PROFITABILITY ANALYSIS AND RESOURCE USE EFFICIENCY IN SWEET POTATO PRODUCTION IN GAYA ZONE, KANO STATE, NIGERIA.

BY

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DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY AHMADU BELLO UNIVERSITY, ZARIA

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DECLARATION

I hereby declare that this dissertation titled **"**Profitability Analysis and Resource Use Efficiency in Sweet Potato Production in Gaya Zone Kano State, Nigeria**"**has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another degree or diploma at any institution. All citation and sources of information are duly acknowledged by means of references.

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CERTIFICATION

This dissertation titled **'Profitability Analysis and Resource Use Efficiency in Sweet Potato Production in Gaya Zone Kano State, Nigeria'** byRabiuAwaisumeets the regulations governing the award of the Degree of Master of Science of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

I dedicated this dissertation to theAlmighty Allah (S.W.T) the most beneficent, the most merciful, the sovereign, the compassionate, thecompeller, the greatest, and the creator of all creatures whose facilitated my successful completion of this work.

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Abstract

This study was carried out in three Local Government Areas in Kano State, Nigeria. A multistage sampling technique was used in selecting respondents for this study. The first stage was purposive selection of the three Local Governments based on predominance of sweet potato production. Secondly, two villages were purposively selected from each local government areas based on their intensity of sweet potato production. Finally, a simple random sampling was employed in selecting farmers from each of the villages. Ten percent of the sample frame (1204) was used as the sample size. In all, 120 farmers were randomly selected. Descriptive statistics, net farm income and stochastic frontier production function was used in analyzing the data. The study showed that 35.8% of the respondents fell within the age range of 30 and 39 years. Some of the farmers (39.2%) had no formal education. while majority of the farmers (64.2%) were not members of a Cooperative Society. The return to scale was estimated to be ₦1.26 (> 1). Sweet potato production was profitable with an average return of ₦0.26k for every ₦1 invested in the study area. The parameters of the stochastic frontier production function were estimated simultaneously with that of the model of inefficiency variables. Results indicated that seed and agrochemical variables were significant (P<0.01) while labour is significant (P<0.10). The mean technical and allocative efficiencies were 86% and 62% respectively. Findings further revealed that none of the sampled sweet potato farmers reached the frontier threshold.However, the average economic efficiency of the sweet potato farmers was 53%. Also, cooperative association and farming experience were the only socio-economic variables responsible for the variation in technical efficiency. It was therefore recommended that timely and adequate supply of fertilizer and improved seed should be made available to farmers through e-wallet programme at affordable prices and formal and strong farmers` association should be form in order to enhance the production and utilization of sweet potato.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Agriculture is the mainstay of the Nigerian economy. It is characterized by a large number of small – scale farmers with small holding ranging from 0.05 to 3.00 hectares of land area, low capitalization and low yield per hectare (Ogundari and Ojo, 2007). The role of agriculture remains significant in the Nigerian economy despite the strategic importance of the oil sector. Agriculture provides primary means of employment for Nigerians and accounts for more than two-third of the labour force (FAO, 2003).

In view of the serious challenges of feeding a world population that reached 6.1 billion in2000, and is likely to approach 9.3 billion in 2050,it has becomerelevant to pay more attention to food production issues(DESA, 2000). About 215 million (43%) sub-Saharan African population is chronically under nourished and unless positive action is taken, this may increase to around 315 million by the year 2020 (World Food Programme, 2005).

If food production is to keep pace with rapid population growth and demand for food, a new, creative and revolutionary approach to agricultural development must be developed. In a country where millions of people are not adequately fed, Nigeria's potentially unexploited food resources must be unearthed and utilized. The rural farmers constituted the back bone of the Nigerian agricultural sector producing about 80 percent of the total national agricultural output by using traditional method under rain-fed conditions (Fayinka, 2004). It is important to emphasize that despite the potential benefits steaming from the expansion of the agricultural sector through various government efforts, its overall productivity remains low and the poor performance of agriculture is most clearly evidenced by the low standard of living of these small-scale rural farmers (Dogon Daji, 2005).

Like other agricultural crops, sweet potatoes have a role to play in developing the economy, through the provision of food to the increasing population and as a source of income to farmers and other stake-holders in value chain. The ease by which sweet potatoes are consumed without much processing in most parts of the tropics is another major advantage of the crops. It is either eaten boiled, cooked and frozen, creamed and used as pie fillings. It is also dried and grinded into flour to make biscuits, bread and other pastries. Sweet potatoes can also be pounded together with yam to give a delicious meal. Although, sweet potato is consumed in all parts of the country, its level of production still remains low.

Sweet potato is the second highest source of energy after cassava producing 465KJ, that is, only 125KJ less than cassava (SPU, 2013).Industrially, sweet potatoes flour can be used to substitute wheat flour in bread making or maize flour in balanced feeds. The human body needs energy to work and play. Energy comes from the nutrients in the foods that are eaten. The main nutrients that give energy are carbohydrates, protein and fat. Energy is measured in kilocalories (Kcal), calories or Kilojoules (KJ), and 1 kilocalorie = 4.2 kilojoules.).However, industrial potentials of sweet potato have not been exploited due mainly to a chronic lack of awareness about the numerous commercial benefits derived from it (Azogu, *et al*., 2001).

1.2 Problem Statement

Food security is a key priority for the over 200 million people of Western Africa, and this population isenvisaged to double by 2030 (Kyamanywa*et al.*, 2011). Sweet potato is the most productive crop among all the other staple crops produced inSub Sahara Africa (SSA) and tolerates occasionally dry spells and yields even on less fertile soil in contrast to other crops such as maize (Low *et al.,* 2009). Despite the fact that it is undoubtedly regarded as a

food security crop, research on sweet potato production is found to be scarce and inadequate. As a result the National Food Reserves Agency (2011) opined that, despite the fact that Nigeria was found to be the second highest producer of sweet potato out of the 23 countries surveyed in SSA, it was ranked 17th in terms of output produced per land area, suggesting that sweet potato producers in Nigeria are quite inefficient in relation to other farmersinSSA.

The Federal Government released its plan early this year to improve the productivity of sweet potato in this country from six tons per hectare to 25tonsper\ hectare by 2015, and national production from two million to six million per annum by 2016 as against the present effort to producing only 6.7 tons per annum (Ajetomobi, 2014). In the same source, the nation is the third largest producer in the world, rank 94% in terms of the yield, and efforts to increase the yields alone can make the nation to be the leading producer.

Poverty reduction which is the first millennium development goal (MDG) is one of the most documented phenomena that adversely affect human beings. In Nigeria, out of approximately 170 million inhabitants, the 70% of this population who are found to be living in poverty are in majority represented by farmers. These statistics are quite alarming given the fact that Nigeria as a country is blessed with abundant human and natural resources that can guarantee the country's sustainable development, food and nutrition security as well as impact positively on regional development of Africa as a whole if properly harnessed(Onyeukwu, 2013).

Consumption of fresh sweet potato roots tends to decrease with urbanization, due to shifts in diet related to factors such as price, convenience and status (Tomlins*et al*., 2010). Enhancing the unrealized potential of sweet potato by improving its marketing system and increasing demands in fresh roots and value-added sweet potato-based products would

contribute to increase productivity and well being among rural producers, especially women and will help meet ever increasing urban food demands (Best *et al*., 2009).

It is therefore, the intention of this study to address the following research questions:

i. What are the socio-economic characteristics of the sweet potato farmers in the study area?

ii. Is sweet potato production profitable in the study area?

iii. What are the levels of technical, allocative and economic efficiency of the sweet potatoes farmers?

ivWhat are the constraints to increase the production of sweet potato in the study area?

1.3 Objectives of the Study

The broad objective of the study was to evaluate the profitability and the efficiency of sweet potato production in the study area.

The specific objectives were to;

i. describe the socio-economic characteristic of the sweet potato farmers in the study area;
ii. determine the profitability of sweet potato production;
iii. determine the levels of technical, allocation and economic efficiency of sweet potato farmers, and

iv. describe the constraints to sweet potato production in the study area.

1.4 Justification of the Study

Sweet potatoes offer a particularly significant potential for increasing food production and income among Nigerian farmers like other agricultural crops. However, sweet potato has a role to play in the developing economics. Its production provides job opportunities for farmer, thus raising their income and it is consumed without much processing in most part of the tropics. The feeding of over 110 Million Nigerian is a common task that must be accomplished, otherwise poverty, malnutrition, and hunger will increase rapidly in the coming years (Adegbola, 1997).

As in the majority of industry, most African, Caribbean and Pacific (ACP) countries, particularly in Africa, are not competitive at the industry and logistic level nor in their research and development. To encourage the cultivation of sweet potato, rural development and working conditions for farmers must be supported, and yet more and more benefit are been discovered in the research and study(UNCTAD, 2012). Little research is known to have been undertaken on the economics of sweet potato production compared to other roots and tubers like cassava and yam (Akinwumi, 2002; Azogu, *et al.,* 2002; UNCTAD, 2012).

This study is expected to provide valuable information on resource use and profitability of growing sweet potato to enable farmers consider its production as a viable option. The study is also expected to provide the most feasible adjustment in resource needed to boost the output of the crop.The result of the study can be used by policy makers as a guide to the development of the appropriate institutional support needed to increased output of the crop.

1.5 Research Hypothesis

The research hypotheses put forward for this study were.

i. Sweet potato production is not profitablein the study area.

ii. Sweet potato farmers are not efficient in their use of inputs in the study area.

