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ECONOMIC ANALYSIS OF SMALL-SCALE RICE PROCESSING AMONG WOMEN IN LAFIA LOCAL GOVERNMENT AREA OF NASARAWA STATE, NIGERIA

Omolara Adebimpe Adekanbi
Nasarawa State University, Keffi, Nigeria

Abstract
This research investigates the technical efficiency, challenges, and contributions of women in the small-scale rice processing sector in Lafia Local Government Area (L.G.A.), highlighting their dominance in the rice production value chain. Using Data Envelopment Analysis (DEA), the study determined a mean technical efficiency of 57%, indicating significant room for improvement, as inefficiencies suggest a potential 43% increase in processed rice output if less efficient processors adopt better strategies and techniques. The analysis identified multiple challenges faced by women in the sector, including epileptic power supply (87%), the adverse impact of foreign rice on local demand (30%), poor pricing of polished rice (27%), high levels of impurities and broken grains (26%), lack of access to credit facilities (17%), and the poor state of infrastructure, particularly outdated or insufficient rice mills (15%). Furthermore, societal constraints related to marriage and childcare, though less significant, were mentioned by a minority. Despite these limitations, women play a central role in the processing sector, with their resilience and entrepreneurial efforts sustaining small-scale rice production. The study underscores the urgent need for targeted policy interventions to address infrastructural deficits, improve access to credit, stabilize local rice pricing, and enhance technical capacity through training and innovation. By resolving these issues, the efficiency and output of women processors can be greatly enhanced, contributing to improved livelihoods and greater food security in the region.

Keywords Economic analysis, rice processing, technical efficiency, challenges, and contributions.

INTRODUCTION

Background of the Study

Rice is a cash crop for Nigerian rice producers, which means it is produced primarily for market. Besides this, it is widely consumed in Nigeria. Nigeria has experienced a rapid growth in rice per capita consumption during the last three decades from 5kg in the '60s up to 25kg in the late '90s (FAO, 2002). Based on Table 1.1, it is obvious that Nigeria is becoming one of the major importers of rice in the world market. The foreign exchange is as high as US $1 billion annually to import rice (FAO, 2002).

A combination of factors seems to have triggered the increase in rice consumption including urbanization and ease of preparation that fits easily with the urban lifestyle of workers.

Domestic production is however below the national rice demand and Nigeria has had to fill the gap by resorting to importing milled rice. The average milled rice production in Nigeria between the '70s and '80s and 2001 to 2006 is shown in Table 1.1.

Table 1.1: Average Milled Rice Consumption and Production in Nigeria (1970s - 1980s & 2001-2005)

Year	Consumption (tonnes)	Production (tonnes)
1970s	1,134	357.24
1980s	2,048	1,177.95
1990s	3,419	2,086.24
2001-2005	4,333	2,186.40

Source: Africa Rice Center (WARDA), 2007.

Role of Women in Rice Processing

The National Cereal Research Institute (NCRI) has developed a rice technique capable of producing high-quality rice, that is comparable to imports, and it carried out a study in 1991 to measure the extent to which women had adopted the technology because women do ninety percent of the work involved in processing rice (Ike Nwachukwu, 2002).

Women do the cleaning of paddy to remove extraneous matter, such as soil, crumps, stones, stalk or straw, dust, weed seed, insects, twine, and pieces of metal. The next stage is parboiling which involves steeping the paddy in water and raising the temperature to a required level to gelatinize the endorsed kernel; this is also carried out by women. They also do the cooking, steaming, and drying of paddy. Some of the women possess small scale milling machines but are very few compared to male mill owners.

Statement of the Problem

Despite the fact that women are highly involved in processing, they are not regarded as a target group for agricultural policies in order to achieve self-reliance in Nigeria and to eliminate rice importation. Instead, the various plans, policies, and programs formulated for the agricultural sector such as the Operation Feed the Nation Program during the plan period (1981-1985) made no direct reference to the rural women as the target group neither did it show them any recognition (Christiana, 1991).

Furthermore, women face constraints that reduce the efficiency of their labor. For example, women are restricted to the use of primitive or traditional milling methods which are very tiresome and less efficient. The study which measured the extent to which women had adopted the processing technology developed by NCRI in 1991 showed that only 49% of women knew about it and fewer had used most of the techniques taught (Ike Nwachukwu, 2002). The reason for this is that women have little access to extension services because very few female extension agents are available compared with the number of processors. In addition, women in the rural areas that are involved in rice processing have limited education, land, agricultural inputs, and credit facilities.

For Nigeria to achieve self-reliance and eliminate rice importation, positive returns must be realized by the rice processing industries, at least they should break even. The question is whether the participants (i.e., women) in this industry operate profitably or not. Do the inputs and method they use in processing rice encourage profitability? What are the problems associated with rice processing among women especially in Lafia? These are the questions that gave rise to the following research questions:

1. What are the socio-economic characteristics of women in rice processing?
2. What are the inputs used for rice processing?
3. What are the costs and returns of small scale rice processing?
4. What is the technical efficiency of small scale rice processing among women in Lafia L.G.A.?
5. What are the problems associated with rice processing in Lafia local government area?

Objective of the Study

The general objective of this study is to examine the economic performance of small scale rice processing carried out by women in Lafia local government area of Nasarawa state.

