THE CONTRIBUTION OF INDIGENOUS KNOWLEDGE PRACTICES TO HOUSEHOLD FOOD PRODUCTION AND FOOD SECURITY: A CASE OF OKHAHLAMBA LOCAL MUNICIPALITY, SOUTH AFRICA

by

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DECLARATION

I, Sthembile Ndwandwe hereby declare that this dissertation submitted at the University of KwaZulu-Natal has not been previously done in this University or any other institution. All the information on it is my work and what is not my work is acknowledged.

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Signature

Date: 28/11/2013

I agree to the submission of this dissertation,

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Signature

Date: 28/11/2013

Supervisor: Dr Maxwell Mudhara

ABSTRACT

Indigenous Knowledge Practices (IKPs) in farming have an effect on household food production and food security. The objective of this study was to investigate IKPs used by smallholder farmers in the production of and access to food and their effects on household food security. The study was conducted in five villages of the Okhahlamba Local Municipality (OLM) under UThukela District of KwaZulu-Natal, South Africa. The villages were selected because their households were engaged in smallholder farming. A mixed method approach was used to collect data. Case studies were used as a preliminary study, followed by a survey questionnaire completed by 100 randomly selected households.

The use of IKPs was identified in the whole production system, such as pest management, weeding management, soil fertility management, seed sources, land preparation, storage and processing of the harvest. Households used the IKPs in combination with conventional practices to suite their farming systems. Binary Logit Regression Analysis was used for determining the effects of IKPs on food availability. The results show that traditional pesticides ($P<0.01$), intercropping ($P<0.01$) and grain storage in tanks without repellents (10% level) had a significant effect on food availability. Household characteristics such as land size ($P<0.05$), household size (10% level) and income ($P<0.01$) also had significant effects on food availability.

Household characteristics such as land size, household income and age of the household head were the main determinants of the use of the IKPs in smallholder farming. Even though households used more IKPs compared to conventional practices in their food production systems, overall, the results showed that households prefer conventional practices. Households rated both IKPs and conventional practices as effective in food production. It was concluded that the use of IKPs is not based on access to finances but on farmers' perceptions of their effectiveness and trust in the local practices.

The study recommended that agriculture policies must acknowledge indigenous knowledge practices in smallholder development programmes and specific policy interventions to promote the IKPs must put focus on enhancing socio-economic factors such as land, and assisting farmers in improving practices such as postharvest storage facilities. Identification of a distinctive role of indigenous knowledge farming in light of relatively new concepts such as sustainable agriculture, organic agriculture, agroecology, and green economy will be essential in recognizing it role in food production and transitioning South African agriculture to alternative forms of farming in light of climate change mitigation and adaptation policies.

Keywords: indigenous knowledge practices, conventional practices, smallholder farmers, household food security; household food production

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LIST OF ACRONYMS

DAFF	Department of Agriculture Forestry and Fisheries
FAO	Food Agriculture Organization
GHS	General Household Survey
GMOs	Genetically Modified Organisms
Ha	Hectares
HH	Household
IFAD	International Fund for Agriculture Development
IKS	Indigenous Knowledge Systems
IKPs	Indigenous Knowledge Practices
OLM	Okhahlamba Local Municipality
PRA	Participatory Rural Appraisal
SA	South Africa
UN	United Nations
USAID	United States Agency for International Development

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CHAPTER 1: INTRODUCTION

1.1 Background

The prevalence of food insecurity has been of great concern worldwide, and has emerged as one of the key development challenges in Africa (Crush and Frayne, 2010). For more than 20 years the continent has been fighting hunger and food insecurity (FAO, 2013). South Africa, is one of the few food secure countries in Africa, however the country experiences food insecurity at a household level (Hart, 2009). Van Zyl & Kristen (1992) suggested that there was a need for South Africa to aim at achieving food security at both national and household levels. National food security suggests that South Africa is able to manufacture, import, retain and sustain food needed to support its population with minimum per capita nutritional standards. Household food insecurity in South Africa suggests that the country has a predominance of unavailability of food in some homes or lack of access to food, and household members live in hunger or fear of starvation (Labadarios *et al*., 2009, Anderson, 1990, Radimer *et al*., 1990).

The South African government has responded to food insecurity with a number of programmes targeted at improving household food security and has produced a food security policy rooted in Section 27, 1(b) of the bill of rights (DAFF, 2013). Section 27, 1(b) state that "every citizen has a right to access to sufficient food and water, and the state must take reasonable legislative and other measures within its available resources to achieve the realization of this right" . In spite of the government development programmes , about 61 percent of the rural communities still survive below international poverty line of US$2/day which can be translated to about R1500 a month for an average household of four members (DRDLR, 2012) and these households are predominantly food insecure (Jacobs, 2012).

Evidence from the Comprehensive African Agricultural Development Program (CAADP) established in 2002 and the South African, Comprehensive Rural development Plan (CRDP) established in 2009, suggests that smallholder farming is one of the main pillars for rural development and key to improving food security.

Ruel *et al* (1998) indicated that households access their food from supermarkets, subsistence production, and other households and from public programmes. The increasing food prices from supermarkets which, according to Reardon *et al*. (2003), are a rising medium for food access in Africa, and increasing unemployment in rural and peri-urban communities, leaves subsistence food production as a viable strategy for ensuring food access and income generation to meet other household requirements (Aliber & Hart, 2009). Support for smallholder or subsistence or semi-subsistence farmers is of critical importance (Aliber & Hart, 2009, Matshe, 2009), but it has been accompanied by a neglect of indigenous knowledge systems.

Indigenous Knowledge Practices (IKPs) play a crucial role in smallholder farming in Africa (Oniang'O *et al*., 2004). Indigenous knowledge is defined as knowledge that includes the social and natural wellbeing continually influenced by local creativity, experimentation and by contact with external systems (Agea *et al*., 2008, Mercer et al., 2007). Literature on food security and indigenous knowledge advocate that food insecurity in the continent can be mitigated and sustainably reversed through the use of indigenous knowledge in farming (Agea *et al*., 2008, Hart and Vorster, 2006, Hart, 2011, Modi et al., 2006, Oniang'O *et al*., 2004, Thamaga-Chitja *et al*., 2004, Vorster *et al*., 2008, Vorster and Van Rensburg, 2005). Most governments however, ignore the role of indigenous knowledge practices in agricultural policies, farmer support systems and rural development. In South Africa, conventional practices are promoted in both commercial and smallholder farming at the expense of indigenous knowledge. The development of smallholder farmers in this case is directed to match the current modern agro-food systems, taking the smallholder systems as underdeveloped and minimising the role of indigenous knowledge (Greenberg, 2013). Hence there is a need to accentuate the contribution of IKPs on smallholder food production and food security.

1.2 Problem statement

Use of indigenous knowledge in agriculture has gained ground in research as one of the options for achieving food security, and studies such as Sakala (2000), Pitakia & Kama (2002); Mkhabela (2003), Martinkova *et al* (2006), Gresta et al (2007), Ghoudzi (2010), Feyssa *et al* (2011) and Ibitoye (2011) have been carried out on indigenous knowledge and smallholder farming. However only few studies have linked indigenous knowledge to food security in SA, and have focused mainly on wild leafy plants, such as Vorster *et al* (2008) and Modi *et al* (2006). Other studies such as Thamaga-Chitja *et al* (2004) focused on traditional grain storage practices impact on household food security and assessed the influence of maize storage practices on food security in South Africa. These studies have shown the importance of indigenous knowledge in smallholder food production and food security in South Africa. However, indigenous knowledge is still scantly incorporated in food security policies of Africa and South Africa, in particular. Strategies adopted for advancing smallholder farmers' agricultural production in South Africa include, but are not limited to intensification, massification, mechanization and genetic modification (DAFF, 2012). Most of these strategies do not support indigenous knowledge practices (IKPs) in smallholder farming.

If indigenous knowledge is to be strongly integrated into agricultural policies for development of smallholders in current modern food production system, there is a need for studies to present indigenous farming system's practices or technologies as a viable option in smallholder household food production and food security. This can be done by looking at indigenous knowledge use in a household context. Briggs (2005) observed that the economic and socio-cultural context in which a household uses indigenous knowledge have been of lesser interest, and looking at perceptions of smallholders towards indigenous practices is seldom central in indigenous knowledge studies and presents a possible barrier to its use relative to adoption of conventional practices. Drawing from Thamaga-Chitja *et al* (2004) approach in assessing grain storage facilities impact on food security, there is a need to present the effect of the IKPs undertaken by smallholder farmers in fertility management, pest management, weed management, seed storage, and land preparation, and to look at their contribution to household food security.

1.3 Research main objective

The main research objective is to investigate the types and prevalence of indigenous knowledge practices used by smallholder farmers for household food production and their effect on household food security.

The specific research objectives are:

- To identify indigenous knowledge practices used by smallholder farmers in their agricultural systems;

- To identify the household level characteristics that determines the use of indigenous knowledge practices by smallholder farmers;

- To assess the perceived positive and negative attributes of indigenous knowledge practices compared to conventional practices; and

- To determine the effect of IKPs on household food production and household food security.

1.4 Study hypotheses

The study hypotheses are:

- Smallholder farmers in the Okhahlamba areas use indigenous knowledge practices in their farming systems for livelihoods;

- Household socio-economic status is a significant determinant of the use of indigenous knowledge by smallholder farmers;

- Smallholder farmers have negative perceptions of indigenous knowledge practices; and

- IKPs applied by smallholders in the Okhahlamba areas enhance the attainment of household food security, compared to conventional practices.

1.5 Definition of key terms

- **Knowledge:** information and skills obtained through experience, awareness, education or familiarity of a fact or situation (Trumble, 2007).

- **Indigenous knowledge:** knowledge that is unique to the given culture or society (Oniang'o *et al*., 2004).

- **Indigenous knowledge practices:** practices that are based on indigenous knowledge or activities undertaken by farmers, using their indigenous knowledge.

- **Conventional practices:** practices that are not based on indigenous knowledge, but are based on scientific knowledge.

- **Household:** A group of people living together who make common provisions of living essentials such as food and water (Ralph, 2004).
- **Household food production**: Ali (2005) noted that household food production is where a smallholder farmer produces food for a household in a home-garden for consumption and for market, but consumption is prioritised.
- **Food security**: A situation that occurs when people have access to nutritious, safe and sufficient food to maintain a healthy life at all times (World Food Summit, 1996). This study limits food security to household food availability throughout the year which, according to World-Bank (2008), entails producing enough to eat.

1.5 Study limits

The study is limited to IKPs used by rural households for food production. These include practices undertaken in production of crops, livestock and poultry and collection of wild edible plants. The study was limited to five rural tribal areas of Okhahlamba Local Municipality (OLM), namely Potshini, Mlimeleni, Nokopela, Busingatha and Okhombe. The conclusions and recommendations are thus relevant to these areas.

1.6 Organisation of the dissertation

This dissertation is divided into seven chapters, including this first chapter. The second chapter is a review of literature covering subjects concerning smallholder farming, indigenous knowledge, food production and food security. The third chapter describes methodologies used to conduct the study. The fourth chapter provides a study area description and an analysis of the sample characteristics. Chapter 5 provides findings on IKPs that are used in rural tribal areas of OLM, and findings on household level characteristics that determine the use of IKPs, including perceptions of IKPs and conventional practices used by farmers. Chapter 6 provides findings on the effect of IKPs on household food production and household food security. Lastly, Chapter 7 presents conclusions and recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

A review of literature was conducted to examine Indigenous Knowledge Practices (IKPs) in relation to smallholder farming and food security and methodologies that have been used in previous studies. . The review covers food crises, as perpetuated by unemployment, which hinders access to food. It also looks at smallholder farming as a solution to household food insecurity and the role of IKPs.

2.2 The food crisis situation in South Africa

In 2007, the Food and Agriculture Organization (FAO) reported that more that 814 million people in developing countries are undernourished (Labadarios *et al*., 2011a). In the recent FAO report on the state of food insecurity in the world, it is stated that the number of undernourished people in developing countries has reached about 815 million (FAO *et al*., 2012).

In South Africa, household food insecurity remains a challenge. The household food challenge is influenced by a number of persistent factors, despite political and economic advances the country has witnessed since 1994. This includes unemployment, increasing food and fuel prices, high energy tariffs and increasing interest rates. These conditions are strenuous for ordinary South African citizens (Labadarios *et al*., 2011b). According to the World Bank (2008), the greatest cause of food insecurity in the developing world since 1971 has been the increasing food prices and lack of job opportunities.

According to Statistics South Africa (Stats SA) quarterly survey, the highest level of employment was reached in 2008, this was followed by a sharp decline in employment with the lowest level being observed in 2010 (Stats SA, 2013). This is depicted in Figure 2.1 below. Unemployment has been increasing since 2008 (Stats SA, 2013), concurrently there has been food and energy price increases (Ernest & Young, 2013). This decline in employment coupled with increasing food and energy prices, affects food affordability especially access by the unemployed population and those living on or below a minimum wage.

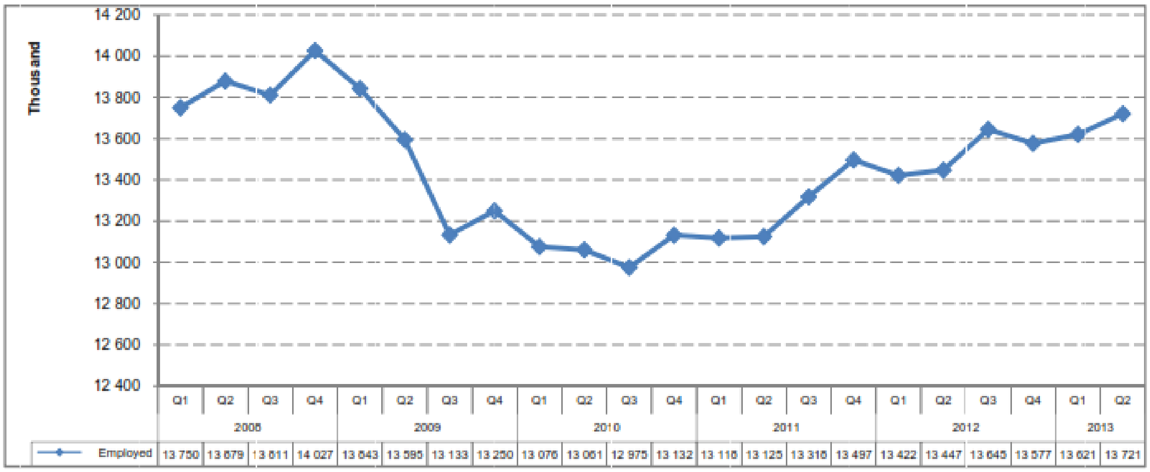

Figure 2.1 Total employment in South Africa, quarter 1:2008 to quarter 2:2013

Source: Stats SA. (2013)

South Africa has experienced national economic growth but food insecurity persists. The country is food secure at a national level but experiences household food insecurity (Hart *et al*., 2010). People residing in South African urban areas (townships) and the former homelands make up almost half of the population living in poverty (Cock, 2013). In 2012, the National Planning Commission reported that 40 percent of households in South Africa were living on less than R418 per person a month. In light of the escalating food prices, household own food production needs to be highlighted as a coping strategy for low income households. The extent of household food insecurity is manifest in the number of children showing signs of stunted growth. One in four children under the age of six in South Africa are stunted as a result of chronic malnutrition (Frayne *et al*., 2009). This is attributed to inequality in distribution of assets, which hinders the poor population from benefitting from economic growth (FAO, 2013). The income disparities in South Africa are depicted by a Gini-coefficient of 0.7 (Cock, 2013; OECD, 2013). Gini-coefficient is a measure of dispersion of a nation’s income distribution. A Gini index of 0 represents perfect equality, while an index of 1implies perfect inequality (World Bank, 2012). A value of 0.7 therefore indicates greater income inequality in the country. The extent of household food insecurity is depicted by Altman *et al* (2009) as follows:

> “South Africa faces a structural household food insecurity problem, the prime causes of which are widespread chronic poverty and unemployment. Rising food prices, particularly of maize and wheat which are the staple diet of the poor in South Africa, pose serious problems for the urban and rural poor as most are net buyers of food. Recent information . . . suggest(s) that (international) food prices will increase steadily over the next decade even if there are

> some fluctuations and the occasional drop in prices . . . Given increasingly strong linkages between the local level and national and international commodity chains and economic networks, even remote rural households in South Africa are affected by changes in these networks . . . Most severely affected will be the urban and rural poor, the landless and female-headed households"(Altman *et al*., 2009, 347–8).

The question is; can indigenous knowledge be optimised to deal with food insecurity in rural communities? If yes, what role can this knowledge play in dealing with household food insecurity in South Africa? Studies on indigenous knowledge and food production have been conducted in South Africa in an attempt to depict the existence and importance of IKPs. The proponents of such practices include Vorster *et al*. (2008), Jansen van Rensburg *et al*. (2007), Hart and Vorster (2006), Modi *et al*. (2006) and Thamaga-Chitja *et al*. (2004). These studies put more emphasis on wild edible plants and demonstrated an existence of indigenous knowledge and its potential for enhancing smallholder household food security.

However, in South Africa, agricultural institutions prioritise conventional practices and ignore indigenous knowledge as one of the areas to enhance household food production and rural economies. This is shown by the implementation of programmes such as mechanisation, intensification, genetically modified inputs and conventional fertilizers, pesticides, herbicides and seeds.

2.3 Defining Indigenous Knowledge Practices

The term Indigenous Knowledge Practices (IKPs) is derived from the concept of Indigenous Knowledge Systems (IKS). The IKS are often referred to as local knowledge, peasant knowledge, traditional knowledge, or African farming systems (Sillitoe, 1998). Indigenous knowledge is defined as the knowledge that is unique to a given culture or society (Oniang'O *et al*., 2004). This knowledge includes social and natural wellbeing, continually influenced by creativity and experimentation, and by contact with external systems. It is sometimes the only asset within which local people are familiar and have control over (Agea *et al*., 2008; Bisong and Andrew-Essien, 2010; Masango, 2010; Mercer *et al*., 2007; Morris, not-dated; Shizha, 2010).

2.3.1 IKS coverage in South African literature

Other than agriculture and food security, indigenous knowledge is used in a wide range of sectors such as health, which has been intensively explored in the literature. The research conducted by Dorothy *et al*. (2010) showed that, out of 851 records of indigenous knowledge in South Africa, only 62 are on agriculture, with culture and medicine being the most studied subjects (Dorothy *et al*., 2010). The subjects covered by indigenous knowledge studies are presented in Table 2.1.

Table 2.1 Coverage of indigenous knowledge records by subject in South Africa

Subjects	Number of records	Percent (%)
Culture	246	28.9
Health and Medicine	182	21.4
Environment	59	6.9
Agriculture	62	7.3
Education	181	21.3
Law	103	12.1
Total	**851**	**100.0**

Adapted from Dorothy et al. (2010)

These areas have been studied either to argue that indigenous knowledge is a good alternative to current knowledge systems, and/or to prove that indigenous knowledge is one of the key areas that could mitigate current food, health and ecological crises.

This study explores the contribution of indigenous knowledge practices in mitigating current food crises in smallholder food production and food security. Drawing from the definition of indigenous knowledge presented above, this paper defines IKPs as an activity where indigenous knowledge is applied. It entails activities that smallholder farmers carry out to utilise their indigenous knowledge.

2.4 Indigenous knowledge in agriculture

According to Ogle and Grivetti (1985a) indigenous knowledge based agriculture ensured a production of a variety of foods long before conventional agriculture was introduced. The discourse on indigenous knowledge use in agriculture emerged as an opposition to colonization policies which emphasised economic maximization in development strategies, and led to scientific tools being put forward and indigenous being seen as backwards and of low production (Cowen & Shenton, 1996). Dholakia & Dholakia, (1992:1) stated that modernizing agriculture "consists largely of using improved seeds, modern farm machinery such as tractors, harvesters, threshers, and chemical inputs in an optimal combination with water". While Indigenous knowledge based agriculture has been identified as one of the low external input agricultural systems (Haverkort, 1995). According to Pretty *et al*. (1992) a low external input agriculture is one that has minimal association with modern farm inputs, access to marketing infrastructure, agro-processing facilities and credit. As such, indigenous knowledge becomes a tool that is structurally unfit for commercial food production systems.

Other proponents of indigenous knowledge based agriculture such as Warren (1992), Gadgil *et al* (1993), Rao (2003), Nanyunja (2006) and Mervyn (2010) present it as an effective food production system for reversing environmental problems caused by conventional practices. Others authors such as Brokensha *et al* (1980) and Agrawal (1995) viewed incorporation indigenous knowledge into development and agriculture as a failure of external development strategies and the need for a participatory or a bottom-up approach to development.

The use of commercial farming has become problematic in countries such as semi-industrialised South Africa, where its policy and programme implementation mainly promotes conventional agriculture practices as effective forms of farming. This promotion is evident in the attempts of South African agriculture to "advance" smallholder producers towards commercial producers through various stages, as defined by the Department of Agriculture, Forestry and Fisheries (Van Averbeke and Mohamed, 2006).

The national plan for agriculture continually neglects IKPs as viable contributors to nation food production systems. This has opened doors for the justification of conventional systems as an appropriate system to produce for the high South African population growth. However, the real problem in South Africa is that poor people residing in rural and township areas have limited access to food. This is shown by the fact that, while the nation food availability is ensured by commercial farming processes, South Africa has about 11.5 million individuals that are experiencing inadequate to severely inadequate access to food (Stats SA, 2009). Indigenous knowledge can be an important tool for improved smallholder household food availability and access.

2.5 IKPs application in agriculture

The IKPs are used in smallholder farming in a number of facets, including management of soil fertility, weeding and pests, seed storage, land preparation, harvest processing and storage.

2.5.1 IKPs in pest management

The Oxford English Dictionary (2000) defines a pest in agriculture as any unwanted and destructive insect or other animal that attacks food or crop and livestock. . In crop farming, pests such as insects, birds, rodents and nematodes feed on and destroy cultivated crops, stored seeds and produce (Alabi *et al*., 2006). Interventions such as those implemented under the FAO Integrated Pest Management programmes have been put in place as means of reducing the pest threat to food production.

Smallholder farmers revert to indigenous ways of pest management as pesticides are not readily available and financially accessible (Mihale *et al*., 2009). A number of IKPs in pest management have been recorded and studies have recommended the use of indigenous pest management strategies as viable and ecologically friendly options (Abate *et al*., 2000, Alabi *et al*., 2006, Gressel, 2010, Farooq *et al*., 2011, Zijlstra *et al*., 2011)

According to Abate *et al*. (2000: 642) these indigenous knowledge pest management strategies are based on "built-in features in cropping systems, such as farm plot location, crop rotation, and intercropping, or on specific responsive actions to reduce pest attack, such as timing of weeding, use of plants with repellent or insecticide action, traps, scarecrows, smoke, and digging up grasshopper egg masses". These IKPs in pest management have also been identified by scholars such as Alabi *et al* (2006); Farooq et al (2011); Gressel (2010); Vorster and Van Rensburg (2005) & Bonwo and Adamu (2003).

