PrOpCom

Making Nigerian Agricultural Markets Work for the Poor

Monograph Series # 6

REPORT ON FINANCIAL ANALYSIS OF RICE PARBOILING/PROCESSING SYSTEMS IN BIDA AREA, NIGER STATE, NIGERIA

Submitted By

National Cereals Research Institute (NCRI), Badeggi, PMB 8, Bida, Niger State, Nigeria

November 2006

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PrOpCom PROJECT: SERVICE AGREEMENT – NCRI 01

REPORT ON FINANCIAL ANALYSIS OF RICE PARBOILING/PROCESSING SYSTEMS IN BIDA AREA, NIGER STATE, NIGERIA

Submitted to

PrOpCom
(Promoting Pro-poor Opportunities through Commodity and Service Markets)
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By

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November 2006

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EXECUTIVE SUMMARY

Rice quality issues have become very important among Nigerian consumers who clearly show a stronger preference for imported rice, because of high quality in terms of cleanliness. This has often been viewed as reflecting the high competitiveness of imported rice when compared to locally produced rice. Existing low quality of local rice can hinder efforts to achieve progress in raising output to meet consumers' demands. The major challenge of rice production and marketing in Nigeria therefore lies in the development of appropriate technology for rice post harvest handling especially rice parboiling and processing.

Parboiling - the hydrothermal treatment of paddy rice before milling, accounts for a significant portion of total rice processing costs and is frequently the source of quality problems. Hence there is need for study on financial analysis of rice parboiling systems that will generate information on the most cost effective ways of rice processing in Nigeria.

In view of the foregoing, a fixed price services agreement no. NCRI-01 between SAII Associates LTD/GTE (An Associates company of Chemonics International (Inc) hereafter referred to as "Prime Contractor" and National Cereals Research Institute referred to as "Service Provider" was signed in order to provide the professional services on financial analysis of rice parboiling system in Bida area.

Data for the study were obtained from operators of the traditional and improved parboiling units using cost route techniques and analysis carried out using partial budgeting techniques and discounted Cash flow analysis.

Result showed that the total fixed investment costs, total working capital and total operating cost were highest for HANIGHA parboiling unit, followed closely by NCRI, and while traditional was the least. The implication is that improved parboiling technology is capital intensive. Credit facility may therefore be required for adoption of improved parboiling system.

The value of output was highest for HANIGHA parboiling system when compared with NCRI system and traditional system. The gross margin, net enterprise income, the return to owner's fixed costs, net enterprise earnings, net profit, return to equity capital and return on investment were all positive for all the systems indicating that all the systems were profitable. Return to labor which measure the return

per day of labor or as a percent of the charge for family labor were all higher than the opportunity cost of labour.

Cash flow analysis for HANIGHA system indicates that the net present value at discount rate of 30% is

positive (₦1,995,152.00), and the internal rate of return (94%) is higher than the current Bank interest rate. The implication is that the parboiling venture can repay back any loan given at interest rate below 94%. The investment is therefore, credit worthy and can therefore be considered for loan by any Nigerian bank.

Break even point of milled rice for HANIGHA, NCRI, and traditional units were less than one batch per day.. The implication is that profit can be generated from parboiling venture within a year of investment. Traditional system will reach break even point before NCRI and HANIGHA systems under one batch per day. However HANIGHA system will attain break even point before NCRI systems whose normal operation is one batch per day, if operated normally at one and half batch per day.

Sensitivity analysis of the impact of change of some basic inputs such as investment in equipments, fuel cost, labour cost, paddy cost and selling price of processed rice on break-even point showed that an increase in costs of these inputs will raise the break even level, thereby impede early attainment of break even level, while an increase in price will bring down the break even level, and thus favors profitability of the business.

Under the two improved parboiling systems, the break even values were all positive, indicating that the business would still make profit if there is any increase or decline in the costs of inputs below 15%. However, in traditional system, an increase in the costs of paddy above 5% will make the business unprofitable. This implies that the business will not generate profit when the cost of paddy is raised more than 5%. Similarly, a decline in the price of processed rice renders the business unprofitable.

In terms of quality, rice parboiled using NCRI improved methods was more preferred. Quality of rice of traditional parboilers could be improved if they are encouraged to adopt new method of parboiling such as the NCRI methods. However, investment in the new equipments will involve a reasonably high investment capital.

1.0. INTRODUCTION

1.1. Macro Aspects of Rice Production, Marketing and Consumption

Rice supplies 6% of total per capita calorie consumption of Nigerian (IRRI, 1994), and occupies about 1.77 million hectares of Nigeria arable land, making it rank sixth after sorghum (4.0 million ha), millet (3.5million ha), cowpea (2.0 million ha), cassava (2.0 million ha) and yam (2.0 million ha) (CBN, 2003). Domestic consumption of rice rose from 3kg/year/person in 1970 to about 11kg/year/person in 1980 (Obiechina and Otti, 1985), and currently annual per capita consumption of milled rice is 25kg/person (Hussein, 2004). The relative ease of its preservation and cooking has influenced the growing trend in its consumption.

In an apparent move to respond to the increased per capita consumption of rice in Nigeria, a huge amount of foreign exchange is spent on importation of rice into the country. About 1.329 billion U.S. dollar was spent on importation of rice between 1991 and 1999 (FAO, 2001). There are serious questions as to whether national economies will be able to sustain these levels of imports so the need to increase local rice production.

Rice quality issues have become very important among Nigerian consumers who clearly show a stronger preference for imported rice, because of high quality in terms of cleanliness (WARDA, 2003). This has often been viewed as reflecting the high competitiveness of imported rice when compared to locally produced rice. However, when a complete assessment of costs and benefit of locally produced rice are made, rarely are the related cost and benefit of post harvest handling included in these calculations. If this were made it will be easy to identify the source of quality problems in locally produced rice. Existing low quality of local rice, reflecting low levels of improved processing technology, can hinder efforts to achieve progress in raising output to meet consumers' demands. The major challenge of rice production and marketing in Nigeria therefore lies in the development of appropriate technology for rice post harvest handling especially rice parboiling and processing.

1.2. Rationale and Justification for the Study

Good quality milled rice is generally preferred for eating and highly priced in the market. A high proportion of broken grains lower the commercial value of rice. It is easy to obtain high quality grains if appropriate steps are followed from harvesting to marketing. One of such steps is the hydrothermal treatment of paddy rice before milling known as parboiling. It involves soaking paddy in water to increase its moisture content; heat-treating wet paddy, usually by steam; and drying again to bring down the moisture content. Parboiling impacts the following desirable qualities to rice:

- It kills the micro-organisms and thus prolongs the storability of paddy.
- It improves the rice structure by making it harder and translucent and more resistant to breakages during milling.
- The cooking characteristic is improved; the grain swells during cooking and losses less starch to the cooking water.
- The cooked rice keeps better and for longer time resisting decomposition.
- The vitamins and the minerals move inwards towards the endosperm, thereby enhancing its nutritional value.

