ECONOMIC ANALYSIS OF UPLAND RICE PRODUCTION IN JIGAWA STATE

By

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A Thesis submitted to the postgraduate School, Ahmadu Bello University, Zaria in partial fulfillment of the requirement for the Degree of Master of Science in Agricultural Economics.

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Dedication

To my parents late Alhaji Aminu Abubakar and late Hadiza Aminu and my wife Amina for their tender love and care and all the farmers that labour hard to feed the teeming population of this country.

Declaration

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

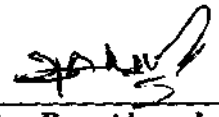
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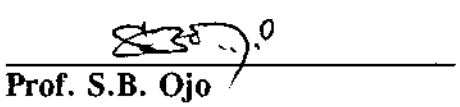
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Abstract

This study sets out to asssess the economic performance of upland rice production in Jigawa State over the 1997/98 cropping year. Input-output data were collected from 120 small (0.1-3.0ha) and medium (3.1-6.0 ha) farms by means of structured questionnaire.

The findings of the study shows that net returns per hectare were #20,705.80 (Costing family labour) and N22,246.20 (excluding family labour) for the small scale category and N44,999.60 (costing family labour) and N45,241.80 (excluding family labour) for the medium scale category.

The average rate of return to total investment including the imputed cost of family labour was 184% and 416% for the small scale and medium scale categories respectively. Excluding family labour the average rate of return to total investment was 197% and 423% for the small and medium scale categories respectively.

The Cobb-Douglas production function which was finally selected as the equation of best fit shows that farm size, fertilizer and labour were statistically significant at 5% level of probability as factors influencing the variability in rice yield. The resulting MVP (Marginal Value Product) to UFC (Unit Factor Cost) ratios for land, fertilizer and labour were found to be greater than unity, indicating that these resources were underused on the sample fields during the survey year. The regression result also indicated that 62.87% of the variation in yield among the

sample fields are explained by the factor inputs included in the model. Rice production in the study area indicate an increasing return to scale (Ebi = 1.44) this implies that more output could be produced by using more of the resources. Some of the factors militating against increased rice production identified by the research include problem of inadequate fund, high costs of farm inputs etc.

The study recommend that credit facilities should be made available to the farmers as to enable them increase their output. In order to reduce costs especially that of fertilizer, subsidy should be reintroduce and the Ministry of Agriculture and their agencies should device a meanms O; ensuring fair and even distribution of the inputs.

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CHAPTER ONE

1.1 Introduction

Before the oil boom of the 70s' agriculture contributed about 50% of the Gross Domestic Product and 45% of export (C.B.N. 1980). During the oil boom period (1970 - 1980), the agricultural sector in general and cash crop in particular declined considerably. The value of export declined by about 46% while that of imports particularly cereals increased considerably (C.B.N 1980). However, the food sub-sector performed better than the export crops. It grew at between 2-3% annually, which was slightly less than the population growth rate of 3% during the same period (F.O.S, 1979).

In Nigeria, agricultural output has been constantly below the aggregate demand, hence to avoid mass starvation and national crisis, food imports had to be embarked upon to supplement domestic output. In 1980, the import bill for food stood at N1,049.048million, but increased to an unprecedented amount of about N76,819million in 1995 (F.O.S, 1995). This is unexpected in a country like Nigeria which has been blessed with abundant natural resources that could be used to attain an efficient agricultural economy. Table 1.2 shows Nigerian Food import bills between the year 1979 - 1995.

Table 1.1Share of agriculture in Nigerian Gross Domestic Product (GDP) for some selected years

Year	Total GDP	Agric GDP	Growth in GDP	Contribution in % of Agric
1960	5275.08*	2915.03*	-	64.0
1965	6639.07*	3240.05*	0.06	55.04
1970	8902.01*	3511.00*	23.03	44.06
1989	83.46**	26.07**	7.33	31.26
1990	90.36**	27.21**	8.27	30.10
1991	94.54**	28.43**	4.61	30.08
1992	98.42**	29.43**	1.12	29.90
1993	100.03**	30.13**	2.90	30.12
1994	101.04**	31.64**	3.02	30.31
1995	103.30**	32.03**	3.19	31.01

* GDP at 1973/1974 cost (N million)

** GDP at 1984 constant factor cost (N billion)

Source: Central Bank of Nigeria Annual report and statements of accounts, 1992 and 1995.

Table 1.2: Nigerian food imports , 1978 - 1995.

Year	Value (N million)
1978	1,027.06
1979	952.02
1980	1,452.05
1981	1,819.06
1982	1,642.03
1983	1,296.07
1984	843.02
1985	940.06
1986	801.09
1987	1,646.05
1988	1,220.00
1989	2,108.09
1990	3,474.05
1991	7,785.50
1992	11,738.40
1993	13,912.90
1994	16,583.80
1995	76,819.01

Sources:(1) C.B.N Statistical Bulletin, No. 1, 1993

(2) C.B.N Annual Report and Statements of Accounts, 1995.

More than a decade ago, most developing economies particularly that of South-East Asian countries were confronted by similar problem of food shortage and imminent starvation. But, within a relatively short period (5 to 10years) the situation changed with the discovery of an efficient and sustainable means of rice production. Today most of these economies, despite their heavy population densities, are self-sufficient in their domestic food requirements. Rice alone account for up to 90%of food requirement in countries like Bangladesh. Burma, Srilanka and Vietnam. (Grist, 1986). Infact, rice production has substantially increased the foreign earning of countries such as Burma, Thailand, Taiwan and South Korea. These countries are today net exporters of rice. The question which we must ask ourselves is, can rice not do for Nigeria what it did for Asian countries?

1.2 Trends in rice production in Nigeria.

Rice is one of the most important staple food crop in Nigeria which is grown mainly by the peasants farmers. Initially, the production of rice stops at the subsistence level to meet the food needs of the family. However, in recent years rice production is becoming increasingly geared for the market as domestic needs are met. To the peasant rice is now considered to be both food and cash crop. Successive governments have continued to

encourage the rice farmers to increase their output so as to meet both domestic and market demand. The provision of productive inputs such as fertilizer herbicides, pesticides and Land through the National Agricultural land Development Authority (NALDA) are some of the efforts made by the government towards achieving increased rice production. Rice production however, has not been on steady increase despite its growing demand among both the local and urban populace. Table 1:3 shows rice imports and the total quantity of rice produced in Nigeria between 1980 - 1994.

Table 1.3: Rice imports and domestic production, 1980 - 1994.

Year	Imports		Domestic supply
	Quantity ('000 tonnes)	**Value in U.S. Dollars**	
1980	400	360,000	105
1981	500	270,070	158
1982	539	183,000	212
1983	630	187,000	145
1984	450	155,000	157
1985	680	188,000	196
1986	Nil	Nil	293
1987	Nil	Nil	687
1988	Nil	Nil	2081
1989	Nil	Nil	3303
1990	Nil	Nil	2500
1991	Nil	Nil	3226
1992	Nil	Nil	3260
1993	Nil	Nil	3065
1994	Nil	Nil	2427

Source:(1) Federal Office of Statistics Lagos, 1986

(2) C.B.N Annual Statements of Accounts, 1980 - 1994.

Notes: "Nil" Rice importation banned in that period, hence no figure.

The table shows a decline in total production from 1980 up to 1986, this may be due massive importation of rice grain during that period of time which discouraged local rice production in the country. With the coming of the structural Adjustment policies in 1986 a ban was placed on rice

importation and this considerably encouraged and increased domestic rice production, hence the total output continue to increase from 1987 up to 1994. Table 1.4 shows the quantity of rice produced in Jigawa state, Nigeria. The ban on rice importation was recently lifted and this is expected to influence the trends in the production and consumption of domestic rice.

Table 1.4: Rice production in Jigawa State, 1992 - 1997.

Year	Crop Area (ha)	Yield kg/ha	Production volume (tonnes)
1992	15,000	1295	25000
1993	12,000	1102	128000
1994	14,000	1305	23000
1995	7,000	1000	7518
1996	27,000	1651	45000
1997	27,000	1107	29000

Source: Jigawa State ADP CAYS

1.3 Problem statement

Rice, which formerly occupied a relatively obscure but elitist position in the dietary habits of Nigerians, had today become an important staple food for the majority of the citizenry. The demand for rice has increased

and this cannot be unrelated to the high population growth rate coupled with rising money incomes.

With the ban on rice importation in 1986, domestic production of rice substantially increased but the gap between domestic demand and supply remain unfilled. The estimated land area under rice cultivation is about 900.000 hectares yielding an average of 1.87 metric tonnes per hectare (WARDA, 1992). It can be noted that although the annual domestic supply of rice has been on the increase according to National Cereal Research Institute NCRI (1992) the Nigerian's annual rice needs are in deficit of 1.5 million tonnes. This shows how wide is the gap between domestic demand and supply.

Several concerted efforts have been made by the government to bridge the gap between domestic supply and demand by way of providing subsidized inputs to farmers and making more land available to interested farmers through the National Agricultural Land Development Authority (NALDA). Also, huge sums of money and other material and human resources have been sunk into rice and rice related development programmes (e.g. River Basin Development Projects, Irrigation Schemes e.t.c). Also the establishment of West African Rice Development Association (WARDA) of which Nigeria is a leading member and the development and introduction of exotic and high yielding Asian varieties of rice into the country are some of the efforts made at achieving increased rice production. However, despite these positive development and efforts, aimed at increasing the production of rice in the country, it still remains a paradox that the domestic production of rice has consistently fallen below the national demand.

From the foregoing, it is pertinent to ask why a country like Nigeria, which is endowed with enormous and potentially productive resources such as land, human and material resources, recorded such persistently low domestic rice yields. The answer partly lies with the way scarce productive resources are organized and allocated at the farm level. Also, the problems of poor farming technologies, inadequate productive inputs, poor marketing system and high cost of production may be some of the reasons behind low level of rice production recorded over the time.

There is therefore, the need to gather and analyze all relevant socio-economic data on rice production in order to determine the possible constraints to increased production.

1.4 Objectives of the study

The overall objective is to assess the economic performance of upland rice production in Jigawa State. The specific objectives are:

1. To determine the costs and returns associated with rice production
2. To describe the input-output relationship
3. To determine the level of resource use efficiency
4. To identify and describe the constraints limiting rice production.