2.5.2 IKPs in soil fertility management

Soil fertility depletion has been identified as a fundamental reason for decreasing food production in Africa (Buresh *et al*., 1997). Smallholder farmers with small land sizes make certain that their land has enough nutrients to provide for household food and/or cash crops (Chamberlin, 2007, Salami *et al*., 2010, Zhou, 2010). The IKPs such as the use of manure, composting and mulching have played a crucial role in soil fertility management (Hepperly *et al*., 2009, Lyimo *et al*., 2012, Mazvimavi *et al*., 2010, Mkhabela, 2003, Chivenge *et al*., 2009). These IKPs have been identified in various rural communities, such as Dundee and Nkwezela in KwaZulu-Natal province (Mkhabela, 2003) and in rural areas from other African countries such as in Zimbabwe, Ethiopia (Lupwayi *et al*., 2000); and Tanzania (Lyimo *et al*., 2012).

Manure is used by indigenous people in their farming systems. The manure ability to sustain fertility is evident in studies conducted by Lupwayi *et al*. (2000) where it was stressed that not all nutrients are released from the manure in one season. This ensures that nutrients are retained in the crop fields or gardens for the next planting season. Lupwayi and Haque (1999b), conducted a two-year study on manure and soil fertility at DebriZeit, Ethiopia. They found that 28% of nitrogen, 19% of phosphorus, and 90% of potassium were released in the first season, while calcium and magnesium were immobilized. That is, calcium and magnesium from manure applied in the previous planting season were available to the crops in the following season.

2.5.3 IKPs in weed management

Weed management refers to the use of weed control practices to prevent and minimise weed spread, introduction and competition with crops and adaptation (Iyagba, 2010). Mandumbu *et al.* (2011) discussed integrated weed management in Zimbabwe and identified various practices that indigenous people undertake during weeding. These practices include intercropping, timing and placement of chemical fertilizers and manure, heaping manures, tillage, early planting, and crop rotations. There is also a use of mechanical weed control methods which involve of hand-hoe weeding (Mandumbu *et al.*, 2011, Wei *et al.*, 2010), and animal drawn implements (Fowler, 2000). The use of mechanical weed control methods has been criticised as not suited for women who usually dominate the smallholder farming sector. Sakala (2000) spotlighted draft animals as an effective source of labour for smallholder farmers. However, since weeding is associated with woman labour, draft animals are underutilised in female-headed households (Sakala, 2000). Hand-hoe weeding requires 40-50% of the total farming labour input per hectare, whereas about 40-80% of labour is saved when using draft animal weeding. Thus, with scarce labour, hand-hoe weeding can be deferred leading to lower yields, compared to draft animal weeding (Shetto *et al*., 2000).

2.5.4 IKPs in post-harvest processing and storage

The IKPs which are used for harvest processing and storage include the use of a maize-crib, sacks and tanks (Thamaga-Chitja *et al*., 2004, Udoh *et al*., 2000). A study conducted in 1999 in northern KwaZulu-Natal found maize-cribs to be inefficient in terms of storage length, losses during storage and storage volume (Thamaga-Chitja *et al*., 2004). That study, found that maize-crib storage sizes were smaller than those of metal tanks. Maize-crib storage also did not allow for the use of chemical pesticides and there was more produce exposure to pests compared to metal tanks. Maize-crib storage was also found to be exposed to harsh environmental conditions, livestock and poultry grazing (Thamaga-Chitja *et al*., 2004).

Another study was conducted by Udoh *et al*. (2000), on the storage structures and aflatoxin content of maize in five agro-ecological zones of Nigeria. The study found maize-cribs efficient, as they were associated with decreased aflatoxin contamination than tanks and sack bags. The aflatoxin contamination was associated with insects infestation, which suggested that tanks and sack bags were more exposed to pests or insects than maize-cribs (Udoh *et al*., 2000). The crib system had rat guards, wire mesh and corrugated iron sheet roof which according to Udoh et al. (2000), was an FAO recommended crib structure. This shows that a maize-crib can be a more efficient storage system for smallholder farmers.

2.5.5 IKPs for land preparation, seed selection and storage

Factors such as temperature regulation and seed germination play a vital role in seed selection and storage strategies (Martinkova *et al*., 2006, Gresta *et al*., 2007). The use of animal traction and hand-hoes (Sakala, 2000, Shetto *et al*., 2000) are the recorded land preparation IKPs.

Studies such as Pitakia & Kama, (2002), Oniang'O *et al* (2004), Agea *et al* (2011), Feyssa *et al* (2011), Ghoudzi, (2010), Ibitoye (2011) have identified IKPs in African regions and elsewhere. While the studies have demonstrated the use of indigenous knowledge and its importance to the attainment of food security and reversing development problems, there seems to be a consensus in the need for continuous documentation of indigenous knowledge. Also, there is a need for further identification of principal motives for the use of IKPs. This is essential in understanding IKPs and ensuring that its owners remain custodians, if practices are to be incorporated in national food production policies and strategies. The knowledge needs to be continually identified and updated, as it is not static but continually adapted to suit ecological and social changes of a given community.

2.6 IKPs as solution to current food security issues

Based on the 2010 report, the United Nations sought strategies for reversing global food and ecological crises. In response to this, the opponents of commercial agriculture perceive IKS as an escape from global ecological crisis (UN, 2010). Jordan (not-dated) state that the capability of nature to produce food needs to be understood and requires a food production system that demands human-nature interactions such as agro-ecology, indigenous knowledge-based agriculture, conservation agriculture and organic agriculture. The problem arises when these low-external input production systems are dismissed for their low financial returns to producers. Obach (2007) reasoned that strategies that work in harmony with nature are becoming more preferable as society becomes aware of the benefits of purchasing products produced with less chemical inputs and living in harmony with nature.

Participation and inclusion of local people in development agendas has gained ground in development. Local people's indigenous knowledge is now accepted by most leading development organisations, including the World Health Organization (WHO), the United Nations (UN) and the World Bank (WB). Khatri (1997) indicated that awareness of indigenous knowledge could be a mind shift in a society that has been exposed solely to the modernised world. There is a need, however, to go beyond appreciation and recognition.

There are seven most cited drivers of food insecurity in southern Africa. These include poverty, lack of education, food price increases, unemployment, property rights failures, poor market access and climate change. Four of these drivers were cited as chronic, while climate change and food price increases were cited as shocks (Gregory *et al*., 2005). Research in IKS such as those from, but not limited to, Sakala (2000), Pitakia and Kama (2002), Mkhabela (2003), Oniang'O *et al* (2004), Thamaga-Chitja *et al* (2004), Martinkova *et al* (2006), Gresta *et al* (2007), Ghoudzi (2010), Agea *et al* (2008), Feyssa *et al* (2011), Ibitoye (2011) has undoubtedly elevated the importance of indigenous knowledge in society and is seen by scholars and development organisations as a sustainable solution to chronic and transient food insecurity.

2.7 Overview of smallholder farmers in South Africa

Smallholder farmers are households that derive most of their livelihoods from crop, livestock and poultry farming (ASFG, 2011), where farms are operated by farm families, using largely their own labour (Berdegué and Fuentealba, 2011). In Africa, smallholder farmers make up 65% of the population (ASFG, 2011). The smallholder typologies in South Africa differ in terms of objectives of production, proportion of market output, access to finance, external-input intensity and contribution to household income (Cousins and Chikazunga, 2013). The smallholder farmers are market orientated while subsistence farmers focus on household consumption.

Smallholders in South Africa are mainly situated in rural areas, which remain underdeveloped because of a lack of investment (DAFF, 2012). The DAFF strategic plan for 2012/13-2016/17 acknowledges that people living in rural areas continue to struggle, in spite of government efforts to boost food production and access. Aliber and Hart (2009) demonstrated that householders in underdeveloped black communities revert to smallholder farming, mainly as an extra source of food.

A study by Aliber *et al*. (2009) on smallholders in South Africa estimates about four million people are involved in smallholder farming, of these, 92 percent farm for subsistence. These farmers use less conventional practices and more of locally available resources and regard farming as their main source of livelihood. Such farmers have managed to develop farming inputs from locally available resources (Hart and Vorster, 2006). Subsistence smallholder farmers have been able to produce food with minimal conventional practices, which suggests a need for inclusion and appreciation of local inputs in agricultural development.

2.7.1 Challenges in smallholder farming systems

The predominant challenges encountered by smallholder farmers are discussed in this section. They include costs of inputs, poor financing (loans) and access to agricultural land (Ali, 2005, Baiphethi and Jacobs, 2009, Chamberlin, 2007, Lahiff and Cousins, 2005, Van Averbeke *et al*., 2011).

2.7.1.1 Food production in small landholdings

Landholding refers to the sum of all plots per household (Chamberlin, 2007). According to Ali (2005), landholding is the primary disadvantage in smallholder farming, because the majority of farmers have limited land size. Limited landholding is evident in southern African countries such as Malawi where 70 percent of smallholders possess less than one hectare of land (Jayne *et al*., 2010). The situation is almost the same in South Africa, where average landholdings for smallholder farmers range from 0.5 to 1.5 hectares per household (Lahiff and Cousins, 2005, Van Averbeke *et al*., 2011). According to Lahiff (1997) small landholdings in South Africa are mainly attributed to unfair distribution of land by the apartheid government.

The small landholding in smallholder farming underpins the choice between planting cash and food crops. According to Chamberlin (2007), small-scale farmers usually grow crops that are vital for household consumption and few grow cash crops. For example, in Ghana, smallholder farmers with smaller land (1.7 hectares) had food crops such as cassava and maize dominating in their fields and cash crops dominated fields of farmers with larger land (Chamberlin, 2007). Diao *et al*. (2000) found that the ratio of vegetable (value added crops) area over total cultivated area increased with every decrease in size of land per household in China. Kakwagh *et al*. (2011) explained that smallholders in Nigeria engage in subsistence farming due to small landholdings. This is also evident in South Africa, where the production of staple food for household consumption is prioritised (Lahiff and Cousins, 2005). The plot size therefore affects household decisions concerning which crops to prioritize and could affect the growing of indigenous crops by smallholders.

2.7.1.2 Access to finances for food production

Several studies indicate that smallholder farming has contributed to rural development (World Bank, 2008; Hart & Vorster, 2006; Manona, 2005; Ogunlela and Mukhtar, 2009). However, despite the contribution of smallholders to rural household’s livelihoods and to the gross domestic product of developing countries, the majority of smallholder farmers are not financed (World-Bank, 2008). According to Salami *et al* (2010) agricultural financing in Africa is poor, and constitutes less than one percent of commercial lending. A large portion of commercial lending goes to large-scale commercial farmers. Smallholder farmers depend on savings of their meagre incomes, which limits their chances to expand farming. Due to lack of access to credit, smallholder farmers rely on remittances from relatives and informal money-lenders to finance farming activities (Salami *et al*., 2010, Takeshima and Salau, 2010). Baiphethi and Jacobs (2009) believed that if smallholder farmers were financed, they would be able to afford purchased inputs and thus enhance their farming production and food security.

African smallholder farmers lag behind large-scale commercial farmers in the use of modern inputs (Baiphethi and Jacobs, 2009). The primary reason is high agricultural input costs (Chibwana and Fisher, 2011, Hart and Vorster, 2006, Smaling *et al*., 2006, Kherallah and Kirsten, 2001). Netting (1994) points out that for generations, smallholder farmers have been successful despite their minimal access to external inputs to increase productivity. In South Africa "most resource-poor farmers in marginalized areas have been practicing low-external input agriculture for generations due their being located in remote areas, and did this in spite of non-existent or minimal support from research and extension services" (Hart and Vorster, 2006: 11).

2.8 South African government interventions to assist smallholders

The government interventions for developing smallholder farming have played a number of roles in enhancing food security. The post-apartheid era has seen the government shift from focusing solely on commercial farmers to providing assistance to smallholder farmers. Significant progress has been achieved, such as relocation of about four million hectares of land to black farmers (Bernstein, 2013); intensive use of conventional practices and implementation of various intervention programmes. These programmes include but not limited to intensification, massification, provision of genetically modified inputs and the Zero hunger campaign. IKPs are, however, not promoted in these programmes.

2.8.1 Genetic modification

South Africa does not have good climatic conditions for crop production and it faces periodic droughts with an average rainfall of about 450 mm per annum, which is far below the global average of 860mm per annum (Benhin, 2006). As a result of the unfavourable climatic conditions, the 1997 Genetically Modified Organism (GMO) Act enforced the genetic modification of food as a way of enhancing food production without placing a greater pressure on scarce resources. The Act was to ensure less harmful consequences of GMOs and the Department of Agriculture Forestry and Fisheries recognizes the Act as both comprehensive and well balanced (DAFF, 2012).

With food production and food security challenges, smallholder farmers are encouraged to use GMOs. Palitza (2012) conducted a study in South Africa on how smallholders' loss of seed security, which stressed that smallholder farmers are pushed to plant genetically modified seed. The study stressed that smallholders' socio-economic status, such as low income, poor education and hunger leads farmers to depend on government for assistance, which eventually leads to the use of conventional practices, including GMOs. The study quoted one of the farmers in rural areas of KwaZulu-Natal as stating that "I know that GMO is not good in the long run, but if someone gave me these seeds I would still plant them, …….. For me, the most important thing is to bring food on the table every week. I can't afford to think now about what will happen next year" Palitza (2012:1). The use of GMOs hand-outs from government by smallholder farmers suggests that indigenous knowledge on seed storage is not being utilized in some areas, and government promotion of GMOs indicates that indigenous knowledge is not yet considered an important tool in enhancing food production and food security.

This somehow undermines smallholder farmers' perspective of food production, which looks at farming as a system that should incorporate nature and culture. The emphasis on new varieties, pesticides and chemical fertilizers seeks to instil commercial farming perspective which views farming as an opportunity for scaling up profits. The South African government has to consider the availability and accessibility of IKPs that can be reinstated and encouraged to assist smallholders in sustainable food production.

2.8.2 Massification of agriculture

Massification entails providing equipment and inputs for smallholder farmers (KZN Department of Agriculture, 2011), with the aim of making their production competitive (Mudhara, 2010). In response to massification programmes, a number of institutions involved in rural development and agriculture have emphasised the improvement of smallholder farming productivity. However, according to Zhou (2010), this is only theoretical, as farmers do not just adopt provided services. Massification is not sustainable because produce markets are still underdeveloped and inputs or financial credits for farmers to sustain required level of production are not in place (Mudhara, 2010).

Some programmes for increasing production in smallholder farming in South Africa include mechanisation, liming and fertilizer and irrigation. These programmes are aimed at ensuring technological efficient agriculture production, assisting in progressing small-scale farmers to become large commercial farmers by rendering extension support (Department of Agriculture and Environmental Affairs, 2012). Figure 2.2 shows the progression from smallholder to advanced farmers with changes in inputs and agriculture systems.

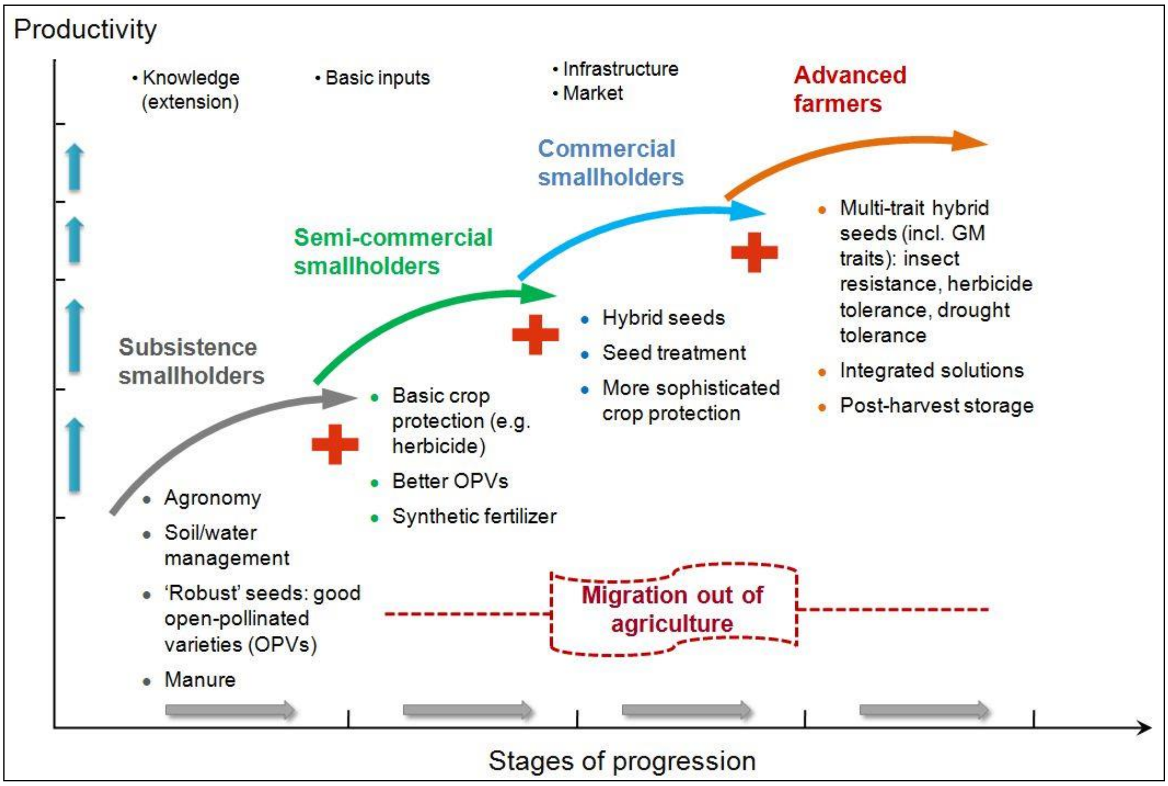

Figure 2.2 Additive stages of agricultural intensification – Source: Zhou (2010)

Some of these programmes that are aimed at improving smallholder farmer productivity may not be effective. Ali (2005) pointed out that household food production focuses on food production in a home-garden for consumption and marketing, but consumption is mostly prioritised. Intensification and massification emphasise cash crops and a shift to commercial farming, basically for a season, where the government provides means for initiating intensified production. The sustainability of these programmes is thus in question. There are about four million smallholders in South Africa (Cousins, 2009). If most of these farmers are sustaining their production using IKPs, then South African agriculture has to consider incorporating indigenous farming in these smallholder agriculture development programmes.

2.8.3 Zero hunger programme

Government has recently proposed zero hunger programmes which are adapted from the Brazil smallholder development initiatives. The government aims at being the main buyer of food from smallholder producers, thereby ensuring financial access for the poor and vulnerable societies. Ensuring incomes for poor and vulnerable societies will be achieved through the promotion of agricultural growth in smallholder farming. However, the Department of Agriculture, Forestry and Fisheries states that the challenge is to improve agricultural growth, while being climate-smart, reducing carbon footprints of the agricultural industry and ensuring sustainability (DAFF, 2013). If the implementation of this programme does not acknowledge the existence of indigenous knowledge as one of the tools that can be used to achieve climate-smart farming practices in the rural communities and expands on them, this proposal will face challenges to achieve its aims.

To address food insecurity in the former homelands, the country needs promotion of practices that sustain food production, instead of advancing programmes that suit commercial farming. This study thus supports scholars such as Agea *et al* (2008) in giving proper attention to IKPs in smallholder farming.

If the role of indigenous knowledge in food security is to be understood, there is a need to recognise the extent to which it contributes to household farming and food security. Failure to understand this role will result in the failure of indigenous knowledge in making its full potential in smallholder food production and food security.

2.9 Methodologies employed in the indigenous knowledge studies

The present study will follow a mixed method approach, which uses both qualitative and quantitative methods. This approach is defined by Creswell (2009) and Johnson (2004) as an inclusion of both the qualitative and quantitative phase in an overall research study. In using this approach, a study uses two phases. The first phase identifies IKPs in the study communities and the second phase is the data collection in households using questionnaires and the Participatory Rural Appraisal (PRA) tools.

Oniang'o *et al* (2004); Feyssa *et al* (2011); Agea *et al* (2008) and Gadzirayi *et al* (2006) used Participatory Rural Appraisal (PRA) tools for data collection and survey questionnaires. PRA enables open-ended conversations focusing on indigenous knowledge practices. This study used PRA tools and survey questionnaires in gathering information on indigenous knowledge practices.

A case study is defined as an enquiry that investigates phenomenon within its real-life context (Yin, 1994; Yin 2009). A case study is a data collection tool that is mostly applied where a case of interest is complex and highly contextualised and an extensive study of a particular case is required (Payne *et al*., 2006, Rosenberg and Yates, 2007, Sutton, 2008). This is an approach which "allows in-depth, multi-faceted explorations of complex issues" (Crowe *et al*., 2011:1). Even though studies have been conducted on food production and IKPs, following a case study approach allows for holistic smallholder farmers' understanding of IKPs.. Different approaches to case study data collection, as shown in Table 2.2.

Stake (2000) defines three approaches to case studies, i.e., intrinsic, instrumental and collective. This research followed an instrumental/exploratory case study approach which is defined by Stake (2000) as a study conducted to understand a phenomenon of interest.

Table 2.2 Epistemological approaches that may be used in case study research

Approach	Characteristics	Key references
Critical	Involves questioning one's own assumptions, taking into account the wider political and social environment.	Howcroft and Trauth [30] Blakie [31] Doolin [11,32]
	Interprets the limiting conditions in relation to power and control that are thought to influence behaviour.	Bloomfield & Best [33]
Interpretive	Involves understanding meanings/contexts and processes perceived from different perspectives, trying to understand individual and shared social meanings. Focus is on theory building.	Stake [8] Doolin [11]
Positivist	Involves establishing which variables one wishes to study in advance and seeing whether they fit in with the findings. Focus is often on testing and refining theory on the basis of case study findings.	Yin [1,27,28] Shanks and Parr [34]

Table adapted from Crowe *et al*. 2011

2.10 Conclusion

Previous research has suggested that indigenous knowledge can contribute to food security. Land, finances and conventional inputs are essential for enhancing smallholder farm yields; however financing of purchased inputs might not be sustainable, thus jeopardising smallholders' food access and farming. It is thus imperative to enhance indigenous practices and reduce dependency on conventional practices in smallholder farming. The indigenous knowledge proponents indicated that IKPs are widely used and adapted by smallholder farmers to cope with challenges of household food insecurity. What is missing is the extent to which a smallholder farmer uses indigenous and conventional practices in food production and their effect on household food security. The literature upholds indigenous knowledge as a contributor to rural households' food production and its harmony with nature. However, it is not clear if the indigenous knowledge users also uphold the same view, or use them because household characteristics enforce the use of indigenous knowledge as the only option.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The study employed qualitative and quantitative approaches to collect data on the households' use of indigenous knowledge practices in food production in five rural communities of Okhahlamba Local Municipality (OLM) of KwaZulu-Natal province. The study was conducted in rural villages of Okhahlamba Local Municipality (OLM). The study area and villages were selected with the assistance of OLM Department of Agriculture – Agricultural Extension Office and the University of KwaZulu-Natal Farmer Support Group organisation. Villages were selected based on the extent of smallholder farming and use of indigenous knowledge.