Parboiling accounts for a significant portion of total rice processing costs and is frequently the source of quality problems. Therefore, PrOpCom (Promoting Pro-poor Opportunities through Commodity and Service Markets), the National Cereals Research Institute (NCRI), the African Rice Centre (WARDA) and other rice stakeholders have identified parboiling as one of the important constraints in the rice commodity chain and accounts for a significant portion of total rice processing costs. Hence there is need for study on financial analysis of rice parboiling systems that will generate information on the most cost effective ways of rice processing in Nigeria.

1.3. Scope of the Study

PrOpCom has identified several sources of improved parboiling equipment, including both the National Cereals Research Institute (NCRI) at Badeggi (near Bida) and HANIGHA, a private design shop in Kaduna. Unfortunately, neither has done a financial study that would allow one to say with confidence that these parboiling units are financially attractive for investors. While particularly the

HANIGHA model appears easier and safer to use, and claims are made about them producing a batch of parboiled rice in as little as 3 hours instead of two to three days, there is no information on financial viability, break-even points, etc. This project plans to facilitate and demonstrate the use of improved parboiling techniques to build the capacity of local parboilers in selected sites in Nigeria. The project also wishes to undertake a detailed financial analysis of both the traditional and improved parboiling systems available. There are many traditional parboiling units scattered around Bida and its environments. Alhaji Ibrahim Umar in the nearby city of Bida, operates a HANIGHA parboiling unit in a commercial rice milling operation. NCRI has a unit operating in the research centre that would allow a direct comparison with traditional parboiling technology and HANIGHA practice.

In view of the foregoing, a fixed price services agreement no. NCRI-01 between SAII Associates LTD/GTE (An Associates company of Chemonics International (Inc) whose registered office situated at 40 Mississippi Street, Maitama, Abuja, Nigeria hereafter referred to as "Prime Contractor" and National Cereals Research Institute referred to as "Service Provider" was signed on 14 September, 2006 for 56 days provide the professional services. SAII associate LTD/GTE enters this agreement on behalf of PrOpCom (Promoting Pro-poor Opportunities through Commodity and Service Markets). The Service Provider has agreed to provide professional services to SAII associate LTD/GTE as set out in the contract agreement no. NCRI 01. Specifically, all steps and variables highlighted in the contract agreement will be addressed. The Service Provider (SP) has agreed to provide professional services to SAII associate LTD/GTE set out in the agreement as follows:

- Fixed Costs (cost of the equipment (parboilers), cost of installation of the equipments, cost of any shelter or shed to keep the equipment in, cost of transport of the equipment, cost of any utility lines needed for use of the equipment, cost of auxiliary items needed for equipment to work, i.e., concrete drying pads, cost of finance (interest, points, etc.), cost of depreciation (useful life, salvage value, etc.)
- Variable Costs (Per bag, per kg, per batch, quantity and cost of fuel to heat water, quantity and cost of water used, quantity and cost of other power sources needed (electricity, fuel), quantity

and cost of labour, estimated cost (and relevant quantities, frequency) of maintenance, estimated cost (and relevant quantities, frequency) of repairs, etc.

* Quantity and cost of paddy (raw material), sales of processed rice (or parboiled price) (per bag, per kg, per batch), and price asked to do parboiling for a fee (per bag, per kg, per batch)
* Breakeven analysis to know the breakeven point in terms of amount of paddy (bags, kgs) that would be required to be parboiled to cover all costs (both fixed and variable) on an annual basis (days worked at a specified level of throughput of X bags/kgs per day).
* Sensitivity analysis to see what the impact on the break even analysis would be of a five, ten and fifteen percent change in the costs of the basic equipment, cost of fuel, water and labour, and the cost of paddy. In addition, sensitivity analysis of the impact of the same percentage changes (five, ten, fifteen percent) in the selling price of processed rice (or parboiled rice) parboiled with the new equipment.

* Compare these costs factors and breakeven analysis between traditional parboiling equipment and each of the improved parboiling systems.
* Assess whether there are any quality differences in the products from the three parboiling systems.
* Address issue of drying the rice after parboiling.
* Assess impact of improved parboiling and drying practices on input-output ratios in the milling process.
* Assess the financial viability of each parboiling systems (traditional, improved NCRI and HANIGHA types).
* Collect market perceptions of quality among the 3 or 4 types of rice indicated above and corresponding price information, as well as price information on the cost of paddy rice.
* Assess the differences in viability between owning and selling the rice processed with providing a parboiling service for a fee.
* Assess the advantages and disadvantages of the traditional and each improved system of parboiling with regard to social, environmental and health issues.

* Provide data on parboiler trial results to the collaborating local and expatriate consultants for use as examples in a training course on "*financial analysis of agricultural technologies*".
* Attend to queries or information gaps that may be noticed during analysis with a view to getting complete answers.

1.4. Specific Deliverables

The Service Provider will complete the following deliverables under the contract agreement:

a. Submit to the Client and reach agreement on a detailed work plan covering specific activities, locations, timeline, and personnel to undertake the exercise.

   submit Curriculum Vitae of personnel to undertake the exercise along with the work plan and budget

b. Prepare a budget for all aspects of the testing and analysis, including any personnel fees, travel and per diems, cost of paddy, and payments or incentives provided to collaborating parboilers and millers. Identify how proceeds from sale of rice will be used. Reach agreement with the client on that budget

c. Share the results of the parboiling trials with the local and international consultants so that they can be used as basic materials for a training course on "*financial analysis of agricultural technologies*".

d. Provide (submit by email) a 1-2 page summary of activities and findings each 7 days during the test.

e. Submit to the Client a detailed report (in both hard and soft copy) including conclusions and recommendations, 7 days after the completion of the exercise. In annex, provide all raw and analyzed data (physical and financial) as well as the list and addresses of contacts used during the exercise.

f. Provide all raw and analyzed data (physical and financial) as well as the list and addresses of contacts used during the exercise to other Consultants that may be hired by the Client to collaborate in the fieldwork and data analysis.

g. Prepare a two-page summary of problems or issues encountered in undertaking the exercise and proffer solutions on how to ameliorate such problems for future assignments, to be completed at the same time as the final report.

h. Present findings and conclusions to the Client and others to be identified by the Client, within 14 days after completion of exercise.

The Service Provider shall primarily report to PrOpCom's Agricultural Commodity Specialist, John Lichte, or to the designated representative of the PrOpCom technical team as appropriate.

