ECONOMICS OF MAIZE PRODUCTION USING TWO TECHNOLOGIES IN FOUR LOCAL GOVERNMENT AREAS OF KADUNA STATE

BY

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A Thesis Submitted to the Postgraduate School, Ahmadu Bello University, in Partial Fulfillment of the Requirements for the Degree of Master of Science (Agricultural Economics)

Department of Agricultural Economics and Rural Sociology
Faculty of Agriculture
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DECLARATION

I hereby declare that this Thesis now submitted for the Master of Science Degree (Agricultural Economics) of Ahmadu Bello University, Zaria is the record of my own research work, except where reference is made to published literature and duly acknowledged. It has not been presented before in whole or in part for application for a higher degree.

Benjamin Ayuba Loms — Date: 26/Jan/99

The above declaration is confirmed

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Chairman, Supervisory Committee — Date: 23/7/99

CERTIFICATION

The Thesis entitled "Economics of Maize Production Using Two Technologies in Four Local Government Areas of Kaduna State" by Ayuba, Benjamin Loms, meets the requirement governing the award of the degree of Master of Science (Agricultural Economics) of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This Thesis is dedicated to my caring Mother (Mrs. Dinatu Ayuba), who inspite of ill-health, she sent encouraging words from the sick-bed to me while I was away pursuing this programme.

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ABSTRACT

The objective of the study was to assess the efficiency of improved technology in maize production in Kaduna State by comparing Sasakawa and Non-Sasakawa Technologies. The emphasis was however, on determination of the quantities and costs of inputs used and the estimation of output and returns from maize production. Also the efficiencies of resources used by both groups of farmers were also determined.

To obtain the data necessary for this study, 80 farmers each of users of Sasakawa and Non-Sasakawa technologies for sole maize production were interviewed from four Local Government Areas of the State. Descriptive statistics, gross-margin analysis and production function analysis were employed in the analyses of the data.

The results of the study showed that with the exception of seeds, the levels of other variable inputs used by the Sasakawa farmers were significantly higher than for the Non-Sasakawa farmers. The output obtained by the Sasakawa farmers was about 34 percent higher than that of the Non-Sasakawa farmers. The pattern of cost of production and returns show that the average cost of production for using Sasakawa technology was greater than for the Non-Sasakawa users by 42 percent. The results further revealed that labour and fertilizer accounted for about 88 percent and 92 percent of cost of production in both the Sasakawa and Non-Sasakawa farms respectively. The gross-return per hectare for the Sasakawa farmers was about 51 percent higher than for the Non-Sasakawa farmers. Similarly, the gross-margin per hectare for the Sasakawa farmers was also

significantly higher than for the Non-Sasakawa farmers with about 62 percent.

The production function analysis shows that the Semi-log and Cobb-Douglass production functions reasonably explained the variability in the total value of output obtained from the use of Sasakawa and Non-Sasakawa technologies respectively. The results showed fertilizer was over-utilized, land and Seeds were under-utilised by Sasakawa farmers In the case of the Non-Sasakawa farmers, fertilizer and seeds were under-utilized, while labour was over-utilized. Both the Sasakawa and Non-Sasakawa technologies will exhibit an increasing returns to scale of 2.2 and 1.1 percent respectively in output if all inputs included in the models are increased by 1 percent.

The study revealed that some increases in the productivity of maize production have been achieved through the use of Sasakawa technology, therefore, planning for maize production should continue to focus on the design and implementation of such programme.

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Chapter 1

INTRODUCTION

1.1 The Significance of Maize in Nigeria

Maize (Zea mays L.) is a major crop in Nigeria as food for millions of its populace and as feed for livestock. It has established itself as a very significant component of the farming system and determines the cropping pattern of the predominantly peasant farmers (Fajemisin, 1985; Ahmed, 1996). The traditional areas of maize cultivation have been the South of latitude 8 degrees North (8°N) where it can be grown twice a year. However, it is now known that because of the higher solar radiation received in the northern parts of the country, relative to the southern parts and the adoption of improved maize seed technology (TZB) have led to its increasing importance and expansion to the Northern parts of the country where it has not been traditionally grown on a wide basis (Ologunde, 1987). Since the potential for its production is greatest in the Savannah Zones, it began to attract the attention it deserves from the farmers and researchers in the Guinea Savannah Zone.

In Nigeria, many researchers including Norman have found improved production technology to be a major factor in its effort to become self sufficient in maize production within a short period of time. For instance, Normal et al; (1976) working with farmers using ox-drawn implements reported that yields of about 3000 - 5000 kg per hectare can be realized only with high levels of fertilizer, optimum plant population and adequate weed control and crop protection measures. At such yield levels maize can become a

highly profitable "cash" crop provided a remunerative product price regime prevails. Despite the high yields obtained from the use of improved production technology and the effort that has gone into promoting its adoption among farmers in Nigeria, the national average grain yield of maize has consistently fallen short of the potential (Table 1.1) due mainly to very poor yields on farmers field resulting from non-adoption of improved maize production technology in Nigeria.

Table 1.1: Average and Potential Yield of Cereals in Nigeria

Crop	Average Yield (Tons/ha	Potential Yield (Ton/ha
Upland rice	0.8 - 1.2	1.5 - 2.5
Lowland rice	1.0 - 2.0	2.5 - 8.0
Maize	1.5 - 2.0	3.5 - 10.0
Sorghum	0.5 - 1.2	2.0 - 2.5
Millet	0.5 - 1.0	1.0 - 1.5

Source: National cereal Research Institute Survey, 1988.

1.2 Sasakawa Global 2,000 Nigeria Programme

In addition to research institutes and Agricultural Development Projects (ADPs), other organizations such as Sasakawa Global 2,000 (SG2000) have been involved in the transfer of maize production technology in Nigeria in an effort to increase the average

yields of the farmers. The Sasakawa African Association (SAA) and the Carter Centre's Global 2000 organization was established in 1986 in an effort to enhance food security in sub-Saharan African. Towards this end, Sasakawa Global 2,000 (SG2000) project was established in co-operation with national extension services in various countries in Africa to demonstrate improved food production and post-harvest technology to small scale emergent commercial farmers. The SG2000 a non-governmental and non-profit making organization is sponsored by SAA through the Nippon foundation.

The SG2000 programme in Nigeria began in June, 1992, in collaboration with Federal Government. It started in Kano and Kaduna States with the assistance of the Federal Ministry of Agriculture and Natural Resources and the Agricultural Development Programmes. Later Jigawa and Katsina States ADPs joined the programme in 1993 and 1996 respectively. Having seen the achievement during a field visit and workshop of the programme in 1996, the Director of the Federal Department of Agriculture, issued a directive to the remaining thirty-three (33) States to adopt the Management Training Plots (MTPs) demonstrated by the SG2000 programme.

In April 1997, a training was organized by FACU/SG2000 for the non-participating State ADPs including Abuja on the Management Training Plots.

The project's main objective is to accelerate the diffusion of improved technologies in wheat and maize production among farmers by establishing a large scale

demonstration programme among them. The programme is assisting ADPs in developing quality extension services and seed production by improving the technical training of front line extension staff and providing some limited logistical field support. The strengthening of linkage amongst research, extension and farmers is a priority in the programme. This linkage is an important strategy in order to transfer the improved technologies from the research institutes to farmers.

1.3 Problem Statement

Inspite of the fact that maize production is on the increase, a deficit still exists between demand and supply. The reason is because small scale farmers who contribute over 95% of domestic food production in Nigeria (Federal Ministry of Agriculture, 1980) are being faced with unimproved means of production such as relying on own seed for planting, use of farm yard manure, crop rotations and fallow to maintain soil fertility and use of family labour and animal power for land preparation and crop cultivation. Raising yields under these circumstances involves using improved varieties and fertilizer technology and promoting improved crop husbandry, but these farmers are yet to fully adopt improved packages recommended for maize production which has been with them for two decades now (Idisi, 1990).

The problem is that relatively, this improved production technology currently being disseminated to these farmers requires high input and a high level of understanding of the agronomic practices by these farmers. But over the past few years, little attention has been given to the evaluation of improved technology with the type of technology the farmers are using in maize production and therefore, there is inadequate basic input -

output data on the use of such technologies in maize production at farmers' level. The research effort therefore focuses on the comparison of profitabilities and resource use efficiency of the two types of technologies used for sole maize production in the study area.

1.4 Objectives Of The Study

The broad objective of the study is to assess the efficiency of improved technology in maize production in Kaduna State by comparing Sasakawa technology and Non-Sasakawa technology. The specific objectives are to:

(i) describe the socio-economic characteristics of the farmers in the study area;

(ii) determine the input-output levels;

(iii) compare the financial costs and returns in maize production;

(iv) determine the production function of maize production;

(v) determine the resource use efficiency in maize production.

1.5 Statement Of Hypothesis

The hypothesis put forward for this study is that:-

H_o: There is no difference in Gross-Margin obtained by farmers using Sasakawa technology and those not using Sasakawa technology.

H_1: There is difference in Gross-Margin obtained by farmers using Sasakawa technology and those not using Sasakawa technology.

1.6 Justification Of The Study

The significance of this study derives mainly from the potential of improved technology as shown in Table 1.2 in increasing maize production in Nigeria. This is particularly important since Kaduna State has great potential for maize production (Abalu and D'Silva, 1980).

Table 1.2: The Rate of Loan Recovery of SG2000 Farmers and their Corresponding Yields

State	Year	Range of Yields (t/ha)	Average Grain Yield (t/ha)	Loan Recovery (%)
Kaduna	1993	1.5 - 8.4	3.8	100
	1994	0.2 - 6.5	2.6	82
	1995	2.8 - 7.6	5.2	100
	1996	1.2 - 6.7	5.1	100
Jigawa	1994	2.6 - 6.4	4.8	100
	1995	1.7 - 7.0	4.2	100
	1996	1.9 - 7.2	4.1	100
Kano	1996	2.6 - 6.7	4.6	100

Source: SG2000 Project, 1996 Field Survey.

The development of improved technology is not in itself sufficient to ensure adoption by farmers. The improved technology must be linked to appropriate economic

policies in order to maximize the return to maize production investments and to modernize the maize economy rapidly. To be in a position to influence agricultural policy, maize research programmes should generate and publicize information on the suitability and economic potential of various technological components for specific environments and group of farmers.