The specific objectives are to:

1. Describe the socio-economic characteristics of women participants in the small scale rice processing in the study area.
2. Determine the inputs used and method of processing rice among women in Lafia local government area.
3. Estimate the cost and returns of small scale rice processing by women in Lafia local government area.
4. Calculate the technical efficiency of small scale rice processing among women in Lafia local government area.
5. Identify the problems associated with rice processing among women in Lafia local government area.

Justification of the Study

Nigeria is one of the major rice-importing countries in the world (FAO, 2001), therefore one of the most important objectives of the agricultural sector is to achieve self-reliance in rice production in order to eliminate rice import. In order to take advantage of the potentiality of the country to provide sufficient rice for the demand, rural women who produce and process most of the rice grain must become the focus of agricultural policies (Christiannah, 1991).

The data collected by NCRI in 1991 shows that out of 28 states from which the data was collected, it is only in two states that men process rice. In the other states, rice processing is done mostly by women. Therefore, there is an urgent need to give support to these women in order to achieve self-reliance by eradicating the constraints that these women face so as to enhance the efficiency of the small-scale rice processing among women.

The small-scale mills are the:

(i) the traditional hand pounding method

(ii) the simple mechanized small-scale milling method

(iii) the modern large-scale milling method

Estimates (Presidential Rice Initiative, 2002) indicate that there are 3500 small/medium rice mills scattered all over Nigeria but most are concentrated in Lafia (Nasarawa state), Abakiliki (Ebonyi state), and Bida (Niger state), and about 85% of Nigeria rice is processed through small units.

Lafia local government area, which is the case study, lies within the rice-producing areas of the River Benue Basin. As a result, a harvest of rice is turned out every year which requires efficient and functional processing facilities.

Study Area Importance

The study area is important because it will provide information to reveal the points and areas in small rice processing among women that require modification of policies, intervention, adjustment, and improvement to enhance the processing of good quality rice under a more advanced and efficient method of rice processing. The findings of

this study will provide vital information to women who process rice in the state. It is also envisaged that this study will bring to focus areas where government policies are needed to improve both the quality of life of women processors and the quality of rice processed locally.

LITERATURE REVIEW

Rice Production

Among low- and middle-income countries, rice is by far the most important crop worldwide. In particular, rice is closely associated with the south, southeast, and East Asian nations extending from Japan. Here the population pressure on limited land resources is high, and close balance is maintained between rice production and food needs. Within this area, rice is preeminent: it occupies more than one-third of total planted area in most countries, and one-fifth or more of China and India. Of 25 major rice-producing countries, 17 are located within this region. The eight countries outside the region produce less than 6% of the world's rice. World rice demand is predicted to increase at about 1% per year from 2001 to 2025.

From 1965-67 through 1989-91, the improvements in production spawned by the Green Revolution spread rapidly. During those years, total rice production almost doubled. Most of this increase came from increased yields and increased cropping intensity, although some resulted from new land brought under cultivation or shifted into rice from other crops. Much of the yield increase could be traced to the introduction of dwarfing varieties and to the increased use of fertilizer and irrigation water outputs (MacLean et al., 2002).

Rice is ranked fifth among the food crops in Nigeria. It is widely cultivated in the country in the former Benue Plateau state (present-day Nasarawa state inclusive), northwestern and western states as the leading producing states in that order, followed by Kwara and East Central states (Barau, 1979). Production of rice on average has increased in Nigeria over the years.

Rice as a Women's Crop

In many areas of West Africa, rice is produced primarily by women farmers, thus producing an important share of their income. Women's economy tends to benefit children and other vulnerable groups more than the income of men. Despite this fact, past efforts to develop and transfer new rice technologies have most often bypassed women farmers. Thus, although rice research can be particularly effective in improving the welfare of rural groups at risk, it needs to be explicitly structured and focused to deal with complex gender issues.

In recent years, it has been recognized by researchers and development agencies that women contribute between 60-80% of agricultural production in developing countries. Moreover, researchers are finding that women farmers tend to predominate in the group that most programs try to reach, namely: smallholders, low-income producers of the most essential crops for self-sufficiency for families, communities, and countries (Maclean, 2002).

Processing in Agricultural Development

Processing is one of the most important physical functions of marketing. For the fact that a large portion of farm production undergoes some degree of change between harvesting and final use, processing is perhaps the most important component of agribusiness development; and because it is capable of strongly shaping farm production processes (Olayide and Heady, 1982).

The purposes of processing are quality enhancement, presentation, and product differentiation. Certainly, in their raw form, most farm products do not give satisfaction unless they are transformed into more acceptable forms

through processing. Simple processing methods can transform perishable crops and cereals into a range of storable value-added products, which can meet the needs of the expanding markets (Ferris, 1999).

Processing is a source of income for many low-income earners in Nigeria; it provides employment opportunities for many people in rural areas. Processing generates exports because raw material must be processed into forms suitable for export. Processing stimulates increased food production for the domestic economy; they contribute to the country's food security by improving storage, transportation, and handling.

Importance of Women in Rice Processing

In Nigeria, the status and role of women vary from one ethnic group to the next. Women play an essential role in socio-economic life. Traditionally, women provide food for the family and are also responsible for performing other stressful household chores.