2.0. METHODOLOGY

2.1. Data and Information Collection Methods

Data for this study were obtained from operators of the traditional and improved parboiling units using cost route techniques. Two village women traditional parboilers and two improved parboiling plant operators were identified by PrOpCom for the financial analysis. One of the improved parboiling systems consists of a double vat parboiling system with a sealed boiler, separate from the soaking and steaming vat, developed by the NCRI at Badeggi (Plate 1). The other one is a single vat system with a sealed boiler directly under the soaking and steaming vat, and a tilting discharge, manufactured by HANIGHA Inc., a private design shop in Kaduna (Plate 2). Both are three bag (paddy) systems whereas traditional parboiling is usually done one bag at a time using big metal cooking pot (Plate 3). A total of 33 bags of rice paddy were purchased from out grower farmers and given to these parboilers. Six bags of paddy (3 each) were given to the two traditional parboilers to be parboiled in three batches of one bag per batch. Nine bags were given to NCRI parboilers to be parboiled in three batches of three bags per batch, while 18 bags were given to HANIGHA parboilers to be parboiled in three days of six bags per day at two batches (of three bags each) per day. Each bag of rice weighed 75 kg. The three bags parboiled by traditional village women were milled with Indian Huller machine, (plate 6) the nine bags parboiled with NCRI parboiler were milled with NCRI milling machine, (plate 4) while twelve out of the fifteen bags parboiled with HANIGHA parboiler were milled with

HANIGHA miller, (plate 5) and the remaining six were milled with NCRI and Indian Huller millers at three bags each.

Parboilers were being watched, as they parboil rice paddy in their usual ways without any interference, and parboiling procedures and other relevant information were taken. Data taken include: all inputs used in parboiling and output of milled rice obtained; the quantity of paddy parboiled per batch and the time required to wash, soak, parboil and dry parboiled paddy, along with detailed labour inputs. Oral interview was conducted to obtain information on fixed inputs, marketing activities and prices as well as costs of inputs used and output obtained.

2.2. Methods of Data Analysis

Data collected were analyzed using partial budgeting techniques to calculate the gross margin. Discounted Cash flow analysis was used to calculate the Net Present Value (NPV) and Internal Rate of Return (IRR).

From the gross margin net enterprise income, net enterprise earnings, net profit, return to capital or return on investment and return to labour were derived as follows:

Gross Margin = Gross Revenue – Total Variable Cash Costs

Net Enterprise Income = Gross Margin – DIRT (Depreciation, Interest, Rent, Taxes)

Net Enterprise Earnings = Net Enterprise Income – Charge for Owner's Capital

This provides a measure of the total return to family labor and management.

Profit = Net Enterprise Earnings – Charge for Family Labor

This yields **net profit** for the enterprise. Net profit is what is leftover after all factors of production have been paid their opportunity cost. It is a joint excess return to all factors of production and management. Because it is a surplus return over and above the opportunity cost of all other inputs, some call it a return to management rather than profit.

Return on Investment (ROI) = $\frac{\text{Net Profit + Charge for Owner's Capital}}{\text{Owner's Equity Capital}}$

There are various ways to calculate this. Typically net profit is added to the charge for owner's capital and the sum is divided by total equity capital. Because interest on borrowed capital has been deducted earlier in arriving at net enterprise income, this yields a percentage return on equity capital, not on total invested capital. If it is a profitable investment it will

Return per Day of Labor = $\frac{\text{Net Profit + Charge for Family Labor}}{\text{Days of Family Labor Used}}$

Rate of Return to Labor = $\frac{\text{Net Profit}}{\text{Charge for Family Labor}}$

By using only profit in the numerator this is a measure of the percentage that the actual return to labor exceeds its opportunity cost.

Net Present Value (NPV) is the difference between discounted costs and the discounted benefits is the net present value. It can be defined algebraically as:

$$NPV = \frac{S_1}{(1+r)} + \frac{S_2}{(1+r)^2} + \frac{Sn}{(1+r)^n} - S_0$$

$$= \sum_{t=1}^{t} \frac{St}{(1+r)^t} - S_0$$

where S = Stream of annual net cash flows of the investment

r = Discount rate used to convert future flows to the present

0, 1, 2, 3, .n, refer to the year in question. S_0 is the initial investment

If NPV is positive the investment returns more than the opportunity cost of capital or other interest rate used; if it is negative, it returns less.

Internal Rate of Return (IRR) is the discount rate that would make the present value of net cash flows equal to zero. Conceptually, it is the rate of return on investment that is directly comparable to the interest rate on a bank deposit account, i.e., it is based on year-of-deposit/ year-of-withdrawal cash flow. It is exactly equal the annual percentage rate on a loan or deposit that accrues interest on the remaining cash balance, compounded annually. It has the advantage of providing a measure of return that can be compared to each individual's reservation rate of return or the opportunity cost of capital. It is profitable to invest on business whose IRR is higher than the interest rate charged by banks.

Sensitivity Analysis was carried out to observe the impact of 5, 10, 15% change in the cost of basic equipment, cost of fuel, water and labour, cost of paddy and selling price of milled rice on break even analysis.

Break even Analysis was used to analyze the relationship between the volumes of output and profitability for an investment with both fixed and variable costs, and a technical capacity that is considerably larger than the current market for the output. It identifies the level of output where all fixed and variable costs are covered and profit is zero. It answers the question of how low can output fall before an investment actually begins to lose money. It shows the point beyond which the enterprise starts making a profit. The break even output is calculated thus:

Break Even Output = Fixed Cost / (Unit Price - Variable Unit Cost)

3.0. STUDY FINDINGS

3.1. Inputs Required for Parboiling Rice

The key inputs for parboiling rice, besides the parboiling equipment itself, are drying slab, wheel barrow, firewood, rice paddy, electricity, water, labor and transportation. Others include: buckets, barrels, rakes and sieves. The operator of the HANIGHA mill has an additional expense of labeled plastic bags for packaging his output as a branded product. He also salvages unspent coals rather than reusing them. NCRI also incurs additional cost on drying shed. Costs of these inputs are presented in Table 1.

3.2. Parboiling Procedure

Traditional Parboiling System involves soaking the paddy in cold water. After two days of soaking, rice paddy is transferred into the parboiling pot (plate 3) which is made of metal. The pot is heated with wood fire for 1-2 hours depending on the varieties. Then parboiled rice is removed from the pot into a basket to drain the water first before sun drying. The pot use for traditional parboiling has no false bottom and there was no conscious effort made to remove floaters or any other contaminants during the process. Under traditional system only one bag of rice paddy is parboiled per batch.

NCRI Improved Steam Rice Parboiling System comprises two tanks made of galvanized sheets. One serves as boiler while the other serves as steamer which contains perforated crates placed on false bottom. The boiler is placed on the furnace. Firewood supplies the required heat. Valves were incorporated for the control of flow of hot water and steam into the steamer. There are also pipe network. To operate this plant, water is poured into the boiler. The cleaned rice paddy is put into perforated crates in the steamer. The steamer is slightly closed. The water inside the boiler is heated for about 2 hours to allow temperature rise to about 75-80^{o}C depending on the variety of rice. The hot water control valve is opened so as to allow it flow into the steamer. This is closed after it has completely covered the rice paddy crates in the steamer. It is left closed for about 3 hours. Then, the hot water is drained off. This is soaking period. The furnace is then fed with firewood, to fire the boiler so as to generate required steam. After about 2 hours, the control valve is opened and the steam is left to flow into the steamer for about 30 minutes. The steamer is opened and the parboiled rice removed for overnight shade drying. This is followed by sun drying for about 5 hours. Floaters and other contaminants are consciously removed during cleaning operation.

