AN ECONOMIC ANALYSIS OF MASAKWA SORGHUM (*Sorghum bicolar L. Moench*) PRODUCTION IN YOLA SOUTH LOCAL GOVERNMENT AREA OF ADAMAWA STATE, NIGERIA.

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DEDICATION

This study is dedicated to my wife Hajiya Fadimatu Abubakar and children: Hayatudeen, Hauwa (Bebelio), Umaru (Daddy), Alkariatu (Ramla.I), Yerima Musa, Fadimatu (Ummy) and Hajara (Ramla II) who made the sacrifice.

DECLARATION

I hereby declare that this Dissertation titled "AN ECONOMIC ANALYSIS OF MASAKWA SORGHUM PRODUCTION IN YOLA SOUTH LOCAL GOVERNMENT AREA, ADAMAWA STATE, NIGERIA" submitted for the degree of Doctor of Philosophy (Agricultural Economics) of the Ahmadu Bello University, Zaria is a result of my research, except where reference is made to published literature and duly acknowledged, it has not been part of any presentation for any other qualification.

_____ _____

JONGUR, ABUBAKAR UMARU DATE

The above declaration is confirmed

_____ _____

Professor, J.O. Olukosi DATE
Chairman, Supervisory Committee

CERTIFICATION

This Dissertation titled “AN ECONOMIC ANALYSIS OF MASAKWA SORGHUM PRODUCTION IN YOLA SOUTH LOCAL GOVERNMENT AREA, ADAMAWA STATE, NIGERIA” by JONGUR, ABUBAKAR UMARU meets the regulations governing the award of the degree of Doctor of Philosophy (Agricultural Economics) of the Ahmadu Bello University, Zaria, and is approved for its contribution to scientific knowledge and literary presentation.

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ABSTRACT

This study aimed at conducting an economic analysis of masakwa production in Yola, Adamawa state. One hundred and seventeen (117) farmers were sampled in 2002/03, 2003/04 and 2004/05 seasons. All were randomly selected from 1123 farmers of the Adamawa ADP records. The study indicated that a total of 313 hectares of land were cultivated in Yola masakwa area, giving an average of 3 hectares per farmer. The results of the study also indicated that an average gross margin per hectare of ₦25, 403 were obtained. The study also revealed that an average of net farm income per hectare of ₦24870 was obtained. The z-test was statistically significant at 1% level of probability. It can be inferred that the relative profitability of masakwa production ensured the sustainability of the enterprise. The result of the study showed that labour and herbicides were under utilized, while seeds and organic manure were over utilized. The study finally recommended that: (i) Laddo dam constructed by the Cameroon Republic on the river Benue should release water timely. The study recommends a convenant law between the Cameroon Republic and Federal government of Nigeria, (ii) Herbicides should be made available at affordable prices to farmers, so that they can clear weeds on time during production. The study recommends an extension agent at masakwa farms for herbicides handling and usage; since it was under utilized (iii) Research institutes e.g. IAR/ABU and Lake

Chad Research Institute (LCRI) should be funded so as to develop tolerable varieties to excessive heat of the area, presently the 3 local cultivars have not been improved scientifically; (iv) Financial institution should provide funds to farmers at a low interest rate to enable them improve labour and other farm inputs on their farms, and (v) Government should provide access roads and transport facilities such as pick-up vans, long trucks and canoes to ease their marketing and transport problems. The study concluded that masakwa production is profitable and therefore calls for other farmers especially the large-scale farmers and NGO's to invest in masakwa, so as to ease the problems of food and livestock feed shortages in Adamawa State.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Guinea corn (Sorghum bicolor L. Moench) is an important tropical cereal crop grown the world over, except in the cool areas. It ranks fourth after wheat (Triticum aestivum, L), rice (Oryza sativa, L) and Maize (Zea mays, L) in the world cereals production (Martin et al 1976; Shebayan (1982); Olukosi and Isitor (1990) and Aba (1997).

The sorghum grain is produced for human consumption and also used as animal feeds. The plant stem and foliage are used as green chop, hay, silage and pasture. In some areas, the stalk is used as building materials and plant remains (after the head is harvested) may be used for fuel (House, 1985; Rowland, 1993 and Aba 1997).

Although the history of sorghum cultivation in West-Africa is unknown, it is likely that what farmers refer to as local varieties today have undergone improvement through research and development efforts of Research Institutes and Universities over the years. Sorghum is a traditional food crop in Northern Guinea and Sudan ecological regions of Nigeria. Cultivation is carried out by hand and the crop is grown mainly for local consumption. A general description of sorghum cultivation in Northern Nigeria has been given elsewhere (Curtis, 1966 and Mirchallum, 1996).

As in other parts of the world where sorghum is grown, Northern Nigeria has a markedly seasonal pattern of rainfall, with the annual total rainfall of about 750mm. The local sorghum varieties are characteristically tall stemmed and late maturing.

Seed is saved from the previous harvest but little conscious selection is practiced apart from rejecting the types that are unpalatable. However, most varieties are well adapted to the duration of the growing season and farmers realize it is unwise to sow seeds from other areas. Therefore, the distribution of sorghum varieties is likely to follow the pattern of natural vegetation.

Masakwa sorghum cultivation is practiced in the North-Eastern State of Nigeria, especially in Bama, Monguno and Ngala Local Government Areas in Borno and Yola Local Government Area in Adamawa State. *Masakwa* is the general name given to all sorghums, which are grown during the dry season on residual moisture (Curtis, 1966; Ugherughe, 1986 and Aba, 1997). Cultivation is restricted to deep cracking, clay soils on the fields, which are bounded during rains. The fields are flooded during September and the crop is not transplanted until October when the water has either soaked in or has been drained off. *Masakwa* is sown on nursery beds during August and as the fields dry, the seedlings are transplanted into deep holes made by driving wooden stakes into the soil. After transplanting, no further operations are carried out until the crop is

harvested in late January or early February (Curtis, 1966; Showemimo and Nwasike 1996; Mshelia *et al* 1997).

1.2 Problem Statement

One of the major economic problems facing Nigeria is shortage of food (Agbo, 1978; Ijere, 1983; Ikpi and Olayemi, 1994). Agricultural productivity and total annual food and fibre production in Nigeria are pitiably poor and much below expectation. Nigeria has been feeling the pinch of general food shortages through soaring food prices, particularly since the end of the civil war in 1970. Food importation has risen from ₦57.8 million in 1977 to ₦107.04 million in 1986 and about ₦165million in the early 1990s but declined to ₦155.4million in 1994 respectively, (Ikpi,1994 and CBN, 1997).

Latest estimates of the per capita food production index in grain equivalent by the FAO (1992), CBN (1992) and Ikpi (1994) separately and independently show that as of 1992 the average Nigerian has less than 350kg of grain equivalent of food available to him for the year if he could afford to buy it. Other studies by the Economic Commission for Africa (ECA) of the United Nations (1983) & (1987) and the World Bank (1985, 1988 and 1990) showed a steady expansion of per capita food production index steadily at an average annual rate of about 3%. Total food production in the country has been rising by not less than 2.5% per annum

on the average, thereby leaving a deficit of 0.5% (NPC, 1991; Ikpi and Olayemi, 1994).

Adamawa State is one of the major producers of sorghum for food and livestock feed. The production of sorghum experienced a drought in 1972 and due to the discovery of petroleum in Nigeria some farmers started shifting to a short duration crops for food and other cash crops. Some breweries and livestock rearers, however, have embarked on barley and sorghum production so as to supplement their raw materials leading to less importation (Aba, 1997).

Consequently, the food self-sufficiency ratio of the country has been dropping from 98% level in the early 1960s to less then 60% in the early 1980s and less than 54% by 1986 (Ikpi, 1994). There have been much improvements in technology transfer for food production in Nigeria since then. This means that the average Nigerian now has over 45% of less home grown food today than he had about 40 years ago (ECA, 1987; CBN, 1992 and Ikpi, 1994). All these arose because the standard of Nigerian agriculture has been largely at subsistence level and have been unable to produce food sufficient in quantity, quality and variety for an increasing population. In spite of our enviable biodiversity and agricultural endowment and the immense contribution of sorghum as staple food in North Eastern States, its production has experienced low annual rainfall and other crops like maize and millet have tended to replace sorghum.

Research effort on the economics of masakwa production has been largely neglected, information is lacking on how much is actually produced. This study therefore intends to determine the economics of masakwa production in Yola South LGA through the farmers that actively participated in masakwa production along the river Benue Valley in Yola, Adamawa State.

The study posed the following research questions:

i What are the socio-economic characteristics to masakwa producers?

ii. What are the differences between masakwa and other cereals?

iii. What are the inputs used in masakwa production in the study area?

iv. Is masakwa production profitable?

v. How efficient are resources used in masakwa production?

vi What are the major constraints to masakwa production in the study area?

In view of the attempt to produce adequate food and livestock feeds for the resource poor population in Yola South Local Government Area, this study intends to provide answers to these questions as a contribution to scientific knowledge.

1.3 Study Objectives

The broad objective of this study is to examine the economics of masakwa production in Yola South Local Government Area of Adamawa State, Nigeria. The specific objectives, however, are to:

i. describe the socio-economic characteristics of masakwa farmers;

ii. examine and describe masakwa production in the study area;

iii. determine the inputs and outputs of masakwa production in 2002/2003, 2003/2004 and 2004/2005 planting seasons;

iv. to determine the costs and returns of masakwa production in 2002/2003, 2003/2004 and 2004/2005 planting seasons;

v. determine the efficiency of resource use in masakwa production in 2002/2003, 2003/2004 and 2004/2005 planting seasons;

vi. identify the major constraints to masakwa production,

1.4 Hypotheses

The following hypothesis has been proposed for the study that the:

i. Socio-economic variables do not significantly influence masakwa production.

ii. Resources are not efficiently used in masakwa production.

iii. It is not profitable to produce masakwa.

1.5 Justification of the Study

The importance of masakwa crop to the people of Adamawa State cannot be over-emphasized. This is evident by the activities which take place along the river Benue valley and its tributaries in Yola South Local Government Area. The masakwa crop is being used as food, feed for livestock, fences and shades, and serves as major source of income to masakwa farmers and the state. The need for research on the resource use efficiency for masakwa production in Yola Local Government Area is therefore justified. It is also hoped that the research will help to provide information on:

i. the socio-economic characteristics of the masakwa farmers,
ii. resources used i.e. input-output prices, so as to find out the profitability levels.
iii. whether it is encouraging for other farmers, private industries to go in to masakwa production, and;
iv. for policy makers in formulating policies on masakwa production.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews related literature on the study topic i.e. sorghum production. It provides a thorough assessment of work that has been done in the field. The aim is to provide an objective assessment of such research work to give guidance for this study

The review here covers items such as the origin and distribution of sorghum, production trend in the world, Nigeria and Adamawa State, theoretical framework of regression analysis, efficiency and frontier production functions, analytical model and empirical methods for measuring technical, allocative and economic efficiency of cereal grains production.

2.2 Origin and Distribution – Guinea Corn (Sorghum bicolar L. Moench).

Guinea corn is the staple food crop of Northern Nigeria, but it is grown as far south as Oyo and Ibadan. Its production is concentrated in the Guinea and Sudan savannah zones. In the north, millet and maize progressively replaces sorghum where the annual rainfall is less than 750mm, Philips (1976); Mirchallum (1996), Showemimo and Nwasike (1996).

Local names:- Hausa – Dawa, Fulbe – gauri, Yoruba-Okababa, Ibo – Okili, Higgi – Ha. Other common names for sorghum include; great millet, durra in Sudan, M'tama in East African, jowal, jula and Cholam in India, Milo and sargo in the United State and Kaoling in China (Onwueme and Sinha, 1991).

Sorghum is the fifth most important cereal, following wheat, maize, rice and barley. It is a staple food in the drier parts of the tropical Africa, India and China. Sorghum, because of its draught resistance, is the crop of choice for dry region and areas with unreliable rainfall. In recent years, maize has tended to replace sorghum in many of tropical Africa in East and Central Africa.

2.3 Breeding

Sorghum is a major cereal grain of Nigeria, produced mainly in the savannah regions covering about 740km^2 (square kilometer) of land between latitude 7^{0}14' and longitude 30^{0}14'E (Owonubi and Nwasike, 1982), Showemimo and Nwasike (1996). The demand for sorghum in Nigeria is on increase due to increase in human consumption, livestock and industrial utilization. In order to meet this rising demand, the present level of production must be doubled in the near future (Nwasike, 1987). Therefore there is an urgent need to develop high yielding varieties and hybrid sorghum. The success of any breeding programme depends on some basic genetic information such as gene-action, habitability estimates

of the desirable traits, as well as correlations and correlated responses between traits in the breeding populations.