In 1985, the Nigerian Stored Products Research Institute estimated that between 30-50% of grains, roots, and tubers, and nearly 100% of the fruits and vegetables end up as waste because of poor processing and storage. In June 1989, the chairman of the Directorate of Food, Roads, and Rural Infrastructure asserted that an estimated N17.9 billion of agricultural output was lost annually through spoilage and wastage. This situation leads to a reduction in national income and nutrition standards, and substantial reduction in the nation's food supply (Olatoye, 1989).

Better processing can reduce this loss by making improved technology available in rural settings. Across Nigeria, food processing and preservation activities are handled primarily by rural women, mainly using traditional methods, which are tedious and often inefficient (Christiana, 1991).

Rice Processing Technology

The National Cereal Research Institute (NCRI) has developed a rice processing technique capable of producing high-quality rice that is comparable with imports. Women do 90% of the work involved in processing rice.

The objective was to find a rice soaker made up of a boiler and a steamer. The boiler is placed on a wood- or gas-fired furnace. The rice is soaked in water heated to 75°C and covered with a jute bag. Soaking lasts for six hours. The water is then drained off; the boiled water is poured into the steamer and left for twenty minutes. It is then spread out to dry before milling.

In the Middle Belt, a study carried out in 1991 measured the extent to which women have adopted the technology. In four out of eight zones, 230 women were interviewed.

This parboiling plant did not prove very popular in the region. Only 49% of the respondents knew about it, and only 2% had used most of the techniques taught. NCRI has decided to organize training for female extension agents, people close to the women who prepare the rice, religious leaders, and professional organizations. It also intends to distribute equipment throughout Nigeria (Ike Nwachukwu, 2002).

To prove that women are more involved in processing than men, Table 2.3 shows the preferred varieties processed in 14 states in Nigeria and the genders involved.

Table 2.3 Preferred varieties of rice processed in 14 states in Nigeria and genders involved

Preferred Varieties	Village	State	Processing Method	Processor	Reasons for choice
FARO 44	Dass	Bauchi	Mill	Female	Palatable sticks well
FARO 44	Debardak	Bauchi	Mill/Manual	Both	Palatable
MAS	Adaka	Benue	Mill/Manual	Female	Sweet long grain
FARO 25	Bar	Benue	Mill/Manual	Female	Sweet long grain
FARO 26	Okwaro	Ekiti	Mill/Manual	Both	Ripens at right time
De Gaulle	Zabarmari	Borno	Mill/Manual	Both	Swells on cooking
Dan maizidun	Konduga	Borno	Mill/Manual	Female	High yield, swells
Jango, Faro, 14, 15	Ugboro	Cross River	Mill/Manual	Both	Sweetness
FARO 14, 15	Igbora	Cross River	Mill/Manual	Both	Expands, sweet
MAS, IR 8	Izi Ugumego	Ebonyi	Mill/Manual	Both	Sweet, not sticky
MAS	Ndicahi	Ebonyi	Mill/Manual	Both	Good taste, good looking
IR 1416	Opanda	Enugu	Mill/Manual	Both	Sweet, long shelf life
IR 1416	Adani	Enugu	Mill/Manual	Male	Sells better than foreign rice
FARO 44	Dasa	Gombe	Mill/Manual	Female	High yield, quality
FARO 44	Hinna	Gombe	Mill/Manual	Female	Taste, bright colour
Ba Yawuri	Mashaya	Kebbi	Mill/Manual	Both	Taste
Danboto, jari iri	Gwadon	Kebbi	Mill/Manual	Female	Taste
Long grain varieties	Maigana	Kaduna	Mill/Manual	Female	Palatability
Small grain varieties	Idon	Kaduna	Mill/Manual	Female	Swells well
Kilaki	Sabolari	Jigawa	Not stated	Female	Nice looking, tastes good
MAS, Ev-China	Kwadage	Jigawa	Not stated	Female	Taste, white colour, long
BG 90	Assakio	Nasarawa	Mill/Manual	Female	Swells very well
BG 90	Sabon Gida	Nasarawa	Mill/Manual	Female	Swells well
FARO 44	Longvel	Plateau	Mill/Manual	Female	Bright, swells, sweet
Bida	Ganawuri	Plateau	Mill/Manual	Female	Easy to swallow
Karamin iri	Alagano	Yobe	Mill/Manual	Female	Very sweet
Karamin iri	Karage	Yobe	Mill/Manual	Female	Sweet

Source: National Cereal Research Institute.

From the above, there is no doubt that women dominate the processing sector of rice production.

Rice Processing Operations and Systems

The rice grain consists of the true fruit or brown rice (caryopsis) and the hull, which encloses the brown rice. Brown rice consists mainly of the embryo and endosperm. The surface contains several thin layers of differentiated tissues that enclose the embryo and endosperm.

The palea, lemmas, and rachilla constitute the hull of indica rice (MacLean, 2002). To make the rice available for consumption, it has to be separated from the husk/hull, a process known as hulling. The rice grain can be hulled raw. For several reasons, it undergoes some processes such as cleaning, parboiling, drying, milling, pearling (whitening), polishing, and grading. In some instances, additives are added to milled rice (Grist, 1975).

