has been static. This study shows that, in some cases, knowledge is static and passed on between generations without modification and changes, as long as it remains economically effective and socially acceptable to those practising it. The mere fact that it is static does not, therefore, mean it is irrelevant to development. The relevant point is to find out why it is held almost unchangingly by farmers.

Sillitoe (1998) has called for a sympathetic understanding of how others know and understand the world. There are advantages when Western science incorporates the other ways of understanding the world. The utilisation of ant hills with high soil fertility and moisture retention capacity can effectively increase farmers' production capacity, which, in turn, will ensure food security and provide for additional income through the sale of surplus produce. For example, crops that can grow well under the shade of bananas can be introduced in mixed stands, thereby utilising the small space of ant hills more efficiently than is the case currently. The study has shown that ant hill soils have higher nutrient levels (nitrogen) than the surrounding ground; this opens a potential space in which development experts and scientists can work together with farmers to achieve progress in development by developing cropping patterns that can best utilise the small land area ant hills occupy. Such a type of solution is likely to lead to a reduction in binary tensions between science and indigenous knowledges that have been referred to in the literature (Briggs and Sharp, 2004; Briggs, 2005). This study suggests that these tensions tend to occur in spaces that do not directly affect farmers. Farmers utilise scientific and indigenous knowledge, as long as these are useful in their day to day life. They do not see science and indigenous knowledge in bipolar terms, as the debate on binary division between indigenous knowledge and Western science has frequently been documented in literature (see Sinclair and Walker, 1999; Peters, 2002; Briggs *et al,* 2007). The debate in the literature is between, and amongst, scientists and has little to do with people on the ground. The farmers in the study area use high yielding maize varieties; they apply pesticides to high-value crops such as tomatoes; and they even use human medicine, such as penicillin, to control diseases in chickens, for example. For the farmers, it is what works, and what is within their means, that is important.

Although indigenous knowledge is unevenly held in the community, some knowledge, such as planting bananas on ant hills and use of drains in *dimba* to control water table levels, is widely held and shared by many farmers. It appears that knowledge that is very important for livelihood attainment, such as for food security, is widely held by many farmers. This type of knowledge is passed on, right from childhood through both practice and observation (see Thompson, 1999; Briggs *et al*, 2007). Children learn from their parents when to plant maize, for example, by being part of the planting team during the cultivation process. However, there is what can be called special knowledges that are kept by a few specialists (see Thompson, 1999). Such knowledges are meant to be the last line of defence against pests and diseases. *Aloe vera* is known to many farmers (90% know of it, but just 35% use it) as a control measure for Newcastle disease in chickens, but *chipombola (Cussiona arborea)* is known by only very few farmers (2%). Farmers appear to guard certain knowledges, to be used only when the commonly used product has failed to work. This is similar to what scientists do in treating diseases in crops, livestock and human beings. They will normally have what is called a last resort drug, such as quinine for malaria. Indigenous knowledges have protected aspects, indicating that it is a well-managed form of knowledge at grassroots level based on technical know-how, which is in contrast to myths and beliefs usually associated with it (see Tucker, 1999). Knowing which knowledge is guarded, for what reasons, and knowing knowledge that is held widely in the community, would help experts to utilise indigenous knowledge effectively in development.

Although farmers may not understand the resistance of pests and diseases to drugs in as much depth as scientists, they are aware that the continued use of a given locally-made medicine becomes less effective over time. The 'first defence line' local medicine will be used first, and, when this fails, an alternative, usually known to be more effective than the commonly used medicine, is then administered by people who have the knowledge. To this effect, farmers within the same community have different knowledges.

There is a need to understand the major factors that contribute to indigenous knowledge production. It is developed in the context of available resources, local microclimates and the physical features of a given area; farmers grow bananas on ant hills, and plant and multiply sweet potato seed in *dimba,* because such features are available. These physical features have been studied by farmers in-depth to produce local knowledge about soil moisture holding capacity and fertility. The presence of wetlands (*dimba)* in the study area has led to the production of knowledge of moisture regulation by digging water channels. The *dimba* have also led to new knowledge relating to the maintenance of soil fertility by the practice of leaving weeds in place during the rainy season to act as sediment trap, as sediment is well understood as a source of soil fertility for the *dimba.* Management of the *dimba* is designed to make the maximum use of sediment for the maintenance of soil fertility. Similarly, the study also observed that farmers (100%) living more than 15km northwest of Mzuzu grow groundnuts, while very few farmers (2%) living between 9-13km northwest of Mzuzu plant groundnuts. Farmers attributed this to two major factors. The first is that farmers believe that the areas nearest to Mzuzu are wetter than the others; however, rainfall data obtained by the researcher of Mzuzu as a district show one figure for the whole of Mzuzu, a clear limitation of the current rainfall data for development planning related to agricultural production. In other words, the records kept by the meteorological department are inadequate to show the differences of rainfall in these two areas, although farmers already know the differences in rainfall between these two areas. The agricultural extension worker for the area keeps rainfall records, but these are based on rainfall outside the institutional house where the officer resides. The extension officer noted that, in the past, rain gauges were located in several designated areas, but, due to theft, it is now prudent to install them where there is security. However, he agreed with the farmers that the area more than 15km from Mzuzu was indeed relatively drier, with past records showing rainfall of about 300-400mm less than the mean annual precipitation of Mzuzu itself of 1264mm. Farmers are able to distinguish variations in rainfall between the two areas without the use of rain gauges.

The second factor is that the soils in the two areas are different in colour. The dominant colour closer to Mzuzu is the red *katondo* soil, while further away it is the grey soil. Therefore, indigenous knowledge is place-specific and yet dynamic. Utilising indigenous knowledge in development requires an appreciation of these facts and the complexity of the realities at the grassroots level, as society cannot be easily or statistically explained (Mohan and Stokke, 2000). Indigenous knowledge, being place-specific, has therefore been misinterpreted as being difficult to use in development, yet development occurs in particular places. Being place-specific should therefore be interpreted as being advantageous and certainly useful for development.

The practice of under-valuing indigenous knowledge is not only limited to government extension staff. Agricultural experts employed by NGOs give advice to farmers on best farming practices, and, as with government officials, the knowledge that farmers have from the lived experience is frequently trivialised. However, NGOs that encourage farmers to use indigenous knowledge have seen farmers adapt technologies, such as drip irrigation, around their homes, and progress has been realised through the production of crops, such as green vegetables. Farmers adapted the drip irrigation system to suit their individual conditions, for example, by replacing plastic buckets that came with the irrigation equipment with modified buckets made out of flat iron sheets by local tinsmiths, who incorporated the design preferences of farmers to suit the individual farmer's operational conditions. Design specification by development experts did not satisfy farmers' expected requirements of the irrigation system; where farmers' input is used, success in development programmes is realised. The reason that farmers did not contribute to the design specification was because the equipment was imported from the USA. The design specification centred on an efficient water delivery system to plants and the use of materials light enough to reduce transport costs. Farmers, however, require additional features to this design specification, of which the strength of the material of the bucket is paramount. Buckets made out of iron sheets last longer than plastic buckets, which break when accidently dropped, an important design feature needed by farmers for the irrigation system to be durable. The bucket size was also smaller than the farmers' requirements, as using a bigger bucket than the one supplied with the irrigation equipment meant that irrigation time would be longer than otherwise. Farmers assess technologies and make sure that they fit in with their needs. It requires more than what Sachs (2005:77) argues for, which is the recognition of the social setting in prescribing solutions to problems, the importance of context, history, or direct observation. Individual demands and expectations have to be incorporated, something development experts consider to be too expensive to effect in development programmes. For experts, development has to be applied at broader scale, in line with advantages associated with the principle of economies of scale for it to be cost-effective. Indeed, Howitt (2001:316) argues that at the core of this imaginary centre of development lies the rationalists' proposition that all value is ultimately reducible to money values; that all value is ultimately tradable. Although this may be true in many walks of life, costs are valued differently between people, and, for farmers in the study area, monetary values are relegated to a lower priority by many.

