THE PROFITABILITY OF SOYBEAN PRODUCTION IN TWO LOCATIONS IN THE NORTHERN GUINEA SAVANNA OF NIGERIA.

BY

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A THESIS SUBMITED TO THE POSTGRADUATE SCHOOL, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS.

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DEDICATION

This work is dedicated to my dear father, the late Tabo,Nguessinda who died while I am away writing this thesis work, to my dear mother, the late Ndodjam Marie, my dear brother Dr. Ramadjita Tabo, to our last born Symphorien N. Tabo and to the entire family.

DECLARATION

I hereby declare that this thesis was written by me and it is a record of my own research work, except where reference is made to published literature and duly acknowledged. It has not been presented before in any application for a degree programme.

Tabo, Nguero — 16/06/99
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The above declaration is confirmed

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CERTIFICATION

This thesis entitled " THE PROFITABILITY OF SOYBEAN PRODUCTION IN TWO LOCATIONS IN NORTHERN GUINEA SAVANNA OF NIGERIA" by Tabo, Nguero meets the regulations governing the award of the degree of Master of Science of Ahmadu Bello University, Zaria , and is approved for its contribution to scientific knowledge and literacy presentation.

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ABSTRACT

Soybean (Gvcine max (L).Merr) is an important food and cash crop in Nigeria. Its cultivation started in the 1930's in Northern Nigeria with the introduction of three varieties from the United States of America. This crop which has high levels of protein, carbohydrates and other valuable nutrients contributes greatly to nutritional requirements of man and animal. It is mostly grown by small-scale farmers as sole or mixed with other crops.

Data and information from the on-farm experiments and the field survey conducted in Makarfi and Malumfashi in Kaduna and Katsina States respectively all in Northern Guinea Savanna of Nigeria were used to ascertain the potential for soybean production.

Twenty farmers were purposively selected in each of the two villages in Northern Guinea Savanna Zone for the study. Data analysis indicate that soybean production both in the on-farm trial and field survey was a profitable enterprise, although the on-farm trial showed higher yield when compared with the field survey. The average yield in the on-farm trial was 1754.1 kg per hectare in both villages while that in the field survey was 1198.23 kg per hectare. All the farmers had more profit and believed that they can increase their yields if inputs such as fertilizers are made available to them at reasonable prices and on time.

The study also showed that among the new technologies tested during the on-farm trial, only Samsoy-2 variety was considered as promising, while the other varieties, TGX 1019, TGX 923, TGX 849 were rejected.

It was observed that most of the farmers sold almost all the produce and left only small quantities for making local food and for sowing during the next season. It is recommended that greater effort should be made to intensify the awareness of the high nutritional value of soybean and to provide appropriate technologies for the transformation of the grain.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF CHARTS

CHAPTER ONE

1.0 INTRODUCTION

1.1 IMPORTANCE OF SOYBEAN TO NIGERIA

Agriculture has been an important sector in the Nigerian economy. The economy growth of Nigeria depends to great extent on the growth of agricultural sector. Agriculture contributed about 55.2 % to the GDP in 1960's, but this contribution declined due to a number of reasons such as discovery of oil , civil war and drought. If the decline worsen then ultimately the agricultural sector will have a feature role to play, especially for providing food to meet the needs of 2.5 - 3.0% growth rate in population, raw materials for the expanding industries, employment opportunities and foreign export of cash crop.

Soybean (Glycine max (L) Merrill) is an important legume crop because of its nutritive value. The crop is known by various names such as golden been, miracle bean and crop of the planet; providing milk meat, oil, cheese, butter, sauce and other products which no other single crop does. The protein content, which is about 40% of the seed weight, is higher than the protein content of any other crop.

Soybean production has expanded from the traditional area of cultivation in the Southern Guinean Savanna ecological zone to Northern Guinea Savanna due to increased demand for confectionery and feed. The spread of soybean in Nigeria is limited because the crop is a short day plant which is highly sensitive to changes in photoperiod .

Another factor responsible for meager production is the fact that farmers yet to realize its economic and nutritional significance; therefore its production is mostly in small-holding of about 0.5- 1.5 ha (Nyiakura,1982).

Soybean was introduced into Nigeria in 1908 and cultivation was centered in Benue state. The first variety introduced was the "Malayan. Benue state remained the sole producer of soybean for many years, but with the ban on importation of vegetable oil in 1984 and the decline in groundnut production, cultivation has spread to other parts of the country, notably Kaduna, Niger, Edo, Kwara, Plateau Oyo and Abia. Current total production from Nigeria is estimated between 150,000 and 200,000 tonnes per annum (CBN, 1996).

Soybean is considered as an important food legume and industrial crop in the country and the work of some scientists has shown that not only does soybean fit into the agro-ecological zones and farming system but its production can be both biologically and economically viable in states within Southern and Northern Guinea Savanna.

The protein-caloric malnutrition which was rampant in the country due to acute shortage of animal protein, with the resulting deficiency of a number of important essential amino-acids, the utilization of soybean was encouraged to solve these problems. Soybean therefore has a major role to play here, not only because it is an excellent source of major nutrient but because 40% of soybean dry matter is protein with amino

acid pattern approaching the optimum recommended by the Food and Agriculture Organization (FAO) of the United Nations. In addition, it contains 20% of desirable fats because of its large proportion of unsaturated fatty acids. It is also a good source of essential vitamins and minerals. Soybean is also flavoured oil because of its high content of unsaturated fatty acids.

Apart from the oil which is used for a range of other preparation such as margarine and the cake which is used for animal feed throughout the world, human food in the form of extracted flakes (containing 50%) soybean concentrate, textured vegetable protein and whole seed have become a large and expanding proportion of diets throughout the developed, developing and under developed world.

Soybean, as we know, has the highest biological value of all vegetable proteins and Nigeria needs it, not just for export as in now happening, but also for processing locally to give us vegetable oil, as well as give us soybean meal for feeding livestock. Another is fishmeal, which we should also be able to produce locally.

Initially soybean was used in Nigeria exclusively for producing food seasoning called *dadawa, ogiri and iru*. This is done through fermentation after boiling. It is then dried and is characterized by a good flavor which if impacts to soups.

Table 1 presents the trends of soybean production in Nigeria from 1975 to 1994.

Table 1: Trend of soybean output and growth rate from 1975-1994

('000 tonnes)

Year	Output	Growth Rates (%)
1975	65	-
1976	70	7.7
1977	70	0.0
1978	72	2.9
1979	73	1.4
1980	75	2.7
1981	78	4.0
1982	82	5.1
1983	42	-48.8
1984	43	2.4
1985	60	39.5
1986	100	66.7
1987	107	7.0
1988	150	40.2
1989	300	100.0
1990	218	-27.3
1991	145	-33.5
1992	159	9.5
1993	163	2.5
1994	180	10.4

Source: Economic and financical Review CBN Vol. 34, March 1996, No. 1, p. 515.

1.2 IMPORTANCE OF WORLD PRODUCTION OF SOYBEANS.

Soybean is a remarkable crop. In the short span of 3-4 decades, it has become the prominent source for animal diets and has gained popularity around the globe for

human nutrition. It has also become the leading source of edible oil and fats, constituting about 20% of the world supply and more than any other single source of these essentials nutrients. Fewer than 50 years ago, the crop was considered as an obscure crop cultivated to a limited extent for east.

Singh *et al.* (1987) suggested that soybean proved more useful than other grain legumes by virtue of its dual purpose as a surce of protein, oil and also its adaptation to temperate condition. Dashiell *et al.* (1987) argued that soybean was easier to be improved genetically because of its higher number of chromosones (2n = 40) compared with 2nd = 14 and 2nd = 20 for other grain legumes. They also noted that this crop has been particularly adaptable to current needs.

Recognising the key role of soybean in national agriculture, especially for production of animal feeds and cooking oils, several subtropical and tropical countries have introduced the crop and have made determined efforts to adapt it to their local conditions (Singh *et al.*, 1987).

Soybean is processed into many protein - rich foods such as meat, milk, cheese, butter, sauce, bread, green shelled beans and chocolate. The seed contains all the essential amino acids. It ranks among the important oil crops in the world. The seed yields edible oil (20%) low in cholesterol and free from aflatoxin,for both domestic and industrial purposes. Industrial uses of the oil include soap, ink, paints, plastics, candles,

insecticides, celluloid, lecithin and lubricants.

The plant makes excellent hay and silage. The cake, which is the residue after oil extraction is rich in protein (70%) and is used extensively for compounding livestock feed particularly monogastrics such as pig, rabbits and also poultry. It is a cash crop, a foreign exchange earner.

The world production of soybean increased from 58.1 million in 1976 to 89.9 million tonnes in 1984 (55% increased) F.A.O, 1983. The total area harvested increased from 37.8 million to 52.1 million hectares and yield from 1536kg/ha to 1727kg/ha during the same period. Yields in Africa were lowest at 660kg/ha, followed by the Far East with 960kg/ha in 1984.

In USA, the production rose from virtually nothing in 1907 to 30 million metric tonnes in 1971, thus accounting for about 2/3 of the total world production (Leakey et al, 1977).

The world's population is destined to reach 6 billion by the turn of the century; at least a third will face serious food shortages. It will be much easier to meet human energy needs than to provide the protein and other nutrients. Daily requirements of carbohydrates should be met with increasing reliance on food crops like roots and tubers, which are easy to grow and well adapted to the humid tropics.

At present, the most serious problems of food shortage ranging from outright famine to the more insidious protein-deficiency diseases occur in Africa. The region affected is a broad belt 20^0 North and South of the equator, stretching across the continent and encompassing and anticipared population of 650 million by the year 2000. The soybean could become a home-grown solution to part of the problem of feeding the groups at risk of malnutrition.

Over 52.6 million hectare of land is believed to be under soybean cultivation in the world, giving a production of 83.5 million metric tonnes at an average of 1,580kg/ha (FAO, 1980). Table 1.2 presents the production figures.

Table 1.2 : Estimated soybean production in major countries.

Country/Region	Total land area (1000ha)	Total grain (1000 metric tonnes)	Grain yield kg/ha
World	52,639	83,481	1,586
North America	27,929	83,481	1,807
U.S.A	27,460	50,468	1,801
South America	11,256	49,454	1,737
Asia	11,662	15,152	1,228
China	9,621	11,964	1,042
Brazil	1,766	19,562	1,728
Africa	324	10,026	749
Nigeria	197	77	3,888

Source: F.A.O Annual Report, 1980.

1.3 PROBLEM STATEMENT

Soybean is considered as one of the most important crops in Nigeria during the last tyo decades. It is consumed in different forms. It is one of the oldest food crop and a modern day success with many uses. It is a highly efficient producer of protein and oil, both of which are essential to the nutritional requirements of man and animal.

Soybean is mostly produced by small scale farmers who grow it mainly as sole crop but sometimes as intercrop. In the study area, soybean does not play an important role in the overall socio-economic status of people. However, the grains are used to produce various forms of local food such as "*dawadawa*","*iru*" and " *ogiri*". The leaves are also used for livestock feed. Some local industries manufacture foods for infants from soybean mixed with maize.