Lodhi et al (1978), Bittinger and Centrell (1979), Birades and Bovika (1984), Likhele and obilana (1984) have reported additive gene action in sorghum for grain yield, number of seeds/head, 100-seed weight. Desai et al (1984); Govit and Murty (1980) and Raju et al (1980) pointed out that the predominant type of gene action in the inheritance of these trait is non-additive. However, the findings of Kohtyleva et al (1983) and Nimbalker and Bapat (1987) indicated that both additive and non-additive gene action are involved. Similar analysis was obtained by Showemimo and Nwasike (1996) i.e. the mean standard errors of mean range and genotypic co-efficient of variations for all the traits measured (Head, weight, number of seeds/head and grain yield had the highest genotypic coefficient of variability, when it was 50 percent to flowering date, the head length and plant height recorded the lowest values (6.0%, 9.6%, and 9.9.% respectively). The high or low coefficient of variation was due to wide or narrow range of the means and their standard errors.

2.4 The Sorghum Crop World Statistics

Sorghum is fifth in importance among the world's cereals production. In 1986 it was grown on some 47 million ha and 57,663 million ha in 2002. Wheat occupied the largest area (229million ha), followed by rice (145

million ha), maize (131 million ha) and barley (79 million ha). The figure for millet in the 1986 FAO production year book of 40 million hectares includes several diverse millet, of which the most important are pearl millet and Prego millet.

Sorghum is grown mainly in the semi-arid areas of the tropics and sub-tropics. Some zones where the crop is grown may have a high rainfall during the actual growing season. Many of the types grown traditionally are photo period sensitive, these have been selected to flower at the end of the period, so that the grains ripen under dry conditions.

Sorghum common names includes guinea corn in West Africa, *Kraffi* corn in South Africa, *durra* in the Sudan, *M'tama* in Eastern Africa, in India the crop is known as *jowar* (*juar*) in the North and *Cholam* in the South, Doggett (1986).

2.5 Origin and Diversification

Crops were developed from wild plants relatively quickly. The whole development of arable agriculture probably covers a period of less than 15,000 years, and basic development of the individual crops occupied a much shorter period. Against the background of the time-scale for the operation of natural selection in evolution. The greatest variation in the genus is found in the north east quadrant of Africa, north of Latitude 10^0N and longitude 25^0E. The crop probably originated there. Snowden (1955)

has reported that of 16 species, 14 are found in this quadrant of Africa, which must be the center of origin and diversification. It is believed that a form (or forms) was domesticated in the Ethiopian region some 5,000 or more year ago to produce sorghum bicolor. Man throughout Africa then spread the cultivated and wield forms. Sorghum was taken from eastern Africa to India, probably the first millennium BC and from there to China. Sorghum then spread to the Mediterranean countries. The crop was introduced to the United States from Africa in about the middle of the 19th C. It was grown along the Atlantic coast and then carried westward to the drier regions.

2.6 Area and Production

The total area sown and production of sorghum in the world in 2002 was 57,663 million metric tonnes. The leading countries in sorghum production are the USA (13,070 M'tonnes). India (8,390 M'tonnes), Nigeria (7,800 M'tonnes) Mexico (5,900 M'tonnes) Sudan (4,365 M'tonnes) Argentina (2,750 M'tonnes) China (2,772 M'tonnes) and Austria (2,123 M'tonnes) ; FAO (2003). The total area sown and production of M'tonnes in Africa were 17 million hectares and 14 million tones respectively. The important countries for M'tonnes in tropical Africa are Nigeria, Sudan, Ethiopia, Burkina Faso, Niger, Uganda and Ghana (Onwueme and Sinha, 1991).

While in Nigeria the sorghum producing states are, Adamawa, Borno Benue, FCT, Jigawa, Kaduna, Kano, Katsina, Kebbi, Kogi, Niger, Plateau, Sokoto, Taraba, Yobe and Zamfara (FAO, 2004).

2.7 Utilization of Sorghum

Sorghum is used as animal feeds and a variety of traditional foods, most common of these are *akamu, kunu* or *ogi* and through milling process, the flour produced are used for preparing *tuwo, dakkere, kunu, fura* and *waina*. The stalks are used for fencing walls, huts, roof, basket making, mat and *argawa*, the grains are used for fermentation to alcohol drinks *Burukutu*, *peto* (Oyenuga, 1967 and Aba 1997).

Recently, sorghum has been used industrially for various purposes, it is used as raw material in brewery and food beverages. Some varieties have been found to have important qualities in the making of composite flour for baking breads, biscuits, cakes and pastries in Nigeria (Obilana, 1985).

2.8 Trends in Sorghum Production

The trends in sorghum production in Nigeria is shown in Table 2.1. Total production in Nigeria was 3.381 million metric tonnes in 1970- 1972 and has risen to 9.339 million metric tonnes by 2000-2002 period.

Table 2.1 Nigeria Estimated output of sorghum ('000 metric tonnes)

Year	Output of Sorghum ('000 tonnes)
1970 – 1972	3.381
1973 – 1975	3.594
1976 – 1978	2.881
1979 – 1981	3.105
1982 – 1984	3.880
1985 – 1987	5.274
1988 – 1990	5.544
1991 – 1993	5.776
1994 – 1996	6.696
1997 – 1999	8.273
2000 – 2002	9.339

Source: (Ojo 1991, CBN 2004 and FAO 2001)

In Adamawa State, the trends for sorghum production according to the available data for 1995 was 121.236 metric tonnes and it declined in 1999 to 22,310 metric tonnes. While it increased in 2000 to 174,000 metric tonnes) as shown in Table 2.2. The sudden jump in production may be due to expansion in land area cultivated.

Table 2.2. Sorghum Areas Cultivated and Output for Adamawa State in Metric Tonnes (M'tonne)

Year	Sorghum Output	Area (Ha)
1995	121.369	60,203
1996	113,078	66,048
1997	96,944	55,056
1998	213,410	150,860
1999	22,310	182,220
2000	174,000	145,000
2001	160,000	120,000

Source: ADADP, 2002

Table 2.3: Major Cereals in Nigeria with their Estimated Output's in Metric Tonnes

Crop	1995	1996	1997	1998	1999	2000
Maize	7240	6217	6285	6435	6515	6991
Millet	4900	5803	5997	6328	6391	6743
Sorghum	6377	7514	7954	8401	8464	8824
Rice	2920	3122	3230	3486	3522	3841
Wheat	36	47	49	51	55	5

Source: CBN, 2000

The national output for sorghum and other cereals (Table 2.3) explains the trends in their production. The sorghum output was lower than the maize output in 1995 by 863 million tonnes, and in 1997 sorghum output was higher than maize by 1669 million tonnes. These increases in sorghum against maize and other cereals continued up to 2000 showing the importance of sorghum production in Nigeria.

2.9 Theoretical Framework

The measurements of effectiveness cannot be isolated from the operational efficiency of the small farmers. Efficiency of the input-output relationship can be judged from the basic objective of the farmers whether or not they are reaching their aims and aspirations to the degree that they desired. Difficulties may arise from the above because they have different farm plans and decisions they take depend on individual goals. This raises the question of 'how' to measure the degree of achievement of individual objective.

Various functional forms exist for productivity studies, their application depends on the choice of the researcher who is normally constrained by the nature of the available data, resources and facilities available and the use to which the results are to be put. The common approaches are:

1. Production function analysis and
2. Farm budgeting analysis.

For the purpose of an economic analysis for e.g. masakwa production, the production function and farm budgeting approach were mainly used for cereal crops (Coelli and Battese, 1996); since much empirical work has focused on imperfect, partial measures of productivity, such as yield per hectare or yield multiplied by the price. Though they have

some limitations since the farms vary according to their gross farm income generated.

This gross farm income is a function of many factors like land size and inputs used. It is the yield multiplied by the price of output to obtain the gross returns.

2.10 Farm Profitability Analysis

According to Olayemi and Oni (1971), farm budget analysis involves the estimation of gross revenue and total cost for some period. The difference between the two parameters is a measure of profit or loss or net return for that period.

The gross margin analysis involves evaluating the efficiency of an individual enterprise (or farm plan) so that comparison can be made between enterprises or different farm plans. It is a very helpful planning tool in situation where fixed capital is a negligible portion in subsistence agriculture (Olukosi and Erhabor, 1988).

Profit maximization is one of the important goals of farm plans. Profit is generally defined as the difference between the Total Revenue (TR) and Total Cost (TC). The total revenue is the product of the output sold and the price. Total cost is traditionally divided into fixed and variable costs. Fixed costs are those incurred on fixed inputs which cannot be used up during one production process. On the other hand, variable costs

are those costs associated with variable inputs (Olukosi and Erhabor, 1988).

Cost and returns analysis usually forms the basis for farm profitability analysis. This involves itemizing the cost and returns of the production and using them to arrive at such estimates as the return to one unit of the resources used, the gross margin, as well as the gross returns (Osifo and Antonio, 1970; and Olagoke 1991). In some cases, these values are subjected to tests of statistical significance to verify differences between them.

The problems associated with the cost-returns analysis as basis for profitability assessment are:-

1. It does not indicate the relative importance of each of the resources in production.
2. It is location-bound and specific applicability due to use of money as the common unit of measurement, and the prevailing Price for the estimate. Cost and returns analysis is a useful tool in enterprise comparison and for indicating the profitable pattern of aggregate input used.

2.11 Resource Use Efficiency

Olukosi and Erhabor (1988) defined resources as those means available for producing goods and services, which in turn satisfy wants.

According to Ogunfowora *et. al*. (1975), resource productivity measures the return per unit of resources employed in production. Resource productivity can be measured in terms of the ratio of the total output to the total inputs of a single resource (e.g. labour productivity). There are two types of efficiency normally identified in economic theory namely allocative or price efficiency and technical efficiency. Technical efficiency is measured by relating the level of output achieved to the level of input employed (Upton, 1979). A firm is assumed to be technically efficient if it produces maximum possible output per unit of variable resource. The price efficiency is a measure of the firm's success in choosing an optimal set of inputs. The overall efficiency is the product of the technical and price efficiencies (Olayide and Heady, 1982). On the other hand, allocative efficiency is concerned with the choice of an optimum combination of inputs consistent with relative factor prices (Timmer, 1970 and Carlson, 1972).

According to Olayide (1982), agricultural productivity may be defined as the index of the ratio of the value of total farm output to the value of the total inputs used in farm production. An increase in farm output will result from one of three factors. Firstly, it will result from an increased quantity of inputs with no change in output per unit of input. Secondly, it will result from increased productivity of inputs with no change or a decrease in quantity of inputs. Thirdly, it will result from a combination of changes in

inputs and productivity. The situation makes the concept of efficiency a central issue in production economics. Resource productivity on the other hand, can be defined in terms of individual resource inputs or in terms of combination of them. Thus for instance, labour productivity can be defined as the ratio of total output to labour inputs. Similarly, land, capital, water and management productivities can each be defined as the ratio of total output to inputs of land, capital, water and management respectively.

Farrel (1957) distinguishes between technical and allocative efficiency (or price efficiency) in production through the use of a 'frontier' production function. Technical efficiency is the ability to produce a given level of output with a minimum quantity of inputs under certain technology (XU and Jeffrey, 1998). Allocative efficiency refers to the ability of choosing optimal input levels for given factor prices. Economic or total efficiency is the product of technical and allocative efficiency. An economically efficient input-output combination would be on both the frontier function and the expansion path.

Empirical studies of productive efficiency have used a variety of approaches in modeling frontier production functions; parametric and non-parametric, deterministic and stochastic, programming methods and Statistical method; Battese (1992) provided a review of parametric efficiency methods, both deterministic and stochastic while Bravo-Ureta

and Pinheirro (1993) provided a review of empirical studies relating to farm level production efficiency in developing countries.

Given the alternative empirical tools available, the choice as to the 'best' method is unclear. Little rigorous analysis has been done in assessing the sensitivity of efficiency measures to the choices of methodology. Bravo-ureta and Rieger (1990) compare the results of deterministic (both programming and econometric analyses) and stochastic parametric efficiency models for a sample of US dairy farms. While the estimates from each approach differ quantitatively, the ordinal efficiency ranking of forms obtained from the different models appear to be quite similar. This would suggest that, to a certain degree, the choice between alternative modeling approaches may be somewhat arbitrary. Even though it gives the best results on production frontier applications (Battese, 1992, Amaza and Olayemi, 2002)

2.12 Analytical Model and Empirical Methods

Xu and Jeffery (1998) employ a stochastic parametric decomposition and neoclassical duality model to measure the technical, allocative and economic efficiency of hybrid and conventional rice production in China. The stochastic frontier production function model is specified as follows:

$Y = f(x_n\ 1\beta) \times v\text{-}u$---------- (1)

Where: y is output (i.e. yield/ha), x_n denotes the actual input vector (i.e. input use/ha). β is the vector of production function parameters, v is a random error term with zero mean and u is the non-negative one-sided error term.