3.2 Geographical location of the OLM area

The OLM is one of the local municipalities under uThukela District Municipality, namely Indaka, Emalahleni, Umtshezi and imbabazani. The size of the uThukela District Municipality is approximately 11500km², located in the western boundary of KwaZulu-Natal. The municipality is characterised by low revenue base, limited access to services, poor infrastructure, high levels of poverty, lack of resources, unemployment, skills shortage, and low level of education, under-developed land and settlement patterns that make it difficult to plan for effective service delivery (OLM, 2011). The OLM has a population of 151,441 and 28,508 households. The OLM is geographically located in the North of KwaZulu-Natal, South Africa: 28^0 44'S, 29^0 22'E. The Municipality is situated in mountainous region of KwaZulu-Natal, bordered by the Free State province in the North and Lesotho in the West. The location of the OLM in relation to other municipalities in KwaZulu-Natal is shown in Figure 3.1.

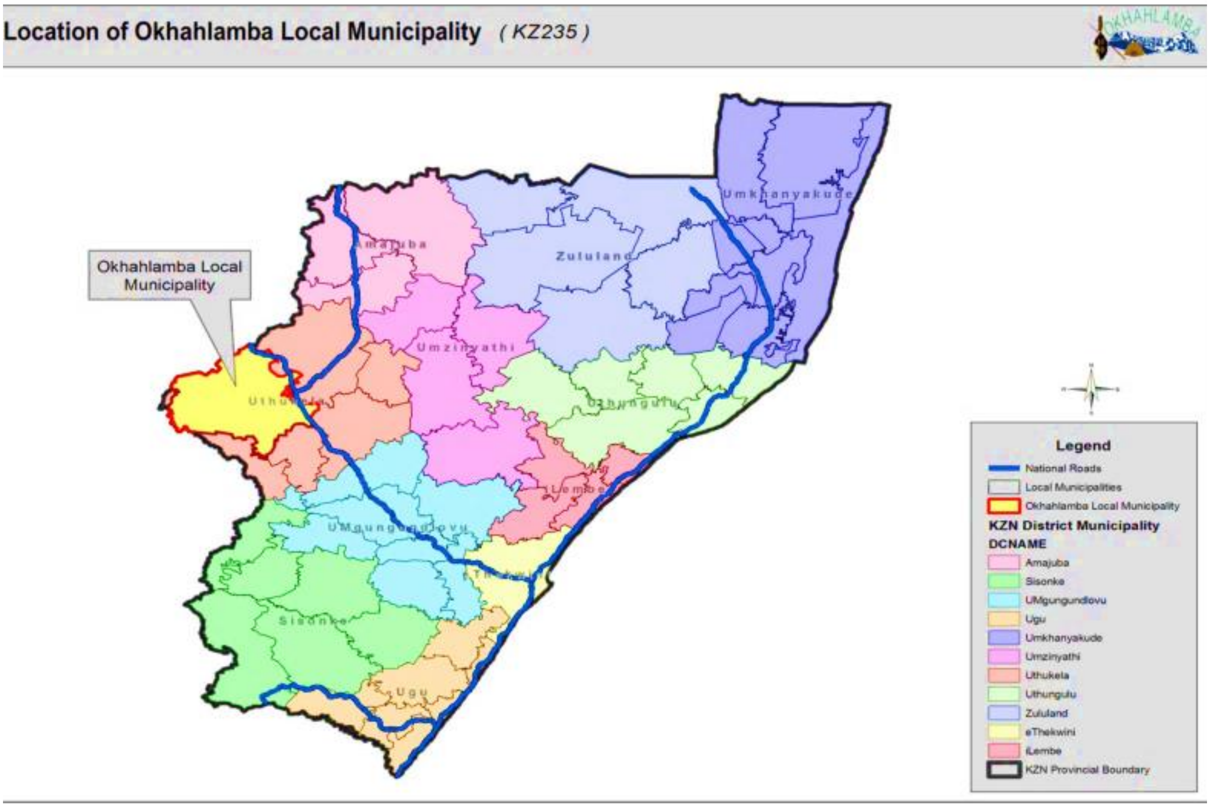

Figure 3.1 Location of OLM in KwaZulu-Natal province Source: OLM (2011).

The OLM is predominantly rural, with four small towns, namely Bergville, Winterton, Cathkin Park and Geluksberg (Elleboudt, 2012). It consists of two traditional authorities, Amazizi and Amangwane (OLM, 2012). Figure 3.2 shows a location of OLM,, within UThukela District Municipality. Five villages under Amangwane and Amazizi traditional authorities were purposively selected for this study. Two study villages; Okhombe and Busingatha are under the Amazizi traditional authority. Three study villages; Potshini, Mlimeleni and Nokopela are under the Amangwane traditional authority.

Figure 3.2 Location of OLM within the uThukela District Municipality. Source: uThukela District Municipality [http://www.uthukeladm.co.za]

3.3 Research Design

The mixed method approach used in this study involves the use of both qualitative and quantitative approaches (Creswell, 2009 and Johnson, 2009). Firstly, the study conducted qualitative data collection and analysis, followed by a quantitative data collection and analysis. The first phase informed the second phase in designing and administering survey questionnaires. Creswell (2009) called this a sequential exploratory strategy of mixed methods research. The study also collected information from key informants, through interviews and case studies, before administering survey questionnaires.

The sequential exploratory strategy helped in collecting detailed data on indigenous practices that farmers use before quantitative data collection. This allowed incorporation of relevant information from qualitative study in questionnaire design.

3.3.1 A qualitative approach

The PRA tools, such as key informant interviews, semi-structured interviews and case studies, were used in qualitative data collection. These tools are discussed in the following sections.

Key informant interviews aimed at obtaining a general idea regarding the extent to which indigenous knowledge practices are applied in each study village and identifying farmers who could be used as case studies. Two informants were selected in each village, making a total of 10 key informants. The selection was conducted using the criteria from Zeeuw & Wilbers (2004), who state that key informant interviews are conducted with specially selected individuals who have a lengthy experience of a village, or knowledge of, and involvement in, a subject matter.

Selection of key informants and case study farmers: Two institutions assisted in selection of key informants and farmers that participated in the case studies. The Extension Officers (EOs) from the KwaZulu-Natal provincial Department of Agriculture and Environmental Affairs in Bergville, which is one of two local towns of the OLM, and the Farmer Support Group (FSG) from the University of KwaZulu-Natal. The EOs from Bergville assisted because of their agricultural knowledge in OLM. FSG works with OLM rural communities, where it addresses a range of community development issues, including the needs of resource poor-farmers and food security status. The criterion for selecting key informants was based on their knowledge of community projects and farming. This criterion was used because key informants had to provide relevant knowledge of their communities. Key informants were interviewed using guides (see Appendix A).

The selection of case study farmers was based on the extent of farmers' involvement in crop and/or livestock farming. For example, farmers who had larger area under crop cultivation, livestock holding size and, where possible, the use of wild plants, were selected. Purposive sampling was adopted for selecting farmers for case studies.

The case studies focused on IKPs used for crop and livestock farming and wild edible plants collected for food consumption. The IKPs identified included those relating to soil preparation, harvest processing, livestock, collection of wild edible plants and management of soil fertility, pests, seed storage and weeding. These were selected because key informants highlighted them as areas that are critical in the use of indigenous knowledge in OLM.

Case study guides (see Appendix B) were designed in order to define boundaries and direction for discussions with farmers in case studies. Stake (2000) defined the exploratory case study approach as a study conducted to understand a phenomenon of interest and was used in this study to understand IKPs in OLM.

Semi-structured interviews were used for conducting case study discussions, which were conducted from August to September 2011. A total of 25 interviews were conducted, five in each village.

Case study interviews were recorded using a tape recorder and notes. This allowed for capturing of all details farmers provided and allowed interviews to be revisited for clarification, when necessary. Each discussion on a case study took a maximum of one hour thirty minutes. All case studies were conducted in homesteads. This allowed farmers to be comfortable and some resources used in farming practices in case studies to be observed, such as stored manure, seeds, insecticides/pesticides, farming implements, wild plants and general socio-economic conditions of households.

The data collected from interviews were categorized in terms of soil fertility management, weeding management, seed storage, soil preparation, wild plants consumption and harvest storage and processing. Each case study was narrated resulting in a total of 25 narrative descriptions of IKPs provided by farmers interviewed as case studies.

For data presentation, the case study data were summarised in tables. All practices under each category were put in a table, with reasons for their use and procedures undertaken in using them.

3.3.2 Quantitative data collection

After conducting case studies, a quantitative approach was conducted using a structured survey questionnaire (Appendix C). Questionnaires were used to collect data on general use of indigenous practices in food production and their contribution to food security.

Both closed and open ended questions were used in the questionnaires. The completed questionnaires were checked each day for errors of data collection. This process allowed enumerators to clarify some responses that were not clear and to complete all questionnaires properly in the field.

Pre-testing of the questionnaires was done in Potshini village. Three households were interviewed. Pre-testing assisted in estimating the time duration for conducting a household interview and crosschecking if the questionnaire questions addressed research objectives. Pre-testing also familiarised research assistants with the questionnaire.

A number of questionnaire shortfalls were identified during pre-testing. The first shortfall was that some questions were repetitive. The elimination of the repeated questions helped in reducing the number of questions and the length of the interviews.

Second, it revealed that female respondents might not have knowledge about livestock farming and fields, unless they are household heads. It was evident from pre-testing that female respondents are responsible for home garden and poultry farming, whereas male respondents are responsible for fields and livestock farming. Thus, before administering the questionnaires, enumerators asked the household head if they were responsible for the entire household's farming activities. If not, members who were knowledgeable were asked to join the in interviews.

Lastly, during pre-test interviews, it was noted that questionnaire structure needed to be adjusted. This was done to group questions into categories. Thus sections in the questionnaire were regrouped in categories rather than in terms of broad categories such as field crop, livestock and garden vegetable farming. Surveys were conducted during the months of February and March 2012. Random sampling was used to select 100 households in the study area.

Unit of analysis refers to members or elements of the population under study such as households in a given region and society members (Welman *et al*., 2005). In the present study, the unit of analysis was farming households. Only households involved in crop farming, livestock farming and collection of wild edible plants were selected for surveys. One hundred households were randomly selected from the study area, twenty households in each village. Spreading the sample over five villages assisted in generalising the results as different indigenous practices were adopted by different villages in OLM. Information on total population and number of households in the villages was not available; the sample could not be pre-listed.. Within each village, stratified random sampling was employed to ensure that households were geographically represented. To ensure the geographical representation of households in a village, household were selected according to villages. In each stratum, five households were randomly selected. For each village, numerators were spread according to the identified strata. Even though it was difficult to determine which household is adjacent to the other, as households were unevenly dispersed, numerators had to skip at least four households in each stratum (depending on the size of the stratum).

3.4 Limitations of the study

There were a number of limitations encountered during case study and survey data collection which may have affected the findings.

Most farmers were willing to participate, but others were not. Others refused to participate because of their involvement in other community projects and interview fatigue resulting from researchers coming every year to interview them. To avoid this, farmers were notified of the scheduled time of their case study to encourage farmer participation and commitment. However, some did not avail themselves. There was then a need to find alternative farmers at short notice. This became a problem because they felt that they were regarded as backups, as they knew the ones that were supposed to be interviewed, which may have affected the quality of the responses.

During survey data collection, some obstacles were experienced in sampling such as the dispersed households setting, and a list of total households in a village was not available, making it difficult to do random sampling.

3.5 Methods used in data entry and analysis

Data were coded and entered into Excel and exported to SPSS for statistical analysis. Descriptive statistics (frequencies, means, cross-tabulations, analysis of variance and correlations) and regression (Logit) were used for data analysis. The results were presented in chapter 4, 5 and 6. Each chapter ends with a conclusion/discussion. Main conclusions are presented in chapter 7.

Analysis of sample characteristics

Correlation tests were used to test if there was any relationship between household socio-economic factors. The results were presented in form of tables. The Chi-square test (X2) was used to assess if there was any significant differences in distribution of socio-economic factors across assets ownership.

The descriptive statistics were used to find percentage of households using the IKPs found through case studies and surveys, the results were presented in a form of tables. The One-way ANOVA was used to compare means of the socio-economic characteristics across the users of IKPs and conventional practices. Excel (stacked columns) was used to analyse data on indigenous and conventional practices effectiveness, preference and costs.

Effect of IKPs on household food security

Descriptive statistics was used to find the average monthly and weekly consumption of the produce. The binary logit was used to find the effect of IKPs using the number of months a household consumed maize it produced as a proxy for food security.

A regression model:

$$L_I = \beta_0 + \beta_i X_i + \varepsilon_i$$

Where L_I = 1 if a household consumed its own maize between 7 – 12 months or 0 if otherwise (a household consumed its own maize between 1- 6 months), ε is the error term, β_i are parameter estimates (coefficients) and X_i are independent variables.

CHAPTER 4: SAMPLE CHARACTERISTICS

4.1 Introduction

This chapter presents analysis of results on sample characteristics. The sample characteristics assist in understanding the context in which IKPs are used. According to Briggs (2005) understanding sample characteristics is essential in every study that concerns indigenous knowledge and its application. A sample of 20 households per village was purposively selected in each of the five villages of OLM, making a total of 100 respondents. The selected households were involved in field cropping (74%), gardening (76%), livestock (65%) and poultry farming (69%). Some 45% were involved in wild foods collection and 81% planted fruit. The characteristics such as gender, educational level and age of the household head, household size, monthly income, and field size and livestock ownership are discussed in this section.

4.2 Household characteristics

Table 4.1 presents the household characteristics. About 51% of the sampled households were female headed and 54% of the household heads were older than 60 years. The results show that about 57% of household heads had a primary education and only 14% had a secondary education. It also shows that about 23% of the households had income less than a R1000 and 16% had more than R3000 per month. The household sizes of sampled households ranged from one to 19 members, with an average of seven. About 62% of the households had field sizes that varied from 0.4 to 1.5 hectares. Garden sizes ranged from 8 to 705m^2 and 92% of the households had garden sizes that ranged from 8 to 100m^2. Only 6% of the households owned more than 20 cattle.

Table 4.1 Sample characteristics

Socio-economic factors	Mean	Standard deviation	Household Frequency (%)
Household head age (years)	57	12.3	
<40			7
41-59			39
60+			54
Household head education (grades)	4	3.5	
No education			29
Primary education			57
Secondary education			14
Household income (R/moth)	1876	1159.7	
0-1000			23
1100-2000			37
2100-3000			24
3100+			16
Cattle ownership (per head)	5	7.4	
0-10			63
11-20			31
>20			6
Household size (per head)	7	3.4	
1-5 members			42
6-10 members			45
10+members			13
Household head gender (1, female; 0, male)	0.51	0.5	
Female heads			51
Male heads			49
Landholding			
Field sizes (ha)	1.5	1.3	
0.4-1.5			62
2-3.5			31
4-5.5			7
Garden sizes (m^2)	49	75.5	
1-100			92
101-200			7
201+			2

4.2.1 Educational level of a household head

The relationship between the educational levels of a household head and other socio-economic factors presented in Table 4.1 was investigated using correlations analysis. For the purposes of this study, it was hypothesised that household head illiteracy is related to their age. Therefore, a correlation analysis was conducted to find a relationship between age and educational levels. The results showed that the younger household heads (28-50) were more literate than older household heads (60-80 years). As shown in Table 4.1, about 29% of household heads never attended any school and only 14% had a secondary education. This level of illiteracy matches that reported in the municipal report, which indicated that 38% of the population had no schooling and only 4% received tertiary training in the study area. In general, there are low levels of education and high illiteracy in the study areas (OLM, 2012). Table 4.2 presents results on a correlation between a head of the household educational level and other socio-economic factors.

Table 4.2 Relation between educational level of household head and other socio-economic factors

	Minimum	Average	Maximum	Correlation with household head educational level
Field size	0.4	1.5	5.5	** (-)
Household size	1	7	19	NS
Household assets	0	3	8	** (+)
Age	28	57	60+	***(-)
Income	0	1876	3100+	NS
Cattle	0	5	20+	NS

n=100; (**) p<0.05 ; (***) p<0.01 ; (NS) not significant

There was a strong correlation between educational level of a household head and field size , age and assets ownership. Household assets in this study refer to the number of non-farm assets such as the electronics, home appliances and vehicles. Educational level of a household head had a strong negative correlation with the field size, depicting that with an increase in literacy level there was a decrease in landholdings. There was a strong negative correlation between the educational level of a household head and age of a household head. This correlation shows that with an increase in age, there was a decrease in literacy level. Therefore, younger heads of households tends to have higher literacy level compared to older heads of households.

In contrast to the literacy rates of the heads, the general household members were more literate. About 43% of the households had at least one matriculated member and 11% had members with tertiary education.

4.2.2 Household size

The study collected data on the number of people residing in one household (household size), based on the number of people spending a minimum of four days in their household per week. This measurement was derived from a description by King (2000), who described a household as people who eat from the same pot. The household size may determine labour availability for implementing indigenous practices (Oni *et al*., 2011). The average number of people living in a household was seven members, with a maximum of 17 and a minimum of one member per household. The results are in line with the OLM annual report, which states that, in the study area there are more than five people living in one household (OLM, 2012). With more household labour, the work load for activities such as hand-hoe weeding, land preparation, animal traction, maize harvesting and storage could be shared. However, as stated above, most members are not involved in household farming. Thus household size may have no effect on IKPs use.

There was a positive correlation between household size and field size, income and the number of cattle owned by a household (see Table 4.3).

Table 4.3 Household size correlation with other socio-economic factors

	Minimum	Average	Maximum	Correlation with household size
Field size	0.4	1.5	5.5	** (+)
Education	0	4	12	NS
Household assets	0	3	8	NS
Age	28	57	60+	NS
Income	0	1876	3100+	*** (+)
Cattle	0	5	20+	*** (+)

n=100; (**) $p<0.05$; (***) $p<0.01$; (NS) not significant

4.2.3 Household income

The household income sources for the sampled households include social grants, salaries and small businesses. About 69% of households receive child grants, 55% pensions, 31% salaries, 28% income from small businesses and 3% receive orphan grants. As most households received child grants and pensions, it implies that social grants contribute greatly to household income in rural OLM.

It was hypothesised that household income in the study areas is associated with the age of a household head. Results show that heads of the households aged between 60 and 80 had a stable average monthly income of R1200 from pension grants, whereas heads of the households aged between 28 and 59 had a stable average monthly income of R250 from child grants and an average of R344 from salaries. As shown in Table 4.4, there was a positive significant correlation between household income and age ($p<0.05$). This could suggest that in the study areas, households with older heads of households had more income than the ones with younger heads of households. The results also show a positive significant correlation between household income and field size, and household size. Table 4.4 shows correlation between household income and other socio-economic factors.

Table 4.4 Household income correlation with other socio-economic factors

	Minimum	Average	Maximum	Correlation with household income
Field size (ha)	0.4	1.5	5.5	** (+)
Education	0	4	12	NS
Household assets	0	3	8	NS
Age	28	57	60+	** (+)
Household size	1	7	19	*** (+)
Cattle	0	5	20+	NS

n=100; (**) $p<0.05$; (***) $p<0.01$; (NS) not significant

4.2.4 Household landholdings

The field size may affect household decisions on either using or not using indigenous practices and choosing household prioritised crops. For example, it is easy for a household with 0.5 ha to use indigenous pesticides compared to a household with 5 ha. The average field sizes were 1.5 ha, with a minimum of 0.5 ha and a maximum of 4.5 ha. The average home-garden sizes were 65 m^2, the minimum size was $8m^2$ and the maximum size was $705m^2$. The field sizes refer to the land size where field crops (also referred to in this study as field cropping) such as maize, pumpkin, and potatoes were planted. This land can be within a homestead or elsewhere in a village. The home-garden refer to small plots in homesteads, where garden vegetables such as carrots, cabbage, onions, green paper, tomatoes, butternut, potatoes, sweet potatoes and spinach were planted. Table 4 shows the results on field size correlation with other household socio-economic factors.

Table 4.5 Field size correlations with other socio-economic factors

	Minimum	Average	Maximum	Correlation with field size
Income	0	1876	3100+	** (+)
Education	0	4	12	** (-)
Household assets	0	3	8	NS
Age	28	57	60+	** (+)
Household size	1	7	19	** (+)
Cattle	0	5	20+	*** (+)

n=100; (**) $p<0.05$; (***) $p<0.01$; (NS) not significant

The results showed a positive significant correlation (p<0.05) between field sizes and income. This suggests that households with a larger field size have a higher income compared to those with a small land holding size. Field size also increased with an increase in the household size. This could entail that households with more members are most likely to use more land to increase produce than households with fewer members.

4.2.5 Age of the household head

The wealth of indigenous knowledge is generally found from older people (UNESCO, 2009, Godoy *et al*., not-dated). The notion is that older people have more indigenous knowledge than the younger ones (Roos *et al*., 2010), this then depicts age as an important factor in indigenous knowledge studies. As shown in Table 4.1, about 54% of the heads of household were aged above 60 years. The households with older heads of households are expected to use more indigenous knowledge than those with younger heads of households.

Field size, education and income showed a significant correlation with the age of the household head (see Table 4.6). The educational level of a household showed a negative correlation with age of head of household. .

Table 4.6 Age of the head of a household correlation with other socio-economic factors

	Minimum	Average	Maximum	Correlation with household head age
Field size	0.4	1.5	5.5	** (+)
Household size	1	7	19	NS
Assets	0	3	8	NS
Education	0	4	12	*** (-)
Income	0	1876	3100+	** (+)
Cattle	0	5	20+	NS

n=100; (**) p<0.05 ; (***) p<0.01 ; (NS) not significant

4.2.6 Household Assets

Physical assets play a vital role in determining household welfare (Catherine, 2004). Results show that about seven percent of the households did not own any of the above-mentioned assets, 26% owned 5 to 8 assets and 69% of households owned 1 to 4 assets. Television and radio are the most frequently owned assets, followed by an electric stove and a DVD player.

The least owned assets were paraffin stove, car and gas stove. From these results it is evident that households invest in non-farm aspects. Assets ownership could be related to household income and educational level. However, the correlation results showed no significant relationship between income and asset ownership. The results showed a positive significant ($p<0.05$) correlation between educational level of head of a household and assets ownership. This correlation may suggest that educated households are more exposed to modern assets, they may also have exposure to or high preference of conventional farming practices compared to indigenous practices.

