PERFORMANCE OF INDIGENOUS FARMING PRACTICES: A CASE STUDY OF MAIZE LAND USE TYPES IN UMZIMKULU AREA, EASTERN CAPE

LETHUKUTHULA L. JONGISA

UNIVERSITY OF KWAZULU-NATAL
CENTRE FOR ENVIRONMENT, AGRICULTURE AND DEVELOPMENT
PIETERMARITZ BURG

2005

Performance of indigenous farming practices: A case study of maize land use types in Umzimkulu area, Eastern Cape

By Lethukuthula Lemon Jongisa

A Mini-dissertation submitted in partial fulfilment of academic requirements for a Degree of Masters in Environment and Development, in the Centre for Environment, Agriculture and Development, School of Environmental Sciences, University of KwaZulu-Natal, Pietermaritzburg, South Africa, 2005

Declaration

This research was carried out under the supervision of Dr Denis Rugege who is Senior Lecturer and Programme Director for Land Information Management in the Centre for Environment, Agriculture and Development.

I Lethukuthula Lemon Jongisa, declare that the work contained in this Mini-dissertation is entirely my own work with the exception of quotations or references which I have attributed to their authors or sources. Furthermore it has not been submitted for any degree or examination in any university.

Lethukuthula Lemon Jongisa

....

Dr Denis Rugege, Supervisor

....

Acknowledgements

I would like to express my gratitude to the people and institutions that contributed to the completion of this research work.

- To Eastern Cape Department of Agriculture for giving me the opportunity to participate in the Master of Environment and Development degree by funding my tuition.

- To my supervisor Dr Denis Rugege and Co-supervisor Dr François Naramabuye for constant support and valuable guidance, especially for giving me a degree of independence to work in my own way.

- To the local extension officers Mr Z Sithole, Mr D Gqwaru and Ms L Tatase; without them I would not have been able to collect the massive data presented in this thesis.

- To the farmers for their full participation and kindness they have displayed during my data collection.

- To my colleagues Sindile Bidla and Mvuyisi Mbangeni for their unconditional support and encouragement throughout the research work, I want to say to them South Africa needs more people like you.

- My mother and dad, brother Thokozani, sisters Busisiwe and Khanyisile for every role they played in bringing me where I am today

- My wife Sandisiwe and my daughter Ozie and sons Sethu and Hlumie for making me believe that there is a reason to go on in life.

NOTES

This Mini-dissertation is divided into Component A and Component B

Component A includes the following:

- Abstract
- Research problem, objectives of the study and hypothesis
- Literature review
- Overview of study area
- Methodology outlining the rationale for the approach.

Component B includes the following:

- Abstract
- Brief introduction to the research problem; aims and objectives
- Methodology
- Results and discussion
- Conclusions and recommendations

COMPONENT A

Performance of indigenous farming practices: A case study of maize land use types in Umzimkulu area, Eastern Cape

Abstract

Although conventional or scientific farming practices have been encouraged and promoted by state and other agencies, rural and resource poor farmers have increasingly resorted to indigenous farming practices. This study was undertaken to test the hypothesis that indigenous farming practices are not only environmental friendly, but are more profitable than conventional practices. A conceptual framework for testing the hypothesis was formulated based on a comparison of Margins above Specified Cost of indigenous and conventional farming practices. The data required were identified and a methodology for data collection and analysis was designed. The research methodology included a literature review, a GIS based sample scheme designed for data collection and statistical analysis.

As a major feature of this component of the mini-dissertation, the literature review reveals that indigenous farming practices have positive impact on the environment by improving soil through mulching, composting and use of non-toxic control of pests and diseases. On the other hand the review reveals that conventional practices can impact negatively on the environment.

List of Contents for Component A

List of Tables

List of Figures

List of Abbreviations

BRU	Bio-Resource Unit
CFP	Conventional Farming Practices
COMBUD	Computerized Budgets
GIS	Geographic Information Systems
IFP	Indigenous Farming Practices
MaSC	Margin above Specified Cost
MFPP	Massive Food Production Programme
SPSS	Statistical Package for Social Survey
TRACOR	Transkei Agricultural Corporation

CHAPTER 1

1. INTRODUCTION

1.1 Problem statement

Most of the farmers have ignored indigenous methods and they have preferred conventional methods of farming. The introduction of conventional farming knowledge to African farmers was intended to increase production capacity, but this however disregarded the fact that most of African farmers do not have economic resources to engage in this western technology. Many African black farmers do not have access to credit facilities; hence they cannot afford production inputs or pay for operational costs. Conventional equipment is very expensive and needs huge capital investment.

There is a perception that indigenous farming cannot be used economically, this is based on the fact that profitability of indigenous farming practices (IFP) has not been widely studied. Conventional farming is geared towards maximising the yield than profit. Profits are gaps between the value of goods and services produced and the cost of resource used in their production (Barry, Ellinger, Hopkin & Baker 1995). Cost of production in indigenous farming is very low in comparison with conventional farming, because of cheaper and readily available inputs such as kraal manure, traditionally made seed, use of animal draft power.

Although indigenous knowledge is increasingly becoming popular it has not been widely integrated in research and development processes (Dawes 1993). Nothing or very little is done to encourage farmers to use IFP in their production. Government and development organizations have focused their investment on conventional farming practices (CFP) because there is a perception that IFP is an out dated practice. Indigenous knowledge is too much sophisticated for farmers of other societies and agricultural advisors to understand, the absence of relevant literature to guide them is worsening the situation.

The above shortcomings form basis of the study that is established with the aim of addressing the question of perception of profitability of indigenous farming practices. This study would be conducted to document information describing the relationship between farming practices and yield; farming practice and profit. This would be achieved by studying IFP used by farmers in the Umzimkulu area of the Eastern Cape Province. Farming practices that would be studied would include land preparation, seed selection, planting, cropping systems, soil care (fertility) practices, pest control and weed control methods. Component A of this research will review the existing literature, give an overview of the study area, define methodology that would be used and outline limitations of the study. The specific objectives of the study are listed in detailed below.

1.2 Objectives

1) To document Indigenous Farming Practices (IFP) used in maize based Land Use systems in the Eastern Cape and assess the extent to which it is used.
2) To make profitability comparison between Indigenous Farming Practices (IFP) and Conventional Farming Practices (CFP) for maize based Land Use Systems in the study area.
3) To make recommendations for promoting IFP

1.3 Research hypothesis

Ho: There is no difference in profitability between Conventional Farming Practices (CFP) and Indigenous Farming Practices (IFP) for rural small-scale maize based Land Use Systems.

Ha: It is more profitable to use Indigenous Farming Practices (IFP) than to use Conventional Farming Practices (CFP) for rural small-scale maize based Land Use Systems.

CHAPTER 2

2. LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews international and national literature primarily relevant to indigenous farming practices. The different views of how various authors distinguish between IFP and CFP are reviewed. Indigenous farming practices are reviewed in detail with specific reference to their impact to the environment and the extent they are used. Comparison is made between many countries. These farming practices are land preparation, seed selection, planting, soil fertility and maintenance, cropping systems, weeding , pest and disease control and storage. This chapter further reviews the involvement of women and the impact of age in indigenous knowledge. The issues that are viewed by many authors as challenges are also highlighted.

2.2 DEFINITION OF THE CONCEPTS

2.2.1 Indigenous farming practices

Agricultural knowledge is a practice, and agriculture is part of culture; successes and failures in agriculture cannot be judged in instruments alone (Taylor, 2000). This means that indigenous knowledge is embedded in the traditional practices of each society. Indigenous farming practices are those practices that contain indigenous knowledge of a particular society.

Emery and Associates (1997) define indigenous knowledge as knowledge that is sacred and secular together; includes the supernatural, holistic of integrated - based on whole systems and stored orally and in cultural practices. Rajasekaran and Warren (1994) view indigenous knowledge as local knowledge that is unique to a given culture or society. It is the information base in society that facilitates decision making process. McCall (1996) categorises indigenous knowledge into four categories, namely vernacular, specialized, controlled and social knowledge. Vernacular knowledge being technical knowledge used by most individuals such as pest control and weed control. Specialized knowledge being technical knowledge being used by highly skilled resource people e.g. medicine. Controlled knowledge refers to knowledge held by dominant group in the society and social knowledge being knowledge that belongs to a particular clan.

In this study the indigenous knowledge will be defined as local knowledge that is unique to a given culture or society. Indigenous farming practices will be polyculture (mixed cropping, multiple cropping, intercropping, interculture and relay planting), use of kraal manure pure or mixed with commercial fertiliser, traditional prepared seed, unique land preparation and planting methods and use traditional methods of weed and pest control. The farmer who practices any of these practices will be defined as an indigenous farmer.

2.2.2 Conventional farming practices

Several authors use the term conventional knowledge interchangeably with Western knowledge. In this Mini-dissertation the term 'conventional knowledge' will be used to describe what other authors refer to as Western Knowledge except where an author is quoted directly.

Conventional farming knowledge is viewed as secular only; excludes the supernatural analytical or reductionist, based on sub-sets of the whole and stored in books and computers (Emery & Associates 1997). Warren (1991) adds that conventional farming knowledge is developed by universities, government research centres and private industries. Eicher (2003) defines conventional agriculture as 'an industrialized agricultural system characterized by mechanisation, monocultures, and the use of synthetic inputs such as chemical fertilizers and pesticides, with emphasis on maximizing productivity and profitability'. In this study this definition will be used to define CFP.

2.3 DISTINGUISHING INDIGENOUS KNOWLEDGE FROM CONVENTIONAL KNOWLEDGE

Agrawal (1995) differentiates indigenous knowledge from conventional knowledge by history and evolution characteristics. Indigenous knowledge is much concerned with the immediate and concrete necessities of people's daily livelihoods, it exists in a local context and anchored to a particular community, while conventional knowledge is concerned with constructing general explanations (Agrawal 1995). Knowledge is transferred from one generation to another through training ties and social interactions between different communities (Prakash 2002). This means that indigenous knowledge that has been improved when transferred to other generation is still indigenous knowledge.

Indigenous knowledge systems are distinguished from conventional knowledge systems by Kolawole (2001) 'on contextual, substantive, and methodological grounds. Firstly, conventional knowledge systems are universal, due to the fact that Western education is entrenched in many world cultures. Secondly, they have long been noted for their rigorous observation, experimentation and validation procedures, all of which are carefully documented. The same cannot be said of indigenous knowledge systems, in particular when it comes to documentation'. With most of countries conducting research and documenting their indigenous knowledge this differentiation may be irrelevant, because it suggests that indigenous knowledge is indigenous when it is not documented.

Agrawal (1995) warns that 'the distinction between indigenous and conventional knowledge can present problems for those who believe in the significance of indigenous knowledge for development', and further suggest that 'attempt to create distinctions in terms of indigenous technology and Western is potentially ridiculous. It makes much more sense to talk about multiple domains and types of knowledge with differing logics and epistemologies'.

2.4 REVIEW OF CONVENTIONAL VERSUS INDIGENOUS FARMING PRACTICES

2.4.1 Land preparation

The use of tractor and other sophisticated implements are characteristic of conventional land preparation for planting. It is well established that use of these implements in land preparation has a negative impact to the soil structure. Fowler (1999) categorises implements into two categories; those that loosen the soil e.g. the plough and those that compact it e.g. rollers. Ploughing can result in soil being pulverised into fine tilth (Fowler 1999), thus resulting to wind erosion, while rollers can result in poor soil drainage and aeration as they compact the soil.

On the other hand however, indigenous practices of land preparation are more pro-soil conservation. Since time immemorial women used digging sticks and practised conservation tillage (Van Averbeke 2002). Indigenous conservation tillage (Kayombo, Ellis-Jones & Martin 2000) is still prevalent in areas with water deficit for example in Kenya trash lines are constructed by placing crop residues on the line to impede run-off and enhance infiltration, while in Tanzania ridges are used to retain some moisture in the soil . In South Africa tillage principles that are used are derived from those expounded in North America and Europe, except possible in the past five years when South African researchers recently discovered and understood indigenous conservation (Fowler 1999).

Colonialists introduced metal hand hoes and the animal drawn plough. Fitshugh & Wilhelm (1995) found that the use of animal draft power has been in existence since its discovery, and has been a main source of power in agriculture. According to Van Averbeke (2002) animal traction is not an indigenous technology because it was introduced by colonialist 100 years ago, and has been forced to people through extension services. Taylor (2000) argues that local knowledge incorporates both exogenous derived technologies and new innovation that result from them. Local agricultural knowledge does not operate in a vacuum; it exists with other external factors which affect it. When colonialists introduced animal traction, African farmers adopted it to their condition by introducing some changes (Simalenga, Belete, Mseleni & Jongisa 2000). Most of indigenous knowledge has developed since then around animal traction and it has become a cultural practice. Bobobee (1999) noted that researchers and policy makers see animal traction as appropriate and affordable technology for farmers in most of the African countries.

Bembridge (1984) reported that 60 percent of farmers in the Eastern Cape who were applying kraal manure used animal drawn planter. This in itself indicated that new knowledge has been developed by African farmers, which did not exist and was never introduced to them.

2.4.2 Seed selection

Agricultural (conventional) development has had negative impact on native plant species worldwide because it has replaced them with marketable crops (Easton & Ronald 2000). Replacement of indigenous seed with the so-called genetically improved seed has not been adopted fully well by African farmers as Bembridge (1991) noted that in Transkei less than half on farmers were effectively implementing the practices of improved seeds. In Latin America Quiroz (1996) also found that maize farmers were still continuing to select local varieties, in spite of the widespread adoption of a modern, high-yielding variety.

As conventional agriculture converts ever-increasing portions of earth's land surface to monoculture, the genetic and ecological diversity of the planet erodes (Soule, Carre & Jackson 1990). The use of hybrid seed results to the impoverishment of genetic stock, developed over years by human agriculture (Easton & Ronald 2000). Reduced genetic diversity in crops results in a loss of flexibility to meet future breeding challenges; as a results recent gains in yield have been achieved by increased dependency on a very few genetically narrow cultivars (Soule *et al.* 1990).

Although the use of traditional seed could be attributed to backwardness, Sibanda (1998) suggested that agencies should first investigate indigenous people, then develop and improve upon indigenous technologies. Agrawal (2004) also added that scientists ignore indigenous knowledge of farmers because they have little interest of externalizing farmer's tacit knowledge.

The farmers in Timor have developed a set of strategies to select the seeds as noted by Kieft (2001), which are holistic in nature and include both physical and spiritual indicators, are widely practised and are of significant relevance to agricultural development. In Lesotho Rosenblum, Jaffe & Scheerens (2001) found that farmers used household sowed local seeds, on 95 percent of their cropland, often saved from their previous harvests. In Ifugao Rice Terrace Joshi, Matchol, Bhatam & Penia (2000) noted that rice farmers have a particular way of selecting seed, they selected big, healthy and stout panicles. These farmers have not used variety recommended by extension officers because they believe that traditional variety has superior eating quality with heavy and non shattering grains (Joshi *et al.* 2000).

The reasons for using traditional practices differ according to different reasons. In Tanzania, Nyaronga, Wein, Olanya & Ojaimbo (2004) found that majority of farmers (89 percent) were using traditional seed because of high costs of certified seeds. In some cases the treated seeds and certified seeds are not readily available when needed. Taste and quality are also determinate factors in seed selection. Genetically modified seed are said to be less tasty in comparison with traditional seeds (Nyaronga *et al.* 2004).

Women played a leading role in seed selection as they had in-depth knowledge of indigenous edible plant. Taste appears to be counting more than size and quantity of production. In a lesson learnt in India (Agrawal 2004) it was found that women have been responsible for seed selection and domestication of seed because of their responsibility to the family (Easton & Ronald 2000). Once farmers adopt crops and cycle seeds, local varieties eventually emerge with high genetic variation and adaptation within the cropping system.

2.4.3 Planting

Conventional farming employs scientifically researched crop calendars for establishing planting dates. However, indigenous farmers select planting periods based on their cultural beliefs and probably based on the observation of natural plant growth. Agricultural knowledge is not only knowing how to plant or theorization about the crop; it is about technical proficiency of wielding a hoe or managing oxen and cultural proficiency (Taylor 2000). Time of planting is viewed by traditional farmers as one of the most fundamental factors that affect crop production. The early planting (Bajwa & Schaefers 1998) is used as a tactic for crop protection in several situations in east Africa.

Indigenous planting methods in many African countries have been the activity of women. Van Averbeke (2002) noted that the common practice by African women for planting was to broadcast seed before land preparation. This has been practised from time immemorial. This practice has been introduced in recent years as modern knowledge under the name of Zero Tillage or Conservation Tillage. Zero tillage and conservation tillage are terms used interchangeably to refer to planting the soil without tillage.

2.4.4 Soil care and fertility practices

Soil structure, fertility and pH are some of the most fundamental characteristics of good soil. Conventional soil fertilizing for crop growth is mainly based on chemical fertilizer applications. Inappropriate timing and quantity of fertilizer application on field crops can lead to excessive leaching of nutrients into underground water or surface water system (Province of British Columbia 2001). Fertilizers release their nutrients based primarily on temperature. Nitrogen is of greatest concern due to its solubility in water and potential for nitrate contamination of groundwater (Province of British Columbia 2001).

Fertilizer Society of South Africa (2000) noted that continuous use of nitrogenous fertilizer results in acidification of soil, thus resulting in gradual drop of yield. Acidity also reduces the general bacteria and biological life in the soil. Continuous use of fertilizer can also result in saline soil which brings about retarded growth. Some of the chemicals applied are leached or washed away, thus polluting water down stream. Contamination with nitrate, a common fertilizer ingredient, can result in an illness called methemoglobinemia in infants (Soule *et al.* 1990).

However, indigenous practices provide more sustainable alternatives of soil care and fertilization. Indigenous soil care and fertility according to Rajasekaran (1993) refers to the practices evolved, adopted, and modified by farmers based on their own informal experiments with an objective of maintaining the fertility and productivity of the soil. These include practices such as crop rotation, fallowing, farmyard manure, casarian leaves and river band sand.

Van Averbeke (2002) noted that Nguni people did not use kraal manure despite its abundance in their households instead they used fallowing and shifting cultivation to address fertility and declining crop yields. Shifting cultivation and slash-and-burn, were common practices among indigenous people of Asia and lowland Latin America, and provided them with a high degree of economic independence and cultural integrity (Burger 1990; Reijntjies, Haverkot & Waters-Bayer 1992). Shifting cultivation involves alteration between crops, for example forest is burnt to clear the land and provides ash as fertilizer or lime for soil (Reijntjies *et al.* 1992).

Fallowing is an indigenous soil fertility practice in which farmers rest the cultivated lands for a certain period before using it again (Rajasekaran 1993). Recently this practice has been incorporated to conservation tillage by researchers. Shifting cultivation and fallowing were used interchangeably; the field that showed reduction in yield were abandoned to fallow and remain unused many decades (Reijntjies *et al.* 1992), until vegetation recovers (Itani 1998), in this way soil erosion is minimized because roots of the de-bushed trees still exist.

Although use of kraal manure is an invention of African rural farmers Van Averbeke (2000) maintains that it is a fairly recent practice not more that 100 year old and chemical fertilizer was only introduced in the 1960s. In a survey conducted in Transkei Mkile

(2001) found that 43 percent of farmers applied kraal manure before planting. Most of the farmers have come out with a new technique of mixing kraal manure with granular chemical fertilizer and gromor. In West Niger it was reported that farmers because of insufficient kraal manure to fertilize the entire field; they developed a strategy of shifting livestock from one low productive spot to another (Lamers, Feil, & Suerkert 1995).

Rice farmers as observed by Rajasekaran (1993) rear sheep for their manure, and they indicated that five to six sheep are sufficient to manure one acre of rice. Rice farmers in Ifugao Rice Terrace incorporated organic fertilizer such as sunflower leaves into the soil prior to land preparation and seed sowing (Joshi *at al.* 2000). The use of kraal manure by farmers depends on the social condition. In a study carried in Western Niger (Lamers *et al.* 1995) three groups of farmers were identified; rich, moderately wealthy and resource poor farmers. Moderately wealthy farmers and poor resource farmers were found to be the only farmers using kraal manure.