Even when the value of indigenous knowledge is acknowledged by experts, its use in development practice may be ignored. The discussions with livestock research officials acknowledged the usefulness of indigenous knowledge practices as being effective in controlling livestock diseases. For example, data available showed that the deaths of calves were reduced when maize stalks and other herbs, such as bamboo stick, were tied around the neck of the calves, a clear indication that this local knowledge was effective in reducing death rates in calves. However, because it was being done without official blessing, and in an unscientific manner, it was not officially recognised, despite local records which showed reduced death rates when calves are given such treatment. For indigenous knowledge to be recognised, it has to be tested through scientific means of assessment. Certainly, although this may be important in reducing death rates in calves, it implies that indigenous knowledge is an inferior body of knowledge to scientific knowledge. The lack of appreciation of the positive contribution of indigenous knowledge to development, as shown by records kept at Lunyangwa Research Station, makes the use of indigenous knowledge in development trivial, even where there is evidence of its relevance and efficacy. Effort was not made by experts at Lunyangwa Research Station to disseminate local knowledge known to control diseases in livestock. It remained within the station despite its known efficacy.

8.8 Local knowledge or indigenous knowledge?

The name indigenous knowledge is suitable for knowledge developed by indigenous people. However, it does not completely represent and capture the true level and nature of production of this knowledge in recent times. Indigenous knowledge production can be influenced by experience, expert-introduced technologies, education, other social-economic factors and the environment, as demonstrated in this study. Based on the various sources of influence on indigenous knowledge development, the proper name would be local knowledge, which portrays the nature of production of this knowledge, and, above all, it represents the most suitable place of utilisation of such knowledge, which is the local area of production. This knowledge is mainly developed and designed to help in solving local problems. Qualifying this knowledge by the word local shows the appreciation of the dynamic nature of not only the people who produce this knowledge, but also the changing nature of the knowledge itself as time and space change including the nature of problems it is intended to solve.

Of particular importance is that the use of local knowledge, as opposed to indigenous knowledge, allows for the acceptance of the fact that very few communities now are isolated. The world is now linked in many ways such that knowledge is easily transferrable from one corner of the world to the other. Internet, mobile phones, radios and improved transport networks improve knowledge transfer and production processes, making indigenous knowledge difficult to find in its pristine state. Where indigenous knowledge has been influenced by other knowledges to form ‘hybridised’ knowledge, the term local knowledge captures this process effectively. This has been shown in the study area where new settlers are renting land to cultivate and the knowledge they bring from elsewhere, and the knowledge found in the area, create new hybrid knowledges about the management of resources. It is important to note that Briggs *et al* (2007) suggest that the term 'indigenous knowledge' may not be particularly appropriate or accurate and call for the use of the term 'local knowledges' to demonstrate its provisional, dynamic and evolutionary nature.

8.9 LEISA in relation to tropical agriculture

There is a growing recognition of the role which small-scale farmers play when it comes to food production and food security while still practising a sustainable form of agriculture under LEISA (Chavez-Tafur, 2009). This has also been demonstrated in this study. Farmers are seen by some experts as playing an important role, not only in food production, but also in terms of ecosystem services (see Chavez-Tafur, 2009). Smallholder farmers' local knowledge and ways of managing the environment as they conduct their farming operations is thus seen to complement efforts under modern scientific ways of managing the ecosystems. Furthermore, there is a recognition by some experts that the practice of small-scale farming is continuously in flux so that any attempt at increasing the impact of sustainable agriculture needs to acknowledge the existence of this continuous change as the starting point (Chavez-Tafur, 2009). The nature of farming in the study area has been changing over time, both from experiences some farmers have had outside the study area and from the changes in the environment demonstrated by declining virgin lands. As we have seen, such changes have led to the development of 'new' indigenous knowledges, such as where cassava is now used as an alternative to shifting cultivation practices, and where some farmers plant maize much earlier than they used to do previously with the first planting rains because of experience gained from living outside the study area at one point in their life time.

Although local knowledge is useful to farmers in solving their local problems, as demonstrated by the innovative poultry farmer in the study area, development experts in the study area have been slow to confirm such findings through research. Gupta (2009), working in India, also demonstrated that experts have been slow to research local innovations that can, for example, reduce the costs of controlling pests using local technologies and principles. Research by development experts in innovations made or discovered by local farmers can reduce fluctuations of income earnings of smallholder farmers. Smallholder farmers' average cultivated areas of around 3.9 hectares can be made to produce commodities using low external inputs, which then increase the profit margins of such farmers. Indeed, Gomes de Almeida and Fernandes (2006), while working in Brazil, found that a farmer who reduced his/her crop hectarage from a commercial scale (>15 ha) to just around 2.7 hectares, while making a transition to ecological agriculture, eliminated the profit and loss cycles forced upon the family as a result of market price changes. The findings of Gomes de Almeida and Fernandes (2006) portray a picture of hope in terms of profit making for smallholder farmers who practice low external input sustainable agriculture, something otherwise perceived by many scholars, including Bebbington (1993), as being inadequate for profit making and only barely useful for subsistence.

8.10 Summary and conclusions

The discussion of the results has shown that indigenous knowledge is relevant not only because it is available at the grassroots level, but because it is based on empirical evidence. However, it is fluid and this makes its use in development difficult for those trained in unidirectional knowledge transfer systems that imply the existence of a vacuum to be filled by Western technologies at the farm level. Indigenous knowledge is applicable in many situations, hence it is dynamic and yet place-specific and situation-specific. Its nature is for it to be adapted to various geographical locations, but it has often been ignored; yet this study has shown that it can be adapted to locations away from its origin with success. The relevance of local knowledge, its adaptability and the strength of empirical evidence puts it in a strong position to be used in development practice and theory.

Ironically, the power embedded in local knowledge undermines the power wielded by development experts, making it important to use it in the design and implementation of development programmes. Indeed, local knowledge use can contribute to the recognition of local people's preferences and priorities particularly when the genuine goal for development is to improve the livelihoods of the grassroots. Indigenous knowledge offers the best option to achieve such goals. It also helps in the creation of trust in technologies and institutions introduced by experts including the markets because it is used by local people to assess them (technologies, institutions and markets). The conclusions drawn from this research are outlined in the next chapter.

Chapter 9
Conclusions

9.1 The role and use of indigenous knowledge

The study has examined the role that indigenous knowledge plays in development, particularly the ways in which farmers use and incorporate it within their everyday practices and wider agricultural production systems. Indigenous knowledge plays a major role in farmers' decision-making processes and is still widely used in agricultural management practices in the study area, despite 60 years of the promotion and dissemination of 'modern' farming practices. This indicates that indigenous knowledge has a robust and effective way of being transferred from one generation to the next. The existence of local knowledges at the farm level has been noted by some researchers including Ostberg (1995), Harrison (2001) and Briggs *et al* (2007), among many and all these observations including the findings of this research suggest that development can be realised only if farmers' decision-making tools, like indigenous knowledge, are incorporated into development processes. This is because indigenous knowledge is based on empirical evidence from 'experimentation' and observation made by farmers, so that it can be difficult to replace with modern technologies which also have to be assessed by farmers before adoption.

The drive to modernise agricultural production in the study area has been based on replacing indigenous knowledge with modern technologies, such as high yielding crop varieties and the use of inorganic fertilisers. This process has not been wholly successful as farmers retain and continue to use indigenous knowledges that are productive and useful. The growing of local varieties of maize is just one example. Farmers have resisted modern technologies that have been found to be less successful under conditions in which farmers produce, demonstrating that they have power over experts in areas concerning the management of their livelihoods. The power of farmers to choose what they want is also demonstrated by Harrison (2001) who, while working in Mozambique, found that farmers adopted agricultural practices under their terms only after one of their own had successfully tried the technology promoted by experts and proved to other farmers that it worked, but rejected those technologies that were seen to be of little economic value by, for example, destroying seeds promoted by experts. Farmers boiled such seeds in water to make sure that they failed to germinate when planted. However, it is important to appreciate that farmers do incorporate Western technologies into indigenous knowledge, which in itself is a modernising and an updating process *in situ;* hence the knowledge which farmers now work with is 'hybrid' knowledge that consists of some elements of both local and Western technologies.