Many Nigerians, particularly children suffer from various types of diseases as a result of malnutrition . This is mainly due to inadequate protein supply to meet their nutritional requirement. The rate of population growth is much higher than the rate of livestock production, thereby leading to a deficit of protein. There is therefore an urgent need to increase the production of soybean to supplement the severe deficiency of animal protein source.

However, despite the high nutritional and commercial value of soybean its production remains low in Nigeria and effort geared towards boosting soybean production

has not achieved the desired result. There are several factors that are responsible for the low production of soybean. These include high cost of inputs such as improved varieties and fertilizer, inappropriate agronomic practices, poor marketing system, low prices of the crop, and poor knowledge of its nutritional value. There are also problems of poor utilization of the grains, competition with other crops, low productivity of the farmland with limited use of fertilizer, inadequate extension services and poor government policy related to its production and utilization.Given all these factors causing low production of soybean one wonders whether farmers are making profit from soybean production.

As a contribution to knowledge, this micro-economic study therefore seeks to evaluate the profitability of soybean production in Northern Guinea Savanna during on-farm testing stage and when farmers have adopted. The choice of Makarfi in Kaduna State and Malumfashi in Katsina State is based on the fact that the EEC/OFAR-IAR (Economic European Community/ On-Farm Adaptive Research - Institute of Agricultural Research) carried out some trials in the two locations during 1991-1993 with the objective of assessing whether the crop can be viable. This study aimed at identifying farmers who participated in the earlier on-farm trial and have accepted the technology.The profitability of soybean production in the two stages were determined and compared. Factors responsible for differences in profit levels were also to be determined in order to guide farmers and policy makers in effort to boost soybean production.

1.4 JUSTIFICATION OF THE STUDY

The issue of profitability for crop production in Nigeria has become important during the last two decades both in terms of subsistence and large-scale farming. This is necessary so as to determine whether or not the enterprise embarked upon is justifiable.

There is an increasing concern about the need to increase food production to meet the dietary requirements of Nigeria's fast growing population. Due to the inadequate supply of animal protein, there is a need to identify a cheap source of protein to supplement the current protein deficit. Soybean, which is also known as a "wonder bean", can be that potential source of protein.

Soybean like other legumes is an important crop in the developing world. It has a high content of protein, carbohydrate and other valuable nutrients. With its high nutritional value, soybean can be a very important food crop for the low income earning families who cannot afford other sources of animal protein. It is therefore essential to promote the cultivation and marketing of this crop.

The study is intended to determine the cost and returns, estimate inputs and output relationship in soybean production and suggests recommendations for better production.

1.5 OBJECTIVES

The broad objective of this study is to evaluate the profitability of soybean production in Northern Guinea Savanna.

The specific objectives are:

1. To describe the socio-economic characteristics of soybean farmers;
2. To estimate input and output relationship in soybean production,
3. To determine the costs and returns to soybean production at the farmer's level,
4. To identify the factors responsible for differences in the profitability levels between the two locations,
5. To make recommendations based on the findings on the research.

1.6 HYPOTHESIS

Ho: There is no difference in the level of profit between the soybean production in Makarfi and Malumfashi

H_A: There is a difference in the level of profit between the soybean production in Makarfi and Malumfashi

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 ORIGIN AND DISTRIBUTION OF SOYBEAN.

Soybean (Glycine max (L) Merrill) is a native of Asia but the exact center of origin is a matter of conjecture. It is probably a native of China and Mancluvia from where it spread to Korea and Japan then India. It is suspected to be derived by hybridization between Glycine Ussuriensis Reggel and Mack and Glycogen tomentosa both of which are found growing wild in China. It is an erect rather than bushy annual legume of the family papillionoida and order leguminosea.

According to Hymowitz (1970), soybean has been in China from prehistoric times, as is evident from Chinese writings dating back to 2800 B.C, in which it was mentioned as one of the 5 principal and sacred crops. It was an important food crop in the orient (China, Manchuria, Korean and Japan) since the earliest times and was carried to Europe by French missionaries in 1940 and to the royal Botanic Gardens. Chew in 1790. Soybean was first brought to the USA in 1840 but failed to receive any recognition. It is only relatively recently that its potential has been recognized and has therefore, now become wide spread. Early distribution was centered on Chinese - Japanese who were the highest producers. The Japanese war of 1894 reduced the Chinese status as world highest producer (Moose, 1950).

In the USA, where it was first cultivated for feeding livestock in the form of hay

and silage (Purseglove, 1979) its domestication started around 1930 using remarkably to rank as the world's highest producer of soybean. The colonial masters and Missionaries introduced soybean into West Africa at the beginning of the 20th century.

Leakey and Wills (1977) reported introduction, were made into Uganda in 1913. It is believed that soybean was introduced to Nigeria at about the same time.

2.2 SOYBEAN IN NIGERIA

Soybeans were introduced into Nigeria by the explorers and missionaries in 1908 and cultivation was centered in Benue state. The first popular variety was the "Malayan". The work on soybean in northern states of Nigeria dates back to 1930 when three varieties, were later found to be low yielding and ill adapted to the environment of Samaru and were soon discarded. The Botanist of the Regional research station, Samaru in 1937 made the next introduction of soybean when Malayan, Benaries and Trinidad were brought from Malayan, India and Trinidad respectively.

Further introduction continued in the 1940s from East Africa, Sudan, USA, South Africa, Ceylon, Far-East, Eastern Europe and Australia. These introductions were grown in various observations plots at Samaru and at the farm centers throughout the northern provinces during the 1950's. Soybean is well adapted in Nigeria and thrives best in sandy-loamy soil with good drainage.

Nigeria, as the largest producer of soybean also has the most extensive research programme. Soybeans were first introduced to the country in 1908 (Fennel, 1966),but the first successful cultivation was in 1937 with the variety, which was found suitable for commercial production in Benue State (Nyiakura, 1982). Since then many small-scale farmers in this area of south-central Nigeria have incorporated soybean in their cropping system.

The current expansion of soybeans in Nigeria has been founded on years of research. In the mid-1960's (Kueneman *et al.*, 1983), the Institute for Agricultural Research (IAR) initiated a breeding programme for soybean and fostered the release in 1983 of two lines from a cross between Malayan and Clemson Non-shattering (Leleji and Adedzwa, 1983). These lines mature in 115-120 days and have given yields more than 2 t/ha in the guinea savanna. Also, they are capable of nodulating with indigenous rhizobia - a trait of the local variety Malayan .

In 1980, soybean scientists in Nigeria adopted a nationally coordinated approach to soybean research that was later endorsed by the federal government. The approach, through its multidisciplinary trials, has led to increased production of improved soybean varieties.

Four major research institutes- the Institute of Agricultural Research and Training, the National Cereals Research Institute, IAR and IITA (International Institute for Tropical

Agricultural) -carry out the bulk of soybean research in the country.

2.3 CULTIVATION OF SOYBEAN IN NIGERIA.

Although soybean was introduced into Nigeria in the early 20th century, the cultivation was localized in Benue State around Gboko, Kwande, Katsina-ala and Makurdi. Production never attained nation-wide significance until the early 1980's when the Federal Government banned the importation of vegetable oil. Some of the reasons advanced for the low status of soybean production included:-

(a) Unpalatability and difficulty association with cooking and high flatus factor.

(b) Unfamiliarity with crop.

(c) Low seed viability

(d) Presence of other pulses the people are accustomed to.

(e) Low producer prices which hitherto prevailed.

(f) Shattering tendency of the Malayan, the first variety introduced, thus making harvesting problematic.

(g) Lack of Rhizobium to effect nodulation.

However, recent developments such as varietal improvement, improved agronomic practices, improved guaranteed producers price and extension activities relating to educating farmers and their families on the nutritional importance of soybean and the processing techniques have stimulated extensive soybean cultivation.

2.4 ECOLOGY OF SOYBEAN PRODUCTION.

Soybean is a short day temperature crop, which has been adapted to the tropics. It is a sub-tropical crops but also grown up to 52° latitudes. In Nigeria, it is normally grown as a sole crop or mixed with cereals crop like maize, sorghum, millet etc. It requires a hot damp summer and it is sensitive to frost. When grown in mixture, it is advised that shading should be reduced during blooming so as to reduce the number of aborted pods. Soybean would grow better under period of reduced day-length, a much longer day length would increase vegetative growth phase at the expense of the reproduction phase, delaying blooming and maturity.

Soybean thrives best in sandy loam with good drainage, optimum soil pH is 6.0 - 7.5 but a pH of 4.5 is tolerated. The plant is sensitive to saline soil containing soluble salts 7m Hs/cm. Benisteen and Ogata (1966) found salinity greatly reduces nodulation of lee soybean at 5.4 atmosphere of added Nacl and the nodule dry weight, loss reduces significantly with increased salinity level. The moist savanna type climate with moonsonal rainfall of about 1,300mm terminating around October - November (Nyiakura, 1982). A rainfall figure of 60-100 mm distributed during the growing season (31/2-4 months) is ideal. And good elevations with temperatures ranging from 21.7°C to 35.9 °C make the Benue area quite ideal for economic production of soybeans. The production figures in Benue are high, the climate is characterized by a hot tropical moist savanna type of climate with moonsonal rainfall ranging between 1200mm - 1500mm, the rain is at its peak between the period of September/October to June and a temperature

of 21.7-35.9 °C incidentally. Soybean does not tolerate frost conditions. Seedbed should be well-prepared and free drainage because the crop does not tolerate water logging. Hunter and Erickson (1952), found that a soil moisture content of about 50% was required for germination of soybean seed. Excessive soil moisture is unfavourable for germination. Probably because it interfere with oxygen supply (V.C. department of Agriculture, 1952). Water soaked seed showed reduced germination (Yakamoto, 1955) while a moisture content of over 15% in sandy soil lowers germination percentage (Delouche, 1953). A dry weather is requiring for harvesting and threshing.

Experiment carried out at Samaru (1976) showed no significant effect of spacing on yield but the highest yield population of about 109,000 plants/ha had the highest yield. However a spacing of 50cm x 50cm with a population of 0.3 million plants/ha is recommended for better performance. Time of planting is an important variable in agricultural production in many parts of the country. It is normally planted to pass the vegetative phase during period of mild rainfall which decreases to time of flowering also affect development at various stages through day length response (Johnson et al, 1960). It is generally recommended that farmers sow their crop early June in the Northern Guinea Savanna and mid-July in Southern Guinea Savanna. A good crop of soybean (1.5 - 2.5 t/ha) requires some agronomic practices and these include: -

(a) Varieties

The first variety of soybean grown in Nigeria was Malayan , tall, lodging prone

with a high level of shattering. Varietal development in the Institute for Agricultural Research (IAR), Samaru resulted in the development and release of short, determinate lodging - resistant, shattering-resistant and high yielding varieties. These varieties Samsoy 1 and Samsoy 2 were produced by crossing the Malayan with clamson non-shattering which is short and shattering resistant (Leleji and Adedzuwa, 1983).

The International Institute for Tropical Agriculture (IITA) Ibadan's also identified some high yielding, shattering-resistant and promiscuous varieties such as Hernous 237, TGM 119, TGX 10192E, TGX 9232EB, TGX 849. IITA maintain a large soybean germplasms.

Choice of variety for any location should take into consideration the length of the growing season, promiscuity, pests and disease resistance ability to give high yield and the shattering characteristics.