CHAPTER TWO

LITERATURE REVIEW

2.1 Origin and Distribution of Sweet Potato

The Columbus in 1492 brought it with him on his return to Spain from his first voyage, eighty years before the potato reached Europe (Purseglove 1981). By the 1520's, Portuguese Mariners carriessweetpotato to ports and territories throughout Africa and Asia, diffusion later continued by other Europeans (Huntington, 2010).However, some other prospective scholars also made various approaches in the origin of Sweet potato and its distribution. A general studies into the origin of domesticated plant have been concerned with establishing the genetic relationship between this plant and some wild ancestors.Evidence established by previous investigation archeological, linguistic and historical establish that this sweet potato originated in the new world either in the Central or South America lowland.

Whatever the circumstance of sweet potato to Africa, the crop was well established across the broad region of humid forest zone from the coast ofGuinea Bissau to the high land of West Africa and South Madagascar. In Africa, the sweet potato production and distribution area were heavily falls in the "middle belt of Nigeria and later research discovered that sweet potato has traditionally grown in a few restricted areas of central and south eastern zone, which might have been centre of concentration as recently as 1971(Tewe, etal.,2001).The preliminary survey estimate indicates average yields in Nigeria of 7 toned per/hectare in south eastern which is a very good result compare to others rooted crop in the south eastern but the case was not the same in north which indicates an average yields per hectare declining to 3-5 toned/ha with the exception of Bauchi and Plateur state with average yields of 7-8 tone/ha (Tewe,*et al*.,2001).

2.2 Trend in Global Production of Sweet Potato

According to FAO (2012), 115 countries produced 106 569 572 tons of Sweet potato in 2010. However, supply remains very concentrated. 82.3% of the global production being in Asia with 81,175,660 tons, China produced by far the largest partandpossesses a little less than half of the global acreage dedicated to the sweet potato. Indonesia is the second Asian producing country and the 4th in the world with more than 2 million metric tons of production, for example in the Papua province in Indonesia, 90% of the dishes contain sweet potato. The second continent in the world of sweet potato production is Africa. Africacontributed up to 14% of the global production with more than 14.2 metric tons. Contrary to the main producing countries which have seen their production level decline over the years, some Africa countries have increased their production level from 2 metric ton in 1999 to 2.83 metric ton in 2010(FAO, 2012).

Nigeria and Tanzania produce 1.43Mt and 1.4Mt respectively followed byUganda; the three countries collectively produce half of the African Supply of sweet potato(FAOSTAT, 2010).

This expansion in Africa is linked to a strong demographic growth. However, Latin America which is the global sweet potato arena,produced 1.97mt in 2010, that is, a little more than 2% of the global supplies (FAOSTAT, 2010. The globalproductions of sweet potato per hectare from 2006-2010 in major producing countries are presented in table 1.

Table 1: The World Production of Sweet Potato (tons)

COUNTRY	2006	2007	2008	2009	2010
CHINA	81,039,000	75,600,000	78,830,000	76,772,393	81,175,660
INDONESIA	1,854,230	188,868,652	1,876,944	2,057,913	2,050,810
VIETNAM	1,460,900	1,437,600	1,325, 600	1,207,600	1,317,060
INDIA	1,066,500	1,067,200	1,094,000	1,119,700	1,094,700
JAPAN	988,900	968,400	1,011,000	863,600	1,026,000
PHILIPINES	566,773	573,734	572,655	560,516	541,525
UGANDA	2,628,000	2,602,600	2,707,000	2,710,000	2,838,300
NIGERIA	3,462,000	2,432,000	3,318,000	2,746,817	2,838,000
TANZANIA	1,396,400	1,322,000	1,379,000	1,381,120	1,400,000
ANGOLA	684,756	949,104	819,772	982,588	986,563
KENYA	724,646	811,531	894,781	930,784	386,563
MADAGASCAR	869,000	890,000	941,355	910,857	919,127
MOZAMBIQUE	929,826	875,216	890,000	900,000	920,000
RWANDA	777,034	841,000	826,000	801,376	840,072
ETHIOPIA	388,814	388,814	526,487	450,763	401,600

BRAZIL	518,541	529,531	548,438	477,475	479,200
CUBA	303,000	414,000	375,000	437,000	384,700
UNITED STATE	743,937	819,641	836,560	883,099	1,081,590
PAPUA NEW GUINEA	560,000	580,000	485,181	534,085	376,000

Source: FAOSTAT (2012)

FAO (2012) reported that in 2010, Nigeria was ranked the second largest producer of sweet potato after Uganda in Africa out of 20 best selected producing countries with 2,838,000 tons. Tewe*et al.,*(2003) reported Kano state is the sixth highest producer of Sweet potato in Nigeria with production figure of 37,016 tons out of the National figure of 527,226 tons.

FAOSAT report of 2012 indicates that sweet potato production in terms of land size used from 2002 to 2012 depicts a law of diminishing returns. In this report, from 2003 to 2006, there were increased and moderate relationships between production per tones and land sizes used, but in 2007 there was a sharp decreased in production even though the land size was increased to about 10.8%. This increase was the biggest in the whole decade while the 2008 gave a remarkable changed. Production figure rose to about 36.4% and land size declined to about 2.2%. But the periods 2009, 2010 and 2011 shown that production and land size used remained unchanged with yields figures of 30000 tons/ha. Lastly, in 2012 the yield figure was increased to 1.6%.The Table 2 below, show more explanation for the information above.

Table 2: Nigeria Production of sweet potato in Tones

Year	Production (Tones)	% increase/decrease in Production	Area Harvested (Ha)	% increase/decrease in Area Harvested	Yield (Tone/Ha)	% increase/decrease in Yield
2002	2631000	……..	877000	…….	30000	……..
2003	2800000	6.42	895000	2.05	31285	4.28
2004	2996000	7	954000	6.59	31405	0.38
2005	3205000	6.98	989000	3.67	32406	3.19
2006	3462000	8.02	1021000	3.24	33908	4.63
2007	2432000	-29.75	1131000	10.77	21503	-36.58
2008	3318000	36.43	1106000	-2.21	30000	39.52
2009	3300000	-0.54	1100000	-0.54	30000	0
2010	3300000	0	1100000	0	30000	0
2011	3300000	0	1100000	0	30000	0
2012	3400000	3.03	1115000	1.364	30493	1.64

Source: Faostat2012

Where: F= FAO estimate and Fc = calculated data

2.3 Economic Importance and Uses of Sweet Potato

Sweet potato is among the major food crops in the world and is cultivated in all tropical and sub-tropical region particularly Asia, Africa and the Pacific and the production per capital in 2001 was highest inRwanda (143kg/year), Uganda (104 kg/year) and Papua New Guinea (98kg/year) (Vilma and O'Sullivan 2012). The important of sweet potato is increasing in Nigerian's farming and food system because it is easy to plant mature early and it has enormous industrial and economics potentials (Chukwu, 1999). Worldwide, sweet Potato's production and consumption is huge. All over the world people eat and use this nutritious

food and the crop ranks among the five most important food crops in over 50 developing countries. (Dogon-Daji, 2005).In Kwara State, of Nigeria, particularly in Offa Local Government Area, it is a major cash crop where it enjoys high cultural status and the harvest season is celebrated with feasting and cultural dance (Agbo and Ene, 1999).

It is important to emphasize that despite the potential benefits steaming from the expansion of agricultural sector through various government efforts, its overall productivity remains low and the poor performance of agriculture is most clearly evidenced by the low standard of living of these small scale rural farmer (Dogon-Daji, 2005).Beside simple starch, sweet potatoes are rich in complex carbohydrates, dietary fiber beta-carotene (a vitamin A equivalent nutrient), vitamin C and vitamin B6.

2.4 Farm Profitability Analysis:

Cost- return analysis usually form the basis for farm profitabilityanalysis. This involves itemizing costs and returns of production, and using them to arive at such estimates as the return to one unit of the resources used, the gross magin, as well as the gross and net returns. In some cases, these values are subjected to test of statistical significance to verify differences between them. According to Libero (1977), monetary unit should be used as basis for measuring all inputs in costs and returns for cropping system.Gomez (1975), developed a farm level model to evaluate alternative cropping mixtures and patterns. These includes;

1. profitability, measured as the difference between value of yields and cost of production, and
2. net return, defined as the differnce between value of yields and as input costs, including hired labour,propritor land, family and labour. In choosing economic

indicators on the basis of production factors affected by potential innovation, Werner (1993) suggested the use of:

a. the gross magin and returns to variable cost, where only capical is affected.
b. yield and labour ratio,where only labour is affected, and
c. gross magin, return to variable cost and monetary return to labour, where capital and labour is affected.

The major problems associated with cost-return analysis as basis for profitability assessment are:

it does not indicate the relative importance of each of the resources in production and

its location bound and specific in applicability due to use of money as common unit of measurement and the prevailing price for the estimates.

Gomez (1975), said that in spite of the limitations, cost and return analysis is a usefull tool in enterprise comparison and in indicating a profitable pattern of aggregate input use. This method was used by Olagoke (1991), in Anambra State, Osifo Antonio (1970), in western Nigeria, Nweke and Winch (1980), in South-Eastern Nigeria and Elizabeth K.S (2013), in Kaduna State.According to Olukosi and Ethabor (1988), gross margin is a very useful planning tool in situation where fixed cost is negligible portion of the farming enterprise as in the case of subsistence agriculture. It is easily computed and represents the most relevant economic indicator to draw the attention of the farmer to the problem of his farm and offer solution to them.