The frontier production is represented by f (x_n 1β), and is a measure of maximum potential output any particular input vector x_n. Both V and U cause actual production to deviate from this frontier. The random variability in production that cannot be influenced by producers is represented by v (e.g. environmental factors such as temperature and moisture); it is identically and independently distributed as N(0, $\sqrt{v^2}$) and may be considered as the 'normal' error terms. The non-negative error term u represents deviations from maximum potential output attributable to technical inefficiency; u is identically and independently distributed 'half normal' [i.e. N(0, $\sqrt{v^2}$)].

The use of stochastic, parametric methodology is consistent with recent agricultural production efficiency studies (e.g. Bravo-ureta and Evenson, 1994); Kumbhakar, 1994; Parikh and Shah, 1994). There are also some conceptual advantages to using a stochastic approach, as it allows for statistical noise rather than attributing all deviation to efficiency differences. Finally, this approach is relatively straight forward to implement and interpret.

A Cobb-Douglas functional form was employed to model rice production technology, in (Xu and Jeffrey, 1998), studies. While more flexible functional forms than the Cobb-Douglas may be chosen for modeling frontier agricultural production technology (eg. The trans log used by Kumbhakar, 1994), Kopp and Smith (1980) suggested that functional form has a limited effect on empirical efficiency studies particularly those relating to developing country agriculture (Battese, 1992). The Cobb-Douglas functional form also meets the requirement of being self dual; allowing an examination of economic efficiency.

The frontier production function model was estimated using maximum likelihood procedures. In order to empirically measure technical efficiency, the deviations from the frontier must be separated into a random component (i.e. v) and an inefficiency component (i.e. u). Given the distributional assumptions for u and v, the maximum likelihood estimation provides sufficient information to calculate a conditional mean for u (Jondrow et al, 1982). From this calculation, estimates of u and v may be determined).

Technical efficiency is empirically measured using adjusted output (Y) for each firm. Adjusted output represents the observed output (Y) adjusted for statistical noise; and is calculated as:

$Y^* = f(x_n ; \beta) - u = Y - v$ ---------- (2)

Where x_n represents actual input use, f() is the 'deterministic' frontier outputs and u and v are estimates of the random and inefficiency components of overall deviations from the frontiers.

Xu and Jeffry (1998) illustrate the differences between observed and adjusted output, for firm I, xi is the vector of actual input use and Yi is the observed output. Given the level of input use, the frontier output is represented by A. This is greater than the deterministic frontier output (i.e. 0,; β = f(xi ; β) due to favourable conditions (i.e.vi>0).

The total deviation from the frontier function for this form, as defined by Eq(1) (i.e. V-U) is the distance B Yi. This distance may be portioned into the random component (i.e. V = AB) and the inefficiency component (i.e. U = AY_i) using the method developed by Jondrow et al (1982). As indicated by Eq. (2), ui (i.e. distance AY_i) is subtracted from the deterministic frontier output to obtain the adjusted output for this firm C. The total deviation from the deterministic frontier function (i.e. DY_j) may be partitioned into the random component CD (ii.e U<0) and the inefficiency component CY_j. Adjusted out Y_j* is equal to the deterministic frontier output minus uj (i.e. D – CY_j).

Adjusted output (Y*) is used to calculate the technical efficient input vector (X_t) X_t is derived by simultaneously solving Eq (1) and the input ratios $X_1/_{xj}$ = K_1(1>1) where K_1 is equal to the observed ratio of the two inputs (i.e. from Xa) in the production of Y*. Bettese (1992) provides a

detailed explanation of stochastic frontier production function methodology and the calculation of X_t (Xu & Jeffery 1998).

Given the assumption of Cobb-Douglas technology, the frontier production function is self-dual. Thus, the corresponding cost function can be derived analytically from the stochastic frontier production function estimate. Shepherd's Lemma is sued to determine the set of conditional factor demand functions. These functions provide the economically efficient levels of input use (X_e); given a particular output level and set of input prices. Since the cost function is derived from the original frontier production function, X_e is both allocative and technically efficient.

The technically efficient, economically efficient and actual input vectors (X_t,X_e and X_a; respectively) may be combined with the input price vector P to compute technical efficiency (TE); economic efficiency (EE) and allocative efficiency (AE) indices, as follow:

TE = $(X_t\text{ 'P})/(X_a\text{'P})$

EE = $(X_e\text{ 'P})/(X_a\text{'P})$ ……3

AE = $(EE)/(TE) = (X_e\text{ 'P})/(X_t\text{'P})$

Where X_t' P is the technically efficient cost of production, X_e' P is the economically efficient cost of production, and X_a' P is the actual cost of production for any particular firm's observed level of output. In all cases, efficient production is represented by an index value of 1.0, and lower index values represent inefficient production.

Cross-sectional data for a sample of 90 conventional rice (CR) producers in China were studied by Xu and Jeffrey, (1998). The sample size for CR production function was 100, since some hybrid rice (HR) household were included in both samples (i.e. produce both hybrid and conventional rice). Dummies were included in the model to represent (the south D_1=1) and (central D_2=1) regions. The maximum likelihood estimates of stochastic frontier for HR and CR; and the standard OLS estimates (i.e. the average functions) were used for comparison.

Some implications were drawn from the results of Xu and Jeffrey, 1998). First, the constant term for the CR function was higher than that for the HR functions (5.944 vs. 4.895). This leads credibility to the views that since CR varieties have been adopted overtime for use in poor conditions with relatively low capital input use, they have a higher 'basic' yield (Hayami and Ruttan, 1985). Also the regional yield differences captured by the dummy variables ($D_1$and D_2) were much greater for HR production than CR production, particularly for the south region.

The results suggest that the response in HR production were much higher elastic with chemical fertilizer and pesticides usage than that for CR production. This is also true to a lesser extent for manurial fertilizer and machinery services. The opposites is true for labour input use, however, these results confirms the findings by Fan (1991) that 'Modern' inputs (e.g. chemical fertilizers and machinery services) are becoming more important

for Chinese agriculture over time i.e. with the increase in hybrid rice production. Over all, HR production is more responsive to scale increases in the five inputs modeled in the analysis, i.e. the elasticity of scale for the HR function is 0.804 v.s. 0.387 for CR production.

2.13 Conclusion and policy implications

Xu and Jeffrey (1998) used a stochastic production and cost frontier to derive technical, allocative and economic efficiency of Chinese conventional rice and hybrid rice production. The results suggest that while HR production increases the potential economies of scale for Chinese rice productions, observed productive efficiencies were lower than for CR production. The results of this study are consistent with 'poor but efficient' hypotheses, small farmers are more efficient in using inputs for CR production than for HR production.

Facing increasing population pressures, China has adopted policies designed to improve technical efficiency and total productivity. This study revealed a positive relationship between efficiency and education for HR production, thus, emphasizing the importance of considering peasant's abilities to receive and understand information relating to new agricultural technologies. This is consistent with the studies of Voh and Atala (1982) and Atala and Tarfa (1991) on the factors affecting the adoption of new technologies i.e. fertilizer use, pesticides, new seeds, etc, their orientation,

again mainly in identifying the factors responsible for adoption of a particular components of modernization. The impact of adoption of the individual (farmers) of modernization on resource productivity and efficiency of resource use were studied.

This study also determined that land size is a positive factor in explaining the efficiency of HR in modern agricultural areas. This suggests that in modern agricultural regions, the predominantly small farm size may pose a restraint to technical change and thus, supports the argument for further liberalization in land markets.

Many studies have subsequently specified and estimated different models of frontier production functions. They include Coelli and Battase (1996); Battese et al (1998); Ajibefun and Abdulkadri (1999).

Amaza and Olayemi (2002) in their study on the technical inefficiency effects of individual farmers are modeled for cross-sectional data, and efficiencies of sample food crop farmers were predicted for Gombe state of Nigeria. The inference drawn was that technical inefficiency value ranged from 13 to 89 percent and mean technical efficiency of 69 percent was predicted for Gombe State Food crop farmers.

CHAPTER THREE

METHODOLOGY

3.1 Study Area

The study area is Yola South Local Government Area of Adamawa State. Yola is the state capital and it lies between latitudes $9^0$13' North and 9^o12' North of the equator and between longitudes $12^0$28' East and 12^o30' East of the Greenwich Meridian within an area of about 1139.1 square kilometers. The state is bordered in the north by Borno state, in the south by Taraba state, in the west by Gombe state and in the east by the Cameroon Republic. The Yola South Local Government Area are bordered in the east by Fufore LGA, in the west by Demsa LGA and in the south by Mayo-Belwa and Fufore LGAs. The population of the area based on the growth rate of 2.5% was 354,346 as against the 1991 National Population Census estimate of 257,706 (NPC, 1991). Figures 3.1 and 3.2 show the location of the study area.

Yola South Local Government Area has a tropical type of climate marked by distinct dry and raining seasons. The dry season commences in November and ends in April; while the wet season is from May to September. The annual rainfall in the state ranges from 700mm in the North-west to 1,600mm in the extreme southern part of Adamawa state (Adebayo, 1999).

Yola, being the capital city for the *Fombina* fulanis, has good breeding centre for cattle, sheep and goats. A lot of fishing is also done at Lake Gerio and Njuwa along the river Benue valleys.

3.2 Sources of Data

Both primary and secondary data were used in this study. The primary data were generated through structured questionnaire. The data gathered included the socio-economic characteristics of masakwa farmers, yields obtained, product selling price, farm size, cropping patterns, input used such as fertilizer/manure and other agro-chemicals. Other information were on family, hired and co-operative labour used in the production process, household consumption, gift and marketable surplus.

The secondary data was collected from the Adamawa State Agricultural Development Programme and other related agencies in the state (i.e. Upper Benue River Basin Development Authority (UBRBDA), Federal Ministry of Agriculture (FMOA) and Federal Office of Statistics (FOS). Other secondary data collected included the market price statistics e.g. prices of inputs and output in various markets in the Yola South LGA between January and December.

3.3 Sampling Technique

The field survey covered Yola South Local Government Area of the state. Yola South LGA was purposively selected on the basis of being the prominent producing area in the state. The sample size for the study was 117 farmers, and all were randomly selected from the sampling frame of 1123 farmers as obtained from Adamawa ADP records. This gave a sampling percentage of 10.42.

3.4 Analytical Framework

Various approaches exist for analyzing farm production information. Such analysis is necessary for an accurate evaluation of resource use efficiency and productivity at farmer's level. The production function approach selected in this study was used by Ogunfowora (1975) and Amaza and Olayemi (2002).

The approach involved focusing attention on the individual farm unit. In adopting this approach it was assumed that farmers try to utilize and coordinate their resources in order to maximize returns. In line with this approach two analytical models was selected. These models were the production function and farm budgeting which provide quantitative estimates of resources used in the production process. On the basis of

such estimates, recommendations were made regarding decisions to adjust resources for optimal returns.

3.5 Analytical Techniques

The analytical tools employed for this study included:

i. Descriptive Statistics,

ii. Farm Budgeting Techniques, and

iii. Production Function Analysis

3.5.1 Descriptive Statistics

Descriptive and inferential statistics (i.e the use of measures of central tendency such as means, frequency distribution, percentages and ratios) were employed. Measures of dispersion (i.e variance and standard deviation) were also used. The tools were used to describe parameters like farm size, age and sex distribution, level of education, household size etc. These were used to achieve objective one.

3.5.2 Budgeting Techniques

The net farm income was used to determine the profitability of masakwa production. This was used to achieve objectives two and three.

Net Farm Income (NFI) = Gross Margin (GM) – Depreciation on fixed inputs.

Gross Margin is a budgeting tool used to estimate total costs and total revenue for a given production period (Osifo and Anthonio, 1970; Olukosi and Erahbor, 1988). The Gross Margin (GM) for an enterprise is given by the equation:

$$GM = Q_y P_y - \sum_{i=1}^{n} X_i Px_i$$

Where:

Q_y = total output of the product (kg)

P_y = Unit price of the product (₦)

Q_yP_y = Total revenue

X_i = Quantity of the i^{th} input used.

Px_i = Price per unit of the i^{th} input (₦)

$\sum_{i=1}^{n}$ = Summation (overall input 1 to n i.e. total variable cost)

Thus;

Gross margin = Gross returns – Total variable costs i.e.

G = GR – TVC.

3.5.3 Production Function Analysis

Koutsoyiannis (1979), Olayide and Heady (1982) and Olukosi and Ogungbile (1989) defined production function as the technical or physical relationship between inputs and outputs in any production process.

The production function includes all the technical efficient methods of production, it describes not only a single isoquant but the whole array of isoquants each of which shows how output varies as the factor input change (Koutsoyiannis, 1979).

Olayide and Heady (1982); Olukosi and Ogungbile (1989) also describe production function as the technical relationship between inputs and outputs in a production process. In mathematical terms, these functions are assumed to be continuous and differentiable which enables it to be used to estimate the rates of returns. Production function takes many forms and is one of the most widely used tool in economic analysis. Different forms are in use for productivity studies. But the choice of any production function will depend on its desirable characteristics.