(b) **Site Selection and Land Preparation**

Soybean does well in well-drained soils, free of rocks and stumps. The land should be well prepared by ploughing followed by 2 harrowing (If feasible). Using the hoe, ensure that weeds are well covered with soil ploughing followed by harrowing ensures incorporation of organic matter into the soil and destruction of weeds. Planting can be done on either ridges or on the flat.

In the Northern Guinea and Guinea - Sudan savanna, Samsoy 2 performs well and does not shatter easily while in the Southern Guinea Savanna, Samsoy 1 is recommended. In the forest zone, long season type such as TGX 932 - 2E can be successfully grown.

(c) Planting.

Soybean should be planted when the rains are established. Planting should be timed so that the grain, mature towards the end of the rainy season. Many of the varieties grown in Nigeria mature between 100 - 120days.

In the Northern Guinea Savanna, soybean should be planted between June and first week of July. In the Southern Guinea Savanna, two planting are possible April and August. Use whole healthy seeds devoid of cracks. Good quality seeds are obtainable from IAR, Samaru, IITA Ibadan, National Cereals Research Institute (NCRI) Baddegi.

Sole crop soybean is planted on 60 - 75cm row ridges and drilled 3-5cm apart. The objective is to achieve a plant density of 300,000 - 500,000 plants per hectare to obtain optimum yield/hectare and control weeks. A seed rate of 40 - 50kg/ha is recommended. Seeds should be planted after a good rainfall. Make a narrow drill about 5cm deep and drop the seeds. Ensure even distribution of the seeds and then cover firmly with soil.

Soybean can also be planted in mixture with other crops such as maize or

sorghum. Plant arrangement could be alternate stands in which case soybeans are planted on the same row with the cereal, with stands of soybean of soybean alternating with one or two stands of the cereal, the recommended spacing of the cereal still maintained.

(d) **Fertilizer Application.**

Soybean responds readily to fertilizer application particularly phosphorus. Ohlrogge (1960) observed that maximum grain yield of soybean was attained with application of 33kg P/ha. Fertilizer trials in Nigeria have also shown phosphorus to be the most important limiting element in soybean production and the optimum rate rarely exceeds 30kg P/ha (Coldsworthy and Heathcote, 1964, Olufajo, 1986, Pal *et al.*, 1989, Chiezey *et al.*, 1991 and Chiezey *et al.* in print). The commonest source of P in Nigeria is the single superphosphate (18.5% P_{205}). The use of SSP ensures concurrent addition of calcium and sulfur, 2 elements also required by soybean. The N and P fertilizers should be applied either during land preparation or at planting. If application is after planting; the fertilizer should be placed 7.5cm away from the seed and below it.

(e) **Weed Control**

Weeds pose a serious problem in soybean field and yield reduction attributed to weed ranges between 12-80%. Weeds not only reduce yield, but also the crop quality.

Method of control includes hand pulling, hoe weeding and use of draft animals at 3 and 6 weeks after sowing (WAS). For large-scale farming operations justify the use

of herbicides such as septic, metobiomurout, metohachlor, etc.

(f) Pests and Diseases.

Soybean in Nigeria is presently free of pests (Jackai and singh, 1989). However, some of these pests have been identified with soybean. They are Aphids, Thrips, leaf eating beetles, American bollworm, flower and pod born etc. Fungal diseases could be controlled with fungicides such as Benlate (Benomyl) at 30g in 20 litres of water, Dithans M.45 (Mancozeb) at 130g in 20 litres of water.

(g) **Harvesting and Theshing.**

Maturation period ranges between 75 days for early to 130 days or more for late maturing lines. Mature plants are characterized by colour change from green to brown or yellow for both leaves and pods. Harvesting should start when the colour change occurs. Delayed harvesting results in shattering particularly in shattering-susceptible types. Harvesting is achieved by cutting the plant from the base with sharp knife.

Threshing should be done on a clean hand floor or tarpaulin spread on the field. It is achieved locally by beating the pods with sticks. A clean crop of soybean looks golden yellow or brown.

Soybean can be stored in bags without fear of damage by insects. The insects that afflect cowpea in storage do not easily damage the seeds. However, the store should be

clean, well ventilated, weather proof and rodent proof. Rats do a lot of damage to the crop during storage.

2.5 ECONOMIC IMPORTANCE OF SOYBEAN

As it is mentioned earlier that it is only recently that is potential has been recognized and has therefore now become wide spread. At present it ranks high among the leguminous crops in its nutritional value owing to a high protein content (as high as 43%). Also, it has about 20% oil. Soybean is an excellent protein supplement for enriching our cereal diet, which is high in carbohydrate. It has gained a special place in the nutrition programme. So numerous are the modern uses of soybean that is called the "Wonder bean" or "God sent bean".

The protein and calories of soybeans are very high for human consumption. Large (1945) reported that the crop has for centuries provided meat, milk, cheese, oil and treenail for Asian.

Soybeans are potential sources of cooking oil. It ranks among the world's most important oil seed crop. The seed yield edible semi-drying oil. It contributes about 20% fat to the diet. The oil is also used industrially for the manufacture of soap, ink, lacithin, and paint as well as in pharmaceutics. Anonymous (1981) estimated Nigeria spent about 96.1 million Naira on imported animals and vegetable fats and oil. This country has enough arable land where those oil seed crops can be successfully grown.

Soybean is an important forage crop. Soybean meal is rich in protein. It has become the leading protein supplement for nearly all kinds of livestock feeding and almost all of it is used in feeds or for feeding. About one million acres of soybean in USA are lusted for pasture, hay and green manure. Dairy Cattle also have a high demand for protein rich feed, which is met by supplementing the forage with soybean meal. The haul (that is the residue after the pods have been removed from the plant).

Commercial products like paints, soy protein, soybean glue for plywood industry, rubber substitute paper plastics, fire fighting compounds, lecithin, fertilizer etc, can be manufactured from soybean.

The other uses are: soybean being a legume makes a good cover crops, which helps to check erosion, with the aid of Rhizobium Spp, it helps to build up the soil nitrogen content.

2.6 PRODUCTION AND UTILIZATION OF SOYBEAN IN NIGERIA

The spread of soybean in Nigeria is limited because the crop is a short day plant, which is highly sensitive to change in photoperiod. Another responsible for meager production is that farmers are yet to realize its economic and nutritional significance, therefore its production is mostly in small holding of about 0.5 - 1.5 ha (Nyiakura, 1982).

Despite this low production, Nigeria is the leading producer in Africa with the bulk of the beans produced in Benue state around Gboko, Kwande, Katsina-Ala, and Makurdi area (Nyiakura, 1982). Other state where soybean is grown include around southern Zaria province (Zonkwa and kafancha) and Abuja. Currently production spread to other southern States, but production figures are not yet available. Agboola (1979), reported that an initial export of 10.2 tonnes of soybean in 1947 rose to 711.2 tonnes in 1942 and production by 1963 was at 16256 tonnes. Ashaye et al (1976) reported that the highest tonnes ever produced in Nigeria was 26456 metric tonnes from a total land area of about 32,000 ha and that by 1975, the total earning from soybean was estimated at ₦882, 400.

Currently, after the decline of 1970/71-production figure estimated to be 77,000 metric tonnes from about 197,000 ha. The variety mostly grown in Nigeria is Malayan type introduced from America.However, other varieties have evolved through breeding for high yielding and desirable quantities.

The uses of soybeans for local diet are fast gaining ground in Nigeria. Where animal protein is both scarce and expensive, soybean can provide a cheap source of the much-needed protein in the diet. The methods employed, to make the various product are still very crude, where there is very little preservation. The use of soybean meal for animal feed has a great potential in this country and this, if fully exploited, will boost and sustain appreciable animal production of the crop.

Nigeria uses almost all its soybean for human consumption. *Dadawa, iru and ogiri* are the most important of the product made commercially from soybeans. In 1986, due to the government ban on import of edible oil and wheat flour (proposed for 1987), Nestle Company started locally manufacturing and distributing weaning food for infants from soybean, maize cereal and new breakfast has recently put on the market.

2.7 PERSPECTIVES OF SOYBEAN PRODUCTION

Recent advances in the improvement of soybean have addressed and at least partially resolved some major determinant to the production of this crop in the low land tropics. They have opened the way for soybean to become a primary source of human food in the protein deficient subhumid and humid tropics where a large proportion of the world population will live in the 21 century.

IITA carried out exploratory research on a number of food legumes in the early 1970's and found that soybean was relatively free of serious diseases and insect pest problem and also had a high potential when compared with other legume crops such as cowpea, groundnut and phasealus beans. Soybean also gave relatively stable yield, which are especially important for small-scale farmers. It was realized that while soybean was a new crop for most of African countries, the market potential for the crop did exist.

However, several challenges remain for scientists, developers and promoters. The most immediate and crucial concern is to develop attractive, easily prepared local

dishes from these beans. Fortunately Asians already have traditional food made from soybean but the people of tropical Africa and the Americans are just becoming acquainted with the crop.

Although, soybean's other uses for animal feed. Stuffs processed protein and oils may sufficiently attractive for national policy makes to encourage production in their constituencies, the greatest potential for soybean is as a regular component of people diet. In the humid tropics, diet tends to be protein deficient, high in carbohydrate and low in plant and animal proteins. Two countries, India and Nigeria with well-defined food preference have developed several local dishes from both unprocessed and processed soybean. Thus soybeans have become established as a market commodity in growing region of these countries. Also, heartening is the move to scale down processing with appropriate machinery so that small industries can develop in the villages, (S.R. Singh *et al.*, 1987).

2.8 PROBLEMS OF SOYBEANS IN THE SAVANNA ZONE

One of the major problems of soybean farmer in the savanna zone is the disposal of his produce. This is partly because soybean seeds are not like cowpea, bought in direct human consumption, invariably some form of processing is necessary before soybean, became fact of human diet. Processing is also needed in corporating soybean seeds into animal feeds and in extracting the oil. Thus increased soybean production is largely dependent on availability of processing machinery. A method of guaranteeing the

farmer a steady market for his produce (at prices comparable to those of cowpea) must be worked out as a matter of utmost priority. He must not be placed at the mercy of middlemen who only exploit him and in the end derive several times more monetary reward than the farmer from the sale of a unit weight of soybean seeds. Further more, vigorous extension effort is needed to convince Nigerians about the desirability of including soybean confectioneries in their diet.

2.9 BASIC CONSIDERATIONS IN SOYBEAN PROCESSING

The off-flavour and off odour in soybeans develop as a result of the lipoxygenese activities on soybean lipids.These unwanted properties develop instantly in injured soybeans in the presence of moisture. These can be prevented by removal of the oil from the beans through solvent extraction or by just boiling (blanching) the beans to destroy the lipoxygenase.

It has been shown that the antinutritional factors destroyed by wet or dry heating to at least 11° C for 1 hour or by extrusion cooking. Undehulled soybeans can be soaked in water for 6-12 hours and tenderized by the addition of 0.5% sodium carbonate, boiled, dried, dehulled and ground. The oligosacchanids (raffinose and starchyose) which cause flalutence can be removed by boiling the beans.

Different procedures have been adopted for processing a full fat soy flour. These are shown diagrammatically in charts 1,2 and 3.

