

# **CROP POST HARVEST PROGRAMME**

**Enhancing rural livelihoods through a new coalition  
arrangement for the dissemination of improved rice post-  
production and marketing technologies in Northern Ghana**

**R8263 (Z0334)**

## **PROJECT FINAL REPORT**

**1<sup>st</sup> January 2003 – 31<sup>st</sup> December 2004**

### Core Partners

Keith I. Tomlins (NRI)  
Ramatu Al-Hassan (DAE)  
Victor Antwi (TNS)  
Abigail Abandoh-Sam (ADRA)  
A.R.Z. Salifu (MOFA)

### Managing Partner

John T. Manful  
Food Research Institute, Accra, Ghana.

# Project Final Report

## Section A Executive Summary

**A very brief summary of how the outputs of the project contributed to the purpose, the key activities and highlights of dissemination outputs. (Up to 500 words).**

Purpose: Enhance rural livelihoods in selected communities in Northern Ghana through promotion of rice post-production technologies and marketing systems

Contribution of project to purpose:

The northern sector of Ghana produces about 60% of the national output of paddy rice. Almost this entire paddy produced in northern Ghana is parboiled and the parboiling is carried out exclusively by women in 40kg batches using rudimentary traditional technologies. The result is a product of very variable quality that commands a low price and is unable to compete with imported rice on the local market. The project outputs have produced 5 “Rice Quality Training Manuals” that have helped in training extension staff and rice farmers, parboilers, mill operators and marketers on the importance of improved product quality as well as a “Rice Recipe Album” that created awareness among consumers on a variety of new preparations from locally produced rice.

Key activities

The key project activities were as follows:

- Existing socio-economic baseline data was validated.
- Forty 40 agricultural extension agents and 50 beneficiaries were trained in improved rice post production handling techniques in a “training of trainer’s programme.
- Four existing rice mills were adapted and fitted with aspirators to improve milling efficiency.
- Seven new mills were installed in selected communities to enhance improved milling capability.
- Cost-benefit analyses as well as constraints faced in adopting improved technologies were assessed.
- Price sensitivity of consumers to improved quality parboiled rice was assessed.
- Over 18,000 seedlings distributed to parboilers to be planted and harvested for fuel wood

Dissemination highlights

- Five “Rice Quality Training Manuals” were produced.
- A “Rice Recipe Album” was produced to popularise new ways of utilising parboiled rice.
- The French Cooperation in Ghana requested for 20 parboiling vessels to be introduced in their rice development project area.
- The Minister of Food and Agriculture requested for the coalition to work more closely with the Ministry in further disseminating the technologies developed after the termination of the project.

## Section B Background

### B.1 Administrative data

<b>NRIL Contract Number:</b> Z0334	<b>Managing Partner / Institution:</b> John T. Manful; Food Research Institute (FRI), Accra; Ghana
<b>DFID Contract Number:</b> R8263	<b>Partner institution(s):</b> Natural Resources Institute (NRI), Department of Agricultural Economics, University of Ghana (DAE), Adventist Development and Relief Agency-Ghana (ADRA), Technoserve-Ghana (TNS), Ministry of Food and Agriculture (MOFA).
<b>Project Title:</b> Enhancing rural livelihoods through a new coalition arrangement for the dissemination of improved rice post-production and marketing technologies in Northern Ghana	<b>Target Institution(s):</b> Small-holder rice farmers; women parboilers; rice millers; engineering companies; consumers; Agricultural extension officers.
<b>Research Programme:</b> Crop Post-Harvest	<b>Start Date:</b> 1 <sup>st</sup> January 2003 <b>End Date:</b> 31 <sup>st</sup> December 2004
<b>Thematic area:</b> Improving processing and exploring opportunities for value addition.	<b>Budget :</b> £152,375

## Section C Identification and design stage (3 pages)

### Poverty focus

**How did the project aim to contribute to poverty reduction? Was it enabling, inclusive or focussed (see definitions below<sup>1</sup>)? What aspects of poverty were targeted, and for which groups?**