The purpose of the production function is to identify and estimate how variable inputs used best explains the variability in the output. The greater the extent to which the variable inputs are able to explain the variability in output, the larger is the influence, which the inputs have on the output.

According to Heady and Dillon (1972), the estimation of input-output relationships therefore, involves the specification of a production function which depicts the factor – product relationship. In the production process inputs are transformed into outputs. Therefore, the most fundamental relationship is that between the factors of production and the product.

Various functional forms such as the square root, quadratic, the linear, the semi-log and Cobb-Douglass production functions were fitted to the data. The lead equation was selected for further analysis. The criteria that guided the selection of the lead equation were:

i. the value of coefficient of multiple determination (R^2);

ii. the appropriateness of the signs of the regression coefficients; and

iii. the significance of t-values.

3.6.3.1 Specification of the Models

i. The implicit form of the production function is:

$Y = f(X_1,X_2,X_3,X_4,X_5,X_6,U)$

Where:

Y = crop yield (kg)

X_1 = farm size (hectare)

X_2 = seeds (kg)

X_3 = family labour used (man-hour)

X_4 = Hired labour (man-hour)

X_5 = organic manure used (kg)

X_6 = agro-chemicals (litre)

U = error term

ii. Linear Production Function

$Y = a+b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e$

Where:

Y, X_1 to X_6 are already defined in the implicit form.

b_1 to b_6 are the regression coefficients

a = constant term

e = error term

iii. Semi-Log Production Function

$Y = a+b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + e$

Where:

Y, X_1 to X_6 are already defined in the implicit form.

b_1 to b_6 are the regression coefficients

a = constant term

e = error term

iv. Cobb-Douglas in its general form is given as:

$Y = a + X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} e$ when linearised it is expressed as:

$\text{Log } Y = a+b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + e.$

Where:

Y, X_1 to X_6, b_1 to b_6, a and e are already defined in the semi-log form.

v. Quadratic Production Function

$Y = a+b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_1^2 + b_8X_2^2 + b_9X_3^2 +$

$b_{10}X_4^2 + b_{11}X_5^2 + b_{12}X_6^2 + b_{13}X_1X_2 + b_{14}X_1X_3 + b_{15}X_1X_4 + b_{16}X_1X_5 +$

$$b_{17}X_1X_6 + b_{18}X_2X_3 + b_{19}X_2X_4 + b_{20}X_2X_5 + b_{21}X_2X_6 + b_{22}X_3X_4 + b_{23}X_3X_5 + b_{24}X_3X_6 + b_{25}X_4X_5 + b_{26}X_4X_6 + b_{27}X_5X_6 + b_{28}X_1X_2X_3X_4X_5X_6 + e$$

Where:

Y, X_1 to X_6, a and e are already defined in the semi-log form.

X_iX_j = interaction terms of variables

b_1 to b_{28} = regression coefficients

The expected signs of the coefficient are $b_1 – b_6 > 0$, $b_7 – b_{12} < 0$, $b_{13} – b_{28} > 0$.

vi. Square Root Production Function

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_1^{0.5} + b_8X_2^{0.5} + b_9X_3^{0.5} + b_{10}X_4^{0.5} + b_{11}X_5^{0.5} + b_{12}X_6^{0.5} + b_{13}X_1^{0.5}X_2^{0.5} + b_{14}X_1^{0.5}X_3^{0.5} + b_{15}X_1^{0.5}X_4^{0.5} + b_{16}X_1^{0.5}X_5^{0.5} + b_{17}X_1^{0.5}X_6^{0.5} + b_{18}X_2^{0.5}X_3^{0.5} + b_{19}X_2^{0.5}X_4^{0.5} + b_{20}X_2^{0.5}X_5^{0.5} + b_{21}X_2^{0.5}X_6^{0.5} + b_{22}X_3^{0.5}X_4^{0.5} + b_{23}X_3^{0.5}X_5^{0.5} + b_{24}X_3^{0.5}X_6^{0.5} + b_{25}X_4^{0.5}X_5^{0.5} + b_{26}X_4^{0.5}X_6^{0.5} + b_{27}X_5^{0.5}X_6^{0.5} + b_{28}X_1^{0.5}X_2^{0.5}X_3^{0.5}X_4^{0.5}X_5^{0.5}X_6^{0.5} + e$$

Where:

Y, X_1 to X_6, a and e are already defined in the semi-log form.

X_iX_j = interaction terms of variables

b_1 to b_{28} = regression coefficients

The expected signs of the coefficient are $b_1 – b_6 < 0$, $b_7 – b_{28} > 0$.

The models ii and iv was selected so as to determine the production function for masakwa production, which was used to achieve objectives two and three.

vii. Estimation of Resource Use Efficiency:

This is computed as follows:

$$r = \frac{\text{Marginal value product}}{\text{Marginal factor cost}} = \frac{MVP}{MFC}$$

Where:

r = is the efficiency ratio

MFC = cost of one unit of a particular resource

The MVP was estimated as follows:

MVP = $MPP x_i P_y$

$MPP_{x_i} = \frac{d_y}{d_{x_i}} = \frac{b_i}{\bar{x}_i}$, where the semi-log form is the lead equation.

$MPP_{x_i} = \frac{d_y}{d_{x_i}} = \frac{b_i \bar{y}}{\bar{x}_i}$, where Cobb-Douglas or double log form is the lead equation.

$MPP_x : \frac{dy}{d_{x_i}} = b_i$; where the linear form is the lead equation.

Note: $\bar{y}$ and $\bar{x}$ are the arithmetic mean values of the yield and input being considered respectively.

In the case of a Cobb-Douglas or double log form, the values of Log Y and Log X when they assume their arithmetic means.

Where:

b_1 = is the estimated regression coefficient of input X_1

P_y = is the unit price of output.

X_i = is the various input i.e. 1 to n.

If r = 1, it implies that resources are efficiently utilized i.e. MVP = MFC = 1

r > 1, it implies that resources are under utilized i.e. MVP > MFC

r < 1, it implies that resources are over utilized i.e. MVP < MFC

In achieving objective four, costs and returns analysis was used, while the estimation of the resource use efficiencies was for the purpose of achieving objective five.

vii. Specification of hypothesis testing:

a. Z-test:

The Z-test was conducted to confirm hypothesis (iii) i.e. It is not profitable to produce masakwa. The formula for the Z-test is given as:

$$Z = \frac{\bar{R} - \bar{C}}{\sqrt{\frac{R^2}{n_R} + \frac{C^2}{n_c}}}$$

Where:

Z = The calculated Z value

$\bar{R}$ = mean of farmers returns (₦)

$\bar{C}$ = mean of farmers cost of production (₦)

R^2 = variance of the returns (₦)

C^2 = variance of the costs (₦)

n_R and n_C = are the sample sizes associated with farmers returns and costs.

b. T-test:

The t-statistics was conducted to confirm hypothesis (ii) i.e. resources are not efficiently used in masakwa production.

The formula for the t-test is given as:

$$t = \frac{b_i}{SE_i}$$

Where:

t = is the calculated t-value

b_i = estimated regression coefficients for variables.

SE_i = standard errors of estimated regression coefficients.

The apriori expectations for the various variables used in the production function analysis are as follows:

X_1 = (farm size): It is expected that yield will increase as farm size increases, *ceteris paribus*.

X_2 = (Seeds) it is expected that yield will increase as seed planted increases, *ceteris paribus*.

X_3 = (Family labour): It is expected that yield will increase as family labour use increases, *ceteris paribus*.

X_4 = (Hired labour): It is expected that yield will increase as hired labour use increases *ceteris paribus*.

X_5 = (Organic manure): It is expected that yield will increase as amount of organic manure use increases *ceteris paribus*.

X_6 = (Agro-chemicals): It is expected that yield will increase as the amount of herbicides use increases *ceteris paribus*.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Socio-Economic Characteristics of the Farmers

4.1.1 Age of the Farmers

Farming requires that one has to reach a certain age to attain a certain level of both mental and managerial ability. Farming activities require manual labour, the provision of which is partly determined by age.

The age distribution of the sampled farmers is shown in Table 4.1. The average age of the farmers was 46 years and majority (about 61%) in the productive years of 31 – 50.

Also, it can be observed that the percentage of the two extremes of age groups (20-30, and 61 and above) are low. The younger or the youth group may have been fully engaged in schooling and not producing much Masakwa while the elderly may be too old for Masakwa production.

Table 4.1 **Ages of respondents**

Age Group Years	No. of Farmers	Percentage of Total
20-30	4	3.42
31-40	27	23.08
41-50	44	37.61
51-60	24	20.51
61 and Above	18	15.38
Total	117	100

Source: Survey Data, 2005.

4.1.2 **Farm Size (hectares)**

The size of the farm cultivated is a function of population pressure, size of the family, labour available and financial background of the farmer. The frequency distribution of sampled farms is shown in Table 4.2. The size of holdings for farmers ranged from 1 to 50 hectares. The overall mean farm size is 2.68 ha. About 66 per cent of the farmers have farm sizes of less than 2 hectares while only one farmer had about 50 hectares of land.

Table 4.2 **Farm size of respondents**

Farm size (ha)	No. of Farmers	Percentage of Total
Under 1	36	30.78
1.1-2.0	41	35.04
2.1-3.0	21	17.95
3.1-4.0	7	5.98
4.1-5.0	4	3.42
5.1-6.0	3	2.56
6.1 and above	5	4.27
Total	117	100

Source: Survey Data, 2005

4.1.3 **Level of Education**

Education is very important in farming and it contributes significantly to managerial performance. Management here means the organisation and co-ordination of factors of production such as land, labour and capital.

In this study, 5.12 percent of the respondents had no formal education (Table 4.3). About 23 percent of the respondents had attended Koranic or Bible schools. From the survey, the highest number of respondents (i.e. about 72%) was found to be literate. Adoption of improved technologies would thereby be enhanced.

Table 4.3 **Educational levels of respondents**

Level of Education	No. of Farmers	Percentage of Total
No formal education	6	5.12
Koranic/Bible Schools	27	23.08
Primary School	26	22.22
Secondary School	29	24.79
Tertiary	29	24.79
Total	117	100

Source: Survey Data, 2005.

4.1.4 **Household Size**

Household size is the composition of all members of a given family that are living together. The working force and the size of farm-land are proportional to the family composition. Hence in the family, the consumption unit is also regarded as the production unit especially under African culture and traditions (Olukosi and Erahbor, 1988).

Majority of the households, about 56 percent have less than 10 people giving an average household size of 8 people (Table 4.4). These household members contributed labour for masakwa production in the study area. This is a common feature in Adamawa State under small-scale farming where household members provide most, if not all, of the labour requirements for farming.

Table 4.4 **Distribution of farmers according to household size**

Household size	No. of Farmers	Percentage of Total
1-5	27	23.08
6-10	39	33.33
11-15	23	19.66
16-20	28	23.93
Total	117	100

Source: Survey Data, 2005.

4.1.5 **Farming Experience**

Experience is proportional with age i.e. as the age increases among the farmers, years of experience also increases. It is believed that the higher the years of farming experience of a farmer, the more the ability of such farmer to make good farm management decisions giving him all the necessary funding at his disposal (Olayemi, 1998).

About 56 percent of the farmers had up to 20 years farming experience. These figures imply that farmers are capable of taking good decisions regarding their masakwa farms.

Also about 8 percent claimed they had farming experience of up to 41 years. This group of respondents may find it difficult to change certain old practices.

Table 4.5 **Distribution of farmers according to farming experience**

Farming Experience (years)	No. of Farmers	Percentage of Total
1-10	22	18.80
11-20	43	36.75
21-30	28	23.93
31-40	15	12.82
41 and above	9	7.70
Total	117	100

Source: Survey Data, 2005.

4.1.6 **Sex**

Gender issue is an important aspect of farming, since farm operations vary from stage to stage. The study shows that about 90 percent are male farmers and 10 percent were female farmers. This study therefore shows that there were more males in Masakwa farming than females (Table 4.6).

Table 4.6 **Sex distribution of respondents**

Sex	No. of Farmers	Percentage of Total
Male	105	89.74
Female	24	10.26
Total	117	100

Source: Survey Data, 2005.

4.1.7 **Major Occupation**

Majority of the farmers (68 percent) were self employed and about 27 percent of them were employed as shown in Table 4.7. Most of those employed were government workers while those who were self employed

owned business ventures or were artisans. Only about 2 percent considered themselves jobless and 5 percent were in school.

Table 4.7 **Distribution of respondent according to major occupation**

Type of occupation	**No. of Farmers**	**Percentage of Total**
Employed	32	26.67
Self-employed	81	67.50
Unemployed	2	1.67
Going to School	5	4.16
Total	120	100

Source: Survey Data, 2005.