Cleaning

The paddy must be put through a cleaning process because when rice is harvested from the farms, threshed, winnowed, and packed for milling, it is not yet in a suitable condition for milling, as it may contain more than 5% extraneous matter such as stalks, sand particles, ionic particles, weed, insects, and twine (Grist, 1975). This extraneous matter can damage processing equipment and cause the final product to be undesirable. To carry out the cleaning operation, cleaning methods and machinery such as drum-type cleaners, sieves,

aspirators, and magnetic separators are involved (Grist, 1986).

Parboiling

Parboiling is a process that consists of steeping the paddy in water and raising the temperature to a required level to gelatinize the enclosed kernel. The parboiling process is a hydrothermal process that involves the gelatinization of starch within the rice grain. An irreversible swelling and fusion of starch granules occur (Barau, 1979). To parboil paddy, three steps are involved: soaking, steaming, and drying.

Soaking:

In the soaking process, the void spaces in the hull and rice kernel are filled with water and swell due to absorption of water by starch granules (Ali and Ojha, 1976). Soaking is faster at high temperatures than lower temperatures.

Steaming:

In steaming, the soaked paddy is exposed to heat for a given period to gelatinize the starch in the rice kernel. The temperature must not exceed 70°C; otherwise, the paddy will be cooked. In modern plants, paddy is steeped and boiled in the same concrete or steel container, using higher average steeping water temperature. Therefore, the whole process is reduced to a period of 6 to 16 hours (Grist, 1986). Steaming duration is dependent on the quality of the paddy. Splitting of the husk can be taken as an indication that the steaming process is completed (Agrawala, 1963). This may not be a necessary condition and the paddy can be properly parboiled without any splitting of the husk (Ali and Ojha, 1976).

Drying of Paddy:

This involves spreading grain on a flat surface to dry, usually on the concrete floor in the local method, to dry in the open. Drying of paddy is essential for proper milling and storing. Excessive exposure to drying, lower moisture content may stress in the rice caryopsis or microscopical cracks in the grain known as sun checking, which result in excessive grain breakage during milling (Grist, 1986). Various industrial drying processes and machines are employed in modern large mills.

After the stages mentioned earlier, it is necessary to store the parboiled paddy so as to protect the grain against moisture and also against temperature change, microorganisms, insects, and rodents. Storage also improves the cooking quality of the product (Kill and William, 1945). The milling quality has been found to be influenced by short duration of storage. About 2-3 hours of storage after conclusion of drying parboiled paddy in the sun has been recommended. A storage period of 60 hours before milling test so that an equal distribution of moisture in the grain may occur.

Parboiling rice is not without some disadvantages, it develops more rancidity than raw rice during storage and it takes more time to cook. It could also develop a taste, texture, characteristic flavor, and color that may be disliked by consumers among others (Ali and Ojha, 1976).

Milling and Milling Technology

The structure of the paddy necessitates the application of friction to the grain surface so as to remove the husk. Through certain percentages of broken rice can not be avoided, however, the breakage can be reduced as much as possible (Ruiten, 1976). The various methods used in milling rice paddy are the

(i). Primitive milling method

(ii). Small-scale hulling and polishing

(iii). Large-scale modern mill (Barau, 1979)

Primitive milling method

This method involves the use of native implements for hulling rice. In Nigeria and some other developing countries, the mortar and pestle made

of wood operated by hand, foot, or water power are used. Barau (1979) observed that 10 hours of labor is required to process 45kg polished rice using this method. Mortars are of various sizes and can hold 5kg to 20kg of paddy; about 20kg can be hulled per hour.

The traditional methods are devised mainly to husk paddy, that is, to just free rice from the glumes and winnow it, for home consumption (Grist, 1986). They are less effective and inefficient.

Small-Scale Hulling and Polishing

The amount of polishing that can be effected in the modern small-scale mill is considerable and the finished product approximates to rice of commerce (Grist, 1986).

The Engel berg husker is often quite satisfactory and are commonly available in hand operated sizes or motorized versions of 3-10kw.

Small scale rice processing is the most common in Nigeria. About 85 percent of Nigerian rice processed through the small mills. This method involves the use of mechanized milling units (often operating the old cono disc technology) with a maximum and minimum capacity of 600 and 200-300 tons per day respectively (Presidential initiative, 2002).

In some small scale mills the husk and bran are removed simultaneously, hence they are called "unit pass mill". A combine husker and polisher, the McKinnon No. 7 'Bon-Accord' rice huller and polisher with suction fan and with output capacity of 300kg to 480kg cleaned rice per hour and is suitable for milling either raw or parboiled rice (Grist, 1986).

The disadvantages of small-scale rice processing are that the incidence of broken rice is high and the milled product still contains impurities. The bran which is valuable as a source of animal feed is lost, since the husk and bran come out together.

Large Scale Modern Mills

The large scale mills require high initial investment cost, and are therefore owned and managed, and are therefore owned and managed corporations, cooperatives or governments. Large mills may be able to deal with 200 to 500 or even 100 tonnes of paddy a day (Grist, 1986). These include the automatic rice mills, where parboiling, drying, milling and polishing are all done by machines with minimum human touch (Golleti, 1994).To obtain high grade rice, the paddy passes through five processes in the clearing, hulling (shelling or husking), pearling and grading (Grist, 1986).

