PRODUCTION AND COMMERCIALISATION POTENTIAL OF INDIGENOUS LEAFY VEGETABLES: CASE STUDY OF CAPRICORN DISTRICT IN THE LIMPOPO PROVINCE, SOUTH AFRICA

by

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Dedication

I dedicate this thesis to my family and Khanyisile Nkuna.

Declaration

I declare that the mini-dissertation hereby submitted to the University of Limpopo, for the degree of Masters of Science in Agricultural Economics has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution, and that all material contained herein has been duly acknowledged.

Mahlangu S.A (Mr.)

……..... .....

Surname, initials (title) **Date**

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"UZimu usese yiKosi"

Sandile Mahlangu, 2011

Abstract

There are few plant species commercialised significantly globally and food requirements are mainly met by only few species. However, there is an enormous number of under-utilised species that play a vital role in the livelihood of rural households. These species are referred to as indigenous crops. Indigenous crops are adaptable to local agro-ecological conditions even where there is unreliable rainfall, which is the case in many parts of the country, require a minimum production management, mature early, and are easy to harvest and preserve and require less capital investments. Despite all these, in South Africa indigenous leafy vegetables (ILVs) were not commercialised and most researchers did not pay much attention to do research on possibilities of commercialising these crops. Thus this study investigated the economic potential of commercialising indigenous leafy vegetables in the rural South African context in general and in the study area in particular.

The objectives of the study were (1) to identify the socio-economic characteristics of ILVs producers in rural areas of Capricorn district, (2), to investigate constraints faced by farmers in commercialising ILVs in rural areas of Capricorn district, (3), to determine the productivity of indigenous leafy vegetables in rural areas of Capricorn district, and (4), to assess different types of marketing channels of ILVs in rural areas of Capricorn district. The study used Stochastic Frontier Production Function to determine the productivity and to assess the socio-economic characteristics of producers of Indigenous Leafy Vegetables. Bubble chart was used to assess the marketing channels whilst consumer data was captured into a statistical package.

The results indicated that there are several significant socio-economic factors that affect ILV production and there are also factors which constraint farmers from commercialising ILVs. Productivity of ILVs in the study area varied a lot among farmers; some farmers had a high productivity but most farmers had a low productivity. The results indicated that out of the factors included in the analysis significant production factors were; amount of labour used, cost of hiring tractor service and land devoted to ILVs and inefficiency factors were; gender, age, household size, farming experience, farm size,

hired labour, primary occupation and land ownership. ILV farmers had no formal marketing channels; they sold their product direct to consumers or through hawkers.

Therefore, the study recommends the integration of science/modern technology and indigenous knowledge, to improve the productivity of ILVs. Since farmers were not technically efficient, therefore it is important to run workshops that will help them improve their production and marketing skills and how to market their products. Or create booklets that have information on how to efficiently produce ILVs. There should also be awareness campaign on the benefit of ILVs in both rural and urban communities. The study also recommends a multi-disciplinary approach in developing the crop; more stakeholders should be involved so as to make the crop appealing. Finally the study recommends the commercialisation of these crops due to the fact that they have the potential and are demanded in most parts of South Africa.

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List of abbreviations and acronyms

DoA	Department of Agriculture
DWA	Department of Water Affairs
FOA	Food and Agriculture Organisation
ILV	Indigenous Leafy Vegetables
MLE	Maximum Likelihood Estimates
M.Sc.	Master of Science
MS	Microsoft
OLS	Ordinary Least square
SPSS	Statistical Package for the Social Sciences
TE	Technical Efficiency
UL	University of Limpopo
UNISA	University of South Africa

CHAPTER ONE: INTRODUCTION AND BACKGROUND

1.1 Introduction

There are few plant species commercialised significantly globally and food requirements are mainly met by only few species. However, there is an enormous number of under-utilised species that play a vital role in the livelihood of rural households. These species are referred to as indigenous crops. Indigenous leafy vegetables are defined as plant species which are either genuinely native to a particular region, or which were introduced to that region for long enough to have evolved through natural processes or farmer selection (Van Rensburg *et al.*, 2007). Indigenous leafy vegetables (ILVs) are commonly produced and consumed by African rural people, and these crops form part of their daily diet. These leafy vegetables are obtained in different ways, they may be harvested from the wild or from cultivated fields where they grow as volunteer crops, or they may be cultivated. Women are main role players in the production, harvesting and processing of indigenous leafy vegetables.

In Africa indigenous leafy vegetables production, trade and consumption are expanding (Schippers, 2002; 2006). In sub-Saharan Africa it is estimated that, there are more than 45,000 species of indigenous plants of which about 1000 can be consumed as leafy vegetables (MacCalla, 1994). The size of ILV markets in sub-Saharan Africa is substantial, and recently conservation of these crops has been a concern in the whole African continent. The problem with many rural African communities is the lack of infrastructure and institutions to be used for the implementation and sustainable production of these crops.

South Africa has a three prone agricultural economy, well-developed commercial farming, emerging farming and subsistence farming in the remote areas. Primary agriculture is critical to the country's rural population; it utilizes the largest portion of the land and thus forms the pillar of the rural economy. Smallholder subsistence farming provides a livelihood to more than 1 million farming households and to another 500 000 occasional workers (DoA, 2005). But most of these farmers are not part of the mainstream agriculture and hence they are not financially profiting from their farming.

Indigenous leafy vegetables have long been in South Africa and mostly consumed by rural people and form part of their staple food. ILVs in the country are mostly produced in rural areas for household consumption with little surplus that reach the informal market in some cases through middle men. Some of these vegetables are cultivated and others are volunteer crops that are readily available. Different communities grow different species mostly for family consumption but there are those who sell their surplus in the informal markets for income generation. However, the production and marketing activities of ILVs are small in scale and mostly produced by resource-poor households.

ILVs are adaptable to local agro-ecological conditions even where there is unreliable rainfall, which is the case in many parts of the country, require a minimum production management, mature early, and are easy to harvest and preserve and require less capital investments. These crops allow most households to produce food, since they require fewer inputs. But the use of less adapted exotic crops has led to a disappearance of some of ILVs species; this is a concern, because it can lead to permanent loss of these species. Exotic vegetable species cannot be grown under the harsh climatic and resource-poor conditions encountered in many rural areas (Van den Heever, 1997).

However, indigenous vegetables are abundant only during rainy seasons, when they are found growing in the wild, often on fallow land, or as weeds in cultivated areas. During the dry seasons, they are scarce or available only in limited amounts as processed dried products. ILVs can be consumed both fresh and in their processed form, thus make them important for food security in many rural households, as they can be available even in dry season. The introduction of exotic vegetables has also led to less production and consumption of these vegetables, especially among young people and people perceive these crops as poor man food.

ILVs are grown under traditional farming system; this is an indigenous practice of cultivating land, while managing natural resources in order to produce nutritious and continual food supply without external contribution but using self-reliance and locally available resources. The World Bank in 2008 stated that transformation of subsistence

agriculture to commercial agriculture is an essential tool towards economic growth and development for many agriculture dependent developing countries. The new generation of rural farmers cannot commercially compete with traditional agriculture; they have to investigate new and alternative crops to become competitive (Reinten, 2002). Global food crisis, economic crisis, and the global warming have raised the importance of strengthening the self-reliance (producing enough food of our own) as the country through diversity.

The study focused on three prominent ILVs in the rural areas of Limpopo, and these are cowpea (*Vigna unguiculata*), amaranth (*Amaranthus cruentu*) and spider flower (*Cleome gynandra*). These crops have other roles other than being used as a relish or supplement to relish; they suppress weeds, build soil fertility, prevent erosion and are used as forage. The inclusion of these crops to the mainstream market will bring the dietary diversity to consumers and improve income of smallholder farmers, and might be the part of the solution to the country's food insecurity problem. With the sky rocketing level of unemployment in South Africa and food insecurity there is a need to diversify. Proper cultivation will improve processing, storage and commercialisation of these species, may lead to bigger markets in cities and towns (Otto, 1979)

1.2 Research problem

In South Africa indigenous leafy vegetables (ILVs) were not commercialised and most researchers did not pay much attention to do research on possibilities of commercialising ILVs despite their several values such as high micronutrient content, medicinal properties, several agronomic advantages (Venter *et al.,* 2004; Kimiywe *et al.* 2007). These vegetables often seem to grow easily, resist pests and diseases, and have acceptable taste. To date most of ILVs are still collected in the wild, with few under cultivation for household consumption. Farmers have limited information on ILVs commercialisation potential, agronomic practices, postharvest handling, that assure availability of food all year round. Communities are also not aware of all the nutritional and health benefits that ILVs can provide. According to (Gockowski *et al.* 2003 and Madisa *et al.* 1997) studies from other countries (e.g. Botswana, Cameroon, Nigeria etc.) show that commercialisation of ILVs provide vulnerable citizens food security and

are used as the source of household income, since they are the ones who are active in the production of these products. Thus, this study investigated the economic potential of commercialising indigenous leafy vegetables in the rural South African context in general and in the study area in particular.

1.3 Motivation of the study

There are lots of agricultural experiments that have been done throughout the continent and they indicate that indigenous leafy vegetables (ILVs) have economic potential and can help with rural development (Schippers, 2000; Abukutsa-Onyango, 2003). There is also an assumption that there is a market for ILVs, so it is essential to investigate the economic potential of commercialising indigenous leafy vegetables. The information generated will be useful to policy makers and farmers since it will outline the commercial potential of indigenous leafy vegetables. Policy makers will be able to develop policies that improve the potential production of indigenous leafy vegetables. The study will also provide other production and marketing system to help the transformation from subsistence to commercial production of indigenous leafy vegetables in Limpopo.

1.4 Aim and objectives of the study

1.4.1 The aim of the study

The aim of the study was to analyse the production and commercialisation potential of indigenous leafy vegetables in the Capricorn district of Limpopo Province of South Africa.

1.4.2 Research objectives

The objectives of the study were to:

i. Identify the socio-economic characteristics of ILVs producers in rural areas of Capricorn district.
ii. Investigate constraints faced by farmers in commercialising ILVs in rural areas of Capricorn district.
iii. Determine the productivity of indigenous leafy vegetables in rural areas of Capricorn district.

iv. Assess different types of marketing channels of ILVs in rural areas of Capricorn district.

1.4.3 Research questions

i. What are the socio-economic characteristics of ILVs producers?
ii. What are the constraints faced by farmers in commercialising Indigenous Leafy Vegetables?
iii. What is the productivity level indigenous leafy vegetable?
iv. What are the existing marketing channels, if there are any, of Indigenous Leafy Vegetables?

1.4.4 Research hypotheses

i. There are no significant socio-economic characteristics affecting production of ILVs in rural areas of Capricorn district.
ii. There are no constraints faced by farmers in commercialising indigenous leafy vegetables.
iii. The productivity of indigenous leafy vegetables is low in rural areas of Capricorn district.
iv. There are no known structured marketing channels for indigenous leafy vegetables in rural areas of Capricorn district.

1.5 Organisational structure

Given that the aim of the study was to analyse the production and commercialisation potential of indigenous leafy vegetables in the Capricorn district in the Limpopo Province of South Africa, the remainder of this study is structured as follows: Chapter two presents the literature review; Chapter three discusses the methodology, including methods of data collection and analytical techniques used to analyse the data; Chapter four presents the results of the empirical analysis; Chapter five summarises the findings and gives conclusion, policy and research recommendations. It is followed by a list of references, and the appendices.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Many African communities had depended on indigenous leafy vegetables for survival before introduction of exotic crops; in some regions these crops are still prevalent. Investment in research and development covering production to commercialised chains for crops currently dominating the international markets have given those crops a distinct advantage over the lesser researched crops, and help even resource poor nations. Venter *et al.* (2007) stated that the use of leafy vegetables during winter helps to address food shortages. Revival of the use of indigenous leafy vegetables within communities will also ensure a focus on the conservation of these crops and ensuring the availability of diverse genetic material for future needs.

2.2 Production and marketing of ILVs

According to Van Rensburg *et al*. (2007), African leafy vegetables are collected from the wild, or from cultivated fields where some of them grow as weeds. The study indicated that vegetables have a long history that has been closely linked to women and their traditional livelihood tasks. Their study also highlighted that in remote rural areas the use of this types of leafy vegetables is still common with a decline in availability particularly in urban areas.

Gockowski *et al.* (2003) investigated the importance of indigenous leafy vegetables (ILVs) in nutrition supply and employment both in production and marketing among urban and peri-urban households in Cameroon. The results showed that ILVs contribute a significant share of essential nutrients for the urban poor. Price analysis revealed a decline in supply during the dry season, which is a food security concern for the very poor. Over 32000 households were estimated to be engaged in producing and marketing ILVs under readily accessible entry conditions. Three production styles were identified in the area: an intensive system within the urban limits, a semi intensive style in the urban periphery and an extensive style also in the urban periphery. Results also indicate that largest number of producers were women employing an extensive mixed crop system.

Vorster (2007) studied the role and the production of indigenous leafy vegetables in three South African rural communities. The results indicated that the Indigenous leafy vegetables production is female oriented, and these vegetables are mostly produced for home consumption. Marketing of these products was very limited and the income generated supplement household income. ILVs were commonly intercropped with maize, and some are uncultivated just harvested from maize and fallow land. Differences in production were found between three villages, the differences were owing to bio-physical and socio-economic factors.

Lyatuu *et al.* (2009) indicated that there is an increase in demand for ILVs in Tanzania, Botswana and Zambia. On the other hand ILVs are at risk of being eroded in these countries, as farmers are replacing them with improved varieties. The reason is the lack of seed and information about their performance, input requirements and marketing. It was also indicated that ILVs marketing are characterized by inadequate government intervention. The challenges that farmers are facing are Lack of reliable market information, market advisory service providers and Lack of pricing mechanism. Farmers sell their products just to cover their cost of living, rather than considering their production cost, supply and demand conditions. High perishable nature of ILVs creates a major challenge in distribution and marketing.