HANIGHA Improved Parboiling System is a single vat system with a sealed boiler directly under the soaking and steaming vat, and a tilting discharge. The steamer is not separated from the boiler and it has thermometer connected to the boiling tank to accurately measure temperature. Mode of operation involves transfer of clean, floater-free rice paddy into the boiling tank. The water is left to boil for about 3 hours, in order to allow water temperature to rise to about 85^{o}C. This is hot water soaking. On attaining the appropriate temperature, one-fifth of the boiling water is drained off and the remaining four fifth of water is heated for about one hour. The parboiled paddy is poured directly on the drying slab for sun drying. Sometimes, if there is no sun, the paddy can be dried overnight on the drying slab.

3.3. Analysis of Costs and Returns

This analysis assumed that the normal number of batch per day is one for traditional and NCRI, while it is one and a half batch per day for HANIGHA for 250 days of operation per annum. A batch consists of one bag for traditional and three bags for improved parboiling systems. Input-Output variables are presented in Annex 1. The number of batches per year was 250 each for traditional and NCRI while it was 375 for HANIGHA parboiling units. The traditional system has the highest output recovery ratio. This could be attributed to the higher moisture content as a result of longer soaking period and presence of contaminants. Traditional parboilers do not clean nor remove floaters, while other parboilers do so. The total fixed investment costs, total working capital and total operating cost were highest for HANIGHA parboiling unit, followed closely by NCRI, and while traditional was the least. The implication is that improved parboiling technology is capital intensive. Credit facility may therefore be required for adoption of improved parboiling system.

Annex 2 presents the enterprise budget for parboiling/ processing systems. The value of output was highest for HANIGHA parboiling system (₦4, 078,255.00), when compared with NCRI system (₦2, 690,335.00) and traditional system (₦832, 455.00). The gross margin which gives the return to all fixed factors; net enterprise income which measure the return to owner's fixed costs, net enterprise earnings, net profit, return to equity capital and return on investment were all positive for all the systems indicating that all the systems were profitable. HANIGHA parboiling system was most profitable when compared with NCRI parboiling system. The Traditional system is the least profitable.

Return to labor which measure the return per day of labor or as a percent of the charge for family labor were all higher than the opportunity cost of labour. It is highest for NCRI, and followed closely by HANIGHA. The implication is that NCRI system is the best in terms of labour employment.

Varying the batch per day of HANIGHA system by 50% indicated that system was still profitable. The net profit changes by about 70%. However percentage in the cash return per day of family labour was very low. The implication is that it is more efficient for HANIGHA system to operate at one and a half batch per day.

3.4. Analysis of Cash flow.

Cash flow analysis as presented in Annex 3 indicates that the net present value at discount rate of 30% is positive (₦1,995,152.00), and the internal rate of return (94%) is higher than the current bank interest rate. The implication is that the parboiling venture can repay back any loan given at interest rate below 94%. The investment is therefore, credit worthy and can therefore be considered for loan by any Nigerian bank.

3.5. Break-even Analysis

Breakeven output is the output beyond which the enterprise starts making a profit. Break even point of milled rice for HANIGHA processor is 28,974 kg. This is about 82% of milled rice (35,250kg) per year. This is less than one batch (three bags of paddy) per day for 250 days per year. Similarly, the breakeven output for NCRI parboiling unit is 22,639kg. This is 62% of annual milled rice (36,337 kg), which is also less than one batch (three bags of paddy) per day for 250 days per year.

For traditional, the break even point is 4,383kg. This is about 33% of 13,200kg of milled rice per year. The implication is that profit can be generated from parboiling venture within a year of investment. Traditional system will reach break even point before NCRI and HANIGHA systems under one batch per day.

Increasing the output of HANIGHA by 50% (i.e. one and a half batch per day), will lead to an increase of the break-even output to 3,0279kg, which is 57% of annual milled rice (52903kg). This implies that HANIGHA system will attain break even point before NCRI systems whose normal operation is one batch per day.

3.6. Sensitivity Analysis

As presented in Table 5 break even point is directly related to the investment cost, labour cost, fuel cost and cost of rice paddy, while it is inversely related to the price of the processed rice. This implies that an increase in costs of these inputs will raise the break even level, thereby impede early attainment of break even level, while an increase in selling price of processed rice will bring down the break even level, and thus favours profitability of the business.

Sensitivity analysis of the impact of change of some basic inputs such as investment in equipments, fuel cost, labour cost, paddy cost and selling price of processed rice on break-even point is considered. Under the two improved parboiling systems, the break even values were all positive, indicating that the business would still make profit if there is any increase or decline in the costs of inputs below 15%. However, in traditional system, an increase in the costs of paddy above 5% will make the business unprofitable. This implies that the business will not generate profit when the cost of paddy is raised more than 5%. Similarly, a decline in the price of processed rice renders the business unprofitable.

3.7. Consumers Quality Preference

In analyzing the consumers quality preferences seven samples of different treatments of parboiling/milling methods were displayed in the market place. Market perception was obtained from consumers based on six different physical characteristics. These characteristics were scored using the scale as shown below. The main score was calculated as presented in Table 6.

1. Like extremely = 9
2. Like very much = 8
3. Like moderately = 7
4. Like slightly = 6
5. Neither likes nor dislike = 5

6. Dislike slightly = 4
7. Dislike moderately = 3
8. Dislike very much = 2
9. Dislike extremely = 1

The result shows that sample parboiled using NCRI parboiling procedure and milled with NCRI machine has the highest preference mean score of 7.5, followed by the sample parboiled traditionally and milled by NCRI machine with mean score of 7. The least preferred sample was the one parboiled by HANIGHA and milled with NCRI machine. This result was attributed to the soaking procedure adopted by the HANIGHA operator. This caused breakages of grains when milled with NCRI machine. The cause of the breakage is due mainly to the parboiling system adopted by the operator of the HANIGHA equipment and has no negative effect on the operational efficiency of the HANIGHA machines however. See the following observations and comments as well as problems and issues on the parboiling systems.

3.8 Observations and Comments on the Parboiling Systems

(A) Traditional Parboiling Systems

1. Mrs Ladidi Chahchaga:

- The paddy rice was also poured directly without any attempt to clean the foreign matters, unfilled grains and other particles.
- The water used for soaking was dirty and colored with some impurities on top.
- Soaking took two days after which the paddy had started fermenting with forms on top of the water.
- The fermentation in the iron pot is more or faster than that of the mud pot.
- In the steaming process part of the water used for soaking, fermented water was retained back for steaming.
- The paddy rice sub-merged by water under the pot over parboiled due to continuous boiling of water.