As with any economic analysis, the profitability of an investment is based on a comparison of the returns and cost of the investment. Another way to add value on the production side would be to reduce processing costs by increasing the efficiency (and thus the profitability) of production (Masters *et al.,* 2005). Hence, the profitability of crop production depends on

reducing the farming cost as much as possible, and at the same time maximizing the income from the sale of the crop.

Profitability in some farm business exists because they are managed more efficiently than others. The reward for doing the job better is usually profit. The prospect of earning and maintaining profitability serves as the incentives for creativity and efficiently among farmers. Profitability stimulates risky ventures and drives farmers to develop ways of cutting cost and improving technology always in an effort to satisfy consumer interest (Troke, 1981). Profitable agriculture is dependent on productive soil and cabbage production is not an exception

2.5 The Concept of Efficiency in Agricultural Production

The analysis of efficiency is generally associated with the possibility of farms producing a certain optimal level of output from a given bundle of resources or a certain level of output at least cost (Amaza, 2000). Efficiency can be defined as the relative performance of the processes used in transforming input into output (Lissita and Odening, 2005). It could also be defined as the attainment of production goals without waste (Ajibefun *et al.,* 2002).The pivotal role of efficiency in accelerating agricultural productivity and output has been applauded and investigated by numerous researchers within Africa and outside. The decreased output of food crop production over the years may not only be connected with deviations of farmers' practices from technical recommendations but also with the use of resources at sub-optimal levels which ultimately leads to technical and allocate inefficiencies (Coelli and Batteses, 1996).

An underlying premise behind much of the research inefficiency is that farmers are not making efficient use of existing technology, then efforts designed to improve efficiency

would be more cost-effective than introducing new technologies as a means of increasing agricultural output (Belbase and Grabowski, 1985 *and* Adeleke *et al.,* 2008).

Production efficiency has two components: technical and allocative efficiency. Technical efficiency is the extent to which the maximum possible output is achieved from a given combination of inputs or the ability of a firm to obtain maximal output from a given set of inputs. Allocative efficiency is the ability of a firm to use inputs in optimal proportions, given their respective prices and production technology (Coelli*, et al.,*2005). Farrell (1957) distinguishes between technical and allocative efficiencies in production through the use of a 'frontier' production function. He defined technical efficiency as the ability to produce a given level of output within a minimum quantity of inputs under certain technology, while allocative efficiency refers to the ability of choosing optimal input levels for given factor prices. Economic efficiency is the product of technical and allocative efficiencies. Thus, if a firm has achieved both technical and allocative levels of production, then the firms is economically efficient and new investment streams may be critical for any new development (Alene and Hassan, 2003).

2.6 Measurement of Production Efficiency Using Stochastic Frontier Approach

Broadly, two quantitative approaches are developed for measurement of production efficiency: Parametric (Stochastic frontier approach) and non-parametric (Data envelopment analysis) approaches. The data envelopment analysis (DEA) has no fixed functional form and does not account for noise in the data. Thus, all deviation from the frontier will be accounted for as inefficiencies (Johnsson, 2005). The Stochastic frontier approach is parametric and is sensitive to the choice of functional form and accounts for random errors. In this approach all deviations from the frontier are due to random effects and inefficiency

(Coelli *et al,* 2002). The measurement of efficiency is important because it leads to substantial resource savings (Bravo-Ureta and Rieger, 1991).

The modeling estimation and application of stochastic frontier production functions to economic analysis assumed prominence in econometrics and applied economic analysis during the last two decades. Early application of stochastic frontier production functions was first used in the analysis of the United States agricultural data.Battese and Corra (1977) applied the techniques to the pastoral zone of Eastern Australia. And more recently, empirical application of the techniques in efficiency analysis have been reported (Ojo and Ajibefun, 2000; Ojo, 2003; Maurice, 2004; Dawang, 2006; Idiong, 2007; Usman, 2009; Adejog, 2009; Amodu, 2010).

The stochastic frontier production was independently proposed by Aigner*, et al.,* (1977) and Meeusen and Van den Broeck (1977). The stochastic Production function is defined by

$y_i = f(x_i, \beta)e^{v-u}$ ..... (1)

Where:

Y_i = observed output of the ith sample farm's*,* $(X_{i:\beta})$ is a suitable functional form such as Cobb-Douglas, X_i vector of the inputs used by the ith farm,β vector of unknown parameters to be estimated,$e_i$is the error team made up of two components: v_i is a random error having zero mean which is associated with random factors outside the farmers control such as topography, weather, measurement errors, disruptions of supplies and is assumed to be an independently and identically distributed N $(0.\delta^2 v)$ random variable and independent of u_i. On the other hand,$u_i$is a non- negative truncated half normal random, variable associated

with farm-specifics factors, which leads to the ith farm not attaining maximum efficiency of production. U_i is associated with technical inefficiency of the firm and ranges between zero and one. U_i follows an identical and independent half-normal distribution, N $(0.\delta^2 u)$. N represents the number of firms involved in the cross-sectional survey.

The stochastic frontier production model is estimated using the maximum likelihood estimation procedure (MLE) (Bakhsh, 2007). The technical efficiency of an individual firm is defined in terms of the observed output (Y_i) to the corresponding frontier output (Y_{i*}) given the available technology.

$TE_i = Y_i / Y_i^*$ ..... (2)

$TE_i = f(x_{i:\beta)} \exp(v_i - u_{i)} / f(x_{i:\beta)} \exp(vi_{)} - \exp(-u_{i)}$ ..... (3)

So that $0 \leq TE_i \leq 1$

Therefore, the technical inefficiency is equal to 1-TE

The stochastic frontier costfunction which is the basis for estimating the allocative efficiency of the farms is specified as follows:

$$C_i = g(p_i; \alpha) \exp(v_i + u_i) \ldots\ldots\ldots\

$v_i + u_i$ =Composed random error terms defined as earlier. However, inefficiencies are assume to always increase costs, error component have positive signs.

The allocative efficiency (AE_i) of individual farms is defined in terms of the ratio of the predicted minimum cost (C_i^*) to the observed cost (C_i).

$$AE_i = Ci^*/C \quad \text{..... (5)}$$

The strength of the stochastic frontier approach is that, it deals with the stochastic noise and permits statistical test of hypotheses pertaining to the structure and degree of inefficiencies. However, the limitations of the stochastic frontier approach are:

i. There is no a prior justification for the selection of any particular distribution for the technical inefficiency effect suit.

ii. Efficiency measures may still be sensitive to distributional assumptions.

iii. the Cobb-Douglas has constant input elasticity and returns to scales for all firms

iv. The elasticity of substitution for the Cobb-Douglas function is equal to one.

2.7 Review of Empirical Studies with Application of the Stochastic Frontier Approach

Stochastic frontier approaches have found wide acceptance within the agricultural economics literature because of their consistency with theory, veracity and relative ease of estimation. The measurement of efficiency (technical, allocative and economic) has remained an area of important in research both in the developing and developed countries, where recourses are meager and opportunities for developing and adopting better technologies are dwindling (Kibaara, 2005).

A study by Liu and Zhuang (2000) on technical efficiency in post-collective Chinese agricultural concluded that 76 and 48 percent of technical inefficiency in Sichuan and Jiangsu respectively could be explained by inefficiency variables. They use a joint estimation of the stochastic frontier model. Ben-Belhassen (2000) estimated the technical efficiency in Missouri hog production. The result revealed a mean technical efficiency of about 82 percent implying that 18 percent of production is due to farm specified production inefficiencies.

Ogundari and Ojo (2006) studied the technical, allocative and economic efficiencies of small scale farms in Osun State of Nigeria. The result showed mean technical, allocative and economic efficiencies of 0.90, 0.81 and 0.89 respectively, implying that technical efficiency appear to be more significant than allocative efficiency as source of gain in economic efficiency

2.8. Socio-Economic Variable Affecting Efficiency of Farm Production

Severalstudies have identified numerous socio-economic variables that influence efficiency of inputs use. These factors include age, education, farmer's experience, contact with extension agents, income of the farmers and access to credit. Awudu and Richard (2000) reported that efficiency increased with the age until a maximum efficiency was reached. Alene and Hassan (2003) reported that technical efficiency of Ethiopian farmers was positive and significantly influenced by education level, credit and contact with extension workers. Ugunyinka and Ajibefun (2003) observed that education and membership of Farm association were the most important factors affecting efficiency.Education level and farming experience have been reported to have a positive and significant impact on technical

efficiency (Adewuyi and Okunmadewa 2001; Bayacag 2001). Extension contact has been reported to have a positive and significant relationship with efficiency (Amaza, 2002).

Therefore farmers that have had extension contacts are likely to be more efficient than those without any extension contact. Greater family size increase efficiency (Bayacag, 2001). This can be explained by the fact that readily available family labour will allow for the timely execution of important farm activities such as fertilization and weeding, thus, contributing to higher yields. Besides, most farmers are financially constrained and thus, the availabilities of family labor will ease hiring of labour. Farm size has been reported to have a positive and significant relationship with technical efficiency (Rahman, 2003).