The study is worthwhile and timely as some States including Kaduna in conjunction with SG2000 are making effort to increase maize production by disseminating the Sasakawa technology which is an improved technology to farmers. Therefore, a comparative economics study of maize production using two different types of technologies in the study area will be of great help to policy makers and farmers for the allocation of their scarce resources and evaluation of impact of measures that will be taken to increase maize production in the country.

Chapter 2

LITERATURE REVIEW

2.1 Maize Production and its Uses in Nigeria

Maize is becoming the miracle seed for Nigeria's agricultural and economic development (Adenola and Akinwumi, 1993). Its production is improving and spreading while its uses are equally increasing. Since 1985, when the Federal Government of Nigeria banned importation of maize, production has been stimulated to meet the rising demand for maize as food, feed and industrial raw material. But a gap still exists between the supply and demand for maize (Table 2.1). It should be the joy of all producers and consumers alike, if more maize is produced to meet the needs of direct human consumers, the industrial users and the government buffer and strategic grain reserves. However, there are a number of factors which constraint the production of maize so that effective demand for the crop is not being met.

Maize is being grown throughout the country, but it thrives and gives highest yield per unit area in the Savannah Zone of the country (Ologunde, 1984; FOS, 1993). With the development of improved open pollinated and hybrid maize varieties, good yields can be obtained at high altitude and forest areas as well (Wudiri and Fatoba, 1991). According to Shaib et al. (1997), the national demand and production of maize is put at 6.993 million tonnes and 6.462 million tonnes respectively. The substantial gap between demand and production (Table 2.1) would be reduced through further productivity increases and possibly expansion of land area together with a more intensive use of improved inputs and production practices.

Table 2.1: Supply and Demand for Maize in Nigeria 1975 - 1997 ('000 Tones)

Year	Demand Estimate	Cultivated Area ('000 ha)	Domestic Production	Imports
1975	1299	804.00	1260	3.50
1976	1239	863.30	1295	1.30
1977	1529	930.00	1395	36.80
1978	1779	966.00	1450	66.30
1979	2119	1000.00	1500	87.30
1980	2279	1033.30	1550	70.30
1981	2450	1053.30	1580	105.70
1982	2385	1166.70	1750	144.10
1983	2506	1066.70	1600	326.10
1984	2634	1200.00	1800	13.60
1985	2871	1200.00	1800	-
1986	2881	1156.70	1735	-
1987	3580	9047.00	1757	-
1988	3840	2513.40	3773	-
1989	4000	3754	5628	-
1990	5875	NA	5768	-
1991	5932	NA	5810	-
1992	5984	NA	5840	-
1993	6058	NA	5950	-
1994	6298	NA	5987	-
1995	6568	NA	6080	-
1996	6776	NA	6160	-
1997	6993	NA	6462	-

Source:
1. CBN (1995), Statistical Bulletin Vol.4, No.1.
2. National Cereal Research Institute, Survey, 1988.
3. Adapted from Shaib et al (1997), Nigerian National Agricultural Research strategy Plan, Abuja.

Where NA: Means Not Available.

Maize is not only a major food crop for many homes in Kaduna State, but also a major "cash" crop which has become a replacement for traditional earlier cash crops such as groundnut and cotton in the area. As food crop, it is prepared and eaten in form of "tuwo", "pete" and "akamu." It is also eaten green by boiling or roasting, while the dry grains are often fried and eaten. Maize also has commercial value in the industrial sector where it is used as a source of energy in livestock feed and as raw materials in brewing and confectionery industries.

2.2 Farm Production Economics Studies

Ogunfowora et al (1975), distinguished two broad categories (macro and micro-forms) of resource productivity studies. The micro oriented studies focus attention on resource use efficiency in individual enterprises such as wheat, maize, rice, poultry, groundnut etc, produced in a sample of farms. This category of studies provides quantitative estimates of resource productivity which could be used as a basis for efficient allocation of resources at the farm level. This type of study has been conducted on maize (Ogungbile and Ologunde, 1986; Ahmed, 1985), traditional agriculture (Ogunfowora et al, 1975). Such study gives an indication of the direction and magnitude of resource adjustment needed to achieve optimum resource allocation.

While the second category of resource productivity study is between enterprise groups such as crop versus livestock enterprises or export versus food crop enterprises. This category of studies provide macro-level resource allocation decision on these groups

of enterprises. They do not however, indicate the magnitude and the direction of needed adjustment within a particular enterprise group. But the micro-approach forms the main basis of the analysis under taken in this study.

The budget analysis brings out the costs and returns, and has been used by many economists in addition to production functions. Ogunfowora et al; (1975) and Coulibaly (1984) used production function to estimate individual resource productivity. Ogunfowora et al (1975) and other researchers have used aggregate or total inputs to estimate resource productivity. Also, Marginal Value Product(MVP) derived from production functions have been used as a fine measure of resource productivity (Ogunfowora et al 1975; Idisi, 1990).

2.2.1 Resource Productivity and Efficiency Studies in Agriculture

Rapid and mass development of agriculture can be achieved only by breaking through the state of the arts and introducing modern technology in a package consisting of new inputs, agricultural education, special skills and techniques and competent guidance in farm planning (VenKreddy, 1967).

The usual interpretation of the production function is that although farms attempt to maximize profits, they are not uniformly successful in doing so due to differences in their managerial abilities (Nerlove, 1965). Sahota (1968) confirmed that resources available to farmers in India had by and large been efficiently allocated. He maintained

that it will be difficult to depend on the often advanced assertion that Indian farmers were tradition ridden and not rational or that marginal product of labour was zero and or the marginal product of any kind of capital was high. Disequilibrium may exist here and there.

Yotopoulous (1968) in his study of farm families in Epirus, also concluded that the farmers were poor but efficient. The implication of the result was that poverty in Epirus was not due to the misallocation of the existing agricultural resources. Mere reshuffling of factors of production could be expected to contribute significantly to economic development. Poverty was more likely to be due to low stock of factors of production (equipment, improved seeds, knowledge etc), one may expect that the production possibility curve will be obtained at higher levels of marginal productivity for all factors. There seems to be no agreement as to which group of farmers (small or large) are technically more efficient in literature. Yotopoulous (1968), observed that small farms were more efficient at one set of factor price ratios and the large farms were at another set of factor price ratios. If they faced different price ratios because of market conditions, it could have been possible for different factor intensities to exist side by side. The results of the production function analysis were therefore, inconclusive, in discussing questions of economic efficiency when the underlying production analysis was different for the two groups of farms. This seems to be in line with what Sen (1966) had observed when he studied the behaviour of two groups of farms in India, capitalist (large farms) and peasant (small farms). The findings of his study showed that there were

significant differences in factor intensities and input - output ratios between different sizes of farms.

Norman (1972), in his input - output study of three villages in Zaria observed that most farms used all inputs with exception of hired labour in an optimally efficient manner. He pointed out that hired labour was at that time not efficiently used because it was not particularly successful in mitigating the effect of peak demand period for labour. The study indicated that the seasonal nature of farm work result in labour shortages at peak period of labour demand. The result of his study also indicates that the number of family members is important in determining farm size. But land quantity was found to be most important contribution to farm productivity. In general, Norman concluded that under the existing technological and socio-economic conditions in the study area, farmers used their resources in a manner consistent with the goal of profit maximization. Ukpabio (1978), conducted a study in Funtua Agricultural Development Project area (FADP), he compared the productivity differentials between small and large farms. He found that while small farmers were more efficient in the production of traditional food crops, large farmers were more efficient in the production of cash crops. He also obtained an increasing return to scale in the production of most of crops grown by both small and large farmers. However, Ekele (1982), in a follow up study of the same area (FADP), observed that while there exist some differences in the level of resource use amongst different classes of farms, there was no significant differences between small and large farms in terms of the relative economic efficiency.

Abalu and Harkness (1978), conducted a study on an economic analysis of production in Northern Nigeria using traditional versus improved groundnut production practices. They found out that hired labour used on family farm was quite high in the study area. This contrasts sharply with Norman's (1992) study carried out in 1967, where only 18% of the total labour used on family farm was hired. A gross yield of 870 kg and 1229 kg and a value of ₦261.00 and ₦368.70 per hectare for traditional and improved production practices respectively was found. The study further shows that the net-return per hectare for the traditional technology was 45% that of the improved one. Therefore, the improved method of production appears to be superior to the traditional method.

Some economic studies have also been under taken on the small scale irrigation. Owera (1979), investigated the economics of dry season tomato production and revealed that farmers were operating at a loss and that most of the resources were being allocated below the economic optimum levels. In a similar study under the Galma irrigation scheme, Ofojekwu (1982), found that labour constituted over 55 percent of the total cost of production, while seed, fertilizer and water accounted for 7.03 percent, 18.61 percent and 10.27 percent respectively. He also found that labour was being used above the economic optimum level. In another study, Makarfi (1985), investigated the economics of wheat production under the Kano River Project. His farm budget analysis revealed that farmers realized a profit of ₦819.69 per hectare at the (then) market price. From his production function analysis, he found that fertilizer and seed were being under

utilized, while labour and irrigation water were being over utilized. Shumba (1989), has also shown that cost analyses singly are suitable to judge the economic benefits. He showed using the minimum cost concept that tillage treatment involved a net cost increase whereas the herbicide treatment was cost saving. This supports the work of Ogungbile and Lagoke (1986).

2.2.2 Improved Maize Production Practices

Idisi (1990), reported that IAR scientists conducted and "on farm testing of improved sorghum and maize packages" between 1981 - 83 inclusive. They compared hand-hoeing and oxen technologies in terms of man hours per hectare, average field per hectare and effectiveness of herbicide used under the two forms of tillage. The oxen-technology proved better in all situation. They also did costs and return analysis for the two crops for 1983, the evaluation year and the analysis showed that experimental plots results for both crops gave a higher net-return per hectare compared to the farmers plot and net returns for maize were higher than those of sorghum. In the same vein, return to labour was higher for maize, which had higher labour inputs. Returns to labour and amount of labour per hectare used were higher for the experimental plots compared to the farmers plot. In 1985, IITA scientists carried out On-Farm Adaptive Research (OFAR) in various parts of Nigeria on maize and cassava inter-crop. Maize varieties used were local and hybrids. Hybrid maize proved superior to local variety when net profits, marginal rates of return for varieties were calculated and compared.