4.3 Food production in the communal rural areas of OLM

Smallholder farmers engage in food production as one of the strategies to enhance their household livelihoods. Results showed that households are engaged in grain farming, horticulture, livestock and poultry farming. Tables 4.7 and 4.8 illustrate crops and livestock and poultry produced by households. These results on households' production are essential in determining the types of foods that households in the study area produce using indigenous and/or conventional practices.

4.3.1 Grain and horticultural products

The households planted maize, using both traditional and hybrid varieties. Maize crop and horticultural crops such as strawberries, lettuce, green pepper, carrots and brinjal are amongst crops that were planted by households in the study area.

Results show that about 74% of the households reported that they practise field crop farming and 76% planted vegetables in their home-gardens. Field cropping was practised around and away from homesteads. Maize was the main food crop planted in the fields, with traditional maize being the predominant type (Table 4.7). Beans, pumpkin, potatoes and sweet sorghum crops are intercropped with maize in smallholder farms. Tomatoes, spinach, cabbage, onion, carrots and beetroot are the main vegetables planted in the garden. These crops may be prioritised because they form a larger ration of households' daily consumption.

Table 4.7 Frequency of smallholders who planted field and garden crops in OLM

Field & garden products	Number of Household (%)
Field	**74**
Traditional maize	76
Hybrid maize	29
Potatoes	2
Sweet sorghum (intercrop)	2
Beans (intercrop)	19
Pumpkin (intercrop)	39
Garden	**76**
Tomatoes	74
Spinach	76
Brinjal	9
Green pepper	11
Maize	16
Cabbage	75
Lettuce	3
Carrots	54
Potatoes	24
Onion	52
Sweet potatoes	6
Beetroot	47
Yams	2
Pumpkin	13
Beans	11
Chillies	17
Spring onions	4
Pumpkin	13
Strawberry	2

Table 4.7 shows that traditional crops such as yams, sweet sorghum, spring onion, sweet potatoes and pumpkin were planted by a low percentage of households. This low percentage may be a result of the small field sizes forcing households to prioritise staple crops such as maize, cabbage, tomatoes, spinach and carrots (Lahiff and Cousins, 2005). Non-traditional crops such as lettuce, carrots and green pepper are some of the least cultivated crops, except for carrots.

4.4 Livestock and poultry production

Livestock and poultry production form part of household food production. Livestock is vital in the use of indigenous knowledge, since practices such as manure use and animal traction depend on its availability. The number of livestock that a household owns is important in determining the extent to which it can adopt these practices. Table 4.8 shows livestock and poultry owned by the households. Table 4.8 shows that households keep cattle, goats, sheep and pigs for livestock farming; and chickens, turkey and ducks for poultry farming. Cattle, goats and chickens are the most commonly kept by most of the households in the study area. Cattle and goats are consumed during traditional ceremonies and thus were consumed approximately once a year. Chickens are consumed on a monthly basis and at least two chickens are consumed per household in a month. Some livestock and poultry such as turkey, ducks, pigs and sheep are not used for traditional ceremonies and are rarely consumed. Pigs, sheep and turkey are consumed on special occasions such as Christmas and other celebrations.

4.5 Wild edible plants consumption

Table 4.9 presents some wild fruits and leafy vegetables, consumed in the study area. Some 45% of households consumed wild edible plants. Wild plants such as pigweed, *Umsonti, Isanjana* and *Lantana camara* were some of the most consumed plants in the study areas (Table 4.9). The percentage of consumption of wild plants differed across villages. In Okhombe village, households consumed 14 different types of wild plants whereas *Amaranthus* spp. and *Opuntia engelmannii* wild plants were the most consumed in Potshini, Busingatha, Mlimeleni and Nokopela.

To establish value of wild edible plants to households, the study collected information on various reasons households collected wild plants. Of the 45% of households which consumed wild edible plants, 60% gathered wild plants as a strategy for diversifying household food. About 31% of households did not purposefully set out to collect wild foods, but collected these while undertaking other activities such weeding, working in fields and walking around the village. Households rarely collected wild plants as they fetch firewood. About 7% of households gathered wild plants in the mountains as they fetch fire wood and only 2% went to the mountains to gather wild plants. This pattern in collection and consumption of wild edible plants suggests that some IKPs cannot be separated from a holistic household livelihood system

Table: 4.8 Livestock and poultry farming by smallholders in OLM

	Frequency household (%)	Mean Total Number	Minimum	Maximum	Mean No. Sold/yr. or month*	Mean No. Consumed/year or month*	Mean No. died/yr.
Livestock total household	**65**						
Cattle	51	9	1	39	1	1	1
Goats	43	8	1	28	2	1	2
Sheep	10	8	1	20	1	1	1
Pigs	5	2	1	3	0	1	0
None	35	-	-	-	-	-	-
Poultry total household	**69**						
Chickens	69	16	2	50	1	2	4
Ducks	1	19	19	19	0	0	8
Turkey	1	2	2	2	0	0	0
None	31	-	-	-	-	-	-

*Poultry consumption, sales are measured per month; Livestock consumption and sales are measured per year

The majority of households in the study area (55%) did not consume wild foods. Of the roughly 45% that consumed wild plants, 91% indicated that wild plant consumption is part of their food consumption strategies. There was no statistically significant relationship between wild food consumption and household characteristics. This implies that wild foods are consumed probably because of their availability and household preferences (Matenge *et al*. 2011), rather than household socioeconomic status (Feyssa *et al*., 2011, Vorster, 2007).

4.6 General use of indigenous knowledge in households

The descriptive statistics on the use of indigenous and conventional knowledge showed that households have been using IKPs for more than 20 years, whereas conventional practices have been used for less than 20 years. However, fertilizers have been used for more than 20 years. Households have been collecting wild plants for 22 years, on average. The use of IKPs for more than 20 years shows that they are well-established in the study area.

Table 4.9 Percentage of households consuming wild plants

IsiZulu names	**Latin names and (English) names**	**Percentage (%) n=45**
Imbuya	*Amaranthus* spp. (pigweed)	93
Snwazi	*Momordica balsamina* (Cucurbit)	2
Isanjana	Unknown*	22
Ibhucu	*Lantana camara (*Tick-berry)	16
Arocedo	Unknown	2
Umfomfo	Unknown	11
Amadolofiya	*Opuntia engelmannii* (Prickly pear)	13
Umtungwa	Unknown	2
Isankontshane	Unknown	2
Inkaza	Unknown	2
Ihalanathi	Unknown	2
Umlubhemu	Unknown	2
Uxhaphozi	*Hydrilla verticillata*	4
Umsonti	Unknown	20

*The term unknown refer to wild edible plants that were not located in scientific and English terms.

4.7 Food security status

Fifty-four percent (54%) of the households reported that they experience food shortages. In addition to purchasing food, households incur other monthly expenditures, such as electricity (58%), instalments (10%), school fees (74%), burial (28%) and community savings schemes (55%). About 28% of households reported that they often forego other household expenses in order to meet food requirements. This suggests that households in OLM areas have limited financial access to food and food insecurity is a concern.

4.8 Conclusions

This chapter provided analysis of sample characteristics. The 54% of households experiencing food shortages indicate a state of food insecurity in the OLM. The households are predominantly female headed, with an average of seven household members.

The literacy rate is generally low in the OLM areas, and lower amongst the older heads of households. The average income of R1876 indicates a low economic base and high rate of unemployment. This is the case particularly for the households with younger heads of households. The low household income may result in more use of locally available resources. The average field sizes of 1.5 hectares and average home-garden plots of $65m^2$ indicate that households in the OLM have small landholdings. Most young people in OLM are not involved in household farming as 61% of the households reported that school going household members are not involved in farming activities. Households plant a variety of field crops, mainly maize, and vegetables in the home-gardens mainly spinach, cabbage, tomatoes, carrots, onions and beetroot respectively. This study hypothesised that household characteristics have an impact on the use of indigenous knowledge. Thus the household characteristics presented in this chapter are expected to have an effect on household use of IKPs which are presented and discussed in the following chapters.

CHAPTER 5: IKPS USED BY SMALLHOLDER FARMERS IN THE OKHAHLAMBA AREAS, KWAZULU-NATAL

5.1 Introduction

This chapter describes IKPs identified in the study area, their relationship with household socio-economic status, and their effect in food production and preference as assessed by the households.

Indigenous knowledge is complex in nature (Agrawal, 1995a) and, according to Briggs (2005), it may no longer exist in a pristine form. This has resulted on traits of both indigenous and conventional knowledge in IKPs. Thus the study used attributes found in the definition of indigenous knowledge to identify IKPs and focused on knowledge relating to local resources, transmitted from one generation to another and continually influenced by creativity and experimentation. In order to identify an indigenous practice, questions regarding the origin of a practice and resources used were asked during case study interviews. This assisted in understanding if the practice was originally from the study area and if it had been changed by innovations or not.

The first part of this chapter focuses on crop farming and wild plants related IKPs. The results are presented in table 5.1 through to table 5.7, outlining IKPs identified in the study areas, farmers perspective on how the practices work and reasons for application, and the percentage of households using the practices. Farmers' perspective in this study refers to an understanding of an individual farmer or shared meaning of the IKPs by the farmers in Okhahlamba areas. This was achieved by following the interpretive case study approach as described by Crowe *et al*. (2011). The areas in crop farming covered in this section include management of pests, weeds and soil fertility, seed selection, storage, post-harvest processing and land preparation. The number of times each IKP was reported by the households assisted in identifying whether or not existing practices are widely applied and shared across households or communities.

The second part of this chapter focuses on household level characteristics that determine use of IKPs practice. The third part covers farmers' perceptions on effectiveness and preferences of IKPs and conventional practices.

5.2 Pest management

Smallholder farmers in the study area use indigenous knowledge for pest management, these include the use of paraffin, salt, and vegetables and plants from gardens and surrounding areas. The indigenous pesticides applied in the study areas are outlined in Table 5.1.

A total of 14 indigenous pest management strategies were identified. Four practices were not included in Table 5.1, because they were identified in case studies but none of the households used them. These included the use of wild onion and "sunlight" bar soap mixture solution, aloe and salt solution, smoke soot and rootworms ash solution. The identified pest management strategies enabled farmers to control pests invading their fields and gardens. Pests reported by households included red ants, root worm, stalk borer, maize weevil, cutworm, moles and butterflies. About 35% and 34% of households had no knowledge of the pest types in their gardens and fields, respectively. Stalk borer and cutworm were among the most reported field pests, while ants and cutworm dominated in the gardens.

For seed pest management, paraffin and a repellent grass such as *Agrostis stolonifera* known as *Gawulabeqhela* in the study communities, are used during storage or before planting. *Agrostis stolonifera* is used immediately after harvesting.

Farmers used anything with a sharp smell for controlling pests in seeds, fields and gardens. The concoctions that these farmers make have a sharp odour such as that of a soap (only "Sunlight" bar soap and washing powder), garlic and pepper, paraffin, aloe, and smoke soot. According to these farmers, anything with a sharp smell, and not poisonous, has an ability to repel and/or kill pests. This shows that farmers have mastered a key factor for pest control. Ashes were used for both field crops and gardens; yet do not have a strong odour. Farmers had no information on what makes ashes useful in pest management, other than that their forefathers used it.

Table 5.1 **Indigenous pest management practices used by smallholder farmers in the Okhahlamba Local Municipality**

Pest management IKPs	**IKPs**	**Farmers perspective on how the IKPs work and reasons for application**	**Percentage of households using practice in fields (n=74)**	**Percentage of households using practice in gardens (n=76)**
Soap solution	Make soap water in times of sudden pest outbreak. Or always broadcast washing water in a garden.	The soap sharp odour kills or repels pests. Cost effective.	0	13
Soap, garlic and pepper concoction	Can be prepared a day or two before use, or when there is sudden pest outbreak. Soap, garlic and pepper are added to water. The mixture is then applied on top of the attacked vegetables.	The mixture creates a sharp odour that repels or kills pests. Cost effective.	0	4
Garlic and pepper concoction	Prepared and/or stored for sudden pest outbreak. Garlic and pepper mixture is added in water. Mixture is spread on top of vegetables under pest stress, in the garden.	The original practice adds soap into garlic and pepper. Garlic and pepper (usually readily available in garden) mix is applied as a way of avoiding using soap for pest management, and no costs therefore and soap access problems (shops are far in times of emergency). Sharp garlic and pepper odour chases away pests.	0	2
Ash powder or ash solution	Often mixed with water, seldom applied as powder. Both are spread on top of the crops. Mixed with water if there are many pests attacking a crop. If there is normal attack or there is no sudden pest outbreak ash powder is spread all over the garden before planting or on crops. For fields ash is spread before planting.	Ash is available in households using firewood for cooking It chases away any pest type.	3	8
Hand harvesting of pests	A container full of water is taken to the fields for the handpicked pests to be put into.	Practised in times of emergency where pest infestation is high to a point where they cannot be ignored. No finances for pesticides purchase. Depends also on the nature of the pests.	2	0
Garden object or waving wood	*	*	2	0
Paraffin	*	*	0	3
Manure solution	*	*	0	3
Salt solution	*	*	0	3

(*) Found through surveys (practices not studied in detail as those identified through case studies). Numbers in columns do not add up to 100% because some farmers use more than one practice.

Table 5.1 shows that most pest management strategies are used more in home gardens than fields. Smallholder farmers indicated that land sizes of fields demand large quantities of pesticides, which are difficult to prepare and sustain if using indigenous pest management strategies. Also, indigenous pesticides require daily monitoring of pest infestation. This is easier in a home garden than in fields, hence the low number of households using indigenous pesticides in their fields.

The use of indigenous practices that were identified in pest management is not widely distributed across the study area. The percentage of household applying identified strategies is low. The results from descriptive statistics show that 44% of households have pest problems but are not using any IKPs and conventional pesticides (see Appendix D).

5.3 Weed management

Weed management plays a critical role in food production by smallholder farmers, as weeds reduce crop yields through nutrient and sunlight competition. Weed threat is severe on root and tuber crop yields, since these crops have a low rate of initial growth, making them poor weed competitors (Iyagba, 2010).

Farmers in the study area use a wide range of indigenous and conventional weed control methods. Table 5.2 shows the indigenous weed management methods used by smallholder farmers in the study area. Households use hand-hoe, animal traction and manure processing methods to control weeds. About 91% of households used the hand-hoe weeding method in the fields and 100% of respondents used it in home gardens. Results also show that about 39% of households use draft animals for land preparation and 3% use draft animals for weeding. Manure processing and burning practices are used to minimise weeds which spread through manure.

Table 5.2 Indigenous weeding practices used by smallholder farmers in OLM

Weeding management IKPs	IKPs	Farmers perspective on how the IKPs work and reasons for application	Percentage of households using practice in fields (n=74)	Percentage of households using practice in gardens (n=76)
Hand-hoe weeding	Used in the fields and gardens.	Farmers are comfortable using a hand-hoe for weeding. Farmers not owning oxen for draft weeding use hand-hoes.	91	100
Animal draft weeding	Use a minimum of two oxen to weed the fields.	Fields land sizes are large for hand-hoe weeding. Shortage of manpower for weeding fields. Farmers own oxen or can afford to hire oxen.	3	0
Kraal manure stored in one pile – heating/anaerobic reaction.	Collect manure at least once a week from the kraal and store it in one pile until the planting season commences. While in the pile, manure undergoes an anaerobic reaction. When ready it forms white patches.	Heated manure is more fertile and it reduces pests. It is mainly used for reducing manure ability to harbour weed seeds. To reduce the amount of work if using hand-hoe weeding.	22	*
Kraal manure burning	Manure is moved from the kraal (wet or dry) and burned a night before use.	To reduce its ability to harbour weed seeds. Ashes kill pests and insects.	22	*

(*) aimed for fields use however the rest are applied in gardens. Numbers (in columns) do not add up to 100% because some farmers use more than one practice.

5.3.1 Hand-hoe and draft animal weeding management

The higher percentage of households using a hand-hoe as a weed management practice shows that even though hand-hoeing is labour intensive, it continues to be the main tool for weeding in smallholder farming. The case study farmers reported that the main disadvantage of using hand-hoe is the intensive labour that comes with its use. The use of draft animals for weeding and land preparation was associated with male members of the household. Case study farmers stated that shortage of male household members is the main factor that hinders the use of draft animals by households. Farmers weigh the efficiency of using hand-hoes and that of using animal traction and optimise what is essential for productivity.

5.3.2 Heaping and burning manure for weed control

Manure processing (22%) and manure burning (22%) were applied as strategies for weed control. The case study farmers stated that manure hosts weed seeds if not treated. Heaping and burning manure are some of the strategies that farmers have adopted to get rid of weeds in manure. Farmers indicated that fields which have untreated manure have a lot of weeds. Processing and burning manure is vital for crop production, as the process allows for elimination of plants in the manure before application on the field. This allows crops especially roots and tubers, to produce well. Farmers did not have a clear understanding of the benefits of the practice of burning kraal manure. The practice is good also if used as a pesticide.

5.4 Soil fertility management

The study identified some indigenous soil fertility management practices used by smallholders in the study area. Smallholders either used manure alone or mixed it with fertilizer or heaped the manure and burned it. Table 5.3 shows some practices used by households to improve soil fertility.

5.4.1 Manure use

The various strategies outlined in Table 5.3 show the extent to which manure is adapted for use in soil fertility management by smallholder farmers. Farmers heaped kraal manure, burned kraal manure, prepared a mixture of kraal manure and fertilizers, used ashes, mulching, compost and untreated kraal manure. Practices used in fields and home gardens by households are different. For example, households used treated manure more in fields than in home gardens. Households use a lot of ash powder and compost in home gardens compared to fields. Some practices, such as a mixture of manure and coarse salt, mulching and kraal manure soaked in water were identified in the case studies. However, the survey showed

Table 5.3 Indigenous soil fertility management practices used by smallholder farmers in OLM

Weeding management IKPs	IKPs	Farmers perspective on how the IKPs work and reasons for application	Frequency (%) of households using practice in fields (n=74)	Frequency (%) of households using practice in gardens (n=76)
Kraal manure stored in one pile – heating/anaerobic reaction.	Collect manure at least once a week from a kraal and store it in one pile until the planting season commences. While in the pile, manure undergoes anaerobic reaction. When ready it forms white patches.	Heaped manure is more fertile. Also beneficial in pest and weeding management.	22	*
Kraal manure mixed with fertilizer	Sieve kraal manure and mix it with fertilizer in the bags. The quantity of manure or fertilizer depends on a farmer's preference. The mixture is made during or before a planting period.	High costs of fertilizer. Manure is added to increase quantity. Fields where only fertilizer is applied are less fertile and acidic. Kraal manure causes stunting, thus fertilizer assists kraal manure in improving growth.	61	11
Burning the kraal manure	Manure is moved from the kraal whether wet or dry and burned before use.	Applied for the benefits of weed and pest management.	22	*
Using ash powder	Ash is spread in the field or garden	Increases soil fertility and also beneficial in pest management.	4	15
Kraal manure only	Manure is spread in the fields or garden, months before planting, and/or applied when planting.	Applied because of its high and sustained fertility rate, especially in the gardens. Usually there are no costs attached and it is cheaper than fertilizers.	10	94
Rotten grass and leaves or compost	Collected from the forest and around household and spread in the garden or fields depending on the quantity.	To boost other fertility methods such as manure or fertilizer.	0	15

(*) aimed for fields use and the rest are applied in the gardens. Numbers (in columns) do not add up to 100% because some farmers use more than one practice.

that none of the households used them, which may imply poor sharing of knowledge amongst households.

About 61% of smallholder farmers stated that manure is easily absorbed in the soil, sustains fertility and reduces the soil acidification caused by fertilizers. Farmers observed that fields where manure only is applied have stunted maize crops, whereas fertilizer application improved maize production. Farmers indicated that the use of manure encourages weed infestation in the farming gardens. They also indicated that fields where only fertilizer is applied are infertile in the following planting seasons, whereas fields where manure is applied are fertile in the following planting seasons.

The main reason for the use of manure, in light of its shortfalls, is its ability to sustain soil fertility compared to inorganic fertilizers. The case study farmers stated that they observed sustained soil fertility in the gardens where only manure is applied. This could be the reason for high percentage use of manure (94%) among smallholder households.

Farmers highlighted stunting of maize as one of the limitations of using manure without fertilizers. The weeds created by untreated manure were also raised as a secondary concern. The strategies for overcoming the shortfalls of using manure were to mix manure (heaped or not) with fertilizer (61% fields; 11% gardens) and heaping (22%) and burning (22%) manure.

To avoid disadvantages such as soil acidification, unsustainable soil fertility (caused by using fertilizers, only) and stunted maize (caused by using manure, only) most households used a mixture of manure and fertilizer for their fields (Table 5.3). The mixture is beneficial in terms of costs and production. Given the shortfalls and benefits of both manure and fertilizer, a mixture of manure and fertilizer is preferred to enhance household food production. The practice of burning kraal manure serves as a strategy for reducing weeds in the manure. There is, however, uncertainty as to whether or not enhances soil fertility.

Soaking manure for use during irrigation after weeding is a practice that is used mainly in home gardens. It is not usually applied in the fields, due to the quantity required for big fields. This practice, according to farmers, replenishes soil fertility and boosts crop growth.

5.4.2 Other soil fertility management strategies

Rotten leaves and grass are some of indigenous practices used to enhance soil fertility in gardens. Mulching is mainly used to retain soil moisture and enhance soil fertility. None of the sampled households used mulching.

5.5 Post-harvest processing and storage

A substantial quantity of produce is lost after harvest due to lack of sufficient storage and processing facilities (Singh and Satapathy, 2003). Smallholder farmers in the study areas use a number of practices (Table 5.5) to ensure a long shelf life after harvesting. Storage facilities are used (Table 5.4) to prevent pest accumulation and enhance the protection of the stored produce from humidity, rainfall, livestock and poultry. Some of the storage facilities used by smallholder households in the study are described below.

5.5.1 The maize-crib

The maize-crib is a post-harvest storage facility built in a homestead using corrugated iron, wood and other suitable resources available in households. Five percent of farmers dried and stored maize in a maize-crib, while 19% used the maize-crib only for drying maize (Table 5.4). These farmers cover the floor and walls of the maize-crib with a repellent plant (*Agrostis stolonifera*) to protect them from pest invasion.

Farmers indicated that the maize-crib is a most efficient processing and storage method and protects the produce from pests and livestock. The farmers had developed ways of preventing loses in the crib. Pests were controlled by using repellent plants such as *Agrostis stolonifera* and dry grass. Farmers reported that the maize crib structure is often built with planks or hard wood which are vertically or horizontally joined tightly for protection from harsh environmental conditions, rodents and livestock. The maize-crib is roofed with corrugated iron or planks of wood. The inside is divided into two sections by planks of wood which are horizontally placed at least two feet from the ground. This is done to protect maize from red ants and to create space for pumpkin storage. For pest management, farmers indicated that whenever there are pests in the maize-crib, it difficult to use conventional pesticides. Hence, *Agrostis stolonifera* is horizontally placed against the maize-crib walls and on the floor, which is 50cm from the ground, and among stored maize.