1.5 Justification of the study

Since the ban on rice importation in 1986, domestic rice production has been on the increase hence an economic analysis of its production is necessary in order to provide a base line information to evaluate the direct and indirect effects of the policy of self-sufficiency in rice production in Nigeria. It is the hope that this study will provide the much needed information about the costs and returns as well as resources use efficiency in rice production. The information disclosed is expected to be of immense help to farmers and planners.

1.6. Hypotheses

The hypothesis that resources employed in rice production are not efficiently utilized was tested.

CHAPTER TWO

Literature review

2.1 Previous studies

In trying to combat the increasing rural urban migration, there is the need to put in place a viable and sustainable integrated rural development approach that would help in raising employment, purchasing power, rural income and increased productivity. One of the pre-requisite for achieving increased productivity is by means of increasing the level of resources committed to farms with optimum efficiency in their allocation. Various kinds of studies on economic analysis have been carried out for different crops and activities. The main concern of all these studies has generally been to obtain farm level input-output data through field surveys in order to determine the relative financial costs and returns of the chosen farm enterprise or crop (Barau, 1979; Norman, 1972 and Idoko, 1996). In an attempt to acquire this type of data, various approaches have been adopted and these include:

1. Interviewing agricultural officers and other persons on locations to obtain the best possible estimate.
2. Conducting "Farm business" surveys among a sample of farmers by interviewing them once or twice about their farm operations, and
3. Conducting intense, "cost -route" village level studies among a sample of farmers.

Among all these, the cost-route method is considered to be the most appropriate and reliable means of obtaining detailed and reliable data on input utilization. This method even though reliable, is equally expensive in terms of human efforts, time and money. Hence, researchers do not normally adopt this method because of lack of sufficient resources (both human and material). The cost-route approach involves extensive survey, which is based on repeated visits and interviews with farmers over an entire crop cycle i.e. from land preparation, through crop planting to crop sales, for information and data gathering.

While Norman (1972) and Winch (1976) used this method in their respective productivity studies. Barau (1979), and Idoko (1996) used "Farm business" surveys in their respective studies.

2.2 Theoretical framework

The Production process is one whereby some goods and services called inputs are transformed into other goods and services, called output. In agricultural production, the physical inputs which we utilized are land, labour, capital,, management and, of recent, water resources. These resources can be organized into a farm-firm or a producing unit, whose ultimate objective may be profit maximization, output maximization, cost minimization or the maximization of satisfaction or a combination of all these motives of enterprise (Olayide and Heady, 1982).

In production, the product is that part of the output that is valuable to the producer while that which has no value is the waste or waste products. But as long as the production generates sufficient profit from the valuable part of the output, the investor is satisfied with the investment (Olukosi and Ogunbile 1980).

2.2.1 Resource Productivity and Efficiency

Olayide and Heady (1982) defined agricultural productivity as the index of the value of total farm output to the value of total inputs used in farm production. It is important to note that one of the chief aim of any society is the attainment of an optimally high level of living and this objective can be achieved by increasing the productivity of resources employed in production at the farm and off-farm level. In an agrarian economy like that of Nigeria, an increase in efficiency of resource use at farm level could suggest general economic advancement with a resultant improvement in the socio-economic status of the citizenry.

The input-output process of farm production, is important in at least four major problem areas. These are the distribution of income, the allocation of resources, the relation between stock and flows, and the measurement of efficiency or productivity (Olayide and Heady, 1982). The term productivity and efficiency are used interchangeably in the production literature. The concept of productivity or efficiency is instrumental in achieving an improved agricultural economy. There has been two concerns; first is that more efficient agriculture could reduce the amount of food which

is imported or release resources which could be used for development in other sectors of the economy and second is that greater productivity would enable the incomes of farmers to be higher (Mijindadi, 1980).

2.2.2 Resource Efficiency and its measurement

Several attempts have been made to define resource efficiency and to measure it in empirical sense. Important as it is from both academic and practical view points, the concept of efficiency has remained loosely defined in the literature (Farrel, 1957). The concept could mean different things to different individual in different circumstances. Although the word "efficiency" is an every day one, problems involving ideas of efficiency are so many and so intimately related to each other that it is easy to slip from one sense of the word to another, and so confuse issues in the discussion, (Olayide and Heady, 1972).

Economic theory distinguishes between at least two types of efficiency namely; allocative efficiency and technical efficiency. Allocative efficiency refers to the choice of an optimum combination of inputs consistent with relative factor prices. Technical efficiency on the other hand refers to the ability of firms to employ the best practices in an industry so that not more than the necessary amount of a givens set of inputs is used in producing the best level of output. The degree to which allocative and technical efficiency are achieved is commonly referred to as production efficiency (Timmer, 1970; Mijindadi, 1980).

There are alternatives approaches to the measurement of farm level production efficiency. These include; rates of production, farm business performance measure, and average production function.

2.2.3 Rates of Production

The use of rates of production as defined by Olayide (1972) involves the calculation of average productivity ratios for different farms or enterprises and comparing them with one another. These ratios differ with the type of operation, for example, for farms in which crop production is the main activity and source of income, yield per hectare and crop yield index are used. Whereas, on farms that specialize in livestock production, measures like number of eggs laid per hen on poultry farm, liters of milk per cow on dairy farm, or livestock index are used. In situation where the contribution of labour and capital are required, then ratios like capital turn over and crop hectarage per man equivalent are used. The limitation of this approach is that it ignores the quantity and quality of inputs used.

2.2.4 Farm Business Performance Measure

Most farmers, especially large scale farmers are interested in higher net income. In determining the extent to which this objective is achieved, the farm business performance measures are used. This method allows for calculation of returns to specific parts of the farm business such as returns to labour, returns to management, returns to capital and capital efficiency (Mijindadi, 1980). The computed measures for individual

farms are then compared with averages of similar farms in a given area. The limitation associated with the use of these measure as pointed out by Mijindadi (1980), are that conditions which apply on the average farm for an area, may not apply on the individual farm.

2.2.5 Average Production Function.

The production function is probably the most fundamental of all the concepts used in connection with modern production theory. Production function describes a relationship between inputs and outputs from a known way of organizing production. There are various functional forms that can be used in a production function analysis depending on the problem at hand and the assumptions made in determining the suitable functional form to use. The following considerations were suggested by Mijindadi (1980):

The nature of the problem, i.e. the consistency of the chosen functional form with the objective of the study.

The type of relationship deemed to exist between inputs and output.
The constraints or assumption implied by the particular function.
Production functions may be estimated either by single or simultaneous equation procedures. However, most studies of farm productivity have used the single equation approach and ordinary least squares (OLS) estimating procedures (Mijindadi, 1980). In

this regards most of the statistical problems encountered in the production function analysis are related to the violation of the basic assumptions of the ordinary least square model. Some of such problems include measurement and specification bias and simultaneous equation bias.

2.2.6 Frontier Production Function

The earliest use of frontier production function was by Farrel (1957) who rejected the conventional production function on the grounds that its result would represent only average levels of efficiency. This measurement is found to measure both the technical efficiency and price efficiency. Farrel asserted that, the measure, i.e. technical and price efficiency, are not different but that economic efficiency is really a product of the two.

However, according to Timmer (1970), the coefficient of frontier and average production functions are identical, except that, the frontier function has a higher intercept. Muller (1974), pointed out that special formulation for the measurement of technical efficiency is unnecessary, because firms at the industry frontier have available additional inputs which make them seem more technically efficient whereas if the production function is interpreted correctly they are not. Nerlove (1969), identified other draw backs of this method like it does not permit comparison of firms in an imperfectly competitive industry and also it neglects the difference in the environment of the different firms.

According to Sanni ((1969), resource is considered to be most efficiently used if its marginal value product (MVP) is just sufficient to off-set its cost. If we assumed that two resources X_1 and X_2 are used in the production of an output Y and the production function is of the Cobb-Douglas, the MVP of X_1 is given as:

$$MVP_{X1} = \frac{b_1\bar{y}.\ Py}{X_1}$$

And that of X2 as:

$$MVPx_2 = \frac{b_2\bar{y}.\ Py}{X_2}$$

Where:

Py = unit price of output, y.

b_1 and b_2 = elasticities of production (i.e. regression coefficient of X_1 and X_2 respectively)

Then X_1 and X_2 are said to be efficiently used if $MVP_{X1} = MFC_{x1}$ and $MVP_{x2} = MFC_{x2}$ respectively.

2.3 Resource Productivity Studies in Agriculture.

One of the most popular and frequently cited work on resource productivity is Norman's study of Zaria villages. In this pioneer work of input – output study in Zaria area. Norman (1972) observes that most farms used all inputs in an optimally efficient manner. With the exception of hired labour, Norman pointed out that hired labour as at that time was not efficiently used because it was not particularly

successful in mitigating the effect of peak demand period for labour. The study found that the seasonal nature of farm work results in labour demand. The result of Norman's study also indicated that the number of family members is important in determining farm size. However, the study found land quantity to be the most important determinants of farm productivity. Norman drew a general conclusion in which he asserts 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.

A similar study was conducted in Funtua Agricultural Development Project (F.A.D.P) by Ukpabio (1978) in which he compared the productivity differentials between small and large scale farmers using both Cobb-Douglas production function and gross margin analysis. The study 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 deduced an increasing return to scale in the production of most of crops grown by both small and large farmers. In a follow-up study of the same area, (F.A.D.P.), to determine the economic efficiency of resource use by different farm sizes, it was observed that while there exist some differences in the level of resource use among different classes of farms, there was no significant difference between small and large farms in terms of the relative economic efficiency.

2.4 Empirical productivity studies in rice

Winch's (1976) carried out a study in Ghana's Northern region to

determine costs and returns from alternative rice production systems and obtain more quantitative data on rice industry in Ghana's Northern region. The study adopted the "cost-route" survey method in collecting farm level input-output data. The study found out that the production strategies used were providing rice producers with high financial returns but at a high cost to the Ghanaian economy. The study therefore advised the government to developed a low cost production strategy in light of growing foreign exchange constraints.

In another study conducted by Idoko (1996) on costs and returns in rice production in Okpokwu local government area of Benue State, Nigeria. In the study it was observed that overall production efficiency of farmers are influenced by a number of factors which has a varying degree of complexity. Some of these factors include:

i. Farmers inherent socio-economic characteristics

ii. The socio-economic environment under which they operate.

The study found also that labour was the most critical requirement in rice production and that net return per hectare increased with increase in farm size. The yield per hectare did not show any significant variation among farm size categories although farmers in the medium category seemed to have higher yields per hectare than those in the small size category.