Maize yield is found to respond to fertilizer application. In the Southern Guinea Savannah up to 150kg N/ha and with basal application of 60kg/ha each of P_2 0_5 and K_2 O is required by maize (Ogungbile and Ologunde, 1986). They also found out that nitrogen recommendations do not vary much with differences inplant density in the new locations in optimal combinations. In a study conducted by Wadderburn et al (1988) to determine crop yield response to fertilizer use at selected Agricultural Development Project Areas, in 1985 and 1986, maize was found to be the most responsive crop to fertilizer use among the cereal crops. Average response of maize was 0.6kg per kg of nutrient while that of millet was 0.1kg per kg of nutrient in Kaduna Area. Phillip (1982) found that though fertilizer and maize yield are positively related, fertilizer application should be within economic consideration. He noted that the economic optimum for fertilizer was always occurring below the technical optimum and if fertilizer price rises in relation to the maize price, the economic optimum occurs at lower level of fertilizer use.

Idisi (1990), conducted a study on the potential of hybrid maize, his costs and returns analysis shows hybrid maize to be superior than open-pollinated variety. Also based on farmers observations and perception ratings hybrid maize was found to be superior to the open pollinated variety and could therefore receive a larger crop in the near future. In a similar study carried out by Edwin (1991), the average gross revenue and cost per hectare where higher for hybrid maize growers than open-pollinated variety growers. However, the production of hybrid maize was more profitable than OPV

maize. This difference in profit level was due to the high yields obtained from hybrid maize. Also, a measure of resource use efficiency showed that only labour was efficiently utilized, while seeds and fertilizers were underutilized in the production of both crops.

Chapter 3

METHODOLOGY

3.1 The Sasakawa Maize Production Technology

The maize production technology being disseminated by SG2000 is basically the outcome of research findings from the Nigeria Agricultural Research Institutes and other national and international agricultural research centres. The technology comprises a package of agronomic practices which include:

(i) Making of ridges between 75cm - 80cm apart.

(ii) Use of high yielding maize hybrid seeds.

(iii) Planting dates of between 15th May - 30th June, when rains are established for Northern Guinea Savannah.

(iv) Use of 17 - 18kg/ha of seeds by planting one seed per hole or hill at a spacing of between 20cm - 25cm apart.

(v) Application of seven bags of N:P:K Fertilizer per hectare (350kg) as first application and two bags (100kg) of Urea per hectare in the second application. Incorporate the fertilizer by making a hole 8 - 10cm away from the plant.

To establish demonstration plots in a community, extension workers enlist farmers who agree to provide labour and piece of their land in order to try out the new methods. These set of farmers are referred as Sasakawa farmers, while the other farmers that do

not follow the guidelines of the extension workers are referred to as the Non-Sasakawa farmers in this study. The plots of the Sasakawa farmers are large to provide a convincing demonstration of the recommended technology and to reward the participating farmer with a significant economic returns and farmers can form a realistic idea of the labour and input costs that the new technology entails. The SG2000 ensures that participating farmers have access to the recommended inputs needed to grow the demonstration plots. The farm families in the area are invited to field days held at the demonstration plots, where they can discuss the advantages and disadvantages of the new technology with the participating farmers. Other farmers in the area soon try out ideas they have picked up from the demonstration plots or learned by talking to their neighbours and extension agents. After a few years, SG2000 moves on to other localities to expose a new set of farmers and local extension workers to the new technology.

Farmers are responsible for the operational costs of their Management Training Plots. At the inception of SG2000 in Nigeria, some loans in kind such as, fertilizer and seeds were provided to farmers. The recovery rate of the loans was very impressive (Table 1.2) partly because of the high grain yield obtained by these farmers. However, farmers have become so enthusiastic about the programme that, they pay for their inputs in advance.

3.2 The Study Area

3.2.1 Location

The study was conducted in Maigana and Lere Zones of Kaduna Agricultural Development Project (KADP). These zones comprised of eleven Local Government Areas (LGA's). These zones are located in the North-Eastern part of Kaduna State and lie between latitudes 10° and 11° 21'N and longitudes 7° 30' and 9°E of the prime meridian (Ileoje, 1989).

3.2.2 The Climate

The climate is generally characterised by alternating dry and wet seasons. The rains usually start in April/May and end in October, while the dry season sets in late October and ends in March. The dry season is marked by a period of cold and dusty weather, the harmattan is between November and February. The length of rainfall varies from 150 days in the Northern parts to 190 days in the Southern parts of the zones. The mean annual rainfall varies between 1107mm-1286mm. Relative humidity is low between 20 and 40 percent in january, rising to between 60 and 80 percent in July. The mean annual temperature also varies between 24°C and 28°C (Ileoje, 1989). The soils are characterised by a PH range of 5.5 to 6.5 and may be generally described as sandyloam in texture (Jones, 1973). The vegetation is characteristic of Northern Guinea Savanna. The vegetation consists largely of tree Savanna or Savanna woodland with Daniella oliveri as the dominant tree species and Andropogon tectorum as the main grass specie.

3.2.3 The Farming System

The bulk of agriculture production in these zones is undertaken by small scale farmers, most of whose labour force management and capital originate from the household. Some few medium to large scale farmers are also found in these areas. The major occupation of the inhabitants in these zones is mainly farming; though trading is being practiced by some few farmers in their localities and other traders in big towns or local government headquarters. The main crops grown in the area include maize, millet, sorghum, rice, cowpea, cotton, groundnut and vegetables. The cropping pattern is mixed with some farmers practicing sole cropping especially of maize. Some of the farmers also cultivate crops like vegetables, sugar cane, green maize etc during the dry season in the Fadama areas. Livestocks such as sheep, goats, cattle, poultry are also kept by the farmers.

3.3 Sampling Procedure

For the purpose of this study, four (4) Local government areas were selected from the total of eleven in the two ADP zones. These are Soba, Giwa, Lere and Kauru. The survey local government areas were selected based on the following reasons.

(i) Maize is one of the major crops grown in these areas;

(ii) SG 2000 project started in these LGAs of KADP;

(iii) Proximity of the areas to Zaria which is the base of the researcher.

The sample for this study was selected using both purposive and random sampling techniques. In each of the four local government areas covered in the study, a

preliminary survey was conducted in which all the Sasakawa and Non-Sasakawa sole-maize farmers were identified with the assistance of some APD's extension agents in these local government areas. The preliminary survey shows that seven hundred and fifty (750) farmers used Sasakawa technology for maize production in the study area. Simple random sampling technique was used to select twenty (20) Sasakawa farmers and another twenty (20) Non-Sasakawa farmers in each of the four local government areas. This gave a total of one hundred and sixty (160) farmers that were interviewed.

3.4 Data Collection and Source

Primary source of data was used for this study. The data were collected with the help of ADP's extension workers using structured questionnaires. The questionnaire was designed to collect the following types of information:

(i) General Information: Demographic data on age, level of education, farming experience, number of farm sites and consumption and utilization of maize by farmers.

(ii) Farm production information: Field operations data which include inputs used in production of maize, sources and quantities of these inputs, labour types and amount in man-days, the type of technologies used in maize production. Information was also collected on the costs involved in inputs procurement, including problems faced in procuring them, dates of farm operations, labour costs and other related data.

(iii) Marketing Information: Information on the output obtained, when they sell their produce, the price per quantity, the cost incurred during marketing e.t.c

3.5 Analytical Framework

Different types of analytical tools have been employed by researchers in production studies. Their application depends on the investigator's choice, who is normally limited by the nature of data, resources, time and facilities available and the use to which the results are to be put. For this study, the following tools were employed in order to achieve the already stated objectives of the study:

3.5.1 Descriptive Statistics

Simple descriptive statistics was employed in order to have a summary description of the data collected. This involved the use of measures of central tendency such as mean, mode, frequency distribution, percentages, ratio and measures of dispersion such as standard deviation to describe parameters as socio-economic characteristics, crop yield, total input-output level, types of cultural practices employed in maize production. This tool was used to achieve objectives (i) and (ii) of the study.

3.5.2 Farm Budget Model

The farm budget as a tool of analysis is one of the oldest and simplest used in farm management and production studies. It has been used in a number of economic

studies for analysing the profitability of farm production practice. This was used to achieve objective (iii) of the study.

Various methods of budgeting exist. However, these methods can be subdivided into two major categories:

(i) Total or complete budgeting and

(ii) Partial budgeting.

A total budgeting is used when contemplating a complete re-organisation of the entire farm enterprise, while partial farm budget is used when the action intended to be implemented does not affect the whole farm, for example, introducing a new enterprise or purchasing a new equipment for the farm. the choice of any type of budgeting tool depends on the circumstances under which the farm business is taking place, goal achievement objective and convenience. Since this study involved in the evaluation of a new technology or enterprise for them as replacement of another, partial budgeting was used as an analytical tool.

Basically, it involves operations, leading to estimates of gross revenue and total cost for the same production period. The difference between the two parameters is a measure of profit (or loss) or net farm income for that period (Osifo and Anthonio, 1970; Oluwole, 1970; Olayemi and Oni, 1971). The purpose of the model is to identify the costs, returns, profitability or loss per hectare. The total revenue represents the value

of the output from the farm (that is physical quantity of crop multiplied by the unit price). The total cost on the other hand is made up of the "Variables" and "Fixed" components. Variable costs also called specific costs vary directly with the level of production and include expenditure on seeds, fertilizers, chemicals, labour, marketing costs etc. Fixed cost known as over head costs do not vary with the level of output and consist of cash expenses on repairs and maintenance, interest on long term loan and non-cash adjustment like depreciation on farm tools, equipments and machinery.

The computed returns and costs were used to derive a measure of profitability of the enterprise, that is gross margin. A general model of the farm budget presented in the equation below was used in the budgetary analysis.

$$GM = GI - TVC$$

where GM = Gross margin in naira

GI = Gross farm income in naira

TVC = Total variable cost in naira.

The small scale traditional farmers which this study has focussed on usually have negligible fixed costs and therefore the gross margin is a good approximation of the net farm income (Olukosi and Erhabor, 1988). Both returns and costs were measured on per hectare basis, hence the gross margin was also based on per hectare basis.

3.5.3 **Test of Hypothesis**

A test of hypothesis was conducted between the gross margin obtained by farmers using Sasakawa and those not using Sasakawa technologies for maize production. The two means of gross margin for the farmers were subjected to Z-test using the formular below:

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S^2_1}{N_1} + \frac{S^2_1}{N_2}}}$$

where:

$\bar{X}_1$ and $\bar{X}_2$ = The gross-Margins of the farmers

S^2_1 and S^2 = Estimated Variance

N_1 and N_2 = Sample Sizes of the Sasakawa and Non Sasakawa farmers respectively.