Table 5.4 Post-harvest processing and storage practices used by smallholder farmers

IKPs in produce processing and storage management	IKPs	Farmers perspective on how the IKPs work and reasons for application	Percentage of households using practice in fields (n=74)	Percentage of households using practice in gardens (n=76)
Store in tanks, basins and bags	Maize is dried in a maize-crib or ventilated house, de-coned and stored in sealed or unsealed tanks or basins or bags	Maize is dried in a crib when produce is substantial. It can also be stored in a ventilated house if there is enough space. Maize is dried to prevent it from rotting when stored in a container.	71	0
Maize stored in crib	Maize is put in a maize-crib, where a repellent plant is added.	Maize is stored in a crib when a farmer prefers to not put it in the tanks or bags after drying, and if the produce is plentiful and a farmer has means of managing pests in a crib.	5	0
Maize processing in crib	Maize is dried in a maize-crib in winter and stored in tanks in spring or early summer	To dry maize if there is not enough space in the house. Stored in tanks in spring or early summer as pest infestation increases with heat.	19	0
Keep in the refrigerator or cool house *	Garden vegetables are harvested and put in refrigerator or cool house	Vegetables must be stored in a cool place to prevent them from rotting.	11	15

(*) Practices are both indigenous and conventional. Numbers (in columns) do not add up to 100% because some farmers use more than one practice.

According to the farmers, the strong smell of *Agrostis stolonifera* and its repellent effects protects stored produce for a long period. Farmers who dried and stored their maize in cribs used this plant as a repellent.

Farmers who used maize-cribs for drying maize in winter (May to July) did not use any pest management strategies because there are no or few pests in that season. The maize is then shelled in spring and stored in metal tanks, basins and sack bags. The maize-crib is constructed based on the famer's maize harvest forecast. Building a crib is time-consuming; thus farmers use tanks for small harvests.

5.5.1 Use of tanks, basins and sack bags

Tanks, bags and basins were the most (71%) used methods for harvest storage (Table 5.4). Farmers often did not seal the storage tanks and basins, which could result in maize losses. Most households did not have a maize-crib to store their maize harvest. Farmers used tanks, bags and basins in 2011 because they harvested relatively low quantities of maize, due to erratic rainfall experienced from November to mid-December 2010. The case study farmers pointed out that yields were so low that some households did not have enough to eat and store for seed.

Farmers also used refrigerators or cool houses to keep garden produce from their home gardens. About 94% of households kept their crops in the home gardens and harvested only when they needed to cook. Some households keep their crops in the garden until the winter season (snowing) and other households kept their crops in the garden for the whole year. In The Okhahlamba areas can experience substantial frost in winter, thus households that kept the crops in the garden in winter mentioned that they had to cover them with nets and irrigated in the mornings for water to infiltrate into the soil during the day when temperatures are warmer, and avoid irrigating in the evenings as water could be retained in the ice and not reach a crop.

5.6 Seed selection and storage

Viability of seeds has a bearing on household farm production. Smallholder farmers store seeds from some of their produce. The quality of stored seeds depends on strategies a farmer employs to prevent storage pests, insects and unconducive temperature (Talawar, 2005). In seed storage, farmers consider a number of issues to maintain their seed viability and knowledge on temperature regulation for seed germination, timing of seed storage and use of repellents for pest control. The practices involved in seed selection and storage are outlined in Table 5.6.

Table 5.5 Seed storage practices used by smallholder farmers in OLM

Crops	IKPs	Farmers perspective on how the IKPs work and reasons for application	Percentage of households using practice in fields (n=74)	Percentage of households using practice in gardens (n=76)
Maize	Dried in the maize-crib or open cool house and de-coned on the edges: coated with paraffin; or stored and only coated with paraffin when planting; or stored with a repellent plant in storage house; or stored in a sealed container. All is stored in a sealed container. Few are hung on the roof in a smokehouse.	Maize-crib ensures a cool temperature for maize. De-coning edges leaves good shaped maize seed for planting. Paraffin, smoke and repellent plant act as pest repellent.	66	0
Beans	Mature bean seed is selected and stored in a container (closed or open).	Storing good seed to sustain mature variety.	11	0
Pumpkins	Pumpkin seeds are removed and washed and sun dried and stored in a sealed bottle. Can be or not be coated with paraffin.	Glass bottles allow a cool temperature while protecting from pests. If dried and sealed in a bottle chances for pests are low.	39	0
Sweet sorghum	Hang in the roof in a smoke house.	Being hung in a roof allows it to dry and smoke is used as a repellent.	2	0
Potatoes	Seeds are kept in a plastic, or container. Sometime seeds are stored in a plastic or container with soil and dead grass inside.	This is done to initiate germination. Grass and closed plastic or container speeding the potatoes germination process.	2	0
Garden vegetables	Harvested and dried outside, or can be put in ventilated plastic bags. Or seeds are first extracted from rotten produce. If not enough, it is extracted from the good produce. It is then sun dried and stored in a sealed container.	Plastic bags are used to protect seeds from birds as the seeds are hung in trees or roof. Ventilated for temperature control. Sun drying is a primary process for preventing seeds from rotting during storage.	0	29

Numbers (in columns) do not add up to 100% because some farmers use more than one practice.

About 76% of households planted maize from what they regarded as traditional seeds. Potatoes and sweet sorghum seed were the least stored. Households stored seeds more for field crops than garden crops. Farmers selected seeds from mature plants. Farmers determined seed quality by considering factors such as shape, size and colour of the produce.

For example, in maize seed selection, farmers did not use maize from the edges of a cob and this ensured even seed size and shape, ideal for good produce.

The maize cobs are dried in crib or in a ventilated house. Seeds from the edges are removed for household consumption and livestock feed. The maize is de-coned in winter or beginning of the spring season to avoid pest infestation. Farmers stated that using planting machines requires a flat-shaped maize seed. Thus, since the maize shape by the cob edges is not suited for machines, farmers select only flattened maize seed from the middle of the cob. Farmers that never used planting machines did not remove maize form the edges. Farmers also considered maize colour for sustenance, storing a white and yellow maize variety for seeds.

The field crops' seeds were stored to maintain traditional varieties and also because the seeds for crops such as traditional maize and pumpkin are not easily accessible in the markets. Thus farmers had to store seed to plant in the next season.

About 76% of farmers use traditional maize seeds. The farmers named three positive and two negative implications of planting traditional maize. Traditional maize is commended for its resistance to high temperatures and high palatability when consumed as fresh corn, compared to hybrid maize. When consumed as maize meal it stays in the stomach and can sustain an individual throughout the day compared to hybrid maize.

One of the negative implications of planting traditional maize is that it requires more quantities for cooking compared to hybrid maize. Secondly, traditional maize produces few lines in a cob compared to a hybrid maize variety. Farmers called traditional maize an eight-line and hybrid a twelve-line. Farmers pointed out that they have observed that traditional varieties are prone to underground pests in the field after planting compared to hybrid varieties, the seeds which are treated with insecticide and fungicide.

The results show that only 29% of households stored garden seeds, compared to 79% who stored seeds of field crops. The case study farmers reported that the garden seeds can be accessed from extension services, as such; there is less storage of these seeds.

5.7 Land preparation

The indigenous practices for land preparation used by the households are presented in Table 5.6. The practices for land preparation include use of animal traction and hand-hoes.

Animal traction and hand-hoes are the indigenous practices used for land preparation. Results show that for field land preparation, 39% of the households used animal traction whereas only 9% of households used a hand-hoe. Farmers regard hand-hoeing as more labour-intensive than animal traction. The hand-hoe is not normally used for tilling fields. Due to the labour-intensive nature of a hand-hoe, it is utilised in small gardens.

Table 5.6 Indigenous practices used in land preparation by smallholder farmers in OLM

Land preparation IKPs	IKPs	Farmers perspective on how the IKPs work and reasons for application	Percentage of households using practice in fields (n=74)	Percentage of households using practice in gardens (n=76)
Use of animal traction use	Two or four oxen are used for ploughing and seeding	It is cheap and not labour intensive. It allows for simultaneous release of seed and manure/fertilizer and thus saves time.	39	0
Use of a hand-hoe	Prepare soil mostly in a garden requiring 1-2 people or more (depending on household labour availability).	Seldom used in the fields because it is labour intensive. Gardens are small, thus no need for machinery or draft animals.	9	100

Numbers (in columns) do not add up to 100% because some farmers use more than one practice.

The availability of male labour and livestock theft, were mentioned in the case studies as major limitations to the use of animal traction. With regards to gender, households with no older males had no readily available labour for animal traction, as it is perceived to be a practice suited for males. These households had to hire unpaid labour, which delayed ploughing, as these households wait for other households to finish ploughing their fields. These households sometimes ended up hiring tractors. Some farmers indicated that livestock theft leaves households with no oxen for ploughing.

5.8 Wild edible plants

Wild edible plants grow naturally and are not nurtured by human beings (Vorster, 2007). A total of 14 wild edible plants were identified in the study area (Table 5.7). About 11 of the recorded wild plants are found in mountains and three in the community. Two of these were wild leafy plants and twelve were wild fruits.

Table 5.7 Wild edible plants consumed in OLM

Name of Wild edible plants#	**Location of plant in the village**	**Description of Plant**	**Season of Availability**	**Percentage of households consuming the plant (n=45)**
Isanjana	Mountains	Big tree producing yellowish fruit	Winter	22
Lantana camara (Tick berry)	Mountains	Tree producing black coloured fruit	Winter	16
Umsonti	Mountains	Tree producing purple fruit	Winter	20
Opuntia engelmannii (Prickly pear)	Fallow lands, around homesteads	Aloe plant producing round red fruit	Winter	13
Umfomfo	Mountains in between rocks	Tree producing big grapelike fruit	Winter	11
Amaranthus (Pigweed)	Fields, gardens and around homesteads	Green leafy plant	Summer	93
Umtungwa	Mountains	*	Summer	2
Isankontshane	Mountains	*	Summer	2
Inkaza	Mountains	*	Summer	2
Ihalanathi	Mountains	*	Summer	2
Umlubhemu	Mountains	*	Summer	2
Hydrilla verticillata	By the rivers	*	Summer	4
Arocedo	Mountains	*	Summer	2
Momordica Balsamina (cucurbit)	Mountains	*	Summer	2

(*) Found through surveys – practices were not studied in detail as ones that were found through case studies. Numbers (in columns) do not add up to 100% because some farmers use more than one practice.
In Italic is Latin names

Knowledge of wild plants is widely shared amongst households, but their consumption is limited to only a few species. The *Amaranthus*, Isanjana, Umsonti, *Lantana camara* and *Opuntia engelmannii* are the most consumed wild plants. Of these plants, only one (*Amaranthus* spp.) is used as a staple food in summer, as the other plants are fruits. *Hydrilla verticillata* is used as a staple food by households but its consumption is low. The case study farmers indicated that this green leafy plant is a poor man's food.

The consumption of wild plants has declined due to changes in community social structures. The introduction of electricity and water reduced the number of villagers collecting firewood in the mountains and water in the rivers, where most of the wild fruits are found. The *Hydrilla verticillata* for example, has been neglected because of its social stigma, but the other reason was that households are not using rivers to access water.

The wild fruits are collected as household members herd cattle and collect firewood. The case study farmers stated that wild fruits are not consumed out of hunger but by preference. Ten of the fruits in Table 5.7 are consumed as villagers rest from herding livestock or collecting firewood from mountains and they are not usually consumed at home. Farmers reported that *Isanjana* and *Opuntia engelmannii* are mostly collected and consumed by all household members, as they can be dried and preserved.

5.9 Household level characteristics that determines use of IKPs practice

This study hypothesised that household socio-economic characteristics are significant to the use of indigenous knowledge. According to Briggs (2005), factors such as age, experience, wealth, household circumstances, production priorities and gender have an impact on the individual's access and ability to use IKPs knowledge. This section seeks to establish the relationship between IKPs and households characteristics, including income, literacy, age, gender of household head and land-holding size. The one way analysis of variance (ANOVA) was used to determine the difference between the means of household characteristics of households using IKPs and households using conventional practices.

A number of household characteristics mean differences were significant in some practices, including seed storage, maize varieties, weeding management, mixture of manure and fertilizer and seed storage (Table 5.8). The detailed results are shown in Appendix D. The household head age mean differences across the seed source groups was significant ($p<0.05$).

Age is one of the key parameters in IKPs utilization and preservation (Mugisha-Kamatenesi *et al*., 2008). The results show that households with older heads store seeds and those with younger heads are purchasing seeds.

Table 5.8 IKPs relationship with household socio-economic status

IKPs	Field sizes	Household head gender	Household size	Household income	Household head education	Household head age
Seed storage	**	NS	NS	NS	NS	NS
Weeding	**	NS	NS	***	NS	NS
Seed storage	NS	NS	NS	NS	NS	**
Maize varieties	**	NS	NS	NS	NS	**

(**): significant difference at p<0.05. (***): significant difference p<0.01. (ns): difference not significant.

The average land sizes of the households using herbicides, hand-hoe, and both, for weeding were significantly different at the $p<0.05$ level. The households using herbicides have large fields while households using a hand hoe have small fields. Household income was significantly different ($p<0.01$) across weeding practices. Households that used herbicides have higher income than those that used a hand hoe or both herbicides and hand hoe.

Households used traditional maize varieties, hybrids and both types. There was a statistically significant mean difference in household age across maize varieties applied, suggesting that age significantly affect household's choice of maize variety. There was also a significant mean difference in land size across maize varieties used, suggesting that land size significantly affect the household's choice of maize variety. Farmers in this study stated that hybrid varieties produce higher yields than the traditional varieties, as it produces more than eight lines of kernels in a cob, compared to traditional maize seed, which produces a maximum of eight lines in a cob. Thus households with a small land size will prefer to plant hybrid maize. Households which planted traditional maize only, or both varieties, had large fields.

There were also statistically significant differences ($p<0.05$) between the average land sizes of households and their storage facilities. Thamaga-Chitja *et al* (2004) found that land size is statistically significant to the type of harvest storage facilities used by smallholder households. Households which stored maize in containers have larger fields than those that used a maize-crib. According to Thamaga-Chitja *et al*. (2004) metal tanks have bigger volumes than maize-cribs and other storage facilities.

5.10 Assessment and perceptions of positive and negative attributes of IKPs and conventional practices by farmers

The hypothesis tested in this section is that smallholders' perceptions of indigenous knowledge practices use are negative when compared to their perceptions of the use of conventional practices. Farmers' assessment of IKPs and conventional practices in terms of effectiveness, preference and costs is analysed in this section, using descriptive statistics. Assessment uses a scale of 1 to 4 (very high (4), high (3), average (2), and low (1)). The results are presented in the figure 5.1 to 5.9.

Practices for home gardens and field cropping are assessed separately, because perceptions may differ depending on whether a practice is used in a field or a garden. Case studies revealed that differences in input requirements for gardens and fields imply differences in effectiveness, farmer preference, and costs of IKPs and conventional practices. Perceptions on management of fertility, weeding, pests and seed storage are analysed.

5.10.1 Comparison of IKPs and conventional fertility management effectiveness and preference

Manure and fertilizer were assessed in terms of their effectiveness in fertility management in fields and gardens by smallholder households, in order to find the effectiveness and preferred strategy of farmers in the study area. Figures 5.1 and 5.2; show the results on effectiveness and preference of manure and fertilizers.

The results in Figure 5.1 suggest that farmers perceived manure and fertilizer as highly effective. On average, farmers rated manure as more effective in the gardens than in the fields. Fertilizers were rated as more effective in fields than gardens.

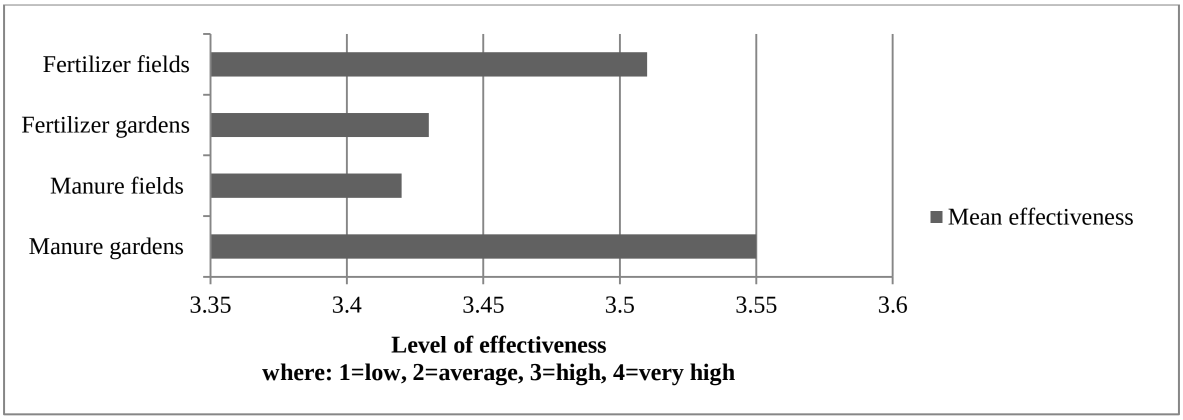

Figure 5.1 Perceived IKPs and conventional practices effectiveness in fertility management by farmers

Figure 5.2 shows the comparison between manure and fertilizer preference by farmers. The results suggest that fertilizers are more preferred in both fields and gardens. However, noting that the mean for both effectiveness and preference was at the high level, one could suggest that, according to smallholders neither fertilizer nor manure is superior to the other. The farmers in the study area perceive manure as a better method of improving soil fertility also equally effective as conventional fertilizers.

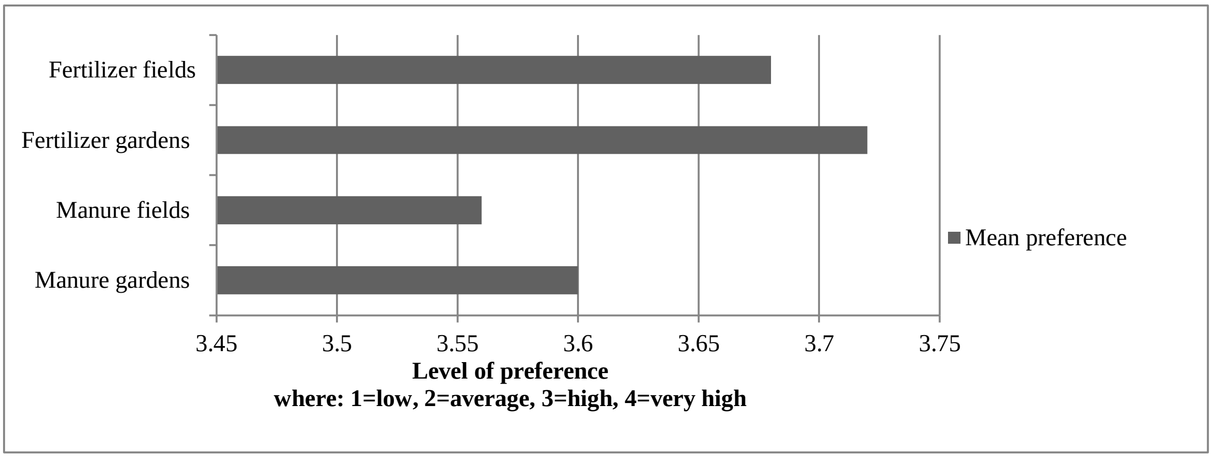

Figure 5.2 IKPs and conventional practices preference in fertility management by farmers

5.10.2 Comparison of IKPs and conventional pest management effectiveness and preference

The results in Figure 5.3 show that farmers perceive pesticides as highly effective in field and home gardens and are rated high in seed and harvest storage usage. In contrast, traditional pesticides are rated high for seed and harvest storage, but only average in their effectiveness in field and garden pest management.

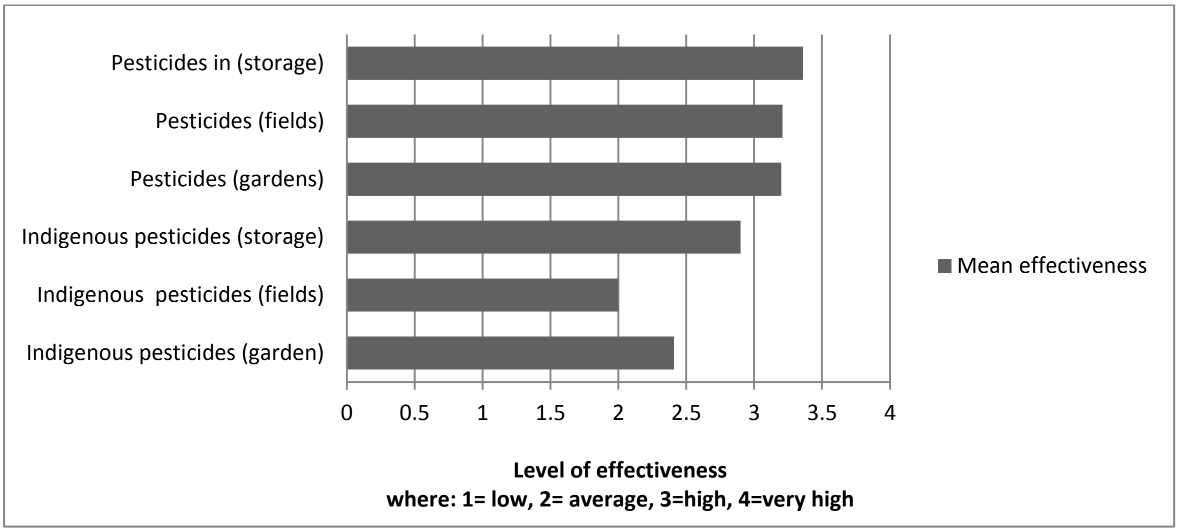

Figure 5.3 Perceived IKPs and conventional practices effectiveness in pest management by farmers

Figure 5.4 shows differences in preference of pesticides and traditional pesticides by farmers. Their preference for conventional pesticides is higher than that for traditional pesticides. The preference for traditional pesticides was only higher for seed and harvest storage. This may mean that farmers do not have alternative conventional harvest storage facilities and are only exposed to traditional harvest storage practices. The assessment of both effectiveness and preference of pesticides and traditional pesticides show that conventional practices on pest management are more effective and preferred by farmers, compared to the traditional practices.