Lamers *et al.* (1995) also noted that farmers use soil colour and texture to differentiate between levels of soil fertility. In South Africa Van Dissel & de Graaf (1998) found that the perception of farmers in erosion is far different from the one of researcher scientists. The major differences are centred around perception of environment as a whole, on one hand scientist believing that farmers influence land degradation on the other hand farmers believing that it is God driven process. Management of soils revolves around husbandry techniques that ensure good yield, as opposed to the simple addition of externally derived inputs (Taylor 2000). For this reason indigenous farming is associated with low resource farming.

Mulching is a common indigenous practice to recycle nutrients (Reijntjies *et al.* 1992). Most of agricultural soils in South Africa have no humus. According to Milner (1996) agricultural experts recommend that soil should contain at least 5 percent humus but in fact soil contains 0.3 percent on average. The vegetative material that is left to mulch has nutrients that were extracted from soil, by mulching them recycling takes place. The benefits of mulch as listed by Milner (1996) are:-

- Prevents weed from growth because it blocks sunlight
- Keeps roots cool in summer
- Keeps roots warm in winter
- Provides food for soil bacteria and earthworms
- Protects bare soil from wind erosion
- Prevents water from evaporation

Mulching modifies the soil temperature by reducing exposure to the sunlight, conserves the moistures and reduces erosion (Wolfe, Ross, Diem, Dillaha & Flahive 2002), and provides food for soil bacteria and earthworm (Milner 1996). Earthworms play a vital role in aerating the soil.

Composting is another soil fertility complementing indigenous practice that can be integrated with mulching. The mulch that is left on the ground is converted into nutrients through a decomposition process by bacteria (Wolfe *et al* 2002). Compost improves the soil as it increases soil water retention and promotes the activity of earthworm and soil micro-organisms.

2.4.5 Cropping systems

Conventional farming systems typically employ mono-cropping. In most of Africa, mono-cropping was also introduced by colonialists. Colonial agricultural extension services were aimed at eliminating multiple cropping (Easton & Ronald 2000), mainly to grow cash crops for colonial consumption. This has resulted in the impoverishment of the poorly resourced farmers. In South Africa, rural farmers were advised to plant one crop in one plot without taking into consideration the current land distribution. The question of where to derive other food types to ensure a balanced diet that is essential for survival has been deliberately ignored by critics of indigenous cropping practices.

Nevertheless, indigenous polyculture has been maintained as a major cropping system (Rajasekaran 1993) in many African countries. Many terms have been used to describe polyculture including mixed cropping, multiple cropping, intercropping, interculture, relay planting and mixed farming (Bajwa & Schaefers 1998). Polyculture is a system of cropping in which farmers cultivate two or more crops of different stature in alternate rows or same rows simultaneously.

Bembridge (1984) indicated that intercropping was widely used in Transkei despite the fact that it was not recommended by extension officers. In South Africa maize is often intercropped with beans and pumpkins (Van Averbeke 2002). Bembridge (1986) suggested that local researchers should put more focus on evaluating intercropping systems with a view of improving intercropping technology. The reasons for using polyculture vary from one country to another. Some of the reasons could be that there is not enough land to practice monoculture, or there is not enough labour or capital to invest on ploughing, harrowing and fertilizing land. Silwane (2000) found that 76 percent of farmers in the Eastern Cape intercrop maize, beans and potatoes and that 93.7 percent of these farmers planted these crops in rows. As stated in the hypothesis of this research, it is implied that the production of multiple crops using indigenous polyculture not only guaranties a balanced diet for the nutritional requirements of farmers and their households but is actually more profitable than conventional monoculture as the costs of production for indigenous polyculture are much lower. Also, surpluses of various produce are marketable within the communities and are able to be sold profitably.

2.4.6 Weed control

The dominant practice that was used by farmers in developing countries was burning the weeds, what is referred to as slash and burn by Burger (1990). Hand weeding has been used widely in African continent not only because it is the best, but because labour can be paid in kind and not cash (Shetto, Kwiligwa, Mkonwa & Massunga 2000). The use of hand hoes is seen as time consuming requiring 300 –400 hours per hectare and the use of animal drawn cultivars reduce labour remarkably.

Reduced tillage is believed to be reducing the weed from the soil, and Fowler (2000) maintains that weed spectrum has a tendency to change under reduced tillage. Farmers in

Tanzania (Reijntjies *et al.* 1992), and in South Africa did superficial hoeing and left dead weed material on the soil surface as proactive mulch to recycle nutrients and prevent weed re-growth by blocking the essential light as already mentioned earlier.

2.4.7 Disease and pest control

Chemical pesticides and fungicides are typically applied in conventional farming to control pests and diseases. Application of pesticides may therefore not be a successful strategy. Most pesticides are toxic. Besides the undesirable pests for which they are intended, pesticides can harm other organisms including pets, livestock, wildlife and human beings. Pesticides and herbicides make environment unfavourable for some microbial activities. Pesticide formulation has some chemicals which can change the pH of the soil (Vermeulen, Sweet, Krause, Hollings & Nel 1990), for that reason not every pesticide formulation is suitable to be used on plants. For example, some formulations can only be applied when certain weather conditions prevail or in particular plant species. Excessive amounts of pesticides can run off and contaminate streams, rivers and groundwater.

Bembridge (1991) suggested that innovators should have knowledge of the characteristics of rural farming populations so that new innovations can be adopted by farmers. Rajasekaran & Warren (1994) added that it is cost effective to use indigenous knowledge since it builds on local knowledge. According to Joshi *et al.* (2000) most farmers know pests and pest damage, although names may be different from those used by scientists. Joshi *et al.* (2000) also found that majority of rice farmers in Ifigao Rice Terraces were not using pesticides, despite the fact that they did not know how to control pests.

Indigenous farming practices do not use toxic substances in controlling pests and diseases. Indigenous techniques include digging-out and destroying the pest or using bait to trap the pest (Bajwa & Scheafers 1998). Traditional practices of biological pest control have recently been the subject of increasing scientific interest, and some interesting findings have been documented. An example is cited by Reijntjes *et al.*

(1992), of China citrus growers who started a century ago to control insect damage in oranges by placing predacious ant.

Bajwa & Schaefers (1998) maintain that fallowing makes the condition unfavourable for pest infestation because it breaks pest and disease cycles. Continued cropping in the same plot can increase insects and disease problems, while shifting cultivation may be seen as an extreme measure to escape pest and diseases (Bajwa & Schaefers 1998).

In India (Prakash 2002) it was found that farmers previously were using pesticides, but are currently using indigenous practices in controlling pest such as sowing of green manure crop in paddy field boundaries, a practice that also improves soil fertility by adding nitrogen. It is a common behaviour by resource-poor farmers that when new knowledge is introduced it is adopted in large numbers, but as the time passes, farmers gradually revert to their indigenous practices.

Early planting of maize as a cultural practice in East Africa plays a significant role in reducing problems of maize leafhopper and stalk borer (DePury 1968; Warui & Kuria 1983 & Prinsley 1987 as cited by Bajwa & Schaefers (1998).

The other method used by indigenous farmers (Bajwa & Schaefers 1998) is crop rotation. It helps in separating crops from their pest by space and time. Rotation is effective for soil pest such as nematodes and cutworms. It is only those species with deeper nests that are able to survive on certain plant residues when normal cultivation and crop rotation are used (Bajwa & Schaefers 1998). Farmers in Lesotho as discovered by Rosenblum *et al* (2001) rotated their maize with wheat to control population of stalk borer.

According to Bandyopadhyay & Saha (1988) farmers in India sow more seed than they actually need to cater for the amount that will be consumed by fowl, snails and wild birds, or to cater for unexpected climatic conditions.

2.4.8 Storage

In India according to Pidatala & Khan (2003) farmers use practices such as threshing (use of wooden stick) winnowing (use of broom sticks) cleaning (use of sieves) and drying in their post harvest operations and storage of grains. Mechanical injury of stored grains during threshing, shelling predisposes them to attack by pest (Bajwa & Schaefers, 1998), hence it is recommended that damaged grains should be consumed first. The most common method of storage structures used by indigenous African farmers is mud-thatched granary (Davis 1970 as cited by Bajwa & Schaefers, 1998). The advantage of mud structure is that it is cheap to construct, yet it does not differ to other plastered structures which are expensive in terms of storage quality.

2.5 CHALLENGES FOR INDIGENOUS FARMING PRACTICES

2.5.1 Interaction between pre-existing knowledge and new knowledge

Indigenous knowledge is constantly evolving. Its enrichment will depend on whether it can interact with new types of information, and can be used to solve emerging problems. However, the process by which pre-existing knowledge and new information interact needs to be explored, so that research and extension approaches can be designed to facilitate the acquisition of knowledge by farmers and counteract the erosion of their prior knowledge (Ortiz, 1999).

2.5.2 Gender and indigenous farming practices

Women are generally ignored by researchers and their knowledge is undermined as Zweifel (1997) noted that the growing interest in women's indigenous knowledge on the part of researchers does not necessarily imply an appreciation of their knowledge, skills and capabilities. Zweifel (1997) further maintains that studies of women's indigenous knowledge may even harm them. Scientists tend to overlook the fact that women are plant breeders and experts in local biodiversity. In some cases they fail to perceive women's knowledge as real knowledge, often referring to it as primitive and intuitive (Zweifel 1997).

Women in rural areas of South Africa are also responsible for specific tasks such as collecting traditional fodder, hoeing, weeding, irrigating, feeding animals, harvesting grains, fruits and vegetables. Women have been ignored in farming decision-making despite their role (Pidatala & Khan 2003). This is because there is a perception that women do not have knowledge about farming and even if they had it, it does not differ from the one of men. Anderson (2001) noted that even if women are farming they are perceived to be assisting their husbands. Haile (2004) found that in Ethiopia women are ploughing with oxen and they were innovating in many agricultural aspects.

Women in most societies play a significant role in managing the diversity of the ecosystem, since they are responsible for sustaining the livelihood of the family (Zweifel 1997). Easton & Ronald (2000) noted that indigenous knowledge of edible plants is vested with women in Africa. In Burkina Faso rural women collect roots of native plants like baobab tree (*Adansonia digitata*) for use in the diet for their families, while in Sudan women cull seeds and preserve a spread of varieties that will ensure resistance to different conditions that may prevail (Easton & Ronald 2000). Information of indigenous knowledge can therefore be viewed and perceived differently by different genders. Pidatala & Khan (2003) added that understanding the role of gender and the way it impacts the intrinsic value of local knowledge system is of critical importance as it determines the dissemination of information. Research done in India indicated that post harvest activities are largely the responsibility of women, and further suggest that women be involved in the development of harvesting technology (Parvathi, Chandrakandan & Karthikeyan 2000). In Timor (Kieft 2001) has shown that seed selection and seed storage are a responsibility of women.

Almost all biodiversity within reach of rural societies is used, developed and maintained by local women (Zweifel 1997). It can therefore be concluded that women are responsible for indigenous plant breeding. The challenge is upon researchers and innovating institutions to involve and acknowledge women role in indigenous farming.

2.5.3 Age and indigenous farming practices

Young people learn values of life from the elders of those particular societies, and if the values are not implanted at an early stage there might be deviations form cultural practices. Agriculture is a part of cultural practices in a society and is inherited from generation to generation. Bembridge (1986) found that in rural areas of Transkei most of the progressive farmers were young farmers because they had higher level of aptitude. However, contrary to that, one can attribute the progressiveness of young farmers to physical capabilities. Indigenous farming is by far and large a laborious activity, it requires farmers to be in a healthy status and to be physically fit. For example the use of animal drawn planter and hand hoeing.

When transferring new knowledge to rural farmers it is important that scientists take the age into consideration. Elderly people are known to be resisting new changes and this is confirmed by Bembridge (1991) that innovative farmers are young. Traditional young people have limited control over decision making because this is regarded as the activity for elders. This results in knowledge completely being rejected if it does not suit the needs of elderly people.

Urbanization has resulted in many young people moving to towns (Pidatala 2001), and that has resulted in the slow transfer of knowledge to young people. Even those who cannot find jobs in urban areas when they return, their minds are also urbanized. Westernization has resulted in many young people viewing indigenous knowledge as obsolete and out dated compared to western cultural practices (Sibanda 1998).

2.5.4 Institutional support

Bembridge (1986) highlighted that there is a lack of institutional support in terms of operating policies and suitable technology for indigenous farmers. Most government support such as technology transfer and research is geared towards conventional innovations. Nothing or very little is done to improve the locally developed knowledge. Educational institutions that are major sources of information are mostly promoting conventional knowledge and technology. Endeavours have been made to transfer conventional knowledge under the good name of 'participatory methods'. It is important that clear distinction is made between disseminating conventional knowledge and improving upon indigenous knowledge.

Farmers need more meaningful options than perceptions. Agrawal (2004) suggested that scientists and development planners who want to develop (not to introduce) new knowledge need to first look at what farmers are doing, how are they doing it and understand the reasons why they are doing it.

Agriculture in South Africa has been shaped by political forces that were based in the fact that there is nothing to learn from black farmers (Taylor 2000). This has created a legacy of socio-economic and political entanglement that has promoted a highly developed commercial white farming sector, that was supported by state institutions and agricultural policies. An illustration of this is in the fact that in many developing countries indigenous vegetables are overlooked by policy makers and extension officers, while exotic vegetables are promoted mainly for commercial purposes (Rubaihayo 1994).

2.5.6 Globalization

In Africa substantial indigenous knowledge has disappeared with colonization. Globalization is irresistible and cannot be avoided. If no tentative measures are taken to preserve indigenous knowledge, most of it is likely to disappear completely (Pidatala 2001). Pidatala (2001) also noted that many countries and development organizations have started initiatives to preserve and revitalize their indigenous knowledge as a measure to counter the effects of globalization.

2.5.7 Documentation of indigenous knowledge

Indigenous agricultural knowledge is passed as culture to other generations and there is no formal training. Pidatala (2001) confirmed that indigenous knowledge collectors are liberated activists with no formal training in the theory of analysis and presentation of results. Sibanda (1998) warns that while documentation of indigenous knowledge systems is a major factor, the absence of scientific procedural explanations is worsening the situation. This calls for indigenous knowledge scientific research and publication of literature more especially in vernacular language.

2.5.8 Knowledge sophistication

Agrawal (2004) classified knowledge as (i) explicit; which can be easily recorded and (ii) tacit; which cannot always be articulated. Knowledge that farmers of a particular society posses, may be too much sophisticated for farmers in other society to understand (Kolawole 2001). This may hinder intersociety transfer of knowledge. The sophistication of knowledge can be a problem in so much that scientist may confuse it with myth. It is also a challenge even to researchers, because when they do not understand certain practice they will take that knowledge as irrelevant and useless. It is therefore important that researchers have a clear cultural background of the topic they are researching.

2.5.9 Commercialization

Although indigenous knowledge is increasingly becoming popular it has not been widely integrated in research and development processes (Dawes 1993). Government and development organizations have focused their investment on CFP because there is a perception that IFP are outdated and cannot be used commercially. The indigenous practices are termed as primitive and their technology as stone-age and most researchers don't believe they can get fruitful results from them.

Although European civilization in South Africa was established in 1652 by Van Riebeek, Holtzhasen (1993) maintains that commercialization of indigenous plants has been very insignificant. In the fruit category only watermelon has made it in the commercial world. Rooibos, a traditional herbal tea of Khoi people in the Cape Province is one of the indigenous plants that has became an important commercial crop. Judging from the number of plants that have been commercialized one can conclude that most of the valuable knowledge that can be used commercially is hampered by wrong perceptions scientists have on indigenous knowledge. However, contrary to Holtzhasen (1993), one can argue that most of the indigenous knowledge has been commercialized. The reason why this has not been noticed is that once scientists adopt indigenous knowledge, it is taken as new conventional or scientific knowledge.

2.5.10 Indigenous knowledge and education

Indigenous knowledge can play a vital role in knowledge development at large. Ulluwishewa, Kaloko & Morican (1997) suggested that the philosophy of 'from the known to the unknown' should be adopted if education is to be effective. This will be a different move form participatory research where researchers develop new knowledge, not from the practices of the farmers but from elsewhere, and trials are done with farmers so that technology transfer takes place.

Teachers should invite farmers who are practicing indigenous farming to make presentation and compare with conventional methods of production. Pupils are already familiar with their culture, and therefore, they would find it interesting to learn about the environment through these cultural forms. The subject of indigenous farming should be introduced in institutions where extension officers receive their education. The statement by a Rhodesian administrator in 1926 that intercropping is nothing more than 'hit and miss planting in mixtures' is an indication of perception of indigenous African agriculture that persists today. These perceptions include National Agricultural Research and Extension Systems (NARES), International Agricultural Research Centers (IARCs) and among expatriate researchers and technicians (Jiggins 1989; Peters 2000 in Barrett, 2000).

2.6 THE USE OF GIS IN INDIGENOUS KNOWLEDGE

Farmer knowledge is valid and rational like scientific knowledge and it is an important factor when planning resource management. It can be quantified, systematically organised and geo-referenced by means of Geographic Information Systems (GIS). Many countries are now starting to promote the use of indigenous knowledge, such knowledge must be available and accessible. Lawas & Luning (1996) maintain that collection of information from diverse indigenous sources from different locations around the world is laborious costly and time consuming so proper storage must be ensured. All the challenges of IFP can be attributed to it perception by researchers, policy and decision makers and fellow farmers. GIS has an advantage in that it narrows the 'distance' between professionals and resource users by being able to include the geographical location of information sources of knowledge and resources.

2.9 DISCUSSION

Literature review revealed that indigenous farming practices (IFP) have a positive impact to the environment such as mulching, composting and non toxic control of plant pest. It has also been illustrated that conventional farming can lead to soil degradation, water pollution, plant injury and loss of genetic diversity. Literature review has also shown that IFP is still widely practised in developing countries by poor resource farmers. All the challenges of IFP can be attributed to its perception by researchers, policy and decision makers and fellow farmers. The use of GIS in promoting and documenting IFP can be viewed as a solution to most of the challenges of IFP. While IFP is widely practised by farmers in developing countries and shows positive impact to the environment, its relationship with maize yield and profitability has not been clearly demonstrated. The next chapter focuses on how study area was selected to assess relationship between various IFP and maize yield.

CHAPTER 3

3 OVERVIEW OF STUDY AREA

3. 1 STUDY AREA

This chapter describes the methodology followed in identifying the study area, the design of data sampling scheme. It further describes the study area, its historical background and justifies its selection by describing criteria used.

3.1.1 Location

A study area (figure 1) was selected in the Umzimkulu Local Municipality in the District Municipality of Alfred Nzo of the Eastern Cape Province. The area is situated between longitude 29° 20' 2"E to 30° 10' 2"E and latitude 30° 60'0"S to 30° 30'0"S.

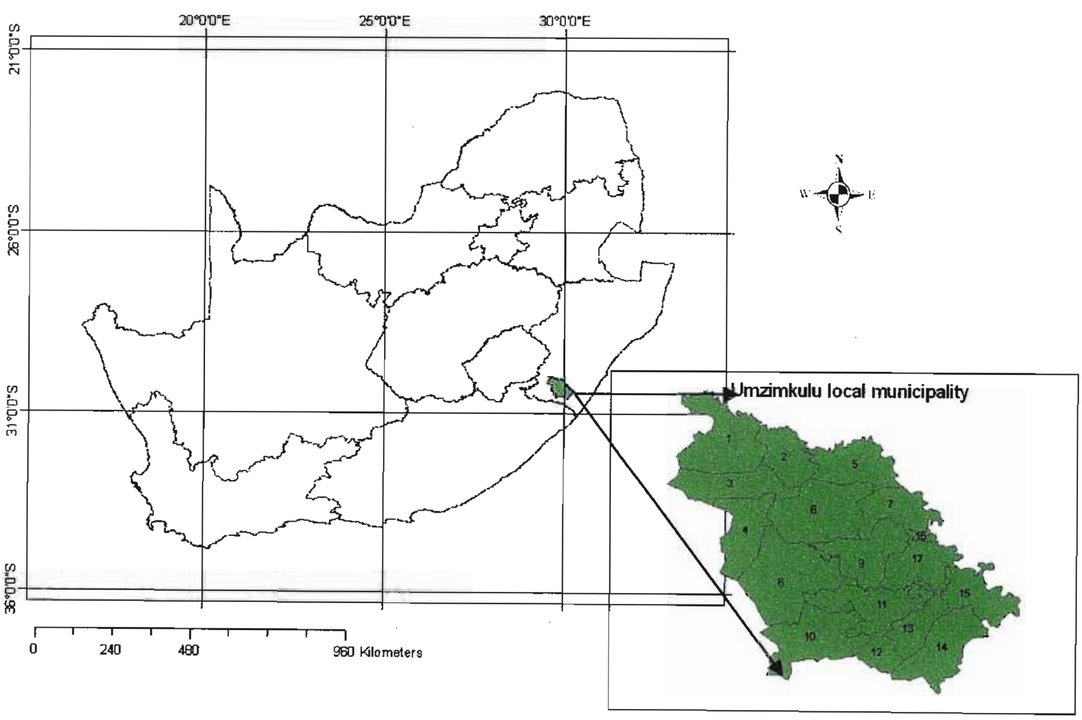


Figure: 1 Map showing locality of study area which is Umzimkulu municipality.