It has been demonstrated in this study that indigenous knowledge also contributes to the development of scientific knowledge. Scientists at Lunyangwa are working to determine the ingredients of ash that protect beans from weevils, a local knowledge that has been obtained from farmers. This is similar to findings made by Lado and Phuthego (2004), who noted that local knowledge was used by experts in counting wildlife in Botswana. Chambers (1993) notes that scientists now use the principle of diffused light to store potatoes, a knowledge farmers developed over a short period of time (less than a generation) soon after experts introduced a new potato variety on which farmers made observations in storage. The input of indigenous knowledge into Western science needs to be recognised, so that the use of indigenous knowledge in development can be based on empirical evidence as demonstrated in this study. Since indigenous knowledge can contribute to the production of Western scientific knowledge, and that scientific knowledge is useful in development programmes, it becomes a small step to suggest that, by association, indigenous knowledge is also useful in development programmes. Furthermore, the use of indigenous knowledge in development is a necessity, not only because it is already present at the community level, but also as a result of the input it contributes to Western science. This study confirms the findings of Chambers (1993) and Phuthego and Chanda (2004) that indigenous knowledge is an important tool for development at the grassroots level.

The producers of indigenous knowledge use several methods to ensure that this knowledge is transferred and acquired by the next generation. One of the major ways used to transfer indigenous knowledge between generations is through the use of social capital, particularly in the form of reciprocal labour. This is used to enhance the training and dissemination of indigenous knowledge by enabling knowledge experts to demonstrate their skills and farming practices to apprentices under field conditions.

Apprentices then show the experts the extent to which they have acquired the knowledge by performing a practice demonstrated by experts in their presence. Reciprocal labour, by its very nature, makes it possible to acquire knowledge through practice over several days, because a job such as harvesting can be performed several times in more than one garden of those who participate in providing the labour. Reciprocal labour involves communities pooling their labour resources and applying them to one garden at a time. After the task is completed in one garden, the whole group moves to the next garden and performs the same task once more. Performing the activity repeatedly enables the apprentices to perfect the practices, thus ensuring that the knowledge is fully acquired, while, at the same time, helping in the building and strengthening of bonds between the participants and the community more generally. Indigenous knowledge can perform a role of activating and maintaining close social relationships within communities. Similar findings were made by Briggs *et al* (1999) who noted the complex nature of vegetation use by communities in Egypt and the training they provided to their children in the management of resources, that included knowledge about livestock grazing in the desert. However, knowledge can also be transferred at an individual level without community involvement; Briggs *et al* (2007) noted that the transfer of knowledge frequently took place from a father to a son. They noted that the father was aware that his son was not equipped with knowledge about the desert grazing because he had not been exposed to it. Had the father taken the son on visits to graze animals in the desert, he would have been gradually equipped with the knowledge of pastures associated with deserts. In the study area, *khonde* are used to transfer knowledge at household level from parents to children particularly of the ages of 5-13 years and this is later maintained by such children cultivating in company of parents in *munda ukulu.* Indigenous knowledge about farming practices is, therefore, also transferred directly from parents to children at the household level.

Another important role of indigenous knowledge in agricultural production is to ensure the ‘survival’ of the communities through the careful and sustainable utilisation of resources at their disposal. The ability of individual farmers and communities to manage resources sustainably using indigenous knowledge in order to produce their own food is very important. Farmers’ livelihoods are dependent on these resources, and, in addition, these resources must be available to the next generation in a state they can provide for their livelihoods. Dei (1993) also observed that indigenous knowledge ensures a sustainable use of resources and encouraged experts to learn from local practices, particularly those that were environmentally friendly in resource utilisation.

Indigenous knowledge is used in the selection of agricultural production sites that are fertile. Well-known indicator species, such as *Brachystegia*[11] and reeds, are used, while soil fertility is maintained throughout the cultivation period by incorporating crop residues that decompose to release soil nutrients for successful crop growth. Furthermore, crops are grown in mixed stands that provide for almost all household requirements, from main meal ingredients to side dishes and fruit. Chambers (1983) argues that mixed stands are a complex agricultural production system developed by small-scale farmers to optimise production, something which has not always been fully appreciated by development experts. For farmers, managing resources sustainably translates into food security that encompasses a wide range of their dietary needs, including carbohydrates, proteins, minerals and vitamins. Food security is further ensured through the use of local knowledge to select varieties that are not only economically beneficial, but also include resistance to pests in storage, such as weevils. The World Bank (2007) acknowledges the importance of the local farmers' knowledge about selecting beneficial traits in crops, such that the World Development Report (2008) specifically encourages experts to involve farmers in seed selection processes. In addition, local knowledge is used to manage a wide range of agro-ecological niches at the farmers' disposal. Peters (2002) shows how farmers used niches within their gardens to improve crop yields. In this study area, farmers carefully select sites that are suitable for each crop type even though they are grown in mixed stands.

This study has found that the use of local knowledge to cultivate crops in wetlands (*dimba*) reduces the reliance on rain-fed crops, and extends the growing seasons of crops to two (one in the rainy season and the second in the dry season in the wetlands), which is consistent with observations made by Dixon (2001), while working in Ethiopia, that farmers have in-depth knowledge about managing wetlands that included extending crop growing seasons and maintaining soil fertility. Indigenous knowledge

[11] The scarcity of virgin land has led to soil colour becoming an important fertility indicator. Soils are rejuvenated through use of cassava thus reducing the need for reliance on virgin land and *Brachystegia* as a fertility indicator species

produced by farmers has several other roles and uses, such as the securing of ownership of resources, that include land, thereby consolidating the fact that indigenous knowledge is versatile and dynamic. Knowledge about cassava has evolved from knowing it only as a food crop, to it being used by farmers in the study area to restore soil fertility, as well as to secure land ownership. The ownership of the crops in the fields secures rights to land that are recognised under customary law. Local knowledge enables past experiences to influence the present in the successful management of resources; lessons learned from past experiences become useful in the management of resources in the present, despite changes in circumstances that can be social, economic and/or environmental. For example, in the past, land that was 'tired' was largely left to fallow. 'New' indigenous knowledge has been produced that involves the growing of crops which can rejuvenate the lost soil fertility and which can make putting land to fallow unnecessary. Briggs *et al* (2007) also note that farmers generate new knowledges. Farmers, who settled around Lake Nasser, are losing knowledge about the desert and are now learning new knowledges about crop farming and feeding livestock from the resources provided by the lake. In Mzuzu, because of land pressure as a result of increasing population, some farmers particularly the young generations have lost knowledge associated with shifting cultivation. Shifting cultivation is no longer practiced by many farmers, not only because cassava has been developed as an alternative crop that adequately replaces the putting of land to fallow, but also because there are limited areas where virgin lands can be opened to allow for putting 'tired' land to fallow.

The relevance of indigenous knowledge in resource management is further shown by its ability to more than double the density of crops normally recommended under modern cultivation methods, particularly mono-cropping. This can be seen, in the study area, by the recommended rate of maize planting, which is either one plant per station spaced at 25cm apart, or three plants per planting station with spacing between planting stations of 90cm apart. Traditional practices, on the other hand, more than double the number of plants per unit area, based on the symbiotic relationships between plants. Beans are planted either in the same planting stations with maize, or separate planting stations without reducing the plant population of maize. The combination of maize and beans within the same field is a rational use of scarce resources, particularly land and labour;

for example, as both crops are weeded at the same time in one operation. This also challenges the ‘superiority’ of Western scientific knowledge, as it demonstrates improvements made by traditional practices rather than recommendations made by development experts. Peters (2002) also notes that farmers consider mixed stands to be more useful than monocultures, as such mixed stands provide farmers with a variety of foods, enabling them to consume those food crops that mature early, while those that mature late are harvested later. Farmers in Malawi explained to Peters (2002) that mixed crop stands are carefully designed to utilise niches in their gardens that result in improved crop yields either by controlling pests or benefiting from crop symbiotic relationships. Of paramount importance was the fact that crops that adversely affect other crops, such as sorghum, are planted on the margins of fields or even along the boundaries to reduce their negative impacts. This is consistent with the findings of this study where farmers in Mzuzu plant pumpkins on sites that are less likely to reduce yields of other crops, while important niches like ant hills are utilised to increase yields of staple food maize, as well as enabling bananas that are planted here (on ant hills) to remain productive throughout the year, increasing food security at the household level. Pumpkin leaves mature early and are eaten as green vegetables providing vitamins to farmers, while bananas that mature throughout the year provide minerals, and maize that matures later provides carbohydrates throughout the year because it is stored after harvest.