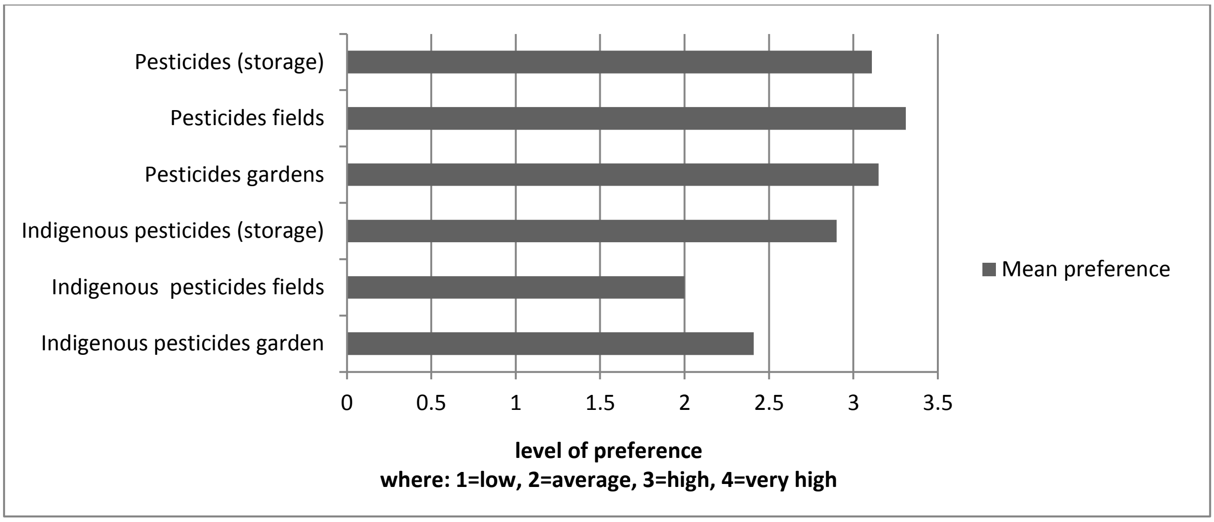

Figure 5.4 IKPs and conventional practices preference in pest management by farmers

5.10.3 Comparison of IKPs and conventional weed management effectiveness and preference as assessed by farmers

Farmers' perceptions of IKPs and conventional practices in weed management are assessed, using a scale of 1-4 (low, average, high and very high). This is shown in Figure 5.5 and 5.6.

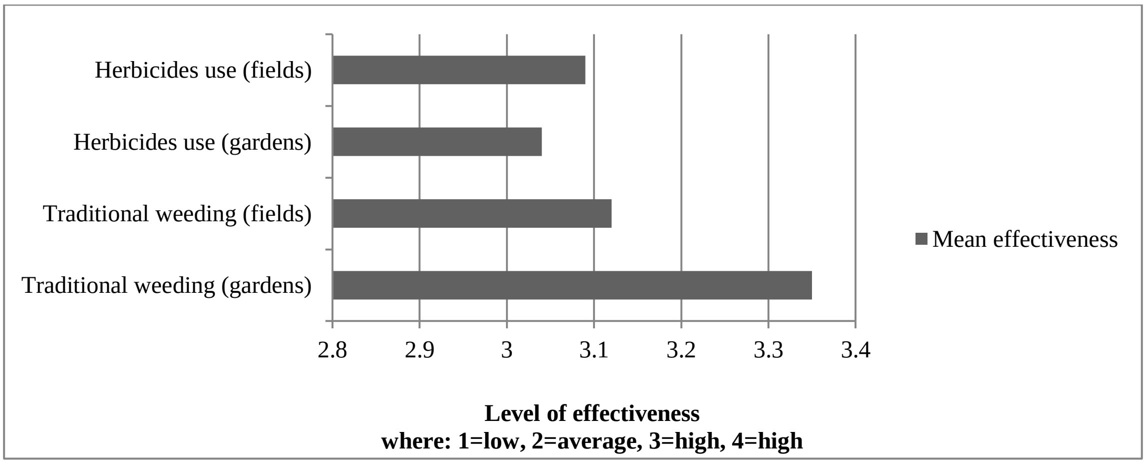

Figure 5.5 Perceived IKPs and conventional practices effectiveness in weed management by farmers

Farmers perception of herbicides and traditonal weeding (hand-hoe and animal draft) effectiveness in weed menagement was generaly high. Traditional weeding was rated more effective than herbicides. However, herbicides are preferred because they are not labour intensive. This could imply that farmers' reliance on traditional ways of farming is limited by household labour availability.

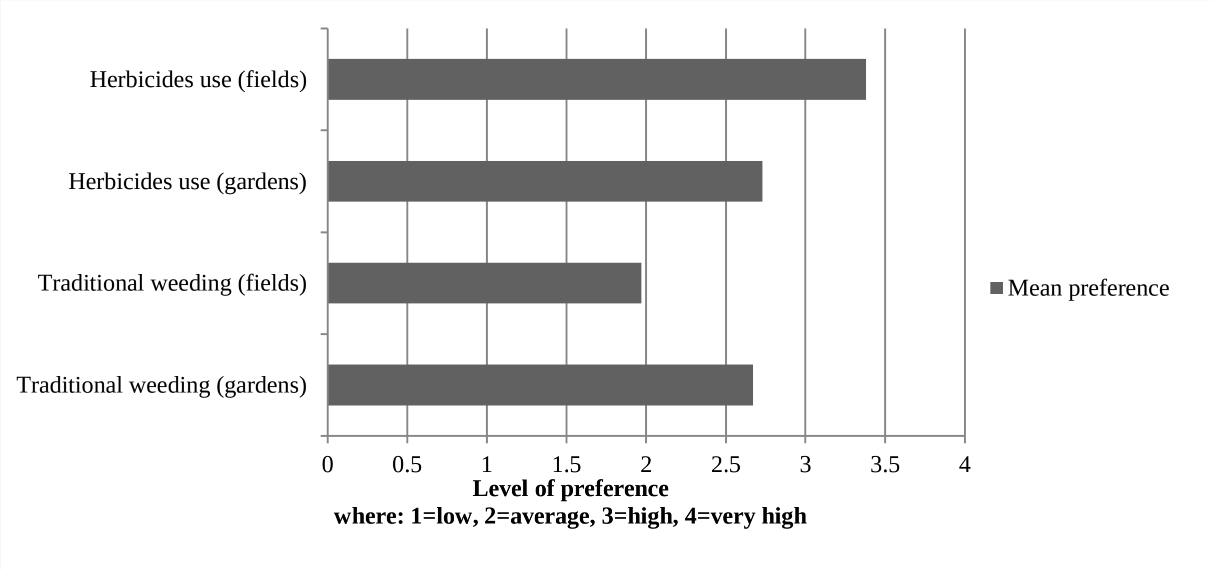

Figure 5.6 IKPs and conventional practices preference in weed management by farmers

5.10.4 Traditional and hybrid seed effectiveness and preference as assessed by farmers

Farmers' perceptions of traditional and conventional seed choices were assessed using a scale of 1-4 (low, average, high and very high). This is shown in Figure 5.7 and 5.8. The purchased seeds and seeds provided by extension services were grouped as hybrid seeds.

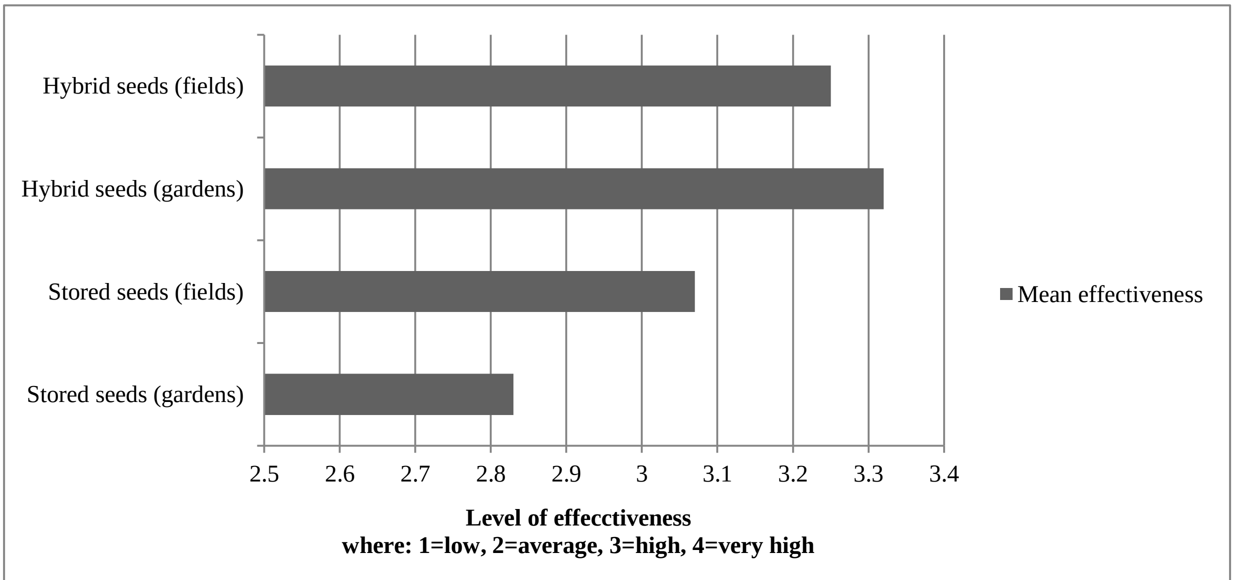

Figure 5.7 Perceived IKPs and conventional practices effectiveness in choice of seed sources

Farmers perceived hybrid seeds as more effective than stored seeds in both fields and gardens and indicated that the hybrid seeds have higher yields than traditional varieties (see Figure 5.7). This was also shown in the previous sections of this chapter. Figure 5.8 shows that farmers did not only rate hybrid seeds as effective but also highly preferred in gardens. Traditional seeds were prefered more than the hybrid seeds when used in fields. Even though farmers have rated traditional seeds as less productive in terms of yields, the preference for these seeds, mainly local maize, over high-yielding hybrid varieties shows smallholder farmers' different view of farming compared to commercial farmers' view of farming. Thus one could question the farmer development policies if they only focus on conventional agricultural practices.

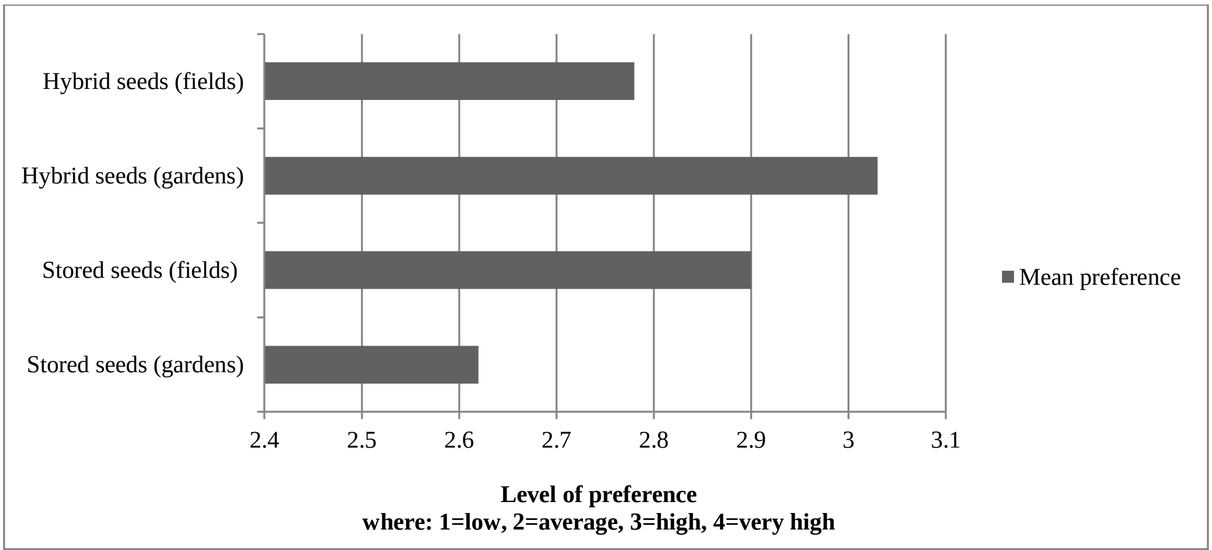

Figure 5.8 Comparison of the preference of traditional and hybrid seed by farmers

5.10.5 Costs assessment of IKPs and conventional practices by farmers

Figure 5.9 presents the comparison of costs of traditional and conventional practices by farmers in the study area. It shows that conventional input costs are higher than IKPs.

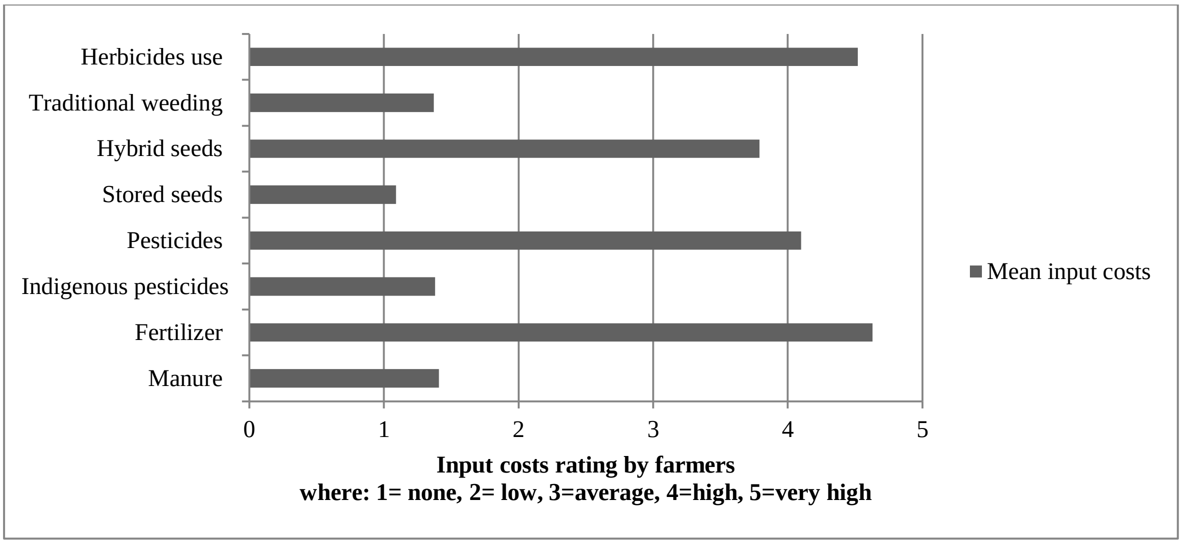

Figure 5.9 Rating of IKPs and conventional practices costs by farmers

Farmers ratedd conventional practices as more expensive than IKPs. The herbicides, pesticides and fertilizers were rated as more costly than hybrid seeds. Considering the costs that the conventional practices incur to the smallholders, promotion of IKPs that are perceived as effective in enhancing the yields could minimise the costs of farming and provide some cash for food.

5.11 Discussion

The IKPs were identified in seed selection, storage, and land preparation, post-harvest processing, management of pests, weeds and soil fertility. However, these IKPs seldom existed in the pristine form. The practices such as mixing manure with fertilizer, storage of hybrid maize seeds and use of pesticides in grain storage are among a few examples which demonstrate a tainted image of IKPs. This was also observed by Briggs (2005) in his reflection on the use of indigenous knowledge in development.

Farmers' indigenous knowledge is similar to that given in the scientific literature on manure, mixing fertilizer and manure, and procedures used in grain and seed storage and pest management. Linking IKPs, for example on manure use and management, to similar scientific studies such as that of Lupwayi and Haque (1999) and Lupwayi *et al.*, (2000) gives credibility to indigenous knowledge. However, indigenous knowledge scholars such as Briggs (2005) and Agrawal (1995b) reason that testing IKPs or cross-checking with scientific or conventional practices is a result of the issue of trust in indigenous knowledge. Agrawal

(2002; 290) states that "independently such knowledge [referring to IKS] has no existence, only possibilities. The use of scientific criteria to test and examine, and the documentation of these tests can be referred to as *validation*….Once validated, particular examples of indigenous knowledge are ready for inclusion in a database of knowledge". While this suggests trust in indigenous knowledge, it is of importance to evaluate competence of IKPs using current scientific knowledge in order to further prove a role for indigenous knowledge in smallholder food production. Agrawal(1995b); Agrawal(1995a), Sillitoe (1998), Agrawal (2002), Agrawal (2004), and Agrawal (2009) Brigs 2005) suggest that indigenous knowledge needs to be used together with conventional practices. Thus evaluating IKPs using science which currently is a dominant form of knowledge may be resourceful if the links between the two are to be understood and used for the development smallholder farmers' food production.

Indigenous knowledge by definition suggests that it is shared among a community or households. The low usage percentage of some IKPs in the study area suggests that practices are not fully shared in the community. Encouraging platforms such as farmers' forums may enable farmers to share such knowledge.

The IKPs such as the use of animal draft in land preparation and weed management are not suited for women because of the drudgery required. Households without male household members struggle to use animal power in farming and their produce could be delayed since they wait for hired labour. Effect of lack of male labour was also the case in Zambia (Sakala, 2000) and Tanzania (Shetto *et al*., 2000). Issues of livestock theft in the rural areas of OLM resulted in reduced household interest in livestock farming. This jeopardise the use of animal draft in smallholder farming and is a threat to other indigenous practices such as the use of manure.

IKPs are also affected by modern lifestyles such as the introduction of electricity and education. These are the essential basic resources for all households living in a semi-industrialised country such as South Africa. However, this is affecting the consumption of wild edible plants. A number of wild edible plants in the rural areas of the OLM are not frequently consumed because of a loss in social functions such as collection of firewood, which enabled the households to access foods from forests or the veld. These plants were identified 17 years ago by Kuhnlein and Receveur (1996) as important in food security of rural households. The author associated the loss of traditional fruits with the decreased nutritional level of householders. Reinstating the value of these fruits and bringing them to the markets could revitalise their use if indigenous knowledge is to be exploited for achieving food security (Vorster 2007). However, these foods are still not being fully utilised in a country where food insecurity is often cited as an issue.

Indigenous practices exist but issues of scale limit their full exploitation by households (Brodt, 2001). Practices such as the use of the hand-hoe for land preparation and weeding and the use of pesticide concoctions are not easy to use in large holdings. As a result, their use is limited to small landholdings, such as gardens, leaving fields with the option of adopting conventional practices.

Enough attention is needed to establish solid indigenous practices such as pesticides that would be cost efficient and readily available. The use of ash as a pesticide serves as one example. In India the use of ash in pest management is referred to as "peppering" (Bio-Dynamic Association of India, 2006). The FAO document on indigenous technology knowledge for watershed management in upper north-west Himalayas of India stated that ash "acts as a physical poison, usually causing abrasion of epi-cuticular waxes and thus exposing pests to death through desiccation. It also interferes in the chemical signals emanating from the host plants, thus obstructing the initial host location by pests" (FAO, 1998: Chapter 6). Hence it is used for pest control. A number of studies, worldwide, such as Integrated Pest Management studies in countries such as the Netherlands and Tanzania (IPM, 2008, Mihale et al., 2009) and in South Africa such as Vorster (2007) and Mkhize (2003) found ash to be one of the main pest repellents for gardens and field crops in smallholder farming.

Indigenous knowledge allows for practices that serve as a solution to a variety of farm problems. This includes using ashes to manage both pests and soil fertility, and heaping and burning manure for soil fertility as the same time minimizing weeds, and mulching for water retention, where dead leaves or grass enhance soil fertility. The advantage is that a household adopt a practice of preference and/or according to resource availability. Results show that only few practices are widely used amongst households. This hinders the availability of common indigenous practices that can be used by all households, but implies that the use of IKPs depend on local resources and are not only specific to the community but also to the household context.

IKPs can be adapted with changing socio-economic status of a household. This is evident in that there were a variety of practices in making pesticide concoctions, or a choice of soil fertility methods but the knowledge base applied in selecting resources that were used was similar. Sillitoe (2010: 16) cites (Sillitoe and Marzano, 2009), who state that "It is the inability to play a part in formulating universal solutions that has inhibited, in some measure, IK's impact on development". Being mindful of the common knowledge base of IKPs can enable the indigenous knowledge to play a part in formulation of development solutions.

Indigenous knowledge gives a foundation for global sustainable development. This has become a given statement or suggestion, as it has been part of literature since 1980's where academicians such as Anderson and Groove (1987) and Flora and Flora, (1989) saw indigenous knowledge's significance in sustainable development. The practices such as those applied in pest and fertility management show the effectiveness and sustainability of IKPs in that they are extracted from the existing household farming system, for example, the use of crops such as chillies and garlic from the garden, the use of ash from the household firewood and the use of manure from household livestock. These resources are readily available for household use. Incorporating IKPs in food security strategies should therefore be encouraged at they are physically, financially and socially accessible for food production.

Household income was significant in weed management. However, for other practices, such as fertilizer, pesticide use and the use of tractors income was not significant. This suggests that whether a household has a high or a low income, the choice of inputs is generally not based on the availability of income. Drawing from the literature on innovation use or adoption, farmers have developed a routine in using both indigenous and conventional knowledge (Owenya *et al*., 2011). Farmers are aware of the conventional and IKPs that suits their household context, thus invest their finances and planning accordingly. Households with larger land sizes use conventional practices such as herbicides and a combination of herbicides and the hand-hoe. This is in line with what Knowler and Bradshaw (2006) stated, in that households with large landholdings tend to invest more in conventional practices. According to Akullo *et al*. (2007) and Brodt (2001), this is a result of issues of scale and labour that comes with using IKPs in large land sizes. Land size was also significantly related to the use of maize varieties. The use of hybrid maize is linked to small land sizes and the use of traditional maize and both varieties is associated with larger land sizes. In the study area farmers did not promote cultivation of traditional maize in small land sizes because of comparative low productivity. Other socio-economic factors such as age, has a significant effect on the use of traditional seeds. This suggested that elderly farmers believe in, and value, traditional ways of farming more than young farmers. Older farmers are also experienced in using traditional maize varieties and storing seeds and will continue to use them even if hybrid varieties have been introduced (Owenya *et al*., 2011). This may be the reason for the continued use of IKPs, despite the promotion of conventional practices. However, points to a need for promotion of IKPs to the younger smallholder food producers if the practices are to be sustained.

CHAPTER 6: EFFECT OF IKPS ON HOUSEHOLD FOOD SECURITY

6.1 Introduction

Household food security is achieved when stable and sufficient food is available, accessed and adequately utilised at the household level (Pinstrup-Andersen, 2009). Household food production is critical for improving food security of rural households, as they are primarily dependent on farming and resources around them for a livelihood (Baiphethi and Jacobs, 2009). Households in the study area tend to produce food mainly for subsistence. This study collected data on indigenous and convention practices applied by households, and on their socio-economic characteristics, in order to assess the effect of IKPs on food production and food security. Chapter 6 provides results on the use of IKPs and their effect on food security.

This study uses food availability as a measure of food security. According to the World Bank (2008), food availability is primarily achieved when households are able to produce enough food. To measure food availability, the study used indicators such as number of months a household consumes its own produce. To establish the contribution of IKPs to the smallholder's food production system, the frequency of use of the IKPs was compared to the frequency of use conventional practices.