3.1.2 Back ground of the area

Umzimkulu municipality is part of former Transkei Bantustan[1]. The agricultural system that is currently practised in South Africa is shaped by policies of the former government as indicated earlier by Taylor (2000). During homeland regime most of the land was communally owned with very few people having private ownership and this resulted in low agricultural production (Jack 1997). To revitalize agriculture in Transkei, administrators formed TRACOR (Transkei Agricultural Corporation). TRACOR introduced conventional practices by doing all activities in the communal fields including tillage, fertilizer application, planting and harvesting for the people. This was seen as top down process as the community had no decision over cropping programme and selling of produce.

When the new government of the Republic of South Africa took over in 1994, TRACOR was dissolved in 1995, and this resulted in the reduction of communal fields cultivated. Although most people stopped cultivating their fields because they did not have enough capital to invest in production cost, they did not stop cultivating in their homesteads. Mkile (2001) found that farmers in Transkei were using indigenous farming methods in their homesteads.

In 2003 the Eastern Cape Department of Agriculture introduced Massive Food Production Programme (MFPP) where communal fields are cultivated using CFP under supervision of local extension officers. This programme was introduced in four phase over a period of four years: in first year (phase 1) government contributes 100 percent of funding, second year (phase 2) government contributes 75 percent, third year (phase 3) 50 percent and fourth (phase 4) year government contribute 25 percent. On the fifth year it is assumed that the farmers will be able to stand by themselves and contribute 100 percent towards their production cost. On its introductory phase MFPP was met with strong objection by local farmers who preferred intercropping, but with social facilitation

[1] Bantustans are States which were demarcated for Blacks under apartheid regime. They were abolished and incorporated to the Republic of South Africa on the 27th April 1994.

by extension officers it was kick-started. Activities of MFPP are similar to those of TRACOR other than that in the former farmers decide themselves how and where to sell.

3.1.3 Farming systems in Umzimkulu

Commercial sector - Massive Food Production programme is seen as commercial production because it is characterized by heavy capital intensity; in 2003 alone 900 hectares have been planted commercially. The plan as indicated in a Policy Implementation Plan by Mamase (2004) is to commercially plant all communal fields. There are about 5 active commercial farmers in Umzimkulu who own approximately 150 hectares of land on average. Umzimkulu town is supplied by neighbouring farmer from Ixopo for agricultural production. Homestead farming - Most of the people are practicing agriculture in their homestead gardens. Some of the farmers are using fertilizer, some use kraal manure and others mix fertilizer and kraal manure. The cropping system that is most prevalent in Eastern Cape is intercropping where maize is intercropped with beans and pumpkins (Bembridge 1991; Rajasekaran 1993). The prevalent cropping system in Umzimkulu will be tested in this research.

3.1.4 Criteria for selection of study area and sampling design

The study area was selected on the basis that farmers who practice indigenous farming existed in sufficiently large numbers for statistical analysis requirements of yield data. Personal knowledge and information available at the Eastern Cape provincial agricultural offices showed that most farmers in the Umzimkulu area practice indigenous farming.

A digital Bio-Resource Unit map of the study area (Figure 2) was used as a basis for stratification in the design of a sample scheme for collecting the required IFP data. An administrative area map was overlaid on Bio-Resource Units (BRU) in a GIS in order to identify homesteads and cultivated areas from which interview samples were drawn. The BRU database will be explained in detail in the proceeding section. A GIS data model (Figure 3) was used in the sampling design. One administrative area (Table 1 and Figure

2) was randomly selected from each of seven Bio-Resource Units occurring in the Umzimkulu area .

Table 1 Selected villages for farmer interviews by administrative ward and BRU

BRU	BRU Name	Admin Ward	Village
Wc44	Glengarry	8	Ngcambele B
WXc13	Upper Bisi River	8	Phelanyeni
Ub28	Mahobe Mission	13	Ntlabeni
Vc33	The Fountains	13	Highlands
Vb31	Deepdale	13	Mahobe Mdeni
VWb8	Tembeni	17	Tembeni
UVb7	Umzimkulu	17	Strangers Rest A

All homesteads using IFP were identified and listed in each administrative selected to make up a sampling frame. A sample of 20 farmers from each Bio-Resource Unit was selected from the list using the simple random sampling method. Where the number of homesteads using indigenous farming practices was less than 20, all farmers were selected. A total of 132 farmers were interviewed.

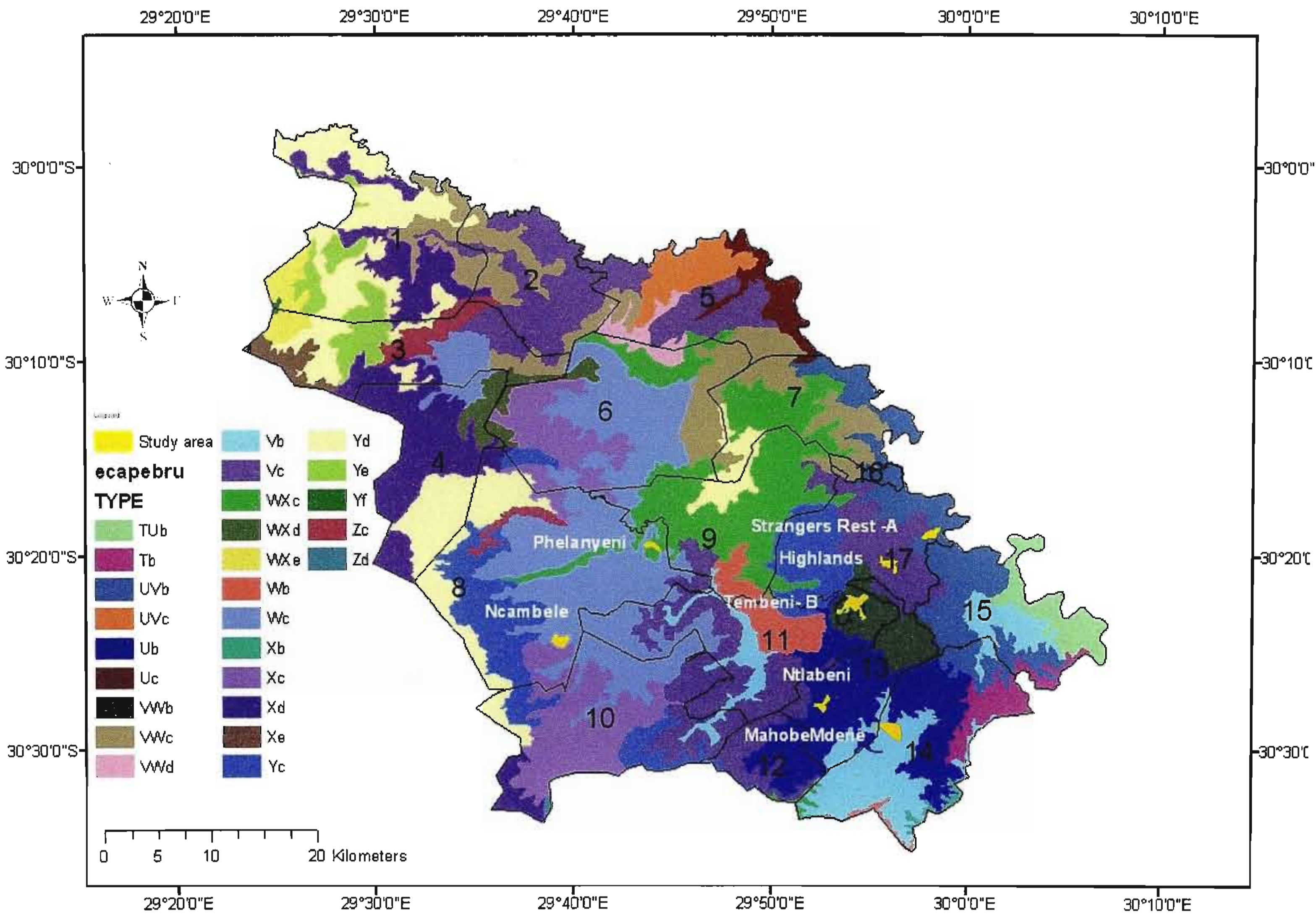


Figure 2 Map of Umzimkulu Municipality showing randomly selected administrative areas.

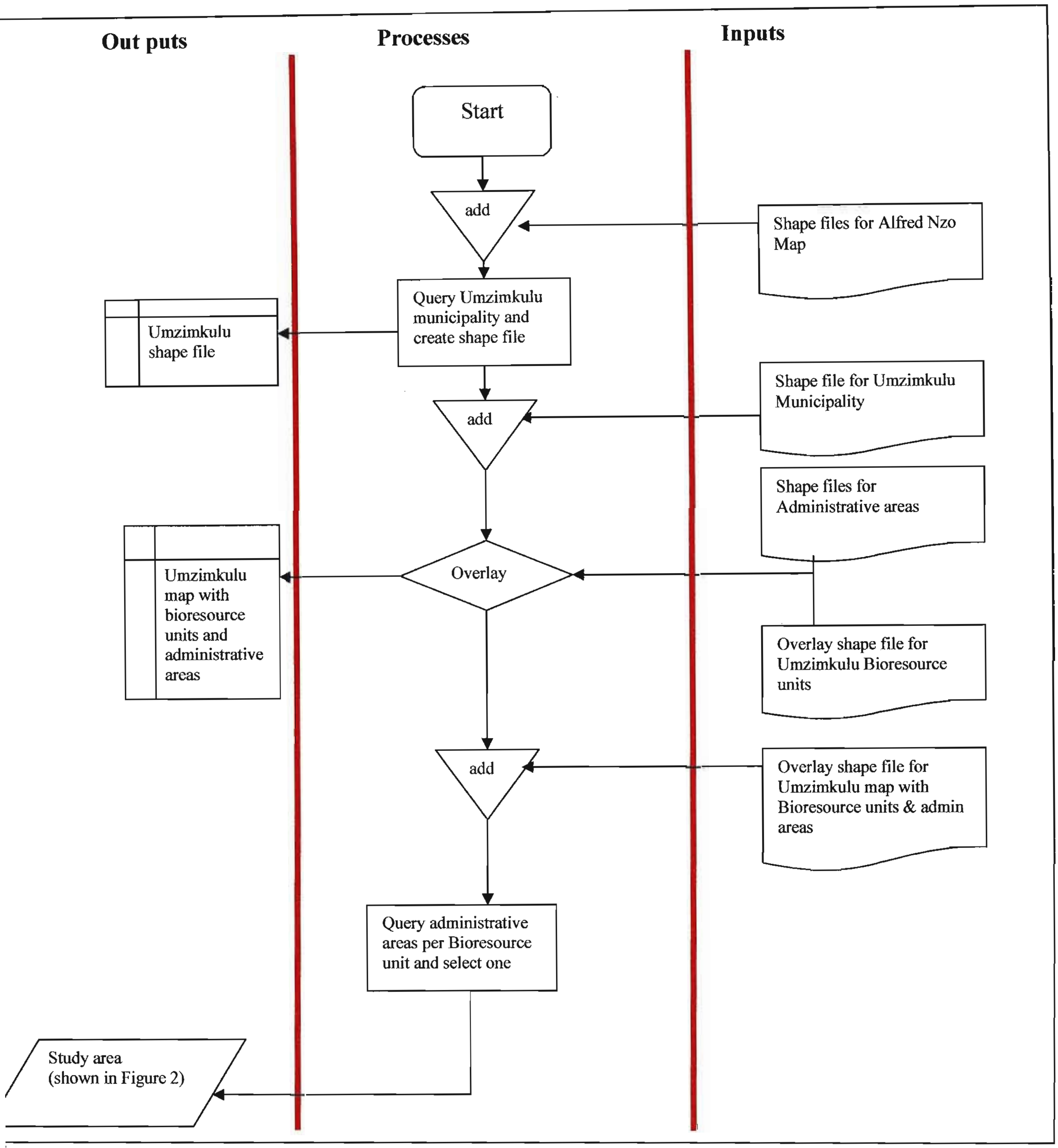


Figure:3 Diagram showing GIS operation conducted to select study area.

3.1.4 Weather conditions during 2003/2004 growing season

The climatic conditions that characterised Umzimkulu area in the 2003-2004 growing season indicate normal warm temperature with mean temperature of 17°C. The risk associated with hail storm and snow was seven percent in frequency. In some parts of Umzimkulu (Figure 4) rainfall normality exceeded 100 percent while in some areas it was between 75 percent and 100 percent. No drought or hail storms were reported. The 2003-2004 growing season was considered a normal year for the purposes of this research.

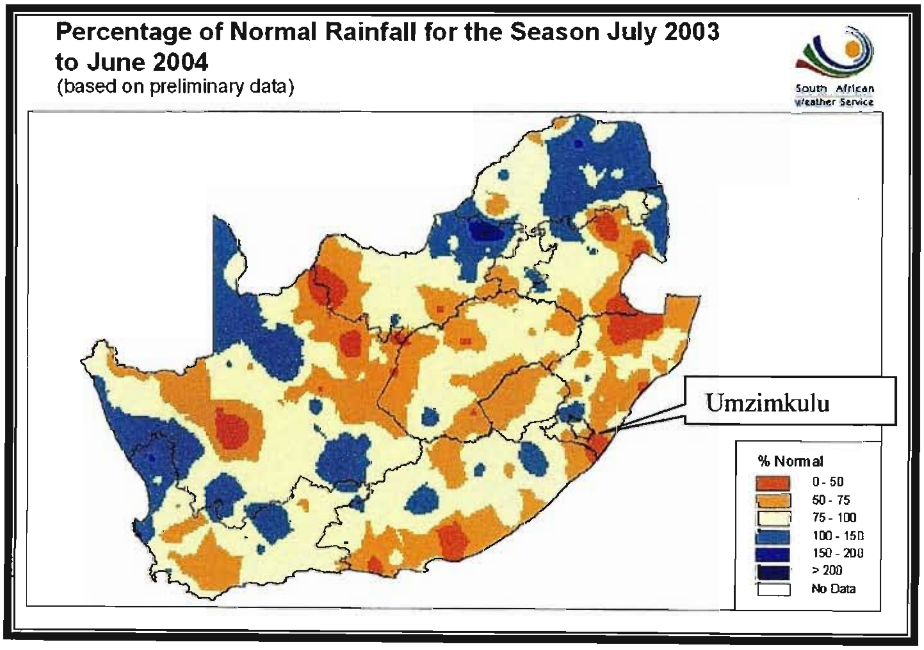


Figure:4 Rainfall normality for 2003-2004 map obtained form South African Weather Service.

3.2 Discussion

This chapter has summarised the study area selection and its background. The background of the study will help in understanding the behaviour pattern and explaining the reason for some indigenous practices. The criteria for study area selection will ensure that there is no biasness from the results as BRUs are homogenous units.

CHAPTER 4

4. METHODOLOGY

4.1 INTRODUCTION

This chapter describes the methodology that would be used to assess the performance of IFP in maize land use systems. The purpose of this chapter is to explain the data requirements and sources for this research and how data would be collected and analysed. Limitations of the study are also explained in this chapter.

4.2 CONCEPTUAL FRAMEWORK

A conceptual framework for testing the hypothesis was formulated based on the Margin above Specified Cost (MaSC) method developed by Van Reenen & Marias (1992). The approach would be used to compare the relative profitability of the two farming practices. The mathematical model for the calculation of the MaSC would be formulated later in the research as data variables are defined from interview data.

Margin above Specified Cost would be used to calculate for profit made. Margin above Specified Cost as defined by Van Reenen & Marias (1992) is an analysis of estimated gross production value and specified costs that can be directly allocated to a production branch (crops or livestock) on a per unit basis (for example per hectare or per crop). The term margin above specified cost is preferred to gross margin because it represents the contribution of each individual production branch towards the redemption of the fixed cost, and the total none directly allocable variable cost and ultimate realisation of farm profit (Van Reenen & Marias 1992). Profits as defined by Barry *et al* (1995) are gaps between the value of goods and services produced and the cost of resource used in their production. The calculated MaSC values for IFP and CFP would be compared in order to determine which one was more profitable than the other.

4.3 DATA REQUIREMENTS AND COLLECTION METHODOLOGY

Production potential estimates of conventional maize land use systems based on scientific inference are well documented. However, data on IFP are not readily available as indigenous systems are neither exhaustively researched nor documented.

Data on IFP farming operations, their sequence and respective costs over the growing season 2003-2004 including seed selection, land preparation, cropping system, planting, soil care and fertilising, weed and pest control as well as yield data per hectare would be collected from primary sources by interviewing farmers in a pre-defined study area. Details of the sampling design and data collection materials and methods have been described in the previous section.

Data on CFP farming operations, sequence and respective costs would be obtained from the so-called COMBUD[2] Enterprise Budgets of the KwaZulu-Natal Provincial Department of Agriculture. COMBUD data including prevailing market prices and allocatable variable costs are compiled for every growing season. Allocatable variable costs are those attributable to material input including fertilizer, lime and manure, weed and pest control, contract work (labour), crop insurance, energy, maintenance and harvest costs.

Potential yields per hectare data for CFP based land use systems including maize are also available in the KwaZulu-Natal Provincial Department of Agriculture and Environmental

[2] COMBUD: Computerized Budget

Affairs Bio-Resource database in Geographic Information System (GIS) medium. The Bio-Resource database (Version 6.012) provides baseline data regarding approximate yields for maize based land use systems attainable for defined production situations using CFP. The database provides units of homogeneous biophysical conditions including terrain, soils and climate referred to as the Bio-Resource Unit. The Bio-Resource Unit (BRU) is defined by Camp (2003) as an ecological unit within which factors such as soil type, climate, altitude, terrain and vegetation display sufficient degree of homogeneity. The BRUs provide a good indication of potential yield for a range of crops, including maize. However, the custodians of the BRU database recommend that for accurate production potentials, detailed soil surveys be carried out to ascertain soil characteristics including depth, type, clay content, drainage class and rockiness.

A BRU is identified by code based on rainfall and altitude and a name. In the example WXc13 – Upper Bisi River, WXc13 is the Bio-Resource Unit and Upper Bisi River is the name. The uppercase letters in the code denote the annual rainfall range (WX) from 800 to 900 mm and the lower case letter (c) the altitude range from 900 to 1400m above sea level and the number 13 indicates that the BRU is the ninth occurrence. Table 2 shows all the designated rainfall and altitude ranges of the database. Coding (Tables 2 and 3) is used to explain the BRUs occurring in the study area of Umzimkulu. In Table 2, the first letter in upper case indicating the rainfall zone in which the BRU falls; a lower case letter indicating the physiographic zone in which it falls and which is an indication of temperature zone.

Table 2: Symbols and codes of the Bio-Resource Units

Rainfall description	
Symbol	Rainfall (mm)
R	< 600
S	601-650
T	651-700
U	701-750
V	751-800
W	801-850
X	851-900
Y	901-1100
Z	>1100

Altitude description		
Code	Name	Altitude range (m)
a	Coast	<450
b	Lowlands	451-900
c	Uplands	901-1400
d	Highlands	1401-1800
e	Montane	1801-2000
f	Escarpment	>2000

Each BRU contains subclasses referred to as soil ecotopes (Table 3) describing dominant soil characteristics in terms of soil form, texture, depth, wetness, slope and surface characteristics (e.g. rockiness).