Limitations of farm budget model:

The farm budget like most common tools of analysis has some limitations. One of its limitations is the inability of the model to define how optimum returns can be attained from limited resources (Orewa, 1978). All it shows is the monetary costs and returns from a production process. Another limitation is that if the study involves a lot of value judgement (e.g imputed cost on input used) the model ceases to be a useful tool. This is because the value attached to either input or output will vary among farmers, thus given a distorted picture of the true profitability situation. It also assumes linear relationship and does not consider supplementary or complementarily between enterprises

and does not help in the initial choice of enterprises or farm plan. It can only be used to find the most profitable among two or more farm plans.

3.5.4 Production Function Analysis

In this study, the purpose of production function was to identify and measure how variable inputs are used to explain the variability in outputs. The greater the extent to which the variable inputs are able to explain the variability in output, the larger is the influence which the inputs have on maize production. In the production process, inputs are converted into outputs. Therefore, the most fundamental relationsip is that between the factors of production and product. Hence, production function is defined as "the physical relationship between outputs and inputs used in the production of output" (Olukosi and Ogungbile, 1989). Therefore, the production function analysis was used to achieve objective (iv) and (v) of the study. The data were fitted into various functional forms specified below:

(i) The Linear production function (LPF)

(ii) The Semi-log production function (SPF) and

(iii) The Cobb-Douglass production function (CPF).

The functional forms, together with others (e.g square root function) are collectively called Multiple Regression Model. Relevant data collected from field survey were fitted into the three functional forms of the model and co-efficients of multiple

determination (R^2) were obtained as a measure of goodness of fit. The equations for Semi-log and Cob-Douglas production functions of the Sasakawa and Non-Sasakawa technologies respectively had the highest R^2-values and thus explained the variations best and were regarded as a better fit (Heady and Dillon, 1972) and were adopted for subsequent analysis of the collected data. Other choice indicators that were used are:- the Standard error of estimated co-efficient, significance of t-value and the adjusted R^2-values.

Model Specification

Two different regression analyses were run, one for farmers using Sasakawa technology for growing maize and the other for farmers not using Sasakawa technology. The model in its general form is:

$$Y = F(X_1\ X_2\ X_3\ X_4\ U_i)$$

where:

Y = Output of maize in kilogramme

X_1 = Area of plots devoted to maize production in hectares

X_2 = Quantity of fertilizer in kilogram

X_3 = Quantity of seeds in kilogram

X_4 = Total labour input in man-days

U_i = Error or disturbance term is included to capture errors of measurement, aggregation, random behaviour of human beings and effects of exogenous and endogenous variables not included in the model.

The Cobb-Douglas Production Function (CPF)

This function is stated as follows:

$$Y = \Lambda X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} U_i$$

where Y and X_1-X_4 as defined in model specification above.

b1-b4 = Regression co-efficients and measure of elasticity of production of factors X_1-X_4 respectively.

Λ = Constant term

U_i = Error term

For CPF to be applied in a form amenable to practical purpose, the function has to be transformed into linear function by the application of logarithmic function where the logarithmic function of the dependent and independent variables are computed as indicated below:

$$\text{Log } Y = \text{Log } A + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + E$$

where all parameters are as defined in model specification above. Where there is diminishing returns to factors, the sum of the values of the co-efficient will be less than 1 and where there is increasing returns, the sum of values will be greater than 1. Constant returns to factors indicated where the co-efficients add up exactly 1 or unity (Heady and Dillon, 1969).

The advantages of CPF are its relative ease of computation since it can be

converted into its linear form. It is convenient in interpreting elasticities of production. The function can be employed to handle any number of independent variables and the estimated parameters involves fewer degree of freedom which allow for decreasing and increasing return to scale.

The major limitation of CPF, according to Heady and Dillon (1972) are the possibility of over estimating an output quantity which equates marginal revenue with marginal cost at high levels of inputs use unless an economic optimum is defined for small magnitude of inputs. One other limitation is that it assume zero-levels of the inputs. In addition, the function cannot show diminishing and increasing returns to factors in a single response curve.

The Semi-log Production

This type of production function is of the form:

$$Y = A + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + E$$

where the dependent and the independent variables are as defined for the CPF.

Selected Variables and their Measurements:

The variables that were used in production analysis are given below:

(i) Farm size (X_1):

This was included in the model as a result of the much discussed inverse

relationship between farm size and productivity in farm management studies (Sanni, 1969). The inclusion was to show the influence of farm size on the production of maize in the area. It therefore helps in determining the extent to which it explained the variability in output. The farm size was measured in hectares.

(ii) Quantity of Fertilizer (X_2):

This referred to the quantity of fertilizer materials used. While some had little or no fertilizer to apply to their farms, others were applying more than recommended level per hectare. It was included in order to know the extent to which variations affect the total output from farms. The unit of measurement used was kilogram.

(iii) Quantity of Seeds (X_3):

This referred to the quantity of seeds used. It was included in the model to examine to which extent variations in the quantity of seeds planted affect the output of maize. It was also measured in kilogram.

(iv) Total Farm Labour (X_4):

This referred to the amount of physical effort used in man-days by adopting the time schedule developed by Olukosi and Erhabor (1988): Adult male (above 15 years) performs one man-day of a normal 5 hours a day; Adult female work about 0.75 man-day in cases of ridging and weeding but not in others where she is considered performing a full man-day in a day of 5 hours normal work. A child of 7-14 years is considered to

have about 0.5 the working capacity of a male adult. It was included to determine if labour is being over or under utilized in maize production in the area. This is important in the light of common assumption in economic literature that labour in developing countries has low or near zero marginal product (Sanni, 1969).

(v) Output (Y):

This refers to maize yield in kilogram harvested from the various sampled fields.

(vi) Error Term (E):

The inclusion of error term in the model was due to the fact that four quantifiable variables independently stated above may not have completely explained the variations observed in the values of output. Some other unquantifiable factors such as management ability, socio-economic factors and weather affect production, but are not accounted for. The inclusion of this disturbance term was therefore to represent these unquantifiable factors in the production of maize error of variable measurement.

Marginal Productivities

Marginal value products were obtained from the estimated elasticities of production. In Cobb-Douglass Production function, the marginal productivity of a factor, X1, in producing maize is given by the formular:

$$MV\ Px_i = MPPx_i\ Py$$

where $MPPx_i = \frac{dy}{dx_i} = \frac{bi\ \bar{Y}}{\bar{X}_i}$

$MPPx_i$ = Marginal Physical product of factor X_i

bi = elasticity/regression coefficient of factor X_i

Y = Arithmetic mean of output

X_i = Arithmetic mean of input X_i

Py = Unit price of output

MVP = Marginal Value Product.

In Semi-log production function, the marginal productivity of a factor, X_i, in producing maize is given by the formula:

$$MV\ Px_i = MPPx_i\ Py$$

where $MPPx_i = \frac{dy}{dx_i} = \frac{bi}{\bar{X}_i}$

MVP = Marginal Value Product

$MPPx_i$ = Marginal physical product of factor X_i

b_i = elasticity of factor X_i

$\bar{X}_i$ = Arithmetic mean of Input X_i

Py = Unit price of output

Information obtained From Production Function Analysis

(i) The Co-efficient (bs) were unknown parameters and their estimator (bs) obtained from the function gave an insight into the direction and magnitude of

change when one of the inputs is changed by one unit. The level of output when input is zero is a_o, the constant factor.

(ii) Marginal Value Product (MVP) calculated from the production gave an insight into efficient use of resources when compared with the respective factors prices. Marginal Value Productivity in input X_1 is the addition to the total value of production resulting from utilization of the last unit or resource X1. If MVP = Price of X1 (P), then X1 is being efficiently used. A positive MVP may imply that output could be increased by using more of a given resources. However, the magnitude of MVP must be compared with the factor cost in order to determine its usefulness. The difference between the MVP and factor cost indicate the scope of resource adjustment necessary to attain economic optimum.

(iii) The co-efficients of multiple determination (R^2) were obtained as a measure of goodness of fit. It is the percentage of total variation of the dependent variable (Y) explained by the variation in the independent variables (X_1 X_2 X_3 and X_4). The equations with higher R^2-values explained the variation better and were regarded as a better fit.

(iv) The regression co-efficients for various inputs used were tested using the t-test to determine the inputs to which output was highly responsive. Only those variables (represented by co-efficients) whose computed values are significant were taken to have significantly influenced variation in output.

Chapter 4

RESULTS AND DISCUSSIONS

The chapter is devoted to the presentation and discussion of the results of the study.

4.1 Socio-Economic Characteristics of the Farmers:

Various studies have emphasized the importance of socio-economic factors influencing the decision of farmers on their farm work (Voh, 1978; Atala, 1980). The Socio-economic variables investigated in this study include, age, level of education, farming experience and household size.

4.1.1 Age of the farmers:

This refers to the approximate age in years of the respondents as given at the time of data collection. Table 4.1 shows the distribution of farmers according to age. About 56 and 50 percent of the Sasakawa and Non-Sasakawa farmers respectively were between the ages of 21 and 40 years, while 27 and 20 percent of the Sasakawa and Non-Sasakawa farmers respectively were middle aged (that is between the ages of 41 to 50 years).

Table 4.1: Distribution of Farmers According to Age:

Age group	Sasakawa Farmers		Non-Sasakawa Farmers	
	No. of Respondents	Percentage of Total	No. of Respondents	Percentage of Total
21-30	16	20.00	12	15.00
31-40	29	36.25	28	35.00
41-50	22	27.50	16	20.00
51-60	11	13.75	16	20.00
61 and Above	2	2.50	8	10.00
Total	80	100.00	80	100.00

Source: Field Survey data, 1998

The rest of the farmers of the total sample size were old aged. Thus about 83 and 70 percent of the Sasakawa and Non-Sasakawa farmers were of middle age. This high youthful age of both groups of farmers might have contributed to the high level of family labour.

4.1.2 Level of Education:

This refers to the type of education and the level which the respondents have attained in formal Schools. Taking into consideration that this study was conducted in a rural area where educational facilities are still limited, the level of education was shown to be on the high scale (Table 4.2).

Table 4.2:Distribution of Farmers According to Level of Education

Level of Education	Sasakawa Farmers		Non Sasakawa Farmers	
	No of Respondents	Percentage of Total	No. of Respondents	Percentage of Total
No formal Education	34	42.50	30	37.50
Primary School	18	22.50	28	35.00
Secondary School	16	20.00	12	15.00
Tertiary School	12	15.00	10	12.50
Total	80	100.00	80	100.00

Source: Field Survey data, 1998.