Chapter 6 begins by demonstrating the use of IKPs relative to conventional practices, the frequency of consumption of the produce by households and the stability of the produced food. The second part of the chapter uses the binary logit model to discover the effect of IKPs on household food security.

6.2 IKPs contribution to household food production

Household food production refers to when a smallholder farmer produces food for a household's own consumption and for the market. The aim of this section is to investigate which indigenous and conventional practices dominate in the production system of smallholder farmers in the study areas. The extent to which IKPs and conventional practices are applied in the study areas is presented in Table 6.1.

Table 6.1 Percentage of households using IKPs relative to conventional practices in field cropping in the OLM

Farming Categories	IKPs	Percentage of household	Conventional Practices	Percentage of Households
Pest management	Use of traditional pesticides	11	Pesticides use	38
Weed management	Hand hoe use	91	Herbicides use	13
	Animal draft use	3		
	Burning manure	22		
	Heaping manure	22		
Fertility management	Mixture (manure and fertilizer)	61	Fertilizer use	30
	Manure use	10		
Seed sources	Stored seed	80	Hybrid seed	30
Land preparation	Animal traction use	38	Tractor use	62
	Hand hoe use	8		
Post-harvest processing	Keep in maize-crib (no repellents)	19		
	Keep in maize-crib (with repellents)	6		
	Keep in house	58		
Harvest storage	Keep in maize-crib (with repellents)	6		
	Keep in tanks/sack bags/basins (no repellents)	47		
	Keep in tanks/sack bags/basins (with repellents)	30		
Intercropping	Intercropped maize	39		

Table 6.1 shows that there are more households using IKPs than those using conventional practices in the study area. Post-harvest processing and harvest storage practices are mainly based on IKPs, since there are no processing systems such as those in commercial farming in rural areas. Some practices involved both indigenous and conventional knowledge, such as using a mixture of manure and fertilizer (61%). This is classified as an IKP, because the source of knowledge used in identifying inefficiencies of manure and fertilizer by farmers led to the use of a mixture of manure and fertilizer (see Chapter 5). Also, the practices used in preparing for a mixture are traditional, such as sieving manure to make certain that it mixes properly with fertilizers and storing manure in a heap before mixing it with fertilizers. The addition of conventional practices into the indigenous practices was identified by Briggs (2005), as an implication that "indigenous knowledge no longer exists in an untouched, pristine form, such that it may be more accurate to define such knowledge as a local knowledge".

Results show that most households use conventional practices in pest management and land preparation. About 80% of households stored their own seed, of which 76% was traditional maize. Only 30% of the households used hybrid maize. Thus, for seed sources, more households used IKPs than conventional practices. About 91% of households used a hand-hoe for weed management and herbicides were used by only 13% of households. In all cases, some households used both IKPs and conventional practices.

Converse to field cropping the results in Table 6.2, show that 84% of households used hybrid seeds in their gardens. This could be a result of cost differences between the field and garden seeds and/or the value of field crops such as traditional maize and pumpkin. All farmers with gardens used a hand hoe for soil preparation and weed management. A low percentage of households (2%) used herbicides in their garden and about 13% of households used them in the fields. This shows that households prefer using indigenous practices in their home gardens and conventional practices in their fields. For soil fertility management, 94% of households used manure and 14% used fertilizer. Of the households that use fertilizers (16%) 13% mixed it with manure.

Table 6.2 Percentage of the use of IKPs and conventional practices in garden cropping in OLM

Farming Categories	IKPs	Percentage of Household	Conventional Practices	Percentage of Household
Pest management	Traditional pesticides use	26	Pesticide use	31
Weed management	Hand hoe use	100	Herbicide use	2
Fertility management	Manure use	94	Fertilizer use	16
	Compost use	14		
	Ash use	15		
Seed sources	Stored seed	29	Hybrid seed	84
Land preparation	Hand hoe use	100		
Harvest processing & storage	Keep in house	15		

Tables 6.1 and 6.2, show that more households used IKPs than conventional practices in field and garden crop farming. However, there is a predominance of practices where households use both indigenous and conventional knowledge. This implies that farmers are able to adapt and use available knowledge and resources to suit their food production systems. This also means that farmers prefer to, and persist in using indigenous knowledge. The prevalence of IKPs could be partly due to the costs associated with conventional inputs.

6.3 Staple food crops produced by households

Households in the study area produce their own food as part of a food security strategy. According to Baiphethi and Jacobs (2009: 462), "Subsistence production and/or smallholder production can increase food supplies and thus cushion households from food price shocks, thereby improving household food security".

Households that produce their own food such as maize and vegetables could spare some income for other household needs and can easily diversify their food consumption. The crops that households produced in their fields include maize, beans, pumpkins and potatoes. Spinach, cabbage, beetroot, onions, tomatoes, potatoes and carrots are some of the crops were produced in the home gardens. Some other garden crops that were not frequently cultivated were sweet potatoes, yams, lettuce, maize, green paper, brinjal, beans and spring onions.

The results in Table 6.3, suggest that the crops produced in the study area ensured household food availability for at least half a year for 74% and 76% of households that engaged in field crop and garden vegetable farming, respectively. The crops were consumed more than one day per week, with maize being consumed five days per week, on average.

Table 6.3 Monthly and daily consumption of the staple crops in the OLM

Crops	Percentage of households	Average number of months a crop was consumed	Average number of days per week a crop was consumed
Maize	100	6	5
Beans	19	4	2
Pumpkin	39	4	3
Tomatoes	74	3	4
Spinach	76	3	3
Cabbage	75	3	3
Beetroot	47	3	5
Onion	52	3	7
Carrots	54	3	3

6.4 IKPs effect on food availability

To illustrate the impact of IKPs on food security at household level, production of maize as a staple crop was used as a measure of food availability. This is because maize is a staple food for most households in South Africa (Twine *et al*., 2003). As shown in Table 6.3, all households that were involved in field cropping planted maize. Some 94% of these households made maize meal using maize from their own harvest.

The literature on indigenous knowledge has emphasized the important role IKPs play in ensuring household food security (Agea *et al*., 2008, Oniang'o *et al*., 2004 and Thamaga-Chitja *et al*., 2004). The question addressed in this chapter is given the household's farming production system which consists of conventional and indigenous practices, and affected by household socio-economic status, what effect does IKPs have on household food availability?

A logistic regression analysis was used to assess the effect of IKPs on household food availability. The model uses the period of own maize consumption as a measure of food availability. The number of months that maize produced at household level was consumed was used as a proxy for period of own maize consumption. Households that consumed their maize within seven to 12 months were regarded as food sufficient and assigned a value of 1 in the model and the rest of the households were assigned a value of 0.

6.4.1 Definition of variables used in the logit regression model

Land size can negatively or positively affect the amount of maize produced. Therefore duration of own maize consumption is indirectly affected by the land size. According to Ali (2005), the households with larger land sizes are expected to have a longer duration of consuming own maize. Land size is expected to have a positive effect on the duration of own maize consumption.

Household size is expected to have a negative effect on the duration of own maize consumption. The likelihood is that as more people depend on produced maize, the fewer months they will have their maize available for consumption. The study conducted by Maharjan and Khatri-Chhetri (2006), on the relationship between socio-economic characteristics and food security status, found that food-secure households had small household sizes.

Household income affects the ability of a household to diversify its food. Sen (1981) stated that income levels determine the ability of a household or an individual to access food. Thus households with higher income may be able to purchase other cereal crops while consuming their own maize, thus prolonging the duration of consuming the maize produce at a household level. Therefore they will have maize available for more months as their ability to diversify cereals is financially enhanced.

The use of indigenous inputs is generally seen as the reason for low production in smallholder farming. The critical stages in production are pest management, fertility management, weed management, intercropping and seed sources. Therefore the likelihood that IKPs will positively affect the amount of produce and duration of own maize consumption is expected to be low. By contrast conventional inputs are generally viewed as more productive compared to the IKPs. The use of pesticides, herbicides, fertilizers and hybrid maize are related to high productivity. Thus households using conventional practices are more likely to have maize available for longer period compared to those who use IKPs.

Maize storage materials can cause losses if measures such as temperature control, pest control and protection from livestock or poultry are not taken into consideration (Udoh *et al*., 2010). Farmers store maize in metal tanks with conventional repellents, or in tanks without repellents. Others store their maize in a maize-crib with traditional repellents (plants or grass). Thamaga-Chitja *et al*. (2004) pointed out that maize-crib storage system is inefficient as it is not protected from pests, harsh temperatures and stock, compared to metal tanks and sack bags. However, because farmers in the study area have measures for preventing losses in a maize-crib, the likelihood is that a maize-crib will have a positive effect on maize availability. Udoh *et al*. (2000) found metal tanks and sack bags are more susceptible to pests and diseases compared to a maize-crib. The likelihood therefore is that storage in metal tanks without repellents will decrease the number of months of maize availability.

6.5 Regression results and analysis

In order to determine the effect of IKPs on duration of produce maize availability in the rural households in the study area, the following logistic model was used:

$$L_I = \beta_0 + \beta_i X_i + \varepsilon_i$$

Where L_I = 1 if a household consumed its own maize between 7 to 12 months or 0 if otherwise (a household consumed its own maize between 0 to 6 months), ε is the error term, β_i are parameter estimates (coefficients) and X_i are independent variables (refer to Table 6.4).

6.5.1 Description of independent variables of the model

The variables used for the model are described in Table 6.4 and shows variables that were negative and those that were positive.

Table 6.4 Independent variables used in the regression model

	Variable Description	Variable Type	
X_1	Traditional maize variety	D	-
X_2	Hybrid maize variety	D	-
X_3	Intercropping	D	-
X_4	Pesticides	D	+
X_5	Traditional pesticides	D	+
X_6	Herbicides weeding	D	-
X_7	Manure	D	-
X_8	Fertilizer	D	+
X_9	Household income	C	+
X_{10}	Household size	C	-
X_{11}	Land size	C	+
X_{12}	Maize storage in tanks with improved repellents	D	-
X_{13}	Maize storage in tanks without repellents	D	-
X_{14}	Maize processing and storage in a crib with repellent plants	D	-

C = continuous variable, D = dichotomous variable where 0 = household does not use the practice and 1=household uses the practice

6.5.2 Results of binary logistic regression

A test of a full model against a constant model was statistically significant, indicating that the independent variables reliably distinguished between the households that have maize for 0 to 6 months and those that have maize for 7 to12 months, (X^2 = 51.211, p=0.01 with df = 14). The Nigelkerke R^2 of 0.697 indicated a moderately strong relationship between prediction and grouping. Prediction success overall percentage was 86.5% (90% for 0 to 6 months and 79.2% for 7 to12 months).

Table 6.5 Estimating IKPs' effect on food availability using a logistic regression model

Predictors (independent variables)	B	S.E.	Level of significance
Traditional maize	-2.935	2.239	0.190
Hybrid maize	-1.670	1.920	0.384
Intercropping	-3.331	1.237	0.007***
Pesticides	1.358	1.086	0.211
Traditional pesticides	5.616	1.934	0.004***
Herbicides	-2.991	1.673	0.074*
Manure	-21.609	12285.360	0.999
Fertilizers	1.570	1.031	0.128
Household income	0.002	0.001	0.002***
Household size	-0.379	0.201	0.059*
Land size	1.308	0.615	0.033**
Maize storage-tanks or sack bags (repellents)	-1.981	1.432	0.167
Maize storage –tanks (no repellents	-3.618	1.607	0.024**
Maize storage-crib (repellent plant)	-1.093	4.443	0.806
Constant	0.607	2.588	0.815

*significant at 10% level, **significant at 5% level, ***significant at 1% level, number of observations = 74, Log likelihood value = 42.042

Out of fourteen variables hypothesised to have an effect on duration of maize availability, seven were significant. These are intercropping (p=0.007), traditional pesticides (p=0.004), herbicides (p=0.074), household income (p=0.002), household size (p=0.059), land size (p=0.033) and maize storage in containers without repellents (p=0.024). The pesticides, fertilizers, manure, maize storage in a crib and in tanks with repellents, and hybrid maize had no statistically significant effect on the duration of maize available for consumption.

6.6 Regression results discussion

Land size had a positive effect on the duration of own-maize availability. This indicated that the odds ratio of a likelihood of increased duration of own maize availability increases with increase in land size. The own maize availability increases by a factor of 3.697 as a household accesses one more hectare of land. This suggests that households with small land sizes had a small produce and thus fewer months of maize available for consumption, compared to those with larger land sizes, irrespective of using IKPs or conventional practices.

Traditional pesticides had a positive effect on the duration of own-maize availability. A shift from non-user (X_i=0) to user (X_i=1) of traditional pesticides increases the odds ratio that the duration of own-maize availability will increase. The odds ratio that the duration of own-maize availability will increase is raised by a factor of 274.805 as a household shifts from none-user to user of traditional pesticides. The households using traditional pesticides are more likely to fall into a group of households that have own-maize between seven to 12 months. Due to the dependence of traditional pesticides on mere household resources, the results of traditional pesticides were expected to negatively affect maize produce and availability.

Herbicides were hypothesised to have a positive impact on the duration of own-maize availability. Contrary to the hypothesis, the use of herbicides had a negative effect on the duration of own-maize availability.

As predicted, intercropping had a negative effect on the duration of maize availability. Even though intercropping has its strengths in weed control (Mandumbu *et al.*, 2011) and pest control (Abate *et al.*, 2000), the results show that a shift from monocropping ($X_{i=0}$) to intercropping (X_i=1) decreases the odds ratio of the duration of own maize. This relationship was expected because the smallholder household has small land sizes, which, on average, is 1.5 hectares. According to Lahiff and Cousins (2005), because of small land sizes, smallholder farmers in South Africa prioritise the production of staple foods. Thus the results indicate that those who prioritised their land for maize production had more produce and thus increased the duration of maize consumption, keeping other factors constant.

According to Singh and Satapathy (2003), lack of sufficient harvest processing and storage results in substantial produce losses. As was predicted, storage of maize without using repellents had a negative effect on own-maize availability. Storage in metal tanks with repellents and maize-cribs had unexpected signs, but were not significant. All the storage practices had a negative effect on the duration of own maize consumption. The smallholders' storage facilities have been identified in many studies as a cause for food losses. However, the farmers in the study perceived them as viable storage mechanisms (Chapter 5). Considerable attention is needed to alert the farmers about the inefficiencies of their harvest storage mechanisms.

It was expected that households that used either fertilizer or manure would have good maize production and increase household consumption of own-produce in the study area. The results of the regression indicated that fertilizer and manure use had no statistically significant effect on maize availability used in smallholder farming. There was a negative relationship between household size and duration of consumption of own maize. That is, for every one unit increase in household size, there was a decrease in the number of months a household consumed its own maize produce. The odds ratio of household size effect (0.540) indicates that the household size had a strong effect on household maize availability.

Total household income had a positive effect on the duration of own maize consumption. An increase in income increased the odds ratio of maize available for consumption. This could suggest that households that have more maize also have financial access to inputs required for productive farming. Also, because the measure of food availability in this study is the number of months a household has or consumes its maize produced on the farm, the relationship relates more to the household's ability to purchase other cereals to diversify food choices and prolong consumption of maize produced on the farm.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

The study investigated the contribution of IKPs in household food production and food security in the rural areas of the Okhahlamba Local Municipality. The literature on indigenous knowledge and household food security in South Africa has not documented some issues on the contribution of IKPs to food production and food security, including socio-economic factors that determine the use of indigenous knowledge practices, how farmers perceive the effect and their preference of the practices, and which of the practices hold a significant effect on enhancing household food security.

Indigenous knowledge practices identified in the study area include practices in pest management, land preparation, soil fertility management, weed management, and postharvest processing and storage. These practices are applied more than conventional ones and have a role in food production systems of smallholder farmers. The findings further show that indigenous knowledge practices do not exist in a pristine nature; these practices have been to some extent, influenced by conventional practice. This is evident in practices such as mixing of manure and fertilizer, storage of conventional seed varieties and the use of herbicides to complement hand-hoe weeding.

Smallholder farmers perceive indigenous knowledge practices as effective in production, but they prefer conventional practices. For smallholders, IKPs and conventional practices are equally effective. Attributes such as productivity of traditional maize compared to high yielding improved maize seeds, intensive labour and shortage of male labour for practices in animal traction and hand-hoe weeding and manure incapability to improve stunted growth in maize are identified as the main limitations for using some of the IKPs and their lower preference by smallholder farmers.

Socio-economic factors such as land size, age of the head of a household and total household monthly income are significant determinants of adoption of indigenous knowledge and conventional practices. Land, income and age of household head are also identified in several references in the literature as determinants of indigenous knowledge use among smallholder households. Smaller land sizes are a limiting factor to the use of traditional maize varieties... There is a need therefore to increase smallholder landholdings in order to sustain production of traditional maize. Household income had a significant effect only on the use of herbicides. This implies that, generally, an increase in income will not significantly change a farmer's perspective on the use of IKPs. This shows that when farmers use IKPs, they applied them not out of ignorance or shortage of inputs, but mainly because they prefer them.

Indigenous knowledge has a significant role in enhancing household food security. This is drawn from the extent to which the indigenous knowledge is applied in the food production systems, compared to conventional practices. It is important to note that postharvest storage and processing, together with intercropping, were identified as the indigenous knowledge practices with negative effect on household food security. Storage facilities and procedures used by the farmers result in harvest losses and therefore have a negative effect on food security. Intercropping is a vital practice for crop diversification and weed management, but the findings suggest that it has negative effects on the availability of staple foods. Thus, if the priority of the farmer is to enhance staple food availability, intercropping as an indigenous practice might be threatened. Land size also has a significant effect on household food availability. Therefore it is imperative to make land more accessible to smallholder farmers to enhance their food security through farming.

This study contributed to the subject of indigenous knowledge and household food security, enriching already existing literature on the important role of indigenous knowledge to food security in smallholder farming and rural households (Agea *et al*., 2008, Hart and Vorster, 2006, Hart, 2011, Modi *et al*., 2006, Thamaga-Chitja *et al*., 2004, Vorster *et al*., 2008, Vorster and Van Rensburg, 2005). The study extends this body of knowledge at it emphasized on the issues of effect and preference of the indigenous knowledge as perceived by the farmers, and also stretches the aspect of household level characteristics determining the use of indigenous practices of which Thamaga-Chitja et al (2004) touched on relating this to harvest storage practices. The study has enabled a look at the indigenous knowledge within the household food production systems, in order to identify its distinctive role in food security. The research has also enhanced on the arguments that studies on the conflicting views of indigenous knowledge and conventional knowledge such as those raised by Agrawal (1995, 2002, 2004, 2009) through providing empirical support of the view that these two domains of knowledge must not be viewed as conflicting, but as their users, who view them as sources that can be enhanced for a better food production system.

The study directs specific policy recommendations to the South African agricultural sector, which has prioritised conventional practices in smallholder agriculture support through programmes such as intensification, massification, mechanisation and the provision of genetically modified organisms. It has ignored indigenous knowledge practices. This study has shown that indigenous knowledge practices contribute to household food security through allowing accessibility of inputs that enables production of staple foods such as traditional maize. Smallholders in the OLM are able to feed household members for an average of six months, using maize and vegetables produced using IKPs dominated farming systems. This reduces household income pressure for food purchases, thereby strengthening household food production through the use of IKPs. Introduction of some conventional practices that can compete with IKPs are essential for government campaign against household food insecurity to have success.

Land is a significant and a sensitive issue in South African development initiatives. Land size was a significant contributor to food security and was identified as a limiting factor in smallholder food production. Improving access to farming land for smallholder households is crucial in improving smallholder food production and food security.

The indigenous practices identified in this study have a potential for informing the green economy or a low carbon economy as the knowledge that informs these practices leads to minimal use of external inputs. This knowledge is what food insecure citizens of South Africa possess and it can be enhanced and used as a resource for radically changing the way of farming and enhancing food access for low income households. The green economy is a new concept under sustainable development and climate change. Proponents of IKPs have a significant chance to add value to the green economy by promoting the adoption of indigenous knowledge practices in smallholder farming.

Further research needs to be done on existing linkages to practices under sustainable farming, organic farming and indigenous farming and how these can be exploited for improved farming. This will ensure that the IKPs are acknowledged and established in the movement towards low carbon agriculture. It is recommended that further studies be done on indigenous pest management practices and the types of pests that can be controlled by indigenous pesticides. In this way, the value of indigenous pesticides in food production can be enhanced through indigenous or conventional innovations and benefit to smallholder farming.

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APPENDIX A

KEY INFORMANTS INTERVIEW GUIDES

University of KwaZulu-Natal

The Contribution of Indigenous Knowledge Practices to Household Food Production and Food Security: A Case of Okhahlamba Local Municipality

Interviewer: Sthembile Ndwandwe

The key informants:

1. Two community facilitators from Farmer Support Group – An NGO
2. Five Extension officers – Bergville Department of Agriculture office
3. Two farmers per village from five villages of Bergville – Potshini, Mlimeleni, Nokopela, Busingatha and Okhombe

KEY INFORMANT INTERVIEW GUIDE

Crop farming

What are the indigenous practices that are applied in crop farming by the households from the village?

- Soil preparation
- Fertility management
- Pest management
- weeding
- Seed storage and selection
- Harvest processing

Livestock and poultry farming

What are the indigenous practices that are applied in livestock and poultry farming by the households from the village?

- Livestock and poultry health
- Livestock and poultry housing
- Livestock and poultry breeding
- Livestock and poultry feed

Wild foods

Are there wild foods that are eaten by the households from the village?

APPENDIX B

CASE STUDY QUESTION GUIDES

Interviewer: Sthembile Ndwandwe

Case study farmers: five farmers per village selected by the key informants.

- The farmer & interviewer identify an indigenous practice(s) to be discussed:
- How is the practice conducted – step by step?
- Why is the practice been conducted – reasons for doing the practice?
- Where the practice is conducted – location?
- When is the practice conducted – season or time during the day?
- How long have the practice been conducted – years conducting the practice?

APPENDIX C

QUESTIONNAIRE

University of KwaZulu-Natal

The Contribution of Indigenous Knowledge to Household Food Production and Food Security: A Case of Okhahlamba Local Municipality.

Interviewer Name: ……………………………………………………..**Date:**……………………

Contents page: Demographics 1-2; Crops 2-9; Livestock 9-11; Wild plants 11; Food consumption 11-12

HOUSEHOLD DEMOGRAPHICS

Respondent Name i.e. Ms Ngubane: ……………………………………………………..........