Cleaning: This is to remove foreign bodies which may accompany the paddy from the fields. Different mechanical cleaning processes and machines are used.

Hulling: This principle is similar to the small-scale mills but here the machines are bigger. Hulling machines are called shelter, de-huskers and hulling mills. An example is the Disc Huller, a rubber roller husker which consists of two horizontal tangential rubber rollers, revolving in opposite directions at different speeds, the paddy runs in between the rollers and causes the husk to be crushed and removed from the kernel (Grist, 1986).

Pearling or Whitening: The rice grain consists of five layers of coating which are removed as rice bran in this process. A standard machine designed for this purpose is the rice pearling cone (Grist, 1986).

Polishing: Rice is polished for a desired appearance after pearling. The rice is passed through one or more polishers.

Grading: Polished consists of whole rice kernel and broken rice, they are separated in the process of grading. Various levels of broken rice one retained depending on the standard. A carter disc separator is used for this purpose.

Additives: In order to give rice a fine glossy and

transparent appearance, additives are added to the rice. The rice is passed through glazing drums, talc with the substance to be added. Edible vegetable oil is used for this purpose, for example groundnut oil, castor oil (Ruiten, 1976).

Rice Products

The by-products of rice are hulls, bran, polished rice, and broken rice.

Husks and hulls constitute 20% of the paddy, 5% dirt, dead grain and other foreign matter; therefore 75 percent yield of rice and its by-products should be expected. Obtainable are whole rice 50%, points and broken 17%, bran 10%, meal 3%, husk 20%.

The husk are of few nutritive value and harmful to animals due to high silicon content and of little value of fertilizer. It can be used as fuel in parboiling (Ali and Ojha, 1976).

Profitability Analysis

Cost and return analysis is usually the basis for profitability analysis. This involves itemizing the cost and the returns of the enterprise and using them to arrive at estimates such as the gross margin and gross returns (Osifo, 1970). Cost and return analysis is a useful tool in enterprise comparison and for indicating the profitability pattern of aggregate used.

The Net Income analysis is also used as profitability analysis. It involves evaluating the efficiency of an individual enterprise so that comparison can be made between enterprises or different operational plans. It is a very useful tool in situations where fixed capital is not negligible portion of the farming enterprise as in subsistence agriculture. Net Income by definition the difference between Total income and total cost.

Descriptive statistics have been used to describe socio-economic characteristics such as sex, age, educational qualification, family size, and years of experience in the rice processing business. Common statistical tools such as the mean, frequency distribution, charts, percentages and tables are used in descriptive statistics.

METHODOLOGY

Study Location

Lafia local government area of Nasarawa state in Nigeria is the location for the project. It is the state capital and its geographical location is latitude 8° 35′ N and longitude 8° 34′ E. The local government area is the ecological zone of the southern guinea savannah.

Many cash and food crops are produced and marketed in local government area. Lafia local government is well known for rice production and processing in the country. These activities offer great opportunities for industrialization of Nasarawa state.

The Lafia rice processing and milling industry started as far back as early 1970s at a location called United African Company (UAC) road initially with 10 members running different mills. Due to expansion in the processing activities, the site could not accommodate the milling firms and became inconducive for business activities. There are 120 registered members including processors, dealers, all with Rice Millers and Dealers Association (RMAD). All rice milling activities cannot take place anywhere in the local government but within this industrial area allocated for the purpose by government.

Sampling Procedure

A reconnaissance survey was carried out to find the population of women rice processors in Lafia local government. The result showed that there is an estimated population of about 450 women processors. Random sample was used to select 20% of the women processors. This gave a total number of 90 women processors who were the respondents.

Data Source and Collection Method

Primary and secondary data were used for this study. The primary data will be collected with the aid of structured questionnaire. The respondents were interviewed. This data include data on socio-economic characteristics such as state, village, local government area, sex, marital status, age, religion and others. Data on processing activities such as costs and number of bags of paddy processed per day/hour/week, charges per bag of rice processed etc. Secondary data were sourced from ADP and Women in Agriculture.

Analytical Framework

The choice of analytical tools used depends on the nature of the data collected and the objectives of the study. Based on these considerations, the following analytical tools were used: (i) Descriptive statistics (ii) Net Income analysis (iii) Data Envelopment Analysis

Descriptive statistics such as mean, median, range, percentages was used to describe the socio-economic characteristics of women processors. These include age, education level, family size, religion, years of experience. Other variables include information on processing activities such as cost and number of bags of paddy processed per day/week. This tool was used to achieve objectives one, two and five.

Net Income Analysis

Net Income analysis determines the difference between the Total revenue and the Total Cost (Total variable and fixed cost). In this study, Net income will be applied to measure the cost and return of rice processors. The formula for calculating Net Income is given as follows:

$NI=TR-TC$

Where:

NI = Net Income

TR = Total Revenue

TC = Total Cost

$$TC=D+\Sigma(X_i r_i)$$

Where:

TC = Total cost of processing per bag (₦)

D= Depreciation

X_i = Quantity of input i used in processing one bag of paddy.

r_i = Price per unit of input iii

Revenue is calculated as:

$$TR=Q\times P$$

Where:

TR= Total Revenue derived from selling the quantity of milled rice obtained from 1 bag of paddy.