CHART 1

Whole Beans

↓

Cracking (Dehull)

↓

Dry Heat Preconditioning

↓

Moisture temperature

↓

Dry, Cool, Mill into flour

↓

Full fat soybean

CHART 2

Whole Beans

↓

Clean by aspiration (removes fibres, mould and immature grains, lighter particles)

↓

Dry Heat and crack (dehull) at 110°C for 1 hour (enzyme inactivation)

↓

Boil meal for 20 minutes in boiling water

↓

Wet milled

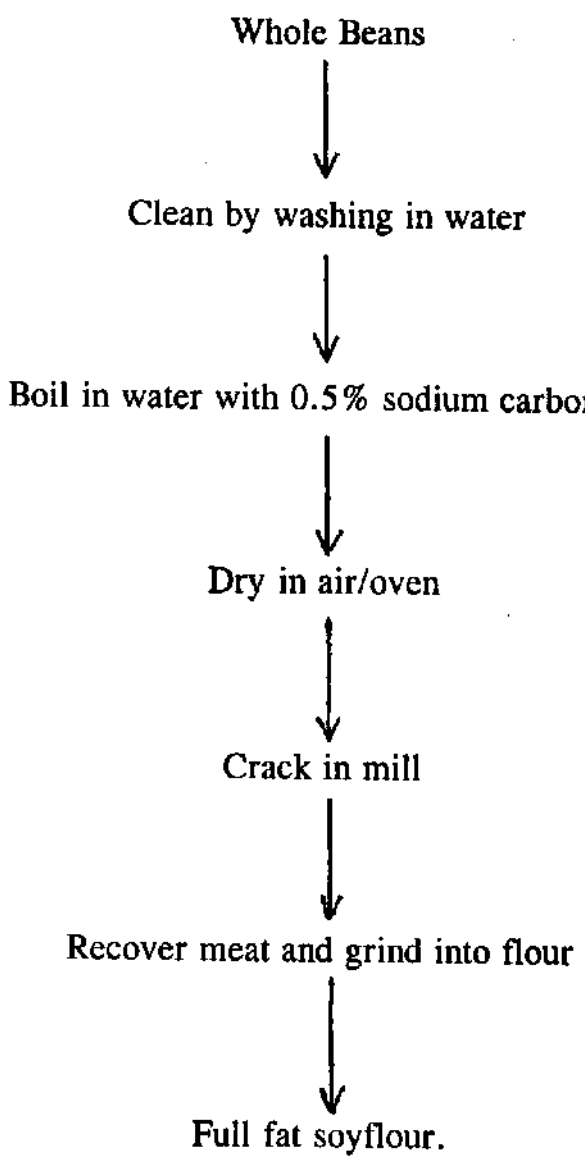
↓

Oven dry and sieve

↓

Full fat soybean.

CHART 3


Whole Beans
Clean by washing in water
Boil in water with 0.5% sodium carbonate
Dry in air/oven
Crack in mill
Recover meat and grind into flour
Full fat soyflour.

CHAPTER THREE

METHODOLOGY

3.1 STUDY AREA

This study was conducted in two farming villages, which fall within the Northern Guinea Savanna ecological zone. The two villages are Makarfi in Kaduna State and Malumfashi in Katsina State. These villages are located between longitudes 7 ^{0} and 8 ^{0}, and latitude 10 ^{0} N and 12 ^{0} N of the equator, which correspond to the area denoted as the Northern Guinea Savanna ecological zone of Nigeria.

According to Kowal and Khose (1972), the vegetation of the zone is made up of short grasses of which Hypendenca andropogon ssp is dominant and with trees which flourish during the dry season. The area covers about 597.012 km^2 of land. The rainy season with a single peak in August last for between 150 and 200 days with the annual rainfall of 508 mm to 1,399 mm. The precipitation/ evaporation ratio ranges from 0.4 to 0.75. The zone has a plain topography, and the soil is mainly ferruginous over acid crystalline rocks. It has a soil carbon content of 0.98 - 1.44 % at 0 - 15 cm depth and sandy/clay ratio of 1.67 - 7.63, with low organic matter, thereby requiring high N and P. At present it supports a wide variety of crops such legumes, cereals, dryseason and rainfed crops.

The agricultural system of the area is dominated by small - scale holders with a few mediums to large-scale farmers. Currently, emphasis are being placed on intensive

cultivation resulting from improved technologies being introduced by Institutes and Extension services organization such as Institute for Agricultural Research (IAR) , Samaru, International Crop Research Institute for Semi-Arid Tropic (ICRISAT), Kano, International Institute for Tropical Agriculture (IITA), Ibadan and National Agricultural Extension Research and liaison Services (NAERLS) Samaru.

The major ethnic group in the study area is Hausa and Fulani with Hausa dominating in population. Their major occupations are farming, cattle rearing and followed by trading , but greater percentage of the dwellers engaged in farming. The crop usually grown is maize, sorghum, millet, cowpea, groundnut, cotton, pepper, soybean etc.

Table 3.1 below is a presentation of climate data of Northern Guinea Savanna obtained from IAR weather station at Samaru and Bakura. The climatic data show that the agro-ecological zone is suitable for soybean production.

Table 3.1 : Mean rainfall, relative humidity and air temperature in the Northern Guinea Savanna.

Year	Rainfall (mm)	Relative humidity	Air temperature max	Min
1991	1027.0	50.28	30.70	17.30
1992	1019.8	51.55	30.77	18.30
1993	1061.7	48.48	31.99	18.30
1994	998.9	52.04	30.55	17.04
1995	867.0	51.70	31.78	18.02
1996	897.2	49.58	30.98	17.62
1997	1056.2	54.80	31.40	17.90

Source : IAR Meteorological Unit, Samaru.

3.2 RESEARCH APPROACH

The research approach was based on farm management survey of soybean enterprise in two villages of Makarfi and Malumfashi . The interviewed farmers were based on their participation in the on - farm trial research trial organized by IAR/EEC from 1991 - 1993. They were identified with the help of IAR enumerators who participated in the trial during that period.

The use of production function and gross margin analysis helped in getting the level of soybean yield obtained by the selected farmers during the 1997/98 cropping season and these help to evaluate whether or not the production of soybean is profitable.

3.3 DATA COLLECTION AND SOURCE.

Two major types of data were used for this study. These were primary and secondary types of data.

a) Primary data

Primary data were collected using structured questionnaires and informal interview with the farmers who participated in the European Economic Community (EEC) On-farm trial in the villages cited above for a three years period (1991 - 1993). The enumerators helped to translate the questionnaire from English to Hausa language. The data collected, consisted of socio- economic factors such as age, major occupation, size of the household, farming experience of the crop under consideration; farm size (ha), output (kg), inputs such as fertilizer (kg), seed (kg), type of variety and labour (man-days). The data was based on 1997/98 cropping season.

b) Secondary data

In order to evaluate the yield of soybean in the two villages, secondary data got from IAR/EEC OFAR soybean trial for the period of 1991 - 1993 were used. The data included farm size (ha), output (kg), inputs such as fertilizer (kg), seed (kg), and type of variety and labour (man-days).

3.4 SAMPLING TECHNIQUES

The two villages, that is Makarfi and Malumfashi were purposely selected for this study based on diagnostic survey carried out by IAR, Samaru in 1990 and also due to their involvement in soybean production trial in Northern Guinea Savanna ecological zone. In each of the two villages, 20 farmers that participated in 1991 - 1993 IAR/EEC OFAR were identified, selected and interviewed.

3.5 ANALYTICAL TECHNIQUES

The following tools of analysis were employed to achieve the objectives of this study.

3.5.1 DESCRIPTIVE STATISTICS

Descriptive statistics are used to summarize and describe a body of data in a format that best suited the major characteristic feature of data. In the study, simple descriptive statistics measures were used and these were : mean , frequency and percentage to achieve objective (1) and (4),.

3.5.2 GROSS MARGIN MODEL

The model was used to achieve objective (3) and (4) of the study by comparing the costs and return and calculating the relative profitability. Gross margin is one of the oldest and simplest methods used in farm production economics

and management especially in a traditional setting. It is farm planning and budgeting tool used to determine the profitability of a given enterprise.

Essentially, gross margin is a budgeting tool needed to estimate total costs and total revenue for a given production period (Olayemi and Oni ; Oluwole, 1970 ; Osifo, 1970). It is also indicates whether a proposed change can improve the earnings of a farm business or not.

According to Olukosi and Erhabor (1988), gross margin analysis involves evaluating the efficiency of an individual enterprise (or farm plan). It is a very useful tool in situation where fixed capital is negligible portion of the farming enterprise as is the case in subsistence agriculture.

By definition gross margin is the difference between the gross farm income (GFI) and the variable costs (TVC). This was used in the study so as to identify costs, returns and profitability or otherwise of soybean production in the study area.

$$GM = GFI - (TVC + TFC)$$

Where GM: Gross Margin in naira (₦)

GFI: Gross farm income. This was computed by multiplying total output by unit price of soybean in naira value.

TVC: Total variable costs. These were costs incurred on variable inputs such as seeds, fertilizers, cost of land clearing or preparation, weeding and so on.

TFC: Total fixed costs were those incurred fixed inputs, which cannot be used up during one production process. Examples: land, building, fences...

REASONS FOR USING THE GROSS MARGIN ANALYSIS

The reasons attributed to the selection of the gross margin are those enumerated by Olukosi and Erhabor (1988) :

1. It is easy to compute, analyses and interpret. Once the gross farm income and the total costs of production are indicated, a difference between the two gives the gross margin;
2. Highly applicable to subsistence agriculture involving small and negligible fixed capital components;
3. Useful where the same capital items are used in many different enterprises in a given farm;
4. It is used to determine net farm income (NFI). Subtracting the total fixed costs (TFC) can be derived from the net farm income from the total gross margin (TGM) of the whole farm or all the enterprises.

   It helps to indicate the profitability of the enterprises being operated. It is a useful concept when other enterprises are operated in the farm;
5. It serves as guide to the selection of enterprises by comparing their margins;
6. It helps the farmer to critically examine the variable cost components

and hence helps in determining how to combine and utilize them;

7. It helps the farmer in building partial budget for the farm. It is used to estimate the effect of relatively small changes such as introducing a new enterprise or purchasing new equipment in addition to the existing farm organization.

LIMITATIONS OF GROSS MARGIN ANALYSIS

Gross margin analysis has the following limitations. These are :

1. The model does not define and indicate how optimum return can be attained from a given level of resources used in production . All it shows, is the costs and returns from production process resulting from any unit of resource applied in production.
2. If the study involves a lot of value judgement e.g. inputted cost of inputs used, the model ceases to be a useful tool. This is because the values attached either to inputs or output will vary among farmers, thus giving a distorted picture of the true profitability situation.

3.5.3 PRODUCTION FUNCTION ANALYSIS

The production function which stipulate the physical or technical relationship between inputs and outputs in any production scheme or process, was used to achieve objective (2). In mathematical terms, this function is assumed to be continuous and differentiable. The production function was constructed for all the farmers using the

important factors of production that were easily measurable. These were : farm size, labour, fertilizer, and seed. The data were fitted into various functional forms of production functions specified below.