Faber *et al.* (2010), investigated about indigenous leafy vegetables consumed by households in the Limpopo and KwaZulu-Natal provinces in South Africa. The study indicated that there are a variety of edible plants that are consumed by rural people. The most consumed leafy vegetables were amaranth (*Amaranthus spp*), spider plant (*Cleome gynandra*), wild watermelon (*Citrullus lanatus*) and blackjack (*Bidens spinosa*), consumed individually or mixed with other leaves. Rural households got most of their leafy vegetables from the wild and the urban households buy from informal market.

According to Madisa and Tshamekang (1997), Botswana indigenous vegetables are mostly imported from South Africa. They also indicated that exotic vegetables demand high inputs for production and nutritional quality and yields are often low compared to indigenous vegetables of equal or better nutritional status could perform better under cultivation with relatively low input levels. Indigenous vegetables market is still

disorganized; they are cheaper than exotic imports and thus affordable by an average citizen. Dried ILVs showed economic potential on the local market, because of its easiness to produce and production is by traditional methods, dried vegetables are popular and marketable even in urban areas. Dried vegetables can be stored for a long time and are easy to transport. ILVs have a good economic potential as it can be sold fresh or dried, which means that the producer don't lose the produce.

Buabeng *et al.* (2002) studied the role of women in marketing of indigenous leafy vegetable: opportunities and challenges. Results indicated that women (99.5%) were the main retailers and also served as middlemen from production points. The study identified major challenges on marketing to be the lack of storage facilities, poor market structures, and unreliable market arrangements, and transportation. Findings from the study suggest that there are good opportunities to take greater advantage of ILVs as valuable local food resources.

Reinten and Coetzee (2002) stated that several international agreements have an influence on the commercialisation of indigenous crops. However, legislation and regulations with regard to Indigenous Knowledge Systems are not yet in place in South Africa, creating a challenge to work on indigenous plants. The study also indicated that some of Indigenous plants are only useful to fill small niche markets; others have the potential to become new products for consumers. It also suggested aspects that can make the commercialisation possible; as technology, market information, entrepreneurial and business skills training, social awareness, environmental awareness, and access to finance.

According to Nekesa and Meso (1997), traditional vegetables provide an important economic mainstay for rural Kenyan livelihood especially women. Production, handling and marketing were mostly done by women; only one man was involved, out of the 20 vendors and 20 farmers contacted during the survey. The farmers harvest, pack and transfer the vegetables to the buying point nearest to their farms, usually by a roadside. Vendors from urban areas buy and transport vegetables to strategic wholesale urban markets. Their counterparts in the retail sector purchase and transfer the vegetables to strategic retail points. One woman producing traditional African

vegetables provides employment to wholesaler and a retailer and made a profit of well over 75 percent.

2.3 Socio-economic attributes of ILV farmers

Mahyao *et al.* (2006) conducted a socio-economic survey in Côte d'Ivoire to illustrate the value chain of ILVs in the two biggest cities (Abidjan and Yamoussoukro) of the country. It was found that rural markets of Yamoussoukro constitute suppliers of ILVs to secondary urban markets (93%) where the vegetables are commercialized. In Abidjan, ILVs were commercialized on principal urban markets (66%). The markets supply chains were dominated by women (100% at Yamoussoukro and 97.5% at Abidjan). Major actors in the chains are the producer-retailers, the wholesaler-retailers and the retailers. These traders were young and are of different social background, and majority of traders were illiterate (76% at Yamoussoukro and 67% at Abidjan). Urban' markets supply chains of indigenous leafy vegetables (ILVs) are socially and economically important in the country.

Kimiywe *et al.* (2007) conducted a descriptive cross-sectional survey in Nairobi and the survey subjects included populations from all socio-economic strata and income levels. Ethnic origin was found to greatly influence consumption of indigenous African leafy vegetables. There was no significant relationship between household income and education level and choice or use of indigenous leafy vegetables. More than 60 percent of the respondents reported that the vegetables had a medicinal value attached to it and some were said to cure more than one disease.

2.4 Opportunities and constraints in commercialisation

Gebreselassie and Ludi (2007), stated that commercialisation of Indigenous Vegetables in the African small family farms can play a key role in the value chain especially at international level. The results indicated that commercialisation process didn't displace staple food crops and, provides opportunity for further diversification of agriculture in the study area. The level of commercialisation consistently increased with the size of farm which indicates the positive role of capital accumulation in the form of farm land in fuelling the commercialisation process. The study shows that diversification into high-

value horticultural crops is one potential avenue for commercialisation of small scale farmers while assisting farm households to improve their income.

Shiundu and Oniang'o (2007) found that the market share of African leafy vegetables (ALVs) in comparison with other vegetable species has been on the upward trend, in the urban markets and increased consumption in rural areas too. However issues of quality control, reliability and pricing remain critical to the future success of ALVs farming. Women have been closely associated with cultivation and selling of ALVs; however, studies have shown that whenever a crop begins to appreciate in the market and starts fetching higher income, men tend to push their way into the trade.

According to Mary (2007) major constraints facing production of African leafy vegetables in western Kenya, are poor seed quality, pests and diseases, drought, poor marketing channels, transport to markets, lack of agronomic and utilization packages are among the major constraints that hinder optimal production of African leafy vegetables. Seed quality is normally affected by the agronomic practices used, the time of harvest and seed processing procedures.

Irungu (2007) in Nairobi identified several major constraints to the growth of the African leafy vegetables market, to be the shortage of physical infrastructural development in terms of road network, storage facilities and actual physical trading space. Other factors included unfavourable policies for production and marketing, lack of capacity to regulate in supply, lack of product differentiation and value addition, and lack of credit and other forms of support to traders.

2.5 Importance and uses of ILVs

Dweba and Mearns (2011) stated that indigenous leafy vegetables could provide families with alternative sources of nutrients that are cheaper and easily accessible. These crops can help most household in rural areas, which have lower incomes, large families and female-headed households.

Abasse *et al.* (2006) in their study on the role of indigenous leafy vegetables on daily diet and rural and urban economy of Niger found that farmers who are involved in ILVs

production obtain 20-30% of their annual income from the sales of ILVs. And in the other region some received higher than 50% from their sales.

Lewu and Mavengahama (2010) stated that wild vegetables are highly nutritious and have great potential to alleviate malnutrition in marginal sectors of the community and also to enhance nutrition among communities with lower income level. They also stated that these crops have the potential to be commercialised if comprehensive studies on their production practices are undertaken. These crops have remarkable nutritious qualities like and micronutrients, minerals and vitamins.

Oladele (2011) study highlighted the contribution of indigenous vegetables and fruits to income and poverty alleviation. The results indicated that the proportion of indigenous vegetables and fruits to farmer's income was significant, implying that they help alleviate poverty. It was also indicated that their commercialisation in the domestic markets would result in raising the standard of living of those involved in it trading activities, in both the rural and urban centers. It was clear that through the volume of production each season contributes to income through trade and thus helps alleviate poverty by increasing the disposable income available to farmers.

Owuor and Olaimer-Anyara (2007), in their study on the value of leafy vegetables: an exploration of African folklore. Found that indigenous leafy vegetables are commonly given as gifts for convalescence to sick relatives and friends and as atonement during funerals. The study also indicated that the consumption of indigenous leafy plants has social, mental, economic, gender, and moral considerations. Results showed that ILVs define ceremonies in special ways, bring distinctions in the social structure, and promote social order and enhance societal cooperation. By virtue of their significance, ILVs enhance human capabilities and widen human nutrition, cultural rituals, environmental adoption and socialising choices.

According Orech *et al.* (2007) in their investigation on mineral content of traditional leafy vegetables from western Kenya, found that most traditional leafy vegetables, domesticated and wild, generally contain higher levels of calcium, iron and zinc as compared to the introduced varieties such as spinach, kale and cabbage. These

vegetables play a role in livelihoods in providing an improved diet in terms of nutritional value and diversity, and in supplementing the food needs of poorer households, as well as at times of famine. Thus ILVs are important in improving health, elevating household food security and increasing household income among women.

Adebooye and Opabode (2004) stated that indigenous leaf vegetables play a key role in income generation and subsistence. These crops fetch higher prices as compared to exotic crops, especially during dry seasons.

2.6 Technical efficiency of smallholder farmers

Economic efficiency can be classified into two; technical and allocative efficiency. Technical efficiency reflects the ability of a farmer to maximize output with a given set of resource inputs and available technology, while allocative efficiency reflects the ability of the farm to use the inputs in optimal proportions given their respective prices and the production technology (Coelli *et al.* 2005*)*.

According to Chirwa (2007), in his study where he investigated sources of technical efficiency among smallholder maize farmers in Southern Malawi, results indicated that smallholder maize farmers were inefficient. The results of the study reveal that inefficiency declines on plots planted with hybrid seeds and for those controlled by farmers who belong to households with membership in a farmers club or association.

Masterson (2007) found that smaller farms had higher net farm income per hectare, and more technically efficient, than larger farms. Another consistent result of this study is that rising shares of household labor employed in agriculture result in lower productivity and efficiency. But Baloyi (2011) in her study the technical efficiency in maize production by small-scale Farmers in Ga-Mothiba, Limpopo province, South Africa, found that small-scale farmers in Ga-Mothiba were experiencing technical inefficiency in maize production due to the decreasing return to scale, which means they were over-utilizing factors of production.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Study area

Limpopo Province is one of South Africa's nine provinces situated in the Northern part of the Republic of South Africa. The province share international border with three countries: Botswana, Zimbabwe, and Mozambique. It covers an area of 12.46 million hectares accounting for 10.2 percent of the total area of South Africa. The province has a population of about 5.56 million, divided into five districts of Capricorn, Mopani, Sekhukhune, Vhembe and Waterberg. The population is mainly rural consisting of about 89 per cent of the total with the main occupation of the people being agriculture.

The study was conducted at Capricorn district municipality which is located in the center of the Limpopo Province. The district is the core for economic development of the province. Its population is approximately 1 409 354 (UNISA, 2011), with 637 communities (DWA, 2011). The district has five local Municipalities; namely, Blouberg, Aganang, Molemole, Lepelle-Nkumpi and Polokwane. It is predominantly rural in nature and there are mainly Northern Sotho ethnic group.

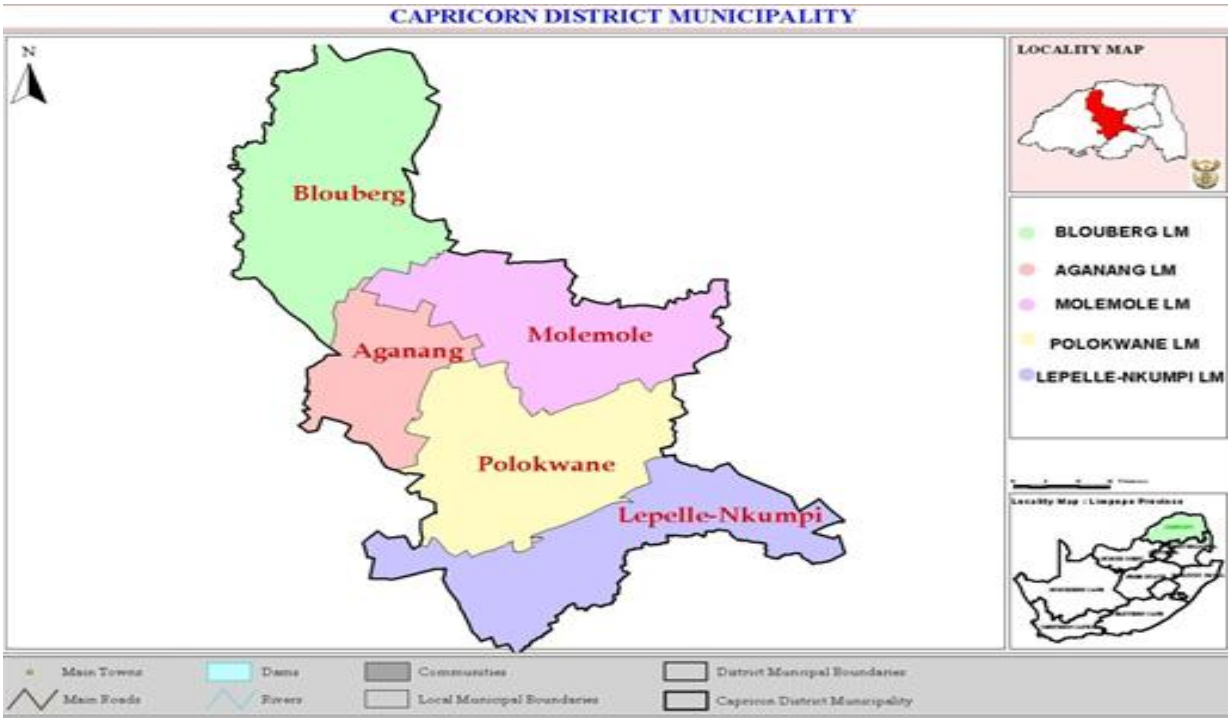

Figure 3.1: Map of Capricorn District Municipality
Source: Capricorn district municipal spatial development framework 2007.

3.2 Data Collection

The study used both qualitative and quantitative, cross-sectional data. Primary data were collected through interviews using structured questionnaires. The selection of ILV farmers within the study area was done using stratified random sampling procedure the strata being gender. The list of indigenous leafy vegetables producers was obtained from the district offices of Department of Agriculture of Limpopo. The ILV farmers were stratified according to gender to make sure that male and female headed households are represented. Disproportionate random sampling procedure was used to select individual households.

Consumers were also interviewed so as to get their perception about ILVs, to find out if they know all the benefits that ILVs provide and if they can buy it from retail shops. The sampling of consumers was done using the purposive sampling procedure, selecting only consumers of indigenous leafy vegetables. Consumers who were selected were not involved in the production. Consumers were sampled from rural and urban areas, rural consumers were from the same areas where the data on production was collected and the urban consumers were selected from one urban area which was Polokwane. Study areas were chosen, because they were known as areas where traditional vegetables were commonly produced and consumed. Elderly people were regarded as primary sources in the study, especially women. The sample size was 60 households producing ILVs from rural areas with 54 being women and only 6 were men (Ga-Mothiba, Sickline and Mothong) and 40 consumers (of which all were women) of ILVs in the Capricorn district.