- In the drying, the slab was not used exclusively for drying paddy rice.
- The drying slab was filled with sand, stones, animal dung, which were not swept before pouring the parboiled paddy for drying.
- The parboiled paddy was not allowed to dry properly before milling containing about18-20% moisture content which will eventually become mouldy if bagged and stored.

2. **Mrs Hawawu Tsado**:

    - During steaming it was observed that there was no enough water at the bottom of the pot.
    - Excessive firing of the pot made the water to dry up. Therefore parts of soaked paddy that was been steamed burnt, turned black.
    - The milled rice had black spote because of the burning.

3. **Hajiya Nana**

    - It was wet cleaned (washed) and foreign materials removed.
    - The water used for soaking was changed. It was steamed using iron pot, dried little, before it was taken to NCRI for further drying since it was to be milled at NCRI.
    - The paddy was over-steamed, higher steam temperature for longer period, which resulted in the milled rice grain having darker brown colour and more harder

Advantages

1. It is easy to handle or operate
2. It uses less water, labour and firewood
3. It requires little capital to start
4. It is a source of income for women

Disadvantages

1. During prolonged soaking, fermentation took place and both paddy and milled rice acquired a smell or odour.
2. It is conducive for the development of fungi that are harmful to humans.

3. In the drying process, losses occurred due to consumption by birds, fowls, rodents etc.
4. Unhygienic conditions exist as a result of people treading on the parboiled paddy and contamination by dusts and animals.
5. Use water from different sources.

(B) National Cereals Research Institute (NCRI) Parboiling System

Advantages

1. There is a reduction in the soaking time, which considerably reduces the processing time and increases production.
2. The bad smell is entirely eliminated or reduced
3. It has a very high heat transfer rate
4. It gives the rice good and uniform color (premium quality) and price
5. The heat can be controlled instantly.

Disadvantages

1. It consumes much firewood
2. It needs technical competence to operate
3. The materials used for its construction are not durable
4. it is very sophisticated.

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(C) HANIGHA Parboiling System

Three (3) bags each of paddy were taken per batch by Umar Bida. They were washed with cold water and unfilled grains removed by decanting. Cleaned paddy was put in the parboiler and water introduced to the tank through a rubber hose to fill the tank. And the fire was set below the parboiling unit with continuous firing for $3^1/_2$ hours as soaking period for each batch. After $3^1/_2$ hours the water was drained to the steaming level, with immediate steaming for 30 minutes as firing continues.

Advantages

1. It reduces odour or smell

2. It consumes less firewood
3. it has thermometer for temperature reading
4. it is easy to discharge parboiled paddy
5. It is easy to handle
6. The materials for its construction are durable.

Disadvantages

1. The parboiled milled rice has white starchy core (white belly)
2. The paddy is cooked during soaking as firing continued
3. There is no uniform distribution of steam
4. Paddy is under soaked due to inadequate absorption of moisture and increase in steam consumption
5. Less grain hardiness leading to easy breakages during milling

3.9 Problems and Issues Encountered During the Study

1. The women were not willing to give us true and correct information at the initial stage. They were inflating the cost of some materials. Their thought was that the money paid to them as honorarium if they did not measure up or give the figure that is up to that, they may be asked to refund it. It was later that we called them and talked to them before they understood our mission and were convinced to open up sincerely.

2. NCRI Rice Mill was not functioning properly during the milling process, due to the replacement of some new parts, such as milling stone, screens, milling blade, since they are not yet smooth, therefore, instead of two pass, three pass milling was done.

3. The HANIGHA cleaner was not functioning therefore; we found it difficult to winnow its milled rice. The lack of proper drying space, moisture tester, and material to determine the broken percentage, head rice yield also presented some difficulties in establishing the true quanlity of this parboiling system.

4. Traditional parboiling has a prolong soaking period of 2-3 days during which

fermentation takes place due to the activities of bacteria which impacts bad odors to both parboiled and milled rice. Drying normally depends on the weather condition, but ideally 5-6 hours during summer and 7-8 hours during winter. But lack of properly dried parboiled paddy been milled, because of breakages or swelling measures is major setback on the traditional parboiling. If the rice is not properly dried the load given to the mill during dehusking and polishing may not be smooth and causes some mills to perform inadequately. With multiple passes before you get cleaned milled rice, some still have under milled (undehusked) rice after milling.

Direct soaking of paddy rice with foreign particles, which decomposed and fermented with paddy rice, changes the color of the water used for soaking. Since the paddy absorbs this water, no amount of polishing will make the rice attractive again.

Breakages in parboiled rice can be caused by rapid drying conditions that favour cracking. The moisture content of the grain during the time of milling may cause breakages. However, rice breakages are related to milling conditions, particularly prevailing relative humidity and temperature. Shape of the grain and its hardness also a contributing factor to breakages.

Rice millers or operators are not very quality conscious, since most of the milling is currently done in custom mills. They charge a fixed rate for milling a quantity of rice. He therefore, has little incentives to produce or milled quality rice, since he does not gain financially. Most mills do not work for the whole day so profits are less or lower than could or what is expected. Servicing and repairs of the equipment is seen as a loss of profit by them, so is often not carried out as it should be resulting in an inferior product quality and an increased number of break downs.

4.0 Conclusion and Recommendation

This study was undertaken to assess the financial viability of investing in rice parboiling business. Based on the analysis of the data collected from two village traditional parboilers and two improved parboilers in Bida area, it can be concluded that rice parboiling business is profitable. However, improved systems are more profitable than traditional parboiling system. In terms of quality, rice parboiled using modern methods are more preferred. Quality of rice and profitability of traditional parboilers could be improved if they are encouraged to adopt new method of parboiling by using NCRI or HANIGHA equipment and follow similar parboiling procedure. He total fixed costs, total working capital and total operating cost were very high for the improved parboiling systems of HANIGHA NCRI. Nevertherless the value of output was highest in the HANIGHA parboiling system and followed closely by the NCRI parboiling system. The traditional parboiling system gave the least value of output.

As investment in the new equipment will involve a reasonably high investment capital, credit should be made available by banks or lending companies to the interested traditional parboilers.

The rice processors, especially traditional rice parboilers should be encouraged to adopt the wet-cleaning method been used by the improved processors (HANIGHA and NCRI). The paddy rice should be subjected to cleaning process involving pouring water into the basin of rice and stirring so that foreign particles will float and removed before soaking. The hot water soaking being practiced by improves of HANIGHA and NCRI can be adopted by the traditional rice processors. Cleaned water should be used both for soaking and steaming to avoid colored water or dirty water. Mixing of different varieties of rice for parboiling and milling should be discouraged. It is important to note that during steaming, the water used for soaking should be drained or removed completely; fresh water should be used for steaming. The false bottom can be constructed by a welder that will be placed at the bottom of the pot, so that during steaming paddy rice can be suspended above the water for even distribution of steam to avoid uneven cooking and burning of rice.