CHAPTER THREE

METHODOLOGY

3.1 Description of the Study Area.

Kano state is located on latitude 13.53N and 10.25^{o}N and longitude 7.4^{0} E and 10.53^{0} E. It shares boundary with Jigawa state to the North East, Katsina State to the North West and Kaduna State to the South.The State is administeredinto 44 local government areas. According to NPC (2006), the state has a total population of 9.4 million with 446 person/km^{2} density. The estimated population as at 2008 and 2013 were 9.88 and 10.11 million respectively at 2.5% annual increase (NPC). The Annual rainfall of the state range from 420mm – 1000mm and temperature is averagely warm throughoutat about 27^{0}Cand37^{0}C.The vegetation of the environment is Sudan savannah which is tropical grassland with scattered tress such as baobao, acaciaand locust been tress **(**Olefin and Tanko, 2002). The cropping system is mostly undertaken under rain fed condition and majority of the farmers are small scale holders with less than 2.5 ha/farming household and other resource are meager (KNADP, 2002). The upland crops commonly grown are millets, sorghum, cowpea and maize. While the low land/*fadama* crops grown in the state includes tomatoes, onions, and peppers with rice and wheat grown in the floods plains and irrigated areas. In fact, agriculture is the backbone of Kano state economy followed by commerce. Other commercial crops grown in the state are cotton, and sesame.

Sweet potato is among the most important crops grown in the state.The state in 2011 was ranked sixth largest producer of sweet potato in Nigeria with production figure of 420420 tonsout of the national figure of 602456 tons (KNARDA, 2012). The crop serves as sources of nutrient that produce energy to human beings and has enormous economic potentials because it is an additional uses of income to the farmers in the state. Sweet potato also helps in eradicating poverty in the state and contributed more than 4% in their daily transaction.

3.2 Sampling Procedure

Kano State comprises of three agricultural zones, namely Danbatta, Rano and Gaya Zone. A multistage sampling procedure was employed to select respondents for this study. Gaya Zone was purposively selected because of its high number of sweet potato farmers. Gaya Agriculture Development Project Zone comprises of fourteen (14) Local Government Areas, namely Ajingi, Albasu, Dala, Dawakin Kudu, Gabasawa,Garko, Gezawa, Kano Municipal, Minjibir,Nasarawa, Tarauni, Sumaila, Warawa and Wudil. Purposive sampling technique wasused to select three (3) local Government Areas that produce significant quantities of sweet potatoes within Gaya Agriculture Zone.

Albasu, Sumaila and Garko Local Government Areas were reported to have high prevalence of sweet potato production in Gaya Agriculture Zone(KNARDA, 2002). TwoVillagesfrom each Albasu,Sumaila, and Garkolocal government areaswere purposively selected for their high prevalence in sweet potato farming. Finally, simple random sampling was used to select farmers from each of the villages. The selection was made by cutting of up a clean carbon paper of the same size base on the number of farmers in each village serially. Each village total number of cards cut was placed inside a small box and twisted, then selection begun randomly until the required 10% of the farmers were ascertained from the total sample

frameof1205 farmers. In all (120) sweet potato farmers were randomly selected.The table 3 below gives the summary of the sample size for the research and location covered.

Table 3: Summary of sample size of the research

Zone	L.G.A	Village	*Sample frame	Sample size
	Albasu	Hungu	130	13
		Gwagwaranda	230	23
Gaya	Garko	Katumari	204	20
		Garki	214	21
	Sumaila	Rumu	225	23
		Kargo	202	20
Total			**1205**	**120**

Source :*Reconnaissance(2014)

3.3 Data Collection.

Primary data were used for this study. Data werecollected with the aid of structured questionnaire. Information on datawere collected on the following variable; ages, education status, household size, access to extension contacts, farming experience, access to credit, cooperative membership, type and cost of labour bothfamily or non-familylabour, access to market, type and cost of input used per hectare and product prices and quantity of output.

3.4 Analytical Techniques

In order to achieve the objectives for this study, the following tools of analysis were employed were: Descriptive Statistic, Net farm income and stochastic frontier Production function

3.4.1 Descriptive statistic

Description statistic was used to achieve objectivesi andivof the study. Simple descriptive statistics such as percentage, frequency distribution and ratio were used to describe the socio-economic characteristics of the respondents and the constraints related to production of sweet potato in the study area.

3.4.2 Net Farm Income

Net farm income was used to achieve objective ii. It was used to show the levels of cost, returns and net profit that accrue to sweet potato farmers. This tool was used to determine the profitability of the farm. The model for estimating the net farm income is represented as;

NFI=GR – TC ……. (6)

Where:

NFI = Net farm income

GR =Gross Receipt

TC = Total cost of production

The model can further be simplified to as;

NFI = $\sum_{i-l}^{n} P_i Y_i - \sum_{j=i}^{m} P_j X_J - \sum_{k=i}^{k} FK$.....(7)

Where:

Yi = output (Kg/ha)

Pi = Unit price of product (#)

Xj= Quantity of variables input (where J= 1, 2, 3 in variable inputs)

Pj= Price per Unit Variable input (#)

FK = Cost of fixed input where K = 1, 2, 3 - - - -K fixed inputs

∑= Summation (addition) sign

Variable Costs that were considered are, cost of inputs like cost of seed (vines), cost of fertilizer, cost of agrochemical (pesticides, insecticide), cost of land used (rental value, deprivation value) and labour (cost of land preparation, weeding, planting, spraying, fertilizer application and transportation cost). The total revenue was estimated by multiplying the total quantity of produce (Kg/Ha) or output by the prevailing market price of the output (₦).

For this study, fixed cost was mainly on depreciation of durable farm tools such as sprayer, hoes and cutlass. Thestraight line method of evaluating depreciation was used to obtained fixed cost such as hoe, sprayer and cutlass for farm tools.Kay et al., (2008) observed that the net farm income should be a starting point for analysing farm profitability, rather than used as the only measure of farm`s profitability.The depreciation method is given by

$$D = \frac{P-S}{N} \quad \ldots\ldots (8)$$

Where:

D = depreciation (₦)

P = Purchase value (₦)

S = salvage value (₦)

N = life span of asset (years)

3.4.2.1. Return per NairaInvested

It is a measureof return on a unit amount of money invested in the farm business. It is express as percentage and hence allows easy comparison with the same values from other farms within a given locality. It is computed as;

RNI= $\frac{TR}{TC}$ ..... (9)

This ratio will be used to determine the profitability of the farm by comparing it with return per nairainvested from other farms (Kay *et al*., 2008).

3.4.3 Stochastic Frontier Production Function

The stochastic frontier production function was used to achieve objective iii. The model in its implicit form is specified as:

$y_i = f(x_i, \beta)e^E$.....(10)

E=vi–ui..... (11)

Where;

Yi= quantity of output of the ith farm (Kg)

Xi= vector of the inputs to be used by i^{th} farm

β= a vector of the parameter to be estimated

E = composed errow term

e = error term

v_i = ramdon errow outside farmers control

u_i = technical inefficiency effect

$f(x_i,\beta)$= a suitable function of the vector

The empirical stochastic frontier Cobb-Douglas production model is specified as follws;

$$InY_i = \beta_o+\beta_1 Inx_1+\beta_2 Inx_2+\beta_3 Inx_3+\beta_4 Inx_4+\beta_5 Inx_5+V_i- U_i \quad \text{.....(12)}$$

Where:

Ln= Logarithmic to base e

Y= output of sweet potato (Kg)

βo= Constant or intercept

β1-β5= Unknow scalar parametersto be estimated

X1= quantity of planting material (Kg)

X2= farm size (Ha)

X3= quantity of fertilizer used (Kg)

X4= quantity of agrochemical(pesticides& insecticide) (Litres)

X5= labour used (Man days)

Vi= random errows outside farmers control (0 <=**V**i<= 0)

u_i= technical inefficiency effects predicted by the model (u_i>= 0)

Xiis expected to be positively related to the cost of sweet potato output production

i=1, 2, 3, 4, 5.

The technical inefficiency model is defined as follows:

$U_i = \alpha_o+\alpha_1Z_1+\alpha_2Z_2+\alpha_3Z_3+\alpha_4Z_4+\alpha_5Z_5+\alpha_6Z_6+\alpha_7Z_7$.....(13)

Where:

Ui= technical inefficiency effects

Z_1= age of farmer(in years)

Z_2= farming experience(in years)

Z_3=educational level of farmers (0 = no formal education, primary 6yrs =1, secondary 12yrs =2, others >12 =3)

Z_4= household size(in numbers)

Z_5= extension contacts (contact per season)

Z_6= cooperative society (years of membership)

Z_7= access to formal credit (in Naira)

α_1-α_9 = parameters to be estimated

Ziis expected to be negatively related to the level of inefficiency in sweet potato production

Subscript i indicate ith farmers in the sample.

The stochastic frontier cost function which is the basis for estimating the allocative efficiency of the farm is specified as follows:

$C=g(p_i,\alpha)\exp(v_i+u_i)$……(14)

Where:

C_i= represents the total input cost of the ith farms

g = is a suitable functional form

p_i= represents the input prices employed by the ith farm

α= parameters to be estimated

v_i and ui are the random errow terms.

The Cobb-Douglas cost function for the sweet potato farms is specified as follows;

$\ln C=\alpha_o+\alpha_1 \ln P_1+\alpha_2 \ln P_2+\alpha_3 \ln P_3+\alpha_4 \ln P_4+\alpha_5 \ln P_5+\alpha_6 \ln P_6+V_i+U_i$.....(15)

Where:

C= total cost of production of the sweet potato farm (₦)

ln= logarithm to base e

αo= intercept or constant

α_1-α_6= parameters to be estimated

P_1= price of seeds (₦)

P_2= cost of rental value (₦)

P_3= cost of fertilizers (₦)

P_4= cost of agrochemicals (₦)

P_5= cost of labour (₦)

P_6= cost of output (₦)

α_i =Partial regression coefficient measuring partial elasticity of the cost of sweet potato production with respect to the various inputs.