The project fell under the “focused” category of poverty reduction. The project addressed issues relating to adding value to locally produced parboiled rice which is exclusively a rural occupation in northern Ghana and is carried out by the poor. The higher quality product subsequently sold for a premium price on the local market. The project set up “best practice sites” where Good Agricultural Practice and Good Manufacturing Practice were adhered to. The designated best practice sites were located in rural, poor communities. The target beneficiaries were farmers, parboilers, rice mill operators and rice marketers as well as agricultural extension workers of the Ministry of Food and Agriculture and agricultural oriented NGOs. Farmers were encouraged to harvest at the optimum time and to thresh on tarpaulins to eliminate stones and other impurities in the paddy. Parboilers were trained and encouraged to use the prototype rice parboiler which reduced fuel and water consumption and produced a better quality product. The level of production was kept at 100kg per batch for artisanal processors. Rice mill operators were encouraged to fit aspirators to their mill to produce cleaner rice on milling and were also trained in the adjusted of the motors and belts to reduce power consumption and increase profit margins.

Some women parboilers in the Upper East Region were linked to a MOFA – IFAD project that provided micro-credit to help them keep control of their processing operations.

---

<sup>1</sup> **Enabling:** addresses an issue that under-pins pro-poor economic growth or other policies for poverty reduction which leads to social, environmental and economic benefits for poor people

**Inclusive:** addresses an issue that affects both rich and poor, but from which the poor will benefit equally

**Focussed:** addresses an issue that directly affects the rights, interests and needs of poor people primarily

**Please describe the importance of the livelihood constraint(s) that the project sought to address and specify how and why this was identified.**

The purpose of the project was to disseminate knowledge of improved rice post-production and marketing systems in Northern Ghana to provide opportunities for the enhancement of rural livelihoods. Locally parboiled rice is of very variable quality and consequently commands a lower market price resulting in low incomes for local rice producers, processors and marketers. An earlier CPHP funded project, R6688 found that whereas post harvest quantitative losses are low, qualitative losses are very high for rice in northern Ghana. The presence of stones in the paddy is a major contributing factor to the loss of quality making the product uncompetitive, as good quality rice should have no stones in it at all. Subsequently, a rice parboiling prototype was developed under CPHP project R7543 and this addressed the problems of drudgery, excessive water and fuel use as well as the length of time required to parboil rice. Many rice mills in northern Ghana were a poor state of disrepair and could not mill even well parboiled paddy to the required quality. 7 new mini rice mills were introduced in the project areas and 5 other already existing mills in northern Ghana were adapted to include aspirators to improve the milled rice quality. Mill operators of these new and adapted mills are charging more for the better quality produce to increase their margins. This product commanded a higher market price and also the drudgery and time spent by the women in winnowing rice after milling was eliminated.

**How and to what extent did the project understand and work with different groups of end users? Describe the design for adoption of project outputs by the user partners?**

A socio-economic study was carried out to validate baseline information available from project R7543. This was accomplished with the collection of both primary and secondary data. Primary data was collected through informal group discussions and the use of structured questionnaires in sample surveys and case studies. Discussions were held with farmers, parboilers, mill operators and marketers to ascertain the details of their current practices. In addition, groups of parboilers at Zebilla, Bawku and Navrongo, who had been using the parboiling vessel on trial basis, gave their assessment of the performance of the vessel.

Secondary data on production (National and Regional), imports, and prices were also collected. Information about ongoing development projects on rice was also collected from the Directorates of Agriculture in the three regions. The data revealed the importance of rice in the three northern regions, the significant role of women in the processing of parboiled rice, and the lack of good agricultural practices that affect the quality of parboiled rice. Imports are growing despite government attempts to reduce imports by 30%.

Some members of the coalition had worked with most of the target end users under previous CPHP projects hence the end users were well understood by the coalition and the cooperation was not a problem. Where new beneficiaries were brought on board, the coalition relied on the older target end users as intermediaries in obtaining the cooperation of the new ones.

The new knowledge to be transferred had been developed with the collaboration of the end users. The extension staff of MOFA and the agricultural NGOs who were in regular direct contact with the end users, were indigenous people who spoke their language, and also lived and worked in those communities. They were therefore

trusted by the end users as people who had their interests at heart so transferring knowledge was made even easier.