Table 3 Ecotope definition coding as described in Bio-Resource Units

Soils	
A	Humic soils
B	Well and moderately drained soils
C	Alluvial soils
D	Motteled and moderately drained soils
E	Motteled and poorly drained soils
F	Black (Margalitic) soils
G	Black (Margalitic) poorly drained soils
H	Young soils
I	Other poorly drained soils
J	Duplex soils
K	Organic soils and wetlands

Clay (percent)	
1	>35
2	5-15
3	<15

Depth (mm)	
1	>800
2	500-800
3	300-500
4	200-300

Slope (percent)	
f	<12
s	12-40
x	>40

Surface characteristics	
n	Not rocky
r	Rocky

An example of ecotope B.1.2.f.r would indicate well and moderately drained soils; clay >35 percent; depth 500-800mm; slope <12 percent and rocky surface.

4.4 DATA ANALYSIS METHODOLOGY

Margins above Specified Cost for IFP based maize land use systems would be calculated using actual yield per hectare and cost of production data obtained from farmer interviews. Comparison values of Margin above Specified Cost per hectare would be calculated for CFP based maize land use systems using Bio-Resource potential yield at 70 percent management factor and COMBUD variable cost data for the 2003 – 2004 growing season. The BRU programme considers controlled research field management to be 100 percent while in a practical farming production situation; good management potential is considered to be 70 percent.

Primary IFP data obtained from interviews would be coded and entered to SPSS statistical analysis software in order to explore distributions, trends and relationships between them. Relationships between the sequential operations over the growing season and IFP maize yield as the output of the main land use would be explored. Observed variable costs associated to the farming operations would be aggregated to make up the total cost. Yields would be converted into monetary equivalents by applying the prevailing market prices and a comparison of profitability between IFP and CFP carried out.

4.5 LIMITATIONS TO THE STUDY

Given the time and resources, constraints of this research would be limited by the following aspects.

- A total number of 7 BRU would be studied because of time and budget constraints.

- The data would be collected from farmers through interviews and validity would entirely depend on the accuracy of information given by farmers. Trials and experiments to get information would have made the study unaffordable in terms of student research budget and time resources. Assumption is made in this study that data that would be given by respondents would be accurate and would be the true reflection of their farming practices.

- A total population in each administration selected will not be interviewed due to time constraints. A Simple Random Sample would be employed to select farmers for interviewing.

- Only data for IFP would be collected as primary data, CFP data will be obtained from secondary data sources. The secondary data obtained will be deemed to be accurate and valid and relevant to CFP in each BRU that would be studied.

5 OVERALL CONCLUSION

Component A has provided a basis on which the study would be undertaken and has explained the problem statement and the need for this research. The literature review of previous studies has revealed that indigenous farming practices have a positive impact on the environment by improving soil through mulching, composting and use of non-toxic control of pests and diseases that damage crops. On the other hand the review has revealed that conventional practices can impact negatively on the environment. The literature review has also summarised the types of indigenous practices used in other developing countries and their challenges.

This component of the research has discussed the overview of study area and justified its selection using GIS operations. A procedure using the Bio-Resource Units as homogeneous mapping units for first stratification for a Simple Random Sample has been described. The conceptual framework of the study has been outlined explaining the method for testing the research hypothesis. The required data and their sources have been identified and data collection and data analysis methods explained.

REFERENCES

AGRAWAL, R.C. 2004. Farmers as partners in knowledge development. *World Bank IK Notes*. No.69. The World Bank, Washington D.C.

AGRAWAL, A. 1995. Indigenous and Scientific Knowledge: Some Critical Comments. *Indigenous Knowledge and Development Monitor* 3: 3-6.

ANDERSON, P.R. 2001. Focus on: Gender and indigenous knowledge. Experiences in Nigeria and the USA. *Indigenous Knowledge and Development Monitor* 9: 16-17

BAJWA, W.I. & SCHAEFERS, G. 1998. Indigenous Crop Practices in Sub-Saharan East Africa. Consortium for International Crop protection, USA.

BANDYOPADHYAY, A.K. & SAHA G.S. 1998. Indigenous methods of seed selection and preservation on the Andaman Islands in India. *Indigenous Knowledge and Development Monitor* 6: 3-6.

BARRETT, C. B. 2000. The challenge of improved natural resource management practices adoption in African agriculture: A social science perspective. *Paper prepared for the workshop on Understanding Adoption Processes for Natural Resource Management Practices for Sustainable Agricultural Production in Sub-Saharan Africa,* Nairobi, Kenya, 3-5.

BARRY, P.J.,ELLINGER,P.N., HOPKIN, J.A. & BAKER, C.B. 1995. Financial management in agriculture. Interestate, Danville.

BEMBRIDGE, T.J. 1984.A systems approach study of agricultural development problems in Transkei. PhD thesis, University of Stellenbosch, Stellenbosch.

BEMBRIDGE, T.J. 1986. Characteristics of Progressive Small-Scale Farmers in Transkei. *Social Dynamics* 12:77-85.

BEMBRIDGE, T.J. 1991. Technology transfer in Small-Scale Dryland Crop Production: Future Challenges. *Development Southern Africa* 8:479-493.

BOBOBEE, E.Y.H. 1999. Role of draft animal power in Ghanaian Agriculture. University of Science and Technology, Kumasi, Ghana.

BURGER, J. 1990. The Gaia Atlas of First Peoples: A Future for the Indigenous World. Penguin Books, Ringwood.

CAMP, K. 2003. Guide to use of the Bioresource Programme. Cedara Report No N/A/99/11, Natural Resource section – Technology development and training. Cedara,1-34.

DAWES, W. 1993. Introduction in Traditional knowledge and sustainable development. *In*: S.H. Davis and K. Ebbe (eds), *Proceedings of a Conference held at The World Bank Washington D.C in Sept. 27 - 28.* p.3-4 Environmentally Sustainable Development Proceeding Series No. 4.

EASTON, P. & RONALD, M. 2000. Seeds of life: Women and Agricultural Biodiversity in Africa. World *Bank IK Notes.* No 23. The World Bank, Washington D.C.

EICHER, A. 2003. Organic Agriculture: A glossary of terms for Farmers and Gardeners. University of Califonia Cooperative Extension, South Broadway.

EMERY, A.R. & ASSOCIATES. 1997. Guidelines for Environmental Assessments and Traditional Knowledge. A Report from the Centre for Traditional Knowledge of the World Council of Indigenous People (draft), Ottawa, 4-5.

FERTILIZER SOCIETY SOUTH AFRICA. 2000. Fertlizer Handbook 4rth edition. Lynnwood Ridge, South Africa

FITSHUGH, H. & A.E. WILHELM. 1995. Value and uses of indigenous livestock breeds in developing nations. *In*: M.L Oldfield and J.B. Alcorn (eds), *Biodiversity: culture, conservation and eco-development,* p.102-116. Michigan: Michigan University Press.

FOWLER, R. 1999. Conservation tillage research and development in South Africa. *In* Kaumbutho PG and Simalenga TE (eds), *Animal power for weed control,* p51-63. A resource book of the Animal Traction Network for Eastern and Southern Africa Tantesa,Wageningen.

HAILE M 2004. A Woman innovator Speaks. *World Bank IK Notes.* No.70 The World Bank, Washington, D.C.

HOLTZHASEN, L.L. 1993 Ennobling and domestication of indigenous African Amarula,. *The indigenous Plant Use Newsletter* 1: 1-3.

ITANI, J. 1998. Evaluation of an Indigenous farming system in the Mantego Highlands , Tanzania, and its Sustainability. *South African Study Monographs* 19: 55-68.

JACK, B. 1997. Development strategy for the agricultural section in the Eastern Cape. *Paper prepared for the Eastern Cape revitalisation of Agriculture Workshop held on the 19th August 1997 in Industrial Hall in Bisho.*

JOSHI, R.C., MATCHOL, O.R.O, BHATAM, R.G. AND PENIA, F.A.D 2000. Farmers knowledge, attitudes and practices of rice crop and pest management at Ifugao Rice Terraces (IRT), Philippines. *International journal of pest management* 46: 43-48.

KAYOMBO, K., ELLIS-JONES, J. & MARTIN, H.L. (2000) Indigenous conservation tillage system in East Africa with example of their evaluation from West Tanzania. *Unpublished paper*, Botswana College of Agriculture, Botswana.

KIEFT, J. 2001. Indigenous variety development in food crops strategies on Timor: their relevance for in situ biodiversity conservation and food security. *Indigenous Knowledge and Development Monitor* 9: 8-13.

KOLAWOLE, O.D. 2001. Local Utilization and sustainable rural development in the 21st century. *Indigenous Knowledge and Development Monitor* 9:13-15.

LAMERS, J.P.A., FEIL, P.R. & BUERKERT, A. 1995. Spatial crop growth variability in Western Niger: The knowledge of farmers and researchers. *Indigenous Knowledge and Development Monitor* 3:17-19.

LAWAS, C.M. & LUNING, H.A. 1996. Farmers knowledge and GIS. *Indigenous Knowledge and Development Monitor* 4:1-15.

MAMASE, M. 2004. Walking the talk continues. *Speech delivered in Policy Implementation 2004-2005 for Department of Agriculture in Bisho.*

McCALL, K. 1996. ITK in East farming systems. *Indigenous Knowledge and Development Monitor* 4: 20-35.

MKILE, Z. 2001. The use and agronomic effectiveness of kraal manures in the Transkei region of the Eastern cape, South Africa. M Sc dissertation, University of Fort Hare, Alice.

MILNER, P. 1996. The earthmill system for organic market garden. Earthmill products, Bredell, South Africa.

NYARONGA, R.O., WEIN, H.L., OLANYA, O.M. & OJAIMBO, P.S. 2004. Farmer's cultural practices and management of potato late blight in Kenya Highlands: Implications for development of integrated disease management. *International Journal of Pest Management*. 50: 135-144.

ORTIZ, O. 1999. Understanding interactions between indigenous knowledge and scientific information. *Indigenous Knowledge and Development Monitor* 7: 7-10.

PARVATHI, S., CHANDRAKANDAN, K. & KARTHIKEYAN, C. 2000. Women and dry land post-harvesting practices in Tamil Nadu, India. *Indigenous Knowledge and Development Monitor* 8: 13-16.

PIDATALA, K. & KHAN, A.R. 2003. Women & Indigenous Knowledge: a South South Perspective. *World Bank IK Notes*. No 63, The World Bank, Washington, D.C.

PIDATALA, K. 2001. Eritrea: The process of Knowledge Capturing Indigenous Knowledge. *World Bank IK Notes*. No 36, The World Bank, Washington, D.C.

PRAKASH, S. 2002. Using Indigenous Knowledge to Raise Agricultural Productivity. *World Bank IK Notes*. No.45, The World Bank, Washington, D.C.

PROVINCE OF BRITISH COLUMBIA. 2001. The Ministry of Agriculture, Food and Fisheries. Victoria.

QUIROZ, C. 1996. Local knowledge systems contribute to sustainable development. *Indigenous Knowledge & Development Monitor* 2:13-17.

RAJASEKARAN, B., & WARREN, D.M. 1994. IK for Socioeconomic Development and Biodiversity Conservation: The Kolli Hills. *Indigenous Knowledge & Development Monitor* 2:13-17.

RAJASEKARAN, B. 1993. Indigenous technical practices in a rice-based farming system. Center for Indigenous Knowledge for Agriculture and Rural Development, Ames.

REIJNTJES, C., B. HAVERKORT, & A. WATERS-BAYER. 1992. Farming for the future: An introduction to low-external input and sustainable agriculture. Macmillan, London.

ROSENBLUM, M.L., JAFFE, L. & SCHEERENS, J.C. 2001. Setting up farmers' research agendas in Lesotho.*Indigenous Knowledge and Development Monitor* 9: 3-7.

RUBAIHAYO, E.B. 1994. Indigenous vegetables in Uganda. *African Crop Science Conference Proceedings* 1: 120-124.

SHETTO, M., KWILIGWA, E.M., MKOMNWA, S. & MASSUNGA, M. 2000. Weed control by draft animals: experience in the South Highlands of Tanzania. In Starkey P and Simalenga T (eds), *Animal power for weed control*, p51-63. A resource book of the Animal Traction Network for Eastern and Southern Africa ,Wageningen The Nertherlands.

SIBANDA, H.1998. Sustainable Indigenous Knowledge Systems in Agriculture in Zimbabwe's Rural areas of Matabele and North and South Provinces. *World Bank IK Notes*. No.2. The World Bank, Washington, D.C.

SIMALENGA T.E, BELETE, B., MSELENI, N. & JONGISA L.L. 2000. Assessing the profitability of using animal traction under small holder farming conditions. *South African Journal of Agricultural Extension* 29: 1-9.

SOULE, J., CARRE, D. & JACKOSON, W. 1990. Ecological impact of modern agriculture. Ecological Impact of Morden Agriculture, McGraw-Hill.

TAYLOR, D. 2000. Local Agricultural Practice: Tradition, modernity and development in the context of low resource farming in South Africa. *Paper presented at the ASA conference School of Oriental & African Studies, London 2nd –5th April, Participating in development: Approaches to Indigenous Knowledge.*

ULLUWISHEWA, R., KALOKO, A.A. & MORICAN, D.H.M. 1997. Indigenous knowledge and sustainable living: Two case studies from Brunei. Ind*igenous Knowledge and Environmental Education*, p. 3-4. Paper presented at Environmental Education Workshop, University of Brunei, Darussalam.

VAN AVERBEKE, W. 2002. Indigenous technology and technology-oriented Research: Implications for research methodology. *AIAEE 2002 proceedings of the 18th Annual Conference held in Durban South Africa* Proceeding Series No. 452.

VAN DISSEL S.C. & DE GRAAFF, J. 1998. Differences between farmers and scientists in the perception of soil erosion: a South African case study. *Indigenous Knowledge and Development Monitor* 6: 8-9.

VAN REENEN, M.J. & MARAIS A. DE K. 1992. Farm management: Financial planning, analysis and control. JL van Schaik Publishers, Pretoria.

VERMEULEN, J.B., SWEET, S., KRAUSE, M., HOLLINGS, N. & NEL, A. 1990. A guide to the use of pesticides and fungicides in the Republic of South Africa. 4th ed. Department of Agriculture, RSA

WARREN, D.M. 1991. Using indigenous knowledge in agricultural development. *World Bank Discussion Papers*.No127. The World Bank, Washington, D.C.

WOLFE,M.L.,ROSS,B.B, DIEM, J.F.,DILLAHA, T.A & FLAHIVE, K.A. 2002.Protecting water quality: best management practice for row grown crops on plastic mulch in Viginia. Viginia Cooperative Extension, Virginia.
ZWEIFEL, H. 1997. Biodiversity and the appropriation of women's knowledge. *Indigenous Knowledge and Development Monitor* 5:1-32.

APPENDIXES

Appendix 1 Questionnaire

1. Profile of respondents
Questionnaire Number…………………………………………………………………
Respondent Number……………………………………………………………………
Date………………………………………………………………………………………
Ward No…………………………………………………………………………………
Administration Area……………………………………………………………………
Size of area used of planting

2. Land preparation

1 How is the land prepared before planting

Digging sticks	Hand hoe	Animal traction	Tractor hire	No preparations
1	2	3	4	5

2 How much does this technique cost to prepare land

No cost	Less than R100	R100 - R300	Above 300
1	2	3	4

3 How land is fertility maintained

Fallowing	Kraal manure	Fertilizer	Fertilizer Kraal Manure Fallowing	Nothing	Kraal manure Fallowing
1	2	3	4		5

4 Indicate how much you apply……………………………………………………

5 How much does this technique cost to fertilize you garden

Less than R50	R50 - R100	R100 – R500	Above R500
1	2	3	4

6 When do you apply fertilizer

Before planting	After Planting	During planting	no fertilizer applied
1	2	3	4

Planting

7 How land is planted

Spreading seed	Plant in rows	Use animal drawn planter	Tractor hire	Other
1	2	3	4	5

8 Which cropping system

Intercrop ping	Intracropping	Intercropping Intracropping	Monocropping
1	2	3	4

9 Which crops do you intracrop

Maize	Maize Beans	Maize Pumpkins	Maize Beans Pumpkin	
1	2	3	4	5

10 Which crops do you intercrop

Maize beans & pumpkins + potatoes	Maize	Maize	No intercropping
	Beans	potatoes	
1	2	3	4

11 How much does this technique cost to plant

No cost	Less than R100	R100 – R500	Above R500
1	2	3	4

12 At what time do you start to plant and why...

13 Indicate the yield that you get in each of these crops

Maize	Beans	Pumpkin	potatoes

Weeding

14 Which method do you use for weeding

Hand and hand hoe	hand hoe	hand	animal traction
1	2	3	4

If other method explain...

15 When do you start weeding after planting

1-3 weeks	3-5 weeks	5-8 weeks	after 8 weeks	no weeding
1	2	3	4	4

Pest control and disease

16 Who is responsible pest and disease control

Male	Female	Both
1	2	3

17 What is the age distribution of a person responsible for pest control

Less than 30	30 - 55	Above 55	All
1	2	3	4

18 Which technique do you ues

Indegenous	Both	combined
1	2	3

19 Indicate the type of pest that and how are controlled

Pest	Measure for control

20 Indicate the type of disease that and how are controlled

Crop disease	Measure for control

21 If there is no measure to control pest and disease indicate how crops survive...........

Seed selection

22 Maize

Seed selection Process	Period

1. INTRODUCTION

1.1 Problem statement

Most of the farmers have ignored indigenous methods and they have preferred conventional methods of farming. The introduction of conventional farming knowledge to African farmers was intended to increase production capacity, but this however disregarded the fact that most of African farmers do not have economic resources to engage in this western technology. Many African black farmers do not have access to credit facilities; hence they cannot afford production inputs or pay for operational costs. Conventional equipment is very expensive and needs huge capital investment.

Although indigenous knowledge is increasingly becoming popular it has not been widely integrated in research and development processes (Dawes 1993). Nothing or very little is done to encourage farmers to use indigenous farming practices (IFP) in their production. Government and development organizations have focused their investment on conventional farming practices (CFP) because there is a perception that IFP is an out dated practice and cannot be used commercially.

IFP includes using both indigenous technology and indigenous knowledge. The term indigenous knowledge is used to distinguish the knowledge developed by a given community from international knowledge systems or scientific knowledge (Warren 1991). Indigenous knowledge refers to the use of organic fertilizers such as animal manures (kraal manure) instead of industrial chemical fertilizer, minimum tillage instead of convectional tillage. A typical example of indigenous technology that is used by farmers is animal draft power (Animal Traction). Fitshugh & Wilhelm (1995) maintains that the use of animal draft power has been in existence since its discovery, and had been a main source of power in agriculture.

In this study the indigenous knowledge will be defined as local knowledge that is unique to a given culture or society. Indigenous farming practices will be intercropping, use of kraal manure pure or mixed with commercial fertiliser, use self made seed, unique planting methods and storage methods. The farmer who practices each of these practices will be defined as an indigenous farmer. This research seeks to study IFP used by farmers in the Umzimkulu area of the Eastern Cape Province. These include land preparation, seed selection, planting, cropping systems, soil care (fertility) practices, pest and weed control methods. Cost and benefits of using these methods will be compared with CFP.

1.2 Objectives

4) To document Indigenous Farming Practices (IFP) used in maize based Land Use systems in the Eastern Cape and assess the extent to which it is used.
5) To make profitability comparison between Indigenous Farming Practices (IFP) and Conventional Farming Practices (CFP) for maize based Land Use Systems in the study area.
6) To make recommendations for promoting IFP

1.3 Research hypothesis

Ho: There is no difference in profitability between Conventional Farming Practices (CFP) and Indigenous Farming Practices (IFP) for rural small-scale maize based Land Use Systems.

Ha: It is more profitable to use Indigenous Farming Practices (IFP) than to use Conventional Farming Practices (CFP) for rural small-scale maize based Land Use Systems.