$P_i$is expected to be positively related to the cost of sweet potato production

i= 1, 2, 3, 4, 5, 6

The inefficiency cost function is defined as follows:

$U_i = \alpha_o+\alpha_1Z_1+\alpha_2Z_2+\alpha_3Z_3+\alpha_4Z_4+\alpha_5Z_5+\alpha_6Z_6+\alpha_7Z_7$.....(16)

Where:

Ui= allocative inefficiency effects

Z_1= age of farmer(in years)

Z_2= farming experience(in years)

Z_3= educational level (primary 6yrs =1, secondary 12yrs =2, others >12 =3))

Z_4= household size(in number)

Z_5= extension contacts(number of visit)

Z_6= group membership (years of membership)

Z_7= amount of credit obtained (in Naira)

α_1-$\alpha_9$are the scalar parameters to be estimated

α_o= constant or intercept

$Z_i$is expected to be negatively related to the level of inefficiency in sweet potato production

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of Sweet Potato Farmers

4.1.1 Age distribution of sweet potato farmers

The study shows that about 36% of the sweet potato farmers were within the age range of 30-39 years with mean of 37 years. Result in table 4 reveal that the farmers were strong,agile,and active and can participate adequately in farming activities. Age is expected to have negative influence on the respondent's participation inimprovedsweet potato production that is why younger farmers are more active in the production of this crop. This agrees with the findings of Maurice (2004) and Yusuf (2005), that age can influence the adoption of improved agricultural practices. The findings are also consistent with those of Nwanko*et al.,* (2009) and Institute for Agricultural Research (2001), reported that the most active farmers' age group engaged in agricultural production is within 31- 50 years.

Table 4: Age distribution of sweet potato farmers

Variable	Frequency	Percentage
Age (years)		
<20	5	4.2
20-29	26	21.7
30-39	43	35.8
40-49	32	26.7
50-59	13	10.8
>60	1	0.8

Total	120	100
Min.	**15**	
Max.	**62**	
Mean	**37**	
St. D.	**10**	

4.1.2 Household size of sweet potato farmers

Table 5: shows the distribution of sweet potato farmers by household size. Majority of the farmers (55%) had household size that ranged from 1-10 persons. The average household size was 8 persons implying that there may be appreciable number of family labour supply to accomplish various farm operations if all family members were to actively participate in farm operations. According to the report of (Oluwatayo*et al.,* 2008), there is a positive and significant relationship between household size and farmers' efficiency in production. This finding is also in line with Solomon (2008) and Banmeke(2003), which indicates that large household size assist more on farm and other household activities. However, the absolute number of people in a certain family cannot be used to justify the potential for productive farm work because most household members do not participate in farm work nowadays.

Table 5: Distribution of sweet potato farmers according to household size.

Variable	**Frequency**	**Percentage**
Non-household member	22	18.3
1-10	66	55.0
11-20	20	15.1
21-30	12	16.7
Total	120	100
Min.	**0**	
Max.	**30**	
Mean	**8**	

4.1.3 Educational level of sweet potato farmers

The result in Table 6: shows that 39% of sweet potato farmers had no formal education, about 25% of the respondent had only primary education, and 23% had secondary education while 13% had tertiary education. This indicates that the farmers' educational level is high. This high literacy proportion of sweet potato farmers in the study area implied that the farmers would be better exposed to more reliable information sources and good decision making in their farm production activities. This finding is in line with Amaza (2000); education has a positive and significant impact on farmers' efficiency in production. Thus, literacy level will greatly influence the decision making and adoption of innovation by farmers, which may bring about increase in productivity.

Table 6: Education level of sweet potato farmers

Variable	Frequency	Percentage
No formal education	47	39.2
Primary education	30	25.0
Secondary education	28	23.3
Tertiary education	15	12.5
Total	120	100

4.1.4 Farming experience of sweet potato farmers

The process of gaining knowledge and skills is termed experience. It is a measure of the period an individual farmer was involved in sweet potato production. The more the number of years of production by sweet potato farmer, the more knowledge and skills gained. Experience influences individual's perception and understanding of the management requirements and consequently improved farm produce. The experience of the majority of the surveyed farmers in sweet potato production shows that 54% of sweet potato farmers had 1-10 years of experience with an average of 13 years while 3% had more than 31 years of experience in sweet potato production. This implies that majority of the farmers are relatively fresh into sweet potato production, as about 54% of them had less or equal to 10 years experience in sweet potato production. The farming experience shows that farmers will be able to make sound decisions as regards resources allocation and management of their farms.

Table 7: Distribution of sweet potato farmers according to farming experience

Variable	Frequency	Percentage
Farming Experience		
1-10	65	54.2
11-20	38	31.7
21-30	14	11.7
31-40	3	
Total	120	
Min	**1**	
Max	**13**	
Mean	**40**	
St. D.	**8**	

4.1.5 Membership of cooperative society

Table 8: shows the number of years spent in cooperative. About 64% of sweet potato farmers do not participate in any cooperative association and the reasons for this include: being small scale and unaware of any association. Also 36% of the respondents became members of cooperative in the last one year, the effect of this result even though these farmersjointed farmingnewlyis that most of the sweet potatofarmers in the study area do enjoy the assumed benefits accrued to co-operative societies through pooling of resources together for a better expansion, efficiency and effective management of resources and for profit maximization.Ajayi(2002) and Ekong (2003) Stated that membership of cooperative societies has advantages of accessibility to micro-credit, input subsidy and also as avenue in cross breeding ideas and information.

Table 8: Distribution of sweet potato farmers according to years spent in the cooperative association

Variable	**Frequency**	**Percentage**
Non members	77	64.2
1-2 years	37	30.8
3-4 years	6	5.0
Total	120	100
Min.	**0**	
Max.	**5**	
Mean	**1**	
St. D.	**1**	

4.1.6 Numbers of extension contact

The ultimate aim of extension services is to enhance farmers' ability to efficiently utilize resources through the adoption of new and improved methods used in sweet potato production instead of using traditional methods which may be inefficient, resulting to low

yield. The distribution of the sampled farmers based on numbers of extension visit is presented in table 9.

The result in Table 9 revealed that 42% of sweet potato farmers in the study area had no contact with extension service within the last one year while 58% had contact to extension service with average of 3 contact per year, This could be attributed to low extension agent-farmers' ratio in the study area.

Table 9: Distribution of sweet potato farmers according to extension con

Variable	**Frequency**	**Percentage**
No contact	50	41.7
1-10	60	50
11-20	8	6.7
21-30	2	1.6
Total	120	100
Min.	**0**	
Max.	**25**	
Mean	**3**	
St. D.	**5**	

4.1.7 Access to Credits among the Farmers

Adequate funding is required by farmers to finance all sweet potato production activities. However, a large number of farmers face serious shortage of funds to finance their sweet potato production activities, which in turn limits their level of production. They obtained their funds through formal and informal sources as presented in table 10.

The results indicated that 69% of the farmers used personal savings to finance their sweet potato production activities while 31% of the farmers finance their production activities

through formal source. This low access to credit could be attributed to the fact that government seldom grants financial credit to large number of farmers. Ekong (2003) asserts that credit is a very strong factor that is needed to acquire or develop any enterprise; its availability could determine the extent of production capacity.

Table 10: Distribution of sweet potato farmers according to credit obtained.

Amounts	**Frequency**	**Percentage**
Personal Savings	83	69.2
5000-35000	14	11.7
35001- 75000	11	9.2
75001-105000	11	9.2
105001-150000	1	0.8
Total	120	100
Min.	**0**	
Max.	**150000**	
Mean	**16800**	
St. D.	**33605**	

4.2 Profitability of Sweet Potato Production

4.2.1 Cost of sweet potato production in the study area.

Sweet potato planting material used by the farmers in the study area was mainly unimproved seeds taken from the last harvest. The average quantity of planting material (seed) used was 374.36kg/ha with an average market price of ₦15 per kg and this (₦5,615.4) constitutes 4.3% of the total cost of production. The quantity of fertilizer was 578.98kg/ha

with an average market price of ₦100 per kg and this constitutes 52.7% of the total cost of production while quantity ofagrochemical(pesticides and insecticide) was 2.44kg/ha with an average market price of ₦1800 per litre was used and this constitutes 4% of the total cost of production.

Labour costs consist of cost of land preparation, planting, fertilizer application, weeding, replacement and harvesting. The family labour was computed on the basis of opportunity cost in man-day. The wage rate varied according to farm operationperformed. An average wage rate of ₦400 per man-day was used, giving the average labour cost per hectare to be ₦40,944 and this constitutes 37.2% of the total cost of production. The average land size used was 0.945ha with an average renting price of ₦1,500 per ha and this constitutes 1.3% of the total cost of production.

The cost of renting land and depreciation of hoes and cutlasses incurred on sweet potato production were ₦170 and ₦430 respectively (i.e. ₦600)and constitute 0.5% of the total cost of production (Table 11)

4.2.2 Return for investment in sweet potato production

The total revenue (TR) was ₦139,200 while the total cost (TVC + TFC) was ₦110,866.67. The net farm income was therefore ₦28,933.33 per ha. the average rate of return on investment (return per naira invested) was ₦1.26, indicating that for every ₦1 invested in sweet potato production in Kano state, a profit of 26 kobo was made. Thus, it could be concluded that sweet potato production in the study area is profitable. This finding is similar to that of Elizabeth (2013) who observed that sweet potato production is profitable by returning ₦1.40 to every ₦1.00 spent.