Name of household (HH) head i.e. Mrs Ngubane: …………………Male 0 emale 1

Age of head of a HH: <40 0 41-59 1 60+ 2

Educational level of a HH head: none 0 rimary 1 econdary 2

Number of the household members spending at least four nights in a week at home in year 2011: females 1-5 0 : 6-10 1 : 10+ 2 males 1-5 0 6-10 1 10+ 2

Number of the household members who matriculated: none 0 1 - 2

Number of matriculated household members who are at home: none 0 1 2

Number of household members still at school: none 0 -2 1 + 2

Number of household members in or with tertiary education: none 0 1 - 2

Number of household members with tertiary education who are at home: none 0 1 2

Number of household members who never went to school: Children: none 0 1 2

Adults: none 0 : 1 1 : +2 2

Name the sources of income from all household members in year 2010; and how much does each source of income add to the household income?

Source of Income	**Amount contributed to Income (R)**	
Total income		**Coding:** 0-1000 = (0) : 1100-2000 = (1): 3100+ = (2)

Give a list of your household assets that were in working condition in 2011: **Yes** 1 0

Asset	**Tick**	**Asset**	**Tick**
TV		Paraffin stove	
Radio		Gas stove	
DVD/Video		Fridge	
Electric stove		Car	

INDIGENOUS PRACTICES IN CROP FARMING *(These questions are applicable to the 2010 farming season – 2011 harvest season).* **Yes** 1 **No** 0

1. Did you practice field crop farming in 2010 – 2011 planting season? **Yes/No**
2. If yes, did household members helping in field crop farming? **Yes/No**
3. If yes, are the children involved in crop farming? **Yes/No**
4. How many hectares of farming land do you own? …………………………………………
5. How many hectares were used for crop farming (fields) in 2010? …………………………..
6. What implements did you use to cultivate your fields? *All implements listed by the households were tabled and coded **Yes** for those who mentioned an implement i.e. tractor and **No** for those who didn't mention i.e. tractor.*
7. What crops did you plant in your fields? **Refer to the table below**

Crop	**tick**	**Hectares covered in 2010/2011**	**State the field Intercrops**	**Hectares covered in 2010/2011**
Traditional Maize				
Improved Maize				
Beans (from stored seed)				
Beans (from other seed)				
Pumpkins				
Other:				
Total ha. Coding: 0.5-1.5 = (0); 2-3.5 = (1); 4-5.5= (2)				

Garden crops

8. Did you have a household garden in 2010 to 2011 planting season? **Yes/No**
9. If yes, how big is the garden area? Length…………Width…………total area: 1-100 [0] : 101-200 [1] : 201+ [2]
10. What vegetables did you plant in 2010/2011? *All vegetables listed by the households were tabled and coded **Yes** for those who mentioned a vegetable and **No** for those who didn't mention a vegetable.*

Fertility management in the garden

11. Did you apply manure in your garden in 2010-2011 planting season? **Yes/ No**
12. How long (years) have you been using manure for your garden? 1-5 [0] : 6-10 [1] : 11-15 [2] : 16-20 [3] : 21+ [4]
13. Are there other fertility methods that you used? **Refer to the table below**

Fertility method	**How long (years) has it been used**
*All methods listed by the households were tabled and coded **Yes** for those who mentioned i.e. manure and **No** for those who didn't mention i.e. manure.*	

Fertility Management in the fields

14. Did you use fertilizers for your fields in 2010 – 2011 planting season? **Yes/No**
15. If yes, what type of fertilizer did you use? *All types listed by the households were tabled and coded **Yes** for those who mentioned i.e. DAP and **No** for those who didn't mention i.e. DAP.*
16. How much (quantity) of fertilizer did you buy? *Recorded as a continuous data in Kgs*
17. What amount of fertilizer did you use? *Recorded as a continuous data in Kgs*
18. Did you use manure? **Yes/No**

19. If yes, what type of manure did you use? *All types listed by the households were tabled and coded **Yes** for those who mentioned i.e. goat manure and **No** for those who didn't mention i.e. goat manure.*
20. How much (quantity) of manure did you apply for the fields? *Recorded as a continuous data in Kgs*
21. Was the quantity in (20) enough for your fields? **Yes/No**
22. If no, what were the limiting factors? *All factors listed by the households were tabled and coded **Yes** for those who mentioned i.e. no livestock and **No** for those who didn't mention the factor.*
23. If no, what quantity of manure would be adequate for your field requirement? *Recorded as a continuous data in Kgs*
24. Did you make a mixture of fertilizer and manure for your fields? **Yes/No**

    If NO, jump to question 29-36
25. How big is the area that you applied the mixture on? *Recorded as a continuous data in hectares*
26. Out of the amount of fertilizer you bought (no. 16) how much did you use in the mixture? *Recorded as a continuous data in Kgs*
27. What field crops did you plant in the field where the mixture was applied? …………………………………
28. How many years have you been using a mixture of manure and fertilizer? 1-5 [0] : 6-10 [1] : 11-15 [2] : 16-20 [3] : 21+ [4]
29. Apart from the area with the mixture, is there an area where you applied manure only? **Yes/No**
30. If yes, how big is this area? *Recorded as a continuous data in hectares*
31. What crops were planted in that area?
32. Apart from the area with the mixture, is there an area where you applied fertilizer only? **Yes/No**
33. If yes, how big is this area? *Recorded as a continuous data in hectares*
34. What crops are planted in that area? ………………………………………………………………........................
35. Do you prefer using a mixture or not? **Yes/No**
36. What are the reasons for the answer in question 35? ……………………………………….............................

<u>Assessment of fertility management methods for the fields and garden</u>

37. How do you rate your manure and fertilizer effectiveness in ensuring field and garden fertility? **Refer to the table below**

Inputs	**Level of effectiveness**				
	low	Average	High	Very high	No idea
Coding	1	2	3	4	0
Manure in fields					
Manure in garden					
Fertilizer (fields)					
Fertilizer (garden)					

38. How do you rate your preference of manure or fertilizer for use in garden and field fertility? **Refer to the table below**

Inputs	Level of preference				
	low	average	High	Very high	No idea
Coding	1	2	3	4	0
Manure in fields					
Manure in garden					
Fertilizer (fields)					
Fertilizer (garden)					

39. How do you rate the financial costs incurred from using manure and fertilizer? **Refer to the table below**

Inputs	Costs of fertility management				
	None	low	average	High	Very high
Coding	1	2	3	4	5
Manure					
Fertilizer					

Pest management in field

40. In 2010 -2011, did you have pest problems in your field? **Yes/No**
41. If yes, did you use these means of field crop pest management? **Refer to the table below**

Pest management	Yes/No	Pest being controlled	Crop(s) to which the practice is applied	Years practice is in use
Solution of Amatoli ash				
Burning Mealies stalks in the field				
Aloe and coarse salt solution				
Use purchased pesticide				
Other:				
Data coding	**Yes (1) no (0)**	*Pests were listed and coded yes if was mentioned and not if not mentioned*		**see question number 28**

Pest management in garden

42. Did you have pest problems in your garden, in 2010 -2011? **Yes/No**
43. If yes, did you use these pest management techniques to control pests in your garden? ***Refer to a table below***

Pesticides	**Yes/No**	**Type of pest being controlled**	**Applied to which crop(s)**	**How long in use (years)**
Water mixed with soap (or water after washing)				
Mixture of soap garlic and chilies				
Mixture garlic and chilies				
Mixture of Ishaladi lenyoka and sunlight				
Ash powder or ash mixed with water				
Coating seed with paraffin before storage				
Coating seed with paraffin when planting				
Improved pesticides				
Other:				
Data coding	**Yes (1) no (0)**	*Pests were listed and coded yes if was mentioned and not if not mentioned*		**see question number 28**

<u>Assessment of field and garden pest management methods</u>

44. How do you rate the level of effectiveness of traditional and conventional pesticides reduce pests and insects in your fields, garden and seed storage? **Refer to the table below**

Inputs	**Level of effectiveness**				
	Low	Average	High	Very high	No idea
Coding	1	2	3	4	5
Traditional pesticides (fields)					
Traditional pesticides (garden)					
Traditional pesticides (seed storage)					
Improved pesticides (fields)					
Improved pesticides (Garden)					
Improved pesticides (seed storage)					

45. How do you rate your preference of traditional or improved pesticides for your garden field, seed storage pest management? **Refer to the table below**

Inputs	**Level of preference**				
	Low	Average	High	Very high	No idea
Coding	1	2	3	4	5

Traditional pesticides (fields)					
Traditional pesticides (garden)					
Traditional pesticides (seed storage)					
Improved pesticides (fields)					
Improved pesticides Garden)					
Improved pesticides (seed storage)					

46. How do you rate the financial costs incurred from using traditional and improved pesticides? **Refer to the table below**

Inputs	**Costs of pesticides**					
	None	low	average	High	Very high	
Coding	1	2	3	4	5	
Traditional pesticides						
Improved pesticides						

<u>Seed storage for field crops</u>

47. In 2010-2011, did you store seed of your field crops? **Yes/No**

48. If yes, which ones did you store? **Refer to the table below**

Crops	**Yes/No**	**How seeds were stored**	**How much seed were stored (litres)**	**How much seed was purchased (litres)**	**How much seed was received from extension officers (bags)**
Traditional Maize					
Improved Maize					
Beans					
Pumpkins					
Other:					
Data coding	*Yes (1); No (0)*	*Methods listed and coded **Yes** if method was applied and **No** if not.*	*Recorded as a continuous data*	*Recorded as a continuous data*	*Recorded as a continuous data*

<u>Seed storage for garden crops</u>

49. Where did you get seeds for your vegetables in 2010? **Stored; bought; extension officers**
50. What seeds did you store, bought or got from extension officers? ***Refer to the table below***

Seeds	**Yes/NO**	**How seeds were stored**	**How much seed were stored (litres)**	**How much was bought (litres)**	**How much was received from extension officer (bags)**
Tomatoes					
Potatoes					
Carrots					
Spinach					
Cabbage					
Onion					
Garlic					
Beetroot					
Other…					
Data coding	*Yes (1); No (0)*	*Methods listed and coded **Yes** if method was applied and **No** if not.*	*Recorded as a continuous data*	*Recorded as a continuous data*	*Recorded as a continuous data*

<u>Assessment of field and garden traditional and improved seeds</u>

51. How do you rate the productivity of your traditional and improved seeds? **Refer to the table below**

Inputs	**Level of effectiveness**				
	low	average	High	Very high	No idea
Coding	1	2	3	4	0
Traditional seeds (fields)					
Traditional seeds (garden)					
Improved seeds (fields)					
Improved seeds (garden)					

52. How do you rate your preference of traditional or improved seeds for your garden and field crops? **Refer to the table below**

Inputs	**Level of preference**					
	low	Average	High	Very high	No idea	
Coding	1	2	3	4	0	
Traditional seeds (fields)						
Traditional seeds (garden)						
Improved seeds (fields)						
Improved seeds (garden)						

53. How do you rate the financial costs incurred from using traditional and improved seeds? **Refer to the table below**

Inputs	**Costs of seeds**					
	None	low	average	High	Very high	
	1	2	3	4	5	
Traditional seeds						
Improved seeds						

<u>Field weed management</u>

54. What method did you use for weeding your field(s) in 2010 - 2011? *All methods listed by the households were tabled and coded **Yes** for those who mentioned an implement i.e. hand-hoe and **No** for those who didn't mention i.e. hand hoe.*
55. How long (years) have you been using these means of weeding in your fields? **Refer to the table below**

Weeding Method	Number of years method is in use
Data coding	See question 28

56. Other than the methods mentioned above, do you burn manure as a means of weed management? **Yes/No**
57. If yes, for how long have you been burning your manure? *See question 28 for coding*
58. How big is the area that the burnt manure covered in 2010? *Recorded as continuous data in hectares*
59. What crops did you plant in this area (no. 58)? …………………………………………………………….
60. Do you process manure as a means of weed management? **Yes/No**
61. If yes, for how long have you been processing manure? *See question 28 for coding*
62. How big is the area that the processed manure covered in 2010? *Recorded as continuous data in hectares*
63. What crops did you plant in this area (62)? …………………………………………………………………

<u>Garden weed management</u>

64. How did you weed your garden, in 2010 - 2011? *All methods listed by the households were tabled and coded **Yes** for those who mentioned an implement i.e. hand-hoe and **No** for those who didn't mention i.e. hand hoe.*
65. Why did you choose using the weeding methods in (64)? **Refer to the table below**

Weeding method	How long (years)
Data coding	See question 28 for coding

<u>Assessment of field and garden weeding methods</u>

66. How do you rate the effectiveness of your traditional and herbicide weeding methods for your field and garden weeding? **Refer to the table below**

Inputs	**Level of effectiveness**				
	low	Average	High	Very high	No idea
Coding	1	2	3	4	0
Traditional weeding (field)					
Traditional weeding (garden)					
Herbicides (field)					
Herbicides (garden)					

67. How do you rate your preference of traditional or herbicides weeding for your field and garden crops? **Refer to the table below**

Inputs	**Level of preference**					
	low	Average	High	Very high	No idea	Low
Coding	1	2	3	4	0	1
Traditional weeding (field)						
Traditional weeding (garden)						
Herbicides (field)						
Herbicides (garden)						

68. How do you rate the financial costs incurred from using traditional and herbicide weeding? **Refer to the table below**

Inputs		**Costs of weeding methods**				
	None	low	average	High	Very high	
Coding	1	2	3	4	5	
Traditional weeding						
Herbicides						

<u>Field crops harvest processing</u>

69. What did you do to keep your harvest fresh in 2011? **Refer to the table below**

Harvest	**Processing method**	**What was the harvest shelve life (months)**
Traditional Maize		
Improved Maize		
Beans		
Pumpkins		
Other:		
Data coding	*Methods were listed and coded* ***Yes*** *if applied and* ***No*** *if not applied*	*Recorded as a continuous data*

Harvest processing for garden vegetables

70. How do you keep your garden vegetables fresh in 2011?

Harvest	**Processing method**	**What was the harvest shelve life (months)**
Tomatoes		
Potatoes		
Carrots		
Spinach		
Cabbage		
Onion		
Garlic		
Beetroot		
Other…		
Data coding	*Methods were listed and coded **Yes** if applied and **No** if not applied*	*Recorded as a continuous data*

LIVESTOCK AND POULTRY FARMING

Yes 1 **: No** 0

71. Do you own livestock and poultry? **Yes/No**
72. If yes, what type of livestock and poultry did you own in 2010 – 2011 farming season? **Refer to the table below**

Livestock & poultry	**How many did you own (Number)**	**How often was livestock and poultry consumed in a period of: 1 MONTH (chicken & Turkey); YEAR (cattle, goats, sheep, pig, other)**	**How many were sold**	**How many died**
Chickens				
Turkey				
Goats				
Sheep				
Pigs				
Cattle				
Other:				
Data coding	*Recoded as continuous data*			

Livestock feed

73. Did you use you your produce to feed your livestock in 2010-2011? **Yes/No**
74. Did you purchase feed for your livestock in 2010-2011? **Yes/No**
75. What type of produce feed and purchased feed did you use for your livestock? **Refer to the table below**

Livestock	**Name feed from produce**	**Feed Quantity/month**	**Feed purchased**	**Feed Quantity/month**	**Costs of feed**
Cattle					
Goats					
Sheep					
Pigs					
Other:					
Data coding	*Feed was listed and coded **Yes** if used i.e. cattle and **No** if not used*	*Recoded as continuous data*			

76. How long have you been using purchased feed for your livestock? 1-5 [0] : 6-10 [1] : 11-15 [2] : 16-20 [3] : 21+ [4]
77. How long have you been using produced feed for your livestock? See question 76 for coding
78. Do you prefer to use purchased or produced feed for your livestock? **Purchased; produced**
79. What are the reasons for your choice in question (78)? ……………………………………………….................

Poultry feed

80. Did you use produced feed for your poultry in 2010-2011? **Yes/No**
81. Did you use purchased feed for your poultry in 2010-2011? **Yes/No**
82. What type of produce and purchased feed did you use for your poultry? **Refer to the table below**

Poultry	**Feed from produce**	**Feed Quantity/month**	**Feed purchased**	**Feed Quantity/month**	**Feed monthly Costs**
Chickens					
Turkey					

Other:					
Data coding	*Feed was listed and coded **Yes** if used i.e. cattle and **No** if not used*	*Recoded as continuous data*			

83. How long have you been using purchased feed for your poultry? See question 76 for coding
84. How long have you been using produced feed for your poultry? See question 76 for coding
85. Do you prefer to use purchased or produced feed for your poultry? **Purchased; produced**
86. What are the reasons for your choice in question (85)? …………………………………………………..

WILD FOODS CONSUMPTION

Yes 1 **: No** 0

87. Do you collect wild foods? **Yes/No**
88. If yes, what wild foods did you collect in year 2011? **Refer to the table below**

Wild foods	**Tick ones consumed**	**Season when they are collected**	**household preference**
Amadolofiya			
Peaches			
Isanjana			
Ibhucu			
Umsonti			
Umfomfo			
Imbuya			
Uxhaphozi			
Other:			
		1=spring; 2; summer; 3=autumn; 4=winter	**high =3; low =1; indifferent =0**

89. Do you eat wild foods as a means of saving or adding to your household food? **Yes/No**
90. If no, why? …………………………………………………………………………………………………….
91. When are these foods harvested? When: collecting firewood (1); herding livestock (2); see the plant around household (3); other (specify)………………………………………………………………………………
92. For how long (years) have you been harvesting wild foods? *See question 76 for coding*

93. Are the children involved in the collection of wild foods? **Yes/No**

HOUSEHOLD FOOD CONSUMPTION

Yes 1 **: No** 2

94. What does your household consume on weekly basis? **Maize; rice; steamed bread; bread; samp; vegetables; meat; milk; mass; fruits.**
95. Are there times where the household faces a situation of having no food? **Yes/No**
96. When there is not enough food, are there any household members who do not get food? **Yes/No**
97. If made maize meal from produced maize in 2011, how many months did it cover? *Recoded as continuous data*
98. How often did you eat this (97) maize meal in a week? *Recoded as continuous data*
99. How many months did you eat your vegetables produced in 2011? (If owning a garden) *Recoded as continuous data*
100. How many months did you eat your field crops in 2011? **Beans**…... **potatoes**…... **pumpkins**…... **Other:** *Recoded as continuous data*
101. How often did you eat your vegetables and field crops in a week? **Refer to the table below**

Vegetables & field crops	**Weekly consumption**	**Household preferences**	**Accessibility**
1.			
2.			
3.			
4.			
5.			
6.			
7.			
Data coding	*Recoded as continuous data*	*low=1; medium =2; high= 3)*	*(all =1, children =2, adults=3)*

102. During the months when your household eat produce; what food groceries do you buy? **Refer to the table below.**

Food groceries	**Consumption in a week**	**HH preferences (low=1, medium=2, high=3)**	**Accessibility (all=1, children=2, adults=3)**
Rice			
Flour			
Chicken (i.e. portions)			
Beef			
Other meats			
Other:			
Data coding	*Recoded as continuous data*	*low=1; medium =2; high= 3)*	*(all =1, children =2, adults=3)*

103. Beside spending money on food groceries, what other household expenses do you have? *Expenses were listed and coded **Yes** for households who incurred them and **No** for those who did not.*

104. Have you skipped paying or buying other household expenses because you needed to buy food? **Yes/No**

105. If yes, how often have you skipped household expenses for food? **More often** 1 **often** 0

APPENDIX D

Descriptive Statistics were used to determine the number of households who experience pest problems in their fields (N=59) and to determine which of these households did not make any means of pest management.

Table 5.1b households with pest problems and applied no means of pest management

	Frequency	Percent
Managed pests	33	55.9
No means of pest management	26	44.1
Total	59	100.0

The one way analysis of variance (ANOVA) was used to determine whether there is any difference between the means of a number of household characteristics of household using IKPs and conventional practices. The tables below present detailed results of Table 5.8 in chapter 5.

Table 5.8a Weeding management by household characteristics

Weeding management	**Average Landholdings**	**Household head Gender**	**Average household size**	**Average household income**	**Average household head education**	**Average household head Age**
Herbicides	2.429 (±1.6938)	0.43 (±0.535)	7 (±3.207)	35789 (±1144)	5 (±2.968)	57 (±17)
Hand hoe	1.454 (±0.9259)	0.55 (±0.501)	7 (±3.162)	1826 (±1095)	4 (±3.486)	58 (±12)
Hand hoe and Herbicides	2.250 (±1.0607)	0.50 (±0.707)	6 (±1.414)	1600 (±707)	0 (±0.000)	70 (±7)
Level of significance	**	NS	NS	***	NS	NS

(**): significant difference at p<0.05. (***): significant difference p<0.01. (ns): difference not significant. Number in brackets: standard deviation

Table 5.8b Post-harvest storage system by household characteristics

Storage systems	**Average Landholdings**	**Household head Gender**	**Average household size**	**Average household income**	**Average household head education**	**Average household head Age**

Store produce in containers (no repellents)	1.265 (±0.9553)	0.62 (±0.493)	7 (±3.674)	1951.47 (±1204.567)	4 (±3.555)	58 (±12.353)
Store in container with repellents	2.119 (±1.2238)	0.43 (±0.507)	7 (±2.109)	2291.43 (±1013.629)	4 (±2.869)	60 (±11.456)
Store in maize-crib (with repellents)	1.625 (±0.4787)	0.50 (±0.577)	5 (±1.155)	2712.50 (±2169.629)	3 (±2.082)	57(±9.535)
Level of significance	**	**NS**	**NS**	**NS**	**NS**	**NS**

(**): significance difference level at p<0.05, (ns): difference not significant. Number in brackets: standard deviation

Table 5.8c Maize varieties by household characteristics

Maize varieties	Average Landholdings	Household head Gender	Average household size	Average household income	Average household head educational level	Average household head Age
Traditional	1.519 (±1.0288)	0.58 (±0.499)	7 (±3.354)	1927.69 (±1164.431)	4 (±3.483)	59 (±11.706)
Hybrid	1.389 (±0.8670)	0.39 (±0.502)	7 (±2.640)	2019.44 (±1341.875)	3 (±3.675)	52 (±12.873)
Traditional & hybrid	3.00 (±1.2247)	0.75 (±0.500)	6 (±2.082)	2587.50 (±1061.740)	3 (±1.893)	65 (±9.129)
Level of significance	**	**NS**	**NS**	**NS**	**NS**	**

(**): significant difference at p<0.05. (ns): difference not significant. Number in brackets: standard deviation

Table 5.8d Seed storage by household characteristics

Seed storage	Average Land size	Household head Gender	Average household size	Average household income	Average household head educational level	Average household head Age
Yes	1.568 (±1.1004)	0.56 (±0.501)	6.68 (±3.267)	1972 (±1138.519)	4 (±4)	60 (±12)
No	1.567 (±0.8423)	0.47 (±0.516)	7.07 (±2.463)	2040 (±1452.854)	4 (±4)	50 (±9)
Level of significance	**NS**	**NS**	**NS**	**NS**	**NS**	**

(**): significant difference at p<0.05. (ns): difference not significant. Number in brackets: standard deviation.