3.3 Data Analysis

The study used Stochastic Frontier Production Function to determine the productivity and to assess the socio-economic characteristics of producers of Indigenous Leafy Vegetables. Bubble chart was used to assess the marketing channels. Microsoft Office Excel was also used as a complementary data analysis tool and consumer data was fed into SPSS for further analysis.

3.3.1 Stochastic Frontier Production Function

The model has been widely accepted and applied since its inception by Aigner, Lovell and Schmidt in 1977. Battese and Coelli (1995) extended the model, suggesting that the technical inefficiency effects could be further expressed as a linear function of explanatory variables, reflecting farm-specific characteristics. The model is able to represent the relationship of an output to input as this give an indication to the level of productivity. It decomposes the error term into a two-sided random error that captures the random effects outside the control of the farm and the one-sided efficiency component. The technique suit an agricultural production largely influenced by randomly exogenous shocks.

The model simultaneously estimates the individual technical efficiency of the respondent farmers as well as determinants of technical efficiency (Battese and Coelli, 1995). The stochastic frontier production function assumes the presence of technical inefficiency of production. The greater the amount by which the realized production falls short, the greater the level of technical inefficiency. The range of TE is 0 to 1. TE = 1 implies that the farm is producing on its production frontier and is said to be technically efficient.

The FRONTIER software uses a three-step estimation method to obtain the final maximum-likelihood estimates. First, estimates of the parameters are obtained by Ordinary Least Square (OLS). A two-phase grid search for γ is conducted in the second step with estimates set to the OLS values and other parameters set to zero. The third step involves an iterative procedure, using the Davidon-Fletcher-Powell Quasi-Newton method to obtain final maximum-likelihood estimates with the values selected in the grid search as starting values (Msuya *et al.* 2008).

The general Model can be written as:

$$Y = f(X_a; \beta)e^{\varepsilon}$$

Whereby:

Y = the quantity of agricultural product

X_a = a vector of input and other explanatory variables quantities

β = a vector of unknown parameter to be estimated

e = error term

ε = stochastic disturbance term consisting of two independent elements U and V, where $\varepsilon = U + V$

U = are assumed to be independent and identically distributed random errors which have normal distribution with mean zero and unknown variance σ_v^2

V = are non-negative unobservable random variables associated with the technical inefficiency of production.

The random error represents random variations in the economic environment facing the production units, reflecting luck, weather, machine breakdown and variable input quality; measurement errors; and omitted variables from the functional form (Aigner *et al*., 1977).

Then the frontier of the farm is given by:

$$Y = f(X_a; \beta) e^{(u+v)}$$

Measures of efficiency for each farm can be calculated as:

$$TE = \exp .\left\| E(V \left| \varepsilon \right.) \right\|$$

Whereby: $V = f(Z_b; \delta)$

Z_b = a vector of farm specific factors, and

δ = a vector of parameters

The function is linearised so that it can be possible to use the maximum log-likelihood function for. Both parameters of stochastic frontier and the inefficiency effects model can be consistently estimated by maximum likelihood procedure. Frontier 4.1 and Microsoft excel were used for analyzing and editing the data. The MS excel was used to log all of the input data before creating a data file for the program to use.

The function is summarized as follows:

$$InY = \beta_0 + \beta_1 InX_1 + \beta_2 InX_2 + \beta_3 InX_3 + \beta_4 InX_4 + V - U$$

Whereby: Y is the total quantity of Indigenous leafy vegetables produced, it is measured in kilograms.

In is the logarithm to base e,

X_1 is the area of the farms devoted to Indigenous leafy vegetables production, it is measured in hectares.

X_2 is the total labour used, measure in man-days.

X_3 is the cost of tractor, in Rands (cost of hiring tractor services)

X_4 is the amount of manure used, measured in kilograms

It is assumed that the inefficiency effects are independently distributed and U arises by truncation (at zero) of the normal distribution with mean and variance, where:

$$U = \delta_0 + \delta_1 InD_1 + \delta_2 InAGEF + \delta_3 InHHSZ + \delta_4 InLVPR + \delta_5 InFSIZ + \delta_6 InD_2$$
$$+ \delta_7 InD_3 + \delta_8 InD_4 + \delta_9 InD_5 + \delta_{10} InD_6 + \delta_{11} InD_7 + \delta_{12} InD_8 + \delta_9 InDSLM + e$$

Table 3.1: Definition of Variables

Variables	Description of variables	Units
	Dependent variable	
U	1, if farmers have high production,0,otherwise	Kilograms per hectare
	Independent variables	
D_1	1,if farmer is a female,0,otherwise	Dummy
AGEF	Age of the farmer	Years
HHSZ	Household size	Numbers
EXP	Experience in ILV farming	Years
LVPR	Amount of leafy vegetables produced per season	Kilograms
FSIZ	Farm size	Ha
D_2	1, if farmer hire labour, 0, otherwise	Dummy
D_3	1, if farmer use manure, 0, otherwise	Dummy
D_4	1, if farmer receive extension services, 0. Otherwise	Dummy
D_5	1, if Farmer own the Land, 0, otherwise	Dummy
D_6	1, if farmer engage in off-farm employment,0, otherwise	Dummy
D_8	1, if farmer have access to transport,0, otherwise	Dummy
D_9	1, if agriculture is the primary occupation of farmer,0, otherwise	Dummy

The β and δ coefficients are unknown parameters to be estimated, In is the logarithm to base e.

3.3.2 Bubble Chart

Bubble chart was used for data presentation as it helps to show the share of each market and the potential of markets that can be explored in future. It indicates the competitiveness and prospect for diversification of supply by farmers for indigenous leafy vegetables. Bubble size was proportional to the share of each market for indigenous leafy vegetables.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This section contains the results that will be used to answer the objectives of the study. Results from three empirical analyses will be discussed. The first one will be the result analysed using Stochastic Frontier production model and the second one will be results analysed using Bubble map. Lastly will be results on consumer perspective.

4.2 Household socio-economic characteristics

Of the 60 respondents interviewed in this study, 90% were females and only 10% were male. In the male headed production, females were, however, not left out because they serve as helping hands especially in harvesting and drying of produce. In the African context, women dominate the cultivation of indigenous leafy vegetables as compared to men, leading to the crops being considered as “women crops”. Men seemed to be interested in livestock farming as it is perceived to be a store of wealth.

Figure 4.1 below shows the age distribution of ILV farmers in the study area, majority (62%) of farmers were older than 60 years, followed by those who range between 51-60 years who form 20%, 41-50 years were 16% and 36-40 years were only 7%. This indicates that in the study area older farmers were the major producers of ILVs, probably younger generation was engaged in some other economic activities other than agriculture. Age of the farmer play a very significant role in farming, as experience help in decision making and young farmers are eager to create wealth. In the study area, majority of farmers of indigenous leafy vegetables were pensioners, who relied mostly on government pension fund. These farmers had lot of experience in producing indigenous leafy vegetables; they grow up farming these crops (ILVs). Other studies (e.g. Oladele, 2011) showed that Age distribution was very important for all agricultural productions. Although experience in farming was very important and it comes with years of practice, yet fairly young farmers are needed on farm because agricultural production is strength demanding. More production activities could be engaged by young farmers, hence, enhanced productivity.

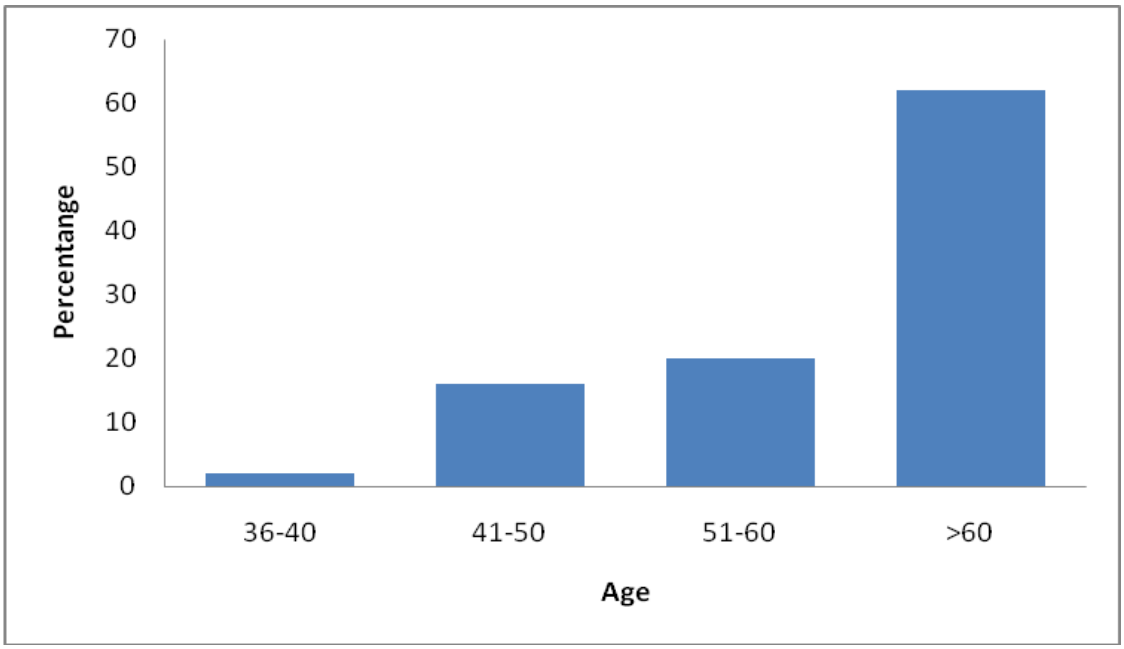

Figure 4.1: Age of farmers

Table 4.1 below indicate that in the study area, most farmers had primary education (43%), 37% had no formal education, 18% had secondary education and only 2% had a tertiary qualification. The high percentage of farmers with low levels of education was due to the ancient believe of Africans that women were not supposed to attend school, as they only belong in the kitchen, which to a greater extent affected production and marketing decisions.

Approximately 55% of farmers interviewed were married, 17% single and 28% widowed. The younger farmer is thirty eight (38) years while the older is ninety (90) years old. Farmers mainly rely on pension as source of income and they have to support their grandchildren, whom they stayed with. They stayed with these grand children because their parents were working in Gauteng and some because the parents had passed away. On average the number of people in the household was six (6), giving farmers a pool of additional labour from family members. Approximately all ILV producers hold locally recognized customary land rights; they have a yearly payment that they made to the chief for the possession of the land. Their scale of production on average was 1.29 hectares, with most of them devoting only 0.75 hectare to ILVs production.

Table 4.1: Socio-economic characteristics of respondents

			N=60		
Gender				**Female**	**Male**
				90%	10%
Age		**36-40years**	**41-50years**	**51-60years**	**>60 years**
		2%	16%	20%	62%
Marital Status		**Single**	**Married**	**Windowed**	**Divorced**
		17%	55%	28%	0%
Educational Level		**No formal education**	**Primary**	**Secondary**	**Tertiary**
		37%	43%	18%	2%
Source of income	**Own salary**	**Farming**	**Pension**	**Social grant**	**Hawking**
	8%	3%	68%	5%	16%
Number of Dependants		**1**	**2-6**	**7-11**	**12-16**
		8%	82%	10%	0%

Results also showed that all farmers had no access to credits; this was due to lack of collateral. Some realised that there is no need to acquire credit as they mainly farm for household consumption. Figure 4.2 below show that only five percent (5%) of farmers belonged to an organization and being part of an organisation could help them in accessing information about new production technologies. Even in the 5% that belong to an organisation only two percent (2%) that were promoting ILVs in their organisation.

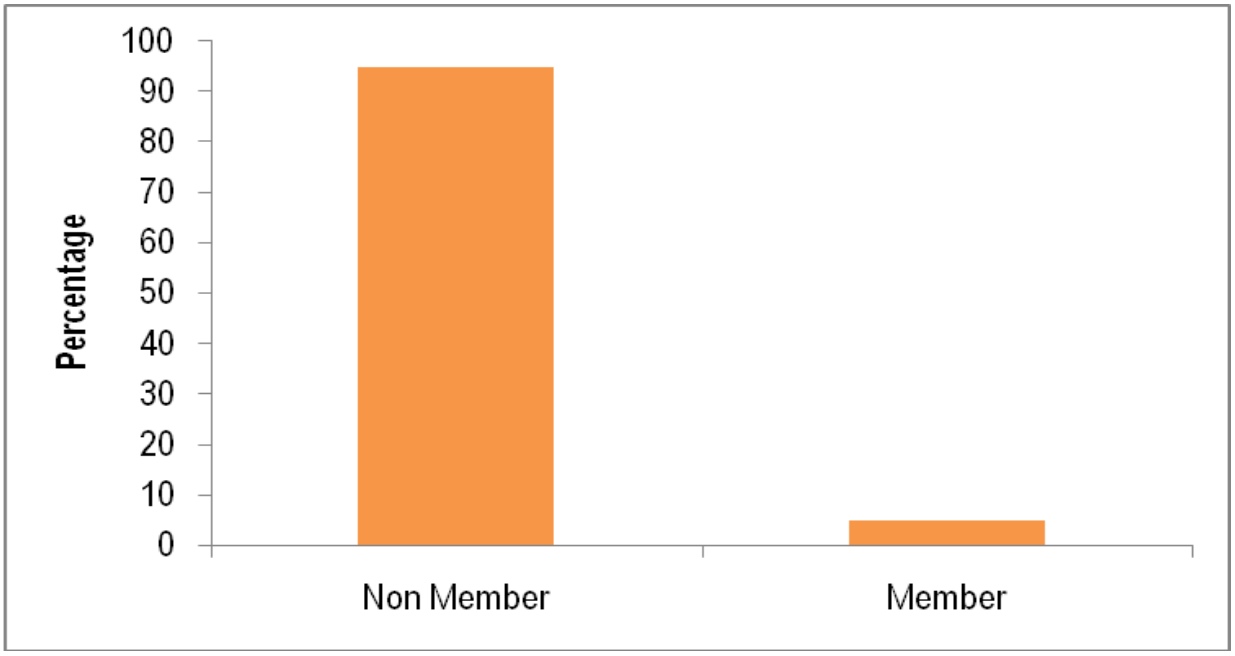

Figure 4.2: Membership to a farmers organisation

In the study area farmers were not receiving any extension services and from observation it seems like extension officers only visit project/farmers that mainly produced exotic crops. Most farms were not fenced even those which were fenced, the fencing was not in good condition. The land devoted to ILVs over the years was mostly constant for many farmers, as they regarded the crops as very important and playing a significant role in their livelihoods. Some were reducing the land devoted to ILV because of the introduction of other crops and others reduced due to chiefs taking the part of their land for human settlement purposes.