### ***Institutional design***

#### **Describe the process of forming the coalition partnership from the design stage and its evolution during the project?**

An initial workshop, held in March 2002 in Accra to prioritise the main themes to be pursued by the CPHP for the next 2 years in Ghana with the aim of maximising the value (impact) of past research investment. The objective of this workshop was to identify potential coalition partners to develop a pre-concept note on 'Increasing incomes through adding value to cereals' (in this case rice). The workshop included an overview of previous work conducted, but primarily focussed on 'coalition-forming' to take this theme forward.

A follow-up coalition forming workshop was held in Tamale, Ghana on the 15<sup>th</sup> of May 2002 at the CPHP Programme Manager and the Regional Coordinator were present.

The project leader gave an overview of current/recent projects funded by the CPHP on rice in Ghana. This included a study on the 'competitiveness of local rice in Ghana' and 'improvements to rice parboiling technologies' which was underway at that time and has since been completed.

The presentation outlined the parboiling process. Some of the issues raised included water quality, foreign matter in the paddy and inefficient milling techniques.

Some of the promising results/technologies emerging from this work included new parboiling vessel developed under project R7543. There was immense interest in these developments, especially from the private sector who were well represented at this workshop. The consensus of the meeting was that the promoting the rice sector in northern Ghana should be viewed holistically with all stakeholders involved

The CPHP Regional Coordinator had presented "The CPHP coalition approach" at the March 2002 workshop in Accra. He summarised this approach as follows: *"a collection of partnerships (i.e. two or more individual/institutions) primarily motivated by their commonality of interest in a shared objective to work to achieve it"*.

He said that CPHP (WA) had developed criteria for different types of partners that could contribute to this specific coalition and presented these to the meeting. These were intended to give guidance and additional suggestions were given to the meeting.

The Regional Coordinator also presented guidelines (ground rules) developed by his office on the formation of the coalition to the meeting.

Participants then identified potential geographic locations where the new project would be carried out. After much debate, it was agreed the work should focus on:

- Northern Region, (old) Districts of Tamale Municipal;
- Upper East Region, Districts of Kassena Nankana, Bawku East and Bawku West; and,
- Upper West Region, Wa District.

After much debate, a provisional list of potential partners was drawn up as follows:

- ActionAid (NGO);
- ADRA (NGO);
- FRI (RI);
- Goodman & Sons Ltd (Private Sector)
- Ghana National Procurement Agency (Parastatal)
- Intermediate Technology Transfer Unit (Parastatal)
- MoFA/WIAD (GO);
- NRI (RI);
- OIC (NGO);
- TechnoServe (NGO)
- University of Ghana (University)
- University of Development Studies (University).

The final composition of the coalition was to be derived after further discussions among the partners and the capabilities and roles for each partner was discussed.

The CPHP Programme Manager explained that DFID's requirements for transparency remain, and all proposals will be discussed by the UK-based Programme Advisory Committee (PAC). All meetings held in developing coalition projects will be advertised on the regional website.

During the subsequent period of developing the pre-concept note, concept note and project memorandum, when the obligations of the partners became clearer, a number opted to drop out leaving the following:

FRI (managing partner)

NRI

Technoserve

Adventist Relief and Development Agency (ADRA)

University of Ghana, Department of Agricultural Economics

Ministry of Food and Agriculture, Bolgatanga.

The above members participated in the development of the pre-concept note, concept note and the final project memorandum. After the signing of the project management contract between the CPHP and FRI, MOUs were signed between the managing partner and the various partners clearly outlining roles in various activities, budgets as well as accounting and reporting schedules. These members have attended all coalition meeting and workshop throughout the duration of the project.

**Is there an explicit institutional hypothesis? If yes, is it trying to attack a failure or inadequacy in a mechanism?**

That the government of Ghana's stated objective of reducing rice imports by at least 30% within the next 3 to 5 years can only be possible when the various operators within the local rice industry are assisted to produce a commodity of consistently high quality that can compete with imports.