Table 4.2 shows about 56 and 62 percent of the Sasakawa and Non-Sasakawa respondents respectively have formal education; though majority of them terminating it at the primary level. The percentage of respondents from Table 4.2 with at least primary education is not quite adequate to influence the adoption of an innovation. Therefore, government should encourage policies of improving education such as promotion of adult education in the rural areas.

4.1.3 Years of Experience in Farming

As shown in Table 4.3, about 50 and 35 percent of the Sasakawa and Non-Sasakawa respondents respectively had at least 20 years of farming experience. Considering the major occupation of the respondents which was farming from the field survey, length of time in farming can be linked with the age of the farmer. That is as the age increases among the farmers, years of experience also increases. The mean farming experience of the Sasakawa and Non-Sasakawa farmers was 21 and 18 years respectively.

Table 4.3: Distribution of Farmers According to Farming Experience

Age group	Sasakawa Farmers		Non-Sasakawa Farmers	
	No. of Respondents	Percentage of Total	No. of Respondents	Percentage of Total
1-10	18	22.50	18	22.50
11-20	22	27.50	34	42.50
21-30	18	22.50	18	22.50
31-40	14	17.50	6	7.50
41 and Above	8	10.00	4	5.00
Total	80	100.00	80	100.00

Source: Field Survey data, 1998.

4.1.4 Household Size

Norman (1972), defined a family (household size) as those people eating from one pot. This definition implies that the consumption unit is also the production unit. Table 4.4 shows about 62 and 60 percent of the Sasakawa and Non-Sasakawa farmers have household size of at least 10 individuals. These individuals might have partly contributed to the high family labour obtained in the study area.

Table 4.4: Distribution of Farmers According to Household Size

Household Size	Sasakawa Farmers		Non-Sasakawa Farmers	
	No. of Respondents	Percentage of Total	No. of Respondents	Percentage of Total
1-5	8	10.00	14	17.50
6-10	22	27.50	26	32.50
11-15	42	22.50	24	30.00
16-20	8	10.50	10	12.50
21 and Above	--	-----	6	7.50
Total	80	100.00	80	100.00

Source: Field Survey data, 1998.

The average size of families was calculated from Table 4.4 and give the values of 8.45 and 10.20 for the Sasakawa and Non-Sasakawa respondents respectively. The above average sizes of household compares closely with Yaro's (1983) study of Gombe Agricultural Development Project Area, where he found an average family size of about eight individuals. The higher average size of families of the Non-Sasakawa farmers, though not statistically different from that of the Sasakawa farmers might have partly contributed to the over-utilization of labour by this group of farmers.

A test of means of the socio-economic characteristics of both groups of farmers was conducted to further substantiate the statement that in establishing demonstration plots in a community, extension workers enlisted farmers who agreed to provide labour, capital for purchase of inputs and piece of their land in order to try out the new methods. Table 4.5 shows that there is no significant difference statistically between the farmers using Sasakawa and those not using Sasakawa technologies. Therefore, no socio-economic characteristics like age, household size, farming experience and educational level were used as criteria for selection of farmers.

Table 4.5: Means and Standard Deviation (SD) of the Socio economic Characteristics of Farmers:

	Sasakawa Farmers				Non-Sasakawa Farmers			
	AG	FE	HS	FS	AG	FE	HS	FS
Maximum	62	46	17	2.50	70	55	25	2.50
Minimum	21	2	2	0.25	23	5	2	0.25
Mean	41.88	19.79	8.45	1.09	45.55	24.56	10.21	0.96
SD	10.25	10.62	4.05	0.59	12.16	13.31	6.56	0.48
Z-value	2.07	2.39	2.37	0.12	2.07	2.39	2.37	0.12
LOS	NS	NS	NS	NS	NS	NS	NS	NS

Source: Field Survey data, 1998

where: AG = Age;

FE = Farming Experience

HS = Household Size;

FS = Farm Size;

LOS = Level of significance

NS = Not Significant at 1%α-level.

4.2 Maize Production Practices of the Sasakawa and Non-Sasakawa Farmers

This subsection focuses on major practices being used by the two groups of farmers for maize production in the study area.

4.2.1 Land Preparation

A total of 87.50 and 76.50 hectares of land were put to maize production by all the Sasakawa and Non-Sasakawa farmers respectively. Both groups of farmers started land clearing at the month of March, 1997. The clearing activity was mainly the removal and burning of previous or preceding year crops stalks. Both groups of farmers prepared ridges as from mid-May to early June when the rains were fully established. Spacing between ridges were 75-80cm and 90-100cm for the Sasakawa and Non-Sasakawa farmers respectively (Table 4.6).

4.2.2 Source of Seeds

The Sasakawa farmers purchased hybrid seeds from seed agents present in the villages. But villages which had no seed agents present, the extension agents usually undertook the responsibility of purchasing seeds for the farmers. The Non-Sasakawa farmers who used the open-pollinated variety (OPV) sourced their seeds from the previous crop harvested.

4.2.3 Planting/Sowing

Farmers mainly used hoes, sticks and or heels to make holes. The Sasakawa farmers sowed one (1) seed per hole and the spacing between stands was between 20-25cm. Hybrid seeds were used by all the farmers in this group. The Non-Sasakawa farmers sowed 2-3 seeds per hole and the spacing between stands was 30-40cm. Their reason for planting more than two seeds per hole was because of poor germination rate of seeds. About 90 percent of farmers in this group used local seeds, while about 10 percent of the farmers used hybrid maize seeds. Hybrid seeds were already dressed with pesticide, but the local seeds in most cases were not.

4.2.4 Weed Control

Both groups of farmers generally weeded two times. The weeding operation was done manually with the use of hoes. Weeding took place 3-4 weeks after sowing (WAS). Farmers remoulded at about 7-8 WAS which acted as a second weeding.

4.2.5 Fertilizer Application

In both cases, farmers applied fertilizer two times, but the period and method of application differ. The Sasakawa farmers applied fertilizer just after seedling emergence (Within 14 days after sowing). They made holes between the maize stands and put the fertilizer before covering it to avoid losses due to heavy rainfall and volatilization. The second application was done when the crop is 4-5 WAS. The Non-Sasakawa farmers applied fertilizer 3-4 WAS. Side placement method was used without making holes. The

second application was usually delayed until the crop is about flowering, that is about 8-10 WAS.

Table 4.6: Major Production Practices employed by the two groups of farmers for Maize Production

Practices	Sasakawa Technology	Non-Sasakawa Technology
Land Preparation	Ridges	Ridges
Seeds Used	Hybrid	Hybrid and OPV
Spacing between ridges	75-80cm	90-100cm
Spacing between stands	20-25cm	30-40cm
No. of Seeds per hole	1	2-3
No of times of Weeding/Remoulding	2	2
Method of Fertilizer Application	Makinghole	Side Placement

Source: Field Survey data, 1998

4.2.6 Harvesting and Threshing

The harvesting operation by both groups of farmers started by mid-September through the month of October, 1997. This was done when the maize Cobs were considered to be physiologically matured. The farmers used cutlasses to cut the maize

stalks together with the Cobs and grouped the stalks together for a period of time until the Cobs were well dried. Thereafter the cobs were removed and dehusked before taking them home. Threshing was done manually with the use of hands and sticks.

4.3 The Input-Output levels in Maize Production

The inputs used for the production of maize in the study area by both groups of farmers were seeds, fertilizer and labour. While the output was the total grain obtained per unit of the area planted or put into production., Since the area of land cultivated by each farmer varies, data in this sub-section were expressed on per hectare basis.

4.3.1 Seeds

The average quantities of planting seeds for the Sasakawa and Non-Sasakawa farmers are shown in Table 4.7. These quantities were obtained as the ratio of quantity of seeds used to land area sown. The table shows that while the Sasakawa farmers used about 18kg of seeds per hectare, the Non-Sasakawa farmers used as much as 28kg per hectare. The high amount of seeds used by the Non-Sasakawa farmers might be as a result of the low viability of planting materials (local maize variety) they used and also because of the more than two seeds that the farmers usually planted to safeguard against any poor germination of the maize seeds. Further analysis shows that there is significant difference between the means of the seeds planted per hectare.

4.3.2 Fertilizer

Table 4.7 also shows the average level of fertilizer used by the two groups of farmers. The Sasakawa farmers were applying as much as 485 kg per hectare, while the Non-Sasakawa farmers were using about 277 kg per hectare. The high amount of fertilizer used by the Sasakawa farmers might be connected with the adequate extension information by the extension agents who ensures that farmers get access to all inputs they need for production. These levels of fertilizer used by both groups of farmers also differed significantly as shown in Table 4.7.

Table 4.7: **The Input - Output levels for Maize Production**

	Sasakawa Farmers				Non-Sasakawa Farmers			
	Seed (Kg)	Fert. (Kg)	Labour (manday)	Yield (Kg)	Seed (Kg)	Fert (Kg)	Labour (Man-day)	Yield (Kg)
Maximum	23.00	750.00	152.00	6400.00	33.00	450.00	106.00	3400.00
Minimum	15.00	300.00	78.00	2600.00	27.00	150.00	76.00	1700.00
Mean	18.51	485.03	103.13	3801.14	28.73	277.78	88.71	2507.00
SD	2.14	165.86	165.86	911.24	2.35	75.31	7.18	383.16
Z-value	-81.00	37.46	2.16	11.07	-81.00	37.46	2.16	11.07
LOS	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Source: Field Survey data, 1998

LOS = Level of significance.

Table 4.8: Average Labour input by activity per Hectare in production of Maize (man-day/ha)

Activity	Sasaakawa Farmer				Non-Sasakawa Farmers			
	Hired	Family	Total	% of Total	Hired	family	Total	% of Tota
Land Preparation	7.25	12.03	19.28	18.69	5.75	11.20	17.95	20.24
sowing/Planting	3.48	10.00	13.44	13.07	3.40	7.05	10.45	11.78
Fert application	1.71	8.34	10.05	9.74	1.25	6.90	8.15	9.19
Weeding and Remoulding	8.67	17.88	26.55	25.74	10.05	15.95	26.00	29.3
Harvesting	7.86	15.64	23.50	22.76	5.35	12.70	18.05	20.3
Threshing	2.75	7.52	10.27	9.96	2.22	5.89	8.11	9.1
Total	31.72	71.41	103.13	100.00	28.02	60.68	88.71	100

Source: Field Survey data, 1998

4.3.4 Maize Output

The output is the total quantity of maize produced or harvested from a given area of land. For this study, the various output levels were converted to per hectare basis, thus given average yields per hectare for both groups of farmers. The average grain yields were found to be higher for Sasakawa technology than for Non-Sasakawa

technology being 3801kg per hectare and 2507 kg per hectare respectively and their difference was significant at 1% level of probability (Table 4.7).