4.1.8 **Land Tenure**

The source of land for farming is either acquired through inheritance or leasing as the case may be. About 43 percent had their land through inheritance while 41 percent had their farm lands through leasing, and 14 percent of the lands were obtained through purchase (Table 4.8).

Table 4.8 **Distribution of respondents according to land tenure**

Type of tenure	No. of Farmers*	Percentage of Total
Inheritance	80	59.70
Purchase	13	9.70
Leased	38	28.37
Borrowed	3	2.23
Total	134	100

* : Multiple responses

Source: Survey Data, 2005.

It is interesting to note that some farmers have acquired some farms apart from their inherited lands e.g. through purchase and leasing.

4.1.8.0 Input-Output Levels in Masakwa Production

A total of 312.5 hectares of land were used by all the farmers in the sample giving an average of 2.68ha. This may indicate scarcity of the input (flooded plains) due to the low-flooding of the river Benue and the Laddo dam constructed along the river Benue by the Cameroun Republic.

The farmers do not have enough land for expansion of masakwa production because of the scarcity of flooded plains and since the bulk of the land is owned through inheritance.

4.1.8.1 **Labour**

Agricultural labour is supplied through family, co-operative and or hired labour. In Yola South area, about 27 percent of the farmers used hired labour, and 73 percent used both family and hired labour.

Communal labour and work gangs (Gayya) and other forms of labour are useful (Jongur, 1993). When it comes to threshing, men, women and children of the household all contribute their quota. Farm tasks tend to be sex related. For instance, whereas men participate in all farm operations, no woman or child is involved in the tillage operation (Nwagbo and Okorji, 1987 and Nwagbo and Onwuchekwu, 1988). Children help in weeding and harvesting activities, but are mostly employed for bird and animal scaring.

Wages are paid on daily basis. The wage rate depends both on the nature of the task and on whether the labourer is a man, woman or child. Men are usually paid higher wages than women, even for similar tasks. High wage rate limits the scale of operation of Masakwa farmers e.g. ₦500/man, ₦350-400 for female adult and ₦200 for children during transplanting operations. Labour input used in man-day was considered in this study.

4.1.8.2 **Capital**

Basically simple tools are used for masakwa production. The average farming household has 2 cutlasses valued at ₦80 each; hand hoes valued

at ₦200; 2 digging sticks valued at ₦200 each, an axe valued at ₦500 each and a rake valued at ₦150 each.

4.1.8.3 **Inferences on Input – Output Levels of Masakwa in Yola Area**

The inferences drawn from the input-output levels in Masakwa production in 2003, 2004 and 2005 are as follows:

a. Inference Drawn in 2003

The maximum hectares of land used by the farmers in Yola were 33 ha, giving an average of 2.69 ha for masakwa production. While the total yield obtained was 32325 kg, giving an average of 1105.07 kg/ha, also the average seed (8.33kg/ha), labour (92.44 man-hours), organic manure (6.5 kg) and herbicides (1.04 litres) were used per hectare respectively (Table 4.9).

Table 4.9 Input-output levels for Masakwa production in 2003

Variables	Maximum	Minimum	Mean hectares/ farmer
Land (ha)	33	0.5	2.69
Seeds (kg)	230	3.31	8.33
Family labour (man-hrs)	2281.21	58.48	62.86
Hired Labour (man-hrs)	1073.51	27.52	29.58
Organic manure (kg)	99.12	1.36	6.5
Herbicides (litres)	27.32	0.0	1.04
Total Fixed Costs: (₦) (Depreciation on hoes, cutlasses, axe)	800	200	550
Yield (kg/ha)	32325	655	1105.07

Source: Survey Data, 2005

b. **Inference Drawn in 2004**

The maximum land used by the farmers was 32 ha, with an average of 2.7 ha were used for masakwa production; while the maximum and average yields were 30100 kg and 976.56 kg/ha. The average seeds (7.58 kg), labour (94.80 man hrs), organic manure (6.84 kg) and herbicides (1.02 litres) were used respectively (Table 4.10).

Table 4.10 Input-output levels for Masakwa production in 2004

Variables	Maximum	Minimum	Mean hectares per farmer
Land (ha)	3250	0.5	2.7
Seeds (kg)	200	3.3	7.58
Family labour (man-hrs)	2263.46	59.16	64.46
Hired labour (man-hrs)	1065.16	27.84	30.34
Organic manure (kg)	73.18	1.34	6.84
Herbicides (litres)	27.5348	0.0	1.02
Total Fixed Costs: (₦) (Depreciation on hoes, cutlasses, axe)	900	200	600
Yield (kg)/ha	30,100	555	976.56

Source: Survey Data, 2004/2005

c. Inference Drawn in 2005

The maximum land used by the farmers were 31 ha, with an average of 2.65 ha were used for masakwa production. The maximum yield obtained were 31250 kg giving an average of 1193.06 kg. While the average seeds (10.97 kg), labour (109.98 man-hours); organic manure (7.11kg) and herbicides (1.11 litres) were used respectively (Table 4.11).

Table 4.11 Input-output levels for Masakwa production in 2005

Variables	Maximum	Minimum	Mean per farmer
Land (ha)	31	0.5	2.65
Seeds (kg)	229	3.2	10.97
Family labour (man-hrs)	2248.93	53.81	72.79
Hired labour (man-hrs)	1058.32	25.32	35.19
Organic manure (kg)	96.77	1.93	7.1
Herbicides (litres)	96.77	0.0	1.11
Total Fixed Costs: (₦) (Depreciation on hoes, cutlasses, axe)	900	200	600
Yield (kg)/ha	31,250	600	1193.06

Source: Survey Data, 2005.

d. Inference Drawn from Yola Area

The maximum land used for maskwa production by the sampled farmers was 32 ha, with an average of 2.68 ha. The maximum yield obtained was 31225 kg, giving an average of 1091.56 kg/ha. The average seeds (8.96 kg), labour (99.07 man hours); organic manure (6.81 kg) and herbicides (1.06 litres) were used respectively (Table 4.12).

Table 4.12 Input-output levels for Masakwa production in Yola (Three years average)

Variables	Maximum	Minimum	Mean hectare per farmer
Land (ha)	32	0.5	2.68
Seeds (kg)	219.67	3.27	8.96
Family labour (man-hrs)	2264.54	57.15	67.37
Hired labour (man-hrs)	1065.66	26.89	31.70
Organic manure (kg)	89.69	1.54	6.81
Herbicides (litres)	27.73	0.0	1.06
Total Fixed Costs: (₦) (Depreciation on hoes, cutlasses, axe)	866.67	200	583.33
Yield (kg)/ha	31225	603.33	1091.56

Source: Survey Data, 2005
Note: 8 man-hours make 1 man-day

An average labourer received ₦350 per day (average of 3 years).

4.1.8.3.1 **Masakwa Output (Yield)**

One of the cardinal objectives of the study was to examine and to describe the masakwa output compared to the other cereals especially the rainfed sorghum output. The total Masakwa yield obtained were 129,293.19 kg, 114,257.52 kg and 139588,02kg in 2002/2003, 2003/2004 and 2004/2005 planting seasons respectively giving an average of 105.07kg/ha, 976.56 kg/ha and 1193.06kg/ha. The overall average yield was 1091.56 kg/ha.

There is a large number of people consuming masakwa because of its taste and flavour especially when prepared in form of *kunu*/porage, *dakkere/fura, waina* and *tuwo*. It also serves as a means of food security for the people of Yola specially when there is a rainfed crop failure.

From the available records (CBN, 2000 and FAO, 2001), the estimated sorghum output for Nigeria including the masakwa output was 8824 metric tones per hectare higher than the other cereals like maize (6691 Mt), millet (6743Mt), rice (3841Mt) and wheat (5Mt) (FAO, 2004) respectively. In a study conducted by (Tabo et al, 1999; and Bage, 2004) the average rainfed sorghum per hectare ranged from 570 to 830 in the North Central states of Nigeria. Masakwa therefore yields more than rain fed sorghum.

4.2 COSTS AND RETURNS ANALYSIS

4.2.1 Gross Returns

The gross returns were obtained by multiplying the total quantity of masakwa produced by the average market price prevailing during the survey periods of 2003, 2004 and 2005 respectively. The prices of masakwa were ₦22.0, ₦28.0 and ₦38.00 respectively in years 2003, 2004 and 2005. The gross returns per hectare obtained from masakwa production was ₦24, 311.43, ₦20, 288.57 and ₦45336.28 in three years respectively. The average gross returns per hectare was ₦32,746.20 while the average price of a kg of masakwa was ₦30.00.

4.2.2 **Costs of Production**

In the computation of the total cost of production, the fixed costs on (hoes, cutlasses and axes) the variable cost components were all taken into consideration. These include the cost of inputs such as the seeds, labour, organic manure, herbicides, transportation and other marketing costs.

4.2.3 **Labour Cost**

The total cost consists of both the family and hired labour. Both were costed because it was assumed that the family labour perfectly substitutes for hired labour. As suggested by Norman (1967 and 1973) 8 man-hours were equivalent to 1 man-day costing about ₦300; ₦350 and ₦400/day in 2003, 2004 and 2005 planting seasons respectively. The average quantities of labour therefore utilized per hectare for these years were 92.44, 94.08 and 109.98 man-hours respectively. The three-year average labour used was 99.07 man – hours.

The total labour cost per hectare was ₦3330.20 made up of ₦2431.05 and ₦899.15 for family and hired labour respectively for the pooled data. The yearly figures are also shown in Table 4.13.

Table 4.13: Labour Costs of Respondents

Type of labour	Labour costs			
	2003	2004	2005	Pooled Data
Family	2448.95	2429.89	2414.29	2431.05
Hired	905.77	898.73	892.96	899.15
Total	3354.72	3328.62	3307.25	3330.20

Source: Survey Data, 2005

4.2.4 **Cost of Seeds**

The quantity of seeds planted per hectare in the nursery fields and later transplanted were 8.33kg, 7.58 kg, 10.97 kg espectively in 2003, 2004 and 2005. The three-year average was 8.9kg. A kg of the seed input was observed to cost ₦22; ₦28 and ₦38 in the three years averaging ₦30. However, in practice, the farmers relied on their previous harvest as their source of planting materials. Though masakwa seedlings are sometimes bought by the Lamido of Adamawa from Bama, Borno state and later distributed free to the farmers. This is done especially when flooded areas increase and farmers have no seedlings to transplant. This implies that they do not buy from the market. Nevertheless, the cost of seeds per hectare was found to be ₦230.0, ₦200 and ₦229.0 for 2003, 2004 and 2005 cropping seasons respectively while the average cost of seeds per hectare was ₦219.67.

4.2.5 **Cost of Organic Manure**

It is worth noting that Masakwa production does not require the use of chemical fertilizer input, because the organic manure is only used at the nursery stage while some farmers do not even apply any. This is so because masakwa fields have some alluvial deposits from the floods of the river Benue. Therefore no further application of manure or fertilizer was needed for the masakwa farms after transplanting. However, the quantities of manure utilized per hectare were 6.5 kg, 6.84kg and 7.1kg respectively for

2003, 2004 and 2005 seasons. While a 100kg bag of manure was transported to the nursery field at ₦40.00, ₦6 0.00 and ₦70.00 respectively for the study years. The average quantity of manure was 6.81kg costing ₦89.69. This implies that the cost of manure used per hectare in masakwa production is quite negligible.

4.2.6 **Cost of Herbicides**

Herbicide is often used by the masakwa farmers, especially when it comes to land clearing before transplanting. The average cost of one litre of grammazone was ₦900.00, ₦1, 100.00 and ₦1, 300.00 during the 2003, 2004 and 2005 planting seasons respectively. An average of 1.04 litres, 1.02 litres and 1.11 litres were used per hectare in those years respectively. The maximum quantities used per hectare were observed to be 27.32 litres, 27.53 litres and 28.34 litres respectively in 2003, 2004 and 2005 in the study area. The average herbicide quantity used per hectare was 1.06 litres/ha. The most notorious weeds found in the area were *Mbure, Katkagel, Wuta-Wuta* and *Ardadel.*

4.2.7 **Other Costs**

These included transportation and other marketing costs. In cultivating an hectare of masakwa, cost incurred on other items were ₦500.00; ₦600.00 and ₦600.00 respectively (Tables 4.9 and 4.12).

4.3.0 **Total Variable Cost of Production**

This was estimated by summing up the costs of labour, seeds, herbicides and other costs used during production. The average variable cost for producing one hectare of masakwa was found to be ₦5088.26; ₦6096.03 and ₦7963.83 respectively in the study years. Labour was the dominant cost items. It accounted for 68% of the total variable costs of production while the average total variable cost per hectare was ₦6343.05 for the area.

4.3 **Gross Margin Analysis**

The gross margin is the difference between the gross revenue and total variable cost. The gross margin of ₦19223.28; ₦21247.51 and ₦37372.45 were obtained respectively for 2003, 2004 and 2005 cropping seasons. The three-year average gross margin per hectare was ₦26403.15. This implies that masakwa production is profitable.