4.3 Description of indigenous leafy vegetables production system

Rural ILV farming system mostly depends on locally available resources and farmers used their indigenous knowledge. This was due to their socio-economic characteristics. These farmers didn't explore the range of innovations and practices that had been developed over the years.

Abukutsa-Onyango *et al.* (2007) stated that production of ILVs was very simple and often requiring very little inputs save for occasional farm yard manure application. In the study area, the type of production system that was used to produce indigenous leafy

vegetables was the extensive mixed crop system: intercropping system, no farmer practice mono-cropping. The ILVs were intercropped with maize**,** thus its management was limited. The other intercrops were watermelon, groundnuts, sugar beans, pumpkins. Abukutsa-Onyango (2007) in another paper stated several intercropping advantages that include having diversity of crops in a given season, optimal utilisation of resources like nutrients, water and light especially if the intercrops have different growth patterns. Intercrops can be planted with crops that have different maturity dates. Farmers in the three communities have indigenous knowledge that agrees with the established fact that intercropping is advantageous. The environmental conditions and soil type prove to determine ILVs that could be produced in the area.

As Table 4.2 below indicates, crops that the study focused on were amaranths (lerotho), spider flower (thepe) and cowpea (monawa) the name in the syntheses are the local name. When the study was conducted farmers also mentioned some ILVs that they were producing, the most common one was the pumpkin leaves. Two of the crops (Amaranth and spider flower) were not cultivated, harvested from maize fields, mostly from fields where they used manure. Only Cowpea was cultivated, and most farmers consider it to be profitable. All the crops that were investigated are summer crops in the study area.

Table 4.2: ILVs considered in the study

Scientific Name	**Common Name**	**Local Name**
Vigna Unguicalata	Cowpea	Monawa
Amaranthus cruenta	Amaranths	Thepe
Cleome gynandra	Spider flower	Lerotho

Reliance on rain-fed production of ILVs has been one of the major obstacles in expanding their production (Shiundu, 2007). Indigenous leafy vegetable production is rain-fed; depend on rainfall for watering the crops. This make the supply not reliable because there will be more produce in rainy season and less in a dry season. Sowing was mainly done by broadcast, most farmers used seeds obtained from older plants,

dried and stored in a bottle or plastic bag mixed with ashes and others store them in the fridge until being planted during summer after the rains. However, there were a limited number of farmers who buy seeds and others used both last season seeds and buy. There seem to be doubts with the quality of seeds; because even those who buy, most of them buy from their neighbors. Uncultivated crops self-seed but in rare cases farmers go find the seeds and broadcast in their fields. These have disadvantages as seed production could be less which leads to fewer plants the next season, which will mean less production.

Manure was commonly applied, with the use of fertilizer and other agrochemicals being very limited. Farmers used different types of manure, but the most used was the cattle and chicken respectively. One of the reason for the use of this manure was the easily availability especial cattle manure. However, most farmers believed that chicken manure has much value. Farmers highlighted some reasons with regard to their limited use of agrochemicals: the main ones were the lack of finances and their negative impact on soil. All farmers in the study area had no electricity in their farms; some didn't even have it in their homes.

More than 90% of ILV producers did not own vehicle, even those who own one, their vehicles were not in good conditions and the vehicles were mostly controlled by husbands who were not that interested in farming Indigenous leafy vegetables but some were using donkeys as a source of transport, to transport from and to the farm. They used both part-time and unpaid family members as labour. The part-time labours used were mostly Zimbabweans, of which they didn't charge them much as payment, some they even pay them with the produce. The produce used mostly as a payment, was the maize, and it depends on the level of production. Those who had older kids and relatives relied more on unpaid family members for labour assistance. The production system of ILVs was closely related to local indigenous knowledge system.

4.4 Stochastic Frontier Production Function results

The results presented below summarise the statistics of variables used in the stochastic frontier production function. Farmers in the study area had comparatively small farms.

The estimated production parameters coefficients had both positive and negative sign. The sign of the coefficients shows the effect that a variable has on the production level of ILVs.

Table 4.3: Maximum likelihood estimates of the Stochastic Frontier Production Function.

Variables	Parameters	Coefficients	Standard errors	t-ratios
Production Factors				
Intercept	β_0	**7.6968**	**0.8341**	**9.2280**
Land devoted to ILVs (X_1)	β_1	**0.0917**	**0.3899**	**0.2353**
Total labour used (X_2)	β_2	**0.2424**	**0.1078**	**2.2490**
Cost of tractor (X_3)	β_3	**-0.1554**	**0.1076**	**-1.4443**
Cost of tractor (X_3)	β_4	**0.0122**	**0.0372**	**0.3275**
Inefficiency Factors				
Intercept	δ_0	**2.5705**	**1.2611**	**2.0383**
Gender	δ_1	**-0.1113**	**0.4556**	**-0.2444**
Age	δ_2	**0.3522**	**0.2538**	**1.3879**
Household size	δ_3	**0.1449**	**0.2230**	**0.6501**
Farming experience	δ_4	**0.0741**	**0.1458**	**0.5081**
ILVs produced per season	δ_5	**-0.6299**	**0.1233**	**-5.1079**
Farm size	δ_6	**-0.3007**	**0.3226**	**-0.9324**
Used of hired labour	δ_7	**0.3093**	**0.3255**	**0.9503**

Use manure	δ_8	**0.0269**	**0.3442**	**0.0781**
Extension service	δ_9	**0**	**1.0000**	**0.0000**
Land ownership	δ_{10}	**0.2438**	**0.4201**	**0.5803**
Off-farm employment	δ_{11}	**-0.0498**	**0.4569**	**-0.1089**
Access to transport	δ_{12}	**-0.0512**	**0.9456**	**-0.0541**
Primary Occupation	δ_{13}	**0.1684**	**0.2193**	**0.7678**
Gamma	**G**	**0.9999**	**0.3778**	**0.2647**
Log likelihood function		**-17.6954**		
LR best of one-sided error		**59.2144(1 restriction)**		

Hypothesis Testing and Model Robustness:

The gamma indicates the orderly influences that were unexplained by the production function and the dominant sources of random error. The results suggest that about 99% of the variation in ILVs output among ILV farmers in the study area was due to the differences in their technical efficiencies. Log likelihood function indicate whether the maximum likelihood estimate (MLE) of the stochastic frontier production functions significantly differs from the original ordinary least square (OLS) estimate and shows the model that best fits the data. The values of the log-likelihood function for the MLE and OLS were -17.6954 and -47.3025 respectively. With MLE function having the highest log likelihood, it shows that the model best fits the data. The results of a likelihood ratio test (LR = 59.2144) confirms that ILV production level relate to the efficient use of available resource.

The tests show that inefficiency effects were present and significant. The null hypothesis that there is no inefficiency effect was rejected.

Production factors are discussed as follows

Land devoted to ILVs- The estimated coefficient for land devoted to indigenous leafy vegetables was found to be positive and significant at 0.1 levels. Considering the lack of technology usage by ILV farmers, output level depends on land size. The results tally with other studies (FOA, 2003; Baloyi, 2011) that also suggested that farm size or land devoted have an impact on the production level. Land was important in crop production, its shortage not only negatively affect production but also indirect negatively affect output by reducing the marginal productivity of non-land inputs. Statistically the coefficient indicate that a 1% increase in the land devoted will lead to a 0.0917 increase in the level of ILVs output. This shows that an improvement of land in terms of size will lead to high ILVs output, assuring that there was enough supply of land and indicating that there was a capacity for increasing the value of farm output by increasing the land devoted to ILVs.

Total labour used- The estimated coefficient of labour was found to be positive and significant as expected**.** This indicated the importance of labour in the production of these crops; this was expected considering the traditional farming system that farmers practice. This confirm what other studies (Oladele, 2011) have found on the importance of labour on farming. Thus, the more labour engaged in ILV production the higher the yield is achieved, the 0.2424 elasticity of labour indicate that a 1% increase in the labour use will lead to an increase of 0.2424 in output level. Labour significance draw from the fact that farming system used by ILV farmers is labour-intensive from land preparation to harvesting. Farmers in the study area didn't own any farming machine, so labour was the readily available resource. With these crops showing to be labour intensive, improving its production, might help solving the high unemployment rate that faces South Africa.

Cost of tractor- The coefficient of tractor cost was negative and significant. This means that a 1% increase in the cost of tractor will lead to a 0.1554 decrease in the output level. The negative sign of the tractor coefficient could be due to small land devoted to these crops production as compared to total farm size. This suggested that there was

an over use of tractor in the study area. The other possible reason might be because the total cost considered was for the whole farm not only the land devoted to ILVs.

Manure used- The estimated coefficient of manure was positive and not that significantly different from zero. This indicates the importance of manure on improving production level. Manure was the land supplementing input therefore leading to improvement in ILV yield. Zobolo (2008) supported that manure application substantially increased crop yield. A 1% increase in the application of manure will lead to 0.0122 in the output level. This indicated that proper higher manure application would result in higher yield except where it was applied too much leading to burning of the plants which will consequently lead to lower yield.

4.3.2 Return to scale

The return to scale was found by adding all the values of betas (β). The return to scale indicates what would happen to output if all the inputs were increased simultaneously. For constant return to scale, the sum of the coefficients β must be equal to one, for increasing return to scale, they must be greater than one, and for decreasing return to scale they must be less than one.

The results as presented in Table 4.3, the sum of β's was less than one, indicating a decreasing return to scale. This meant that resources were over-utilised, resulting in ILVs farmers being technically inefficient. Input cost used per unit was more than the return from output. Farmers invested more inputs into this production, more than they received. With farmers experiencing decreasing return to scale they will have to decrease the amount of input used for them to reach the point where the cost per unit of inputs used was equal to output/returns per unit. Then, there would be sufficient room for further production and productivity improvement in ILVs production.

Technical inefficiency estimates

The discussion below is based on the factors that are responsible for inefficiency and how they affect the production of ILVs. The impacts of these factors accounting for this inefficiency are given by the estimated coefficients, indicated in Table 4.3. The signs of

the estimated parameter coefficients have important implications on the resource use efficiency.

Gender- The estimated gender dummy coefficient was found negative and significant as expected. This indicated that female farmers, who were dominating (90%), were more involved in the production of ILVs as compared to their male counterparts. This was due to the fact that ILVs were culturally perceived to be women crops; they were the ones who harvested even volunteered crops (ILVs). This could also be explained by the fact that in most rural farming communities, women are the ones who mostly engaged in agricultural activities while male counterparts engaged in off-farm activities.

Age- The age coefficient of ILV farmers in the study area was positive and statistically significant. This implied that age of a farmer contributes to the inefficiency use of resources. Older farmers were less efficient as compared to their younger counterparts, who were willing to implement new technology and create wealth. The younger generation has longer planning horizons and this contribute to their efficient farming; they also showed to have high formal schooling. Younger farmers were expected to be more receptive to improved farming techniques and be more technical efficient.

Household size- The coefficient of household size was found to be positive and significant. The positive coefficient suggested that household size contribute to inefficiency use of resources in this case labour. An increase in the level of household (more adults/workforce) led to an increase in technical inefficiency. More adults available in a household, meant more labour engaged in the farming activities regardless of the land size cultivated, this lead to overuse of labour resources making production process more inefficient. In some cases children were forced to go help in the farm resulting in poor work done.

Farming experience- Farming experience coefficient of ILV farmers in the inefficiency model was positive. The positive coefficient indicated that farming experience contribute to inefficiency use of resources. Most ILV farmers in the study area grow up producing ILVs under traditional farming system; to them farming has always been just a culture they were not farming to make profit.

Farm size- The coefficient of farm size in the inefficiency model was negative and significant. This implied that the inefficiency use of resources decrease with the farm size. When the farm size increase the inefficiency use of resources decrease, due to the fact that farms in the study area used almost same level of inputs regardless of the land size; thus larger ones get to use less input level. Therefore, the larger the farm size, the more land available and consequently the more the productivity.

Hired labour- The coefficient of labour used by ILV farmers was positive. This indicated that inefficiency use of resources increase with the number of labourers used. Farmers overused the hired labour, showing positive coefficient in explaining production of ILVs. They tend to use hired labour together with the family labour whereas they cultivate small piece of land. This might be due to limited opportunities for income generating activities outside agriculture especially in rural areas.

Manure usage- The coefficient of manure used was positive and insignificant. In the study area farmers were over using manure, this was because of poor production knowledge and the easy accessibility to manure as most of them had cattle's.

Extension service- The coefficient of extension in the inefficiency model was total insignificant, this was due to the fact that almost all ILV farmers were never in contact with an extension officer in connection with the production.

Land ownership- The coefficient of land ownership was found to be positive and significant. This indicated that land ownership contribute to resource use inefficiency in the study area. Farmers who had ownership seem not to be using the land efficiently but the ones who rent or borrow the land make sure that they use the land efficiently. This might be due to the reason that they don't know when the land will be taken from them since they don't use the land under any formal contract.

Off-farm employment- The coefficient of off-farm employment was found to be negative and not significantly different from zero. The negative coefficient implied that farmers who were not employed off-farm tend to be more technical efficient, since they allocate the best labour time to ILV production. Most ILV farmers were not participating

in off-farm opportunities because of lack of capacity. Off-farm employment improves the household income but negatively affect labour time allocated to ILV production.

Access to transport- The coefficient in the inefficiency model was negative and not significantly different from zero. Possible explanation was that access to transport tend to help farmers to be technical efficient, giving them ability to reach their input and output market. In the study area majority of farmers didn't own transport but public transport was easily accessible.