Table 11: Average Cost and Return per Hectare of Sweet Potato Production in Kano State

A. CostQty	Price(N)		Value (N/ha)	% Contribution
1. Variable Cost				
a-Plantingmaterial (Kg)	374.36	15	5615.4	4.3
b-Fertilizer (Kg)	578.98	100	57897.778	52.7
c- Agrochemicals (Kg) 2.44	1800		4400	4.0
d- Labour (man-day)	102	400	40944	37.2

e- Land size (Ha)	0.95	1500	1410	1.3
Total Variable Cost (TVC) = (a+ b +c + d + e)			**110,266.67**	**99.5**
2. FixedCost				
e- Land Renting			430	0.39
f- hoes and cutlasses			170	0.11
Total Fixed Cost (TFC) = (e + f)			**600**	**0.5**
Total Cost (TC) = (TVC+TFC)			**110,866.67**	
B. Return				
Total Revenue (TR) =	7733	18	139,200	
Net Farm Income (NFI) = (TR-TC)			**28,933.33**	
Return per Naira invested = (TR/TC)			**1.26**	**100**

4.2.3: Hypothesis testing

The hypotheses result tested using t-text statisticsare presented in table 12. The null hypothesisstates that sweet potato production is not profitable. The hypothesis was tested using a t-test statistics and it was observed the critical value of 1.98. The average net farm income was observed to be statistically significant at 5% level of probability. Then, the null hypothesis was rejected and the alternative accepted.This implies that an average return of 1.26, indicating that for every ₦1 invested in sweet potato production in Kano state, a profit of 26 kobo was made

Table 12: Hypothesis Testing for Profitability

Variables	Mean	SDEV.	D.f	t-Stat	T Critical two-tail
Total Revenue	54651.58	41483	119	-6.09	1.98**
Total Cost	150336	200319			

Note: ***=1%, **= 5%, * = 10% Level of significance

4.3 Efficiency of Sweet Potato Production

4.3.1 Technical efficiency of sweet potato farmers

The stochastic frontier production function was estimated by the maximum likelihood (ML) method using FRONTIER 4.1 software developed by Coelli (1995). The ML estimates and inefficiency determinants of the specified frontier are presented in Table 13. The study revealed that the generalized log likelihood function was -97.860. The log likelihood function implies that inefficiency exist in the data set.Thevalue of gamma (γ) is estimated to be 17% and not statistically significant. This is consistent with the theory that true γ-value should be greater than zero. This implies that 17%of random variation in the yield of the farmers was due to the farmers' inefficiency in their respective sites and not as a result of random variability. Since these factors are under the control of the farmer, reducing the influence of the effect of γ will greatly enhance the technical efficiency of the farmers and improve their yield. The value of sigma squared ($\boldsymbol{\sigma^2}$) was significantly different from zero level of probability. This indicates a good fit and correctness of the specified distributional assumptions of the composite error terms while the gamma γ indicates the systematic influences that are unexplained by the production function and the dominant sources of random error. This means that the inefficiency effects make significant contribution to the technical inefficiencies of sweet potato farmers.

However, the estimated coefficients of (seed, agrochemical and labour) were positive and significant at 1% and 10% level of probability and hence play a major role in sweet potato production in the study area. The average technical efficiency for the farmers is 0.86 implying that, on the average the respondents were able to obtain 86% of potential output from a given mixture of production inputs.Thus, in a short run, there is minimal scores 24% of increasing the efficiency, by adopting the technology and techniques used by the best sweet potato farmer.

The estimated coefficient for planting material (seed) was 0.411 which is positive and statistically significant at 1% level. The estimated 0.411 of seed implies that increasing seed by 1% will increase sweet potato output by less than 1% which means, all things being equal the output is inelastic to changes in the quantity of seed used. The significance of seed quantity is however, due to the fact that seed determines to a large extent the output obtained. If correct seed rates and quality of seeds are not used, output will be low even if other inputs are in abundance. This is in line with the findings of Shehu*et al.,* (2010) who observed that the estimated coefficient of seed and labour inputs were positive as expected and significant at 1% level implying that the more seed is applied and the more labour employed the better the output of sweet potato.

Table 13: Maximum Likelihood Estimates Results of Frontier Production Function (Technical Efficiency) of Sweet potato production

Variables	Parameters	Coefficients	Std. error	T-Value
Production Function				
Constant	β_0	0.559	0.356	2.157**
Seed	β_1	0.411	0.051	8.053***
Fertilizer	β_2	-0.017	0.061	-0.271
Agrochemical	β_3	0.445	0.121	3.654***
Labour	β_4	0.201	0.192	1.924*
Land size	β_5	0.031	0.082	0.376
Inefficiency variable				
Constant	Z_0	-0.284	0.671	-0.423
Age	Z_1	0.005	0.023	0.217
Household size	Z_2	0.016	0.026	0.642
Education	Z_3	-0.139	0.115	-1.203
Farming Experience	Z_4	-0.346	0.178	-1.94*
Cooperative Association	Z_5	-0.200	0.121	-1.650*
Amount of credit borrowed	Z_6	-0.001	0.005	-0.041
Extension Contact	Z_7	-0.076	-0.048	-1.59
Diagnostic Statistic				
Sigma-square	(σ^2)	0.337	0.039	8.621***
Gamma	**(γ)**	0.170	0.182	0.936
Log likelihood function	*L/f*	-97.860		
LR test		4.596		
Total number of observation		120		
Mean efficiency		**0.86**		

*Asterisk indicate significance ***1%, **5%, *10%.*

The estimated coefficient for fertilizer was -0.017 which is negative and statistically not significant. The estimated coefficient of agrochemical was positively related with the output and statistically significant at 1% level of probability. The estimated 0.445 of agrochemical implies that increasing agrochemical by 1% will increase sweet potato output by less than 1% which means, all things being equal the output is inelastic to changes in the quantity of agrochemical used.

The coefficient of labour was 0.201 which is positive and statistically significant at 10% level. This shows the importance of labour in sweet potato farming in the study area. The

implication is that an additional increase in labour supply, the output of sweet potato will increase by 0.201. This is in line with several studies by Umoh (2006) and Okike (2000) which show the importance of labour in farming, particularly in developing countries where mechanization is rare on small scale farms. In the study area, human power plays a crucial role in virtually all farming activities. This situation has variously been attributed to the practice of split-plot cropping on small scattered land holdings and lack of affordable equipment (Umoh, 2006).

The estimated coefficient for land size used in the production of sweet potato in the study area was 0.031 which is positive and statistically not significant. This implies that an increase in labour input has no positive impact on the output of sweet potato in the study area but yet the interpretation of the result says that 1% increase in land area bring about increase in output by 0.031. Lau and Yotopoulos (1971) found out that smaller farms were economically more efficient than larger farms within the range of output studied. If farm size is small, farmers are able to combine their resources better (Hazarika and Subramanian, 1999).

The estimated result of the inefficiency model is contained in table 13. Generally, a negative sign on a parameter means that the variable reduces technical inefficiency, while a positive sign increases technical inefficiency. The results shows that level of education, farming experience, cooperative association, credit accessibility and extension contact have a negative sign, and therefore reduce technical inefficiency (or increase technical efficiency) while age of the farmers and household size have positive signs, implying that they increase technical inefficiency (or reducing technical efficiency).

The estimated coefficient of cooperative association has a negative sign related to inefficiency and statistically significant at 10% level of probability. The effect of this result is that most of the sweet potato farmers in the study area do enjoy the assumed benefits

accrued to co-operative societies through pooling of resources together for a better expansion, efficiency and effective management of resources and for profit maximization. Ekong (2003) and Ajayi (2002) Stated that membership of cooperative societies has advantages of accessibility to micro-credit, input subsidy and also as avenue in cross breeding ideas and information.

The coefficient of farming experience in the inefficiency model is negative and statistically significant at 10% level of probability. This indicates that an increase in the number of years in sweet potato production decreases technical inefficiency. This is in line with findings of Ojo and Ajibefun (2000) and Usman(2009); Opined that farming experience shows that farmers will be able to make sound decisions as regards resources allocation and management of their farms.

The coefficients for age, household size, level of education, credit accessibility and extension contact were 0.005, 0.016, -0.139, -0.001 and -0.076 respectively and were not statistically significant. This means that from the result of this analysis, by implication, change in the age of the farmer, household size, educational level and access to formal credit in the study area, have no positive impact on output of sweet potato.

4.3.2 Hypothesis testing

The second (ii) hypothesis was tested using F-test statistic. The estimated F-value was 35.25 with a P-value of 0.0001 which is greater than 0.001. In other words, the test is significant at 1% probability level. This implies that there is significant relationship between the physical inputs and output of sweet potato. The null hypothesis is therefore rejected and the alternative hypothesis accepted.

4.4 Estimated Stochastic Frontier Cost Functions

The Maximum Likelihood (ML) estimates of the stochastic frontier cost parameters for sweet potato are presented in Table 14. For the cost function, the sigma (σ^2= 0.16) and the gamma (γ=0.0005) are quite high and highly significant at 1% level of probability. The high and significant value of the sigma square (σ^2) indicate the goodness of fit and correctness of the specified assumption of the composite error terms distribution (Idiong, 2005). The gamma (γ = 0.0005) shows that 0.05% of the variability in the output of sweet potato farmers that are unexplained by the function is due to allocative inefficiency.

The result of Cobb-Douglas stochastic frontier cost function for sweet potato in Kano State is presented in Table 14. The estimated coefficients of the parameters of the cost function are positive except that of land size which is negative. The cost variables seed, agrochemical, labour and output were statistically significant at 1% level of probability while fertilizer and land size were not statistically significant.