The use of indigenous knowledge in farming practices varies between individual household and community levels. It has been developed to play an important role in decision-making and the management of the resources available to the individual farmer, but it can incorporate Western technologies. However, some farmers utilise indigenous knowledge to assess which Western technologies can be adopted, as demonstrated by the cultivation of hybrid maize. Farmers in the study area have assessed hybrid maize using local maize and have found that local maize is resistant to weevils in storage, while hybrid maize is susceptible. Farmers now combine the growing of these crops so that hybrid maize is used before it is destroyed by weevils and local maize is stored up to the next harvest. This combination of cultivating both maize varieties (local and hybrid) by farmers has an added advantage of enabling farmers to avoid ‘extra’ costs associated with purchases of pesticides.

However, indigenous knowledge can involve power contestations at various community and individual levels. It has been used as a tool for those who are considered experts to exert power over others, such as apprentices, and those who have limited access to resources. In the study area, farmers who can cultivate land put to fallow are denied the chance by their close family members who grow cassava to retain land rights. Cassava enables its owners to have power over land as a resource. Furthermore, at the household level, women have power related to gender. Pumpkins in the study area are managed by women with 'good hands' enabling them to retain power over an important food resource. Experts thus need to consider the different levels of power possessed by individuals within communities if development programmes are to be successful.

There is power in holding indigenous knowledge, which then can be seen not only to undermine the power considered in literature (see Harrison, 2001; World Bank, 2004; Briggs, 2005) to be held only by development experts as they conduct development programmes, but which complicates relationships within local communities. In the study area, farmers use local knowledge particularly concerning crop planting time to challenge the recommendations of agricultural experts. They plant maize at varying times from November to January and the corresponding results show that disease and pest incidence can be comparatively higher in the early planted maize, particularly that which is planted in November and early December, which is the agricultural experts' recommended time of planting in the study area, than in the 'late' planted maize (during the Christmas period).

There is power or a 'force' inherent in indigenous knowledge, as shown by its ability to persist despite the presence of development programmes designed to replace local knowledge with Western science. Formal education, research and extension services have been used as tools to replace indigenous knowledge with Western knowledge. The type of education underpinning local knowledge production, however, appears to be robust and effective in knowledge dissemination, even resisting the replacement of local knowledge with Western science. The robustness of training programmes underpinning indigenous knowledge require further research, so that they can perhaps be used in formal education and extension services for effective knowledge transfer.

Indigenous knowledge gives power to local people to resist change that is not seen to be beneficial. Within the community, it enables those in power to deal with problems with ease, as demonstrated by solutions applied to land disputes in the study area.

However, indigenous knowledge is largely influenced by socio-economic factors, making it dynamic as well as situation specific, a point well recognised by Beckford and Barker (2007). Thus, development programmes have to be tailor-made to suit specific situations and places, thereby increasing the likelihood of their success. Its role in development practice and theory cannot be ignored if improvements in living standards are to be realised where indigenous knowledge exists. The power it exerts on external forces means that without its use and role, expert-designed development is unlikely to be attained. Since the use of Western science and technology in development has failed to displace indigenous knowledge, Western science and technology can only benefit from using indigenous knowledge in development practice and theory. Research can be done to find ways in which Western science and technology can benefit from the incorporation of local knowledge. The low external input use by farmers, especially their low levels of pesticide use, creates opportunities to find ways of enhancing crops as a premium product so that they fetch high prices on the market, not necessarily as organic, but at least as environmentally friendly products. The measure need not necessarily be low levels of carbon footprint, but can be the lack of pesticide residues on products. Awanyo (2008), just like Dei (1993), also notes the environmentally friendly nature of smallholder farmers while working in Ghana, observing that farmers possess considerable local agro-ecological knowledge on various aspects of agricultural land management, while using modest resources to expand productivity in both an economically and ecologically sound manner.

9.2 The production, perceptions and management of indigenous knowledge

The examination of factors that affect local knowledge production has demonstrated that their impact is complex. This study has found that many factors influence the production of indigenous knowledge, including environmental factors, underpinned mainly by the influence of seasons (weather) on factors such as soil moisture, pests and diseases, by the presence of physical features such as ant hills and wetlands, cultural factors as demonstrated by the practice of reciprocal labour, and the market opportunities provided by Mzuzu city, which is adjacent to the study area.

Indigenous knowledge production is based on an in-depth understanding of the environmental, socio-cultural and economic factors by farmers. Similar observations were made by Eriksen (2007) working in Zambia, where she noted that markets influenced the smallholder farmers' production of cash crops. In addition, farmers in Zambia were also aware of the importance of fire as a management tool in the cultivation of their crops, particularly millet which benefits from ash produced from burning plant matter. Similarly, farmers in the Mzuzu study area are aware of the importance of fire in the production of millet and of the environment on crops, including rain on the increase of pests such as maize stalk-borer at the beginning of the rainy season. The rainy season provides living organisms with abundant food. It also acts as a trigger for growth of many pests, such as moulds, that infest crops. For example, scientific research has established the fact that maize stalk-borer adults (*Busseola fusca)* emerge from pupae in the last quarter of the year, which is the beginning of the rainy season in Malawi. It is therefore well understood that early planted maize acts as a good site for the moth to lay eggs, which then develop into pests resulting in a high infestation rate of the crop.

There is, however, a difference in the manner in which these factors are interpreted by users of indigenous knowledge in developing solutions to problems encountered. For example, experts believe that diseases in plants or crops can be treated with the use of pesticides, an example of scientists exercising their power to conquer nature; farmers' understandings are the same, which is that of treating the disease or pests, but only when they have no other choice. When farmers vary the planting time of crops in the study area, they are using Mother Nature to deal with pests, enabling them to live with nature, where possible, as opposed to treating crops with pesticides that can have unwanted side-effects. Dei (1993) and Awanyo (2008), as noted earlier, observed the environmentally friendly nature of resource management and crop production, something which the results of this study confirm.

For farmers, pests and diseases can be avoided or moderated which demonstrates an understanding by farmers for the need to work within the limits of nature, without necessarily conquering it. However, management practices of using less pesticide have largely been attributed to high costs, which smallholder farmers with low incomes cannot afford. Lele (1989) attributes low levels of production in southern Africa to be the result of high costs of inputs including pesticides, and, for her, development is to be achieved through increased input use through the provision of credit to smallholder farmers. However, this study has shown that, although costs of inputs such as pesticides can be a limiting factor in adopting their use, farmers deliberately 'experiment' to generate alternative knowledge, with 'experimentation' increasing the options available to farmers in their agricultural management practices. The resultant availability of alternative measures in their general management practices (agricultural and domestic) is of paramount importance to farmers as it enables them to prepare for a range of eventualities. This finding of farmers' need for a variety of options to prepare them for a range of eventualities calls for creation of informal schools where farmers can share their 'local knowledges' with each other as well as with development experts. Development experts can then spread the 'local knowledges' beyond the point of production, mindful of the need to be sensitive to 'local knowledges' having to be adapted to different environments.

Knowledge production in this study is based on systematic, careful and detailed observations made over a long period of time. Phuthego and Chanda (2004) note that Bushmen in Botswana generate local knowledge by observing the condition of plants that are then linked to animal behaviour. Some plants lost leaves as a result of birds eating them, while others were uprooted by wildlife in the dry season because they were essential food for animals in the dry season. The observations of the Bushmen of their major source of food (wildlife) are made throughout the year. Similarly, farmers in the study area who cultivate crops make observations to produce knowledge throughout the year, from seed selection at the beginning of the rainy season to storage and consumption in the dry season. In the field, farmers carefully look at plants such as maize and note the number of cobs per plant and those plants that have no cobs. This is recorded in memory and forms part of the knowledge on crop yield. The number of conical heaps made after cutting maize to harvest are recorded in memory as part of the process in estimating yields. During harvesting the numbers of baskets carried to the storage facilities are noted and the level of maize in storage facility is linked to the number of baskets put into the facility. When farmers start using the maize in storage for consumption, the decrease in the levels of maize in storage is linked to both the number of baskets put in, as well as the number of days it has taken to consume the food taken out of the storage. The details from these observations in total contribute to knowledge on crop yields necessary for household consumption needs. The methods and tools used, such as baskets, may be of varying sizes and thus not precise in measuring yields up to the standards envisaged by agricultural experts, but it is useful to farmers and it is utilitarian in nature. The knowledge produced in communities is based on measurements they understand.