The total product was regressed on the inputs used. Only the two following functional forms of the production model were observed to be fitted. They were as follows :

- Cobb-Douglas production function of the type;
- Semi-log production function of the type

a) - **Cobb-Douglas production function**

The functional form of Cobb-Douglas function is given by equation below

$$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} U$$

The Cobb-Douglas production function is normally estimated in the logarithmic form as either semi - log or double log. In the semi - log form, either input or output is in the log form while in the double - log form both the input and the output are in the log form.

Through transformation, we obtained the following equations.

$$\text{Log } Y = \log a + b_1 \log X1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + e$$

where b_1-b_4 are the regression coefficient and elasticities of production x_1-x_4 respectively.

Y = Total output of soybean (kg)

X_1 : farm size (ha)

X_2 : labours (man-days)

X_3 : fertilizer (kg)

X_4 : seed (kg)

a : constant term

e : error term.

The values of the coefficient b_1 - b_4 were the direct measures of the elasticities of response to input X_1 - X_4 respectively in the production process.

The major limitation of this production function is the possibility of over estimating an output quantity which equate marginal revenue with marginal cost at high level of inputs use unless an economic optimum is defined for small magnitude of input. One other limitation is that, it assumes zero level of inputs. In addition, the function cannot show diminishing and increasing returns to factors in a single response curve.

b) Semi-log production function

This function was used and found useful in aggregate production function

analysis. The equation is given as follows.

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

where Y : output (kg)

b_1 - b_4 : regression coefficients

X_1 : farm size (ha)

X_2 : labour (man-day)

X_3 : fertilizer (kg)

X_4 : seed (kg)

a : constant term

e : error term.

c) Advantages of Cobb-Douglas

The Cobb-Douglas production function has peculiar properties, which make it useful tools for analyzing production function.

(I)- It can be used to handle any number of independent variable;

(ii)-When using Cobb-Douglas production function, it is convenient in interpreting elasticities of production function. This gives premise for using this function widely in farm survey data (Heady and Dillon, 1972), Ogungbile and Olukosi (1989) attested to this by asserting that while a classical production function measures constant, decreasing and increasing marginal productivity, the Cobb-Douglas function allows for any of the three but not all the three at a time;

(iii)- The estimation of parameters in the model involves fewer degrees of

freedom than other algebraic forms which allows for decreasing and increasing returns to factors of production;

(iv)- Since the Cobb-Douglas production function can be transformed into a linear function, computation in the regression analysis using a linear model is relatively easy.

In general the functional forms are collectively called Multiple Regression Model. Relevant data collected from the field survey were fitted into the two functional forms of the model and the coefficient of multiple determination (R^2) was obtained as a measure of goodness of fit. The equation with the highest R^2 value explained the variation best and was regarded as a better fit (Heady and Dillon, 1972) and was adopted for subsequent analysis of the collected data. Other choice of indicators was the t-value and adjusted R^2 value.

3.6 TEST OF HYPOTHESIS

A test of hypothesis was conducted between the gross margin of farmers in Makarfi and those of Malumfashi. The two means for the farmers were subjected to a t-test using the formula below.

$$t = \frac{X_1 - X_2}{\bar{\sigma}_{x_1 - x_2}}$$

where $\bar{\sigma}_{x_1 - x_2} = \bar{\sigma}\sqrt{1/N_1 + 1/N_2}$

with $N_1 + N_2 - 2$ degree of freedom

where X_1 and X_2 are the two sample means, N_1 and N_2 are sample sizes and $\bar{\sigma}$ are estimated standard deviation drawn from normal population.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter is devoted to the presentation and discussion of the results of the analysis carried out in the villages on the profitability of soybean production.

4.1 SOCIO-ECONOMIC CHARACTERISTICS OF THE FARM HOUSEHOLD.

Various studies have in the past and presently emphasized the importance of socio-economic factors in having influence on the decisions of the farmers to increase or decrease farm size, to accept or not an innovation (Voh, 1978; Atala, 1980). Most of these factors have in one way or the other has great impact on the production of any type of crop. In this study, some socio-economic factors such as age, household size, farming experience of crop under consideration, area under cultivation, labour utilization etc have been investigated.

4.1.1 AGE

The age distribution of the farm household is shown in Table 4.1. The age of the farmers ranged from 20 - 70 in the two locations with an average of 43 in Makarfi and 47 in Malumfashi.

The Table shows that about 40 % of the farmers were between the age of 20 and 40 years in Makarfi while about 30 % were in the same age group in

Malumfashi; 25 % of the farmers in both locations were of middle age while the rest of the farmers were above 51 years old. The result indicate further that most of the farmers were between the ages of 20 - 50, which comprises of able strong men that are capable of manual work in term of farm operations.

Table 4.1 : Age distribution of the farmers.

Age (years)	Makarfi		Malumfashi	
	Frequency	Percentage	Frequency	Percentage
20 - 30	5	25	3	15
31 - 40	3	15	3	15
41 - 50	5	25	5	25
51 - 60	4	20	6	30
Over 61	3	15	3	15
Total	20	100	20	100

Source : Field survey, 1997/98.

4.1.2 THE HOUSEHOLD SIZE

The sizes of the families ranged from 1 to 25 with an average of about 11 persons in Makarfi and from 1 to 14 with an average of 9 persons per household in Malumfashi. The two averages size of household are higher than that shown in Norman's study of Zaria of 6.8 but the average size of household in Malumfashi is closed to the one of Orewa's study carried out in 1978 while that of Makarfi is a little bit higher.

Table 4.2. indicates that 65 % of the respondents in Malumfashi have family size between 1 to 10 people and 35 % between 11 to 20 peoples.

In Malumfashi, about 65 % of the respondents have between 1 - 10 family sizes, 30 % between 11 - 15 and only 5 % between 16 - 20. It was observed that in both locations , the family size of 6 - 10 is the majority. This shows that under traditional agriculture, the bulk of labour input and other managerial functions lie in the hands of the members of the family.

Table 4.2 : Household size distribution of the farmers

Range of the household size	Makarfi		Malumfashi	
	Frequency	Percentage	Frequency	Percentage
1 - 5	5	25	5	25
6 - 10	7	35	8	40
11 - 15	4	20	6	30
16 - 20	2	10	1	5
Over 21	2	10	0	0
Total	20	100	20	100

Source : Field survey, 1997/98.

4.1.3 FARMING EXPERIENCE

Farmers were asked about their experience in soybean production under rain-fed conditions and this help to know when the soybean cultivation started particularly in these two villages. Table 4.3 summarizes the results.

It shows that 5 % of the farmers had between 1 - 2 years of farming experience, 25 % between 3 - 5 and 70 % between 6 - 8 years in Makarfi while in Malumfashi 0 % had 1 - 2 years farming experience, 20 % between 3-5 years and 80 % had between 6 - 8 years . These results indicate that the majority of farmers in the two locations have been growing soybean for about 6 - 7 years.

Table 4.3 shows that the cultivation of soybean in the two locations is of recent and this indicated most of the farmers started with the on - farm trial carried out by IAR with the assistance of European Economic Community (EEC). Consequently their experience on the crop is not much, when compared with other leguminous crops such as cowpea, groundnut etc.

Table 4.3 : Distribution of soybean farming experience

Years of experience	Makarfi		Malumfashi	
	Frequency	Percentage	Frequency	Percentage
1 - 2	1	5	0	0
3 - 5	5	25	4	20
6 - 8	14	70	16	80
Total	20	100	20	100

Source : Field survey, 1997/98.

4.1.4 AREA UNDER SOYBEAN CULTIVATION

This point refers to the number of holdings possessed by the respondents at the time of the survey. It was observed that most of the farmers did not have uniform sizes of farmland under cultivation and also only very few Nigerian farmers bothered to have their farms measured. Thus they normally do not know the sizes of their farms but can easily tell the number of farm plots they own (very few can tell you the acreage). Table 4.4 shows the number of sites under soybean production.

The results indicated that both in the two locations, more than 50 % of the farmers have farm holdings between 0.1 - 0.9 hectare. About 20 - 24 % have above 1.0 hectare.

Most of the farmers interviewed in the two locations grew soybean sole. Very few farmers said they grow soybean in mixture with other crops like maize, sorghum, and millet. When they were asked, why they grow sole soybean, the answer is that, their experience during the on - farm trial showed that, soybean grown as sole has higher yield than that grown in mixture.

The survey also showed that soybean crop cultivation did not occupy a good position among other legumes crops. This tells us that either the importance of soybean is not properly graped or the crop is not profitable to produce.

Table 4.4 : Distribution of the respondents according to area under cultivation.

Area (hectare)	Makarfi		Malumfashi	
	Frequency	Percentage	Frequency	Percentage
0.1 - 0.4	7	35	6	30
0.5 - 0.9	6	30	10	50
1.0 - 1.4	3	15	4	20
1.5 - 2.0	4	20	0	0
Total	20	100	20	100

Source : Field survey, 1997/98.

4.2 RESOURCES USED

One of the primary objectives of this study was to determine the type and quantity of various resources (inputs) used in the production of soybean. These resources include: labour, chemical fertilizers, seeds, animal manners etc.

4.2.1 LABOUR UTILIZATION.

It was observed that both family and hired labour were used in the production of soybean. Most of the farmers interviewed used family labour in all the operations, from the field clearing and preparation to the harvesting and threshing. Only very few used the combination of the both family and hired labour.

From Table 4.5 about 85 % of the respondents used family labour in the two locations, none used hired labour only while 15 % in Makarfi and 10 % in Malumfashi used the combination of both the family and hired labour. This shows that most of the farmers in the rural areas prefer using family labour which is cheaper to obtain than hired labour and it is very effective when compared to hired ones sometimes.

Table 4.5 : Distribution of the respondents according to labour utilization.

Labour source	Makarfi		Malumfashi	
	Frequency	Percentage	Frequency	Percentage
Family labour only	17	85	18	90
Hired labour only	0	0	0	0
Combination of both	3	15	2	10
Total	20	100	20	100

Source : Field survey, 1997/98.

Table 4.6 shows the labour required for producing one hectare of sole soybean the on - farm trial and at farm level.

The mean labour requirement for soybean in 1992 and 1993 on - farm trial in the locations showed that harvesting and threshing constitute about 50 % of the total labour requirement in Malumfashi and 30 % in Makarfi. Labour requirement for land preparation was higher at Makarfi compared to the one of Malumfashi.

Both whether during the on - farm trial or at farmers own level, the labour used in Malumfashi were higher than of Makarfi. These might be due partly on the types of implement used during land preparation and ridging operations. It was observed that farmers at Makarfi used ox-drawn implements to make ridges while most of those in Malumfashi used hands hoes.

Table 4.6: Average labour used for soybean production in man-days per hectare during on-farm trial and field survey.

Operations	Makarfi		Malumfashi	
	On-farm trial	Field survey	Field survey	Field surve
Land preparation	10.80	9.0	4.60	11.0
Planting	4.40	3.0	6.20	3.0
Weeding	21.80	17.0	17.20	9.0
Fertilizer application	6.0	5.0	7.0	4.0
Ridge molding	8.80	9.0	8.60	10.0
Harvesting	12.0	13.0	24.0	14.0
Threshing	10.4	-	16.60	-
Total	75.20	56.0	84.20	61.0

Source : On-farm trial, 1992-93; and field survey, 1997/98.