4.4.1 **Gross Margin per Naira Invested**

The gross margin per naira invested in masakwa production was ₦3.78; ₦3.49 and ₦4.69 respectively in the study years. The three-year average was ₦4.16. This shows that masakwa production is relatively a profitable venture, even with the drought experienced in 2005. If the production is increased to a larger scale there is every likelihood that more profit could be realized to justify production. This is only possible, however,

if the Cameroon Republic will release water from the Laddo dam as required because increase in masakwa production depends heavily on the rain fall water that floods river Benue.

The masakwa production appears more profitable than rainfed sorghum as shown by the research conducted by Loms (1999) and Bage (2004). Returns of ₦0.99, N0.87 and ₦1.03k were realized on every naira invested by Sasakawa, non-Sasakawa and traditional rainfed sorghum farmers respectively. The study was conducted in Kaduna State.

4.4.2 **Net Farm Income Analysis**

As depicted in Tables 4.14 to 4.17, the net farm incomes per hectare obtained were ₦18723.28; ₦20747.51 and ₦36772.45 respectively in the period of study. The average value was ₦25,869.85.

4.4.3 **Net Farm Income per Naira Invested**

On every naira invested in masakwa production, a net income per naira of ₦3.35; ₦3.15 and ₦4.29 respectively were obtained in the three years of study while the average net farm income per naira invested for the study area was ₦3.76.

4.4.4 Inference Drawn from the Average Costs and Returns to Masakwa Production

Table 4.14 shows the summary of costs and returns by year. There is a general upward trend in net far income between 2003 and 2005 as well as net farm income per naira invested. The breakdown by year is shown in Tables 1-4, Appendix A.

Table 4.14: Average Estimated Costs and Returns of Respondents

Variables	2003	2004	2005	Three-years
Average yield kg/ha	1105.07	976.56	1193.06	1091.56
Gross returns ₦/ha	24311.43	27341.72	45336.28	32746.20
Total variable costs ₦/ha	5088.26	6096.03	7963.83	57776.38
Labour cost ₦/ha	3466.05	4147.50	5499	4334.31
Cost of seed ha/₦/ha	183.15	212.24	416.86	268.8
Cost of organic manure ₦/ha	2.60	4.09	4.97	4.09
Cost of herbicides ₦/ha	936	1132.2	1443	1169.18
Fixed costs ₦/ha	500	600	600	566.67
Gross margin ₦/ha	19223.17	21245.69	37372.45	26403.15
Gross margin/₦ invested	3.78	3.49	4.69	4.16
Net farm income ₦/ha	18723.28	20745.69	36772.45	25836.48
Net farm income/₦ invested	3.35	3.15	4.29	3.76

Source: Survey Data, 2005.

4.5 Hypotheses Testing

4.5.1 Z-test

The costs and returns obtained in masakwa production were tested statistically using the Z-test. The test showed that the calculated value of Z (Z-cal) of 7.97 is more than the tabled value (Z-tab) of 5.73 at 0.01 level of significance. Therefore, the null-hypothesis (No. 3) which states that masakwa production is not profitable is rejected. The test of significance computed showed a significant difference between costs and returns in 2003. In 2004 the Z-cal 7.77 is more than the Z-table value of 5.73 at 0.01 percent level of significance. Therefore, the null hypothesis is also rejected. While in 2005 the Z-cal of 8.44 is greater than the Z-tab 4.95 at 0.01 level of significance. Therefore, the null hypothesis is also rejected.

For the three-year average the value of Z-cal (8.19) is more than the Z-tab value of 4.95 at 0.01 level of significance. Therefore, the null hypothesis is rejected implying that there is a significant difference between the costs and returns in masakwa production (Table 4.15).

It can, however, be inferred that the relative profitability of masakwa production makes farmers continue to grow it year after year. Presently there is no improved variety of masakwa except the three local cultivars *Ajagamari, Bamari* and *Ndaneri* (Pic. 4.1) that are available to the farmers.

Table 4.15 Hypothesis testing of the profitability of masakwa production

Variables	N	X	S.D	Variance	Z.cal	Z.tab	L.S
2003							
Returns	117	24311.43	5155.29	265769.21	7.97	5.73	
Costs	117	5888.22	1578.06	2490285.64			0.01
2004							
Returns	117	27341.72	4974.48	24745401.53	7.77	5.73	
Costs	117	7053.15	1693.17	2866813.36			0.01
2005							
Returns	117	45336.28	5087.75	25882486.67	8.44	4.90	
Costs	117	9232.83	1818.50	3306942.25			0.01
Three-Years Average							
Returns	117	32746.20	5072.51	1694552.47	8.19	4.95	
Costs	117	7343.28	1691.58	2888013.75			0.01

Source: Survey Data, 2004/05

Where:

N_R and N_C = Sample size associated with returns and costs
N = Sample size
Z-cal = Z-calculated
Z-tab = Z-table
X = Mean
S.D = Standard Deviation
L.S = Level of significance

4.5.2 **T-test**

The calculated value of t (t-cal) of 2.08 is more than the table value (t-tab) of 1.28 at 5% level of significance in 2003, hence the Null hypothesis (No. 2) i.e. that resources are not efficiently used in masakwa production is rejected. In 2004 the t-cal of 3.46 is more than the t-tab value of 1.98 at 5% level of significance, hence the null hypothesis (No. 2) is rejected. Also for 2005, the t-cal of 6.07 is more than the tabled value of

1.98 at 5% level of significance, therefore the Null hypothesis (No. 2) is also rejected.

The three-years average t-cal of 3.87 is more than the t-tabled valued of 1.75 at 5% level of significance; hence the Null hypothesis (No. 2) is also rejected. This implies that resources were efficiently utilized in production of masakwa area in 2003, 2004 and 2005 respectively (Table 4.16).

Table 4.16: Hypothesis testing of the resource use efficiency in masakwa production.

Year	Variables b_i	SE_i	t-cal	t-value	L.S
2003	3.38	1.625	2.08	1.28	0.05
2004	6.85	1.980	3.46	1.98	0.05
2005	3.60	0.593	6.07	1.98	0.05
Three years average	4.61	1.399	3.87	1.75	0.05

Source: Survey Data, 2005.

Where:

b_1 = Estimated Regression Coefficient for variables

SE_i = Standard Errors of Estimated Regression Coefficients.

t_{cal} = Calculated t-value

$t\text{-}tab_{value}$ = t-table

L.S = Level of significance.

4.6 PRODUCTION FUNCTION ANALYSIS

The Cobb-Douglas function was selected as that which gave the best fit for the data based on its coefficient of multiple determination, signs of the estimated coefficients and the number of significant variables. The results are summarized in Table 4.17. For 2003 for example, the adjusted coefficient of multiple determinations ($\bar{R}^2$) showed that 71 percent of the variations in masakwa output were accounted for by the variables namely: farm size, labour, seeds, organic manure and herbicides included in the model.

The F-value of 36.12 was significant at 1 percent level of probability. This implies that the model was well specified. The coefficients of farm size (Log X_1) and seed (Log X_2) were positive and significant at 1 percent, while that of herbicides were significant at 5%. This implies that a unit increase in the farm size when other variables are held constant will result in 3.38kg increase in yield of masakwa.

The coefficient for seeds (Log X_2) was positive and significant at 1 percent. This means that as seed use is increased, *ceteris paribus,* the output will also increase. The coefficient of labour (Log X_3) was not significant.

The coefficients for organic manure (Log X_4) were negative and insignificant; and this implies that increase in organic manure use will result in decrease output *ceteris paribus.* The coefficient of herbicides (log X_5) was positive and significant at 5 percent level of probability. This implies that increase in the use of herbicides will result in increase output *ceteris paribus* .

The adjusted coefficient of multiple determinations ($\bar{R}^2$) for 2004 model showed that 37 percent of the variation in Masakwa was accounted for by the variables farm size, labour, seeds, organic manure and herbicides. The F-value of 7.23 was significant at 1 percent level of probability implying that the model was adequately specified. The coefficient of farm size ($\log X_1$) was positive and significant at 5 percent. This suggests that a unit increase in the farm size when other variables are held constant will result in 0.3025 increases in yield of masakwa. The inference drawn is in consonance with the *apriori* expectation earlier stated. The coefficients of seeds ($\log X_2$), labour ($\log X_3$), organic manure ($\log X_4$) and herbicides ($\log X_5$) were not significant.

For 2005 model, the adjusted coefficient of multiple determination ($\bar{R}^2$) was 77 percent. The F-value of 33.96 was significant at 1 percent level of probability implying that the model was well specified. The coefficients of seeds ($\log X_2$), labour ($\log X_3$) and organic manure (logX4) were not

significant while the coefficient of herbicides ($\log X_5$) was positive and significant at 5 percent level of probability. The positive sign implies that an increase in herbicides will cause an increase in masakwa yield.

The estimated Cobb-Douglas production function for masakwa for the three years pooled data is given in Table 4.18. The coefficient of multiple determination was 61 percent, the F value of 25.77 was significant at 1% level of probability implying the model is well specified.

Table 4.17: Estimated Cobb-Douglas production function for masakwa by year.

	2003		2004		2005	
Input variables	Coeff	T-value	Coeff	T-value	Coeff	T-value
Constant	12.21* (0.004)	2.97	3.06* (0.00)	7.72	2.82 (0.00)	15.79
Farm size (X_1)	3.39* (0.007)	2.8	0.30** (0.04)	2.16	0.32* (0.00)	3.26
Seeds (X_2)	1.75* (0.000)	4.96	0.20 (0.15)	1.46	0.11*** (0.13)	1.55
Labour (X_3)	0.05 (0.52)	0.65	-0.05 (0.68)	-0.42	0.07 (0.39)	0.87
Organic manure (X_4)	-0.03 (0.992)	-0.01	0.29*** (0.06)	1.96	0.05*** (0.07)	1.97
Herbicides (X_5)	0.23 (0.011)**	2.65	0.01 (0.96)	0.05	0.23** (0.09)	2.65
F-value	36.12		7.23		33.96	
R^2	.732		.429		.773	
R^2 (adj)	.711		.37		.75	

Where: Coeff = Coefficient
* = 1 percent level of significance
** = 5 percent level of significance
*** = 10 percent level of significance

Source: Survey Data, 2005

The coefficients of farm size ($LogX_1$) and seeds ($logX_2$) were significant at 5 percent level and herbicides was significant at 10 percent level of probability.

Table 4.18. Estimated Cobb-Douglas production function for masakwa production Three years average

Input variables	Coefficients	T-value
Constant	5.99	8.83
	(1.56)	
Farm size (X_1)	1.34**	2,74
	(0.48)	
Seeds (X_2)	0.69	2.66
	(0.19)**	
Labour (X_3)	0.02	0.36
	(0.09)	
Organic manure (X_4)	0.10	1.28
	(0.93)	
Herbicides (X_5)	0.16***	1.78
	(0.10)	
F-value	25.77	
R^2	.6447	
R^2 (adj)	.6103	

4.7 **RESOURCE USE EFFICIENCY FOR MASAKWA PRODUCTION**

The estimated Cobb-Douglas production function was used to compute marginal value productivities of the inputs used in masakwa production. The marginal value productivity when compared with the unit price of each input gives an indication of how efficient each resource has been utilized. The marginal value product of land was not computed for the majority of the farmers that indicated they inherited the land on which they

are farming. While an average of ₦400.00 per hectare was paid as a rental value for land in the study area.

The results of the analysis for 2003, 2004 and 2005 respectively are as follows:

(a) **Inferences Drawn from 2003**

When the marginal value productivity of seeds was compared with its respective marginal factor cost (Table 4.19), the result showed a value of 10.56 greater than 1. This implies that seed was under utilized but labour, organic manure and herbicides were over utilized.

Table 4.19: Determination of resource use efficiency from ratios, 2003

Variables (resources)	Estimated MVP	Estimated MFC	MVP/MFC Ratio
Seeds (X_2)	232.31	22	10.56
Labour (X_3)	0.65	300	0.002
Organic manure (X_4)	-4.25	0.40	-106.26
Herbicides (X_5)	246.8378.51	900	0.27

Source: Survey Data, 2005

(b) **Inferences Drawn from 2004**

The marginal value productivity of seeds was compared with its respective marginal unit cost. The result showed a value of 0.9243 which is almost equal to 1 (Table 4.20). This implies that seed was efficiently utilized but labour (-0.0013) and herbicides (0.0049) were over utilized, while organic manure (68.92) were under utilized.

Table 4.20: Determination of resource use efficiency ratios, 2004.

Variables (resources)	Estimated MVP	Estimated MFC	MVP/MFC Ratio
Seeds (X_2)	25.88	28	0.9243
Labour (X_3)	-0.47	350	-0.0013
Organic manure (X_4)	41.35	0.60	68.92
Herbicides (X_5)	5.46	1100	0.005

Source: Survey Data, 2004/2005

(c) **Inferences Drawn from 2005**

The marginal value productivities of the inputs were compared with the respective marginal factor costs. The result showed that seeds, labour and herbicides were over utilized but organic manure was under utilized (Table 4.21).