Drying slabs should be constructed outside the living yards to avoid treading on the parboiled paddy by animals and human beings.

Gradual drying of paddy rice before milling to storable and good milling moisture content is essential. Therefore tempering of parboiled paddy before milling should be adopted (sun drying and shade drying). Milling of un-dried paddy rice should be discouraged. Based on the fact that the HANIGHA cleaner was faulty and not functioning as expected during milling and winnowing coupled with lack of drying space, moisture tester, among other factors it is recommended that the HANIGHA Parboiling and Milling Systems be re-tried elsewhere for confirmation of result.

Table 1: The Input – Output Variables of the Parboiling Systems in Bida Area, 2006

Parboiling System	Traditional	NCRI	Hanigha
Normal batch size	75kg	225kg	225kg
No. of batches/day	1	1	1.5
Days of operation	250	250	250
Max. capacity/year	18.8mt	56.3mt	84.4mt
Recovery ratio	0.704	0.646	0.627
Output of milled rice	13.2mt	36.3mt	52.9mt

Mt = metric tons

Table 2: The Costs for the Rice Parboiling/Processing Systems in Bida Area, 2006

Budget items	Traditional	NCRI	Hanigha
Fixed invest. costs	23150	494975	820525
Working capital	5825	63934	183032
Depreciation expen.	3010	54838	71366
Cash operating cost	78175	333348	343432
Total variable costs	728175	2283348	3268432

Table 3: The Profitability indicators for rice parboiling systems in Bida Area 2006

Budget items	Trad.	NCRI	Hangha
Gross margin	104280	406987	813023
Net enterprise income	101270	352149	741652
Net enterprise earnings	92577	184476	440590
Net profit (R. to Mgt)	24421	146976	296731
Return to equity cap.	33114	314649	597798
Return to family labor	92577	184476	440590
Cash return/bag of paddy	418	544	724
Rata of Return on Total Investment	114%	56%	60%

Table 4: The Discounted Cash Flow Analsis of Hanigha Parboling system in Bida Area, 2006

Year		2005	2006	2007	2008	2009	2010	2011	Salva value
TIC	820525	820525	0	107100	0	107100	18800	0	**-0.464m**
TWC	122762	245524	0	245524	0	245524	0	0	**-0.736m**
NIC		1.066M	0	352624	0	352624	18800	0	**-1.201m**
TVC	2.288M		4.576M	4.576M	9.152M	9.152M	13.728M	13.728M	
TR			5.4M	5.4M	10.9M	10.8M	16.3M	16.3M	
NB/R		-1.066M	0.866M	0.509M	1.723m	1.379	2.566	2.585	1.20M
NPV 30%	1.985M								
IRR	94%								

TIC = Total Investment Cost, TWC = Total Working Capital, NIC = Net Investment Cost
TVC = Total Variable Cost, TR = Total Revenue, NB/R = Net Benefit/Return,
NPV = Net Present value, IRR = Internal Rate of Return

Table 5: **Sensitivity analysis of the impact of change in the costs of input and selling price on break even levels of different parboiling systems in Bida Area, 2006**

Cost/Price item	5%	10%	15%
Traditional system *(4383)			
Increase in investment cost	4403	4530	4657
Increase in fuel cost	4420	4574	4738
Increase in labour cost	4722	5271	5964
Increase in paddy cost	4263	-5350	-2516
Increase in selling price of milled rice	1996	1298	962
Reduction in investment cost	4149	4022	3896
Reduction in fuel cost	4142	4015	3901
reduction in labour cost	3908	3596	2906
Reduction in paddy cost	2251	1528	1156
Reduction in selling price of milled rice	-26900	-3258	-1735
NCRI System *(22639)			
Increase in investment cost	22719	23343	24073
Increase in fuel cost	22118	22340	22570
Increase in labour cost	21995	22107	22221
Increase in paddy cost	29727	45300	105024
Increase in selling price of milled rice	16041	12693	10510
Reduction in investment cost	21153	20422	19692
Reduction in fuel cost	21666	21449	21236
reduction in labour cost	21772	21663	21341
Reduction in paddy cost	17314	14324	12214
Reduction in selling price of milled rice	34364	79017	-27046
Hanigha system *(30279)			
Increase in investment cost	30533	31541	32529
Increase in fuel cost	29686	29837	29974
Increase in labour cost	29908	30239	30577
Increase in paddy cost	37911	52757	86715
Increase in selling price of milled rice	22720	18356	15461
Reduction in investment cost	28608	27630	26652
Reduction in fuel cost	29469	29338	29223
Reduction in labour cost	29263	28960	28069
Reduction in paddy cost	24258	20557	17835
Reduction in selling price of milled rice	42340	76034	338575

Parenthesis indicates break even values when there is no change

Table 6: Preference ranking of rice Quality Characteristics by Consumers in Bida Market 2006

Samples	Colour	Grain size	Impurities	Breakages	Acceptance	Moiture content	Mean Score
Traditional parboiled and milled	6	7	6	8	7	2	6
Traditional parboiled and NCRI milled	7	7	6	7	7	8	7
HANIGHA parboiled and milled	6	6	6	7	4	4	5.5
NCRI parboiled and milled	8	7	7	7	8	8	7.5
Traditional parboiled at Bida and NCRI milled	4	6	3	7	4	7	5.1
HANIGHA parboiled and Indian milled	5	6	4	6	4	3	4.6
HANIGHA parboiled and NCRI milled	2	2	6	4	3	7	4.0

Annex .1 Input-Output variables of the parboiling systems in Bida Area, 2006

Parboiling system			Ladidi	Hawawu	Average of Traditional	NCRI	HANIGHA
Number of trials included			1	1	1	3	3
Price for paddy per kilo @ N	2600	/bag	34.7	34.7	34.7	34.7	34.7
Value of milled rice (kg) with this paddy cost			63.0	63.0	63.0	73.6	76.6
Technical Input/Output Coefficients per Batch							
Paddy & rice (kgs)							
Amount of raw padddy			225	225	225	225	225
Floaters removed in washing			0	0	0	11.7	0.0
Amount of parboiled paddy, dried			228	235	231.5	207.5	0.0
Estimated Moisture content			18.0%	18.0%	0.18	14.0%	14.0%
Amount of milled rice			162	155	158.5	145.3	141
Whole/unsorted rice			162	155	158.5	145.3	141
Broken rice							0
Recovery ratio							
Whole/unsorted rice			0.720	0.689	0.704	0.646	0.627
Broken rice							0
Implied production of bran and husks			66	80	73	62.2	-141.0
Annual Throughput - Normal operation							
Normal Batch size (kilos)			75	75	75	225	225
Assumed number of batches/day			1	1	1	1	1.5
Assumed days of operation			250	250	250	250	250
Batches per year			250	250	250	250	375
Annual throughput of paddy (mt)			18.8	18.8	18.8	56.3	84.4
Maximum annual capacity of paddy (mt)			39.0	39.0	39.0	56.3	140.6
Annual output of milled rice (mt)			13.5	12.9	13.2	36.3	52.9
of which is broken rice							0.0
Fixed Investment Costs							
Parboiler			16,800	13,300	15,050	120,000	75,000
Drying slab			13,400	13,400	13,400	20,100	60,300
Proportion allocated to rice enterprise			0.50	0.50	0.50	0.75	0.75
Equipment shed			0	0	0	30,000	30,000
Drying shed			0	0	0	40,000	0
Rice mill			0	0	0	240,000	270,000
Cleaner			0	0	0	0	350,000
Bag sealer			0	0	0	0	14,000
Installation expenses							
Equipment			0	0	0	24,000	0
Utilities, transport & other			0	0	0	17,500	17,500
Accessories							
Wheelbarrow			0	0	0	0	4,000
Dolly/truk			0	0	0	5,000	0
Barrels			1,500	1,000	1,250	0	11,500
Shovels			0	0	0	500	500
Rakes			0	0	0	500	500