Q = Quantity of milled rice obtained from a bag of paddy.

P = Average selling price of the milled rice (₦)..

Therefore, the Net Income for a processor equals NI=TR−TC

Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a non-parametric, linear programming-based frontier analysis method that was originally developed to analyze the performance of organizations whose goals are not limited to profit maximization. DEA uses a non-parametric non-stochastic piecewise linear production frontier in estimating technical efficiency.

An input-oriented variable returns to scale DEA mode was used to calculate technical, allocative and scale efficiency in rice processing. The variable returns to scale (VRS) specification allows for the estimation of technical efficiency measures not confounded by scale efficiency effects.

Assuming that there is data available on K inputs and MMM outputs in each of the N decision-making units (DMUs) and input and output vectors are represented by the vector x and y, respectively for the ith processing. The data for all processing may be denoted by the K×N input matrix (X) and M×N output matrix (Y). The envelope form of input-oriented VRS DEA model which is the most widely used is then specified as follows:

$$\text{Min } \theta\lambda\theta$$

Subject to:

$$\begin{gathered} \text{St } -yi+Y\lambda\geq 0 \\ \theta xi-X\lambda\geq 0 \\ NI'\lambda=1 \\ \lambda\geq 0 \end{gathered}$$

Where the value of θ obtained signifies the efficiency score for the ith DMU. It will satisfy θ≤1 with a value of 1 indicating a point on the frontier hence a technically efficient DMU. Thus, the linear programming problem needs to be solved N times.

Total Cost (TC) is normally made up of two components: Fixed Cost (FC) and Variable Cost (VC). Fixed Costs are those costs which do not vary with output; they are costs incurred on fixed items or are not completely used up in one production period. Fixed cost items in parboiling activities are drums, buckets, baskets, shovel, drying tarpaulin, etc. These items lose value over time due to wear and tear. They are important in deriving net income or profit. The variable costs are those cost items that change with a change in output. For the processors, the variable cost items include rice paddy, transportation, and payment for services, wood, water, etc.

Depreciation: In estimating the depreciation rates on fixed assets used during processing, the straight-line method will be adopted.

Depreciation = (Initial Cost - Salvage Value) / Life Span

This tool was used to achieve objective three.

Table 4.7 Net income of Rice Processing among Women in Lafia L.G.A. per bag

Items	Unit	Price (₦)	Cost (₦)	Value (₦)
COSTS				
A. RETURNS				
Quantity of polished rice	1	16,000		16,000
Quantity of hull sold per day	1	600		600
Total returns				16,600
B. Fixed cost (At 20% depreciation for 5 years)				
Parboiling drum	1		800	
Buckets	5		350	
Drying Tarpaulin	2		48	
Shovel	1		110	
Total fixed cost			1,308	
C. Total variable cost				
Rice paddy	1	11,000		
Water (liters)	50		50	
Wood	5		200	
Transportation	1		50	
Milling	1		50	
Loading and off-loading	1		50	
Pre-cleaning	1		50	
Market charges	1		10	
Total variable cost			11,460	
D. Total cost (B + C)			12,768	
NET INCOME (A - D)			3,832	
				16,600
Average Net Rate of Return				= 30 kobo

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Women Rice Processors in Lafia Local Government Area.

Marital Status

Table 4.1 shows that most of the women processors are married. There are no single women among the respondents. The percentage of widows is 2.2% while 97.18% of the women are married.

Table 4.1 Marital Status of sampled Women Processors

Marital Status	Frequency	Percentage
Widow	2	2.22
Married	88	97.18
Total	90	100

Source: Field Survey data, 2008.

Age Distribution

Table 4.2 shows that 1.10% of the sampled respondents were between 21 and 30. About 89% of the sampled women fell between the ages of 31 to 60 while only 10% were more than 60 years. The table shows that most of the sampled women were in their middle age.

Table 4.2 Age distribution of the sampled women rice processors

Age Limit	Frequency	Percentage
1-30	1	1.10
31-60	80	88.90
Above 60	9	10
Total	90	100

Source: Field Survey data, 2008.

Religion

Table 4.3 shows that 67.78% are Muslims while 32.22% are Christians. There are no traditionalists among the respondents. The significance of religion in rice processing is that Muslim women work on Sundays and therefore make more sales every month than their Christian counterparts.

Table 4.3 Religion of the sampled women rice processors

Religion	Frequency	Percentage
Islam	61	67.78
Christianity	29	32.22
Traditionalism	0	0.00
Total	90	100

Source: Field Survey data, 2008.

Educational Level

Table 4.4 shows that majority of the women have no formal education and they constitute 81% of the respondents. 16.65% of the women have primary school education while 2.2% have secondary school education. None of them have tertiary institution education. This implies that adaptation of innovation is likely to be difficult.

Table 4.4 Educational Level of the sampled women Rice Processors

Education	Frequency	Percentage
No formal	73	81
Primary	15	16.67
Secondary	2	2.33
Total	90	100

Source: Field Survey data, 2008.