2.5 Methods of rice cultivation

2.5.1 Hand or traditional method cultivation

In the traditional method of cultivation majority of the work is done by using manual labour in which the hand remain the busiest instrument of operations. Kilne (1969) observed that in West African sub-region majority of the work in rice cultivation is done using manual labour. For an efficient agricultural system the F.A.O. (1972), recommended that 0.75kw per hectare should be available but in West Africa, only 0.02kw per hectare is available where only manual labour is used; (Dadey, 1973). This according to Dadey's study, leads to enormous shortage of labour during some peak periods (e.g. weeding), hence limiting the number of hectares that could be cultivated by a farm family.

According to Kilne (1969), human power still remain the most important in agricultural production in West Africa as over 99% of the farm power is derived from human efforts. The use of hand tools even though tedious and expensive in terms of human power, but, the fact that they are readily available locally, cheap to purchase and simple to maintain gives them an advantage.

2.5.2 Animal draught cultivation

An intermediary between the use of traditional hand tools, which are produced locally, and tractorization, is the animal draught cultivation. This method is an exploitation of animal energy to cultivate soils. In areas where the climatic conditions may allow the survival of large-scale domestic animals, animal power become a cheap

source of power. The animal draught cultivation has the following advantages:

i. it can increase output per man while reducing drudgery

ii. timeliness of operations can be achieved through this system

iii. the farmer using animal traction can cultivate more hectares of land than he could with only hand tools

iv. the animal feces can be used in making manure for sustaining fertility.

2.5.3 Tractorized power cultivation

The extreme of modernization as per cultivation of land for farming, is what is known as tractorization. This refers to the employment of engine powered implements and machines as a means of farm power. This modern method gives the farmer the opportunity of cultivating a large hectarage of farm land, and allows good timeliness of operations.

However, in a developing country like Nigeria, where most farmers hold their farm lands in fragmentation's of less than a hectare, to about ten hectares, and in different locations, tractorized farming system cannot provide sufficient cash income to pay for the purchase of the tractor and the necessary implements and machines, their maintenance, repair, housing and depreciation, (Fashina, 1980).

2.6 Techniques in rice production

This refer to the cultural practices employed during rice production, ranging from land preparation to harvesting of the crop.

2.6.1 Land preparation/site selection

While a lot of research work has been done on the agronomy, breeding insect and disease control of rice, there is limited research recorded on land preparation (Grist, 1986). It is important to select a suitable side for rice production. The land should be well prepared so as to get a desirable yield from the crop. The land should be thoroughly plowed and harrowed, after the trees, the undergrowth and the debris are cleared and burned this is normally done between February – March.

The essence of plugging and harrowing is to give the soil good tilts and these operations can be done by any method but the adopted depend on the financial ability of the farmer. Generally rice does not do well in sandy soil depending on variety rice does well in clay loam soil (JARDA, 1995).

2.6.2 Planting

Planting is usually done by hand in rows 25cm x 20cm to 30cm x 30cm in the case of upland rice. The planting rate is usually 5 - 8 seeds per hole 2-3cm deep. The usual seeding rate used varies between 36 and 47kg/ha.

2.6.3 Fertilizer application

Rice should receive the first top dressing about 4 weeks after germination. CAN or Urea should be applied at the rate of 100kg per hectare, (JARDA, 1996).

Split application of Nitrogen fertilizers at planting and at early flowering stage had proved to be more advantageous than single application at planting. (Grist, 1986).

A viable alternative to chemical or inorganic fertilizer have been developed by the National Cereal Research Institute, Badeggi. This involves the use of a green manure plant known as sesbania rostrata, which is fast growing nodulating legume commonly found in West African Sub-regions. The plant fixes atmospheric nitrogen in its stem and root nodules in order to use it as a source of nitrogenous fertilizer, the plant should be grown through seed production, preferably, in the rice field about two months to the main rice season. The plant is than harvested by either uprooting it or cutting it at the soil surface. This is then cut into smaller bits and incorporated into the soil during the pudding of the rice field just before transplanting the rice seedlings.

Weed control

Rice is highly susceptible to weed competition, therefore proper weed control is advised. Weed control is a major farm operation during the growing period of rice. Le Moigne, (1971) considers weeding as the major bottleneck in the rice

agricultural calendar. Weeds can be control by either direct or indirect means.

Direct method of weed control

Hand Weeding

This is the most common method of weed control particularly in upland rice. It is an effective but tedious means of weed control (Aiyesry, 1970). It was noticed that by the time weeds have reached the stage when they can be removed by hand, they have competed with the crops and reduced yields (Surgajiti 1981). Hand weeding apart from being tedious is also labour intensive, for example at ITTA, 244 man – hour were required in an upland rice field for one hand weeding 14 days after seedling transplanting. It is not advisable to delay weeding both from technical and economic point of view, because the delay apart from increasing the duration of competition and hence further affect the yield, it can also considerably increase the time required to weed. Example, in the ITTA, upland rice field, it was observed that a one week delay in weeding increased the time required to weed by more than 40 man – hours.

Hoe Weeding

Both the hand and how weeding are suitable only for use on small farms. Hoe weeding even though has many of the disadvantage of hand weeding, but it is a faster operations (approximately twice as fast), it can be carried out at an earlier stage in the growth cycle of the crop and is more through when weeds within the row are

removed by hand at the same time in addition, it has proved superior to other mechanical methods of weed control, (De Datta, 1973).

Inter-row Cultivation

In West Africa, both in Ivory cost and Nigeria, attempts to control weeds by inter-row cultivation have failed. (ITTA, 1973). Weeding achieved by inter-row cultivation used to be ineffective, mainly because weed within and close to the rice row are not controlled so as to avoid damage to the rice plants. But in Fiji it was reported that inter-row cultivation by horse drawn equipment had been used successfully for weed control in upland rice planted at wide row spacing, (Patel and Rhodes 1969).

Chemical Weed control

The chemicals used in controlling weeds are called herbicides. There are many herbicides used for weed control on rice e.g. Ranstar 25EC (Pre-emergence) and Basagram PL2, (JARDA, 1995).

Other herbicides that can be used in weed control include 2, 4 - D which for many years has been successful for control of broadleaf weeds, (Patel and Rhodes, 1969). Considering the problems associated with other methods of weed control, herbicides may offer the most practical, effective and economical means of reducing weed competition, crop losses and production costs in upland rice, (JARDA 1993). Herbicides may be the only efficient method of weed control suitable for large scale rice

farms.

Herbicides can be applied either before the emergence of the crop and weed so that their residual effect linger on until the critical period of weed competition has passed or they can be applied after the emergence of crop and weed so that they become effective during the period of weeds competition with the crop.

Indirect Method of Weed Control

The indirect method of weed control usually refer to those cultural practices that help in the control of weeds. The menace of weeds is usually largely influenced by cultural practices. After the rice crop has been harvested, the field will be infested with drop-seed rice and weed seeds. Which, if neglected, will eventually form a dense growth. Early plugging before these seeds mature is desirable. (Grist, 1986).

In order for rice to be able to compete successfully against weeds, it must to be planted into a weed free seed-beds. However, only about ten percent of the rice crop is planted into reasonably clean seed-beds (Dadey, 1973). The penalty for broadcasting paddy rice is the increase of weeds. Hence, where rice is usually sow by transplanting, adequate opportunity occurs for suppression of weeds, (Grist, 1986). Dadey (1973) reported that sowing of upland rice by broadcasting is widely practiced and this tends to delay weeding hence, making it difficult and expensive. According to

Abifarin (1972) it is almost impossible to control weeds satisfactorily without herbicides if rice seeds have been broadcast. The most effective way of reducing the burden of weeding would be to sow all crops in rows (Patel and Rhodes, 1969).

2.6 Cropping system

System of cropping usually adopting by the farmers in Nigeria include mono-cropping, strip cropping, mixed cropping, multiple cropping and so on. All these systems have their merits and demerits. However, the fear of total crop failure which, is a peculiar feature of mono-cropping has influenced many farmers to take precautionary measures usually by adopting mixed or multiple cropping.

In Nigeria rice is commonly grown as a sole crop, but in the Southern part of the country inter cropping with other crops like maize, yams and sometimes species is often practice (WARDA, 1981).

2.7 Harvesting

The rice grain is harvested when it attain a particular level of maturity which determined by its moisture content among others. A moisture content of between 19 and 21 percent is a good guide to ripeness, (Surgajiti, 1981).

There are two methods of hand harvesting usually employed by the farmers in Nigeria. One involve using a sickle to cut the rice about 7.5 – 15cm above

the ground. The cut stems are bundled and allowed to dry about 3 – 4 days after which threshing is carried out. The other method involves cutting only the heads with about 5 – 15cm of rice stalk on. This second method is the one usually adopted by small scale rice farmers because it allows them to thresh immediately after cutting.

2.8 Threshing and winnowing

Threshing of paddy separate the grain with its adhering husk or glumes from the stalk. Generally throughout Nigeria the paddy crop is threshed as soon as it is harvested, but occasionally, as conditions of the crop demands, the threshing is done after a short period of sun-drying.

Two methods are popularly used by farmers for threshing, they are trampling of rice head by foot and beating the head with a stick on the floor, or beating a bunch of rice heads against the floor, table, stones or into a cemented pit. All these methods have the disadvantage of breaking the rice grains. The use of the mechanical thresher is still not common and in most cases shunned by the farmers due to its higher cost or unfamiliarity.

The native method of winnowing is of the simplest. Winnowing using the native method is performed by shaking the paddy backwards and towards on a flat tray

of plaited bamboo. The paddy is shaken and tossed with a twist of the writs, which has the effect of working the empty husk, light grain and chaff to the edge of the tray furtherest removed from the worker. Winnowing by mechanical means is very uncommon in Nigeria.

CHAPTER THREE

Methodology

3.1 The study area

Jigawa State is located mainly in the Sudan Savannah ecology and the State has a wild climate. The mean daily maximum temperature are 33^{oc} and 22^{oc}at the afternoon and evenings respectively. The year is divided into well marked rainy and dry seasons. The dry season last from October to May and rainfall is between June and September. Rainfall varies from year to year but ranges from 635.0 - 889.0mm the state has an estimated population of 2,829.929 people by the 1991 census. It has very high potential for arable crops particularly grains such as rice, millet, sorghum and cowpea. Livestock production occupies a central stage as almost every household keep one or more domestic animals such as sheep, goats, cattle and chickens. The farmers are predominantly illiterate and production is largely dependent on unimproved technologies. Cultivable land appears to be plentiful but the size of the holdings still remain small ranging from 0.5 to 6 hectares. Farm operations are largely performed by family labour but hired labour is sometimes used especially during the peak periods of weeding and harvesting when labour is in high demand.