Primary Occupation- The study differentiated this variable from off-farm employment by giving emphasis that a farmer might be employed elsewhere but still regard and get sufficient benefits from agriculture. The coefficient was found to be positive and significant. The implication was that primary occupation contributes to use of resource inefficiently. The positive relationship between technical efficiency and agriculture as a primary occupation can also be explained by low levels of education among farmers, that affect their technical skills (education level affect their ability to use resource efficiently).

The results of the frequency distribution of technical efficiency of ILV farmers were presented in Table 4.4 below. The estimated technical efficiency varied with minimum and maximum values of 11 percent and 99 percent respectively and an average of 31 percent. It indicated that the average farmer in the study area could save 69% [i.e. 1-(31/99)] of costs and the most technical inefficient could realise an 89% cost saving [i.e., 1-(11/99)] compared with the technical efficient level of the most efficient farmer. The wide range in technical efficiency indicated that most farmers were using their resources inefficiently and there still exists a huge opportunities for improving their current level of technical efficiency.

Table 4.4: Frequency distribution of technical efficiency of ILV farmers

TE level (%)	Number of Farmers (n=60)	Percentage
>90≤100	2	3.3
>80≤90	2	3.3
>70≤80	2	3.3
>60≤70	2	3.3
>50≤60	1	1.7
≤50	51	85
Total	**60**	**100%**
Mean 31%	**Minimum 11%**	**Maximum 99%**

4.5 Reasons for cultivating ILVs and its contribution to rural livelihood

As much as indigenous leafy vegetables were regarded as secondary to other crops, they actually contribute immensely to rural households. ILVs have a range of contributions to rural community livelihoods, both direct and indirect. Consumption of these vegetables provides nutritional benefits while sales supplement or complement family income. ILV sales provided income that was vital in substantial seasonal gaps, and in helping the farming community to respond to odd expenses. ILVs also had a role as crops that people fall back on in times of crop failure because of their survival attributes. Other farmers cultivate ILVs for contribution to nutrient recycling, soil fertility.

In the study area farming was part of their culture; they grow up feeding off the land, they were thought to produce and consume ILVs. Most of them don't take farming as a business, was just for food security. Ethnicity had a very strong influence on the type of ILV produced and consumed. Farmers also mentioned that ILV help with food security as there are easily available and have a high nutritional content. Dried ILVs come in handy in winter when there is a shortage of food. These products were regarded as having a good taste, good for fresh skin, prolonging life, good eye sight and prevent

illness. Farmers used ILVs as their part of strategy to alleviate poverty in rural communities. Dlamini (2010) advocated by stating that promotion of amaranthus spp. Important as of its large nutritional advantage, both from the point of view of supplying pro-vitamin A, and also for their nutraceutical benefit. Farmers also perceive ILVs as soil improver; they stated that these crops help soil fertility. ILVs had a short growing period, easy to cultivate, especially that they were grown as intercrops, need no extra labour, finances and other inputs. Adaptable to local conditions, can be able to survive hard conditions and have few insect and disease problems. In 2007 Kimiywe *et al.* concluded with the same arguments that dietary diversity of indigenous African leafy vegetables in addition to providing essential nutrients presumably offers broad benefits to health.

Farmers also mentioned the advantage of dried ILVs product; it helps during dry season when there was shortage of food. The study focused on, two ILVs semi-cultivated (amaranth and flower spider) and a cultivated (cowpea). Cowpea was perceived as the best and profitable crop and it had a long shelf life even when it's not dried. Respondents mentioned that, determination is required to cultivate the two semi-cultivated crops as some farmers notice no benefit of cultivating something that grows in abundance in the wild. Importance of ILVs in rural areas shows that increasing yield will assist in enhancing livelihood of many household, both in rural and urban areas.

4.6 Reasons ILVs were under-utilized

In the study area farmers suggested that the under-utilisation of indigenous leafy vegetables was because of its seasonality nature, making them to be available in their fresh state only in one season. Others said it was because people had a negative perception about these products, especially black diamond's (middle income earners) of which they were the targeted customers of many products. Black diamonds take these crops to be food for the poor and having low status but on the other hand this group is starting to be conscious about their diet. This was advocated by Stevens *et al.* (2008), observed that a barrier to ILV utilisation was that the youth had a negative view of ILVs. This may be qualified by the change in food culture pushing people to leave their old and traditional food culture and adopt a modern food culture. About four percent complained about too much work related to processing the produce.

Also the loss of indigenous knowledge contributed to the under-utilisation of ILVs, older generation of which they were the custodians pass-on without transferring the knowledge to younger generation. These led to less production of these crops since they didn't know much about ILVs. In some case younger people regard some ILVs as weed. The production system had an effect to some extent, especially with uncultivated crops. There were evidence of lack of seeds of some crops, and over-harvesting.

Shiundu and Oniang'o (2007) in their study stated that ILVs remain under-exploited and under-utilized due to various constraints, including processing, distribution and marketing, as well as nutrition information.

4.7 Implication of under-utilizing ILVs

Food insecurity- ILVs were the easily available vegetables especially to rural communities, helping them to have enough food. They were abundant in rainy season but were also preserved by drying them for winter season. The under-utilisation of these crops poses a threat to food security in terms of food supply. According to Kwenin, (2011) ILVs are important commodities for poor households because their prices are relatively affordable when compared to other food items.

Reduce income- According to Schippers (2000) Indigenous vegetables are reported to play a very important role in income generation and subsistence. The under-utilisation of these crops doesn't allow farmers to supplement their income in order for them to improve their standard of living.

Health- Vegetables are important source of nutrients that help maintain good health and prevent diseases. As cited by Kwenin (2011), Okeno *et al.,* 2003 stated that a great number of African indigenous leafy vegetables have long been known and reported to have health protecting properties and uses.

Table 4.5: Perception of ILVS crops as compared to exotic crops

	Bad %	Fine %	Good %	Excellent %
Drought tolerance	2%	5%	48%	45%
Maturity	0%	15%	60%	25%
Bunch size	0%	35%	55%	10%
Performance in poor soils	0%	0%	42%	58%
Resistant to nematodes	0%	15%	55%	30%
Input costs	0%	11%	57%	32%
Easy to produce	0%	10%	57%	33%
Texture	2%	15%	45%	38%
Colour	2%	22%	32%	44%
Storability	0%	5%	37%	58%
Freshness	0%	13%	53%	34%
Taste	0%	0%	25%	75%
Nutritious	0%	0%	7%	93%

ILVs were generally perceived to be the best crop and the rescuing crop during hard times. These crops have an advantage of possessing desirable agronomic and organoleptic traits. Table 4.5 Indicate how farmers in the study area rate ILVs in terms of their traits as compared to exotic crops. Many farmers perceive ILVs as drought tolerant and mature early. More than 50% of farmers indicated that ILVs are excellent and they also found them to be very resistant to nematodes. Input costs are indicated to be low about 57% of farmers and 32% indicated that costs are good and excellent respectively. Farmers perceived production of ILVs to be easy, as they don't need too much management. ILVs were also perceived to have a good texture, highly storable, and an attractive colour.

4.8 Processing techniques

In the study area producers used two local traditional knowledge of processing (preservation) ILVs, the first one was sun-drying after being cooked and second one was sun-drying raw leaves. Women are the principal agent of processing ILVs, the processing help with post-harvest preservation to maintain supply throughout the year since ILVs are perishable and were only abundant during rainy season but scarce the rest of the year.

First method- they pre-boil the water then put washed leaves into the pot with boiling water. Boil till there is no or little water remaining, then when the leaves were half cooked they cool it. The blanched leaves were spread thinly (or if not it will spoil and take time to dry) on a corrugated iron-sheet out on the open surface directly in the sun. For complete dry products it takes two to three days on sunny days but can go up to five days if the weather is not good.

Second method- they were drying raw leaves by placing them on a corrugated iron-sheet out on the open surface directly in the sun. For leaves to be completely dried it took two to three days.

According to Smith and Eyzaguirre (2007) although drying is one solution to the problem of perishability, it does not satisfy the needs of a large population of consumers, particularly urban dwellers. Thus there is a need to improve the drying methods that are currently being used taking into account hygienic considerations as well as nutrient degradation and loss. Farmers should incorporate the use of modern methods and equipment.

4.9 Production constraints

While ILV production has been shown to be important in so many ways, there seem to be constraints in their production. Water scarcity was a major constraint since the production depends on rain-fed and the area receive small summer rainfall. Thomas (2002) also stated that the rainfall pattern is erratic and severe droughts are experienced about once every eight years. Farmers lack financial resource to can reinvest in their farming activities, this hinder growth. Farmers were unable to acquire all the necessary inputs needed and the one that will help them improve their production. Farmers also struggle with infrastructure, they didn't have proper infrastructure like storage, irrigation system etc. There were also signs of inefficient and unsustainable usage of available inputs. The constraints were taking its toll because extension services were apparent concentrated on commercial exotic crops.

4.10 Marketing of ILVs

According to Lyatuu *et al.* (2009), ILVs have long been regarded as minor crops and thus have attracted little marketing attention, in favor of major crops and cash crops. These vegetables were recognised as subsistence crops. The marketing of ILVs is very limited, most farmers produce for their own consumption with little produce reaching the informal market. Women are the major agents involved in the marketing of ILVs.

Results from the study area indicated that 50% of farmers sell and 50% didn't sell their produce. The ones, who were not selling, mostly shared their produce with relatives, orphans and poor community members who didn't own a land/farm. The group that was selling their produce usually sells about 50% of their produce, some sell up to 60%. Income from these sales helps to supplement the family income and put them in a position to fulfill some of the basic needs.

Farmers sold their products to three output market; locally, neighbouring villages, and in town. This information is represented below by a bubble map.

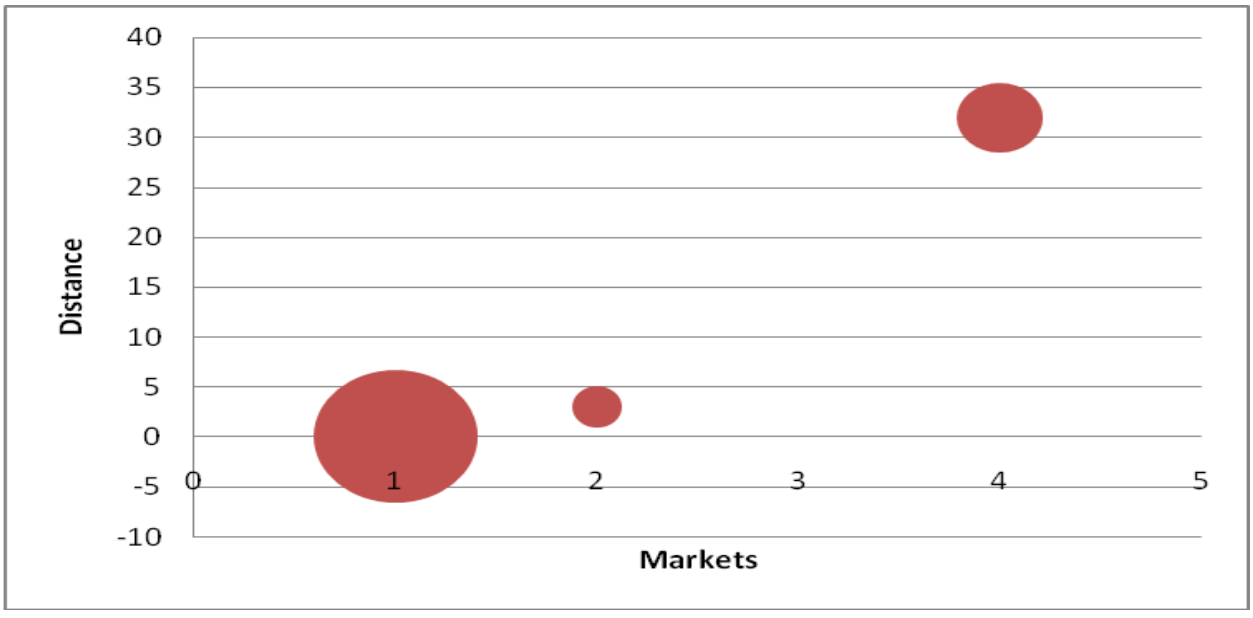

Figure 4.3: Represent the market, market share and distance to market

Table 4.1 outline ILVs market results from the study area, the x-axis represent markets whereby 1(one) was the local market, 2(two) neighbouring villages, 3(three)

supermarkets and 4(four) town market. From the results it was clear that local market has a bigger market share of about 73%, followed by town market with 20%, neighbouring village share was 7%. There were no evident of ILVs reaching the supermarket. Most farmers sold their produce locally because of lack of market information and lack of resource to reach other markets. The reason neighbouring village market absorb small percentage was because there were also producing ILVs.

The distance to different output markets vary, results indicate that a majority of local consumers buy from the farmer's house with few farmers selling door to door or in pension points. Distance to a neighbouring village on average was about 6km, the largest selling point being pension points and shopping centers. The average distance to town output market was 35km; mostly farmers who utilized this market are the one who worked in town especially as hawkers. Respondents who were not working in town faced high transaction costs in marketing their products in town; these made them not to market in town. Du toit *et al.* (2010) cited de Bruyn *et al.* (2001) on how transaction costs influenced cattle marketing decisions in the northern communal areas of Namibia it showed that a number of transaction cost variables had a significant effect on the proportion of meat sold and thus indirectly on the choice of marketing channels. The lack of exploitation of the town marketing channels opened an opportunity for middlemen who were hawking in town. These middlemen helped move the produce from the hands of the farmer to town at the same time giving them a share of income but there seem to be uninvestigated allegations that these middlemen benefit way more than farmers.

As found by most studies even in the study area females were the ones mainly undertaking ILVs marketing and other allied activities. ILVs were sold as both fresh and dry products. Most farmers sell both fresh and dry, with a little percentage that only sell their product as fresh or dry only.