Buckets/basin	150	150	150	2,400	2,300	18,800
Total Fixed Investment Costs	25,150	21,150	23,150	494,975	820,525	
Working capital per day			2,913	9,133	13,074	
Number of days required			2	7	14	
Total working capital			5,825	63,934	183,032	
Depreciation						
Period (years)						
Parboiler	8.16	6.46	7.31	6	10	
Drying slab	10	10	10	10	10	
Equipment shed	20	20	20	20	20	
Drying shed	20	20	20	20	20	
Rice mill	10	10	10	10	10	
Destoner	15	15	15	15	15	
Bag sealer	7	7	7	7	7	
Installation expenses	10	10	10	10	10	
Accessories	5	5	5	5	5	
Amounts						
Parboiler	2,060	2,060	2,060	20,000	7,500	
Drying slab	670	670	670	1,508	4,523	
Equipment shed	0	0	0	1,500	1,500	
Drying shed	0	0	0	2,000	0	
Rice mill	0	0	0	24,000	27,000	
Destoner	0	0	0	0	23,333	
Bag sealer	0	0	0	0	2,000	
Installation expenses	0	0	0	4,150	1,750	
Accessories	330	230	280	1,680	3,760	
Sub-total depreciation expense	3,060	2,960	3,010	54,838	71,366	
Cash Operating costs						
Costs Per Batch						
Paddy						
Fuel	88	100	94	300	150	
Water	0	0	0	0	0	
Electricity	0	0	0	0	0	
Hired labor	0	0	0	900	0	
Transportation	66	66	66	0	360	
Sales and other variable taxes	0	0	0	0	0	
Milling cost	150	150	150	0	0	
Bags	0	0	0	0	300	
Sub-total batch cost	304	316	310	1,200	810	
Annual costs						
Total batch costs	76,000	79,000	77,500	300,000	303,750	
Other water	0	0	0	7,200	7,200	
Electricity	0	0	0	12,000	12,000	
Repairs & maintenance	0	0	0	9,903	19,957	
Bags	100	100	100	0	0	
Wire netting	0	0	0	3,120	0	
Baskets/sieves	150	150	150	1,000	100	
Brooms/cloth	425	425	425	125	425	
Total Operating Costs	76,675	79,675	78,175	333,348	343,432	
Family labor (hours)						

Batch amounts					
Acquiring paddy & water	0.72	0.36	0.54	0.50	0.50
Washing, soaking, heating, steaming	1.50	1.50	1.50	0.00	2.58
Emptying,spreading, raking & turning	2.17	2.13	2.15	0.00	2.40
Bagging	0.33	0.33	0.33	0.00	1.08
Milling, winnowing	1.50	1.50	1.50	0.00	1.67
Marketing	1.25	1.25	1.25	0.50	0.50
Operator labor	0.00	0.00	0.00	3.00	1.50
Sub-total batch cost	7.47	7.07	7.27	4.00	10.23
Annual amount (hours)	1,868	1,768	1,818	1,000	3,836
Annual amount (days @ 8 hr/day)	233	221	227	125	480

Annex 2: Enterprise budgets for selected rice parboiling/processing systems in Bida, 2006

Parboiling system			Traditional	NCRI	Hanigha
Normal Batch size (kilos)			75.0	225.0	225.0
Assumed number of batches/day			1.0	1.0	1.5
Assumed days of operation			250.0	250.0	250.0
Number of batches per year			250.0	250.0	375.0
Milling ratio			0.704	0.646	0.627
Annual throughput of paddy (mt)			18.8	56.3	84.4
Annual output of milled rice (mt)			13.2	36.3	52.8750
Of which is broken rice					0.0
Annual output of rice bran & husks				17.0	31.5
Milled rice per bag (kgs)					
Cost of paddy (N/bag)	2600				
Value of output per bag of paddy					
Milled rice @ N	63.0	/kilo	832,455		
Milled rice @ N	73.6	/kilo		2,673,335	
Milled rice @ N	76.6	/kilo			4,049,955
Rice bran @ N	1.0	/kilo	0	17,000	31,500
Total value of output			832,455	2,690,335	4,081,455
Equipment Costs					
Parboiler			15,050	120,000	75,000
Rice mill			0	240,000	270,000
Cleaner			0	0	350,000
Drying slab and sheds			6,700	85,075	75,225
Other			1,400	49,900	50,300
Total Investment in Equipment			23,150	494,975	820,525
Working capital per day			2,913	9,133	13,074
Number of days required			2	7	14
Total working capital			5,825	63,934	183,032
Total Investment Cost			28,975	558,909	1,003,557
Borrrowed capital/outstanding loans			0	0	0
Depreciation					
Rates					
Parboiler			7	6	10
Rice mill				10	10
Cleaner					15
Other			Var	Var	Var
Annual Depreciation					
Parboiler			2,060	20,000	7,500

Rice mill				24,000	27,000
Destoner					23,333
Other			950	10,838	13,533
Total Depreciation			3,010	54,838	71,366
Variable Cash Costs					
Paddy @ N	2600	/bag	650,000	1,950,000	2,925,000
Fuel			23,500	75,000	56,250
Hired labor			0	225,000	0
Other cash operating costs			54,675	33,348	287,182
Total Variable Cash Costs			728,175	2,283,348	3,268,432
Gross Margin			104,280	406,987	813,023
Fixed Costs					
Depreciation			3,010	54,838	71,366
Interest on borrowed capital @	20%	p.a.	0	0	0
Rent			0	0	0
Taxes - fixed (real estate)			0	0	0
Sub-total fixed cash costs			3,010	54,838	71,366
Net Enterprise Income			101,270	352,149	741,657
Charge for Equity Capital @	30%	p.a.	8,693	167,673	301,067
Net Enterprise Earnings			92,577	184,476	440,590
Days of family/owner labor			227	125	480
Charge for family labor @ N	300	/day	68,156	37,500	143,859
Charge for family land per annum			0	0	0
Net Profit & Return to Management			24,421	146,976	296,731
Return to Equity Capital			33,114	314,649	597,798
Return on Investment			114%	56%	60%
Rate of return on total Investment			114%	56%	60%
Return to Family Labor			92,577	184,476	440,590
Return per day of family labor			407	1,476	919
Rate of Return to Labor			36%	392%	206%
Cash return per day of family labor			459	3,256	1,695
Cash return per bag of paddy			418	544	724