4.2.2 VARIETIES OF SEED USED.

During the on - farm trial, 4 varieties of soybean were used in order to show to farmers which one yield higher return, but the field survey carried out 1997/98 cropping season showed that only one variety was accepted and adopted by farmers.

Table 4.7 showed that almost all the farmers used Samsoy 2 variety (number one, as it was commonly called), except the one that has tried TGX 849. Farmers recognized the varieties introduced to them by the grain size and colour. None of the farmers have grown soybean before. All those who had grown the crop were introduced to it by the Institute for Agricultural Research (IAR), Samaru, Nigeria.

Table 4.7 : Distribution of farmers based on the variety of seed used.

Variety of seed used	Makarfi		Malumfashi	
	Frequency	Percentage	Frequency	Percentage
Samsoy – 2	20	100	19	95
TGX - 1019	0	0	1	5
TGX – 923	0	0	0	0
TGX - 849	0	0	0	0
Total	20	100	20	100

Source : Field survey, 1997/98.

4.3 SOYBEAN YIELD

The yield obtained by the respondents varied from one field to another with respect to land area, fertilizer application and the level of management. For the field survey, in Makarfi some respondents had as high as 1750 hg per hectare and others as low as 800 kg per hectare while in Malumfashi some had as high as 1355 kg per

hectare and others as low as 712.5 kg per hectare.

Table 4.5 shows the distribution of respondents according to farm size. It shows that the majority of in both locations had an average yield of 1.0 - 1.5 tonnes per hectare. Only 10 % of the farmers in Makarfi had output of above 1.5 tonnes per hectare. Average in Makarfi was 1296.192 kg per hectare while in Malumfashi it was 1100.27 kg per hectare when grown in sole.

In general, Table 4.7 indicated that farmers after the on - farm trial in 1991 to 1993, adopted samsoy - 2 variety which according to them ranked best followed by TGX 1019. In addition to that they said that samsoy - 2 variety is readily available in the market. In ranking the varieties on preference, it can be seen that 1997/98 field survey, out 40 farmers interviewed in the two locations, only one farmer still grows TGX 1019 while the rest were growing Samsoy-2.

Table 4.8 : Average yield distribution of the farmers.

Yield in tonnes/hectare	Makarfi		Malumfashi	
	Frequency	Percentage	Frequency	Percentage
0.1 - 0.5	0	0	0	0
0.6 - 1.0	3	15	7	25
1.1 - 1.5	15	75	13	65
1.6 - 2.0	2	10	0	0
Total	20	100	20	100

Source : Field survey, 1997/98.

In terms of utilization, farmers were asked what do they do with the produce ? About 55 % of the total number of the farmers said that they sold all their produce and 25 % sold one part and consumed . The other 20 % said that they sold 3/4 of their produce and kept 1/4 as seed for next season. These results indicated that the farmers have not recognized the nutritional value of soybean. The initial purpose for most of them of planting this crop may be to earn extra cash.

Table 4.9 : Soybean grain yield (kg/ha) as influenced by variety in the 2 locations for 2 years under on-farm condition (1992-93) and one year at farmer's level (1997).

Location variety	Year (mean yield)		
	1992	1993	1997
Makarfi :			
Samsoy - 2	1,829	1,805.45	1,296.2
TGX - 1019	1,848	1,280	-
TGX - 923	1,331	-	-
TGX - 849	-	1,317	-
Malumfashi :			
Samsoy - 2	1,140	2,242	1,100.3
TGX - 1019	2,279	1,007	8,87.5
TGX - 923	1,030	-	-
TGX - 849	-	2,024	-

Source : On-farm trial, 1992/93 and field survey, 1997/98.

The yield of on-farm trial was better because it was better monitored and the field size was small and easier to manage.

The test of significance between the mean yield of soybean produced during the on-farm trial and the one of field survey showed that there is significant difference at 5% probability level. The yield obtained during the on-farm trial was significantly greater than the one of field survey.

4.4 COSTS AND RETURNS ANALYSIS.

As was mentioned earlier, farm budgeting was used to achieve objective (3). In order to facilitate the use of such model, costs and returns analysis was done for each soybean farmer separately in order to see if they are making profit or not. This is to say that the computation of actual costs and returns for each farm enterprise was done and are reported in appendix.

The profitability of any farm enterprise can be deduced from the relationship between the costs incurred in running the farm and the returns accruing from it.

4.4.1 GROSS RETURNS

The gross returns obtained by each farmer sampled in the study was derived by multiplying the total quantity of soybean produced (threshed grain) by the average prevailing market price at the period of the survey. The results of analysis have been shown in Table 4.10 at farmer's level.

Table 4.10 : Average gross returns per hectare for soybean production for the field survey.

Item	Makarfi Field survey	Malumfashi Field survey
Yield (kg)	1,296.19	1,100.27
Price (₦)	20	20
Gross return (₦)	25,923.84	22,005.4

Source : Field survey, 1998.

From Table 4.10, the analysis showed that the yield obtained during the on-farm trial in both locations were higher than those obtained during the field survey. The differences in gross returns in the two locations could be attributed to the costs of operations and level of management. It could be also attributed to the unforeseen natural calamities.

4.4.2 COST OF PRODUCTION.

In estimating the total cost of production only, the variable cost elements were considered and these were labour, seed, fertilizer (other costs such as cost of bagging, transportation and marketing were excluded).

LABOUR COSTS.

Efforts put in during the production were recorded in man-days. The average wage rate was put at ₦ 100.00 per man-day, which is equal to ₦ 20.00 per man-hour (assuming 5 man-hours are equal to one man-day) during the field survey. In this

Table 4.11 indicated that on the average, farmers in Makarfi used 40 kg per hectare while those of Malumfashi used 49.50 kg per hectare. These showed that Malumfashi respondent spent ₦ 1386.00 per hectare on fertilizer while those of Makarfi spent ₦ 1120.00 per hectare. These quantities of fertilizer used by all the respondents' fall within the range recommended by IAR, which is 40 - 50 kg per hectare. The result shows that fertilizer cost occupied the second portion after labour cost.

SEED COST.

After the on-farm trial, which ended in the two villages in 1993, it was observed that among the four soybean varieties tried, only Samsoy-2 got appreciable acceptance among the farmers. This can be explained by the larger percentage of the farmers that adopting it. Statistics show that 95 % of the respondent adopted Samsoy-2 and only 5 % adopted TGX 1019.

The results of the study indicated that farmers spent an average of ₦ 225.00 per hectare on seed at Malumfashi and those of Makarfi spent an average of ₦ 167.40 per hectare. This is illustrated in Table 4.11. The cost of planting seeds in Malumfashi was greater than that of Makarfi during the field survey.

4.4.3 TOTAL VARIABLE COST OF PRODUCTION.

The total variable cost of production was estimated both for on-farm trial and the field survey by adding costs of labour, fertilizer, and seeds, used in the

production. The result is as shown in Table 4.11.

Table 4.11: Average production cost per hectare for soybean (₦).

Item	Field survey	
	Makarfi	Malumfashi
Labour	5,600.00	6,100.00
Fertilizer	1,120.00	1,386.00
Seed	167.40	225.90
Total variable cost(₦)	6,887.40	7,711.90

Source : Field survey, 1997/98.

The average total variable cost of producing one hectare of soybean in Malumfashi which was ₦ 7,711.90 was greater than that of Makarfi ,₦ 6,887.40 during the field survey. The difference between the two locations was not statistically significant at 5 %. This was due to the fact that Malumfashi farmers used more inputs than the Makarfi farmers.

4.5 GROSS MARGIN ANALYSIS.

The gross margin analysis or net returns were computed as the difference between the total revenue and the total variable cost per hectare in production of soybean. Where the difference is positive, it means that there is profit, but if

negative, it implies a loss. Table 4.12 showed how the average gross margin of all the farmers per hectare.

Table 4.12 : Average costs and returns for soybean production per hectare.

Item	Malumfashi Field survey	Makarfi Field survey
Output kg/ha	1,100.27	1,296.19
Gross value (₦)	22,005.40	25,923.80
Inputs costs (₦) :		
Labour	6,100.90	5,600.00
Fertilizer	1,386.00	1,220.00
Seed	225.90	167.40
Total variable cost(₦)	7,711.90	6,887.40
Gross margin(₦)	14,293.50	19,036.40
Yield required to cover cost	385.60	344.37
Return to labour (₦)	2.343	3.403

Source : Field survey, 1997/98.

Soybean valued at ₦ 20/kg during field survey

Labour valued at ₦100/man-day during field survey

Table 4.12 shows that all the respondents during field survey were making reasonable profit despite the differences in inputs and output prices that prevailed in space and time. It was observed that the profit farmers were making that is gross margin were ₦ 19,036.40 and ₦ 14,293.50 per hectare in Makarfi and Malumfashi respectively. Farmers believe that, family labour is cheap source of labour because

the labour is not valued; but the estimated cost is usually higher. They used too many people or spent more time on a piece of land for a particular operation in the field which if hired labour was used , less people will be used, hence less time spent.

It is true that large farm sizes with good management can result in high yield, which would generate higher income. The analysis showed also that farmers with large farm sizes (greater than one hectare) ended up having low gross margin. This might be due to poor management system and the concentration or spending more time on the various operations. Also the differences within farmers with the area of farm size might be due to the differences in the allocation of various inputs. The price at which each respondent purchased farm inputs, also contributed to the differences. Soil fertility and productivity vary from one area to another and this could have effect on the yield and consequently the yield. In general the production of soybean is more profitable than other legume crop such as cowpea. The work carried out by Shehu A. in 1996 (unpublished) showed that the gross margin obtained from sole cowpea was ₦3837 for the field survey per hectare, which it can be said that is much lower than that of soybean when compared.

4.6 LABOUR PRODUCTIVITY

This has been calculated by dividing gross margin per hectare by the total labour inputs. Table 4.12 showed that the return to labour was ₦ 234.31 and ₦ 340.32 during the field survey in Malumfashi and Makarfi respectively. Considering

the wage paid per man-day which was ₦ 100.00,during the field survey, the labour productivity showed that family members will benefit more when they work on their own farms because they will deriving higher profit. The values obtained from the analysis showed that the labour was underutilized.

4.7 THE GROSS MARGIN STATISTICAL TEST FOR SIGNIFICANCE.

The gross margin data was statistically tested for significance using the t-test by comparing mean yield of the villages surveyed.

Table 4.13 : Means and standard deviation of gross margin from two villages (Makarfi and Malumfashi) surveyed.

Locations	N	Mean	Standard Deviation	t-value	LOS
Makarfi	20	18,087.68	4,759.66	3.96	0.05
Malumfashi	20	13,761.60	3,580.37		

Source : Field survey, 1997/98.

L.O.S : Level of significance at 5 % alpha level.

N = Sample size

From the test of two means that gross margin of Makarfi and Malumfashi, there is significant difference in the gross margin at 5 % level of probability. This implies that the gross margin obtained by the farmers in Makarfi is significantly

greater than that of Malumfashi. Therefore, the null hypothesis rejected and the alternativ is accepted.