3.2 Sampling procedure and sample size

Rice is produced in seven out of twenty six Local Government Areas in Jigawa State. The rice producing Local Government Areas are; Roni, Ringim, Gwaram,

Jahun, Birnin Kudu and Auyo. Based on a recent survey by the State Ministry of Agriculture and Natural Resources, the six rice producing areas have been categorized into low, medium and high producing strata, (Table 3.1.)

TABLE 3.1:Rice producing local government areas of Jigawa State, Nigeria.

Low producing L.G.A'S	Medium producing L.G.A'S	High producing L.G.A'S
1. Roni	1. Ringim	1. Auyo
2. Gwaram	2. Birnin Kudu	2. Jahun

Source:Field Survey by State Ministry of Agric. 1996.

A multi-stage sampling system was employed to arrive at random and fairly representative sample size. Firstly a stratified random sampling using fifty percent proportionate allocation was used in selecting three Local Government Areas, one from each of the three strata. The selected Local Government Areas are Gwaram (low), Ringim (medium) and Auyo (High). According to 1991 population census Gwaram, Ringim and Auyo Local Governments Areas were having an estimated population of 195.618, 247,553 and 183,527 thousands people respectively of which over 80 percent of these populations were estimated to be farmers. The major crops grown in these areas include rice, millet, sorghum, groundnut and cowpea during the dry season using irrigation facilities, vegetables such as tomatoes, pepper and garden egg are also grown. A total of twenty-two rice producing villages were identified by the State Ministry of

Agric and Natural Resources out of which four are from the low producing area, eight from the medium producing area and ten from the high producing, area stratified random sampling using fifty percent proportionate allocation was used to selected eleven out of the twenty-two rice producing villages. Information obtained from the village extension agents indicated that there is an estimate of one hundred (100) , another one hundred (100) and one hundred and twenty (120) rice farmers in each of the selected rice producing villages from the low, medium and high producing strata respectively.

Finally, the sampling frame provide by the village extension agents was used for random sampling based on ten percent proportionate allocation. This gave 10, 10 and 12 rice farmers from each of the selected rice producing villages in the low, medium and high producing strata respectively. Hence a total of one hundred and twenty (120) was obtained as the sample size (Table 3.2).

TABLE 3.2: RICE PRODUCING VILLAGES IN THREE REPRESENTATIVE L.G.As OF JIGAWA STATE AND SELECTION OF SAMPLE VILLAGES.

L. G. As	Number and Names of Rice Producing villages per L.G.A	Number and Names of selected rice producing villages per L.G.A.s (50% allocation)	Estimate of rice farmers population per villages in the L.G.A.	Total estimate of rice farmers population per L.G.A.	Selected rice farmers per village (10% of allocation	Total selected rice farmers
GWARAM	4. 1. Sara 2. Tsohuwar Gwaram 3. Kila 4. Basirka	2. 1. Sara 2. Basirka	100	200 (100 x 2)	10	20 (10 x 2)
RINGIM	8. 1. Ringim 2. Auramo 3. Gabarin 4. Dabi 5. Suntul Mawa 6. Yakasawa 7. Yan Dutse 8. Karwe	4. 1. Gabarin 2. Ringim 3. Yakasawa 4. Auramo	**100**	400 (100 x 4)	**10**	40 **(10 x 4)**
AUYO	10. 1. Auyo 2. Gamsarka 3. Marina 4. Adeha 5. Shawara 6. Yamidi 7. Kafur 8. Wailari 9. Gatafa 10. Kuka	5. 1. Yamidi 2. Gamsarka 3. Marina 4. Adeha 5. Kafur	120	600 (120 x 5)	**12**	60 (12 x 5)
Total	22	11	320	**1200**	32	120

Source: Field Survey by State Ministry of Agric 1996/97.

3.3 Data collection

Data were collected from both primary and secondary sources. Primary data were collected from farmers by the use of structured questionnaire designed to obtain relevant information. Secondary data were obtained from the three Local Government headquarters and the State Ministry of Agriculture. Direct face to face interviews with the farmers was conducted during which the questionnaires were dully filled by the researcher.

Data were collected based on the 1997/98 cropping season. Some of the socio-economic variables which the data covered include: farmers age, sex, household size, experience, source of income, type and cost of labour (i.e. family or hired labour), type and costs of inputs used, total output and output prices, types of implements or tools used for farm operation and so on.

The sample farmers were stratified on the basis of farm size. Farmers owning up to 3.0ha of rice farm-land were grouped as small scale farmers those owning 3.1 to 6.0 hectares were grouped as medium scale. This stratification was necessary because variable such as farm size have importance in rice production, as it likely that farmers cultivating larger fields may use more inputs and employ tractors than those having smaller farm sizes. This classification was based on the one adopted by the State Ministry of Agric and Natural Resources. The average rice hectarage in the area of

study was found to be around 2.0 hectares.

3.4 Analytical frame work

There are many analytical techniques that can be employed in productivity studies but, the choice of a particular one depends essentially on the available facilities, the nature of the data and the use which the results will be put. For convenience and relevance the following tools of analysis were employed to achieve the already stated objectives.

i. Descriptive statistics

ii. Net farm income

iii. Regression Analysis

3.4.1 Descriptive Statistics

Descriptive statistics involving the use of measure of central tendency such as mean, percentage and measures of dispersion such as range, standard deviation were used to analyze farmers parameters such as age, average holdings, proportion of total and variable costs and so on. The tool was also used in achieving objective iv.

3.4.2 Net Farm Income

This is one of the oldest and simplest tool of analysis in farm production and management studies. Basically, it involves the estimation of total costs and revenue

for a production period (Olayemi and Oni, 1977). This model was used to achieve objective one. The net farm income model is shown as follow;

$$NY = TR - (TVC + TFC)$$

Where:

NY = Net Farm income from the production of rice in Naira/ha

TR = Total Revenue or gross returns to rice production in Naira/ha

TVC = Total Variable cost in Naira per hectare

TFC = Total fixed cost in Naira per hectare e.g. land rent.

Note: In the case of fixed cost depreciation on equipment's or tools such as hoes was not included because the farmers were found using such tools in the production of other crops apart from rice, hence the wears and tears were not due to rice production activities only. Therefore including depreciation as a cost will only over estimate the cost involved in rice production as such it was not included.

- The net farm income model shows only the monetary costs and returns from a production process. But, it cannot show how optimum returns can be attained from limited resources.
- If the study involves a lot of value judgement e.g. inputed costs of inputs used, the model ceases to be a useful tool. This is because the values attached to either inputs or outputs will vary among farmers thus given a distorted picture of the true profitability situation.

3.4.3 Regression Analysis

Regression analysis reflects the interaction among variables as they would naturally occur in the real world (Koutsoyiannis, 1981). Hence, the main concern of classical production function is the relationship between one or more variable inputs when other inputs are kept constant. It is assumed that production function consist of three stages, increasing returns to inputs (i.e. positive), increase with decreasing return and decreasing return (i.e. negative). The rational stage for economic operation is stage two.

For this study production function analysis was used to determine the extent to which the key factors of production that are quantifiable explain the variability in the output of rice. The greater the extent to which these factors are able to explain the variability in output; the more influence the factors have on the production of rice. The data were fitted into three functional forms of the production functions, which were linear Cobb-Douglas and Quadratic functions.

3.4.4 Cobb-Douglas production function

The model in its implicit form can be written as follows:

$$\mathbf{Y} = f(X_1 \quad X_2 \quad X_3 \quad X_4 \quad X_5 \; U)$$

Where Y is the output of rice, which is the dependent variable, while $X_1 \ldots X_5$ are the explanatory variables and 'e' is the error term

The functional form of the model with variables inputs can be written as;

$$\mathbf{Y} = aX_1^{b1} \quad X_2^{b2} \quad X_3^{b3} \quad X_4^{b4} \quad X_5^{b5} \quad U$$

For ease of estimate the function was transformed into its linear from through what is called logarithmic transformation. Thus:

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

Where:

Y = Output of rice (kg)

X_1 = Farm size (ha)

X_2 = Quantity of seeds (kg)

X_3 = Quantity of fertilizers (kg)

X_4 = Total labour used (man – days)

X_5 = Dummy variable representing farm size category. X_5 = 0. If small scale farmer and X_5 = 1 if medium scale farmer.

U = error term is assumed to be normally distributed with zero mean and constant variance

a = Constant term

$b_1 - b_5$ = Regression coefficients and elasticities of production of factors $X_1 - X_5$ respectively.

The values of the coefficients $b_1 - b_5$ are direct measures of the elasticites of response to inputs $X_1 - X_5$ respectively, in the production process. In condition of diminishing returns to factors of production, the value of the coefficient will be less than one, where there is increasing returns the value will be greater than one in each case. A constant

return to factors of production is indicated when the sum of the values is unity. The sum of elasticities of production was used as a measure of the return to scale in the production process.

The model has been extensively used for farm survey data because of its convenience in computation and ease of interpretation of elasticity of production. The estimation process involves fewer degrees of freedom than other functional forms which allows for decreasing or increasing return to scale. However, the assumption of zero output at zero level if inputs and constant eleasticities at all levels of inputs are some of its limitations. In addition, the function cannot show diminishing and increasing returns to factors in a single response curve.

3.5 Input – output variables definition

3.5.1 Inputs

i. Farm size, (X_1) in hectares. This refers to the total land area measured in hecatres under rice cultivation by a farmer during a cropping season. However, most of the farmers are familiar with "acre" as a unit of farm size, hence the use of acre was adopted before conversion to hectares. In the study area 2.5 acres were found to be equivalent to one hectare; (JARDA, 1997). This system of conversion was adopted in this study to estimate farm sizes. Farm size was include in the model as a variable because of the much discussed inverse relationship between farm size and productivity in farm management studies (Sanni, 1966). The inclusion

was also to show its influence on the yield of rice.

ii. Seeds, (X_2), measured in kilogramme (kg). This include the initial quantity of seeds planted and the additional quantity used for refilling. This variable was included in order to show its influence on rice

iii. Fertilizers (X_3). These were measured in terms of quantity used on the farm in bags or kilograms and the cost in Naira per unit. Fertilizer was included because of the variation of quantities used by the farmers and thus determine the extent to which the variation can influence rice output.

iv. Labour, (X_4), Labour was measured in man - days. This variables was defined to include family, and hired labour used in land preparation, weeding, ridging, planting, harvesting, e.t.c. Labour was divided into male and female adults and since work rates differ according to different categories weights were assigned to different categories of labour input, (Collison, 1972). Farm labour was measured in man-equivalent based on age and sex as categorized by Norman (1973): as follows:

Table 3.3: **Estimated Labour man - hour equivalent**

Age (years)	Sex	Man equivalent
0 - 6	Male & Female	0.00
7 - 14	Male and Female	0.50
15 – 64	Female	0.75
15 – 64	Male	1.00

Source: Norman, 1973.

v. Dummy variable, (X_5). A dummy variable was used to represent the two farm size categories. The variable takes a value of zero for small- scale farmers and a value of one for medium scale farmers. The use of the dummy variable enable the estimation of a single regression equation, instead of separate equations for each farm size category, at the same time it enable us to know the difference between the constant terms of the equations of the two categories and to know further whether the difference is statistically significant from the result of the t–test.