The observations made above about farmers' measuring techniques and the study as a whole contribute to the debate raised by Escobar (1995:98) who argues that the remaking of development must start by examining local constructions to the extent that they are the life and history of the people, which is the condition for and of change. Understanding farmers' practices and the empirical evidence underpinning them can help experts achieve development by examining local constructions as suggested by Escobar (1995). In addition, there is a suggestion in this study that it is not enough to listen, learn and respect rural people's priorities, as Chambers (1983:10) argues for, but it has to be realised that development is already taking place using indigenous knowledge in most communities, so that the application of Western knowledge may not be used as though it is filling a vacuum, but must reflect that knowledge existing in the communities is well-tested and ready to be applied in the process of development.

This study has established that indigenous knowledge can be traded as a commodity. Indigenous knowledge in the study area is protected by some farmers in a manner similar to patenting rights. Some farmers sell remedies but do not share the knowledge about the ingredients in those remedies, thereby maintaining monopoly over knowledge so that they can charge a price of their choice. In these circumstances, in Mzuzu there is a capitalist element of production in indigenous knowledge. This is an interesting finding because there appears to be differentiated community responsibility to maintain indigenous knowledge production to support community survival, which is based on free knowledge-sharing, while, at the same time, there is specially protected knowledge for sale.

9.3 Indigenous knowledge and development

The study has shown that indigenous knowledge helps farmers both to 'survive' and to make a living under subsistence and market-oriented production systems. Farmers are producing sufficient food with surpluses for sale using local knowledge. Of paramount importance is the manner in which farmers utilise Western and indigenous knowledge to complement each other in their agricultural management practices. Farmers do not see these knowledges as separate and antagonistic in nature. For farmers, there are no tensions between indigenous and Western knowledges, such that it can be argued that the tensions between scientific and indigenous knowledge only exist in the minds of researchers and development experts. Agrawal (1995), Sinclair and Walker (1999) and Briggs (2005) have pointed out that the divide is based on the epistemological foundations of the two knowledge systems. At the level of farmers, the debate about epistemological foundations is non-existent, because knowledge is assessed for its usefulness under practical conditions in their everyday farming practices. For farmers, the knowledge is either useful, which means it is then applied in their agricultural management practices, or useless, and it is consequently discarded. Farmers test and evaluate knowledge before it is accepted and the basis of accepting knowledge is not its origin. Knowledge that is not tested, whether indigenous or Western, is treated with suspicion until it demonstrates its viability and usefulness under farmers' farming conditions. Farmers choose aspects of both Western and indigenous knowledges as they best suit their specific conditions and places. The fact that farmers recognise that knowledge can be suitable for their specific conditions and places implies that development 'must' in turn be implemented in specific places and locations. Development programmes, therefore, have to be designed and implemented to suit the conditions of given specific areas, and this means that it also has to suit the needs of each individual farmer. Some development experts, however, sometimes consider indigenous knowledge to be too place-specific to be of much theoretical use, or, indeed, of much developmental value beyond the particular location.

However, when there is a need to apply indigenous knowledge on the wider scale beyond its origin of production, it has to go through an adaptation process, which is similar to the knowledge production process by the communities who produced it. It simply has to be retested, re-evaluated and adapted to suit the new conditions and situations. In so doing, it retains the notion that it is place-specific and situation-specific, which is an important aspect for indigenisation, because it then becomes local knowledge. The need for indigenous knowledge to be applied only within its economic, political and cultural context, as suggested by Adams *et al* (1994) and Bebbington (1993), precludes the ability to re-work indigenous knowledge to suit the new conditions to which it is being applied. This study has shown that farmers apply knowledge gained from outside the study area in their farming practices. It is safe, therefore, to conclude that indigenous knowledge, just like Western scientific knowledge, can be transferred beyond its place of production. However, it has to be borne in mind that such knowledge has to go through a rigorous validation process by farmers that involves the assessment, evaluation and acceptance stages, before it is adapted and/or adopted. The process of adaptation and/or adoption can be seen as fine-tuning knowledge to suit new economic, cultural and environmental factors. The process of adaptation and/or adoption also confirms that farmers are active participants in knowledge production, and therefore active participants in their own development.

The study has shown that, contrary to the widespread belief that indigenous knowledge has rarely been of viable use in economically productive agriculture (see Beckford, 1985; Bebbington, 1993), it has been well utilised by farmers in the study area to produce crops and livestock for commercial purposes. To this effect, the local production systems used in *dimba* have been well-utilised by farmers to produce sugarcane for sale, while some farmers have engaged in commercial poultry production by using indigenous knowledge to reduce costs. It is a small step to accept that some commercial development can take place not only using Western technologies but also with the use of indigenous knowledges.

Development programmes that promote either the separate use of these knowledges, or the replacement of one by the other, are likely to fail from the outset. It is, therefore, not surprising that modernisation has largely failed to transform small-scale African agriculture, because it has relied on replacing indigenous knowledge with Western (modern) technologies. This has left development experts lagging behind farmers who use these two knowledges where appropriate after evaluation. In some ways, experts also lag behind farmers' expectations and realities in terms of developing programmes that need to take into account farmers' nature of knowledge production and acquisition, particularly when they either only rely on their own knowledge and/or exclude farmers in some stages of development. Chambers (1983) also noted that the outcome of the exclusion of farmers' inputs by experts was that development programmes initiated were inappropriate and irrelevant. The study has shown that it is important for farmers to participate in development because it 'almost guarantees' the success of programmes initiated by experts, a finding that is consistent with observations made by Harrison (2001), who also noted that the success of expert-initiated development programmes, was ensured by the incorporation of inputs from farmers.

Indigenous knowledge is still perceived as static and a symbol of ignorance by researchers and extension workers in the study area despite its successful use by farmers (at the farm level). Indigenous knowledge is seen by these development experts as a major barrier to the adoption of Western technologies, such as pesticides, by farmers in the study area. Indeed, these experts in the study area are still failing to acknowledge the importance of local knowledge in agricultural production.

Meanwhile, the emphasis on economic growth by experts has relied on prescribing external solutions to farmers. There is a series of steps and stages set out by experts for farmers to follow if they are to achieve the main goal of economic growth. In this study, this is manifested by experts promoting the growing of crops or rearing of livestock for income generation, almost as if development is only synonymous with increased incomes. Experts have largely ignored social and cultural factors that farmers value as part of development. The improvement of the quality of life of farmers, measured in the form of free time and self-sufficiency in all dietary needs, has been largely ignored by development experts with their emphasis on cash generation. Beckford (2002), Beckford *et al* (2007) and Beckford and Barker (2007) have all argued that farmers see progress in more than just economic terms, and, in particular, they prioritise the achievement of food security at the household level. Social and cultural values are included in farmers' efforts to achieve economic progress. It is clear from this study that farmers need more meaningful options from which to choose, rather than being given prescriptions. For farmers, cash income is not sufficient as a measure of progress or development. This study has shown that farmers value their way of life, although some literatures portray them as struggling to make a living. Portraying farmers as struggling to survive can be not only inappropriate, but also unhelpful.

The study has established another problem associated with experts' emphasis on increased production for the market to generate income. Farmers' order of priorities is first to produce sufficient for consumption, and only then to sell the surplus to generate income. The emphasis by experts on market-oriented production might be appropriate for expert-led economic growth, but, for farmers not prioritising this, it is much less relevant. This implies that farmers' valuation of resources, such as food, is based on intrinsic values embedded in food. Escobar (1998:168) alludes to this point indirectly when he argued that the peasants' economy is geared towards the satisfaction of the needs defined qualitatively, while Western technology and science is based on exchange value with its drive towards accumulation and profit. It is important that this gap has to be recognised and addressed if meaningful development is to be achieved in local communities.

From this study, there is an indication that when resources, particularly land, become a limiting factor for sufficient food production at the household level, and results in it being difficult to feed families, farmers will produce for the market to generate incomes needed to buy the food required by their households. This behaviour of farmers is in line with most development programmes in the past which have been planned and implemented, based on the understanding that factors of production are in limited supply, a point also noted by Power (2003:30), who said that for modernists, production is a function of land, labour and capital. Indeed, Beckford (1985) notes that smallholder farmers in Jamaica occupied lands that were not only small (about 5 acres which is equivalent to 2 hectares), but also infertile so that their agricultural production was limited by soil fertility as well as small land holding size. In situations where factors of production are in a limited supply, experts believe that progress can only be made by producing for the market.