The estimated coefficient of the variable output was positively signed and statistically significant at 1% level of probability indicating that if there is an increase in sweet potato output the total cost of production will increase. This shows that the cost of production is influenced by the quantity of output realized. The result of this research agrees with the findings of Ogundari*et al.,* (2006) where they reported direct effect of output on cost of production in their study on cost efficiency in small scale maize production in Nigeria.

The coefficient of the cost of planting material (seed) was positive and statistically significant at 1% level of probability. This implies that an increase in the cost of seed will result in an increase in the total cost of production.

The coefficient of the cost of agrochemical and labour were positive and statistically significant at 1% level of probability. This implies that an increase in the cost of agrochemical and labour will result in an increase in the total cost of production. Credit availability shifts the cash constraint outwards and enables farmers to maketimelypurchases of those inputs which they cannot providefrom their own resources. Pesticide use is an input which positivelyaffectedthe allocative efficiencyof the farmers is collaborates tocredit. If a farmer fails to buy agrochemical for his crop, output loss may be irretrievable.

The factors influencing allocative efficiency of sweet potato farmers in Kano State were age of the farmer, household size,level of education, farming experience, cooperative association, Credit accessibility and extension contact.

The coefficient for farming experience was negative and statistically significant at 5% level of probability. This implies that farmers rely on their years of experience to allocate theirresources efficiently. Most of the farmers (53%) are literate; this could probably be explained by the fact farmers probably employ their educational advantages as opportunity to develop their production capability and inferably would be ready to adopt innovations and technologies for improved productivity. This finding is in line withAmaza and Olayemi (2000) who reported that increasing years of farming experience increases a farmer's level of allocative efficiency.

Household size coefficient had a positive magnitudeandstatisticallysignificant at 5% level of probability. This implies that the absolute number of the household size increase the total cost of production, therefore, the farmers in the study area spent more money on hired labour than what the family labour contributes. This finding is in line withBayacag, (2001), there is a positive and significant relationship between household size and farmers' efficiency in production. However, the absolute number of people in a certain family cannot

be used to justify the potential for productive farm work. This is because it can be affected by some important factors namely; age, sex and health status.

The coefficients for age, level of education, cooperative association, credit accessibility and extension contact were -0.005, -0.043, -0.020, 0.00001 and 0.004, respectively and were not statistically significant.

Table 14: Maximum Likelihood Estimates Results of Frontier Cost Function (Allocative Efficiency) of Sweet potato production

Variables	Parameters	Coefficients	Standard error	T-Value
Production Function				
Constant	β_0	5.843	0.492	11.87***
Output	β_1	0.204	0.066	3.093***
Seed	β_2	0.185	0.052	3.549***
Fertilizer	β_3	0.030	0.052	0.569
Agrochemical	β_4	0.320	0.099	3.204***
Labour	β_5	0.321	0.075	4.297***
Land size	β_6	-0.038	0.062	-0.06
Inefficiency				

Variable				
Constant	Z_0	0.802	0.269	2.976***
Age	Z_1	-0.005	0.007	-0.656
Household size	Z_2	0.015	0.006	2.205**
Education	Z_3	-0.043	0.042	-1.026
Farming experience	Z_4	-0.017	0.007	-2.232**
Cooperative association	Z_5	-0.020	0.041	-0.492
Credit borrowed	Z_6	0.00001	0.00001	0.988
Extension contact	Z_7	0.004	0.010	0.401
Diagnostic Statistic				
Sigma-square	**(σ^2)**	0.157	0.022	7.240***
Gamma	**(γ)**	0.0005	0.0002	0.231
Log likelihood function	*L/f*	-158.820		
LR test		-57.567		
Total Number of Observation		120		
Mean efficiency		**0.62**		

*Asterisk indicate significance ***1%,**5%, *10%.*

4.5 Frequency Distribution of Technical Efficiency, Allocative Efficiency and Economic Efficiency Estimates of Sweet Potato Farmers

4.5.1 Technical Efficiency Estimates of Sweet Potato Farmers

The frequency distribution of the technical efficiency estimates for sweet potato farmers in the study area was obtained from the stochastic frontier model and is presented in Table 15. It was observed from the study that 81% of the farmers had technical efficiency (TE) of 0.81 and above while 19% of the farmers operate at less than or equal to 0.8 efficiency level. The farmer with the best and least practice had a technical efficiency of 0.97 and 0.57 respectively. This implies that on the average, output fall by 24% from the maximum possible level due to inefficiency. Also 81% of the farmers were estimated to have technical

efficiency exceeding 0.8, indicating there are some 19% technical inefficient farmers in the study area.

The study also suggest that for the average farmer in the study area to achieve technical efficiency of his most efficient counterpart, he could realize about 14 percent (1-0.86/0.97*100) cost savings while on the other hand, the least technically efficient farmers will have about 44 percent (1-0.57/0.97*100) cost savings to become the most efficient farmer.

4.5.2 Allocative Efficiency Estimates of sweet potato Farmers

The Maximum Likelihood (ML) estimates of the stochastic frontier cost function for sweet potato are presented in Table 15. The sigma (σ^2= 0.16) and the gamma (γ=0.0005) are quite high and highly significant at 1% level of probability. The high and significant value of the sigma square (σ^2) indicate the goodness of fit and correctness of the specified assumption of the composite error terms distribution (Idiong, 2005). The gamma (γ = 0.0005) shows that 0.05% of the variability in the output of sweet potato farmers that are unexplained by the function is due to allocative inefficiency.

The allocative efficiency estimates presented in table16 indicates that it ranged from 0.20 to 1.00; the mean allocative efficiency was 0.62. The result indicates that average sweet potato farmer in the state would enjoy cost saving of about 38 (1-0.62/0.99*100) percent if he or she attains the level of the most efficient farmer among the respondents. The most allocatively inefficient farmer will have an efficiency gain of 85 (1-0.16/0.99*100) percent in sweet potato production if he or she is to attain the efficiency level of most allocatively efficient farmer in the state.

4.5.3 Economic Efficiency Estimates of Sweet Potato Farmers

The frequency distribution of the economic efficiency estimates for sweet potato farmers in the study area as obtained from the stochastic frontier model and is presented in(Table 15). It was observed from the study that 7% of the farmers had economic efficiency (EE) of 0.81 and above while 93% of the farmers operated at less than 0.8 efficiency level. The mean economic efficiency of the 120 sampled farmers in the study area was 0.53. The farmer with the best and least practice had economic efficiencies of 0.88 and 0.15 respectively. This implies that on the average, output fall by 47% from the maximum possible level due to inefficiency.

The study also suggest that for the average farmer in the study area to achieve economic efficiency of his most efficient counterpart, he could realize about 53 percent (1-0.53/0.88*100) cost savings while on the other hand, the least economically efficient farmers will have about 97 percent (1-0.15/0.88*100) cost savings to become the most efficient farmer. However, the average economic efficiency of the sweet potato farmers was 53 percent. This indicates that sweet potato farms were economically inefficient.

Table 15: Frequency Distribution of Technical, Allocative and Economic Estimates from the Stochastic Frontier Model

Efficiency Level	Technical Frequency	%	Allocative Frequency	%	Economic Frequency	%
< 0.2	0	0	1	0.83	5	4.17
0.21-0.40	0	0	22	18.33	30	25.00
0.41-0.60	1	0.83	25	20.83	34	28.33
0.61-0.80	22	18.3	39	32.50	43	35.83
0.81-1.00	97	80.8	33	27.50	8	6.67
Total	**120**	**100**	**120**	**100**	**120**	**100**
Minimum	0.56		0.16		0.15	
Maximum	0.97		0.99		0.88	
Mean	0.86		0.62		0.53	

4.6 Constraints of Sweet PotatoProduction in the study area.

The problems faced by sweet potato farmers in the study area were ranked according to the magnitude of the problems as stated by the farmers (Table 16). Inadequate capital, inadequate access to inputs (fertilizer, land and labour), unavailability of improved seed and poor pricing were the most prominent constraints of sweet potato production in the study area. About 37% of sweet potato farmers indicated inadequacy of capital and credit facilities as the most important constraint, because the meager savings the farmers might have made or the funds generated from relatives is not sufficient to satisfy various activities in sweet potato production.

The study revealed that 28% of the sweet potato farmers perceived that unavailability of inputs like fertilizer, land size and shortage of labour ranked second. According to the respondents fertilizer is made available when farmers are far into the production period, sometimes at the middle of the raining season despite the fact that fertilizer is available in the market everywhere. Farmers wish to wait for government subsidized and qualitative fertilizer in other to gain more profit, and family labour was predominantly used in the study area and that is why there was acute shortage of labour. According to the farmers, during active period of production-every household would have been engaged in his family farm work. The demand for labour is normally very high and expensive during the peak period of land clearing, ridging, harvesting, processing and weeding in the study area.

Unavailability of improved seed is ranked third (12%) by sweet potato farmers in the study area. According to the respondents they make use of seeds from their previous harvest which is not reliable and can jeopardize improved and sustainable productivity. This finding

is in line with Zulu(2004), who opined that most farmers havelittle or no access to improved seeds and continuestorecycleseedsthathavebecomeexhaustedaftergenerationsofcultivation.

About 8% of the respondentsattested to the fact that poor pricing and price fluctuation of fresh sweet potato were the fourth constraint faced by farmers. This finding is in line with Bureau of Statistic (2012) that saysPrices for fresh sweet potatoes responded to the law of demand and supply as no price regulation mechanism exists and there is no international organization that records their movements such as for cocoa, coffee and sugar.