1.4 Conceptual framework

In order to test the hypothesis stated above, a study was designed and carried out to determine and describe maize land use systems that rely on IFP and to make a comparison in profitability with CFP systems. A cost-benefit analysis based on the Margin above Specified Cost (MaSC) method developed by Van Reenen & Marias (1992) was used to compare the relative profitability of the two farming practices. The mathematical model for the calculation of the MaSC is explained later on in this section.

Margin above Specified Cost was used to calculate for profit made. Margin above Specified Cost as defined by Van Reenen & Marias (1992) is an analysis of estimated gross production value and specified costs that can be directly allocated to a production branch (crops or livestock) on a per unit basis (for example per hectare or per crop). The term margin above specified cost is preferred to gross margin because it represents the contribution of each individual production branch towards the redemption of the fixed cost, and the total none directly allocable variable cost and ultimately realisation of farm profit (Van Reenen & Marias 1992). Profits as defined by Barry *et al.* (1995) are gaps between the value of goods and services produced and the cost of resource used in their production.

The calculated MaSC values for IFP and CFP were compared in order to determine which one was more profitable than the other.

1.4.1 Data requirements and availability

Production potentials estimates of conventional maize land use systems based on scientific inference are well documented. However, data on IFP were not readily available as indigenous systems are neither exhaustively researched nor documented.

Data on IFP farming operations, their sequence and respective costs over the growing season including seed selection, land preparation, cropping system, planting, soil care and fertilising, weed and pest control as well as yield data per hectare had to be collected from primary sources by interviewing farmers in a pre-defined study area. Details of the sampling design and data collection materials and methods are described in the proceeding section.

Data on CFP farming operations, sequence and respective costs were obtained from the so-called COMBUD Enterprise Budgets of the KwaZulu-Natal Provincial Department of Agriculture. COMBUD data including prevailing market prices and allocatable variable costs are compiled for every growing season. Allocatable variable costs are those attributable to material input including fertilizer, lime and manure, weed and pest control, contract work (labour), crop insurance, energy, maintenance and harvest costs. An example of COMBUD gross margin model is provided in an enterprise budget in Appendix 5.

Potential yields per hectare data for CFP based land use systems including maize are also available in the KwaZulu-Natal Provincial Department of Agriculture and Environmental Affairs so-called Bio-Resource database in Geographic Information System (GIS) format. The Bio-Resource database (Version 6.012) provides baseline data regarding approximate yields for maize based land use systems attainable for defined production situations using CFP. The database provides units of homogeneous biophysical conditions including terrain, soils and climate referred to as the Bio-Resource Unit.

The Bio-Resource Unit (BRU) is defined by Camp (2003) as an ecological unit within which factors such as soil type, climate, altitude, terrain and vegetation display sufficient degree of homogeneity. The BRUs provide a good indication of potential yield for a range of crops, including maize. However, the custodians (KwaZulu-Natal Provincial Department of Agriculture and Environmental Affairs) of the BRU database recommend that for accurate production potentials, detailed soil surveys be carried out to ascertain soil characteristics including depth, type, clay content, drainage class and rockiness. The alternative to BRU yield estimates is to obtain actual CFP based yield data from interviewing a suitable sample of commercial farmers. Neither the detailed soil surveys nor commercial farmer interviews were feasible within the means of this educational research exercise for obtaining more reliable CFP yield data for the study area. It was therefore decided that for the purposes of this academic exercise, BRU potential yield estimates would be used as CFP baseline yield together with COMBUD data for the calculation of Margin above Specified Costs, bearing in mind the limitations advised.

A BRU is identified by code based on rainfall and altitude and a name. In the example WXc13 – Upper Bisi River, WXc13 is the Bio-Resource Unit and Upper Bisi River is the name. The uppercase letters in the code denote the annual rainfall range (WX) from 800 to 900 mm and the lower case letter (c) the altitude range from 900 to 1400m above sea level and the number 13 indicates that the BRU is the ninth occurrence. Coding (Tables 1 and 2) is used to explain the BRUs occurring in the study area of Umzimkulu. The first letter in upper case (Table 1) indicates the rainfall zone in which the BRU falls; a lower case letter indicating the physiographic zone in which it falls and which is an indication of temperature zone.

Table 1: Symbols and codes of the Bio-Resource Units

Rainfall description	
Symbol	Rainfall (mm)
R	< 600
S	601-650
T	651-700
U	701-750
V	751-800
W	801-850
X	851-900
Y	901-1100
Z	>1100

Altitude description		
Code	Name	Altitude range (m)
a	Coast	<450
b	Lowlands	451-900
c	Uplands	901-1400
d	Highlands	1401-1800
e	Montane	1801-2000
f	Escarpment	>2000

In each BRU contains subclasses referred to as soil ecotopes (Table 2) describing dominant soil characteristics in terms of soil form, texture, depth, wetness, slope and surface characteristics (e.g. rockiness).

Table 2 Ecotope definition coding as described in BRUs

Soils	
A	Humic soils
B	Well and moderately drained soils
C	Alluvial soils
D	Motteled and moderately drained soils
E	Motteled and poorly drained soils
F	Black (Margalitic) soils
G	Black (Margalitic) poorly drained soils
H	Young soils
I	Other poorly drained soils
J	Duplex soils
K	Organic soils and wetlands

Clay (percent)	
1	>35
2	5-15
3	<15

Depth (mm)	
1	>800
2	500-800
3	300-500
4	200-300

Slope (percent)	
f	<12
s	12-40
x	>40

Surface characteristics	
n	Not rocky
r	Rocky

An example of ecotope B.1.2.f.r would indicate well and moderately drained soils; clay >35 percent; depth 500-800mm; slope <12 percent and rocky surface.

1.4.2 Profitability comparison of indigenous farming practices against conventional faming practices

Margins above Specified Cost for IFP based maize land use systems were calculated using actual yield and cost of production data obtained from farmer interviews. Comparison values of Margin above Specified Cost were calculated for CFP based maize land use systems using Bio-Resource potential yield at 70 percent management factor and COMBUD variable cost data that were available for the 2003 – 2004 growing season. The BRU programme considers controlled research field management to be 100 percent while in a practical farming production situation; good management potential is considered to be 70 percent. Figure1 shows a flowchart describing the methodology for obtaining MaSC for the two farming practices for comparing profitability.

Profitability analysis: Indigenous Vs Conventional Farming Practices

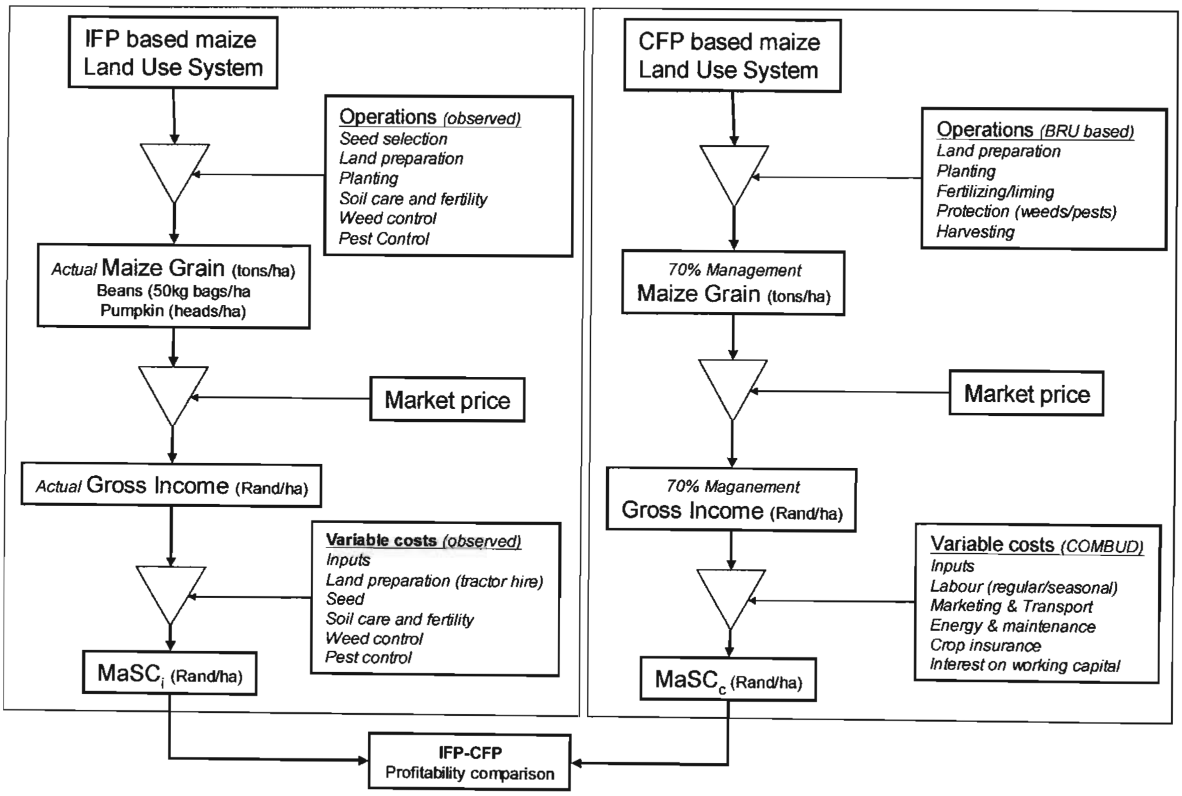


Figure 1 Flowchart showing a procedure for analyzing profitability for by comparing Margins above Specified Cost between Conventional farming Practices and Indigenous Farming Practices.

The following procedure describes the equations for obtaining differences between the actual IFP MaSC value and the potential yield using CFP.

<u>Margin above Specified Cost for Indigenous Farming Practices (IFP)</u>

$$MaSC_i = IFP_{ti} - IFP_{tc}$$

Equation 1

$$IFP_{ti} = \sum (M_i \times M_p) + (B_i \times B_p) + (P_i \times P_p)$$

$$IFP_{tc} = \sum (L_c + S_c + P_c + SS_c + DP_c + W_c)$$

Where,

$MaSC_i = Magin\ above\ Specified\ Cost\ for\ IFP$

$IFP_{ti} = Total\ Income\ for\ IFP\ based\ maize\ Land\ Use\ Systems$

$IFP_c = Observed\ Total\ Cost\ of\ IFP$

$M_i = Observed\ maize\ yield\ (tons / ha)$

$B_i = Observed\ bean\ yield\ (50kg\ bags / ha)$

$P_i = Observed\ pumpkin\ yield\ (heads / ha)$

$M_p = \Pr evailing\ maize\ \ price\ (Rand / ton)$

$B_p = Observed\ \ bean\ \ price\ \ (Rand / 50kg\ bag)$

$L_c = obesrved\ \cos t\ \ for\ land\ \ preparation$

$S_c = Observed\ \cos t\ \ for\ soil\ treatment$

$P_c = Observed\ \cos t\ \ for\ \ planting$

$SS_c = Observed\ \cos t\ \ for\ \ seed\ selection$

$DP_c = Observed\ \cos t\ \ for\ desease\ and\ \ pest\ control$

$W_c = Oserved\ \cos t\ \ for\ \ weeding$

<u>Potential Margin Above specified cost for Conventional Farming Practices (CFP)</u>

$$MaSC_c = CFP_{ti} - CFP_{tc}$$

Equation 2

$$CFP_{ti} = B_y \times M_p$$

Where,

$MaSC_c = Magin\ above\ Specified\ Cost\ for\ CFP$

$CFP_{ti} = Total\ Income\ for\ CFP\ based\ maize\ Land\ Use\ System$

$CFP_c = Total\ Cost\ of\ CFP\ from\ COMBUD (2003-2004)$

$B_y = 70\%\ maize\ yield\ (tons/ha)\ from\ BRU\ database$

$M_p = \Pr evailing\ maize\ price\ (Rand/ton)$

MaSC comparison between IFP and CFP

$$MaSC_{dff} = MaSC_i - MaSC_c$$

Equation 3

Where,

$MaSC_{dff} = Difference\ in\ Magin\ above\ Specified\ Cost\ between\ IFP\ and\ CFP$

2 DATA COLLECTION AND ANALYSIS

2.1 Study area and data sampling design

A study area was selected in the Umzimkulu Local Municipality in the District Municipality of Alfred Nzo of the Eastern Cape Province. The area is situated between longitude 29° 20' 2"E to 30° 10' 2"E and latitude 30° 60'0"S to 30° 30'0"S.

The study area was selected on the basis that farmers who practice indigenous farming existed in sufficiently large numbers for statistical analysis requirements of yield data. Personal knowledge and the information available at the Eastern Cape provincial agricultural offices suggest that most farmers in the Umzimkulu area practice indigenous farming.

A digital Bio-Resource Unit map of the study area (Figure 2) was used as a basis for stratification in the design of a sample scheme for collecting the required IFP data. An administrative area map was overlaid on Bio-Resource Units in order to identify homesteads and cultivated areas from which interview samples were drawn. One administrative area was randomly selected from each of seven Bio-Resource Units occurring in the Umzimkulu area. Table 3 and Figure 2 show the villages selected and the administrative wards and BRUs in which they fall.

Table 3 Selected villages for farmer interviews by administrative ward and BRU

BRU	BRU Name	Admin Ward	Village
Wc44	Glengarry	8	Ngcambele B
WXc13	Upper Bisi River	8	Phelanyeni
Ub28	Mahobe Mission	13	Ntlabeni
Vc33	The Fountains	13	Highlands
Vb31	Deepdale	13	Mahobe Mdeni
VWb8	Tembeni	17	Tembeni
UVb7	Umzimkulu	17	Strangers Rest A

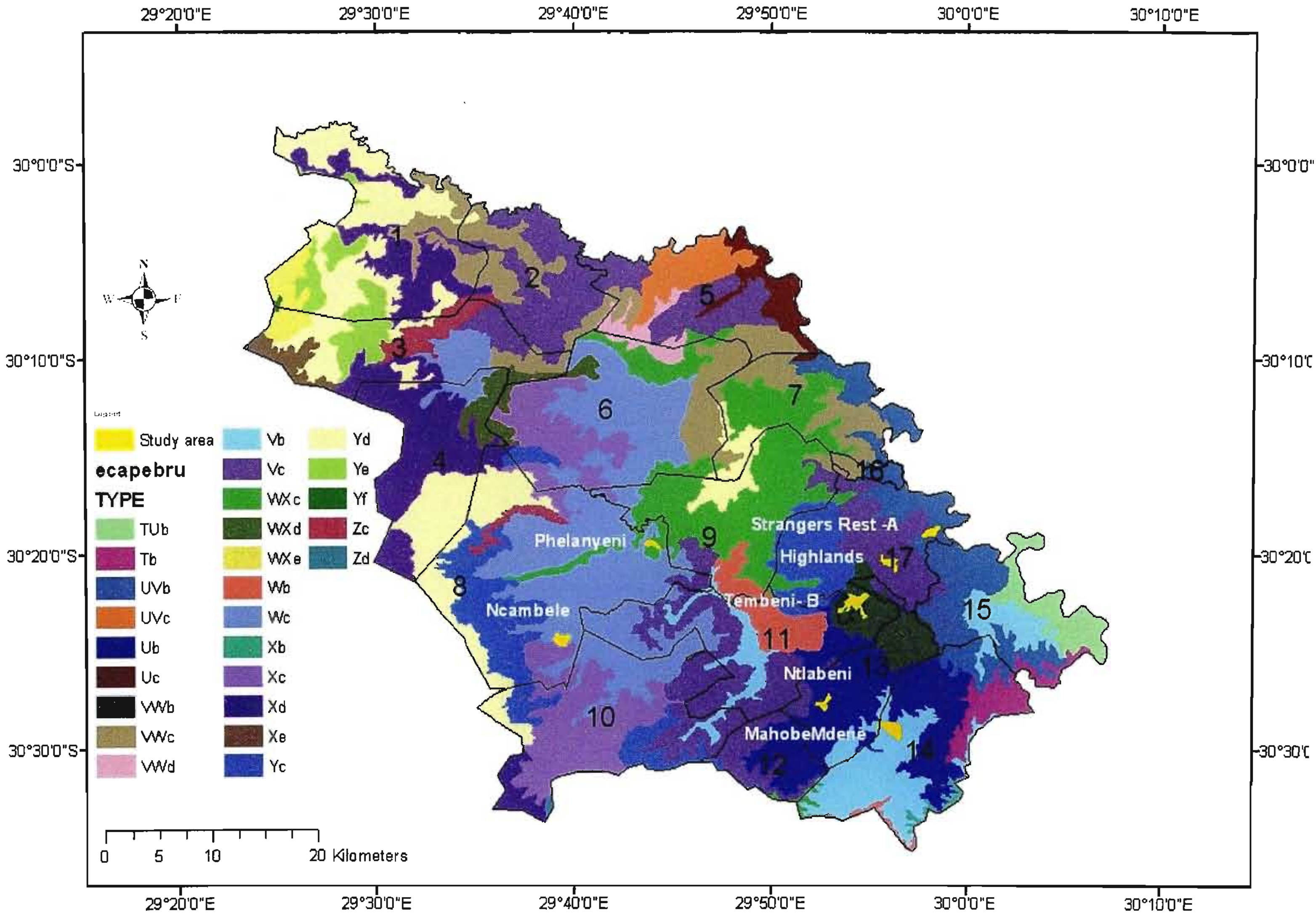


Figure 2 Map of Umzimkulu Municipality showing randomly selected administrative areas.

All homesteads using IFP were identified and listed in each administrative area selected to make up a sampling frame. A sample of 20 farmers from each Bio-Resource Unit was selected from the list using the simple random sampling method. Where the number of homesteads using indigenous farming practices was less than 20, all farmers were selected. A total of 132 farmers were interviewed.

2.2 Collection of indigenous farming practices data

A structured questionnaire (Appendix 1) was used to collect data from the selected homesteads. The randomly selected farmers were interviewed by the researcher using the structured questionnaire which aimed at obtaining data on indigenous production practices regarding to land preparation, planting, soil fertility, cropping system, plant pest control and seed selection and associated variable costs as well as yields obtained for the growing season 2003-2004. All data were collected from each homestead per unit area on a hectare basis. Prior to interviewing the farmer, the areas of the plots harvested were measured. Most farmers in the study area practised intercropping and therefore, multiple crops were often harvested from a single plot. Yield data were recorded as reported by farmers in the units in which they collect their harvests: maize in kg of grain, beans in 50kg bags and pumpkin in number of heads.

Poate & Daplyn (1993) discuss criticisms against this method which include arguments that farmers tend to distort their responses either to under-report actual output for tax evasion and other fears or tend to inflate their performance to qualify for credit and other favourable treatment. Critics also allege that farmers may not know their output sufficiently accurately. Response to the criticisms counter that concealment can also be possible in other techniques such as crop-cutting which is thought to be the preferred objective method and that it is highly unlikely that a farmer does not accurately know the quantity of the harvest that is usually key for survival for another year. Poate & Daplyn (1993) suggest that if harvesting techniques practised permit the farmer estimates of output method, the latter should be considered as a valid, cost-effective and simple approach for local and regional production or for total farm family output. Other established methods such as crop cutting, whole plot harvest, sample harvest and market records tend to be comparatively more complex and expensive while they are at the same time prone to the similar levels of bias.

2.3 Collection of conventional farming practices data

As mentioned in the previous sections, yield data at 70 percent management factor for CFP was obtained from KwaZulu-Natal Bio-Resource programme. It was assumed that CFP farmers would run operations at a 70 percent management factor. Total cost of production and prevailing maize grain price were obtained from COMBUD document for the 2003-2004 growing season as shown in appendix 5.

2.4 Data analysis

Primary IFP data were coded and entered to SPSS (Statistical Package for Social Survey) in order to explore distributions, trends and relationships between them. The so-called dummy variables were created whereby categorical variables with more than two levels are allocated numerical codes. Observed yield data were displayed in a histogram and P-P plot and a test performed for normal distribution using the non-parametric One-Sample Kolmogorov-Smirnov. Conventional parametric statistical analysis requires the dependent variable to have a normal distribution. Transformation of the independent variable is usually required before parametric analysis may proceed. However, non-parametric analysis methods have been developed so that analysis may be performed on non-normally distributed data. Both approaches were used in this analysis as appropriate.