Household Sizes

Table 4.5 shows that among the respondents, 36.67% have between 4 to 5 persons in their households, 21.10% have between 6 to 7 persons, 26.67% have between 8 to 9 persons, and 15.56% have between 10 to 12 persons in their households. The household is a source of labor for a few of the women such as those that are as old as 63 years, but for those that are middle-aged or below 30 years used paid labor.

Table 4.5 Household sizes of the sampled women Rice Processors

Household Size	Frequency	Percentage
4-5	33	36.67
6-7	19	21.10
8-9	24	26.67
10-12	14	15.56
Total	90	100

Source: Field Survey data, 2008.

Years of Experience

Table 4.6 shows that majority (88.8%) of the women processors have been processing for between 9 to 15 years. Only a few of them (11.11%) have been processing for between 4-8 years.

Table 4.6 Distribution of women processors based on their years of experience

Years of Experience	Frequency	Percentage
4-8	10	11.11
9-15	80	88.89
Total	90	100

Source: Field Survey data, 2008.

Inputs Used in Rice Processing

Parboiling Drums

The parboiling drums are indispensable in rice processing; they are used for cooking the rice paddy to a temperature not exceeding 70°C after which the rice paddy is spread over the drying tarpaulin to dry. The parboiling drums have different sizes: small, medium, and big.

Rice Paddy

The rice paddy is the unpolished rice which has not been dehusked in the milling machine. The rice paddy is purchased from various rice farms in Lafia. It is measured in bushels; 1 bag (100kg) of rice paddy contains 5 bushels.

Buckets

Buckets and basins are used for fetching water from the water tanks; the large ones are used and are quite affordable.

Shovel

The shovel is used for packing rice and for spreading rice over the drying tarpaulin. Each processor usually owns one to five shovels depending on the amount of rice paddy they purchase.

Drying Tarpaulin

The parboiled rice paddy is spread under the sun to dry on drying tarpaulins.

Water

Water is absolutely essential in rice processing. The processors usually buy water in 50 liters jerry cans. The price of water is determined by the presence or absence of electricity; in the absence of electricity, it becomes costly as water will be pumped out by a generator, requiring the purchase of fuel by the water seller, and this cost is transferred to the processors.

Wood

Wood comes in different grades; the wood is for making fire for parboiling the rice paddy.

Labor

Some men are paid for the task of loading and off-loading rice paddy, and some women, who are called 'cookers,' are paid to carry out the

parboiling.

Method of Processing

The method of processing employed by these women is the small-scale husking and polishing. This method produces clean marketable rice of fair quality and is suitable for smallholders. It is more efficient than the primitive method of pounding. The milling machine used for dehusking is the rubber roller-husker. This method has a disadvantage of containing many broken rice particles, which determines the price at which the rice is sold. The less the amount of broken rice, the higher the price of the polished rice.

COSTS AND RETURNS ANALYSIS

Cost of Parboiling Drum

The cost of parboiling drum is ₦4000, and its depreciation is at 20% for 5 years.

Cost of Buckets

The price of buckets ranges from ₦350. It was observed that buckets branded as "ok" plastics are costlier and more durable. Depreciation is at 20% for 5 years.

Cost of Shovel

The average price of a shovel is ₦200.

Cost of Rice Paddy

Rice paddy is measured in bushels; 1 bag contains 5 bushels (100kg). The price of a bag varies from ₦12,000.

Cost of Water

The cost of water is ₦1.00 per liter. In the absence of electricity, the cost increases as water is pumped out by a generator, which requires the purchase of fuel by the water seller, and this cost is transferred to the processors.

Cost of Wood

Wood costs ₦150 per bundle.

Cost of Transportation

The average cost of conveying bags of rice paddy from the farm gate to the rice mill is ₦50 per bag.

Cost of Milling

The average cost for milling one bag of rice paddy is ₦50.

Labor

The cost of labor is ₦100 per bag of rice paddy.

Drying Tarpaulin

The cost of drying tarpaulin is ₦120.

Net Income

The total return from processing one bag of rice paddy is ₦16,600. The total fixed cost of processing one bag of rice paddy is ₦1,308, while the total variable cost is ₦11,460. This gives a total cost of ₦12,768. Therefore, the net income of processing one bag of paddy rice is ₦3,832. The average rate of return from processing one bag of rice paddy is 30 kobo, which means that for every naira invested in rice processing by the women, 30 kobo was gained per bag. This implies that rice processing among women in the study area is profitable.

Table 4.7: Net Income of Rice Processing Among Women in Lafia L.G.A. per Bag

The net income of rice processing among women in Lafia Local Government Area is detailed as follows. The total return from processing includes ₦16,000 from polished rice and ₦600 from hull sold per day, giving a total return of ₦16,600. The fixed cost components include ₦800 for a parboiling drum, ₦350 for buckets, ₦48 for drying tarpaulin, and ₦110 for a shovel. This results in a total fixed cost of ₦1,308. The total variable cost is made up of ₦11,000 for rice paddy, ₦50 for water, ₦200 for wood, ₦50 for transportation, ₦50 for milling, ₦50 for loading and off-loading, ₦50 for pre-cleaning, and ₦10 for market charges, which sums up to

₦11,460. The total cost (fixed and variable combined) is ₦12,768, resulting in a net income of ₦3,832. The average net rate of return is 30 kobo, indicating a gain of 30 kobo for every naira invested.