Table 4.21: Determination of resource use efficiency ratios, 2005.

Variables (resources)	Estimated MVP	Estimated MFC	MVP/MFC Ratio
Seeds (X_2)	12.12	38	0.3189
Labour (X_3)	0.71	400	0.0018
Organic manure (X_4)	8.19	0.70	11.70
Herbicides (X_5)	249.68	1300	0.19

Source: Survey Data, 2005

Most importantly, the implications are that masakwa farmers can still raise their output and returns by using more of organic manure at the nursery site, since it is free. Inputs such as seeds and herbicides that were under utilized, while labour and organic manure could be reduced or maintained at the existing level (minimum). However in order to increase

their returns bearing in mind the fact that labour was the dominant cost item, it is rational that the masakwa farmers adopt labour saving devices such as ox-drawn implements or locally fabricated machines that can help in land preparation and control of weeds.

(d) **Inferences Drawn from the three years Average**

The results showed that seed, labour and herbicides were under-utilized, but organic manure was efficiently used, since the value is almost equal to 1.

Table 4.22 Computation of marginal value product (MVP), 2003

Input Variables	$\bar{y}$	$\bar{\bar{x}}$	**b_i**	**bi^Y/x = MVP**
Seed (X_2)	1105.06	8.33	1.7512	232.31
Labour (X_3)	1105.06	92.44	0.05414	0.6472
Organic manure (X_4)	1105.06	6.5	-0.0250	-4.2502
Herbicides (X_5)	1105.06	1.04	0.2323	246.83

Source: Survey Data, 2005

Table 4.23 Computation of marginal value product (MVP), 2004

Input Variables	$\bar{y}$	$\bar{\bar{x}}$	b_i	bi^Y/x = MVP
Seed (X_2)	976.56	7.58	0.2009	25.88
Labour (X_3)	976.56	94.80	-0.0454	-0.47
Organic manure (X_4)	976.56	6.84	0.2896	41.35
Herbicides (X_5)	976.56	1.02	0.0057	5.46

Source: Survey Data, 2005

Table 4.24 Computation of marginal value product (MVP), 2005

Input Variables	$\bar{y}$	$\bar{x}$	b_i	bi^Y/x = MVP
Seed (X_2)	1193.06	10.97	0.1114	12.12
Labour (X_3)	1193.06	109.98	0.0655	0.71
Organic manure (X_4)	1193.06	7.11	0.0488	8.19
Herbicides (X_5)	1193.06	1.11	0.2323	249.68

Source: Survey Data, 2005

Table 4.25 Computation of marginal value product (MVP) of inputs for three years pooled data

Input Variables	$\bar{y}$	$\bar{x}$	b_i	bi^Y/x = MVP
Seed (X_2)	1091.56	8.96	0.6878	83.79
Labour (X_3)	1091.56	99.07	0.0247	0.27
Organic manure (X_4)	1091.56	6.81	0.1045	16.75
Herbicides (X_5)	1091.56	1.06	0.1739	179.08

Source: Survey Data, 2005

Table 4.26 Computation of marginal factor costs (MFC) of the inputs, three years pooled data

Input Variables		Unit Price (₦)			
	Unit	2002/03	2003/04	2004/05	Three years average
Seed (X_2)	Kg	22.0	28.0	38.0	30
Labour (X_3)	Man-hour	92.44	94.8	109.98	99.07
Organic manure (X_4)	Kg	0.40	0.60	0.70	0.56
Herbicides (X_5)	Litre	900.0	1100	1300	1103

Source: Survey Data, 2005

Table 4.27: Determination of resource use efficiency from ratios of three years pooled data

Variables (resources)	Estimated MVP	Estimated MFC	MVP/MFC Ratio
Seeds (X_2)	163.25	30	5.44
Labour (X_3)	7.60	350	0.021
Organic manure (X_4)	3.21	0.60	5.35
Herbicides (X_5)	164.48	1169	0.14

Source: Survey Data, 2004/2005

4.8 RETURNS TO SCALE

This is essentially the response of the output when all the factors of production are changed simultaneously in the same direction. For the Cobb-Douglas production function, the sum of the coefficients gives the returns to scale because the coefficients are direct elasticity measurements for each variable input (Table 4.28).

Land, seeds, labour, organic manure and herbicides with elasticities of 0.30, 0.20, -0.05, 0.29 and 0.01 respectively are inelastic. This implies that when all the inputs required for masakwa production are increased by one percent, the output will increase by 0.75 percent. In addition, the productivity of the variables specified in the model for masakwa production is adequate in 2005.

Table 4.28: Elasticities of production of the variable inputs used in Masakwa production.

Variables	Elasticities			
	2003	2004	2005	Three years pooled data
Land (b_1)	3.39	0.34	0.30	1.34
Seeds (b_2)	1.75	0.08	0.20	0.67
Labour (b_3)	0.05	0.05	-0.05	0.02
Organic manure (b_4)	-0.03	0.03	0.29	0.10
Herbicides (b_5)	0.23	0.22	0.01	0.15
$\sum (b_i)$ (Total)	5.39	0.72	0.75	2.28

Source: Survey Data, 2005.

The elasticities of all the inputs except labour (b_3) were positive (Table 4.28). Implying that one percent change in any of the input, while holding others (not specified in the model) constant results in a certain percentage in the quantity of masakwa yield.

The return to scale for the response of the output in 2003 was obtained from the Cobb-Douglas function for each of the variable inputs such as land (3.39), seed (1.75), labour (0.05), organic manure (-0.03) and herbicides (0.23). Land and seed were elastic and labour is almost a unit elastic, while organic manure and herbicides were inelastic (Table 4.28).

The return scale for the response of the output in 2004 was obtained through the sums of their coefficients. Since the coefficients from the Cobb-Douglas function was direct elasticity measurements for each variable input.

Land, seeds, labour, organic manure and herbicides with elasticities of 0.34, 0.08, 0.05, 0.03 and 0.22 respectively were inelastic (Table 4.28).

This implies that when all inputs required for masakwa production were increased by one percent, the output will increase by 0.72 percent.

However, with respect to individual inputs, the elasticity of production indicated that land is the input to which output is most responsive in all of the three years, followed by herbicides, seeds and organic manure. This implies that it is advisable for the farmers to increase the seed input as well as that of herbicides, since labour can be reduced if the herbicides are properly administered.

4.9 CONSTRAINTS TO MASAKWA PRODUCTION

Low flooding, low rainfall or moisture stress were ranked by 20.28 percent of the respondents in the study areas (Table 4.29). This low flooding according to the respondents was due to the low rainfall of 2004 and the Laddo dam constructed by the Cameroun Republic on the river Benue. This has resulted in low moisture or stress to masakwa crops during transplanting operations and crop establishment. These have led to low yields or no grain at all.

Inadequate supply and cost of agro-chemicals was ranked third by the respondents. This shows the importance of keeping the fields free of weeds.

About 13 percent of the farmers claimed that they received low prices for their produce. Farmers received low prices at the beginning of the harvest for their masakwa grains. The prices rose from ₦2,200 per 100 kg

bag at harvest period to ₦3,600. The 2005 prices were fair because it started at ₦2, 800.00 and rose to ₦4,200.00/bag and beyond. Sometimes bulk buyers would come to buy on credit and there was sometimes delay in recovering such monies.

Pest and diseases were ranked sixth by the respondents. Masakwa as a crop is not usually attacked by insect pests such as green flies – stem borers and head bugs diseases, but parasitic weed `striga' hermonthica, *wuta-wuta, katkangel, mbure* and *Ardadel* were persistent in most farms. This is because farmers usually clear their farms late after the weeds might have fully germinated. This makes it necessary for farmers to seek capital to purchase herbicides.

Another major problem are the grazers or cattle/sheep and goat rearing on the masakwa prior to the harvest time. Livestock feedstuff become depleted in the farmers' compounds and some animals usually sneak into the fields to feed on the masakwa crops.

Lastly, lack of access to credit facilities make farmers depend heavily on friends and relations for credit.

Table 4.29: Constraints to Masakwa Production

Constraints	No. of Respondents*	% of Respondents	Rank
Grazers/Cattle rearers	100	27.78	1
Low flooding/rainfall	73	20.28	2
Inadequate supply of agro-chemicals	57	15.83	3
Prices not renumerative	45	12.5	4
High cost of transportation	37	10.8	5
Pest and diseases infestation	36	10.0	6
Insufficient credit	12	3.33	7
Total	360	100	

* Multiple responses

Source: Survey Data, 2004/2005

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

This study was designed to measure the performance of masakwa farmers in Yola Local Government Area. The objectives of the study were to describe the socio-economic characteristics of the farmers; to examine and describe masakwa production and other cereals, to determine the inputs and outputs of masakwa production in 2002/2003, 2003/2004 and 2004/2005 years; to determine the costs and returns of masakwa production; to determine the efficiency of resource use in masakwa in each of the three years and to identify the major constraints to masakwa production.

A total of one hundred and seventeen (117) farmers were randomly sampled in each of the 2002/03, 2003/04 and 2004/05 seasons respectively. Structured questionnaire were was administered to the farmers producing masakwa. The data generated included the socio-economic characteristics of the farmers i.e. household size, farm size, labour used, inputs costs and output produced.

The secondary data was collected from the Adamawa State Agricultural Development Programme (ADADP), and other agencies like the Upper Benue River basin Development Authority (UBRBDA), the

Federal Office of Statistics (FOS) and the Ministry of Agriculture (MOA), Headquarters in Yola. The data collected also included market price statistics between January and December for each of the three years.

The various analytical tools that were used to achieve the objectives of this study included descriptive statistics like mean, frequency distribution, percentages and ratios. Measures of dispersion (i.e. variance and standard deviation), farm budgeting techniques and production function analysis.

The survey revealed that the average age of the farmers was 46 years. Majority of them are in the productive age of 15-64. The study revealed that a total of 312.5ha were used by the respondents. The average size of holdings was 2.68 hectares

Majority of the farmers had one form of education or the other. This shows that the masakwa farmers were not all illiterates. The study revealed that 56 percent of the respondents have family size of less than 10 people, and the average household size was 8 people. The study also revealed that the average years of farming experience was 20 years. Most of the respondents were male farmers with only 10 percent as female farmers.

The result showed that gross margins per hectare of ₦19223.28, ₦21247.51 and ₦37372.45 were obtained in 2002/03, 2003/04 and 2004/05 planting seasons respectively. The average was ₦26,403. This

implies that masakwa production is profitable despite the low-flooding of the river Benue in 2004. The gross margin per naira invested revealed that on every Naira (₦) invested in Masakwa, a profit of ₦3.78; ₦3.49, ₦4.69 were made respectively in the study years. The average of the three years was ₦4.16.

Also the costs and returns were subjected to statistical test using the z-test for comparing the farmer's arithmetic means. The test showed that the null hypothesis which states that masakwa production is not profitable was rejected. The test of significance computed showed significant differences between the costs and returns. It can be inferred that the relative profitability of masakwa production ensured the continuous cultivation of the crop.

The study also revealed that a net farm income of ₦18723.28, ₦20747.51 and ₦36772.45 with an average of ₦25869.85 were obtained in 2002/03, 2003/04 and 2004/05 respectively. The net farm income per naira invested revealed that net profits of ₦3.35; ₦3.15, ₦4.29 and with an average of ₦3.76 were obtained in 2003; 2004 and 2005 respectively.

The marginal value productivities were compared with the respective marginal factor costs. The results showed that seed was over utilized but labour, organic manure and herbicides were under utilized in 2003. The inferences drawn for 2004 were that seeds, labour and herbicides were under utilized but organic manure was over utilized. The inferences drawn

for 2005 showed that seeds, labour and herbicides were under utilized but organic manure was over utilized. Therefore, there are differences in the results from one year to the other.

5.2 CONCLUSION

This study has revealed that masakwa production in Yola area is relatively profitable, even though its productivity is still very low.

Secondly labour was the dominant input used in masakwa production, accounting for over 68 percent of the total variable costs. Masakwa output could be improved if the observed inefficiencies in the utilization of production inputs (e.g. over utilized or under utilized in some variable inputs) are overcome. However, higher output can be realized by increasing the level of resources committed to masakwa sorghum production especially by improving the farmer's access to credit to buy inputs like herbicides and supportive services.

5.3 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. The Laddo dam constructed by the Cameroon Republic on the river Benue should release water at appropriate times and not to release

water in a way that it will destroy the crops A covenant law between the Cameroon Republic and Nigeria could be enacted on this issue.

2. Herbicides should be made readily at affordable prices to farmers, so that they can clear weeds on the farms in good time before transplanting their seedlings.