Relationships between the sequential operations over the growing season and IFP maize yield as the output of the main land use and were explored using box-plots. Observed variable costs associated to the farming operations were aggregated to make up the total cost. Yields were converted into monetary equivalents by applying the prevailing market price, from which the total cost was subtracted to obtain the $MaSC_i$ value according to equation 1.

$MaSC_i$ value was calculated for each respondent farmer. Similarly, CFP Margin above Specified Cost ($MaSC_c$) was calculated for each BRU according to Equation 2. As mentioned in the previous section, 20 randomly selected interviews were conducted in each BRU, except for Vb which had only 12 respondents. For each BRU, differences between IFP and CFP Margins above Specified Cost were calculated to obtain $MaSC_{diff}$ values according to Equation 3.

3 RESULTS

3.1 Data exploration and descriptive statistics

3.1.1 Indigenous farming yield data

As mentioned in the previous chapter, yield data collected from IFP farmer interviews were tested for normality in SPSS statistical software. The Kolmogorov-Simirnov 2-tail normality test revealed non-normality ($P=0.028$, $\alpha=0.05$); a mean = 2615; standard deviation = 1487; N = 132. A histogram plot of the data showed a right-skewness that may be attributable to unequal access to resources and a P-P plot showed that most of the data did not fall on a straight line. A square root data transformation was performed on the IFP yield data resulting in a normal distribution ($P=0.25$, $\alpha=0.05$); mean 49; standard deviation 14; N = 132. The histograms (Figure 3 and 4) and P-P plots (Figure 5 and 6), display original and transformed yield data side by side for comparison.

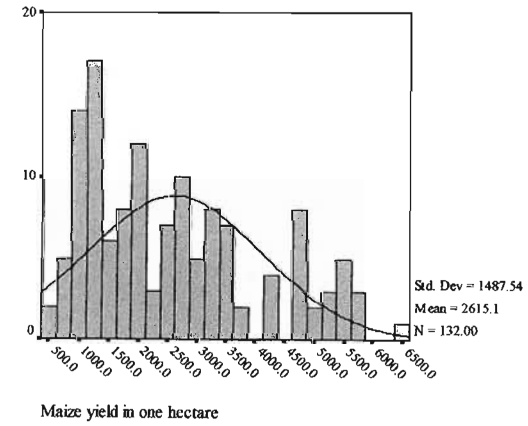


Figure. 3 Histogram for actual yield.

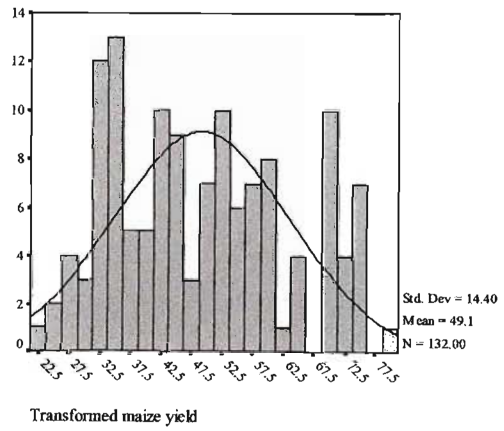


Figure. 4 Histogram distribution for transformed IFP yield.

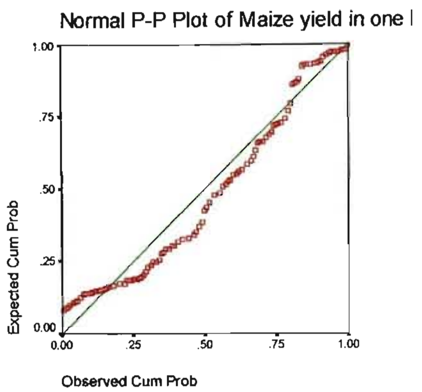


Figure. 5 Normal probability plot for actual maize yield.

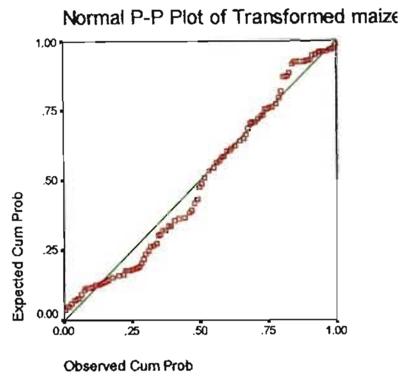


Figure. 6 Transformed probability plot.

2.2 Relationship between individual indigenous farming practice and maize yield

3.2.1 Land preparation

There is a significant difference between these three methods of land preparation in relation to maize yield production (P=0.004) with animal traction associated with highest yield (Figure 7) and this conform to the findings of Simalenga, Belete, Mseleni & Jongisa (2000). This also could be attributed to the fact that tractor equipment has a negative impact on the environment as it results to soil degradation as some implements can lead to soil being pulverised into fine tilth (Fowler 1999).

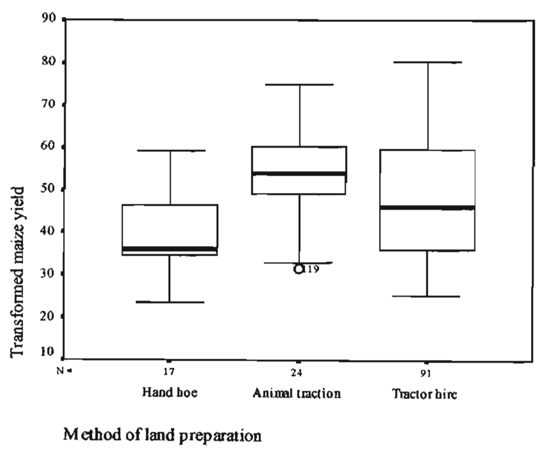


Figure 7: Relationship between transformed maize yields and methods of land preparation.

Although animal traction is associated with highest yield, tractor hire is used by many people, the reason behind this according to Bobobee (1999) is that many people do not own cattle. This could also be seen as results of westernization which has resulted in many young people viewing indigenous knowledge as obsolete and out dated compared to western cultural practices (Sibanda 1998). Van Averbeke (2002) regards the practice of using digging sticks as a practice which was practised since time immemorial, but no respondent was found using this practice.

3.2.2 Soil care and fertility

The results show that the maize yield is significantly different between soil treatment methods (P=0.000) The number of respondents mixing fertilizer with kraal manure are the largest distribution (Figure 8), this was also note by Silwana (2000). The use of fertilizer (Figure 8) is associated with high yield. The yield for people using kraal manure is lower than those using fertiliser only because it contain nutrients needed by plants in a desired proportion (Van Averbeke & Yoganathan 2003).

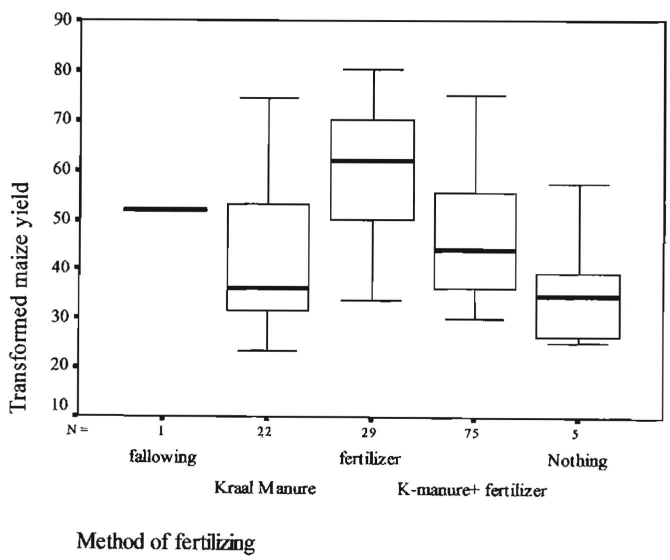


Figure 8: Relationship between transformed maize yield and methods of fertilizing.

Kraal manure is applied in rows using animal drawn planter, this was noted by Mkile (2001) or manually using hand hoe. The rate of application of fertilizer ranges from 5 bags to 10 bags of fertilizer (50kg) per hectare. Application of kraal manure ranges from 10 bags to 15 bags (50kg) per hectare depending on the availability of it. Kraal manure is applied in rows using animal drawn planter or manually using hand hoe. All respondents apply it during planting. The mixture of fertilizer and kraal manure is 1:2 ratio based on mass.

3.2.3 Method of planting

The maize yield is not significantly different between planting methods (P=0.562).
The median (Figure 9) is around 50kg/ha. Planting in rows using hands occupies largest distribution as it has biggest interquartile. A very small number of people use tractor to plant. It is only those people who have tractors who plant with them.

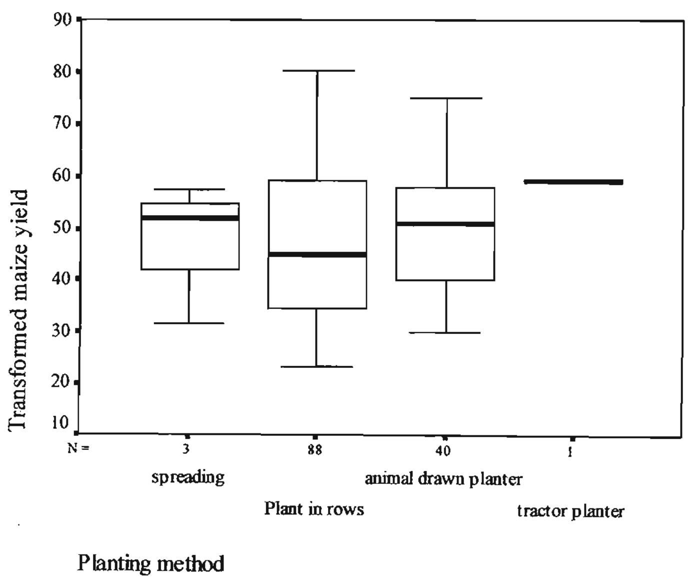


Figure 9: Relationship between transformed maize yield and planting method.

These results agree with Simalenga et al (2000) who found that the use animal traction by small scale farmers in Eastern Cape was profitable than the use of tractor. This was based on the fact that the yield that you get when using animal traction is the same as the one that you get when using tractor, but the cost of the former is lower.

3.2.4 Cropping system

Maize yield is significantly different between cropping systems (P=0.003). Intra-cropping has the largest distribution of number of respondents that use it as a practice, it has also a largest distribution of number of people getting high yield, this is in agreement with what was highlighted by Bembridge (1991) and Rajasekaran (1993) that polyculture is still widely used in Eastern Cape despite the fact that it was not recommended by extension officers

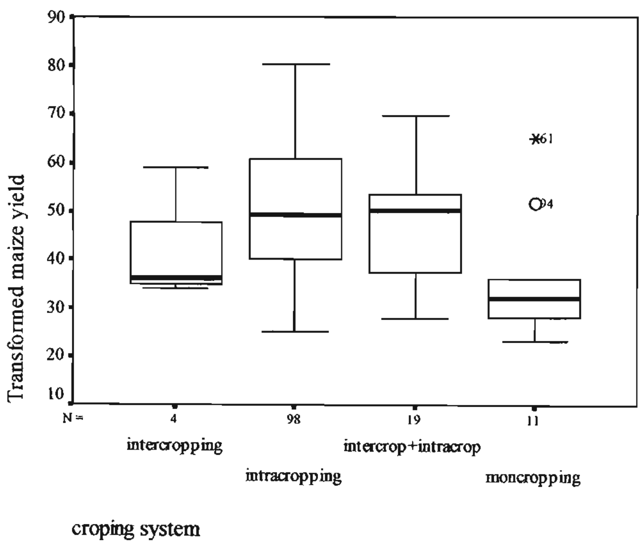
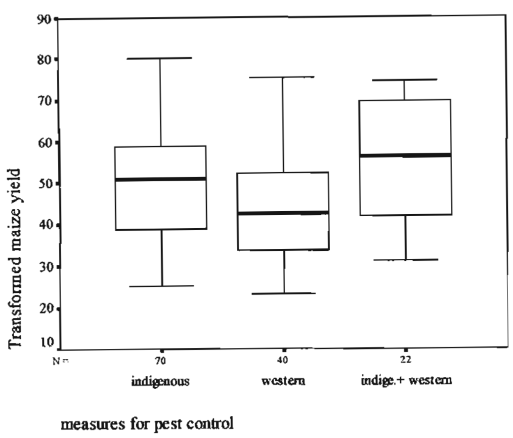


Figure 10: Relationship between transformed maize yield and cropping systems.

Monocroping is associated with the lowest yield (Figure 10), explanation for this could be that the farmer do not use proper pesticides. Continued cropping in the same plot can increase insects and disease problem, and the presence of other crops can be seen as measure to escape pest and diseases (Bajwa & Schaefers 1998).

3.3.5 Plant pest measure

There is no significant difference between measures for plant pest control in relation to maize yield (P=0.019). The practise that has largest distribution in relation to maize yield is combining indigenous practices and conventional practices (Figure 11). Combining indigenous practices and conventional practices is associated with highest yield, this is agreement with advice given by Bembridge (1991) who suggested that innovators should have knowledge of the characteristics of rural farming populations so that new innovation can be diffused and adopted by farmers.



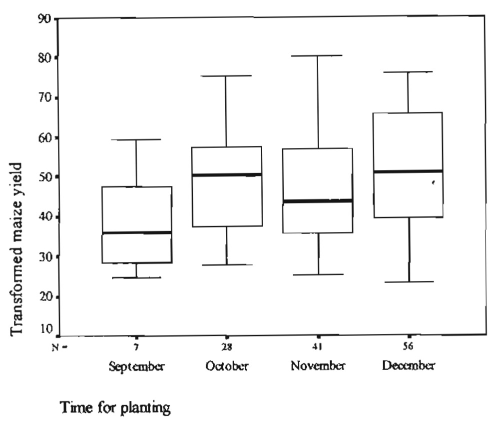


Figure 11: Relationship between transformed maize yield and measure for pest control.
Figure 12: relation ship between transformed maize yield and time for planting.

The distribution of people using indigenous methods of controlling pest is largest than those who are using purely pesticides (Figure 11). This behaviour was also observed by Prakash (2002) that when new knowledge is introduced it is adopted in large numbers, but as the time pass by farmers gradually revert to their indigenous practices.

Early planting is used as a tactic for crop protection in several situations (Figure 12). This was also noted in East Africa by Bajwa & Schaefers (1998) The largest interquartile range is in December which implies that most of respondents prefer to plant later. The respondents who get the highest yield are those who plant in November.

Most respondents indicated that the indigenous method they use to control pest is to plant more seeds than actually needed to cater for the amount that will be consumed by fowl, snails and wild birds, or to cater for unexpected climatic conditions. This practice is also prevalent in India (Bandyopadhyay & Saha 1988).

3.2.6 Seed selection

There is significant difference between seed selection method in relation to maize yield (P=0.000) Isiswenya has the larges distribution of number of people that use it and has a largest distribution in term of farmers getting high yield (Figure 13).Isiswenya is a traditional prepared seed, selected and dried using indigenous technique. Maize cobs are dried under a fireplace for a period of three months, tips are removed and strong and big grains are selected as seed. Isiswenya a traditional seed is the most prevalent method of seed selection, this confirms findings of Rosenblum, Jaffe & Scheerens (2001) that farmer preferred to use local seed on their crop land in Lesotho. It also confirms findings of Bembridge (1991) that in Transkei replacement of indigenous seed with genetically improved seed has not been adapted fully well by African farmers as less than half of farmers were effectively implementing the practices of improved seeds.

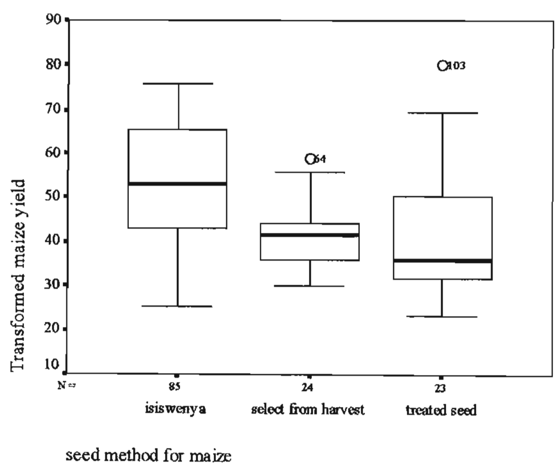
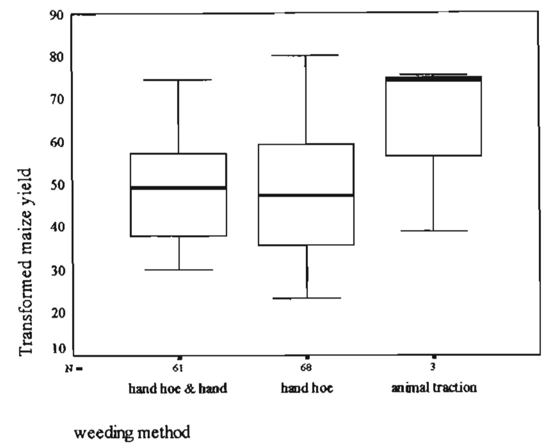


Figure 13: Relationship between transformed maize yield and methods for seed selection.

The practice of selecting from harvest appears to be unpopular. A substantial number of people (23 of 132) are using treated seed, this could be result of the influence of agricultural researchers and technicians (Barrett 2000) who have great influence on farmers.

3.2.7 Weeding method



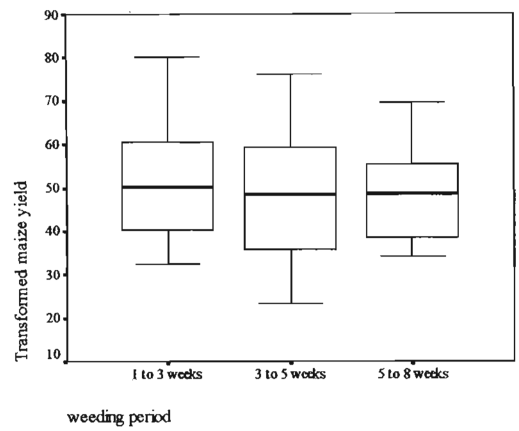


Figure 14: Relationship between transformed maize yield and weeding method.
Figure 15: Relationship between transformed maize yield and weeding period.

There is significant relationship between maize yield and weeding method P= 0.000. Weeding using animal traction is associated with highest yield. Hand hoeing has the largest distribution and this could be attributed to the fact that labour can be paid in kind (Shetto, Kwiligwa, Mkonwa & Massunga 2000). Superficial hoeing is encouraged by Reijntjies, Haverkot & Waters-Bayer (1992) because it leaves dead weed material on the soil surface as proactive mulch to recycle nutrients and prevent weed re-growth by blocking the essential light as already mentioned earlier . Weeding period does not have significant relationship with maize yield as P=0.805. The largest distribution of people (Figure 15) does weeding between 3 to 5 weeks after planting. The weeding period is determined by type of the encroaching weed.

3.2.8 Bio-resource unit

There is significant relationship between Bio-Resource Units in relation to maize yield (P=000). This reason for this significant difference is that biophysical condition such as terrain, soils and climate in each BRU is homogenous and differ accordingly with other BRUs

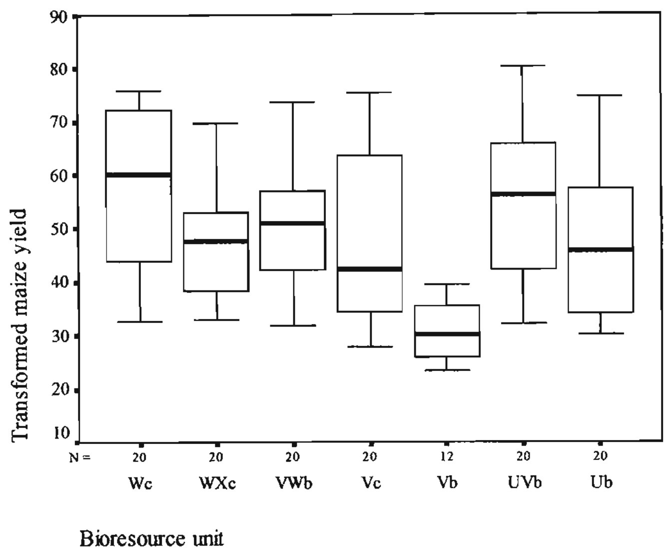


Figure 16: Relationship between transformed maize yield and Bio-Resource Unit.