3.5.2 Output

i. Rice paddy – this was measured in terms of quantity produced in kilograms or tonnes. This was first measured in local unit such as "Tiya" before being converted to kilograms or tonnes. A standard "Tiya" equivalent to 2.5kg of paddy rice was used by all the farmers in the study areas. This standard measure was the one recommended by all the local authorities in the state.

ii. Total revenue or gross returns – this refer to the value in Naira of rice sold by the farmers.

CHAPTER FOUR

Results and discussions

4.1 Socio-economic factors

Farmers' production and marketing decisions and overall production efficiency, are influenced by a number of factors, most of which are outside the control of the farmers and may be taken as given. Some of these factors include:

a. Farmers socio-economic characteristics

b Their resource endowment and technology of production

c. The socio-economic environment under which they operate

d. Market prices

e. Institutions

f. Government policies and

g. Climatic conditions

In this sub-section, farmers' socio-economic factors such as age, family size, level of education, land tenure, sources of income e.t.c. are discussed.

(a) Age

Experience is gained with age, physical strength declines with age. The strength and direction of this paradoxical relationship are known to affect agricultural production. Otherwise, the more years a farmer spends on the farm, the better his

understanding of the economic, social, and climatic factors that affect farming. Table 4.1 shows that 30.83% of the respondents were within the age of 21 - 30 years, 30% were within the range of 31 - 40 years, while 19.17, 12.5%, 4.17% and 3.33% within the range of 41 - 50, 51 - 60, 61 - 70 and 71 - 80 years respectively. The mean age was 39years. This analysis indicated that majorities of the rice producers in the study areas were young people within the active age of 40years and this may likely have a positive effect on rice production

TABLE 4.1: Age distribution of the respondents in Jigawa State 1997/98

Age	Mean Age (X)	Freq. (F)	%
21 - 30	25.5	73	30.83
31 - 40	35.5	36	30.00
41 - 50	45.5	23	19.17
51 - 60	55.5	15	12.5
61 - 70	65.5	5	4.17
71 - 80	75.5	4	3.33

Source: Field Survey, 1997/98

(b) Farm size

The size of the farm cultivated is a function of population pressure, family size, financial background of the farmer and labour availability. Table 4.2 shows that majority of the respondents (50.83%) had 0.1 - 1.0ha of sole rice. 16.67% had 1.1 -

2.0ha, 4.17% had 2.1 - 3.0ha, 16.67% had 3.1 - 4.0ha, 8.33% had 4.1 - 5.0ha and 3.33% had 5.1 - 6.0ha. The mean farm size was 1.8ha.

Table 4.2: Farm size distribution of sole rice growers in Jigawa State.

Farm size (ha)	Mean size (ha)	No. Of respondents	%
0.1 - 1.0	0.55	61	50.83
1.1 - 2.0	1.55	20	16.67
2.1 - 3.0	2.55	5.0	4.17
3.1 - 4.0	3.55	20	16.67
4.1 - 5.0	4.55	10	8.33
5.1 - 6.0	5.55	4	3.33

Source: Field Survey, 1997/98

It shows that majority of the producers were small scale having 0.1 - 3.0ha, only 28.33% of the respondents could be termed as medium scale farmers having more than three hectares of rice farm.

(c) Family size

In traditional agriculture, the size of the family is very important since it influences the supply of labour for immediate farm employment. Table 4.3 shows that

male elders constitute 11.4% of the total number of people used for family labour in the production of rice, while male adults and male child had 52.38% and 19.05% respectively. Female adults had 17.14% but female elders and female child were not engaged in the production process.

Table 4.3: Family size of rice growers in Jigawa State

Family Size Structure	Number	%
Male elders	48	11.43
Male adult	220	52.38
Male child	80	19.05
Female elders	-	-
Female adult	72	17.14
Female child	-	-
TOTAL	420	100

The analysis indicated that adult males and females constitute the greatest portion of the family work force, implying that the farm families had significant labour force. The average family size of the respondents was found to be around four persons per household.

(d) Land tenure

According to Dorner (1972), Land tenure is a concept which involves the many relationships established among men that determine their right to control, occupy and use landed property. Table 4.4 shows that 42.5% of the respondents acquired their land through inheritance while 57.5% acquired their land through renting. No

respondents reported leasing land.

TABLE 4.4: Land tenure system of rice producers in Jigawa State.

Tenure System	No. of Respondent	%
Inheritance	51	42.5
Lease	-	-
Rent	69	57.5
TOTAL	120	100

Source: Field Survey, 1997/98

The analysis shows that the majority of the rice producers acquire their land through renting because they were not opportune to own rice farm land. This may be due to the nature of the customary land tenure system prevalent in the area which, places ownership more to the community, villages and family leaving little to the individual farmer.

(e) Educational level

Education is one important socio-economic variable that influence farmers' decision because of its sharp influence on farmers' awareness, perception, reception and adoption of modern technologies. Table 4.5 shows that only 10% of the respondents had no formal education.

TABLE 4.5: Educational levels of rice producers in Jigawa State.

Educational Level	No. of Respondents	%
No formal Education	12	**10**
Primary	**12**	**10**
Secondary	**19**	15.83
Quranic	**23**	19.17
Tertiary		
a) Polytechnic	18	**15**
b) College of Education	23	19.17
c) University	13	10.83
TOTAL	**120**	**100**

Source: Field Survey, 1997/98

It must be noted that in the study area, apart from the Western or formal education, there is another form of education which is known as Quranic. If literacy is taken to mean the ability to read and write, then those with Quranic education are literate. Even though not all of them understand and communicate in Arabic, the language of the Quran, but they read, write and understand "Ajami" (Hausa Language written in Arabic letters).

It is in recognition of this potential in some farmers particularly in the North that National Agricultural Extension and Research Liaison Services has been producing extension messages - guides, poster and pamphlet in Ajami. Example of such publication was the Extension guide No. 13, 1985 on Bambara nut production in Northern Nigeria. About 19.17% of the farmers interviewed have this form of

education.

(f) Other occupations

Apart from farming majority of the respondent were engaged in other occupation such as driving, barbing, trading e.t.c. Table 4.6 shows that 20.83% of the respondents were full time farmers and had no other source of income apart from farming. The table also shows that 20.83% of the respondents combined farming with buying and selling of good as their sources of income.

TABLE 4.6: Sources of income of rice growers in Jigawa State.

Other occupation	No. of Respondent	%
Farming only	25	20.83
Trading	**25**	20.83
Civil servant	**61**	50.83
Commercial drivers	**4**	3.33
Others	**5**	4.17
TOTAL	**120**	**100**

Source: Field Survey, 1997/98

50.83% of the respondents work as civil servant as well as farmers, while 4.17% of the respondents combined farming with other activities such as barbing and butchering.

4.2 Resource use

Modern production technology is usually made available to farmers, either in form of production inputs or practices but to a larger extent as a combination of the two in form of packages. In this sub-section farmers use of inputs and production practices were examined. The inputs examined include fertilizer, labour, seeds, machinery, buildings, pesticides and herbicides.

a) Fertilizer

Fertilizers were used by all the respondents though at varying rates. All the farmers interviewed were found to use fertilizer. This shows that they knew the importance of fertilizer in rice production. It was specifically pointed out that lack of fertilizer and its high price was responsible for the reduction of rice production through reduced hectarage.

TABLE 4.7: Average quantity of fertilizer applied by rice producers in Jigawa State (kg/ha).

Farm size category	No. of respondents	Average rate of fertilizer brands applied in kg/ha		
		NPK	UREA	TOTAL
Small scale	86	267.15	101.55	368.7
Medium scale	34	125.5	87.7	213.2

Sources: Field Survey, 1997/98

Table 4.7 shows the average quantity of fertilizer applied by the two categories of farmers. It shows that the small-scale category used on the average a total of

368.7kg/ha of fertilizer while the medium scale used on the average a total of 213.2kg/ha, representing 63.36% and 36.64% of the total fertilizers used by the two categories respectively.

TABLE 4.8: Sources and prices of fertilizer brands in Jigawa State

Source	No. of Respondents	Fertilizer Brand	Govt. Price (N)	Open Market Price (N)	Difference
Govt. Depot	7	N.P.K 15:15:15	350	1500	+1150
Open market	113	UREA	450	1800	+1350
		CAN	250	1200	+950

Source: Field Survey, 1997/98

From Table 4.8 it can be observed that majority of the respondents 94.17% obtained their fertilizers from the open market while only 5.83% of the respondent reported obtaining their fertilizer from the government depots. Different reasons were given by the farmers for these, most of them find it easier to buy from the open market because they can buy as many as they require at the convenient time and place. Also some of the respondents noted that the sale of fertilizer in the government depots is most of the times politised, as fertilizer is only sold to those who are closer to the government who in turn resold them in the open market at very high prices. The recent government policy on fertilizer production, procurement and distribution has made fertilizer relatively unavailable at the government depots and this had forced many farmers to opt for the

open market where fertilizers are always available. The farmers were observed to have experienced similar prices per bag of the different fertilizer brands in all the three Local Government Areas of the study.

Table 4.8 showed that the common price paid by 5.83% of the respondents at government price for the different brands of fertilizer were N.P.K, N350, SSP N250 and UREA N450 while 94.17% of the respondents paid N1500 for NPK, N1800 for UREA, and N1200 for SSP in the open market. From table 4.8 it was obvious that there existed wide price differentials between government sources and open market sources.

After the examination of the type, price and sources of fertilizer used by the farmers, the rates of fertilizer application were examined. For upland rice, the National Cereal Research Institute (NCRI) Baddegi recommends the following rates per hectare.