Annex 3: Cost of parboiling and milling paddy rice with alternative techniologies

Parboiling system			Traditional	NCRI	Hanigha
Normal Batch size (kilos)			75.0	225.0	225.0
Assumed number of batches/day			1.0	1.0	1.0
Assumed days of operation			250.0	250.0	250.0
Conversion ratio paddy/milled rice			0.70	0.65	0.63
Annual throughput of paddy (mt)			18.8	56.3	56.3
Annual output of milled rice (mt)			13.2	36.3	35.3
of which is broken rice					0.0
Investment Costs & Working Capital			28,975	558,909	943,287
Annualized Costs					
Cash operating costs excluding paddy			78,175	333,348	242,182
Fixed costs			3,010	54,838	71,366
Charge for equity capital @	30%	p.a.	8,693	167,673	282,986
Charge for family labor @ N	300	/day	68,156	37,500	95,906
Charge for family land @N			0	0	0
Total Costs			158,034	593,358	692,440
Cost Summary for Milled Parboiled Rice					
Variable cost excluding family labor					
Per kilo			**5.92**	**9.18**	**6.87**
Per bag of paddy (75 kg)			313	444	323
Variable cost (including family labor)					
Per kilo			**11.08**	**10.21**	**9.59**
Per bag of paddy (75 kg)			585	494	451
Total cost					
Per kilo			**11.96**	**16.33**	**19.64**
Per bag of paddy (75 kg)			632	791	923

Annex 4. Discounted cash flow analysis of HANIGHA rice processing system in Bida area, 2006

Year of Operation		2005	2006	2007	2008	2009	2010	2011	Salvage Values
Normal Batch size (kilos	225.0								
Assumed number of batches/day	2.0								
Assumed days of operation	250.0								
Number of batches per year	500.0								
Milling ratio	0.627								
Annual throughput of paddy (mt)	112.5								
Annual output of milled rice (mt)	70.500000								
Annual output of rice bran & husks	37.7								
Cost of paddy (₦/bag) 2600			2,600						
Implied value of rice (N/kilo)									
Milled rice @ N76.6/kilo	5,400,300		76.6	Value of milled rice implied by cost of paddy					
Rice bran @ N1.0/kilo	37,733								
Total value of output	5,438,033								
Number of parboilers added		1	0	1	0	1	0	0	
Number of parboilers replaced									
Number of drying slabs added		1	0	1	0	1	0	0	
Number of parboilers operating			1	1	2	2	0	3	
Purchase of parboiler	75,000	75,000	0	75,000	0	75,000	3	0	
Drying slab per parboiler	20,100	20,100	0	20,100	0	20,000	0	0	
Other costs per parboiler	12,000	12,000	0	12,000	0	12,000	0	0	
Investment Costs									
Parboiler	75,000	75,000	0	75,000	0	75,000	0	0	-135,00
Rice Mill	270,000	270,000	0	0	0	0	0	0	-108,000
Destoner	350,000	350,000	0	0	0	0	0	0	-210,000
Drying slab and sheds	75,000	75,000	0	20.100	0	20,100	0	0	0
Other	50,300	50,300	0	12,000	0	12,000	18,800	0	-11,280
Total Investment Costs	820,525	820,525	0	107,100	0	107,100	18,800	0	-464,280

Working Capital per day per batch per parboiler	8,769								
Number of days required	14								
Total working capital	122,762	245,524	0	245,524	0	245,524	0	0	-736,573
Borrowed capital/outstanding loans	0	<u>0</u>	0	0	0	0	0	0	-736,573
Net Investment Cost		1,066,049	0	352,624	0	352,624	18,800	0	-1,200,853
Variable Costs per batch per parboiler									
Paddy @ N2,600/bag	1,950,000		3,900,000	3,900,000	7,800,000	7,800,000	11,700,000	11,700,000	
Fuel	37,500		75,000	75,000	150,000	150,000	225,000	225,000	
Hired labour	0		0	0	0	0	0	0	
Family labour 300/day	95,906		191,813	191,813	383,625	383,625	575,438	575,438	
Other cash operating costs	<u>204,682</u>		<u>409,364</u>	<u>409,364</u>	<u>818,728</u>	<u>818,728</u>	<u>1,228,092</u>	<u>1,228,092</u>	
Total Variable Cash Costs	2,288,088		4,576,177	4,576,177	9,152,353	9,152,353	13,728,530	13,728,530	
Gross Revenue									
Milled Rice									
Rice Bran			5,400,300	5,400,300	10,800.00	10,800,600	16,200,900	16,200,900	
Total Revenue			<u>37,733</u>	<u>37,733</u>	<u>75,467</u>	<u>75,467</u>	<u>113,200</u>	<u>113,200</u>	
			5,438,033	5,438,033	10,876,067	10,876,067	16,314,100	16,314,100	
Net Benefit/Return									
NPV @ 30.0%	<u>1,985,555</u>	-1,066,049	861,857	509,232	1,723,714	1,371,089	2,566,771	2,585,571	1,200,853
IRR @ 94.0%									
Compound factor		1.00		1.94	7.30	14.16	27.47	53.30	103.40
NPV @ 94.0%	<u>0</u>	-1,066,049		444,272	236,105	96,810	93,423	48,511	11,614
4.5%									1,000,000

PHOTO-SCENES

Plate 1:   NCRI Parboiling System and the Drying Slab

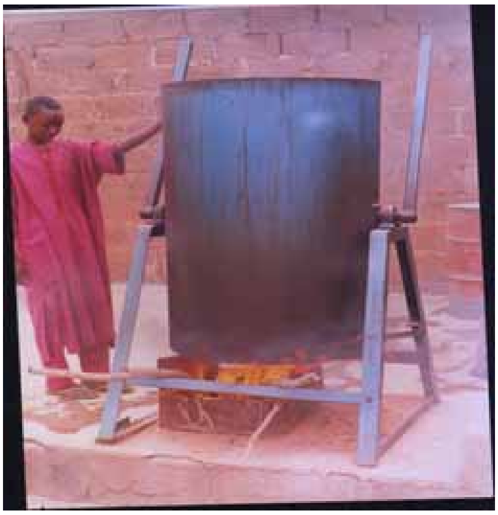

Plate 2:   HANIGHA Parboiling System

Plate 3: Traditional Parboiling System and the Drying Slab

Plate 4: NCRI Fabricated Milling Machine

Plate 5: HANIGHA Milling Machine

Plate 6: Indian Huller Machine used by the Traditional women Millers

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