Environmental factors like climate, vegetation, soil type and terrain have major influence on the yield of maize. The Bio-Resource Unit with a lowest maize yield is Vb33 (Figure16). The maize yield potential in BRU Vb33 is generally low its 2800. The reason behind this is that this BRU has ecotopes which are rocky, naturally not suitable for maize production.

3.3 Profitability comparison of indigenous farming practices and conventional farming practices

A detailed presentation of the calculated Margin above Specified Cost figures by BRU is presented in Appendix 3. Comparison in profitability between the CFP and IFP methods was analysed by calculating the average MaSC for each farming practice by BRU and then subtracting them to obtain the average differences (Figure 1).

As mentioned earlier in the previous chapter, data were obtained from random samples of 20 farmers that use IFP selected from each BRU, except in Vb in which only 12 farmers practised IFP. Since the BRU sample was relatively small with respect to conventional statistical analysis requirements, it became necessary to ascertain that the observed average differences in MaSC were not significantly different from the 'true' or population averages. *(Proof to the contrary would mean that the obtained average difference would not be a valid representation of the real situation.)* This was achieved by comparing the observed average differences with proxy population of average differences simulated using a bootstrap resampling procedure.

Bootstrap resampling is an established procedure for randomly replicating a given sample to create a proxy population from which the sample was derived The bootstrap resampling methodology is described to some detail by Efron and Tibshirani (1993); Burt and Barber (1996); Blank et al (1999); in Rugege (2002) and by Davison & Hinkley (1997).

Results of the calculation process for $MaSC_{avd}$ (Margin above Specified Cost average difference)by BRU is provided in Appendix 3. A summary of observed average differences in Margin above Specified Cost denoted by $MaSC_{avd}$ by BRU and their respective resampled proxy population average differences are displayed in Table 4. In the resampling procedure 10000 samples of $MaSC_{avd}$ were generated with replacement at 95 percent confidence level or significance level $\alpha = 0.05$.

Table 4 Summary of profitability analysis by BRU

BRU	$MaSC_i$	$MaSC_c$	$MaSC_{avd}$	Resampled $MaSC_{avd}$ ($\alpha = 0.05$)	Achieved level of significance P-value
Wc44	3453	1699	1754	1333	0.4828
WXc13	2837	1287	1550	1578	0.5103
VWb8	2718	699	2019	1979	0.5126
Vc33	2555	1081	1474	1511	0.5078
Vb31	63	-1494	1557	1454	0.5021
UVb7	2572	1287	1285	1247	0.5043
Ub28	3286	669	2617	2251	0.4941

Results (Table 4) show that the average differences between the CFP and IFP MaSC calculated from observed data are very close to those calculated from the proxy population generated using the bootstrap resampling procedure. All observed cases showed p-values well above the set 0.05 level of significance (Table 4). Appendix 4 shows histogram distributions of resampled $MaSC_{avd}$ values indicating the position of the observed $MaSC_{avd}$ within the proxy population and the 95 percent confidence limits. All the histogram distributions (Appendix 4) indicate that none of the observed $MaSC_{avd}$ were significantly different from the population mean. In all BRUs average $MaSC_{avd}$ is above 1285 in favour of IFP.

Although CFP maize yields in kg/ha are significantly higher than those of IFP (Table 5), CFP production costs are also much higher. The income derived from the intercropped and intra-cropped beans and pumpkins makes a significantly increase total IFP income. It is important also to note that the income of beans and pumpkins is not so high as it would have been if CFP was used. The cost of production when using IFP is cheaper when compared to using conventional method as most of indigenous inputs like kraal manure, seeds, and indigenous pesticides are readily available at little or no cost. Ploughing is paid in kind (provision of home brewed beer made out of traditional fermented malt to neighbours) if one does not have livestock to use as animal drawn power.

Table 5: Summary for maize yield analysis

BRU	Avg IFP Yield (kg/ha)	CFP Yield (kg/ha)	Avg Diff in Yield (kg/ha)
Wc44	3593	5900	2306
WXc13	2263	5500	3236
VWb8	2263	4900	2637
Vc33	2547	5300	2753
Vb31	965	2800	1834
UVb7	3116	5500	2383
Ub28	2496	4900	2403

3.4 Discussion

Profitability is measured in terms of MaSC which is the difference between cost of production and income derived from production. It is not measured in terms of yield per hectare or potential of production system. CFP systems produce high yield per hectare as compared to IFP systems, but this high yield is obtained at a high cost. Cost of production in IFP is very low, because of cheaper and readily available inputs such as kraal manure, traditional prepared seed, use of animal draft power. CFP encourages monoculture which limits income to one enterprise while IFP promotes intercropping and intra-cropping which result in more income derived from one hectare. Indigenous practices by small scale farmers in Umzimkulu are more profitable in comparison with farmers using conventional farming practices as has been shown my higher MaSC levels realised by IFP systems.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

5.1.1 Indigenous farming practices used in Umzimkulu

This research has shown that digging using sticks has vanished as it is no longer practised in South Africa. Animal traction is still being used by people who own livestock and those who are close to them. The majority of people use tractor to prepare their land, not because it is cheap but because it is readily available. The people who are using animal traction have the highest yield.

The findings of the research indicate that the largest distribution of people still use hand hoes to plant in rows and some use animal traction to plant. There is no significant relationship between planting methods in relation to maize yield. Hand hoeing is also common practice in Umzimkulu.

Shifting cultivation is no longer done as people are settled in their communities. A very small number of people are still fallowing 1 out of 132 people was practising fallowing. There is a significant number of people who are using kraal manure. The practise of mixing kraal manure and commercial fertilizer is still prevalent in many BRUs and is associated with highest yields. A very small number of people apply nothing to fertilize their soil.

A large number of people are intercropping and intra-cropping while some combine these practices. A small number of people practise monocropping. The people who use indigenous methods in controlling crop pests is still large. Some people because of financial constraints mix indigenous methods and conventional methods of preventing crop pests. Indigenous seed Isiswenya is the most prevalent seed selection. Although treated seed is still used, many people prefer to use isiswenya.

5.1.2 Profitability

This study has shown that IFP is more profitable than CFP for small scale maize farmers. Although profitability differs according to BRU, in all cases $MaSC_i$ was greater than $MaSC_c$. This can be attributed to production costs of IFP which are very low while income per hectare is high. The reverse is true for CFP. For example the cost of operating a tractor and that of operating an animal drawn planter differs significantly. Furthermore, some of the inputs like kraal manure are available at no cost. The seed is prepared from previous harvest. The reason for high income is that intercropping and intra-cropping result in more than one enterprise, deriving income for one hectare.

5.2 Recommendation

IFP should be integrated to research and development. Innovations should be based on what people are doing and should suite their way of life. Research should focus on improving the current indigenous practices.

Further research on IFP needs to be done in order to document all the information for future references and also to change the perception of researchers, scientist and extension officers on indigenous farming practices.

References

BAJWA, W.I. & SCHAEFERS, G. 1998. Indigenous Crop Practices in Sub-Saharan East Africa. Consortium for International Crop protection, USA.

BANDYOPADHYAY, A.K. & SAHA G.S. 1998. Indigenous methods of seed selection and preservation on the Andaman Islands in India. *Indigenous Knowledge and Development Monitor* 6: 3-6.

BARRETT, C. B. 2000. The challenge of improved natural resource management practices adoption in African agriculture: A social science perspective. *Paper prepared for the workshop on Understanding Adoption Processes for Natural Resource Management Practices for Sustainable Agricultural Production in Sub-Saharan Africa,* Nairobi, Kenya, July 3-5.

BARRY, P.J.,ELLINGER,P.N., HOPKIN, J.A. & BAKER, C.B. 1995. Financial management in agriculture. Interestate, Danville.

BEMBRIDGE, T.J. 1991. Technology transfer in Small-Scale Dryland Crop Production: Future Challenges. *Development Southern Africa* 8:479-493.

BOBOBEE, E.Y.H. 1999. Role of draft animal power in Ghanaian Agriculture, University of Science and Technology Kumasi, Ghana.

CAMP, K. 2003. Guide to use of the Bio-Resource Programme. Cedara Report No N/A/99/11, Natural Resource section – Technology development and training, Cedara, 1-34.

DAVISON, A.C. & HINKLEY, D.V. 1997. Bootstrap methods and their application. Cambs, London.

DAWES, W. 1993. Introduction in Traditional knowledge and sustainable development. *In*: S.H. Davis and K. Ebbe (eds), *Proceedings of a Conference held at The World Bank Washington D.C in Sept. 27 - 28.* p.3 Environmentally Sustainable Development Proceeding Series No. 4.

FITSHUGH, H. & A.E. WILHELM. 1995. Value and uses of indigenous livestock breeds in developing nations. *In*: M.L Oldfield and J.B. Alcorn (eds), *Biodiversity: culture, conservation and eco-development,* p.102-116. Michigan University Press, Michigan

FOWLER, R. 1999. Conservation tillage research and development in South Africa. *In* Kaumbutho PG and Simalenga TE (eds), *Animal power for weed control*, p51-63. A resource book of the Animal Traction Network for Eastern and Southern Africa Tantesa,Wageningen.

MKILE, Z. 2001. The use and agronomic effectiveness of kraal manures in the Transkei region of the Eastern Cape, South Africa. M Sc dissertation, University of Fort Hare, Alice.

POATE, C.D. & DAPLYN, P.F. 1993. Data for Agrarian Development. Cambridge University Press.

PRAKASH, S. 2002. Using Indigenous Knowledge to Raise Agricultural Productivity. *World Bank IK Notes*. No.45 The World Bank, Washington, D.C.

RAJASEKARAN, B. 1993. Indigenous technical practices in a rice-based farming system. Center for Indigenous Knowledge for Agriculture and Rural Development, Ames.

REIJNTJES, C., B. HAVERKORT, & A. WATERS-BAYER. 1992. Farming for the future: An introduction to low-external input and sustainable agriculture. Macmillan, London.

ROSENBLUM, M.L., JAFFE, L. & SCHEERENS, J.C. 2001. Setting up farmers' research agendas in Lesotho. *Indigenous Knowledge and Development Monitor* 9: 3-7

RUGEGE, D. 2002. Regional analysis of maize-based land use systems for early warning application. Doctoral Thesis, Wageningen University, The Nertherlands.

SHETTO, M., KWILIGWA, E.M., MKOMNWA, S. & MASSUNGA, M. 2000. Weed control by draft animals: experience in the South Highlands of Tanzania. In Starkey P and Simalenga T (eds), *Animal power for weed control*, p51-63. A resource book of the Animal Traction Network for Eastern and Southern Africa ,Wageningen The Nertherlands.

SIBANDA, H.1998. Sustainable Indigenous Knowledge Systems in Agriculture in Zimbabwe's Rural areas of Matabele and North and South Provinces. *World Bank IK Notes*. No.2. The World Bank, Washington, D.C.

SILWANA, T.T. 2000.The performance of maize/bean and maize/pumpkin intercrops under different planting combinations and weeding in Transkei, Sout Africa. M Sc dissertation, University of Fort Hare, Alice.

SIMALENGA T.E, BELETE, B., MSELENI, N. & JONGISA L.L. 2000. Assessing the profitability of using animal traction under small holder farming conditions. *South African Journal of Agricultural Extension* 29: 1-9.

VAN AVERBEKE, W. 2002. Indigenous technology and technology-oriented Research: Implications for research methodology. *AIAEE 2002 proceedings of the 18th Annual Conference held in Durban South Africa* Proceeding Series No. 452.

VAN AVERBEKE, W. & YOGANATHAN, S. 2003. Using kraal manure as fertilizer. Department of Agriculture, Republic of South Africa.

VAN REENEN, M.J. & MARAIS A. DE K. 1992. Farm management: Financial planning, analysis and control. JL van Schaik Publishers, Pretoria.

WARREN, D.M. 1991. Using indigenous knowledge in agricultural development. *World Bank Discussion Papers*. No 127. The World Bank, Washington, D.C.

Appendix 1: Questionnaire

1. Profile of Respondent

Questionnaire Code/ID……………………………………………………………………

Date……………………………………………………………………………………

Ward No…………………………………………………………………………………

Administration Area………………………………………………………………………

Size of area of planted

2. Land preparation

1 How is the land prepared before planting

Digging sticks	Hand hoe	Animal traction	Tractor hire	No preparations
1	2	3	4	5

2 How much does this technique cost to prepare land

No cost	Less than R100	R100 - R300	Above 300
1	2	3	4

3 How land is fertility maintained

Fallowing	Kraal manure	Fertilizer	Fertilizer Kraal Manure Fallowing	Nothing	Kraal manure Fallowing
1	2	3	4		5

4 Indicate how much you apply……………………………………………………………

5 How much does this technique cost to fertilize you garden

Less than R50	R50 - R100	R100 – R500	Above R500
1	2	3	4

6 When do you apply fertilizer

Before planting	After Planting	During planting	no fertilizer applied
1	2	3	4

Planting

7 How land is planted

Spreading seed	Plant in rows	Use animal drawn planter	Tractor hire	Other
1	2	3	4	5

8 Which cropping system

Intercrop ping	Intracropping	Intercropping Intracropping	Monocropping
1	2	3	4

9 Which crops do you intracrop

Maize	Maize Beans	Maize Pumpkins	Maize Beans Pumpkin	
1	2	3	4	5

10 Which crops do you intercrop

Maize beans & pumpkins + potatoes	Maize	Maize	No intercropping
	Beans	potatoes	
1	2	3	4

11 How much does this technique cost to plant

No cost	Less than R100	R100 – R500	Above R500
1	2	3	4

12 At what time do you start to plant and why……………………………………………

13 Indicate the yield that you get in each of these crops

Maize	Beans	Pumpkin	potatoes

Weeding

14 Which method do you use for weeding

Hand and hand hoe	hand hoe	hand	animal traction
1	2	3	4

If other method explain…………………………………………………………………

15 When do you start weeding after planting

1-3 weeks	3-5 weeks	5-8 weeks	after 8 weeks	no weeding
1	2	3	4	4

Pest control and disease

16 Who is responsible pest and disease control

Male	Female	Both
1	2	3

17 What is the age distribution of a person responsible for pest control

Less than 30	30 - 55	Above 55	All
1	2	3	4

18 Which technique do you ues

Indegenous	Both	combined
1	2	3

19 Indicate the type of pest that and how are controlled

Pest	Measure for control

20 Indicate the type of disease that and how are controlled

Crop disease	Measure for control

21 If there is no measure to control pest and disease indicate how crops survive…………

Seed Selection

22 Maize

Seed selection Process	Period

Appendix 2: Codebook

Code	Label	Value label
biores	Bio-Resource Unit	1= Wc
		2 =WXc
		3=VWb
		4=Vc
		5=Vb
		6=Uvb
		7=Ub
landmthd	Method for land preparation	1= digging sticks
		2= hand hoe
		3=animal traction
		4=tarctor
		5=no preparation
landcost	Cost of land preparation	1= no cost
soilmthd	Method of soil treatment	1= fallowing
		2=kraal manure
		3=fertilizer
		4= kraal manure and fertilizer
		5=nothing
		6=fallowing and kraal manure
soilcost	Cost of soil treatment	1= no cost
soiltime	Time for soil teatment	1= before planting
		2= after planting
		3= during planting
		4= no treatment
plantmtd	Method of planting	1= spreading
		2= plant in rows
		3= animal drawn planter
		4= tractor
		5= other
plantcro	Cropping system	1= intercropping
		2= intracropping
		3= intercropping and intracropping
		4= monocropping
plantntr	Crops intracropped	1= maize only
		2= maize and beans
		3= maize and pumkins
		4= maize, beans and pumkins
		5= other
plantnte	Crops intercropped	1= maize beans with pumkins
		2= maize with beans
		3= maize with potatoes
		4= no intercropping
plantcos	Cost of planting	1= no cost

plantime	Planting time	1= August
		2=September
		3= October
		4= Novemebr
		5= December
maizeyld	Maize yield in one hectare	Yield expressed in killograms
beanyiel	Yield of beans in one hectare	Yield expressed in killograms
pumkinyl	Pumpkin yield in one hectare	Yield expressed in heads
potayild	Potato yield in one hectare	Yield expressed in killograms
weedmeth	Weeding method	1= hand hoe & hand
		2= hand hoe
		3= hand
		4= animal traction
weedperd	Weeding period	1= 1 - 3 weeks
		2= 3 - 5 weeks
		3= 5 - 8 weeks
		4= after 8 weeks
		5= no weeding
pestmeas	Measure for pest control	1= indigenous
		2=western
		3= both
seedmaiz	Seed selection method for maize	1= isiswenya
		2= select from harvest
		3= buy treated maize seed
seedbean	Seed selection method for bean	1= select from harvest
		2= buy seed
		999= not planted
seedpump	Seed selection method for pumpkin	1= taste
		2=colour
		3= size
seedpot	seed selection method for potatoes	1= indigenous
		2= buy seed
trnmaize	Transformed maize yield	
trnsbean	Tranformed beans yield	
trnspmp	Transformed pumpkin yield	
transpot	Transformed potato yield	

Appendix3 : Margin above Specified Cost calculation

(All prices are expressed in South African Rand and have been rounded into rands)

Margin above Specified Cost calculation for IFP in BRU Wc44

Respondent no (N)	Observed Maize Yield (Kg/ha) (M_i)	Prevailing Marketing Price/kg (M_p)	Observed Bean yield (50kg/ha) (B_i)	Prevailing marketing price/50kg (B_p)	Observed pumpkin yield (head/ha) (P_i)	Prevailing marketing price/head (M_p)	Total Income IFP/ha (IFP_{ti})	Total Cost for IFP/ha (IFP_{tc})	Margin Above Specified Cost for IFP/ha ($MaSC_i$)
1	5176		1		168		5447	2166	3281
2	5285		0		420		5556	1445	4111
3	2938		0		1034		3209	570	2639
4	1793		3		0		2064	1133	931
5	3524		4		0		3795	1514	2281
6	4831		4		816		5102	1927	3175
7	3700		2		430		3971	825	3146
8	1276		4		0		1547	890	657
9	2000		6		240		2271	1067	1204
10	1724	1	5	270	178	1	1995	1088	907
11	5482		1		225		5753	1338	4415
12	5772		0		416		6043	1455	4588
13	2528		4		1153		2799	1064	1735
14	1057		1		280		1328	1017	311
15	5510		1		264		5781	1528	4253
16	5682		0		483		5953	1495	4458
17	1949		2		1801		2220	1445	775
18	1906		3		728		2177	1064	1113
19	4918		1		182		5189	1334	3855
20	4826		0		292		5097	1064	4033

Margin above Specified Cost for Conventional Farming Practices (CFP)

BRU	BRU Potential Yield (Kg/ha) (B_y)	Prevailing marketing price/kg M_p	BRU Income/ha (CFP_{ti})	Total cost of production obtained from COMBUD/ha (CFP_{tc})	Margin above Specified Cost for CFP/ha ($MaSC_c$)
Wc44	5900	1	6077	4378	1699

DATA AND CLULCULATIONS FOR BRU WXc13

Margin above Specified Cost Indigenous Farming Practices (IFP)

Respondent no (N)	Observed Maize Yield (Kg/ha) (M_i)	Prevailing Marketing Price/kg (M_p)	Observed Bean yield (50kg/ha) (B_i)	Prevailing marketing price/50kg (B_p)	Observed pumpkin yield (head/ha) (P_i)	Prevailing marketing price/head (M_p)	Total Income IFP/ha (IFP_{ti})	Total Cost for IFP/ha (IFP_{tc})	Margin Above Specified Cost for IFP/ha ($MaSC_i$)
1	2860	1	0	270	0	1	3131	850	2281
2	1500		0		0		1771	892	879
3	2938		0		1026		3209	1162	2047
4	1435		7		2375		1706	1195	511
5	2723		7		1401		2994	1276	1718
6	1932		7		0		2203	1064	1139
7	1212		0		424		1483	876	607
8	1591		4		1774		1862	1751	111
9	1208		7		0		1479	1064	415
10	1082		0		1166		1353	1064	289
11	1208		8		1176		1479	1770	-291
12	2801		8		0		3072	1064	2008
13	2528		0		280		2799	1064	1735
14	2114		8		0		2385	1064	1321
15	2787		0		0		3058	1064	1994
16	2564		0		1324		2835	1434	1401
17	2437		7		728		2708	1443	1265
18	1906		7				2177	1064	1113
19	3580		0		824		3851	1064	2787
20	4870		11		0		5141	2041	3100