4.8 PRODUCTION FUNCTION ANALYSIS.

The analysis of production function was carried out in order to arrive at some judgement about the efficiency of the considered factors of production. The purpose of this production analysis is to determine the extent to which the important factors explain the variability of the output. The greater the extent to which these factors of production are able to explain the variability of the dependent variables; the larger the influence of the independent variable taken together have on the dependent variable. If the marginal value product (MVP) is lower than its marginal factor cost (MFC), it is apparent that there is an over use of that input and its use should be curtailed. The reverse of this rule means that the employment should be increased in the production process.

The function enables us to compare the marginal product of each input estimated with its acquisition price. Also the estimation of elasticity of production, returns to scale are also possible from production analysis.

The production function was applied only to the field data due to the variability of inputs used. During the on-farm trail inputs such as seed, fertilizer and land were fixed, thus it cannot be applied.

4.8.1 MULTIPLE REGRESSION ANALYSIS AND DETERMINATION OF BEST PRODUCTION FUNCTION FOR SOYBEAN PRODUCTION.

This analytical procedure was used to investigate the casual ability of certain explanatory variables on the dependent variable.

Three functional forms were used and they were linear function, Cobb-Douglas and semi-log functions but only the last two were observed to be the best fitted for the analysis.

Table 4.14: Regression coefficientS and standard error for soybean production (Cobb-Douglas) in Makarfi.

Variable	Regression coefficient	Standard error	T-value	Level of significance
Farm size (X_1)	1.140	0.119	1.894	0.1
Labour (X_2)	2.140	0.064	2.804*	0.05
Fertilizer (X_3)	0.180	0.676	1.687	n.s
Seed (X_4)	0.226	0.784	2.731*	0.05

Source : Field survey, 1997/98.

* significant at 5% level of probability

$R^2 = 0.96$

$\bar{R}^2 = 0.95$

Constant : 1.977

$\Sigma bi = 3.686$

Table 4.15: Regression coefficients and standard error for soybean production in Malumfashi (Semi-log).

Variable	Regression coefficient	Standard error	t- value	Level of significance
Farm size (X_1)	21.57	213.98	0.101	n.s
Labour (X_2)	297.39	163.05	1.824**	0.1
Fertilizer (X_3)	149.32	36.99	4.036*	0.01
Seed (X_4)	276.67	151.55	1.826**	0.1

Source : Field survey, 1997/98.

Constant : 1396.29

R^2 : 0.92

$\bar{R}^2$= 0.87

Σbi : 3.2

n.s : not significant at specified level.

* Significant at 1% probabilty level

** Significant at 10% probabilty level

The coefficient of multiple determination, R^2 indicate the percentage of the variation in the observed Y - value that is explained by the fitted regression equation. The values of R^2 were 0.96 and 0.92 for Makarfi and Malumfashi respectively. This means that in the fitted equations, the explanatory (independent) variables explained

the 96 and 92 percent of the variation in the output of soybean in the two locations respectively. The unexplained part of the variability in the output of soybean is obviously due to other inputs, which have not been specified in the model.

Table 4.14 indicates that labour and seed were significant at 5 %, farm size at 10 % while fertilizer was not significant beyond 10 % probability level in Makarfi where as in Malumfashi, labour and seed were significant at 1 %, while farm size did not give any significance.

The elasticities of all input were positive. This means that one- percent change in any one of the input, while holding other constant, would result in percentage change in the quantity of output equal to the coefficient.

In Makarfi, Table 4.15 indicate that the labour and seed were the important inputs to which output was most responsive, while in Malumfashi, fertilizer was the important input to which output was most responsive.

The non-significance of fertilizer in Makarfi was due to lack of respect for the agronomic recommdation. It might be also due to lack of fund to acquire the chemical fertilizer. Farm size was not significant becuase farmers in Malumfashi were using almost the same size of farm.

4.8.2 MARGINAL PRODUCTION AND ECONOMIC OF RESOURCE ALLOCATION.

The estimated production function enables one to evaluate the efficiency of the factors of production in the enterprise. Given the prices of both inputs and output, the marginal value productivity is the yardstick for judging the efficiency of the resource use. Equality in marginal value product (MVP) to marginal factor cost (MFC) is therefore the basic condition that must be satisfied to obtain efficient use of resource.

Table 4.16: Marginal value products and their respective arithmetic mean for Makarfi farmers.

Variable	MPP	MVP	MFC	MVP/MFC
Labour (X_2)	44.31	886.2	100.00	8.862
Seed (X_4)	36.87	737.4	20.00	36.87

Source : Field survey, 1997/98.

MPP : Marginal Physical Product

Table 4.17: Marginal value products and their respective arithmetic mean for Malumfashi farmers.

Variable	MPP	MVP	MFC	MVP/MFC
Labour (X_2)	6.19	123.8	100	1.238
Fertilizer(X_3)	4.54	90.8	28	3.24
Seed (X_4)	35.47	708.4	20	35.47

Source : Field survey, 1997/98.

Table 4.16 shows that the marginal value productivity of labour and seed were compared with their respective marginal factor costs and the results show 8.862 and 36.87 respectively. In both cases, labour and seed were underutilized during the production of soybean. These results show that farmers in Makarfi will have been getting higher return per hectare if they comply actually with the recommended agronomic practices of IAR, which eventually will lead to higher gross margin. Farmers in the case of seed will have increased seed rate in order to make more profit.

Table 4.17 also shows that the various variables used in the production of soybean in Malumfashi were underutilized. The values of the three variables obtained in the table were greater than one and this indicates that farmers in this location did not also comply with the recommended agronomic practices. Despite these, they still

made appreciable level of profit, but lower than that of the on-farm trial. .

Farmers in the location could still increase their return by using more of fertilizer and seed and watch out for labour uses in the production process.

4.8.3 MULTIPLE REGRESSION ANALYSIS AND DETERMINATION OF BEST PRODUCTION FUNCTION FOR THE COMBINED LOCATIONS.

Among the three production functions used for the analysis of the combined data, Cobb-Douglas production function was selected due to its best fit. Table 4.18 Show the results of the analysis.

Table 4.18: Regression coefficient and standard error for soybean production in both locations (Cobb-Douglas production function).

Variable	Regression coefficient	Standard error	T - value	Level of significance
Farm size (X_1)	0.034	0.31	1.24	n.s
Labour (X_3)	0.89	0.33	3.41*	0.05
Fertilizer (X_3)	0.19	0.05	2.66**	0.01
Seed (X_4)	0.16	0.14	0.11	n.s

Source : Field survey , 1997/98.

* significant at 5% probability level,

** significant at 1% probability level.

Constant : 3.02

R^2 : 0.87

$\bar{R}^2 = 0.85$

Σbi : 1.274

n.s : not significant.

The result in Table 4.18 shows that labour and fertilizer were significant at 5 % and 1 % respectively while farm size and seed were not.

The regression coefficient or elasticities of the production of all the inputs are positive. This also implies that one percent change in any of the input variable, while holding others constant, would result also in a percentage change in the quantity of output equal to the coefficient of the variable in the same direction as the change of the input.

4.8.4 MARGINAL PRODUCTIVITY AND RESOURCE ALLOCATION FOR THE COMBINED LOCATIONS.

Table 4.19 shows the results of the combined marginal productivity that explained the extent to which the various variable inputs were put. Due to non-significance of farm size and seed variable inputs, their marginal value product need not to be determined.

Table 4.19 : Combined marginal value products and their arithmetic mean.

Variable	MPP	MVP	MFC	MVP/MFC
Labour (X_2)	15.88	317.6	100.00	3.176
Fertilizer (X_4)	5.9	11.8	28.00	4.21

Source : Field survey, 1997/98.

In this combined marginal value productivity of resources Table 4.19 also shows that there were under-utilization of the two variables (labour and fertilizer) with their respective values of 3.176 and 4.21. It is evident that increasing the two variables (labour and fertilizer), will increase return and hence the enterprise will be more profitable.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS.

5.1 SUMMARY

A field survey was conducted in two villages namely Makarfi in Kaduna State and Malumfashi in Katsina State to determine the profitability of soybean production. The on-farm trail was carried out by European Economic Community / On-Farm Adaptive Research of Institute of Agricultural Research (EEC/OFAR-IAR) in these villages for three years period and ,their results were also discussed.

The results of the study showed that the average age of the respondents was 43 years in Makarfi and 47 years in Malumfashi. The results indicate further that most of the farmers interviewed were between the ages of 20 - 50, which comprises of able strong men that are capable of manual work (work on the field). The average household size was 9 persons in Malumfashi while it was 11 persons in Makarfi.

With regard to farming experience, most of the farmers interviewed have been cultivating soybean in two locations for about 7 years. This indicated that they started growing this crop during the on - farm trial. The results showed that more than 50 % of the farmers have farm holding between 0.1 - 0.9 hectare, 20 - 25 % above 1.0 hectare.

In terms of resources used in the production, mainly the farm family provided farm labour force. The use of chemical fertilizer varied from one farmer to another and from one area to another. The analysis showed that during the field survey 95 % used Samsoy-2 variety and they believed the variety gives relatively stable yield and it is very much marketable.

The yield obtained by the farmers varied from one field to another. On the average, farmers in Malumfashi were making 1100.27kg per hectare , while those in Makarfi were having 1296.19 kg per hectare. But the average yield obtained during the on - farm trial was 1817.23 kg per hectare in Makarfi while that of Malumfashi was 1691 kg per hectare which was greter than those of field survey.

More attention was focused on the nature of the costs and returns which is one of the main objectives of this study. As it is said, the profitability of any farm enterprise is based on the difference between the gross revenue and total costs. The analyses have shown that the average cost of production were ₦ 7,711.90 in Malumfashi while it was ₦ 6,887.40 in Makarfi all per hectare during the farm survey. The gross revenue obtained varied from one village to another. On the average farmers in Malumfashi were making ₦ 22,005.40 during the field survey, while those in Makarfi had ₦ 25,923.80 per hectare.

The gross margin, which is the net return to the producers, was calculated and

the results also have shown differences. The analysis indicate that on the average farmers in Malumfashi were making a gross margin of ₦ 14,293.50 per hectare during the field survey while those in Makarfi were had ₦ 19,036.40 per hectare respectively. But despite this, about 35 % difference in between the two villages in terms of net returns per hectare, the soybean production is much more profitable. None of the respondents made a negative gross margin. The test of significance has shown the profitability of soybean production .

As regards the production function analysis, Cobb-Douglas function and semi-log function were used in the analysis of the input -output data from the field survey, the results in the locations indicate that the independent variables selected, namely farm size, labour, fertilizer and seeds explain the variability in the total value of the output earned from the farm. Cobb-Douglas function was used for analysis of data obtained from Makarfi, because it best fit and the results are as follows : $R^2 = 0.96$ and summation of regression coefficients is 3.686, while semi - log function was selected for Malumfashi data due to the fact that it was the best fit for the data. The result was 0.92 for R^2 and 3.2 Σb_i.

The marginal value productivity of the two locations was calculated and the results have shown that labour, fertilizer and seed were underutilized. From the analysis, farmers have been earning higher return per hectare, if the various resources used in the production process respected the recommended agronomic practices.

5.2 CONCLUSION.

Steps towards improving the yield of soybean production in some located areas of the Northern Guinea Savanna by IAR-Zaria have shown through the findings of the researcher that the crop can be successfully grown in the large scale, due to its adaptability in the zone and if farmers are supported and encouraged with some impetus from the authorities responsible for the development of the agriculture in the country.