The study found that prices ranged between R6.00 and R8.00, dry products fetch a high price as compared to fresh product. This made an economic sense since there have been a value added by processing and packaging. Among farmers no one really knows who set the price and what were the standards used to set it but in each area prices

were found to be unique. Farmer's price setting was based on the market, with few setting their price as dictated by buyers. Buyers who mostly dictated the price were the ones, who were acting as middlemen between the farmer and consumers, prices they set were disadvantaging farmers but on the other hand they were helping farmers to sell their produce.

Farmers found this price setting system to be important, since it gives some form of guarantee that your produce would be sold as the price is uniform for everyone. But their challenge was that there was no institution controlling the price, which makes some farmers to be easily manipulated in changing their prices and the fact that all products are sold at the same price regardless of the quality.

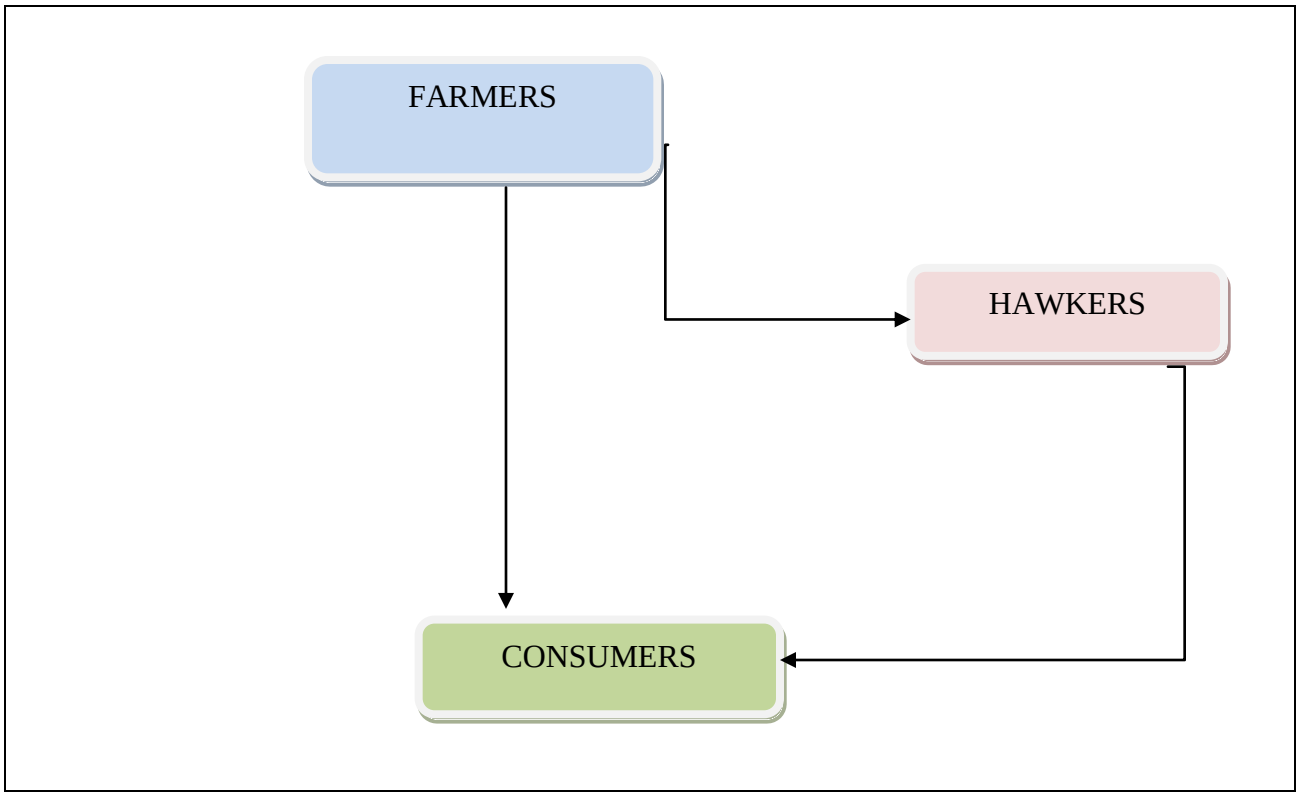

Figure 4.4: Value Chain of ILVs

Farmers were not utilising all the available marketing channels, if they were exploiting available options they will increase efficiency in business hence raise the total generated income and improve competence thus increasing the market share. Farmers had two routes that they used to supply their product to customers. Farmers supplied

their produce direct to consumers; this selling route is mostly to rural consumers but with an exception of little percentage to urban consumers. On this route farmers supplied both fresh and processed (dried) produce. This marketing channel has its own advantages as there were no marketing costs involved.

The other channel is the one where farmers supplied hawkers; even with this channel they supplied both fresh and dried products. Middlemen in this case hawkers, added value to the fresh product by drying it. With these route hawkers sell to the final consumer. Middlemen tend to get more money than farmers themselves because of high prices they charge as they sell in areas were ILVs were scarce.

4.11 Potential markets

In the country there is an increasing trend of supermarket chains in the food system and consumer preferences for quality and easy to prepare food. The emergence and growth of the black middle class is the most powerful marketing trend in the country, the advantage of ILVs to be absorbed by this market is considerable tremendous as most of them grow up consuming these crops. Urban and peri-urban consumers should be target since they don't have the land where they can plant and in these areas there is a rising health conscious and high willingness to experiment.

4.12 Consumer perception of ILVs

4.12.1 Consumer socio-economic and intake level of ILVs

The socio-economic conditions of household influenced the consumption and perception towards ILVs. Ninety two percent (92%) of respondents (consumers) were females; this was because they were the ones who mostly cook in the household. Large number of respondents was between the ages of 41-50 years, whom most had formal education with some having up to tertiary education. Consumers interviewed were both from rural and urban areas of the Capricorn district.

The average number of people living in a household was six (6), with the average of two people working. The main source of income for rural consumers was found to be a social grant, in the urban areas was found to be salary. The socio-economic conditions

of rural consumers indicated that the introduction of ILVs in the main stream will really help them improve their standard of living.

ILVs were consumed in both urban and rural areas and played a vital role to their diet. Households preferred different types of ILVs but most consumed all ILVs considered in the study, these product were consumed in their fresh and dried state. These crops were mostly consumed in rainy season when they were abundant, but dried were available in winter.

Consumers were buying these products from hawkers and from farmers household. Ninety five percent of respondents indicated that they would be very interested in buying the products from retailers, the reason being that retailers are hygienic, easily accessible and they will be assure of constant supply. Then these will force farmers to supply high quality and enough ILVs.

4.12.2 Attitude of consumers towards ILVs

Generally consumers know ILVs but among white communities were not so popular, young generation consider the crops to be of low status. The main reason for young people to perceive the crop the way they do was because of the way parents cook it. To young people ILVs are just bitter vegetables that are not even that hygienic because of little stone detected when eating it.

Attitude of respondents who were consumers of ILV was shocking, since they value ILVs but seemed to be shy about these crops. A large number about 80% of respondents don't serve ILVs to visitors, they only serve when visitor asked for it especially the one from urban areas. Most of people don't serve these crops because it associated with poverty. ILVs were never served in special occasions as they believe that in ceremonies was time to eat meat. Consumers love the taste of ILV, because of its uniqueness. Not all family members were consuming ILVs; it was mostly preferred by woman and older males. Most kids ate only if they didn't have other relish to eat and adults were not teaching their kids on how to cook these crops. Approximately 99% of respondents highlighted that currently there are less varieties of ILVs as compared to

older days, suggested that it might be because of climate change, loss of interest in farming and immigration to urban areas.

4.12.3 Local preparing/cooking technique

Preparation methods have an influence on both safety and how younger generation perceives the product. Cooking methods from all the villages proved to be similar, different methods come with age difference. When preparing, they pre-boil little water in a pot then put leaves while the water is boiling. Leaves are boiled with no/ little water remaining after cooking. Ingredients that they add were tomatoes, salt and onion and sometimes peanut butter, the young generation sometimes add soups and cooking oil. Older generation don't add soups and cooking oil, they said when you add these ingredients you taking away the indigenous flavour, making it to taste like exotic crops. The reason they pre-boil water was to distil, to fasten the cooking process and make it tastier. Spider flower was cooked with lot of water in order to mask/reduce the bitterness. At times they mixed spider flower and Amaranth.

ILVs were usually eaten with maize meal porridge, at times together with meat. There is a need to introduce more recipes so as to make the ILVs more attractive.

4.12.4 Traits preferred by consumers

Crop appearance to some extend it determines how consumers perceive it, ILV consumers are of no exception. They preferred dark big green leaves, which show freshness of the product. Consumers perceived ILV to be healthier because of less use of agrochemicals.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarises the main findings of the study and concludes on the basis of the findings derived from the empirical results. It also gives recommendations on how the potential of these crops can be exploited.

5.2 Summary

The aim of the study was to analyse the production and commercialisation potential of indigenous leafy vegetables in the Capricorn district in the Limpopo Province of South Africa. The study had four objectives that are; (1) to identify the socio-economic characteristics of ILVs producers in rural areas of Capricorn district, (2) to investigate constraints faced by farmers in commercialising ILVs in rural areas of Capricorn district, (3) to determine the productivity of indigenous leafy vegetables in rural areas of Capricorn district and (4) to assess different types of marketing channels of ILVs in rural areas of Capricorn district.

To answer the objectives, the study used two analytical techniques, which were Stochastic Frontier Production model and Bubble Map. Results of the study indicate that majority (99%) of ILV farmers were females and were old age pension group. Most respondents had no or low formal level of education. The average household size in the study area is six and most respondents were married.

There were several constraints faced by farmers towards production and commercialisation of ILVs but the most outstanding were; water scarcity that bring threat into consistent supply, lack of financial resource that restricts farmers from purchasing the required inputs, lack of proper infrastructure, lack of knowledge on how to introduce a product to the market, lack of government support; absence of policies that support the development of ILVs and their marketing. In conjunction with these constraints farmers as well never saw or believe that these crops could fit in the main-stream food system, although they know its benefits.

Stochastic Frontier Production Function indicated that some of the variables were found to be positively significant, while others were negative but significant, and some non-

significant. Although some variables were not significant but still contributes to the level of ILV output. Production factors that were considered by the study were; land devoted to ILVs, labour, tractor cost, and manure. All were found to be significant except manure. This might be due to the fact that farms soils were already fertile. All these factors of production showed a positive contribution towards level of ILVs output apart from tractor cost which make an economic sense, meaning that when costs increase less output will be realized.

Also factors engaged by inefficiency model were found to be both negatively and positively significant while others were non-significant. The findings indicated that factors that were very significant were: age, farm size, labour, land ownership. Results also showed that factors that contributed to technical efficiency were gender, farm size, off-farm employment and access to transport. The mean technical efficiency in the study area was 31% with the minimum and maximum being 11% and 99% respectively.

5.3 Conclusions

The study had four research hypotheses; the first one stated that there were significant socio-economic characteristics affecting production of ILVs in rural areas of Capricorn district. Results of the study support this hypothesis because several socio-economic factors were identified that affect the production of ILVs.

The second hypothesis stated that constraints faced by farmers in commercialising indigenous leafy vegetables are not investigated. In support to this hypothesis results indicated that there were constraints affecting farmers from commercialising.

The third hypothesis stated that the productivity of indigenous leafy vegetables is low in rural areas of Capricorn district. The findings from the study supported this hypothesis since the technical efficiency of most farmers was found to be less than 50%.

The fourth hypothesis stated that there are no known structured marketing channels for indigenous leafy vegetables in rural areas of Capricorn district. Results from the study support the hypothesis as it was found that only informal market exist for these crops.

In general the study can conclude that there is a potential for commercialising ILV but there is a lot of work to be done in assisting farmers since their socio-economic status negatively affect the exploitation of these crops.

5.4 Recommendations

Based on the findings of this study, the study recommends the integration of science/ modern technology and indigenous knowledge, to improve the productivity of ILVs there is a need to introduce things such as improved seed, fertilizers but at the same time consider the knowledge and resources of farmers have. The integration of science and indigenous knowledge will allow rural people to improve production and participate in the main stream.

The study also recommends the awareness campaign on the benefit of ILVs in both rural and urban communities. The main focus of the campaign should be to change the perception of people towards ILVs so that they can start consuming them; this will raise the demand of these crops helping it to enter the main stream food system. Young people have a negative perception about these crops; they need to be educated about all the benefits of these crops. Also farmers need to know all the benefits associated with these crops, in terms of agronomic advantages, nutritional value and etc. so that they can sell the crops with confident and enthusiasm. Awareness should incorporate recruitment of youth to agriculture.

Since farmers were not technically efficient, therefore it is important to run workshops that will help them improve their production skills and how to market their products. Or create booklets that have information on how to efficiently produce ILVs. Both the booklets and workshops should take into consideration socio-economic characteristics of ILV farmers. These will help farmers understand the requirements of the crops their farming allowing using resources in manner that will help them achieve the highest level of efficient.

During the course of the research it appears like indigenous crop producing farmers were not given much attention by extension officers. This calls for government to spread their services even on indigenous crops producing farmers, it will help a lot in improving

the production as extension officers do frequent visit and they understand the local environment. Also encourage the formation of local well oriented formal institutions that will also discuss issues surrounding indigenous vegetables and promote the spirit of entrepreneurship among farmers. This will help farmers to be well organised and treat their farming as a business so as to make profit will feeding the nation.

More stakeholders should be involved as these crops are being developed, stakeholders like processing companies. Proper processing will help maintain nutrient content, help eliminate the loss due to spoilage and make these crops more attractive leading to it becoming a brand. Other stakeholders could be people who will come up with different recipes for these crops. These will help to introduce an appealing product into the market, the one that will be highly demanded rather than be forced into consumers. And more research is needed in finding alternative uses of these indigenous vegetables.

The study recommends the commercialisation of ILVs as these crops do have a great potential: they prove to add value into the lives of both producers and consumers. The crops will help communities financially, with health issues and socially. In urban areas, these products are highly demanded unfortunately they are scarce as they are mainly produced in rural areas.