Margin above Specified Cost for Conventional Farming Practices (CFP)

BRU	BRU Potential Yield (Kg/ha) (B_y)	Prevailing marketing price/kg M_p	BRU Income/ha ($CFPti$)	Total cost of production obtained from COMBUD/ha ($CFPt_c$)	Margin above Specified Cost for CFP/ha ($MaSC_c$)
WXc13	5500	1	5665	4378	1287

DATA AND CLULCULATIONS FOR BRU VWb8

Margin above Specified Cost Indigenous Farming Practices (IFP)

Respondent no (N)	Observed Maize Yield (Kg/ha) (M_i)	Prevailing Marketing Price/kg (M_p)	Observed Bean yield (50kg/ha) (B_i)	Prevailing marketing price/50kg (B_p)	Observed pumpkin yield (head/ha) (P_i)	Prevailing marketing price/head (M_p)	Total Income IFP/ha (IFP_{ti})	Total Cost for IFP/ha (IFP_{tc})	Margin Above Specified Cost for IFP/ha ($MaSC_i$)
1	2860	1	1	270	1740	1	3131	1339	1792
2	4941		2		0		5212	1740	3472
3	2938		4		1666		3209	1560	1649
4	1793		4		1500		2064	1339	725
5	3524		2		0		3795	1339	2456
6	3367		2		0		3638	1339	2299
7	1603		5		0		1874	1339	535
8	1060		5		0		1331	1339	-8
9	2364		1		0		2635	1339	1296
10	5411		5		1604		5682	2977	2705
11	3289		2		0		3560	1339	2221
12	3224		5		0		3495	1339	2156
13	1011		4		0		1282	844	438
14	2643		1		1567		2914	1339	1575
15	2787		1		0		3058	1339	1719
16	2564		6		0		2835	1339	1496
17	2437		8		1688		2708	1876	832
18	1906		7		0		2177	1339	838
19	1790		1		0		2061	879	1182
20	1748		2		0		2019	1339	680

Margin above Specified Cost for Conventional Farming Practices (CFP)

BRU	BRU Potential Yield (Kg/ha) (B_y)	Prevailing marketing price/kg M_p	BRU Income/ha ($CFPt_i$)	Total cost of production obtained from COMBUD/ha ($CFPt_c$)	Margin above Specified Cost for CFP/ha ($MaSC_c$)
VWb8	4900	1	5047	4378	669

DATA AND CLULCULATIONS FOR BRU Vc33

Margin above Specified Cost Indigenous Farming Practices (IFP)

Respondent no (N)	Observed Maize Yield (Kg/ha) (M_i)	Prevailing Marketing Price/kg (M_p)	Observed Bean yield (50kg/ha) (B_i)	Prevailing marketing price/50kg (B_p)	Observed pumpkin yield (head/ha) (P_i)	Prevailing marketing price/head (M_p)	Total Income IFP/ha (IFP_{ti})	Total Cost for IFP/ha (IFP_{tc})	Margin Above Specified Cost for IFP/ha ($MaSC_i$)
1	4228		0		1779		4499	1453	3046
2	1333		0		1565		1604	1339	265
3	3840		6		0		4111	1339	2772
4	3484		5		0		3755	1665	2090
5	4276		0		1004		4547	1339	3208
6	4831		0		1775		5102	2007	3095
7	2528		5		1553		2799	1949	850
8	1374		5		0		1645	1339	306
9	1208		7		0		1479	1339	140
10	2976	1	0	270	56	1	3247	1339	1908
11	1287		4		88		1558	1339	219
12	1603		1		10		1874	1339	535
13	5653		0		0		5924	1723	4201
14	1057		1		1565		1328	1339	-11
15	970		0		1779		1241	1339	-98
16	774		3		620		1045	1339	-294
17	1949		0		1334		2220	1339	881
18	1163		4		434		1434	1339	95
19	896		6		710		1167	1339	-172
20	5510		2		0		5781	1339	4442

Margin above Specified Cost for Conventional Farming Practices (CFP)

BRU	BRU Potential Yield (Kg/ha) (B_y)	Prevailing marketing price/kg M_p	BRU Income/ha (CFP_{ti})	Total cost of production obtained from COMBUD/ha (CFP_{tc})	Margin above Specified Cost for CFP/ha ($MaSC_c$)
	5300	1	5459	4378	1081

DATA AND CLULCULATIONS FOR BRU VB31

Margin above Specified Cost Indigenous Farming Practices (IFP)

Respondent no (N)	Observed Maize Yield (Kg/ha) (M_i)	Prevailing Marketing Price/kg (M_p)	Observed Bean yield (50kg/ha) (B_i)	Prevailing marketing price/50kg (B_p)	Observed pumpkin yield (head/ha) (P_i)	Prevailing marketing price/head (M_p)	Total Income IFP/ha (IFP_{ti})	Total Cost for IFP/ha (IFP_{tc})	Margin Above Specified Cost for IFP/ha ($MaSC_i$)
1	617	1	0	270	0	1	888	922	-34
2	1111		0		0		1382	1007	375
3	701		1		0		972	922	50
4	791		0		88		1062	1223	-161
5	545		0		0		816	922	-106
6	635		1		0		906	922	-16
7	1318		0		0		1589	947	642
8	1008		0		50		1279	922	357
9	1208		0		0		1479	1007	472
10	820		0		0		1091	922	169
11	1287		0		0		1558	922	636
12	1543		0		0		1814	1223	591

Margin above Specified Cost for Conventional Farming Practices (CFP)

BRU	BRU Potential Yield (Kg/ha) (B_y)	Prevailing marketing price/kg M_p	BRU Income/ha (CFP_{ti})	Total cost of production obtained from COMBUD/ha (CFP_{tc})	Margin above Specified Cost for CFP/ha ($MaSC_c$)
Vb	2800	1	2884	4378	-1494

DATA AND CLULCULATIONS FOR BRU UVb7
Margin above Specified Cost Indigenous Farming Practices (IFP

Respondent no (N)	Observed Maize Yield (Kg/ha) (M_i)	Prevailing Marketing Price/kg (M_p)	Observed Bean yield (50kg/ha) (B_i)	Prevailing marketing price/50kg (B_p)	Observed pumpkin yield (head/ha) (P_i)	Prevailing marketing price/head (M_p)	Total Income IFP/ha (IFP_{ti})	Total Cost for IFP/ha (IFP_{tc})	Margin Above Specified Cost for IFP/ha ($MaSC_i$)
1	1029		0		0		1300	1027	273
2	2667		0		0		2938	1466	1472
3	3506		5		0		3777	1466	2311
4	2319		0		0		2590	1339	1251
5	1634		0		0		1905	1339	566
6	3472		0		0		3743	1339	2404
7	3033		0		3472		3304	2554	750
8	1299		0		1033		1570	1339	231
9	4831		0		1299		5102	1553	3549
10	4237	1	0	270	1831	1	4508	2765	1743
11	6435		10		0		6706	2765	3941
12	4728		0		0		4999	1339	3660
13	2165		0		0		2436	1221	1215
14	5285		0		0		5556	1339	4217
15	4364		0		1285		4635	1486	3149
16	1282		0		2364		1553	1339	214
17	1949		0		1282		2220	1339	881
18	3241		3		1949		3512	2443	1069
19	3580		0		0		3851	1339	2512
20	1279		0		0		1550	1339	211

Margin above Specified Cost for Conventional Farming Practices (CFP)

BRU	BRU Potential Yield (Kg/ha) (B_y)	Prevailing marketing price/kg M_p	BRU Income/ha (CFP_{ti})	Total cost of production obtained from COMBUD/ha (CFP_{tc})	Margin above Specified Cost for CFP/ha ($MaSC_c$)
Uvb7	5500	1	5665	4378	1287

DATA AND CLULCULATIONS FOR BRU Ub28

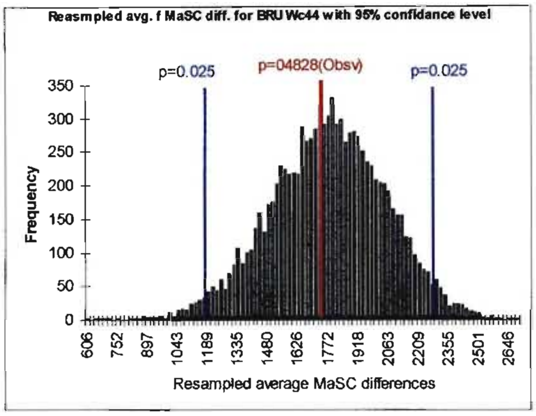
Margin above Specified Cost Indigenous Farming Practices (IFP

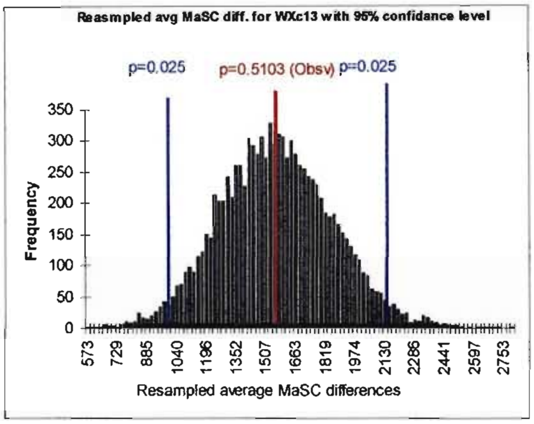
Respondent no (N)	Observed Maize Yield (Kg/ha) (M_i)	Prevailing Marketing Price/kg (M_p)	Observed Bean yield (50kg/ha) (B_i)	Prevailing marketing price/50kg (B_p)	Observed pumpkin yield (head/ha) (P_i)	Prevailing marketing price/head (M_p)	Total Income IFP/ha (IFP_{ti})	Total Cost for IFP/ha (IFP_{tc})	Margin Above Specified Cost for IFP/ha ($MaSC_i$)
1	1163		14		0		1434	1221	213
2	896		14		0		1167	1553	-386
3	2834		2		1024		3105	1339	1766
4	2710		2		1055		2981	1339	1642
5	3289		10		0		3560	1339	2221
6	4821		4		800		5092	2443	2649
7	1001		4		0		1272	1339	-67
8	1848		4		813		2119	1339	780
9	1136		6		0		1407	1339	68
10	1089	1	11	270	828	1	1360	1339	21
11	1838		15		0		2109	1445	664
12	1122		5		0		1393	1339	54
13	3342		5		833		3613	1339	2274
14	2114		14		0		2385	1445	940
15	2033		15		636		2304	1339	965
16	3230		4		0		3501	1339	2162
17	1949		4		704		2220	1432	788
18	3125		8		0		3396	1339	2057
19	5550		6		0		5821	2443	3378
20	4836		6		0		5107	1887	3220

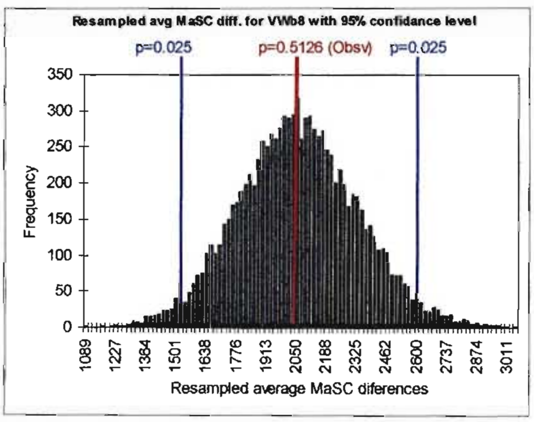
Margin above Specified Cost for Conventional Farming Practices (CFP)

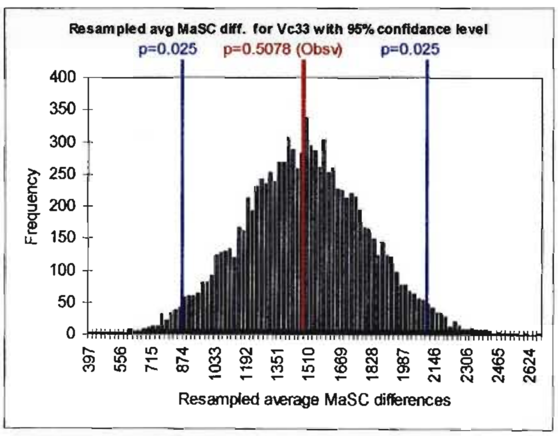
BRU	BRU Potential Yield (Kg/ha) (B_y)	Prevailing marketing price/kg M_p	BRU Income/ha (CFP_{ti})	Total cost of production obtained from COMBUD/ha ($CFPt_c$)	Margin above Specified Cost for CFP/ha ($MaSC_c$)
Ub28	4900	1	5047	4378	669

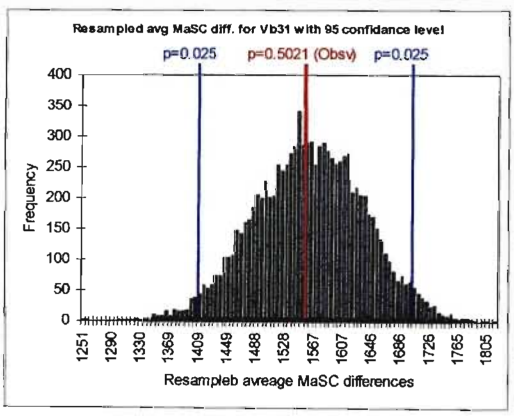
Appendix 4: Histogram distributions of resampled average MaSC differences

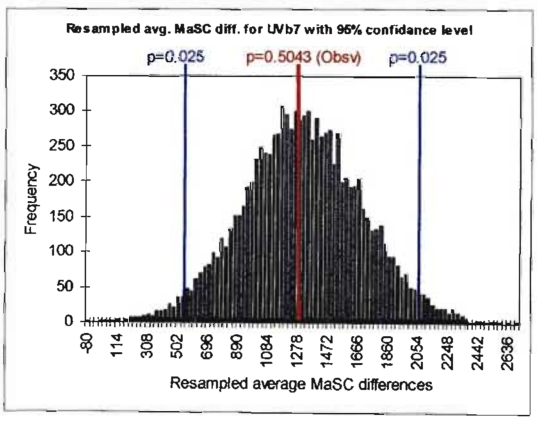


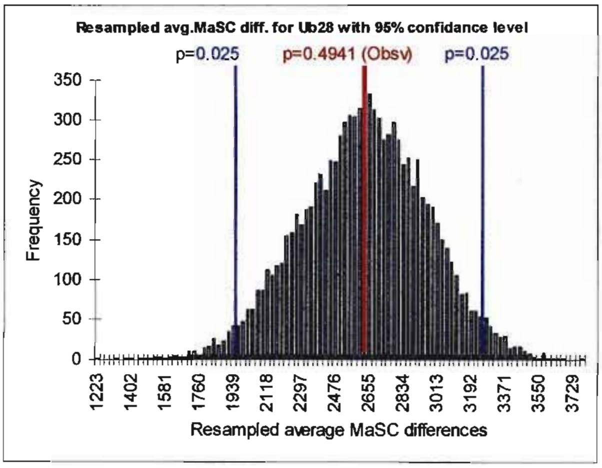












Resampled avg.MaSC diff. for Ub28 with 95% confidance level
p=0.025
p=0.4941 (Obsv)
p=0.025
350
300
250
200
150
100
50
0
Frequency
1223
1402
1581
1760
1939
2118
2297
2476
2655
2834
3013
3192
3371
3550
3729
Resampled average MaSC differences

Appendix 5:Maize Enterprise budget from COMBUD 2003/2004

GROSS MARGIN

	Unit	Price Per Unit	Qty	Per Ha	Value Per Land Unit
GROSS INCOME				[illegible]	[illegible]
Gross Income (Crop)					
Grain					
Maize	Ton	1100.00	5.00	[illegible]	[illegible]
MARKETING COSTS				0.00	0.00
GROSS INCOME minus MARKETING COSTS				[illegible]	[illegible]
ALLOCATABLE VARIABLE COSTS				3858.25	771.65
Directly Allocatable Variable Costs				[illegible]	[illegible]
PRE HARVEST COST				2934.19	586.84
Plant material					
Seed - Grain					
Maize seed	Kilogram	26.00	20.00	[illegible]	[illegible]
Fertiliser					
Granular fertilisers					
KCl	Ton	2190.00	0.15	[illegible]	[illegible]
LAN 28%	Ton	1905.00	0.16	[illegible]	[illegible]
MAP(33)	Ton	[illegible]	0.15	[illegible]	[illegible]
Lime & Manure					
Dolomitic lime	Ton	[illegible]	[illegible]	[illegible]	[illegible]
Weed control					
Chemicals					
Atrazine 500	Litre	27.85	4.00	111.40	[illegible]
[illegible]	Litre	52.45	4.00	[illegible]	[illegible]
Pest control					
Chemicals					
[illegible]	Litre	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Litre	195.94	[illegible]	[illegible]	[illegible]
Fungicide control					
Chemicals					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Contract work					
[illegible]					
Hire	Hectare	[illegible]	1.00	[illegible]	[illegible]
[illegible]					
[illegible]					
[illegible]	Ton	50.00	5.00	[illegible]	[illegible]
HARVEST COSTS				575.00	[illegible]
Contract work					
Harvest					
Harvest	Hectare	300.00	1.00	[illegible]	[illegible]

GROSS MARGIN

Enterprise budget　　　　　　　　　　　　　　　　　　　　　　　　Page 16

Budget no　001 / 002 / 001 / 003 / 0010　　　　　　　　Date Modified 13/11/2003

Maize　　AGRONOMY　　　　　　　　　　　　Dryland

Country South Africa　　　　　　　　　　Land Type BRG 3

Province KwaZulu/Natal　　　　　　　　Farming Area Bio-resource group 3.4

Status T　　　　　　　　　　　　　　　Farming Unit

Usage S

Clay loam

	Unit	Price Per Unit	Qty	Per Ha	Value Per Yield Unit
Marketing cost					
Transport					
Transport	Ton	47.00	5.00	235.00	47.00
MARGIN ABOVE DIRECTLY ALLOCATABLE VARIABLE COSTS				2030.81	406.16
Indirectly Allocatable Variable Costs				389.05	77.81
PRE HARVEST COST				389.05	77.81
Energy				188.33	37.67
Repairs and Maintenance				200.72	40.14
HARVEST COSTS				0.00	0.00
TOTAL PRE HARVEST COSTS				3323.25	664.65
TOTAL HARVEST COSTS				535.00	107.00
GROSS MARGIN ABOVE TOTAL ALLOCATABLE VARIABLE COSTS				1641.75	328.35
Interest on Working Capital (14.000%)				274.83	54.97
Regular Labour Costs				247.14	49.43
MARGIN ABOVE SPECIFIED COSTS				1119.78	223.96

R2_1　　Compiler G S Muller　　Province KwaZulu/Natal　　Compilation Date 25/07/1997　　12/12/200

COMPONENT B

COMPONENT B

Performance of indigenous farming practices: A case study of maize land use types in Umzimkulu area, Eastern Cape

Abstract

A case study was conducted in 7 Bio-Resource Units in Umzimkulu area in Eastern Cape to examine the profitability of indigenous farming practices. This was achieved by comparing Margin above Specified Cost of indigenous farming practices with conventional farming practices. The farming practices were examined in the following categories: land preparation, planting, soil care and fertility, cropping systems, seed selection and plant pest measure. In all categories mentioned above there was significant relationship between farming practices and maize yield ($P<0.005$) except for method of planting and plant pest control. The practices that have shown highest yield are animal traction (land preparation), use of fertilizer (soil care and fertility), intracropping (cropping practices) mixing indigenous and conventional (plant pest measure). In all Bio-Resource Units the observed average difference in margin above specified cost was greater that R1,285,00 in favour of indigenous farming practices. All observed cases showed p-values well above the set 0.05 level of significance indicating that none were significantly different from the population mean.

TABLE OF CONTENTS OF COMPONENT B

LIST OF TABLES

LIST OF FIGURES