TABLE 4.9:Recommended fertilizer rates for upland rice by NCRI

Crop	Fertilizer Type	Rate/Ha
Upland rice	UREA	70 kg N (152kg or 3 bags)
	*CAN	70 kg N 269Kg or 5 ½ bags)
	*NPK	467kg or 9 a bags
	*SSP	30kg P_2O_5 (167kg or 3 ½ bags)
	*TSP	30kg P_2O_5 (567kg or 11 bags

*CAN = Calcium Ammonium Nitrate
NPK = Nitrogen, Phosphorous And Potassium
SSP = Single Super Phosphate
TSP = Triple Super Phosphate
Source: NCRI Advisory Leaflet No. 1, January, 1994.

All the farmers in the two categories used fertilizer at rates at were far below the rates recommended by NCRI (Table 4.7 refers). Therefore, both the small and medium scale farmers have under-utilized fertilizer. All the farmers give different reasons for the under utilization of fertilizer on their rice farms. All of them acknowledge the importance of fertilizer in rice cultivation but complained that high prices coupled with non-availability of the commodity were the major constraints. From Table 4.8 it can be noted that four types of fertilizer were available to the farmers and they used different combination of them. The most common fertilizer used was NPK, over 90% of the farmers used this fertilizer. Some farmers were found to combined NPK with Urea.

b) **Pesticides and Herbicides**

None of the farmers in both the small and medium scale categories reported the use of either pesticides or herbicides. The use of pesticides during the production of crop like rice is usually necessitated by an outbreak of pests or diseases. However, there was no such incidence reported by any of the farmers interviewed, that needed the use of pesticides. As for herbicides most of the farmers, particularly in the small-scale category said that they did not use it, because labour for weeding in form of family and hired labour which is economically cheaper especially considering their small farm sizes was available. As for the medium scale farmers, high price of such chemicals which is much more than labour cost for weeding was their major excuse for not using it.

c) **Machinery**

Machinery compared with other resource is a resource with a difference. It is a fixed asset whose contribution in the production process is intangible. The services of machinery rather than the total material form is what is consumed during the production process. As such, in assessing farmers use of machinery and equipment, two were examined. First, is the ownership and use of the services of machinery and equipment. The second is the use of the services, irrespective of the ownership which is examined in relation to actual use in the 1997/98 growing season, as well as the use of machinery for production purpose by all farmers irrespective of the forms of ownership of the machinery.

The type of machinery and equipment owned and or used by the farmers include; tractors and equipment, delivery truck, sickle, hoes and cutlasses. None of the farmers in both the small or medium scale categories own tractor. However, 30 (88.20%) of the medium scale farmers reported the use of tractor by hiring. Also, 45 (52.33%) of the small scale farmers reported the use of tractor by hiring.

d) **Buildings**

Building, unlike machinery were not a predominant feature of most of the farms. Ten of the farms in the small-scale category had small building structures made of mud and local roofing. None of the farms in the medium scale category had building structure.

e) Seeds

Seeds for planting were either bought or obtained from previous years' reserve. 85.23% of the medium scale farmers reported using seeds bought from the market, while the remaining (14.77%) reported using seeds from previous harvest for planting. It was observed that farmers used different seed rates per hectare. While the National Agricultural Extension and Research Liaison Services (NAERLS) recommended 33 - 36 kg of seed per hectare for upland rice, the small-scale farmers on the average, used 18.52kg/ha while the medium scale category used on the average, 15.12kg/ha. There was under-utilization of seeds which consequently affected output. Table 4.10 shows the average rate of resources by the farmers in the different farm size category.

Table 4.10: Resources employed by sole rice growers in Jigawa State 1997/98.

Farm size category	Labour (man – days/ha)		Other resources		
	Family	Hired	Fertilizer Kg/ha	Seeds kg/ha	Average holding (ha)
Small scale	24.85	126.6	368.7	18.52	1.2
Medium scale	5.20	34.43	213.2	15.12	4.0

Source: Field survey, 1997.98

4.3 Labour

Labour is work done by human beings. While it is recognized that work can be done using other sources of power, human labour is the major focus in this sub-section.

The discussion on human labour is centered on the family and hired labour force. This is because of the observed importance of these categories of human labour from the

data. It was observed that all the farmers in both categories carried out their production activities from land preparation to harvesting by using one form or combined form of these types of labour. Among the two categories of the labour mentioned, the most prevalent was the hired labour force which is locally known as "kodago". This could be in the form of contract, which involves a contractual agreement between the farmers and the labourer. In this case the labourer is shown the area where the operation is to be carried out and based on the area and the nature of the job a price is struck, after which the labourer is given the free hand to do the job. In most cases part or advance payments are made initially and the balance paid after the farmer is satisfied with the completion of work. The determinants of the amount to be paid are type of operation to be performed such as weeding, ridge making, workability of the soil e.t.c. More often than not, payment is on per acre basis; which could be higher or lower than the prevailing rate in the locality depending on the aforementioned determinants and the interpersonal relationships between the farmer and the labourer.

Table 4.11 is a summary of labour usage employed by the farmers for different production activities. The table shows that ridging operation is most cases was done manually had the highest percentage of (27.6%) of the total input. The small-scale farmers used 13.77% of their total labour for ridging while the medium scale farmers used 13.99%. Weeding operation accounted for 27.15% of labour input which was used 15.23% among the small-scale farmers and 11.92% among the medium scale farmers. Harvesting and threshing expended 26.13% of the total labour input. The small scale

used 14.25% while the medium scale farmers used 11.88%. Winnowing and bagging, fertilizer application, planting and land preparation consumed 6.21%, 2.12%, 4.59% and 6.05% of the total labour input respectively.

TABLE 4.11: Summary of labour inputs in man-days per hectare for 120 rice growers in Jigawa State.

Farm size category	Operation	Labour (Man - days)		Total	%
		Family	Hired		
Small scale	Land preparation	1.698	2.443	4.141	6.05
Medium scale		0.436	2.252	3.388	
Small scale	Ridging	3.448	16.14	19.59	27.76
Medium scale		0.4367	14.63	15.11	
Small scale	Planting	1.085	2.884	3.969	4.59
Medium scale		0.5588	1.3860	1.945	
Small scale	Weeding	3.120	18.566	21.60	27.15
Medium scale		0.6617	12.21	12.87	
Small scale	Fertilizer application	0.6202	0.9554	1.5756	2.12
Medium scale		0.2515	0.8382	1.089	
Small scale	Harvesting & threshing	3.649	16.64	20.28	26.13
Medium scale		0.7205	12.11	12.83	
Small scale	Winnowing & bagging	0.9767	3.314	4.292	6.21
Medium scale		1.157	2.289	3.447	
	Total				100

Source: Farm Survey, 1997/98

The total family labour used by the small-scale category was 1506.4 man-days an average of 14.57man-days/ha against the medium scale that expended 579.8 man-days

of family labour, an average of 4.26man-day/ha. The small-scale category expended a total of 6288.9 man-days of hired labour an average of 60.82man-days/ha while the medium scale category used a total of 6312.5 man-days of hired labour, an average of 46.42man-days/ha. A total of 14687.25 man-days of labour were used by all the farmers for the different operations in rice production, an average of 61.35man-days/ha. Family labour accounted for 14.20% of the total, while hired labour accounted for 85.8% of the total labour.

4.4 Marketing of Produce

The existence of markets makes possible the existence of specialized production. People can exchange their produce with what they cannot produce and therefore are encouraged to concentrate on a particular line of production where they can gain more skill and becomes more efficient. The mechanism by which people can exchange what they produce with what they cannot produce is marketing.

In the study area, there are rural markets, which are held periodically once or twice a week. The rice produce are brought by the farmers to the rural markets where the buyers participate actively in assembling the produce. It was observed that farmers sold their rice produce at different times through different channels.

Table 4.12 shows that majority of the farmers in both categories (75%) sold their produce in the rural markets, while 25% sold their produce to the local buyers. The

implication is that the farmers received different prices for their produce. All the farmers in the medium scale category reported selling their produce in the rural market. This was because of the possible advantage of selling at higher prices. In the rural markets, prices were determined through the process of haggling. The price arrived at remain the ruling market price for that day, although other factors such as familiarity between the buyers and sellers, the time of the day the transaction was made and the language spoken by the buyer could influence the actual price paid.

The unit of measure was not standard it varies from one market to another. In some markets the commodity was sold in bags of 50kg or 100kg while in some remote markets it was sold in "Tiyas". The local buyers purchased directly from the farmers by making contacts with them in their various homes or farms. The price the farmer receives also depends on his bargaining power and his knowledge of the ruling market price. The advantage here is that it saves the farmer of transportation costs to the markets.

Table 4.12:Means of marketing rice by rice growers in Jigawa State.

Farm size category	Rural market	Co-operative market union	Local buyers
Small scale	56	-	30
Medium scale	34	-	-

Source: Field Survey, 1997/98

None of the respondents reported selling his produce through the co-operative market union. This was because such union, do not exist in all the areas of study. The average prices received by the rice growers from different marketing channels are shown in table 4.13.

Table 4.13:Prices received by rice growers in Jigawa State.

Type of market	Average prices received/bag in N		
	50kg	100kg	Mudu
Rural market	1000	2000	50
Local or farm-gate buyers	950	1800	45

Source: Field Survey, 1997/98

Table 4.13 shows that farmers that sold their produce through the rural market on the average received higher prices than those who sold through the other means. The higher prices received by the farmers that sold in the rural market was made possible because buying in large quantities from the farmers minimizes the farmers' marketing and transportation costs.

The inference drawn from this analysis was that a well organized marketing system is that all farmer needs as an incentive to increased output.

4.5 Costs and Returns Analysis

4.5.1 Costs

The costs and returns in rice production in the study area are discussed based on the following assumptions.

1. Open market prices for some inputs rather than subsidized prices were used, because most farmers found it difficult procuring these inputs from the subsidized sources. Fertilizer is a case in point, while the subsidized price at the time of the study was N450 for Urea and N350 for NPK, the open market prices were as high as N1800 per 50kg bag of Urea and N1500 per 50kg of NPK. Only 5.83% of the respondents got their fertilizer from government or subsidized sources while the remaining 94.17% bought from the open market.
2. Hired and family labour usage were prominent in the areas and for this exercise labour charges were calculated at the prevailing rate of N60.00 per man-day.
3. In the study area, N2500 was charged on the average as rent for land per hectare. This figure was taken as the opportunity cost of land.