TECHNICAL EFFICIENCY

Data Envelopment Analysis (DEA) was used as an analytical tool for calculating the technical efficiency of small scale rice processing among women in Lafia L.G.A.

The frequency distribution of efficiency estimates obtained from the DEA is presented in table 4.8.

The result shows that 20% of the respondents obtained 100% technical efficiency. 42.22% of the women obtained between 60 to 99% while 37.78% of the respondents obtained below 60% technical efficiency. The minimum technical efficiency was 0.154 (15.4%). The maximum technical efficiency was 0.100 (100%). The mean technical efficiency for the sample was 0.570 (57%). This implies that on the average, women rice processors have been able to obtain 57% technical efficiency in rice processing; therefore there is chance of increasing processed rice output by 43% if the inefficient women rice processors adopt the techniques and strategies employed by the efficient women processors.

Table 4.8 Technical Efficiency of rice processing among Women in Lafia L.G.A

Technical Efficiency Indices	Frequency	Percentage
0.154 - 0.323	18	20
0.324 - 0.500	16	17.78
0.600 - 0.790	20	22.22
0.890 - 0.990	18	20
1.00	18	20
Total	90	**100**

Source: Result of Analysis

Mean: 0.570

Minimum: 0.154

Maximum: 1.00

Problems Associated with Rice Processing Among Women in the Study Area

Several problems are associated with rice processing among women in the study area. The most significant issue, mentioned by 87% of respondents, is epileptic power supply. This increases the cost of purchasing water and milling rice due to the absence of electricity. The second problem is the impact of foreign rice, which reduces the demand for local rice. Poor price of polished rice was identified as the third problem; respondents noted that this was due to seasonal and climatic fluctuations in the cost price of rice paddy. The presence of impurities and dirt, such as stones and large amounts of broken grains, was also highlighted. This problem reduces the quality and grade of the output, consequently lowering its price. Other challenges include a lack of credit facilities, which ranked as the fifth problem, and the poor state of infrastructure, such as the condition of rice mill buildings, which need renovation to be suitable for storage. The least mentioned problem was related to marriage and children, which was not considered a major constraint for most women.

Table 4.9: Problems Faced in Small-Scale Rice Processing

The problems faced in small-scale rice processing, ranked by frequency, include epileptic power supply (87 respondents), the impact of foreign rice (30 respondents), poor price of polished rice (27 respondents), impurities and dirt (26 respondents), lack of credit facilities (17 respondents), poor state of infrastructure (15 respondents), and marriage or children constraints (2 respondents). Multiple responses were allowed, leading to a total frequency exceeding the sample size.

Table 4.9: Problems faced in small scale rice processing

Nature of Problem	Frequency	Rank
Epileptic power supply	87	1
The problem of foreign rice	30	2
Poor price of polished rice	27	3
Impurities and dirt	26	4
Lack of credit facilities	17	5
Poor state of infrastructure	15	6
Problems related to marriage and children	2	7

Multiple responses were allowed; therefore total frequency exceeds the total sample size.

Summary, Conclusion, And Recommendations

SUMMARY

The findings of the study reveal that there were no unmarried women among the respondents. The percentage of widows was 2.2%, while 97.18% of the women were married. The age distribution shows that 1.10% of the women were 77 years or less, with 88.90% aged between 28 and 60 years, and only 10% aged 60 years or older. Religious affiliations indicate that 67.78% of the respondents were Muslims, while 32.22% were Christians. No traditionalists were recorded among the respondents. Educationally, the majority of the women (81%) had no formal education, while 16.65% had primary school education, and only 2.2% had secondary school education. None had tertiary education. In terms of experience, 88.8% of the women had been processing rice for up to 15 years, while 11.11% had been processing for less than nine years. Household size varied, with 36.67% having four to five persons, 21.10% having six to seven persons, 26.67% having eight to nine persons, and 15.56% having ten to twelve persons. The inputs used in small-scale rice processing include parboiling drums, rice paddy, buckets and basins, shovels, drying tarpaulin, water, wood, and labor. The cost analysis revealed that the total return from processing one bag of rice paddy was ₦16,600, with a total fixed cost of ₦1,308 and a total variable cost of ₦11,460, resulting in a total cost of ₦12,768. The net income for processing one bag of paddy rice was ₦3,832.

CONCLUSION

Based on the findings, it is concluded that small-scale rice processing among women in the study area is profitable. The profitability can be further increased with the availability of more advanced milling machines and the introduction of innovations for the entire rice processing activities.

RECOMMENDATIONS

Small-scale rice processing holds the potential to increase the income of women rice processors in the study area and improve their standard of living. It is recommended that measures be taken to enhance technical efficiency, introduce innovations, and sustain rice processing activities

in Lafia Local Government Area.

i. There should be deliberate effort to improve the quality of rice processed by these women by encouraging quality control, destoning, pearling or polishing, and possibly glazing of milled rice in order to match the quality of imported rice.

ii. Rice importation policy should be reviewed in order to encourage local production and processing so as to create opportunity for healthy competition.

iii. Government and development agencies as well as banks need to devise the means of increasing the access of these women participants. This will contribute to the acquisition of more modern processing machines e.g., destoning machines, polishing machines, etc., to improve the quality of locally processed rice by women.

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