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ANNEXURES

Annexure A: Household Questionnaire

COMMERCIALISATION POTENTIAL OF INDIGENOUS LEAFY VEGETABLES: CASE STUDY OF CAPRICORN DISTRICT IN THE LIMPOPO PROVINCE, SOUTH AFRICA

Household Questionnaire

Sandile Alexandra Mahlangu

Hi, my name is Sandile Alexandra Mahlangu. I am a Master (Agricultural Economics) student at the University of Limpopo, Turfloop campus and I am conducting a research, the topic my research is as stated above. I would really appreciate if you could spend the next 30 minutes responding to the questions. Feel free not to answer any question that you not comfortable with and you can ask any question. The information exchanged between us is going to be used to compile a M.Sc. research report.

Interview date …… 2012
Interview/questionnaire no …….
Interviewer's name …….
Name of village …….
Village Head …….

Respondent's name ……..
House no …….
Initial time ……
Ending time ……...

Part one:

GENERAL SOCIAL CHARACTERISTICS OF THE RESPONDENT

1. Respondent's name and surname …….

2. Gender

Female	Male

3. Marital status?

Single	Married	Windowed	Divorced

4. Number of people in the household? …….

5. What is your highest educational level?

No formal education	Primary	Secondary	Tertiary	Vocational qualification	Abet

6. Source of income

Own Salary	Remittance	Farming	Social grant	Others(specify)

7. Age of household head

<35 years	36-40 years	41-50 years	51-60 years	>60

8. Number of dependents

1	2-6	7-11	12-16

Part two: Production of ILVs

1. How big is your land/Farm?

   .....……..

2. What is the size of the land devoted to Indigenous Leafy Vegetables?

   …….

3. What types of Indigenous Leafy Vegetables do you produce?

Amaranths (Lerotho)	Spider Flower (Thepe)	Cowpea (Monawa)	Others (specify)

4. Do you use seeds? Yes…….No……...

   4.(a). If yes, where do you get them?

Buy	From last season	Buy and use from last season

5. What other types of crops do you produce?

   ……

   ……

6. For how long have you been producing Indigenous Leafy Vegetables?

   …….

7. What was the reason for you to start producing Indigenous Leafy Vegetables?

   ……

   ……

8. Why are these leafy vegetables under-utilised?

Seasonal	People don't buy	Expensive	Food for the poor

9. Which production system do you use?

Intensive	Semi-intensive	Extensive

10. Do you use manure? Yes…….No…….

10. (a). If yes how many bags? .....

10. (b). Where do you get the manure?

Buy	From your own kraal	From Neighbours

10. (c). If you buy how much do you pay? .....

10. (d). What type of manure do you use?

Chicken	Cattle	Goat	Leaves	Mix

11. Do you use fertiliser? Yes…….No……

11. (a). If yes how many bags? …….

11.(b). Where do you get the fertiliser?

Local shops	From Town	Donation (specify)

11. (c). How much do you pay? ……..

12. What is your water source?

Borehole	Dam	River	Rainwater	Other (specify)

13. How do you irrigate your crops?

Rainwater	Furrows	Canal	Horse pipe	Irrigation system	Go fetch	Other (specify)

14. Do you have labour assistance and what type? Yes……No……

Type of Labour	Full time	Part time	Unpaid family labour	**Total**
Number				

15. How much is the tractor? R……

16. How many bags do you produce per season?

Type of crop	Amaranths	Spider flower	Cowpea	Other (specify)
Number				

Part Three: Socio-Economic characteristics related to Indigenous Leafy Vegetables production

1. Do you have ownership of the land you farm on? Yes……No…….

2. Is your farm fenced? Yes…….. No…….

2. Is the land devoted to ILVs increasing or decreasing over the years? Yes….No…..

3. What is the reason for the above situation? .....

……

4. Do you receive extension services regarding ILVs? Yes……..No…….

4. (a). if yes, how do you rate the service?

Bad	Fine	Excellent

5. Are you employed elsewhere other than farming? Yes…….No……

6. Do you own a vehicle? Yes…….No……..

7. Do you have electricity on the farm? Yes…….No…….

8. Do you have access to credits? Yes…….No……..

9. What's your perception of Indigenous Leafy Vegetables as compared to exotics?

	Bad	**Fine**	**Good**	**Excellent**
Drought tolerance				
Maturity				
Bunch size				
Performance in poor soils				
Resistant to nematodes				
Input costs				
Easy to produce				
Texture				
Colour				
Storability				
Freshness				
Taste				
Nutritious				
Any other (specify)				

10. Do you belong to any farmers group? Yes……No……

11. Do you promote the production of ILVs in the group? Yes…….No……

12. Number of years in farming? ……..

13. What are the major challenges that you face in producing ILVs?

……

……

……

……

Part Four: Marketing of the products

1. Do you sell the produced? Yes……No……..

2. Where do you sell most of your produce?

In the local Village	In the neighbouring village	In the nearest shopping centre	In town

3. How do you sell your products?

Fresh	Dry	Fresh and Dry

4. How much is a bunch or pack of ILVs?

	Cowpea	Amaranths	Spider Flower
Fresh			
Dry			

5. How is your price set?

Market driven	Dictated by buyers	Through negotiations	Other specify

6. How important is the system you use to set the price? ……

……

……

7. How do you market your produce?

Advertisement	
Word of Mouth	
Sell along the road	
Other (specify)	

8. Which of the ILVs is profitable?

Amaranths	Spider Flower	Cowpea

9. How do you dry you produce? ……

……

……

10. How long can a dried product be stored?

	Amaranths	Cowpea	Spider flower
In months			

11. How many bags do you sell per season? ……

12. What is the distance to the out put market?

	local Village	neighbouring village	Supermarket	Town
Distance in Km				

13. Do you think it's possible to commercialise ILVs?

……

……

……

……

Annexure B: Consumer Questionnaire

COMMERCIALISATION POTENTIAL OF INDIGENOUS LEAFY VEGETABLES: CASE STUDY OF CAPRICORN DISTRICT IN THE LIMPOPO PROVINCE, SOUTH AFRICA

Consumer Questionnaire

Sandile Alexandra Mahlangu

Hi, my name is Sandile Alexandra Mahlangu. I am a Master (Agricultural Economics) student at the University of Limpopo, Turfloop campus and I am conducting a research, the topic my research is as stated above. I would really appreciate if you could spend the next 30 minutes responding to the questions. Feel free not to answer any question that you not comfortable with and you can ask any question. The information exchanged between us is going to be used to compile a M.Sc. research report.

Interview date …… 2012
Interview/questionnaire no …….
Interviewer's name …….
Name of Area …….
Initial time ……
Ending time ……....

Consumer Perspective

1. Respondent's name and surname? …….
2. Gender?

Female	Male

4. Where do you stay, is it rural or urban area? .....

4. Number of people in the household? ……
5. Highest school qualification?

No formal education	primary	Secondary	Tertiary	Vocational qualification	Abet

6. Source of income for the household head?

Own Salary	Remittance	Farming	Social grant	Others(specify)

7. Age of household head

<35 years	36-40 years	41-50 years	51-60 years	>60

8. How many people are working in the household?

1	2-6	7-11	12-16

9. How many times do you consume ILVs in a week? ……...

10. Does the frequency of consumption decreased or increased over the years?.....

……

11. Which ILV do you consume?

Amaranths (Thepe)	Spider Flower (Lerotho)	Cowpea (Monawa)	Others(specify)

12. What are the traits of the best ILVs? ……

……

13. What is your perception of ILVs?

13. (a). Do you offer ILVs when visitors come to your home and what is your reason? Yes/No……

……..

13. (b). Do you consume ILVs at special occasions and why? Yes/No……

……..

……..

13. (c) Do you like the taste of ILVs and why? Yes/No……...

……..

13. (d). Are ILVs an important contribution to the diet when there is food shortage? Yes/No……

13. (e). Do adult males in your household eat ILVs? Yes/No……

13. (f) Generally, do your children like eating ILVs? Yes/No ……

13. (g). Are you teaching your children how to prepare ILVs? Yes/No ……

……

13. (h).Are fewer varieties of ILVs to be found nowadays than 10-20 years back and what might be the cause? Yes/No ……

……..

14. How do you prepare your ILVs? ……..

……

……

……

15. Would you like to buy ILVs from retailers and why? Yes/No……...

……

……

……

Annexure C: Pictures of ILVs

Mixture of Fresh ILVs

Dried Packaged ILV (cowpea)

Annexure D: Result from Stochastic Frontier Production Model

Inputs

```
2           1=ERROR COMPONENTS MODEL, 2=TE EFFECTS MODEL
dta.txt      DATA FILE NAME
out.txt      OUTPUT FILE NAME
1           1=PRODUCTION FUNCTION, 2=COST FUNCTION
y           LOGGED DEPENDENT VARIABLE (Y/N)
60           NUMBER OF CROSS-SECTIONS
1           NUMBER OF TIME PERIODS
60           NUMBER OF OBSERVATIONS IN TOTAL
4           NUMBER OF REGRESSOR VARIABLES (Xs)
y           MU (Y/N) [OR DELTA0 (Y/N) IF USING TE EFFECTS MODEL]
13           ETA (Y/N) [OR NUMBER OF TE EFFECTS REGRESSORS (Zs)]
n           STARTING VALUES (Y/N)
           IF YES THEN    BETA0
                          BETA1 TO
                          BETAK
                          SIGMA SQUARED
                          GAMMA
                          MU          [OR DELTA0
                          ETA             DELTA1 TO
                                        DELTAP]

                          NOTE: IF YOU ARE SUPPLYING STARTING VALUES
                          AND YOU HAVE RESTRICTED MU [OR DELTA0] TO BE
                          ZERO THEN YOU SHOULD NOT SUPPLY A STARTING
                          VALUE FOR THIS PARAMETER.
```

Output

Output from the program FRONTIER (Version 4.1c)

```
instruction file = ins.txt
data file =       dta.txt


 Tech. Eff. Effects Frontier (see B&C 1993)
 The model is a production function
 The dependent variable is logged
```

the ols estimates are :

	coefficient	standard-error	t-ratio
beta 0	0.69116263E+01	0.52844217E+00	0.13079248E+02
beta 1	0.60188826E+00	0.17201956E+00	0.34989524E+01
beta 2	0.19174869E+00	0.13017853E+00	0.14729671E+01
beta 3	-0.20912990E+00	0.73400339E-01	-0.28491680E+01
beta 4	0.55265727E-01	0.32013818E-01	0.17263085E+01
sigma-squared	0.30909300E+00		

log likelihood function = -0.47302577E+02

the estimates after the grid search were :

beta 0	0.70081424E+01
beta 1	0.60188826E+00
beta 2	0.19174869E+00
beta 3	-0.20912990E+00
beta 4	0.55265727E-01
delta 0	0.00000000E+00
delta 1	0.00000000E+00
delta 2	0.00000000E+00
delta 3	0.00000000E+00
delta 4	0.00000000E+00
delta 5	0.00000000E+00
delta 6	0.00000000E+00
delta 7	0.00000000E+00
delta 8	0.00000000E+00
delta 9	0.00000000E+00
delta10	0.00000000E+00
delta11	0.00000000E+00
delta12	0.00000000E+00
delta13	0.00000000E+00
sigma-squared	0.29265061E+00
gamma	0.50000000E-01

iteration = 0 func evals = 20 llf = -0.47313742E+02
0.70081424E+01 0.60188826E+00 0.19174869E+00-0.20912990E+00
0.55265727E-01
0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00
0.00000000E+00
0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00
0.00000000E+00

0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00
0.29265061E+00
0.50000000E-01
gradient step
iteration = 5 func evals = 56 llf = -0.40879534E+02
0.69897264E+01 0.57512418E+00 0.17592076E+00-0.16840613E+00
0.10448374E+00
0.73636748E-01 0.47235851E-01 0.18082351E+00 0.16712037E+00 0.21102682E-
01
-0.16669616E+00 0.79721309E-01 0.77894023E-01 0.11448421E+00
0.00000000E+00
0.13332654E+00 0.96583737E-01 0.11139638E-01-0.10653922E+00
0.21748448E+00
0.53575654E+00
iteration = 10 func evals = 81 llf = -0.38250347E+02
0.69336965E+01 0.49720048E+00 0.12415873E+00-0.14116798E+00
0.13031564E+00
0.46420989E+00 0.89925443E-01 0.23390931E+00 0.15695418E+00-
0.22028527E-01
-0.27214380E+00-0.28044873E-01 0.23116751E-01 0.35911372E+00
0.00000000E+00
0.34565122E+00 0.76507853E-01 0.90027862E-02-0.13639849E-01
0.20099811E+00
0.77521559E+00
iteration = 15 func evals = 137 llf = -0.28671037E+02
0.74801141E+01 0.31173947E+00 0.21885295E+00-0.15459726E+00
0.56162964E-01
0.11459013E+01 0.64438258E-01 0.42775095E+00 0.64950324E-01 0.32107958E-
01
-0.46443364E+00 0.31999177E-01 0.74995366E-01 0.29044984E+00
0.00000000E+00
0.21466878E+00 0.23687668E+00 0.15100385E+00 0.10964308E+00
0.22397168E+00
0.96567532E+00
iteration = 20 func evals = 203 llf = -0.17697627E+02
0.76967645E+01 0.91772198E-01 0.24235077E+00-0.15536421E+00
0.12203937E-01
0.25700175E+01-0.11126232E+00 0.35227187E+00 0.14492609E+00
0.74072589E-01
-0.62988939E+00-0.30070790E+00 0.30930205E+00 0.26945301E-01
0.00000000E+00
0.24382314E+00-0.49822279E-01-0.51142246E-01 0.16838018E+00
0.18035244E+00
0.99999999E+00
iteration = 22 func evals = 220 llf = -0.17695369E+02 0.76967817E+01
0.91736971E-01 0.24235342E+00-0.15536533E+00 0.12198164E-01