4.4 Cost-Return analysis

Farm budgeting was employed to achieve objective (iii) of the study. the profitability of any farm business can be deduced from the relationship between the costs incurred in running the farm and the returns accruing from it. If the returns are higher than the costs, there is a surplus that could be put to economic use. This subsection discusses the overall picture of cost-return relationship of the selected farm samples within the two groups of farmers.

4.4.1 Gross-Return/Revenue

The gross returns obtained by the sampled farmers in this study were derived by multiplying the total quantity of produce harvested by the average market price prevailing at the period of the survey. The gross returns obtained under both groups of farmers are shown in Table 4.9. Both the yield and gross-returns obtained from using Sasakawa technology to produce maize were higher than that obtained from the use of Non-Sasakawa technology. The average gross return per hectare of the Sasakawa technology was ₦64,619 and ₦42,633 for the Non-Sasakawa technology. This shows that non-Sasakawa farmers are only getting 66 percent of what the Sasakawa farmers are getting. The difference could be attributed to the higher grain yield per hectare obtained by the Sasakawa farmers than the non-Sasakawa farmers.

4.4.2 Cost of Production

In estimating the total cost of production, only the variable cost elements were considered. These composed of costs incurred on inputs which included seeds, labour, fertilizer and other cost items such as bags, transportation and marketing costs.

Labour Cost

The total labour force consisted of family and hired labour input in man-days. The average wage rate was put at ₦150.00 per man-day. For the family labour input, the evaluation was carried out using the opportunity cost principle. It was assumed that family labour was perfectly substitutable for hired labour and imputed labour cost was used for family labour equal to the wage rate of hired labour. The average cost of labour input per hectare for using Sasakawa technology was found to be ₦15,469.50, while for the Non-Sasakawa technology, it was found to be ₦13,305.90- (Table 4.9). When compared, the cost of labour input per hectare for the Sasakawa technology exceeded that of the non-Sasakawa technology by 16 percent. From the average cost information presented in Table 4.9, it can be observed that labour accounted for about 48 and 58 percent of total variable cost (TVC) of production for the Sasakawa and Non-Sasakawa farmers respectively. Generally, the high cost of labour may be linked with high labour demand during period of production thereby making labour supply to become limited and thus costly.

Fertilizer Cost

Price of fertilizer in the study area varied, but an average price of ₦1400 per 50 kg bag was used for this analysis. This gave a price of ₦28 per kilogramme. Table 4.9 indicates that the average cost of fertilizer per hectare accounted for about ₦13,580 and ₦7,777 for the Sasakawa and Non-Sasakawa technologies respectively. It is expected that the average cost of fertilizer per hectare would be higher for the Sasakawa technology considering the fact that more fertilizer input was used by this group of farmers. Further examination of Table 4.9 reveals fertilizer cost to be the second highest contributor to TVC. This high figure could be attributed to the high and unstable fertilizer price in the "black market" from where over 95 percent of the farmers obtained their fertilizer. High fertilizer prices may be due to a reduction in government fertilizer subsidy, scarcity and at most times non-availability in the input market during the 1997/98 production season.

Hybrid maize seeds which was mainly used by the Sasakawa farmers was valued at ₦80 per kilogramme, while the local seeds were costed at ₦17 per kilogramme. Both types of seeds were valued based on the prevailing average market price. Table 4.9 shows the average cost of seeds per hectare was ₦1,481.12 and ₦480.41 for the Sasakawa and Non-Sasakawa technologies respectively. The results indicate that the cost of planting seeds for the Sasakawa technology was about three (3) times the cost of seeds for the Non-Sasakawa technology. The high cost of hybrid seeds and its unavailability at the desired place and time were the reasons given by Non-Sasakawa farmers for their inability to use hybrid seeds for planting. Similarly, the Sasakawa farmers also

complained of the high cost of hybrid seeds, even though the extension agents ensured that this group of farmers obtained the hybrid seeds needed for planting.

Other Costs

In maize production, other costs such as cost of transportation of produce from the field to stores or markets, cost of bags were also incurred during production. Such costs are also indicated in Table 4.9. The table shows that Sasakawa and Non-Sasakawa farmers incurred ₦1,900 and ₦1,250 respectively as an average cost on other expenditures.

Total Variable Cost (TVC) of Production

The total variable cost of production was estimated by adding costs of labour, fertilizer, seeds and other costs used during production. The average total variable cost in producing one hectare of maize using Sasakawa technology was ₦32,431.46, while it will cost ₦22,822.15 to produce the same hectarage using Non-Sasakawa technology (Table 4.9). This shows that the TVC of Non-Sasakawa technology is about 70 percent of the TVC of Sasakawa technology. The higher cost in producing maize using Sasakawa technology might be due to high cost of hybrid seeds, high amount of fertilizer and labour input that are used by the Sasakawa farmers.

all output per hectare (gross-revenue) and the total variable cost per hectare. Where the difference is positive, it implies a profit, while a negative means a loss. Table 4.9 shows that Sasakawa farmers earned a gross margin of N32,186.92 per hectare, while Non-Sasakawa farmers earned ₦19,811.13 per hectare. The margin shows that Sasakawa farmers are earning a profit of about 62 percent higher than the profit earned by the Non-Sasakawa farmers. Further analysis of the 10 percent of the Non-Sasakawa farmers that used hybrid maize seeds shows that they obtained ₦22,930 as their gross-margin, while the other 90 percent of the Non-Sasakawa farmers that used OPV earned ₦19,646.56 as their gross-margin. This shows that the Non-Sasakawa farmers that used hybrid seeds obtained higher yields compared with the Non-Sasakawa that used OPV. The disparity found among this group of farmers is because of the high yielding characteristic of a hybrid seed. While the difference of the gross-margin found between the Sasakawa farmers and the Non-Sasakawa farmers that used hybrid seeds might be connected to the use of improved agronomic or management practices by the Sasakawa farmers as discussed in subsection 4.2.

Table 4.9: Average Costs and Return of Maize Production Per Hectare:

Detail	Sasakawa Technology	Non-Sasakawa Technology
Yield (kg)	3,801.14	2,507.840
Price (₦/Kg)	17.00	17.00
Gross-return (₦)	64,619.38	42,633.28
Labour:		
Hired (₦)	4,758.00	4,203.00
Family (₦)	10,711.50	9,102.90
Total Labour (₦)	15,469.50	13,305.90
Seed (₦)	1,481.12	488.41
Fertilizer (₦)	13,580.84	7,777.84
Other Costs (₦)	1,900.00	1,250.00
Total Costs (₦)	32,431.46	22,822.15
Gross-Margin (₦)	32,186.92	19,811.13

Source: field Survey data, 1998.

4.4.4 Return to Variable Inputs

This gives an idea of productivities per unit of variable inputs used. This was calculated by dividing the sum of gross-margin and cost of the variable input per hectare by the input used per hectare. Table 4.9B shows the productivities of the variable inputs used.

Table 4.9B: Returns to variable Inputs.

Variable input	Sasakawa Technology	Non-Sasakawa technology
Return to labour (₦/man-day)	462.10	373.33
Seeds (₦/kg)	1818.91	706.56
Fertilizer (₦/kg)	94.36	99.31

Source: Field survey data, 1998.

On the average ₦462.10 was received per man-day for labour in growing maize using Sasakawa technology, while ₦373.33 was received using Non-Sasakawa technology. This shows that the use of Sasakawa technology was more profitable and beneficial to farmers to work on their own farms when the wage rate of ₦150.00 is considered as in the study area. The use of hybrid maize seeds by the Sasakawa farmers is also shown to be more profitable (Table 4.9B) than the use of local seeds by the Non-

Sasakawa farmers. In the case of fertilizer ₦94.36 per kilogram was received by the Sasakawa farmers, while ₦99.32 per kilogramme was received by the Non-Sasakawa farmers. The lower return to fertilizer used by the Sasakawa farmers might be as a result of the over-utilization of this resource as discussed in subsection 4.6.2. Therefore, the use of this resource by the Sasakawa farmers should be curtailed in order to get higher return.

4.4.5 **Yield Required to cover Cost of Production**

This can be defined as the output that is needed in other to settle all the expenditure incurred during production. This was obtained by dividing the total cost of production of maize per hectare with the unit price of maize. The calculated results show that 1,907.73 Kg and 1,342.48 Kg of maize grain are required to cover the costs of maize production using Sasakawa and Non Sasakawa technologies respectively. The average rate of return to total investment shows that, a profit of ₦0.99 was realised by Sasakawa farmers and ₦0.87 was realised by Non-Sasakawa farmers on every Naira invested in maize production in the study area.

4.5 The Gross-Margin Statistical Test for Significance

The gross margin data were statistically tested for significance using the Z-test for comparing two sample arithmetic means between farmers using Sasakawa technology and farmers not using Sasakawa technology for maize production (Table 4.10). the test of significance of gross-margin confirmed that there is significant difference in the mean

gross-margin between farmers using Sasakawa technology and those not using Sasakawa technology. This implies that the null hypothesis (Ho) which states that, there is no significant difference in the mean gross margin of farmers using Sasakawa technology and those using Non-Sasakawa technology should be rejected; while the alternative hypothesis (H_1) which says that there is a significant difference in the means gross margin of farmers using Sasakawa technology and those using Non-Sasakawa technology of maize production should be accepted.

Table 4.10: Means and Standard Deviation of Gross-Margin of the Two groups of Farmers

Farmers Group	N	Mean	SD	Z-Value	Z-tab	LOS
Sasakawa	80	32,186.92	9,130.50	10.66	2.58	0.01
Non-Sasakawa	80	19,811.13	4,953.00			

Source: Field survey data, 1998.

The results and discussion above have shown that the use of Sasakawa technology for maize production is more profitable than the type of technology the farmers are using in the study area. Further analysis was however necessary to determine resource use efficiency in both types of technologies of maize production.

4.6 Production Function Analysis

The analysis of the production function is used to arrive at some judgement about the efficiency of the prevalent factors of production. An empirical production function enables us to do so because the marginal product of each input estimated from the function could be compared with its unit factor cost. Also the estimation of elasticity of production, returns to scale are also possible from the production function analysis. All these give some basis for economic decision making.