The average total cost of production incurred by all the respondents was Twenty-one Thousand, Four Hundred and ninety-three Naira, Sixty-nine Kobo (N21,493.69k) per hectare. The average total cost is made up of both fixed and variable components. The values of the various cost components are presented in Table 4.14.

The total fixed cost (Tfc) for the small scale category was N86,188.3k, an

average of N1,002.2k per hectare, while the total variable cost (Tvc) was N2009,563.73k, an average of N23,367.01k per hectare. The medium scale farmers incurred a fixed cost of N17221k, an average of N506.5k per hectare. As shown in table 4.14, variable costs accounted for 95.99% while fixed costs accounted for 4.009% of the total costs of production. The fixed costs constitute the cost of land rent only.

TABLE 4.14:Average costs analysis of rice growers in Jigawa State, 1997/98 (N/Ha).

Variable inputs	Small scale	Medium scale
Labour (man - days/ha)		
Family	1540.45	242.23
Hired	8321.11	2494.45
Fertilizers (kg/ha)		
NPK	6507.33	5579.43
UREA	3889.50	2347.16
Seeds (kg/ha)	355.36	315.89
Bags	1037.17	1065.59
Marketing cost (Transportation)	703.25	760.68
Tractor hire charges (N/ha)	1012.84	908.47
Fixed costs Land rent	1002.2	506.5
AVERAGE TOTAL COST	**24369.21**	**14220.40**

Source: Calculations from field survey, 1997/98.

Depreciation on equipment's and tools such as hoes and cutlasses was not included because the farmers were not using the equipment's or tools for the rice production enterprise only but for a combinations of other enterprises. Hence the wear and tear cannot be due to rice production activities only.

4.5.2 Profitability measures

Returns

Yields were observed to vary from farm to farm size categories. The average yield by farm size category is shown in table 4.15.

TABLE 4.15: Rice yield per hectare, in Jigawa State.

Farm size	Average yield kg/ha	No. of respondents	% total of respondents
0.1 - 1.0	3891	61	50.83
1.1 - 2.0	2815	20	16.67
2.1 - 3.0	2310	5	4.167
3.1 - 4.0	3580	20	16.67
4.1 - 5.0	3870	10	8.33
5.1 - 6.0	4393	4	3.33

Source: Field Survey, 1997/98

For this analysis returns were calculated based on the average of these figures which gave 3.948 tons per hectare for the medium scale farmers and 3.005 tons per hectare for the small-scale farmers. The table indicated that 50% of the respondents produced an average of 3.89 tonnes/ha, while 16.67% produced an average of 2.185 tonnes/ha, 4.167% produced an average of 2.310 tonnes/ha, 16.67% produced an average of 3.580 tonnes/ha, 8.33% produced an average of 3.870 tonnes/ha and 3.33% produced an average of 4.393 tonnes/ha.

Based on the selling price of N15.000 per tonne for 1997/98 season, the returns were calculated. The various measures of return to rice production among the respondents are shown in table 4.16.

TABLE 4.16: Average costs and returns per hectare from the production of rice in Jigawa State, 1997/98. (N/ha).

(a) Variable inputs	Small scale	Medium scale
Hired labour	8321.11	2494.45
Family labour	1540.45	242.23
Fertilizers	10369.83	7926.59
Seeds	355.36	315.89
Bags	1037.17	1065.59
Marketing cost (Transportation	703.25	760.68
Tractor hire charges	1012.84	908.47
(b) Fixed costs		
Land rent	1002.2	506.5
(c) Average total cost	24369.21	14220.40
Gross returns	45075	59220
Net farm income (costing family labour)	20705.8	44999.6
Net farm income (Not costing family labour)	22246.2	45241.8
Average rate of return		
costing family labour	N1.84	N4.16
not costing family labour	N1.96	N4.23

Source: Calculations from field survey data 1997/98.

Table 4.16 shows the various measures of return to rice production among the respondents. The gross return per hectare for the small scale category was N45.075k and N59,220 for the medium scale category. The table also shows that the net returns per hectare were N20,705.8k (costing family labour) and N22,246.2k (excluding family labour) for the small scale category and N44,999.6k (costing family labour) and

N45,241.8k (excluding family labour) for the medium scale category.

The net farm income calculated excluding or not costing family labour for the two categories represent returns to management, labour and capital inputs, while that calculated costing family labour is a measure of returns to management and capital. The average rate of return to total investment including the imputed cost of family labour was 184% and 416% for the small scale and medium scale categories respectively. Excluding family labour the average rate of return to total investment was 197% and 423% for the small and medium scale categories respectively. This implies that on the average, a profit of N1.84k costing family labour and a profit of N1.97k not costing family labour was realized on every Naira invested by the small scale farmers, and N4.16k and N4.23k by the medium scale farmers in rice production respectively.

Further analysis of the production indicated that the unit grain production cost for the small scale farmers was N0.12 per kilogram (N0.12/kg) and unit grain price was N2.00 per kilogram (N2.00/kg). The unit grain production cost for medium scale category was N0.28 per kilogram (N0.18/kg) and the unit grain price was N2.6 per kilogram (N2.6/kg). Thus, these figures indicated that rice production was a profitable enterprise. Farmers yield level required to break even in terms of costs and returns are 1.65 tonnes/ha and 1.20 tonnes/ha for small and medium scale categories respectively.

4.6 Production Function Analysis

In this section, the interest is to determine the nature and magnitude of the relationship between the inputs and output in rice production. The three types of production functions mentioned in chapter three were fitted to the data. The following criteria were used in selecting the estimated equation used in computing the resource use levels in rice production.

a) correct signs of explanatory variables

b) significance level of the coefficients with respect to t-values and

c) the adjusted value of the coefficients of multiple determination ($\bar{R}^2$)

Based on the aforementioned criteria, the Cobb-Douglas production function was selected as the equation of best fit. The results of the estimated production functions are presented in Table 4.17a and 4.17b. A dummy variable was used to represent the two categories of farmers, that is small and medium scale categories. The dummy variable affect the constant term of the equation only. Its coefficient b5, shows the difference between the constant term of the equation for the medium and small-scale categories (Olayide, 1981). The advantage of using the dummy variable is that instead of estimating a separate regression equation for each category, one equation for both categories was estimated and at the same time the difference between the two categories was shown.

Table 4.17a: Results of Estimated Cobb-Douglass Function for Rice Production in Jigawa State, 1997/98.

Sample size	Coefficients						F-ratio	$\bar{R}^2$
	Constant	Log X_1	Log X_2	Log X_3	Log X_4	X_5		
120	6.18*	1.29*	0.56	0.32*	0.29*	0.10	40.96	0.6287
		(0.334)	(0.236)	(0.465)	(0.211)	(0.377)		

Source: Calculations from field survey data, 1997/98.

Notes:

(i) Figures in parentheses are standard errors
(ii) * = Significant at 5% level of probability

Table 4.17b: Results of Estimated Quadratic Function for Rice Production in Jigawa State, 1997/98.

Sample size	Coefficients									
	Constant	X_1	X_2	X_3	X_4	X_5	X_1^2	X_2^2	X_3^2	X_4^2
120	-533.09	1250.8 (1229.7)	33.06 (57.87)	7.396 (3.297)	4.954 (10.55)	5194.4 * (1377.4)	-0.7272 (1.9151)	-0.2171 (0.1819)	0.0031 (0.031)	-31.11 (590.73)

Table 4.17b Contd.

Coefficients					F-ratio	$\bar{R}^2$
X_1X_2	X_1X_3	X_1X_4	X_2X_3	X_2X_4		
-2.346 (48.84)	-1.679 (2.568)	0.7457 (3.272)	0.1524 (0.1479)	-0.2689 (0.2923)	58.33	0.8718

Source: Calculations from field survey data, 1997/98.

Notes:

(i) Figures in parentheses are standard errors

(ii) * = Significant at 5% level of probability

The estimated Cobb-Douglas function is shown as follows:-

$$\text{LogY} = 6.18 + 1.29\log X_1 + -0.56\log X_2 + 0.32\log X_3 + 0.29\log X_4 + 0.10X_5 + \text{loge}.$$

From the adjusted value of the coefficient of multiple determination ($\bar{R}^2$) of the Cobb-Douglas function, the inputs explained 62.87% of the variation in rice output for all the respondents. This is a reasonably high percentage considering that other important explanatory variables, such as soil fertility, seed viability, farmers' management abilities, and timeliness of cropping operations are not included in the model. The f-value (40.96) of the regression equation was significant at one percent level of probability which suggests that the independent variables included in the model were important in explaining the variation in the dependent variable. Thus, the proposition, which says that the explanatory variables included in the model are not important determinants of rice yield, was rejected.

From the critical t-values of the regression coefficients farm size (X_1), fertilizer (X_3) and labour (X_4) were found to be significant at 5% level of probability while seeds (X_2) and the dummy variable (X_5) were not significant at 5% level of probability.

The coefficient of the dummy variable 'b_5' affects the constant term of the equation. Its positive value indicated that the value of the constant term is higher for the medium scale category than it is for the small-scale category. The reverse would have been the case if 'b_5' is negative, statistical test of significance as obtained from the multiple regression results

indicated that 'b_5' was not statistically significant level of probability hence the difference between the constant term of the equation for the medium and small scale categories was not statistically significant. The implication of this is that the medium scale category were technically more efficient (because of the higher constant term) than the small scale category but the difference was statistically insignificant.

4.6.1 Efficiency of resource use

The marginal value products from the Cobb-Douglas production function was computed for those resources that were found to be statistically significant. The MVPs of factors when equated to their respective factor prices indicate the efficiency of resource use. The MVP for land, fertilizer and labour inputs were calculated as follows:

$$MVP = \frac{bi.\bar{Y}_i Py}{\bar{X}_i}$$

Where :

MVP = Marginal value product of each resource

bi = elasticities of production of each resource

$\bar{Y}_i$ = geometric mean of crop yield

$\bar{x}_i$ = geometric means of the resources (x_i)

Py = unit price of output

Table 4.18: MVPs from Cobb-Douglas function

Variable	$\bar{X}i$	Ufc	Mvp	Mvp/Ufc
Land (X_1)	1.99	2500	31815	12.72
Fertilizer (X_3)	324.6	34	48.38	1.42
Labour (X_4)	119.7	60	118.9	1.98

$\bar{Y}$ = 3272kg

Py = N15 per kg

Ufc = unit factor cost

Mvp = marginal value product

Source: Calculations from field survey data, 1997/98

The ratio of the MVP to Mfc was used to compare the productivity and efficiency in rice production, it was assumed that the farmers choose inputs combination in such a way as to maximize profit. A necessary condition is that;

$MVP_{xi} = P_{xi} = Ufc$

Where:

MVP_{xi} = Marginal value product of the factor Xi

Ufc = Unit factor cost

Pxi = Price of factor Xi

To use the ratio of MVP to Ufc as a basis for comparison, it is expected that;

a) a value of the ratio equal to one implies optimum (i.e. efficient use of the inputs)

b) a value greater than one implies that increase return will be achieved if more of such input could be used and it also indicated that such input had been under utilized.

c) a value of the ratio less than one implies that it would be better to decrease the use of such inputs so as to minimizes loses, i.e. production at that level of inputs was unprofitable since the marginal contribution of the input to output was less than the opportunity cost of the input.