Another conclusion from this study is that farmers produce evidence-based knowledge that is verifiable using Western technologies. The fact that some of the farmers' knowledge is verifiable using Western technologies means that it is unhelpful for experts to classify indigenous knowledge as backward, as such knowledge is in line with Western understandings. The results of soil analysis carried out during this study show that farmers' knowledge of soil fertility is comparable to Western ways of knowing. Osanude (1994) working in Swaziland also established a link between farmers' soil knowledge with that of soil scientists. There was a resemblance in the way farmers understood soils in terms of properties that was similar to the scientific ways of classifying soils. The farmers' knowledge is, therefore, comparable to that of Western scientific knowledge; hence farmers have the necessary capacity to make decisions concerning development. Bearing this in mind, it becomes necessary for development experts to maintain the important role of introducing and promoting modern technologies (such as chemical fertilisers), where they are most effective, and leaving those at which farmers are equally conversant. Such an approach to development can reduce tensions between scientists and farmers, and generate trust and respect for each other that can be important in development processes. Many studies, including this one, have shown that there is little trust between farmers and development experts that contribute to failures of many development programmes. As noted above, Harrison (2001) and Peters (2002) also allude to the need for trust and respect between farmers and experts. In Malawi, Peters (2002) noted that farmers did not trust experts to show them fields on which tobacco was grown in mixed stands, because they advised and insisted on growing tobacco as a monoculture, a situation farmers had proven to be an inefficient way of using their resources.

However, the mode of delivery and introduction of modern technologies need to be improved, and this can be achieved when development experts become facilitators and realise that farmers are active participants in the choice and development of technologies. This form of modernisation can allow farmers to choose the best combination of Western and indigenous knowledges. After all, it has been established in this study that farmers already incorporate Western technologies in their farming practices; it therefore becomes a small step to make for development experts to utilise both bottom-up and top-down approaches to development, with development experts becoming facilitators rather than dictators of those technologies that farmers adopt. These findings, as noted earlier, contribute to the debate that farmers base their decision-making on empirical evidence; that they 'experiment' and make careful observations so that their farming practices are more complex than some experts believe, and, as such, it is now the time for experts to become facilitators of development.

The danger with defining development in the Western ways of knowing lies in superimposing ways of knowing of the West on the global South that discounts the use of indigenous knowledge in favour of science and technology, as if there is no science and technology in indigenous knowledge. There is nothing wrong with this, except that past experience with development programmes has shown that external forces for change have frequently not improved the living standards of the local people in the global South.

9.4 The challenges of indigenous knowledge

The lack of understanding by development experts in the study area concerning the farmers' assessment and evaluation of modern technologies can be attributed to the lack of written record-keeping by farmers. The findings in this study that farmers do not keep records, and thus sometimes fail to progress, concur with results of a World Bank study (2004), which found that farmers are unable to make incremental gains on their 'experiments' largely due to lack of record-keeping. This is further compounded by the very nature of indigenous knowledge to try to accommodate nature rather than control it. This makes the knowledge held by farmers to be considered as a performance of events over time, rather than a series of planned activities using past experiences. Again, lack of record-keeping makes it difficult for experts to believe that the farmers' current research work and farming practices are based on past experiences. Furthermore, the nature of farmers' 'experiments', such as planting crops behind bathrooms and other places where there is a continuous water supply, makes it look as though the practices adopted are done so by chance. This chance factor is amplified and not understood as an ‘experiment’, particularly when the crop concerned is perennial in nature such as fruit trees which cannot easily be uprooted when they fail to be productive, either because they can then be used to provide shade, which is an important aesthetic factor for farmers in the hot months (which is completely different from the original plan of trying to learn the management of the fruit tree), or be used as a land boundary marker or simply maintained over a long period of time such as one’s life time because the ‘experiment’ is not yet completed. This fluidity of indigenous knowledge production systems becomes difficult to comprehend when development experts are conditioned by training to think that farmers are ignorant. Development experts then fail to see the logical thinking that underpins farmers’ ‘experiments’, activities and practices. Perhaps there is a need to debate more fully with development experts the *nature* of IK.

Despite these challenges being linked to the limitations of development expert training, there are genuine inherent difficulties with indigenous knowledge. The scale of the ‘experiments’ is small because of geographical limitations. Smallholder farmers in the study area cultivate on average above three hectares (3.9 ha). Ngwira (2003) and Chirwa (2005) suggest that in some parts of Malawi, especially in the southern region, farmers cultivate less than one hectare. Consequently, the size of samples and replications may be too small for statistical inferences made to be reliable. In addition, the observations made by farmers in the study area, for example, are limited by what the naked eye can see, such as pests in maize crops, a point also noted by Chambers (1983; 1993) and Chambers *et al* (1989). The production of indigenous knowledge is largely based on what can be seen and not based on the small elements that constitute the whole, such as soil fertility being largely determined by nitrogen levels. Nitrogen in the soil cannot be seen with the naked eye. In addition, the equipment used to measure nitrogen has not been adapted for use by the local farmers, either because of associated costs or in order for experts to retain their roles as advisors in development processes. The use of penicillin and soap by farmers to control diseases in livestock requires research as to when it can be safe to consume meat or eggs after livestock have been administered with these (penicillin and soap) products.

Indigenous knowledge associated with food production that ensures self-sufficiency at both household and community levels has not been adequately understood and recognised, probably because food reserves at the world scale have been adequate and corresponding prices low and steady over the past thirty years. Harrison (2001) observes that peasants in Africa have been marginalised by crop prices falling since the 1980s. The case is further demonstrated by BBC (2008) which produced a graph that shows food prices being high in 1973 following an increase in the price of oil, but decreasing ever since to levels below those of 1973. In Sub-Saharan Africa, low food prices formed part of the major constraints to development that included the limited use of modern agricultural inputs, land tenure, seasonal markets and lack of government financial support (Morgan and Solarz, 1994). The current low world food reserves and rising food prices makes food suddenly a conspicuous item that commands higher prices than before, thereby putting into the forefront the importance attached by smallholder farmers to meeting their food requirements at the local level (see BBC, 2008). The situation at the individual and community levels in the study area, and probably in many low income countries, may not have changed as food remains a major concern that may not be sourced at the market place for fear of the unknown and the preference of farmers to obtain satisfaction from producing adequate food at the household level. This is consistent with findings by Mtika (2000), who, while working in Malawi, observed that farmers provided labour to those with adequate land so that they become self-sufficient by sharing the jointly produced food. The challenge for indigenous knowledge is therefore to remain at the forefront, even when its basis and foundation of utilisation is questioned by experts. This phenomenon of food crisis provides an opportunity for further research on how indigenous knowledge can respond to achieving food security during the current high global food prices. Furthermore, there is need for further research as to how IK can be used to respond to the diminishing virgin land in the study area and across the globe where development is affecting virgin areas, threatening food production at both local and global scale. Virgin lands are important sources of firewood, wild fruits, local herbal medicines, wildlife and are a beautiful part of nature worth preserving. The products found on virgin lands need to be conserved and protected so that they are available for utilisation to the present as well as future generations.

Scientific research attracts recognition and respect as a result of publications and research stations have to live by this expectation (see World Bank, 2004).

Unfortunately, this translates into indigenous knowledge being undervalued and assumed to have ‘less power’. The technology being used at the Lunyangwa research station to control livestock diseases is not published because it is practised in a ‘non-scientific’ manner. Yet the farmers and research assistants are not active participants in publishing papers in academic journals. Whose knowledge therefore counts? And what is development then if it ignores the increase in knowledge of farmers? It is not surprising then that Mohan and Stokke (2000) argue that Western science has silencing effects. Further, research needs to be done to find out how indigenous knowledge could be included in publications that are acceptable to both the local farmer and the academics.

In the specific context of Malawi, further research might usefully be undertaken in two important areas. Firstly, how has the closure of Commonwealth Development Corporation activity in 2003 impacted on smallholder agricultural production in Malawi, and especially how has this closure of activity impacted on local knowledge production? Secondly, although biofuel production in the 1970s was very much in the hands of Lonrho, in the last couple of years opportunities have emerged for smallholders to become involved in biofuel production. In this context, how might smallholders engage in this sector, and how might local knowledge be used, and how might it evolve, to support such engagement?