The purpose of this sub-section is therefore to determine the extent to which the important factors explain the variability of the output. The greater the extent to which these factors are able to explain the variability of dependent variables, the larger the influence which the independent variables taken together have on the dependent variable. If the marginal value of product (MVP) is lower than its unit factor cost (UFC), it is apparent that there is over-use of that input and its employment should be curtailed. On the other hand a higher marginal value of product than its unit factor cost, means that its employment should be augmented in the production process.

4.6.1 Multiple Regression Analysis and Determination of Best Production Function for Maize Production

In this study, the semi-log and Cobb-Douglas functions were used in the analysis of the Sasakawa and Non-Sasakawa technologies respectively, as they were the only equations that gave the best fit (Tables 4.11 and 4.12 respectively). The co-efficient

of multiple determination (R^2) indicates the percentage of the variation in the observed Y-values that is explained by the fitted regression equation. The values of R^2 are 0.84 and 0.86 for the Sasakawa and Non-Sasakawa technologies respectively. This implies that in the fitted equation, the independent variables explained on the average 84 and 86 percent of the variation in the output of maize for the Sasakawa and Non-Sasakawa technologies respectively. The unexplained part of variability in the output of maize is obviously due to other inputs which have not been specified in the model. One such input may be management which is unquantifiable.

The regression co-efficients of the production functions are also shown in Tables 4.11 and 4.12 for the individual inputs. The t-values have been derived and tested for significance. For the Sasakawa technology, the regression co-efficients for farm size, seeds and fertilizer are significant at 10%, while labour is not significant at 10% probability level. In the case of Non-Sasakawa technology, fertilizer, seeds and labour are significant at 10%, while farm size shows no significance at 10% probability level. This means that farm size, seeds and fertilizer are the most important variables that explained variation in output for the Sasakawa farmers while fertilizer, seeds and labour were the most important variables that explained variation in output for the Non-Sasakawa farmers.

Table 4.11: Regression Co-efficients and Standard errors for Maize Production Using Sasakawa Technology

Variable	Regression co-efficient	Standard Error	T-Value	Level of Significance
Farm Size (X_1)	4640.68	987.19	4.70	0.10
Fertilizer(X_2)	627.86	353.98	1.77	0.10
Seed (X_3)	2541.01	866.27	2.93	0.10
Labour (X_4)	579.55	359.26	1.61	NS

Constant = 5211.211

R^2 = 0.842

D.F = 75

NS = Not significant at 10% α-level

Source: Field Survey data, 1998.

Table 4.12: Regression Co-efficients and Standard errors for Maize Production Using Non-Sasakawa Technology

Variable	Regression Co-efficient	Standard Error	T-Value	Level of Significance
Farm Size (X_1)	0.13	0.08	1.52	NS
Fertilizer(X_2)	0.49	0.03	13.57	0.10
Seed (X_3)	0.33	0.10	3.25	0.10
Labour (X_4)	0.10	0.04	2.22	0.10

Constant = 3.416

R^2 = 0.86

D.F = 75

NS = Not Significant at 10% α-level

Source: Field Survey data, 1998.

4.6.2 Marginal Productivities and Economics of Resource Allocation

The estimated production function enables us to evaluate the efficiency of the factors of production in agriculture. Given the prices of both inputs and output, the marginal value productivity is the yardstick for judging the efficiency of resource use. A given resource is optimally allocated if its marginal value product is just sufficient to offset its cost. Equality of marginal value product to unit factor cost is therefore the basic condition that must be satisfied to obtain efficient use of resources.

The marginal value product of land was compared with its unit factor cost (cost of rentage) and it was found that land was being under-utilized as shown in Table 4.13. The marginal value productivities of fertilizer and seeds for the Sasakawa farmers were also compared with their unit factor costs (Table 4.13), the results show 0.78 and 29.17 in that order respectively. This indicates over-utilization of fertilizer and under-utilization of seeds. This means that Sasakawa farmers will be better off if they decrease the use of fertilizer to minimize losses since their marginal contributions to output was less than their opportunity costs. While in the case of seeds, since its marginal value product was higher than its unit price, it implies that farmers would increase profit by using more seeds. This can be done by planting two seeds per stand or reducing the spacing between stands to 15-20 cm.

Table 4.13: Marginal Value Products and their Respective Arithmetic Means for Sasakawa Farmers

Variable	$\bar{X}$	MPP	MVP	UFC	MVP/UFC
Farm Size (X_1)	1.09	4241.94	72112.98	2300.00	31.35
Fertilizer(X_2)	485.03	1.29	22.00	28.00	0.78
Seed (X_3)	18.51	137.24	2333.22	80.00	29.17

Source: Survey data, 1998.

When the marginal value products of the variables of the Non-Sasakawa farmers were compared with their respective unit factor costs (Table 4.14), Fertilizer and seeds

were shown to be under-utilized, while labour was over-utilized. Therefore, the Non-Sasakawa farmers could still increase their return by using more seeds and fertilizer. Since the result of labour input indicates that this input was over-utilized in maize production, it implies that its employment should be curtailed by use of labour saving technologies such as use of tractors and herbicides for land preparation and weed control respectively. This over-utilization of labour input tend to support the common assumption of low productivity of labour in traditional agriculture. Ogunfowora et al (1975), in their study of resource productivity in traditional agriculture in Kwara State, found the marginal value products of labour to be lower than their respective marginal factor cost indicating low productivity of labour in traditional agriculture.

Table 4.14: Marginal Value Products and their Respective Arithmetic Means for Non-Sasakawa Farmers

Variable	$\bar{X}$	MPP	MVP	UFC	MVP/UFC
Fertilizer (X_2)	277.77	4.49	76.00	28.00	2.73
Seeds (X_3)	28.73	29.41	500.08	17.00	29.41
Labour (X_3)	88.70	3.08	52.38	150.00	0.34

Source: Survey data, 1998.

4.6.3 Returns to Scale

The sum of elasticities indicate the nature of returns to scale associated with a particular production system. Therefore, the behaviour of the output when all the factors

of production are changed simultaneously in the same proportion is referred to as return to scale. With decreasing, constant or increasing returns to scale, the sum of elasticities of production has to be less than, equal to or greater than unity respectively. Table 4.15 shows the sum of elasticities of the two forms of technologies. Both technologies exhibited increasing returns to scale. This implies that if all inputs included in the model for farmers using Sasakawa technology are increased by 1 percent, output will increase by 2.2 percent and for farmers using Non-Sasakawa technology, an increase in all inputs by 1 percent will result in output increase by 1.1 percent. The farmers should therefore use their resources based on the marginal product of the individual input as a guiding factor so as to miximize total output.

Table 4.15: The Elasticities of the Variable Inputs:

Variable	Sasakawa Technology	Non-Sasakawa Technology
Farm Size (X_1)	1.22	0.13
Fertilizer (X_2)	0.17	0.50
Seed (X_3)	0.67	0.40
Labour (X_4)	0.15	0.11
Σbi	2.2	1.14

Source: Survey data, 1998.

The elasticities of all the inputs are positive (Table 4.14). This implies that a 1 percent (1%) change in any one of the input variable while holding others constant result in a certain percentage change in the quantity of output equal to the elasticity of the variable in the same direction as the change of the input. The elasticities of production with respective to the various inputs indicate that land and seeds were the important inputs to which output was more responsive for the Sasakawa technology because their elasticities value (1.22 and 0.67) are higher than the elasticities values for fertilizer and labour (0.17 and 0.15) while, for the Non-Sasakawa technology, Fertilizer and seeds were the important inputs to which output was more responsive because their elasticities values (o.50 and 0.40) are higher than the elasticities values for farm size and labour (0.13 and 0.11).

Chapter 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The significance of maize as a major staple food and its remarkable industrial uses as food for both man and livestock in Nigeria has necessitated the improvement of the crop both in quantity and quality so as to curb the food scarcity problems caused by ever-increasing population in Nigeria. This persistent food scarcity over the years has generated research interest in maize production. Some have been directed towards studying the relationship between demographic or socio-economic characteristics of farmers and adoption, others on the resource use efficiency of the farmers. In order to improve the conditions for maize production and increase its production to meet the national demand, the government of Nigeria together with Sasakawa Global 2,000 have embarked on a project called SG2000 aimed at raising the level of agricultural production technology on the small farms. A major component of this technology improvement have been the introduction of improved production practices such as the use of hybrid seeds and recommended fertilizer rates.

The purpose of this study was to compare the improved method of maize production being promoted or disseminated by SG2000 with regard to the profitability and resource use productivity on farms at the farmers' level with the farmers current

practices. For the purpose of the study, four Local Government Areas (LGAs) were selected. Data collected from a total of 160 farmers, 80 farmers using the Sasakawa technology and 80-using the Non-Sasakawa technology of maize production provided the basis for the analysis carried out in the study. Specifically, descriptive statistic, gross-margin and production function analyses were carried out for these comparisms.

A descriptive analysis of sampled farmers using the Sasakawa and Non-Sasakawa technologies was done to determine and understand the socio-economic characteristics of these farmers. The results show that there isno significant difference between these group of farmers. This may be as a result of the fact that the extension agents did not use socio-economic characteristics as criteria for choosing farmers that participated in the programme.

The test of levels of the inputs used and output obtained by these two groups of farmers showed that fertilizer, seed, labour and yield were significantly different. The results showed that Sasakawa farmers used an average of 485kg of fertilizer, 103 man-days of labour and 18kg of seeds per hectare, while the Non-Sasakawa farmers used an average of 277kg of fertilizer, 88 man-days of labour and 28kg of seeds in each hectare. The output levels were 3801kg and 2507kg per hectare for the Sasakawa and Non-Sasakawa farmers respectively.

The pattern of cost of production and returns for the two groups of farmers was

also examined. The overall total average cost of production for using the Sasakawa technology was greater than for the Non-Sasakawa technology by 42 percent. While the Sasakawa farmers were using an average of ₦32,431.00 to produce one hectare of maize, the Non-Sasakawa farmers used ₦22,822.00. The use of more fertilizer and labour, and hybrid seeds contributed to the higher cost of production for the Sasakawa farmers. The results further revealed that labour and fertilizer accounted for about 88 percent and 92 percent of cost of production in both the Sasakawa and Non-Sasakawa farms respectively. The gross-return per hectare for the Sasakawa farmers was also greater than for the Non-Sasakawa farmers. This might be attributed to the high yield obtained by these farmers. The gross returns per hectare for the Sasakawa and Non-Sasakawa farmers was ₦64,619.00 and ₦42,633.00 respectively. This represents about 51 percent increase in gross return per hectare for the Sasakawa farmers.