The study revealed that 7% of the sweet potato farmers in the study area do not have access to market to sell their agricultural produce. About 5% of the farmers revealed that pest and disease was the sixth constraint of sweet potato producers and was responsible for pre-harvest and post-harvest losses by farmerswhile 1% of the respondents said low quantity of rainfall was among the major constraint faced in the study area.

Table 16: Production Constraints of Sweet Potato Farmers in Gaya Zone, Kano State

Contraints	**Fréquence**	**Percentage**	**Rank**
Inadequate Capital	70	37.43	1
Inadequate Access to Inputs	53	28.34	2
Unavailability of ImprovedSeed	23	12.3	3
Poor Price	15	8.02	4
Poor Access to Market	14	7.49	5
Pest and Disease	10	5.35	6
LowQuantity of Rainfall	2	1.07	7

Total	187*	100

 Multiple responses

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study looked at profitability and resource-use efficiency of sweet potato among smallholder farmers in Kano state. Two villages were randomly selected from three local government areas and 120 farmers were selected in this area. The purpose of the study was

to examine the profitability and resource-use efficiency of sweet potato among smallholder farmers in Kano state, Nigeria, and to achieve this, the study came up with four main objectives. These were to: describe the socio-economic characteristics of sweet potato farmers, determine the cost and return associated with sweet potato production, determine the technical, allocative and economic efficiency in sweet potato production, and to describe the constraint faced by smallholder sweet potato farmers in the study area.

The primary data were collected from 120 respondents using structured questionnaire. The statistical tools used to analyze the data were descriptive statistics, net farm income and stochasticproduction frontier function model. A descriptive analysis of the sample farmers was done to understand and describe the socio-economic factors influencing sweet potato production and as well as the constraints encountered by sweet potato farmers in the study area.

The result of the analysis shows that (36%) of the respondents fall within the age range of 30-39years, the household size ranged from1-10 persons with 55% and the majority of the farmers (61%) were literate. Thus, 54% have farming experience ranging from 1-10years with an average of 13 years. Most of the farmers (64%) were not members of a cooperative society. Majority of the farmers 42% do not have extension contact while 69% of these farmers financed their sweet potato production through their personal savings.

The average costs incurred and revenue obtained per hectare for sweet potato were estimated to determine the profitability or otherwise of sweet potato production in the study area (table 11). The total revenue (TR) was ₦139,200 while the total cost (TVC + TFC) was ₦110,866.67. The net farm income was therefore 28,933.67. The average rate of return on investment (return per naira invested) was₦1.26, indicating that for every ₦1 invested in sweet potato production in study area; a profit of 26kobo was made. Thus, it could be concluded that sweet potato production in the study area is profitable.

The stochastic frontier production function was estimated for technical, allocative and economic efficiency. It was observed from the study that 81% of the farmers had technical efficiency (TE) of 0.81 and above while 19% of the farmers operate at less than 0.8 efficiency level. The mean technical efficiency for the 120 sampled farmers in the study area was 0.86. The farmer with the best practice has a technical efficiency of 0.86 while 0.14 was for the least efficient farmers. This implies that on the average, output fall by 14% from the maximum possible level due to inefficiency.The mean allocative efficiency was 0.62. The result indicates that average sweet potato farmer in the state would enjoy cost saving of about 38% while allocative inefficient farmer will have an efficiency gain of 85% to attain the level of most efficient farmer among the respondents. The mean economic efficiency was 0.53. The farmer with the best practice had an economic efficiency of 0.88 while 0.15 was for the least efficient farmers. This implies that on the average, output fall by 47% from the maximum possible level due to inefficiency.

Finally, among the constraints identified in the study area, majority of the respondent attested to the fact that inadequate capital and inadequate access to inputs were major constraints faced.

5.2 Conclusion

Based on the findings of this study, it could be concluded that sweet potato production in the study area is profitable by returning 26 kobo to every ₦1.00 spent. Farmers should be encouraged to go into sweet potato production since it is a highly profitable venture. The farm specific technical efficiency distribution reveals that none of the farmers achieved the maximum efficiency level. Thus, within the context of efficient agricultural production, output can still be increased by 24 percent using available inputs and technology. These

results call for policies aimed at encouraging new entrants especially the youths who are agile and stronger to grow sweet potato and the experienced ones to remain in farming.

5.3 Recommendations

From the findings of this study, the following recommendations, among others are put forward:

i. Inadequate capital was one of the constraint to sweet potato production, it is therefore, recommended that sweet potato farmers should form cooperative societies, to pull their resource together and help themselves in purchasing of inputs for sweet potato production.

ii. Majority of the farmers source their credit from personal savings and relatives which are mostly not adequate for appreciable production. Agricultural loan facilities should be made accessible to sweet potato producers to ensure timely and adequate utilization of agricultural inputs for improvement in farm production efficiency.

iii. The study revealed that for every naira spent in sweet potato production, a gain of 26 kobo is made. It is therefore, recommended that farmers should be encouraged to go into sweet potato production in the study area in order to generate more income.

iv. Considering the economic potential of sweet potato production at 86% level of technical efficiency, there is need for the local government and non-governmental organization to address the problem of unimproved seed observed in the study in other to boost agricultural productivity.

5.4 Contribution of the study to knowledge

i. The study revealed that sweet potato production in the study area is profitable with farmers making a profit of ₦28,933.

ii. The study revealed that sweet potato farmers in the study area achieved technical efficiency of 86%.

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APPENDIX

PROFITABILITY ANALYSISANDRESOURCE USE EFFICIENCY INSWEET POTATO PRODUCTION INGAYA ZONE,KANO STATE.

Dear Respondent,

This questionnaire will be used by a student of the Department of Agricultural Economics and Rural sociology, AhmaduBelloUniversity, Zaria. Please, fill as appropriate. All information will be treated with confidentiality and strictly for the purpose of research. Thanks for your co-operation.

Village/Community……L.G.A
…….

A. SOCIO –ECONOMICS CHARATERISTICS

1. Name of farmer……

2. Sex: Male ( ) Female ( )

3. Age (years)……

4. Marital status: Married ( ) Single ( )

5. Highest level of Education:

(a) No Formal Education ( ) (b) Primary school Education ( ) (c) Secondary School Education ( ) (d) Tertiary Education ( )

6. Family Size (All the number of the people depending on you for living)…….

(a) No of Adult Male ( ) (b) No of Adult female ( ) (c) Children >15yrs ( ) (d) Children <15yrs ( )

7. How long have you been in sweet potato farming? (Years of experience)……

8. Do you belong to any co-operative/Association? Yes ( ) No ( )

9. If yes, (Years of participation) ----------

10. What benefit did you derive as a member?

11. What is your major source of capital for sweet potato farming?

A .Personal savings ( ) b. credit (borrow) ( ) c. Friends and family ( )

d. Money Lenders (Borrow) ( )

12. If you borrow, what were the sources of the credit?

a. commercial bank( ) b. Bank of Agriculture ()c. Cooperative Society ( ) d. Money Lenders ( ) e. Friends and Family ( )f. Others (specify)……

13. How much did you borrow to finance last production? (Fill for the source you indicated in Q .12)

SOURCE OF LOAN	AMOUNT(₦)	INTERST RATE (%)
Commercial Bank		
Bank of Agriculture		
Cooperative Societies		

Money Lenders		
Friends And Family		
Others (Specify)		

14. Have you been visited by an extension agent/experienced sweet potato farmers? Yes ( ) No ( )

15. If Yes, How many times in last one year?

16. What activities did the agent teach you? .....

17. Of what benefit were the techniques learnt to you to the success of your farm? ....

18. Have you been trained on sweet potato farming? Yes ( ) No ( )

19. If Yes, which organization conducted the training?

20. Was the training beneficial to you?

a. Not beneficial ( ) b. somehow beneficial ()c. beneficial ( ) d.very beneficial ( )

B.INFORMATION ON INPUTS

(1) Farm size (Ha)

(1) How many sweet potato farm plots do you have? ..... Indicate and the size in the table below.

Plot NO	Plot Size (Ha)
1	
2	
3	

(ii). How did you acquire your land? *(Tick below)*

Plot	**Mode of Acquisition**				
	(a) Inheritance	(b) Lease	(c) Borrowed	(d) Gift	(e) Purchased

1					
2					
3					

(iii). What does it cost to rent one Hectare of land per season in your village? ..... Naira

(II) Variable inputs (Last production Cycle)

(ii)Seed (Kg)

Plot No	Quantity of Seed(Kg)	Cost (₦)
1		
2		
3		

(iii).Fertilizer.

Plot No	Fertilizer type	Quantity(Kg)	Cost(₦)
1			
2			
3			

(iv).Agrochemical.

Plot No	Agrochemical type	Quantity(litres)	Cost(₦)
1			
2			
3			

(v) Labour input

(a) Land preparation

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(b)Planting

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(c) Fertilizer Application

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(e) First Weeding

Plot No	Hire Labour	Family Labour

	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost(₦)
1						
2						
3						

(f) Second Weeding

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost(₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(g).Replacement of dead sweet potato seed planted

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(h)Harvesting

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(i) Information on sweet potato output

Plot No	No. of output produced(Kg)	Total Qty sold	Price/Unit
1			
2			
3			

21. Where do you sell your produce?

a. Farm gate ( ) b. Rural market ()c. Urban market ( )

22. When do you sell your produce?

a. immediately after harvesting ( ) b. Few months after harvest ()c. Off season ( )

CONSTRAINTS OF SWEET POTATO PRODUCTION

S/n	Constraints	Ranking according to severity 1=least severe, 2=moderately severe, 3= severe, 4= more severe, 5= most severe.	Coping Strategy
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Thank you for your Attentio