3 Livestock should be kept off the masakwa farms. They have to wait until after harvest.

4 Research institutes in Nigeria, especially Institute for Agricultural Research, Zaria and Lake Chad Research Institute Maiduguri should develop new hybrid varieties for masakwa. Presently the three local cultivars have not been improved scientifically (*Ajagamari, bamari and Ndaneri)*, and the farmers may require a new hybrid of masakwa seeds.

5 Financial institutions such as the banks and other agricultural agencies should provide assistance in kind e.g. herbicides, tractors, empty bags etc to the farmers at a supervised rate, so as to avoid default in repayments.

6 Transport facilities such as pickup vans, lorry, buses and even canoes were used in transporting produce. The government can assist in such direction if possible, so that it can ease the capacity of the business.

7. Even though problem of pests and diseases were not so pronounced on the farms, infestations during storage is eminent. Therefore farmers should be assisted with storage chemicals.

8. There is lack of extension workers/agents on masakwa farms. The Ministry of Agriculture and Adamawa State Agricultural Development Projects/Programmes should improve extension visits to the masakwa farms.

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Appendix A

Table 1. Average Cost and Returns to Masakwa Production in 2003

Variables	Unit Price (₦)	Unit/ha	Value (₦)/ha
Yield (kg)	22.00	1105.07	24311.54
Seeds (kg) (S)	22.0	8.33	183.26
Labour (man-hrs) (L)	300	92.44	3466.50
Organic manure (kg) (M)	0.40	6.5	2.6
Herbicides (litres) (H)	900.00	1.04	936
Other Costs (₦) (O)	-	-	500
Total variable costs (TVC)			
TVC = S+L+M+ H + O			
183.26+3466.50+2.6+936+500		=	5088.26
Gross Margin (GM)			
GM = Gross return (GR)-TVC			
= 24,311.54 – 5088.26		=	19223.28
Fixed Cost (₦)			
(Total Depreciation on hoes, cutlasses, axe)			500.00
Gross Margin per naira invested = Gross Margin / Total variable Cost			
= 19223.28 / 5088.26		=	3.78
Net Farm Income(NFI) = Total Gross Margin (TGM) – Fixed Cost (FC)			
NFI = TGM – FC			
= 19223.28 - 500			
NFI = 18723.28			
Net Farm Income per naira invested = Net Farm Income / Total variable Cost + Fixed Cost			
= 18723.28 / 5088.26+500		= 18723.28 / 5588.26	= 3.35

Source: Survey Data; 2005

Table 2. Average Cost and Returns to Masakwa Production in 2004

Variables	Unit Price (₦)	Unit/ha	Value (₦)/ha
Yield (kg)	28.00	976.49	27341.72
Seeds (kg) (S)	28.00	7.58	212.24
Labour (man-hrs) (L)	350.0	94.8	4147.50
Organic manure (kg) (M)	0.60	6.82	4.09
Herbicides (litres) (H)	1100	1.02	1132.2
Other Costs (₦) (O)	-	-	600
Total variable costs (TVC)			
TVC = S+L+M+ H + O			
= 212.24 + 4147.50 + 4.09 + 1132.2 + 600		=	6096.03
Gross Margin (GM)			
GM = Gross return (GR)-TVC			
= 27343.54 – 6096.03			21245.69
Fixed Cost (₦)			
(Total Depreciation on hoes, cutlasses, axe)			500.00

Gross Margin per naira invested = $\frac{\text{Gross Margin}}{\text{Total variable Cost}}$

$= \frac{21245.69}{6096.03} = 3.49$

Net Farm Income(NFI) = Total Gross Margin (TGM) – Fixed Cost (FC)

NFI = TGM – FC

= 21245.69 - 500

NFI = 20745.69

Net Farm Income per naira invested = $\frac{\text{Net Farm Income}}{\text{Total variable Cost + Fixed Cost}}$

$= \frac{20745.69}{6096.03 + 500} \quad \frac{20745.69}{6596.03} = 3.15$

Source: Survey Data; 2005

Table 3 Average Cost and Returns to Masakwa Production in 2005

Variables	Unit Price (₦)	Unit/ha	Value (₦)/ha
Yield (kg)	38	1193.06	45336.28
Seeds (kg) (S)	38	10.97	416.86
Labour (man-hrs) (L)	400	109.98	5499
Organic manure (kg) (M)	0.70	7.1	4.97
Herbicides (litres) (H)	1300	1.11	1443
Other Costs (₦) (O)	-	-	600
Total variable costs (TVC)			
TVC = S+L+M+ H + O			
416.86+5499+4.97+1443+600		=	7963.83
Gross Margin (GM)			
GM = Gross return (GR)-TVC			
= 45,336.28 – 7963.83			37372.45
Fixed Cost (₦)			
(Total Depreciation on hoes, cutlasses, axe)			600.00

Gross Margin per naira invested = $\frac{\text{Gross Margin}}{\text{Total variable Cost}}$

$= \frac{37372.45}{7963.83} = 4.69$

Net Farm Income (NFI) = Total Gross Margin (TGM) – Fixed Cost (FC)

NFI = TGM – FC

= 37372.45 - 600

NFI = 36772.45

Net Farm Income per naira invested = $\frac{\text{Net Farm Income}}{\text{Total variable Cost + Fixed Cost}}$

$= \frac{36772.45}{7963.83 + 600} \quad \frac{36772.45}{8563.83} = 4.29$

Source: Survey Data; 2005

Table 4 Three years Average Costs and Returns to Masakwa Production the Study Area.

Variables	Unit Price (₦)	Unit/ha	Value (₦)/ha
Yield (kg)	30	1091.54	32,746.20
Seeds (kg) (S)	30	8.96	268.80
Labour (man-hrs) (L)	350	99.07	4334.31
Organic manure (kg) (M)	0.60	6.81	4.09
Herbicides (litres) (H)	1103	1.06	1169.18
Other Costs (₦) (O)	-	-	566.67
Total variable costs (TVC)			
TVC = S+L+M+ H + O = 268.8+4334.31+4.09+1169.18+566.67 =			6343.05
Gross Margin (GM)			
= Gross return (GR)-TVC			
= 32746.20 – 6343.05		=	26403.15
Fixed Cost (₦)			
(Total Depreciation on hoes, cutlasses, axe)			533.3

Gross Margin per naira invested = $\frac{\text{Gross Margin}}{\text{Total variable Cost}}$

= $\frac{26403.15}{6343.05}$ = 4.16

Net Farm Income (NFI) = Total Gross Margin (TGM) – Fixed Cost (FC)

NFI = TGM – FC

= 26403.15 - 533.3

NFI = 25869.85

Net Farm Income per naira invested = $\frac{\text{Net Farm Income}}{\text{Total variable Cost + Fixed Cost}}$

= $\frac{25869.85}{6343.05 + 533.3}$ $\frac{25869.85}{6876.35}$ = 3.76

Source: Survey Data; 2005

Appendix B

Plate 4.1: The three local cultivars identified are: A – Bamari, B – Ajagamari and C-Ndaneri.

Plate 4.2: A healthy heads of Ajagamari ready for threshing.

Plate 4.3: The researcher (Left) and Enumerator (Right) standing infront of Bamari masakwa, ready for threshing.

Plate 4.4: Shows the researcher standing within the masakwa farm where the drought has affected (Zero harvest place)

Plate 4.5: The researcher showing where the masakwa crop has not fully matured in head size due to the drought (periods of extreme heat)

Plate 4.6: Shows the soil characters due to drought and the crop failure (zero harvest, except stalks were collected to feed livestock)

Masakwa Cultivars

The study has identified three local cultivars of masakwa in Yola and these are:

(1) Ajagamari – white seed grain with darker testa;

(2) Bamari – initially introduced from Bama, Bama Local Government Area of Borno state, some years ago; white seed grain with slight black testa.

(3) Ndaneri – oldest local cultivar and has another 3 species and these are; cholade (white testa), danejum (red testa) and belmbalegum (white testa).

AN ECONOMIC ANALYSIS OF MASAKWA SORGHUM PRODUCITON IN YOLA SOUTH LOCAL GOVERNMENT AREA OF ADAMAWA STATE.

SURVEY QUESTIONNAIRE

SECTION A: GENERAL

1. Name of Respondent/Farmer:……

2. Name of the District (a) Village:…… (b) L.G.A……

3. Age of the Farmer –years :…….....

4. Sex (Gender) Male [ ] Female [ ]

5. Marital Status

   (a) Never married [ ]
   (b) Married [ ]
   (c) Widowed [ ]
   (d) Divorced [ ]
   (e) Others (specify) [ ]

6. Major occupation

   (a) going to school [ ]
   (b) working self-employed [ ]
   (c) working employee [ ]
   (d) working apprentice [ ]
   (e) unemployed/looking for a job [ ]

7. (a) How many people are involved in farming in the family?
      (i) No. of wives [ ]
      (ii) Sons [ ]
      (iii) Daughters [ ]
      (iv) Other relatives with you (specify please)……

   (b) If you are a woman, state whether your husband contribute to the family labour in the production
      (a) does contribute [ ]
      (b) does not contribute [ ]

8. Farming experience……. years

SECTION B: SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

9. Educational status

(a) No formal education/never been to school [ ]
(b) primary school [ ]
(c) secondary school education [ ]
(d) Tertiary education [ ]
(e) Koranic/Bible education [ ]
(f) Others (specify):……

10. What is your occupation, apart from masakwa production?.....

11. For how long have you been cultivating masakwa?..... years

12. How many hectares of masakwa did you cultivate at 2002/03/, 2003/04 and 2004/05 planting seasons…….. per hectare/farm field or unit of a farmer.

13. What problems did you encounter in the previous years on masakwa production? Before 2002/03, 2003/04 and 2004/05 respectively.

SECTION C: DATA ON THE FARM ACTIVITIES

14. What is the size of your masakwa farm…… hectares/farm plot and other field of the farmers in 2003, 2004 and 2005.

15. (a) How did you obtain your land?

(a) inherited [ ]
(b) purchase [ ]
(c) leased [ ]
(d) borrowed [ ]
(e) Others (specify)……

(b) If purchased what is the cost?.....₦/ha

(c) If the land is got by hiring, how much do you pay for the land per season?
…….₦/ha in 2003, 2004 and 2005.

16. Did you use fertilizer? Yes [ ] No [ ]

17. If yes what is your source

(a) market [ ]
(b) MOA/ADP [ ]
(c) Cooperatives [ ]
(d) Others (specify):…….

SECTION D: DATA ON INPUT

18. (a) Amount and cost of input used in 2003, 2004 and 2005
(b) What is the cost in N for 50kg bag?
(c) Indicate quantity of the following inputs used per season and their cost at the time of purchasing them

Input/Kg ₦	Amount	Total	2003	2004	2005
Seeds in kg					
Fertilizer in kg					
Hoes					
Cutlasses					
Rake					
Digging sticks					
Chemicals litre					
Herbicides litre					
Seedlings kg or bundles kg					
Organic manure kg					
Others (specify)					

SECTION E: LABOUR AND COST PER FARM (₦) FOR 2003, 2004 AND 2005 PLANTING SEASONS

19. Labour costs

Activities	Cost of Hired Labour		Family Labour	
	No. of People	Hrs of Manday	No. of People	Hrs of manday
Land Clearing				
Ploughing/harrowing				
Planting				
Transplanting				
Weeding				
Fertilizer application				
Second weeding				
Bird Scaring				
Harvesting				
Threshing/winnowing				
Storage/bagging				
Transporting				
Marketing 100kg/bag				

SECTION F: DATA ON FARM OUTPUT AND CONSTRAINTS/ PROBLEMS

20. How many 100kg bags of masakwa did you get at 2002/03, 2003/04 and 2004/05 planting seasons…….

21. What was the initial selling price per 100 kg/bag at harvest? ……

22. What was the lean period price (not at harvest?)……..

23. How much was consumed at home …… gift ….. zakkat…….. kg? in 2003……, 2004 …….. and 2005……

24. What problems did you encounter in marketing your produce/masakwa?....

25. What was your means of transportation?

    (a) Vehicles……. Lorry…….. Buses/pick up van…. Canoe …….
    (b) Donkey; (c) Horse; (d) on foot; (e) Cattle; (f) Others (specify)…… for farm gate prices

26. How much does it cost you to transport a 100kg/bag of masakwa from farm to market and house to market…….₦ in 2003….., 2004….. and 2005…..

27. How many times were you visited by Extension agents? Times

28. What sort of advice did you usually receive from the Extension agent?

    (a) Production problems
    (b) Input procurement
    (c) Marketing of output
    (d) Pest and diseases
    (e) Others (specify)……

29. Do you normally have access to any credit facilities yes/No
    Amount…….. Year 2003……., 2004…….. and 2005……..

30. Do you have any advice on how to improve on masakwa production?
    (a) To other farmers
    (b) Government intervention
    (c) Others (specify)……

Thank you for the response.