Finally, there is a clear need to weigh the positive contributions of indigenous knowledge against their negative ones, in the sense that, for many in Africa, the use of indigenous knowledge has not necessarily transformed their lives. However, for many others, nor has the use of formal, western science and technology. An important task for future research, therefore, is to ensure that indigenous knowledge is fully valued in the development process, and that we carefully describe and evaluate such knowledge so that it contributes fully to development without the need for farmers to have to keep “re-inventing the wheel”. How we might go about this is a pointer to future research.

Appendix A. Questionnaires and interview guides

QUESTIONNAIRE FOR SMALLHOLDER FARMERS

General Information

1. What crops do you grow?

Crop	Hectares

2. What type of livestock do you keep?

Livestock	Numbers
Cattle	
Goats	
Pigs	
Chicken	
Ducks	
Rabbits	
Pigeons	
Sheep	
Guinea fowls	

Traditional ecological knowledges.

3. How do you control pests and diseases in crops?

Pesticides	
Varying planting time	
Field rotation	
Resistant local varieties	
Trap crops	
Locally made pesticides	
Cropping pattern	
Any other	

4. How important are the following in controlling pests and diseases in crops?

Control method	Very important (4)	Important (3)	Neutral (2)	Unimportant (1)	Very un important (0)
Pesticides					
Varying planting time					
Field rotation					
Resistant local varieties					
Trap crops					
Locally made pesticides					
Cropping pattern					
Any other					

5. Which methods are no longer used?

6. What pests and diseases did you observe this season in crops?

Crop	Pest	Crop	Disease

7. How important were they?

Pest	Very important (4)	Important (3)	Neutral (2)	Unimportant (1)	Very unimportant (0)

Disease	Very important (4)	Important (3)	Neutral (2)	Unimportant (1)	Very unimportant (0)

8. How did you control them?

Pest and crop	Control	Disease and crop	Control

9. From whom did you learn methods of disease and pest control mentioned above?

Sources: Extension, Research, NGOs, Friends, Relatives, Parents, Any other/specify

Control method (pest and disease)	Source of knowledge

10. How important are these sources of information?

Source	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)

11. How many times did you plant beans in 1970s

	Once	Twice	Three times
Upland			
Dimba/dambo			
Elsewhere (around house)			

12. How many times do you plant beans in a year today?

	Once	Twice	Three Times
Upland			
Dimba/dambo			
Elsewhere			

13. What are the reasons for the changes?

14. How do you control livestock pests and diseases?

Pesticides	
Resistant types of livestock	
Resistant breeds	
Exclusion zones	
Locally made pesticides	
Positioning of housing	
Any other means	

15. How important are the following in controlling livestock pests and diseases?

Method	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)
Pesticides					
Resistant types of livestock					
Resistant breeds					
Exclusion zones					
Locally made pesticides					
Positioning of housing					
Any other means					

16. What pests and diseases did you observe this year?

Livestock	Pests	Livestock	Disease

17. How important were they?

Pest	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)

Disease	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)

18. How did you control them?

Pest	Control	Disease	Control

19. Which methods are no longer used?

20. From whom did you learn methods of disease and pest control mentioned above?

Sources: Extension, Research, NGOs, Friends, Relatives, Parents, Any other/specify

method	Source	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)

Factors affecting use and evolution of traditional ecological knowledges.

21. How many fields do you have?

One
Two
Three
Four
Five
More than five.

22. What crops are grown in the fields mentioned?

Field	Crops grown	Reason

23. Why are these crops grown in the mentioned fields?
    - Type of soil (sandy, loam, clay)
    - Isolated place
    - Fewer incidences of pests and diseases
    - Near to my house
    - Water availability
    - Any other/specify?

24. What is the total size of your farm operations?
    - Half hectare or below
    - Above half hectare
    - A hectare
    - More than a hectare
    - Above two hectares

25. How important are the following in influencing decisions in pest and disease control in crops?

Category	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)
Friends					
Relatives					
Chemical Companies					
Extension staff					
Research staff					
NGOs					

26. Which group of income do you place yourself in?
    - High
    - Low
    - Medium

27. What value of income in Malawi Kwacha (per year) falls in the categories mentioned above?

28. How far did you go with formal education?
Primary (mention class attended)
Secondary (mention class attended)
Tertiary (mention level attended)
Any other (e.g. artisan training)

Tensions between scientific and local knowledge

29. How do you define damage as a result of pest and diseases in crops?

30. When normally do you expect first rains?

31. What are the signs for the onset of rains in your area?

32. How do you rate the different sources of knowledge with regard to forecasting the on the onset of rainy season?

	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)
Own knowledge					
Met Department					
Agricultural officers advice					
Friends/other villagers					
Any other					

33. When do you normally plant your maize crop (verify with extension records at ADD)?

34. Why do you plant at this particular time?

35. What is the official advice on when to plant your maize crop?

Plant with the first rains
Dry plant
Plant around Christmas
Flexible (depending on the on set of the rain)

36. How do you rate the importance of the above time of planting?

	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)
Plant with first rains					
Dry plant					
Plant around Christmas					
Flexible depending on rain					

37. How important is your knowledge in time of planting as compared to advice from technical staff?

	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)
Own Knowledge					
Extension staff					
Any other					

38. What are the objectives of in controlling pests and diseases in crops and livestock?

Livestock						
Objective	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)	Comments
Higher output						
Reduced environmental damage						
Higher profits						
Food security						
Higher quality						

Crops						
Objective	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)	Comments
Increased yields						
Reduced environmental damage						
Higher profits						
Food security						
Blemish free						

Demographic data

39. What is size of your household?

40. How many members of you household are currently not residing with you?

41. What is the age distribution?

42. What is the gender distribution?

43. What levels of education have they achieved?

Category			Non	Primary (class)	Secondary (class)	Tertiary (level)	Any other (level)
Name	Age	Sex					

QUESTIONNAIRE (GUIDE) FOR EXTENSION STAFF

Traditional ecological knowledges

1. What methods of pests and disease control are currently used in crops and livestock production?

Crops				Livestock			
Pest	Method	Disease	Method	Pest	Method	Disease	Method

2. Which of the above are scientific and which are traditional ecological knowledges?

3. What methods of pest and disease control in crops and livestock are no longer in use? Why not?

4. What methods of pest and disease control have you observed being used by smallholder farmers in your area?

Crops		Livestock	
Pest	Disease	Pests	Disease

Factors affecting use and evolution of traditional ecological knowledges.

5. Which technologies in pest and disease control in crops have been developed with small-scale farmers input?

6. Which technologies in pest and disease control in livestock have been developed with small-scale farmers input?

7. (i) Which crops are no longer grown in the area as a result of disease or pest incidence?

(ii) Which types of livestock are no longer reared in the area as a result of disease or pest incidences?

8. How do you define damage as a result of pest and disease incidence in crops?

9. What factors influence farmers' choice in disease and pest control methods?

10. How do you rate factors that influence farmers' decision-making in disease and pest control in both crops and livestock?

Crops

Factor/Rate	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)
Extension training					
Farm size					
Field position					
Soil type					
Cost of pesticide					
Education					
Household size					
Experience					
Any other					

Livestock

Factor/Rate	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)
Extension training					
Type of disease or pest					
Field position					
Livestock numbers					
Cost of pesticide					
Education					
Household size					
Experience					
Any other					

Tensions between scientific and traditional ecological knowledges.

11. Does training in your field cover both scientific and indigenous methods of pest and disease control in crops and livestock?
If not/why?

12. What methods of pest and disease control in crops and livestock are classified as indigenous and which methods are classified as scientific?

13. What methods of disease and pest control in crops and livestock did you find farmers practising?

14. Which of the above mentioned methods do you recommend or disapprove based on your training?

15. Which methods of disease and pest control in crops and livestock do you promote as a technical advisor to small-scale farmers?

16. What are the objectives of the organisation in controlling pests and diseases in crops and livestock?

Livestock						
Objective	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)	Comments
Higher output						
Reduced environmental damage						
Higher profits						
Food security						
Higher quality						
Any other						

Crops						
Objective	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)	Comments
Increased yields						
Reduced environmental damage						
Higher profits						
Food security						
Blemish free						
Any other						

17. What is the policy on indigenous (ecological) methods of pest and disease control in crops and livestock?

18. What is the advice on time of planting of maize?

Plant with the first rains

Dry plant

Planting around Christmas

19. How do you rate this advice?

	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)
Plant with first rains					
Dry plant					
Planting around Christmas					
Flexible depending on rain					

QUESTIONNAIRE GUIDE FOR NGOS

Traditional ecological knowledges.