At various stages during the field survey, side discussions were held with farmers of the study area. These discussions and the results of analysis revealed that the implementation of soybean production in the zone which started in 1991 with the aid of EEC /OFAR - IAR was practised and it was only Samsoy - 2 (seed variety) can be said to have been widely adopted by the farmers to a large extent. Only one farmer in Malumfashi was observed to have grown TGX 1019 during the field survey.

It is finally concluded after the analysis that despite the problems encountered by all the respondents 100 % were able to make some reasonable profit. The gross margin analysis results showed that the technology per se was profitable. It was realized that farmers after the on - farm trial which took place from 1991-1993 in their respective village, they were able to make good yield (above 1.5 tonne/ha).

Due to the relatively low level of input requirement(unlike cowpea) and good

price, soybean production has gained wider acceptance in the target area. Many more farmers not included in the project had accepted soybean production. A lot of training is needed in the soybean utilization status of the producers because most of the soybean produced is sold and not consumed by the farmers.

The analysis also showed the variability of various inputs among themselves which put together to produce the expected output. This was done by the use of production function , particularly Cobb-Douglas and semi-log. The resource use efficiency for each input was also calculated and was satisfactory.

Due to the multipurpose use of soybean recently which pushed some researchers and policy makers to call it the " wonder bean " of the century, there is no doubt that the production of it will continue to increase.

5.3 LIMITATIONS OF THE STUDY.

The validity of the results of this study depend much on the accuracy of the data obtained from the field survey and used. The lack of records keeping by the farmers was a problem in getting the necessary information, especially concerning the past years. Difficulty due to high level of illiteracy of the farmers made them to be ignorant of the record keeping.

My lack of Hausa language can also affect the accuracy of the information

delivered by the respondents. This has necessitated the help of an interpreter, who due to human nature might introduce biasness in the interpretation and measurement errors in the data. The interpreter might be a barrier to the accuracy of the data collection.

The on -farm trial in those villages lasted for three years period, but the field survey data collected was based on a year's data. The variation in output, from year to year, particularly in agriculture is very common due to vagaries of nature or climatic conditions. The results of one year field survey cannot be used to generalize, thus this study need to be completed with the results in other area in the space and time in order to obtain a comprehend findings that allow room for broad generalization.

Some farmer's unwillingness and the reluctance to answer some questions might be a kind of stone in getting good and accurate information. They sometime felt that such questions touched their personal affairs and they believed by answering such question it would implicate them.

5.4 RECOMMENDATIONS.

1. Due to the multipurpose and commercial value of the soybean in the world today, there is need to continue educating farmers about the improved agronomic practices such as type of seed, quantity and type of fertilizer application in order to boost the production of the grains.

2. Nutritionists should intensify their education in rural areas as well as in urban areas about the high nutritional value of soybean thereby solving the rampant deficient animal protein;
3. As mechanization tends to lower the cost of production, it is my suggestion that government through its specialized agencies should make tractors available at a reasonable price to farmers. Farmers also in their turn should provide single large land area and devote it to soybean production;
4. The immediate need of protein concentrates for poultry foodstuffs are considerable and increasing rapidly in response to the growing population, therefore Nigerian government should look into soybean production within the country in order to fill the need (gap);
5. The Federal and State Government should intensify soybean production awareness and utilization and also mobilize the local industries to incorporate small amount of soybean flour into the wheat flour. This would reduce the amount of wheat imported and at the same time improve the nutritional quality of bread, which has in recents years become increasingly important food.

5.5 SUGGESTIONS FOR FURTHER RESEARCH.

Since it is known that the improved soybean production technology is zone specific, it is possible that the technology could have performed better in other

regions in the Northern Guinea Savanna zone where the present study was conducted. There is need therefore to have a wider research area covering most of the regions of the ecological zones where soybean is not grown to enable a more meaningful evaluation and comparison of the reasons underlying the success or failure of the technology in the various zones.

An interdisciplinary approach involving agronomists, agric-economists, extensionists, soil scientists, weed, pathologists, social and food scientists could reveal more meaningfully the problems of production and utilization of soybean.

Part of the problems of soybean technology possibly lie with the institution responsible for the transfer. A study of the effectiveness of extension system will also be useful.

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APPENDIX A:
Determination of the Profitability of 40 Soybean Production Enterprise by Gross Margin Analysis In Makarfi and Malumfashi.

Makarfi S/No	Farm size in Hectares	Labour Cost (₦)	Fert. Cost (₦)	Seed Cost (₦)	Total Var. Cost (₦)	Gross Return (₦)	Gross Margin (₦)	Gross Margin/ Hectare (₦)
1	0.8	5,100	420	130	5,650	17,840	12,190	15232.5
2	1.0	6,400	294	140	6,834	22,900	16,066	16066
3	0.8	5,200	280	100	5,580	19,600	14020	17525
4	0.8	5'100	700	100	5,900	20,040	14140	17675
5	0.6	4,000	490	100	4,590	13,400	8810	14683.3
6	2.0	13,000	420	240	13,660	32,000	18340	9170
7	0.4	2,500	-	100	2,600	10,000	7400	18500
8	0.2	1,500	700	50	2,250	7,400	5150	25750
9	0.2	1,700	560	50	2,310	12,000	9690	20250
10	0.6	4,200	700	140	5,040	16,200	11160	18600
11	1.2	8,000	1,400	200	9,600	38,000	28400	23666.66
12	0.2	1,600	700	100	2,400	7,000	4600	23000
13	0.8	5,300	700	200	6,200	18,140	11940	14925
14	1.6	10,000	2,100	220	12,520	47,000	34480	21550
15	0.2	1,650	280	160	2,090	7,000	4910	24550
16	1.2	8,500	1,750	200	10,450	37,440	26990	22491.66
17	1.6	10,700	1,400	260	12,360	42,400	30040	18775
18	2.0	13,000	1,400	200	14,600	41,440	26840	13420
19	0.4	3,100	700	100	3,900	15,440	11540	28850
20	0.1	800	-	50	8,500	3,800	2950	20060
Total	16.7	111,550	14,994	2,940	129,384	429,040	299656	384745.12
Aver.	0.835	5,577.5	749.7	147	6,469.2	21,452	14982.8	19237.256

APPENDIX B:

Malumfashi S/No	Farm size in Hectares	Labour Cost (₦)	Fert. Cost (₦)	Seed Cost (₦)	Total Var. Cost (₦)	Gross Return (₦)	Gross Margin (₦)	Gross Margin/ Hectare (₦)
21	0.4	2,700	2,100	100	3,010	5,700	2690	6725
22	0.8	5,100	1,400	140	6,640	14,200	7560	9450
23	0.4	3,200	1,400	100	4,760	13,500	8740	21850
24	0.4	2,800	336	100	3,236	7,000	3764	9410
25	0.4	2,200	1,400	120	3,720	10,040	6320	15800
26	0.4	2,650	280	120	3,050	9,500	6450	16125
27	0.8	4,700	1,400	160	6,260	20,000	13740	17175
28	0.8	5,000	1,400	140	6,540	18,100	11560	14450
29	0.8	5,300	1,400	160	6,860	21,000	14140	17675
30	0.4	3,000	700	100	3,800	10,840	7040	17600
31	0.8	4,500	1,400	120	6,020	17,000	10980	13725
32	0.6	3,300	700	140	4,140	14,400	10260	17100
33	0.6	3,800	700	140	4,640	12,200	7560	12600
34	0.8	5,400	280	200	5,880	15,600	9720	12150
35	0.8	5,800	490	200	6,490	18,200	11710	14637.5
36	0.8	6,000	700	160	6,860	17,200	10340	12925
37	1.0	6,400	700	240	7,340	17,600	10260	10260
38	1.0	5,900	700	220	6,820	19,600	12780	12780
39	1.2	8,200	1,400	260	9,860	25,000	15140	12616.66
40	1.2	10,100	1,400	200	11,700	23,600	11900	9916.66
Total	14.4	96,050	18,396	3120	117,628	310,280	192651	274970.82
Aver.	0.72	4,802.5	919.8	156	5,881.3	15,514	9632.7	13748.54

Appendix C.

A QUESTIONNAIRE ON THE PROFITABILITY OF SOYBEAN PRODUCTION IN TWO LOCATIONS IN THE NORTHERN GUINEA SAVANNA OF NIGERIA.

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY, FACULTY OF AGRICULTURE, A.B.U. - ZARIA POST-GRADUATE RESEARCH PROJECT

A. GENERAL INFORMATION

1. Date of interview .....
2. Name of informant .....
3. Village of the informant.....
4. Age of the informant .....
5. Sex : Male ( ) Female ( )
6. Marietal status : Married ( ) Single ( )
7. Family size .....
   (a) Male.....
   (b) Female.....
8. Is farming your main occupation ? Yes ( ) No ( )

B . CROPPING SYSTEM

1. How long have been farming soybean ? Please state the year (s).....
2. Do you farm any other crop (s) than soybean ? Yes ( ) No ( )
3. If yes, what other crop(s) do you farm ?

(a).....

(b).....

(c).....

4. Why do you choose to grow soybean ?

(a).....

(b).....

(c).....

5. How many field crop did you have last cropping season for soybean production.....

6. What was grown in each field ?

Field No	Crop (s) grown	Size (acre or hectare)

C. RESOURCES USED

1. What was the total land area under soybean production last season.....

2. Mode of cultivation
   (a) . By hand tools only ( )
   (b). By the use of animal traction only ( )
   (c). By the use of tractor only ( )
   (d) . Others (specify) ( )

3. What type of labour did you use in your production process :
   (a). Household only ( )
   (b). Hired only ( )
   (c). Others (specify) ( )

4. If family was used, fill the table below for each soybean field seperately. Farmers with more than one soybean field should use extra sheet please.

Form of operation	Types of people used	No of people	No of hours spent	Total
Land prep.				
Harrowing				
Ridging				
Planting				
Fert. applic.				
Spraying				
Weeding				
Harvesting				
Threshing				

5. If hired labour was used, fill the table below for each soybean field separately. Farmers with more than one soybean field should use extra sheet please.

Form of operation	Types of people used	No of people Used	No of hours spent	Total cost of Hiring
Land prep.				
Harrowing				
Ridging				
Planting				
Fert. Appl.				
Spraying				
Weeding				
Harvesting				
Threshing				

6. Other inputs used in the production process.

	Field No	Seeds	Fertilizer	Others
Quantity used				
Cost of inputs				
Cost of fertilizer				
Total cost				

7. What types of soybean cultivars did you grow last season ?
   (a) . Improved
   (b) . Local
   (c) . Others (specify)
8. Please give some reasons in cultivating the above cultivars:
   (a).....
   (b).....
   (c).....

D. YIELD (OUTPUT)

1. How many bag (s) of soybean grains did you produce last season per field ?
   (a). Field 1.....
   (b). Field 2.....
   (c). Field 3.....
   (d). Field 4.....
2. Do you think that the output of soybean is rising or falling from previous years?
   (a). Rising .....
   (b). Falling.....
   (c). Constant.....
3. How many bags were consumed by the family ?.....
4. How many bag(s) were sold ?.....
5. How many bag (s) or kg(s) were kept for the season ?.....

Thanks for your cooperation.