0.25704541E+01-0.11132588E+00 0.35222602E+00 0.14494752E+00
0.74083762E-01
-0.62991114E+00-0.30074054E+00 0.30927580E+00 0.26886936E-01
0.00000000E+00
0.24377493E+00-0.49778053E-01-0.51153168E-01 0.16837363E+00
0.18033851E+00
0.99999999E+00

the final mle estimates are :

	coefficient	standard-error	t-ratio
beta 0	0.76967817E+01	0.83406535E+00	0.92280319E+01
beta 1	0.91736971E-01	0.38986516E+00	0.23530436E+00
beta 2	0.24235342E+00	0.10775934E+00	0.22490247E+01
beta 3	-0.15536533E+00	0.10756817E+00	-0.14443431E+01
beta 4	0.12198164E-01	0.37245279E-01	0.32750901E+00
delta 0	0.25704541E+01	0.12610746E+01	0.20383046E+01
delta 1	-0.11132588E+00	0.45556907E+00	-0.24436662E+00
delta 2	0.35222602E+00	0.25378650E+00	0.13878832E+01
delta 3	0.14494752E+00	0.22297170E+00	0.65007138E+00
delta 4	0.74083762E-01	0.14579598E+00	0.50813309E+00
delta 5	-0.62991114E+00	0.12331989E+00	-0.51079443E+01
delta 6	-0.30074054E+00	0.32255910E+00	-0.93235795E+00
delta 7	0.30927580E+00	0.32545519E+00	0.95028691E+00
delta 8	0.26886936E-01	0.34424252E+00	0.78104634E-01
delta 9	0.00000000E+00	0.10000000E+01	0.00000000E+00
delta10	0.24377493E+00	0.42009533E+00	0.58028479E+00
delta11	-0.49778053E-01	0.45694185E+00	-0.10893739E+00
delta12	-0.51153168E-01	0.94564345E+00	-0.54093505E-01
delta13	0.16837363E+00	0.21928039E+00	0.76784624E+00
sigma-squared	0.18033851E+00	0.61108258E-01	0.29511316E+01
gamma	0.99999999E+00	0.37778778E-01	0.26469887E+02

log likelihood function = -0.17695370E+02

LR test of the one-sided error = 0.59214415E+02
with number of restrictions = *
[note that this statistic has a mixed chi-square distribution]

number of iterations = 22

(maximum number of iterations set at : 100)

number of cross-sections = 60

number of time periods = 1

total number of observations = 60

thus there are: 0 obsns not in the panel

covariance matrix :

0.69566502E+00 0.21794759E+00 0.30812484E-01 -0.81625673E-01 -0.18849829E-02
0.67753825E-01 -0.15911643E+00 -0.10268486E+00 0.68437879E-01 0.47363165E-01
0.11821130E-01 -0.22517790E-01 0.11060987E+00 -0.54092877E-01 0.00000000E+00
0.16900453E+00 0.76412646E-02 -0.55040309E-01 -0.51381858E-01 0.49313131E-02
0.16647744E-01
0.21794759E+00 0.15199484E+00 0.66259459E-02 -0.17853011E-01 0.26755501E-02
0.78462973E-01 -0.98178767E-01 -0.63705693E-01 0.52559460E-01 0.30351704E-01
0.11748641E-02 0.37573261E-01 0.38800732E-01 0.66779196E-02 0.00000000E+00
0.77596072E-01 -0.68660451E-01 -0.17551783E-01 -0.41933284E-01 0.88244868E-02
0.70326950E-02
0.30812484E-01 0.66259459E-02 0.11612075E-01 -0.56752842E-02 0.12964772E-02
-0.68576798E-02 0.25668530E-02 -0.74559884E-02 0.35198307E-02 0.53680465E-02
-0.94285458E-04 -0.72705830E-02 0.17409911E-01 0.39158336E-02 0.00000000E+00
0.85177929E-03 0.84822237E-02 -0.41443290E-02 -0.18648670E-02 -0.15467541E-03
0.17283105E-02
-0.81625673E-01 -0.17853011E-01 -0.56752842E-02 0.11570910E-01 -0.69754521E-03
0.22317692E-01 0.59479140E-02 0.92696670E-02 -0.64899926E-02 -0.49004700E-02
-0.24294253E-02 0.12005830E-01 -0.17252107E-01 0.49067475E-03 0.00000000E+00
-0.15201363E-01 -0.77978226E-02 0.79887769E-02 0.43827933E-02 -0.36034619E-03
-0.16644564E-02

-0.18849829E-02 0.26755501E-02 0.12964772E-02 -0.69754521E-03 0.13872108E-02
-0.21345040E-01 0.74637669E-02 -0.14702005E-02 0.27729073E-02 0.16153602E-02
 0.33192816E-03 -0.39010336E-02 0.50471461E-02 0.92259220E-02
0.00000000E+00
-0.23809089E-02 -0.30889320E-02 -0.12428604E-03 -0.18915570E-02 0.81103529E-03
 0.10070761E-03
 0.67753825E-01 0.78462973E-01 -0.68576798E-02 0.22317692E-01 -0.21345040E-01
 0.15903092E+01 -0.31021329E+00 -0.13774619E+00 0.12010851E-01
0.31400553E-01
-0.93753580E-01 0.98836950E-01 -0.71205208E-01 -0.17113695E+00
0.00000000E+00
-0.65413172E-01 -0.15115402E+00 -0.49948963E-01 -0.81849013E-02 -0.15012939E-01
 0.92860348E-02
-0.15911643E+00 -0.98178767E-01 0.25668530E-02 0.59479140E-02
0.74637669E-02
-0.31021329E+00 0.20754318E+00 0.55708713E-01 -0.28611998E-01 -0.53594101E-02
-0.57948349E-02 -0.84851220E-01 0.30915916E-01 0.45520631E-01
0.00000000E+00
-0.98547969E-01 0.75575054E-01 -0.45098468E-01 0.29236815E-01 0.38362381E-02
-0.21710050E-02
-0.10268486E+00 -0.63705693E-01 -0.74559884E-02 0.92696670E-02 -0.14702005E-02
-0.13774619E+00 0.55708713E-01 0.64407588E-01 -0.34813005E-01 -0.21885718E-01
 0.14857378E-03 -0.51890508E-02 -0.24501424E-01 -0.13799139E-01
0.00000000E+00
-0.47535555E-01 0.40763170E-01 0.10962913E-01 0.26447315E-01 -0.19509944E-02
-0.43814188E-02
 0.68437879E-01 0.52559460E-01 0.35198307E-02 -0.64899926E-02 0.27729073E-02
 0.12010851E-01 -0.28611998E-01 -0.34813005E-01 0.49716380E-01 0.16482241E-01
 0.11131940E-03 0.64985942E-02 0.19872351E-01 0.63834650E-02
0.00000000E+00
 0.20173174E-01 -0.45805497E-01 0.24882189E-01 -0.26262762E-01 0.27383740E-02
 0.34380745E-02

0.47363165E-01 0.30351704E-01 0.53680465E-02 -0.49004700E-02 0.16153602E-02
0.31400553E-01 -0.53594101E-02 -0.21885718E-01 0.16482241E-01 0.21256468E-01
-0.67064716E-02 -0.11793071E-02 0.21896153E-01 -0.19654603E-02 0.00000000E+00
0.59448532E-03 -0.81673102E-02 0.10022696E-01 -0.13540936E-01 0.18462644E-02
0.32182248E-02
0.11821130E-01 0.11748641E-02 -0.94285458E-04 -0.24294253E-02 0.33192816E-03
-0.93753580E-01 -0.57948349E-02 0.14857378E-03 0.11131940E-03 -0.67064716E-02
0.15207796E-01 0.46090102E-02 -0.64382190E-02 0.10906951E-01 0.00000000E+00
0.28202957E-01 0.65605893E-02 0.91503831E-02 -0.45184178E-02 0.11966052E-03
-0.11291188E-02
-0.22517790E-01 0.37573261E-01 -0.72705830E-02 0.12005830E-01 -0.39010336E-02
0.98836950E-01 -0.84851220E-01 -0.51890508E-02 0.64985942E-02 -0.11793071E-02
0.46090102E-02 0.10404437E+00 -0.47237509E-01 -0.27059746E-01 0.00000000E+00
0.33874437E-01 -0.43480926E-01 0.66035196E-01 -0.15651921E-01 0.25868656E-02
0.66960795E-04
0.11060987E+00 0.38800732E-01 0.17409911E-01 -0.17252107E-01 0.50471461E-02
-0.71205208E-01 0.30915916E-01 -0.24501424E-01 0.19872351E-01 0.21896153E-01
-0.64382190E-02 -0.47237509E-01 0.10592108E+00 0.16772127E-01 0.00000000E+00
-0.64031786E-02 -0.17243699E-01 0.47947948E-02 -0.16825210E-01 0.42639560E-02
0.56052576E-02
-0.54092877E-01 0.66779196E-02 0.39158336E-02 0.49067475E-03 0.92259220E-02
-0.17113695E+00 0.45520631E-01 -0.13799139E-01 0.63834650E-02 -0.19654603E-02
0.10906951E-01 -0.27059746E-01 0.16772127E-01 0.11850291E+00 0.00000000E+00
0.13708953E-01 -0.21117001E-01 -0.46865164E-01 -0.45166945E-02 0.21931093E-02
-0.13391157E-02

0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00
0.00000000E+00
0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00
0.00000000E+00
0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00
0.10000000E+01
0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00
0.00000000E+00
0.00000000E+00
0.16900453E+00 0.77596072E-01 0.85177929E-03 -0.15201363E-01 -
0.23809089E-02
-0.65413172E-01 -0.98547969E-01 -0.47535555E-01 0.20173174E-01 0.59448532E-
03
0.28202957E-01 0.33874437E-01 -0.64031786E-02 0.13708953E-01
0.00000000E+00
0.17648009E+00 -0.20252723E-01 -0.20378800E-01 -0.24187505E-01
0.14518301E-02
0.12421822E-02
0.76412646E-02 -0.68660451E-01 0.84822237E-02 -0.77978226E-02 -0.30889320E-
02
-0.15115402E+00 0.75575054E-01 0.40763170E-01 -0.45805497E-01 -
0.81673102E-02
0.65605893E-02 -0.43480926E-01 -0.17243699E-01 -0.21117001E-01
0.00000000E+00
-0.20252723E-01 0.20879585E+00 -0.19551929E+00 0.48628602E-01 -
0.45516334E-02
-0.12337785E-02
-0.55040309E-01 -0.17551783E-01 -0.41443290E-02 0.79887769E-02 -0.12428604E-
03
-0.49948963E-01 -0.45098468E-01 0.10962913E-01 0.24882189E-01 0.10022696E-
01
0.91503831E-02 0.66035196E-01 0.47947948E-02 -0.46865164E-01
0.00000000E+00
-0.20378800E-01 -0.19551929E+00 0.89424153E+00 -0.75984862E-01
0.28814915E-02
0.32217116E-02
-0.51381858E-01 -0.41933284E-01 -0.18648670E-02 0.43827933E-02 -0.18915570E-
02
-0.81849013E-02 0.29236815E-01 0.26447315E-01 -0.26262762E-01 -0.13540936E-
01
-0.45184178E-02 -0.15651921E-01 -0.16825210E-01 -0.45166945E-02
0.00000000E+00
-0.24187505E-01 0.48628602E-01 -0.75984862E-01 0.48083892E-01 -0.23874113E-
02
-0.24514078E-02

0.49313131E-02 0.88244868E-02 -0.15467541E-03 -0.36034619E-03 0.81103529E-03
-0.15012939E-01 0.38362381E-02 -0.19509944E-02 0.27383740E-02 0.18462644E-02
0.11966052E-03 0.25868656E-02 0.42639560E-02 0.21931093E-02 0.00000000E+00
0.14518301E-02 -0.45516334E-02 0.28814915E-02 -0.23874113E-02 0.37342192E-02
0.45756566E-03
0.16647744E-01 0.70326950E-02 0.17283105E-02 -0.16644564E-02 0.10070761E-03
0.92860348E-02 -0.21710050E-02 -0.43814188E-02 0.34380745E-02 0.32182248E-02
-0.11291188E-02 0.66960795E-04 0.56052576E-02 -0.13391157E-02 0.00000000E+00
0.12421822E-02 -0.12337785E-02 0.32217116E-02 -0.24514078E-02 0.45756566E-03
0.14272360E-02

technical efficiency estimates :

firm	year	eff.-est.
1	1	0.23681019E+00
2	1	0.13103684E+00
3	1	0.63393821E+00
4	1	0.15088892E+00
5	1	0.20351569E+00
6	1	0.33058045E+00
7	1	0.22430725E+00
8	1	0.17768742E+00
9	1	0.46730240E+00
10	1	0.71424534E-01
11	1	0.23989959E+00
12	1	0.82011748E-01
13	1	0.11251631E+00
14	1	0.88989091E+00
15	1	0.24939687E+00
16	1	0.26239652E+00
17	1	0.22972159E+00
18	1	0.27040173E+00
19	1	0.18520920E+00
20	1	0.24420202E+00

21	1	0.24647696E+00
22	1	0.29541460E+00
23	1	0.19280969E+00
24	1	0.18085613E+00
25	1	0.11273428E+00
26	1	0.24381663E+00
27	1	0.32375681E+00
28	1	0.19439309E+00
29	1	0.10714748E+00
30	1	0.14555231E+00
31	1	0.27668259E+00
32	1	0.20730345E+00
33	1	0.21137589E+00
34	1	0.15200746E+00
35	1	0.32605370E+00
36	1	0.56249550E+00
37	1	0.24417250E+00
38	1	0.75964777E+00
39	1	0.21883255E+00
40	1	0.17926782E+00
41	1	0.26478173E+00
42	1	0.99635786E+00
43	1	0.64607881E+00
44	1	0.17134900E+00
45	1	0.99969178E+00
46	1	0.24110061E+00
47	1	0.38714692E+00
48	1	0.14880333E+00
49	1	0.22888231E+00
50	1	0.14914946E+00
51	1	0.45521249E+00
52	1	0.48505424E+00
53	1	0.40470026E+00
54	1	0.45904227E+00
55	1	0.18329496E+00
56	1	0.41685125E+00
57	1	0.10813309E+00
58	1	0.45180511E+00
59	1	0.45877746E+00
60	1	0.33364681E+00

mean efficiency = 0.30939659E+00