1. What methods of pests and disease control measures were being practiced in the area before the project came into the area?

Livestock				Crops			
Pest	Control	Disease	Control	Pest	Control	Disease	Control

2. What methods are still being utilised by farmers in pest and disease control in crops and livestock (each crop and each type of livestock)?

Livestock				Crops			
Disease	Control	Pest	Control	Disease	Control	Pest	Control

3. Which of the above would you classify as traditional ecological methods of disease and pest control and which ones would be classified as scientific methods?

Scientific	Indigenous	Comment

Factors affecting use and evolution of traditional ecological knowledges.

4. What are the objectives of your programme in the area?

5. What advice is given to farmers on pest and disease control in crops and livestock?

Livestock				Crops			
Disease	Advice	Pest	Advice	Disease	Advice	Pest	Advice

6. What methods were recommended as control measures for pests and diseases in crops and livestock before NGO's project or programme was put in place?

Livestock				Crops			
Pest	Method	Disease	Method	Pest	Method	Disease	Method

7. What crops and types of livestock are promoted in NGO's programme and projects and why?

8. Does the organisation provide extension staff in the area?
If yes, what is their role?

9. What type of advice do these give to farmers on pest and disease control in crops and livestock?

10. Which other bodies do you collaborate with?

Government extension staff,
Fellow NGOs
Research staff
Any other

Tensions between scientific and traditional ecological knowledges.

11. What are the objectives of the organisation in controlling pests and diseases in pests and livestock?

Livestock						
Objective	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)	Comments
Higher output						
Reduced environmental damage						
Higher profits						
Food security						
Higher quality						

Crops						
Objective	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)	Comments
Increased yields						
Reduced environmental damage						
Higher profits						
Food security						
Higher quality						
Blemish free						
Any other						

12. What are the main messages to farmers on disease and pest control in crops and livestock (and rate them as above)?

Livestock			Crops	
Objective	Disease	Pest	Disease	Pest
Use pesticide				
As recommended				
Eradicate				
Escape				

(Use pesticides, use recommended methods of pests and disease control, eliminate diseases and pests, avoid diseases and pests)

13. What measures are put in place when disease and outbreaks occur (and rank them on a scale of 0-4)?

Provision of pesticides,
Seclusion of the area

14. What local knowledges did you find farmers using in pest and disease control in crops and livestock when the organisation came in the area?

15. Which of these are still in use?

16. Why have some of local methods disappeared and (rank them as above in terms of importance)?

Extension advice
Less effective
Forgotten them
Elders do not pass them on
New generations refuse their use.

QUESTIONNAIRE GUIDE FOR RESEARCH STAFF

Factors affecting use and evolution of traditional ecological knowledges.

1 .Which methods of disease and pest control in crops and livestock have been based on farmers' local knowledge?

2. What methods of pest and disease control in crops and livestock do you discourage farmers from using?

3. Which methods do you promote?

4. Please classify the above as traditional ecological knowledge and scientific knowledge.

5. What is the policy on pest and disease control in crops and livestock regarding the classification in question four above?

Tensions between scientific and traditional ecological knowledges.

6. What technologies in pest and disease control in crops and livestock have been developed using local knowledge of farmers?

7. What technologies in pest and disease control in crops and livestock are being researched on having been observed as being used by local farmers?

8. How do you define damage from pest or disease infestation and infection?

9. How do you rate the following advice for maize crop that is rain fed?

	Very important (4)	Important (3)	Neutral (2)	Not important (1)	Very unimportant (0)
Planting with first rains					
Dry plant					
Plant around Christmas					
Flexible depending on rain.					

10. What are the farmers' objectives in pest and disease control in crops and livestock? Please rank them as above.

QUESTIONNAIRE GUIDE FOR CHEMICAL COMPANIES

1. What products do you promote for control of pests and diseases found in the area?

2. What methods of pest and disease control were used by farmers before products you promote were available?

2. Do you have follow up programmes on use of your products?

3. What is your policy on the promotion of your products used?

Appendix B. Maps of the study area

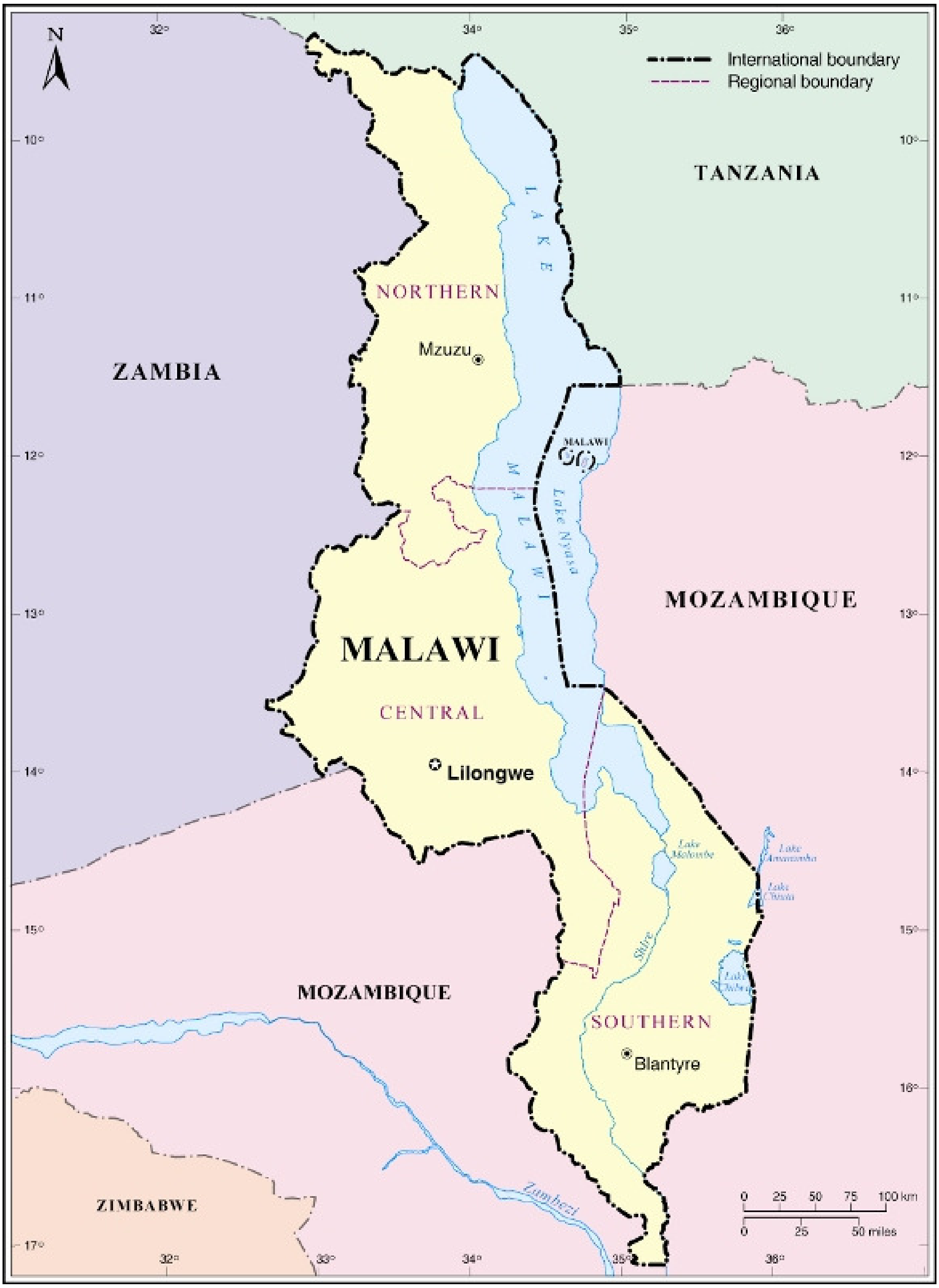

Figure 1. Map of Malawi and its 3 regions

Figure 2. Map of northern Region of Malawi

Figure 3. Cultivated areas versus natural vegetation cover

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