Table 4.22 shows that the value product of land was N31815.0k which is much higher than the opportunity cost of land (N2500). The ratio of the MVP to Ufc for land was greater than one, implying that the farmers could increase output of rice by using more land. So also was the value of fertilizer (1.42) and labour (1.98), which also implies that more output could be produced by using more of fertilizer and labour. The inference drawn from this analysis was that resources employed in rice production were not efficiently utilized. Hence the hypothesis put forward in chapter one was accepted.

4.6.2 Return to scale

Return to scale refers to the behaviour of the output when all the factors of production are changed simultaneously in the same proportion. In the Cobb-Douglas production function, the regression coefficients equals the elasticities of production of the respective inputs and their sum indicates return to scale. If the sum of the elasticities of production is equal to one, it is then an indication of constant return to scale, if the sum of the elasticities are greater than one or less than one then we have increasing or decreasing returns to scale respectively.

Table 4.17 shows that rice production indicated an increasing return to scale (Σbi = 1.44). The economic implication of this is that the farmers are still in the irrational stage of production i.e. production is still at the early stages, where output is increasing as a result of increase use of some factors of production. The economic explanation for this could be that the farmers have not been combining their inputs properly.

4.7 Cost – farm size relationships in rice

In this sub-section the relationship between farm size and cost of production is examined. It was observed that the average total cost (ATC) of production per hectare decreased with increase in farm size. While the ATC of production for the small scale category was N24,369.17/ha, it was N14,220.4/ha for the medium scale category; (Table 4.14). The average total cost for all the farmers was N21493.69. This amount was lower than that of small-scale category but higher than that of the medium scale category. However, in all the farm size categories, variable cost was found to contribute higher proportion to the total cost of production than fixed cost, variable cost constituted 95.87% of the total cost of production by the small scale category and 94.44% by the medium category. The variable cost were composed of material input and operation costs. Fertilizer was found to be one of the most important physical input in rice production in all the farm size categories, though at varying degrees of importance and application. Fertilizer constitutes about 42.67% of the total cost of production by the small scale category and 55.74% by the medium category.

Ridging and weeding were found to be the most critical operations requiring more labour

days and hence higher cost in rice production, in all the farm size categories.

The fixed cost which is land rent was found to be N2500 per hectare on the average. The fixed cost constitute about 4.11% of the total cost of production in the small scale category and 3.56% in the medium category.

4.8 Factors Militating Against Increased Rice Production

Given the relatively high positive returns per hectare of rice, it is surprising that enterprising farmers have not used all the available land to produce rice, and why the country is yet to attain self-sufficiency in rice production. Constraints to increased production of rice in the study area as identified by the research include;

i) inadequate fund

ii) high cost of farm inputs especially fertilizer

iii) labour shortage at some stages or points during the production period

iv) marketing problems

v) government policies

i) Inadequate funds

The findings of this study revealed that the level of operation of most of the surveyed farmers was fixed by resource constraints mainly financial. Most farmers reported that they would devote more resources to rice production if suitable financing is available at affordable rate.

ii) **High cost of farm inputs**

The study revealed that fertilizer and labour costs were some of the major bottlenecks to increased rice production in the study area. It was reveal that investment costs incurred by the farmers in the purchase of fertilizers and labour were considerably high, fertilizer accounted for about 45.12% of the total costs of production by all the farmers while labour accounted for 36.49%. The high cost of fertilizer coupled with its short supply when required by the farmers forced the farmers to apply dosages that are below recommended rates.

iii) **Labour shortage**

The study revealed that there was labour bottleneck in rice production due to higher demands during harvesting and weeding when more farmers are compelled to hired more labour. The shortage of labour at these crucial stages of rice production had forced many farmers to delay the operations, which consequently affect output.

iv) **Marketing problems**

The study revealed that majority (75%) of the farmers sold their rice produce in the rural markets. In such markets the prices the farmers received was often dependent on his bargaining power; which could have been higher if the farmers sold their produce through more organize channels such as marketing cooperative. However, in all the study area there was no such cooperatives at all. The lower prices the farmers received for their rice produce is as a result of marketing through a less organized channels was also a major constraint to increased rice production.

v) **Government policies**

Government policies were also found to be another important constraints to increased rice production in the study area and the country in general. A case in point, was the recent removal of ban on rice importation. This was believed to have cause a decrease in the aggregate demand of domestic rice and there by causing a fall in its price, hence discouraging increased domestic production.

The recent abrogation of mandatory credit allocation to the preferred sectors of the economy (agriculture inclusive) as announced in the 1997 budget has further decreased farmers access to credit. This has serve as disincentive to increased rice production.

CHAPTER FIVE

5.0 Summary, Conclusion and Recommendations

5.1 Summary of findings

The major findings of the study were as follows:

Majorities (71.67%) of the respondents were small-scale farmers cultivating three or less than three hectares of rice farm. 28.33% were medium scale cultivating 3.1 - 6.0ha of rice. A total of 239.2 hectares of land was under sole rice cultivation by all the respondents. The study revealed that about 30.83% of farmers were within the age bracket of 21 and 30 years, 30.0% within the age bracket of 31 - 40 years and 19.17% were within the age bracket of 41 - 50 years. The study also shows that only 10% of the respondents were illiterate with no formal education. 10% had up to primary education, 15.83% had up to secondary education, 19.17% had Quranic education while 45% of the respondents went to tertiary institutions. It was also found that majority of the illiterate farmers were in the small-scale category. While about 30% of those who had secondary education and above were in the medium scale category. Farming was the only source of income and occupation for 20.83% of the respondents.

All the farmers reported the use of fertilizers but at varying rates that were far below the recommended rates. The National Cereal Research Institute (NCRI) recommends an average of 467kg/ha of fertilizer for upland rice but the small scale farmers use on the average 368.7kg/ha and the medium scale farmers use 213.2kg/ha of fertilizer on the average. The respondents also planted seeds at the rates that were below the recommended rates per hectare

but reported the use of improved varieties. The National Agricultural Extension and Research Liaison Services (N.A.E.R.L.S.) recommends 33-36kg/ha of seeds on the average, but the small scale use 18.52kg/ha on the average while the medium scale use an average of 15.12kg/ha. The low utilization of some vital inputs like seeds and fertilizers could be responsible for the very low yields reported by some of the respondents.

The study also revealed that there was complete absence of usage of both herbicides and pesticides by the two categories of farmers. It was observed that some of the respondents had little knowledge about the uses of herbicides and pesticides.

The major input was human labour consisting of family and hired force. There was a complete absence of communal force in the area of the study. Family and hired labour were used in all the stages of production all the respondents.

The study found that labour was the most critical requirement in rice production. A total of 14687.25 man - days of labour were expended by all the farmers, accounting for 36.49% of the total cost of production. Net returns per hectare, which was N20,705.8 (costing family labour) for small scale farmers and N44,999.6 (costing family labour) for medium scale farmers increased with increased in farm size. The total cost of production per hectare, which was N24369.21 for small-scale farmers and N14220.40 for medium scale farmers decreased with increase in farm sizes. Yield per hectare did not show any significant variation among the farm size categories in all the areas but farmers in the medium category were observed to have higher

yields per hectare than those in the small-scale category. This could be attributed to higher levels of farm sizes, and inputs such as fertilizers and seeds.

Fixed cost constituted only 4.01% of the total cost of production by all the respondents and therefore less significant than variable costs (95.99%).

Rice production was observed to be profitable in the study area. An average rate of return per Naira investment of N1.84 and N4.16 when family labour was costed for the small scale and medium scale categories respectively and N1,97 and N4,23 when family labour was not costed respectively. Though rice production was observed to be profitable and local production has increased substantially since the ban on the importation of rice in 1985, this profit is not very adequate and Local production is also yet to meet local demand.

The resulting MVP to Ufc ratios for land, labour and fertilizer were greater than unity, 12.72 and 1.42 respectively. This indicate that these resources were under used on the sample fields during the survey year. Rice production in the study area indicated an increasing return to scale which suggested that the farmers are still in the irrational stage of production and more of the output could be produce by using more of some of the resources (i.e. fertilizer and land).

5.2 Conclusion

This study has revealed that rice production in the study area was profitable. The level of profitability measured by the farm income has been relatively high but not quite sufficient due to high costs of production inputs like fertilizer and labour. Farmer's production per hectare

was also found to be high but not sufficient due to observed inefficiency in the utilization of productive inputs. The study suggest that more output of rice could be realized by increasing the level of resources committed to rice farming and this can be achieved by improving the farmer's access to inputs and support services.

5.3 Recommendations

To attain the much needed self-sufficiency in rice production in the country, the various constraints identified earlier should be addressed and removed. These constraints may be minimized with the following suggestion:

1. In order to reduce costs, especially that of fertilizer, the farmers should be provided with adequate productive inputs at affordable prices. As such the recent policy that remove subsidy on fertilizer should be removed. The agencies responsible for the procurement and distribution of fertilizer must devise a means of ensuring fair and even distribution of such input and this can be achieved through the decentralization of the sell of such input so as to allow the farmers in the interior villages to have access to the inputs.
2. The farmers should also be educated on the need to form marketing cooperatives through which they can market the produce at cost and received better prices.
3. An effective farm management advisory services should be provided so as to enable the farmers learn how to use the available resources they have effectively and efficiently in order to increase their productivity.
4. The level of operation of most surveyed farmers was fixed by resource constraint,

mainly financial. Most farmers reported that they would devote more resources into rice production if suitable financing is available at affordable rate. Therefore, there is the need to provide credit facilities to the farmers to enable them increase their level of resource use. The rural banking scheme should be intensified, and the credit delivery system should be improved to accommodate more farmers with varying socio-economic status.

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