The gross-margin per hectare for the Sasakawa farmers was also higher than for the Non-Sasakawa farmers with about 62 percent. These two groups of farmers have gross margin of ₦32,186.00 and ₦19,811.00 in that order. Also, the average productivity of human labour was higher for the Sasakawa technology with about 19 percent. The test of means of the gross-margin obtained by these two groups of farmers showed that there was difference statistically between their gross-margin. Therefore, the null hypothesis (Ho) was rejected and the alternative hypothesis (H_1) which states that there is difference in gross-margin obtained by farmers using Sasakawa technology and those not using Sasakawa technology was accepted.

The Semi-log and Cobb-Douglass production functions were used in the analyses of the input-output data obtained from the use of Sasakawa and Non-Sasakawa technologies respectively. The results for both types of technologies indicate that the independent variables selected namely farm size, fertilizer, seeds and labour reasonably explain the variability in the total value of output earned from the farms. The summation of the elasticities of the variable inputs show increasing returns to scale. The marginal value productivities of variable inputs that were significant in production were also calculated and compared with unit factor cost. The results show that fertilizer was over-utilized and seeds and land were under-utilized by the Sasakawa farmers. It implied that the Sasakawa farmers will be better off if they reduce the use of fertilizer and increase the use of seeds and land. For the Non-Sasakawa farmers, the results indicate that fertilizer and seeds were under-utilized, while labour was over-utilized. Therefore, this group of farmers will increase their gross-margin if they increase the use of fertilizer and seeds and at the same time reduce the use of labour by employing some labour saving technologies such as the use of tractors for land preparation.

5.2 Conclusion

The study focused on the efficiency of improved technology in maize production by comparing Sasakawa technology and Non-Sasakawa technology. The findings above revealed that the use of both types of technologies for maize production are profitable.

Further analyses indicated that some increases have been achieved in gross output,

gross-margin, resource use and productivity through the use of Sasakawa technology for maize production. Therefore, planning for maize production should continue to focus on the design and implementation of such programme.

5.3 Recommendations

Bearing in mind that the maize technology being disseminated by SG2000 is basically the outcome of research findings from the Nigerian Agricultural Institutes and other national agricultural research centres, the implications of the study are:-

1) The need to educate the farmers on the type, quantity and time of fertilizer application. This will mean knowing the size of fields to be cultivated and having specific fertilizer recommendation for each farm size and farm type (that is upland and lowland).

2) It is also important to look into ways of raising the level of fertilizer currently being used in the study area. The timeliness of fertilizer availability to the farmers has a direct link with the Management and distribution system which for now is very inefficient. Efforts should be made at both state and local government levels to ensure that fertilizers are lifted in time, latest at the beginning of the planting season and made available to the farmers. Also, the Federal Government should set-up an agency to monitor the type of fertilizer in terms of quality that is being sold in the markets.

3) National research institutes and organisations such as UAC, UTC and Premier seeds which are into the development and production of hybrid maize should be encouraged to continue in order to produce a more stable higher yielding hybrid varieties.

4) Since the use of such improved technology involves training, the level of education of farmers is an important factor. Government policy should give some priorities to adult education in order to develop and increase the education level in the villages.

5) Government should assists the Ministries of agricultures and ADPs in developing quality extension services by improving the technical training of extension agents and also increase their number to meet the farmers demand interms of close supervision and monitoring.

6) The problem created by inadequate facilities to purchase inputs by individual farmers, the farmers should be encouraged to form co-operative societies, which will be responsible for input purchases. This may require an initial credit from the government or any financial agency close to them.

5.4 Suggestions for Further Research

Since it is known that the improved maize production technology is zone specific,

it is possible that the Sasakawa technology could have performed differently in other ecological zones than in the present area where the study was conducted. There is a need therefore to have a wider research area, covering most of the ecological zones where maize is 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 breeders agronomists, soil scientists, weed scientists, plant pathologists, social scientists and agricultural economists could reveal more meaningfully the problems of the improved maize technology. This team can develop a more acceptable maize technology for the farming population.

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

5.5 Limitations of the Study

The data collection for this study which started in January 1998 and ended in February, 1998 was not without problems. Some of the obvious problems encountered during the study are as follows:-

i) The reliance on data collected in a single planting season. The variations in output, from year to year, particularly in agriculture are very common. Apart

from the vagaries of nature, the character of agriculture is determined by changing price structure which greatly influences production decisions on farms in the short-run. The results of this study thus needs to be complemented with other similar studies in different areas and time in order to broaden the scope of application of the results of this study.

ii) Lack of maintenance of records relating to input and output by the farmers when the survey was carried out. Though every effort was made during the survey to get accurate information from the farmers, it should be remembered that there could be lapse of memory by the farmers in regard to details about operations and resource utilization.

iii) Costing both family and hired labour uniformly at market wage rate was another limitation of this study. The system of costing might have caused under valuation of the family labour and/or over-looking of the quality difference between the two types of labour sources. Also the use of an imputed cost for rentage of farmland, since most of them have their land.

iv) The sample size (160) for the four LGAs was small due to inadequate funds, however such a sample allowed detailed interviews of the farmers.

v) The report relied on averages over a wide range of farmers data and production

practices. Therefore, the results are beset by problems that limit the tools, particularly in costs and returns analysis.

Despite the limitations, the results of the study provide some useful insights into the impact of improved maize production technology in the study area.

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APPENDIX A

QUESTIONNAIRE FOR FARMERS

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY,

AHMADU BELLO UNIVERSITY, ZARIA - NIGERIA

SECTION A: BACKGROUND INFORMATION

1. Farmer's Name:_____ Age:_____
2. Sex: Male [ ] Female [ ]
3. Village: _____ L.G.A:_____
4. Are you married? Yes [ ] No [ ]
5. If yes, give the number in your family _____
6. Level of Education:
   a. Not been to School [ ]
   b. Primary [ ]
   c. Secondary [ ]
   d. Tertiary [ ]
   e. Others specify:_____
7. How long have you been farming? _____
8. How did you acquire your land?
   a. By inheritance [ ]
   b. By purchasing [ ]
   c. Others specify:_____

SECTION B: PRODUCTION TECHNOLOGY

9. Do you practice Sasakawa technology on maize? Yes [ ] No [ ]
10. If yes, for how long have you been practicing the technology ____ years.
11. If no, do you want to practice it or be included in the Sasakawa programme?
    Yes [ ] No [ ]
12. If yes, why:_____
13. What do you use in preparing your land?

a. Tractor [ ]

b. Oxen drawn plough [ ]

c. Hoe and cutlass [ ]

14. When did you plant maize?

a. After the first rain [ ]

b. After the second rain [ ]

c. When the rain was fully established [ ]

15. What was the distance between your ridges?

a. 75cm apart [ ]

b. 25cm apart [ ]

c. 1000cm apart [ ]

16. What was the spacing between maize stand or holes on the ridge?

a. 20cm apart [ ]

b. 25cm apart [ ]

c. 30cm apart [ ]

17. How many maize seeds did you plant per hole?

a. One seed per hold [ ]

b. Two seed per hold [ ]

c. Three seeds per hold [ ]

d. More than three seeds per hold [ ]

18. When did you apply fertilizer?

a. Before germination [ ]

b. 1 - 2 weeks after germination [ ]

c. 3 - 4 weeks after germination [ ]

d. 6 - 7 weeks after germination [ ]

19. How did you apply the fertilizer?

a. By broadcasting [ ]

b. By making hole close to the maize [ ]

c. By placement close to the maize [ ]

20. List the major constraints in maize production.

a. _____

b. _____

c. _____

SECTION C: CROPS AND CROPPING PATTERNS

FIELD	FIELD SIZE IN HECTARE	SOLE CROP
NUMBER		NAME OF CROP

SECTION D: INFORMATION ON INPUTS USED

(i) Seeds

Field Number	Farm size in hectare (ha)	Name of crop	HYBRID SEED			LOCAL SEED		
			Source	Unit Used (kg)	Cost (₦/Unit)	Source	Unit Used (kg)	Cost (₦/Unit)

(ii) Fertilizers: How many times was fertilizer applied? _____

Field Number	Farm Size in Hectare	Name of Crop	NPK		UREA		OTHERS		MANURE	
			Unit Used	Cost (₦ Unit)	Unit Used	Cost (₦ Unit)	Unit Used	Cost (₦ Unit)	Unit Used	Cost (₦ Unit)

N.B. Unit used to be number of bags

SECTION E: LABOUR INPUT

(1) Land clearing

Field Number	Farm Size in Hectare	Name of Crop	FAMILY LABOUR			HIRED LABOUR			Total No. of days
			Male	Female	Child	Male	Female	Child	

(2) Ridging

Field Number	Farm Size in Hectare	Name of Crop	FAMILY LABOUR			HIRED LABOUR			Total No. of days
			Male	Female	Child	Male	Female	Child	

N.B. Labour (in Man-days) here means number of people that worked for a particular farm operation.

(3) Planting

Field Number	Farm Size in Hectare	Name of Crop	FAMILY LABOUR			HIRED LABOUR			Total No. of days
			Male	Female	Child	Male	Female	Child	

(4) Weeding

Field Number	Farm Size in Hectare	Name of Crop	FAMILY LABOUR			HIRED LABOUR			Total No. of days
			Male	Female	Child	Male	Female	Child	

(5) Earthling-up or Remolding

Field Number	Farm Size in Hectare	Name of Crop	FAMILY LABOUR			HIRED LABOUR			Total No. of days
			Male	Female	Child	Male	Female	Child	

(6) Fertilizing

Field Number	Farm Size in Hectare	Name of Crop	FAMILY LABOUR			HIRED LABOUR			Total No. of days
			Male	Female	Child	Male	Female	Child	

(7) Harvesting/Threshing

Field Number	Farm Size in Hectare	Name of Crop	FAMILY LABOUR			HIRED LABOUR			Total No. of days
			Male	Female	Child	Male	Female	Child	

SECTION F: INFORMATION ON PRODUCTION (OUTPUT)

(i) Sole Cropping

FIELD NUMBER	NAME OF CROP	UNIT	TOTAL NUMBER OF UNIT HARVESTED

(ii) Prices of Produce

NAME OF CROP	UNIT USED	PRICE IN ₦/UNIT