On the international rice market, parboiled rice sells at a premium as it is considered to be a superior product. In Ghana however, this is not the case at present due to the very poor quality of the local product. Previous CPHP funded projects in Ghana (R6688 and R7543) sought to identify the major causes for this situation and develop technologies and processes to improve the situation. The dissemination of these technologies to the industry operatives will improve product quality and subsequently market price

### **What other institutional factors were seen as being important?**

The historical and existing working relationships between coalition partners were seen as essential. In the past Food Research Institute (FRI), Natural Resources institute and Ministry of Food and Agriculture (MOFA) have had a number of fruitful collaborative works. In addition, the research institutions and University of Ghana have also worked with NGOs and the Ministry of Food and Agriculture in extending research findings. The collaborative effort of the beneficiaries (farmers, miller operators, processors and marketers) was essential in achieving the desired impact. Besides the working relations the following were also important:

- Co-ordination among the coalition members due to their multi-location.
- Joint activity implementation visits by coalition members reduced the number of visits and hence collaborator fatigue and improved participants understanding of the singularity of purpose of visits.
  
- Clear and timely communication of major project decisions.
  
- Smooth and timely release of funds and strict reporting deadlines.
  
- Coalition members' willingness to flex their organization's specific programmes to accommodate unforeseen changes in project implementation plan.
  
- Good interaction – formal and informal – among coalition members and among collaborating farmers, parboilers, and millers.

### **Section D Implementation process (5 pages)**

**How was participation maintained among the different stakeholders (the Managing Partner(s) and the Core other Partners and, where relevant, user communities) in the research process?**

The members of the coalition maintained regular contact with each other during the lifetime of the project. This was aside of the regular coalition meetings that were held. The partners also kept in constant touch with the target beneficiaries. Field extension staff of MOFA and ADRA lived and worked in these communities and they communicated the participation and concerns of the beneficiaries to other members of the coalition. The managing partner made it a point to visit all the target communities at least once every quarter. Contentious issues that arose between the core partners and the beneficiaries were resolved amicably by consensus.

**What were the major changes that took place during the implementation period. For each one, explain why they came about and how well did the project manage them?**

No major changes took place during the implementation period. There were however minor changes to the completion times of certain milestones. These changes came about as some activities coincided with the planting season and the farmers were all busy on their farms. The activities were successfully carried out in the quarter after the planting season.

**What were the strengths and weaknesses of your monitoring system? How did you use the information provided by your monitoring system?**

Project progress was monitored by the preparation of work plans (including Milestones and Deliverables), based upon the project logframe. Regular monitoring visits were paid to the project sites by the managing partner and coalition meetings were also held to review progress quarterly.

The main strength of our monitoring system was the fact that MOFA and ADRA put the expertise of their Monitoring and Evaluation specialists at the disposal of the coalition. The MOFA specialists lived within the project area and they followed activities of the beneficiaries closely. During our mid-term review meeting, a private consultant was invited from the UK to visit the project sites and give the coalition an independent assessment of progress on the project.

**What organisations were involved at the end of the project? Were there changes to the coalition (joining/leaving) during the project? If yes, why?**

The organisations involved at the end of the project were the following:

Food Research Institute

Natural Resources Institute

Technoserve

Adventist Relief and Development Agency

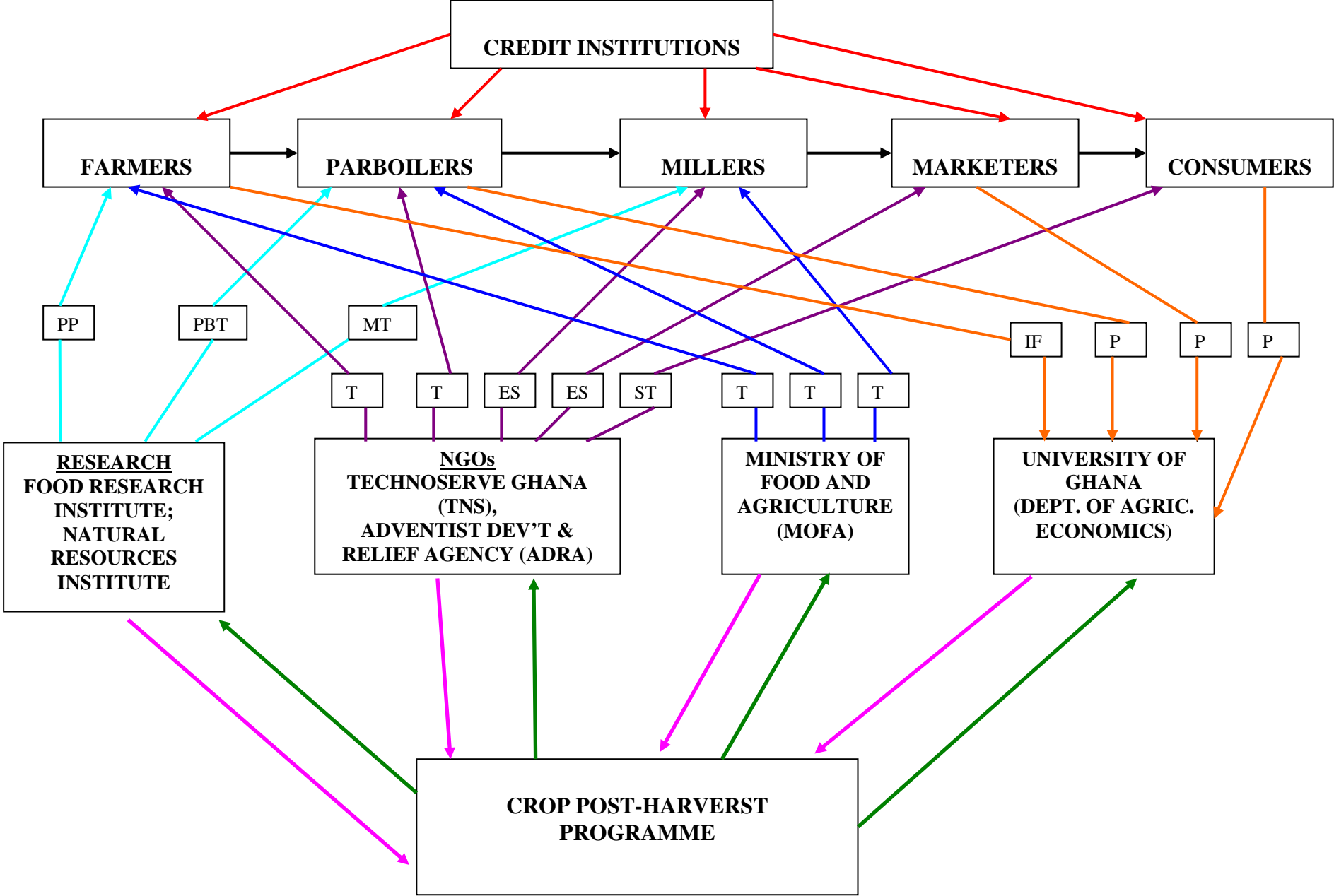
Ministry of Food and Agriculture

Department of Agricultural Economics and Agribusiness, University of Ghana

- There were no changes to the coalition during the project



Fig. 1: Project Linkages between Stakeholders and coalition Partners



## Legend

PPT	–	Production and post-harvest Technology
PBT	–	Parboiling Technology
MT	–	Milling Technology
TES	–	Technical and entrepreneurial skills
ES	–	Entrepreneurial skills
ST	–	Sensitisation
TE	–	Technical extension
IF	–	Information
PA	–	Participatory assessment

Information 

Funds 

### **How have project outputs affected the institutional setting?**

***How will the technical outputs of the project (if successful and if adopted) change the organisations and the relationships between them and in what way? Refer to the project's technical hypothesis.***

The successful execution of the project activities resulted in delivering on all the project outputs. This success has strengthened the working relationships between the members of the coalition and between their respective organisations. The various institutions have become very committed to the idea of contributing towards the production of parboiled rice of a consistently high quality in northern Ghana. This commitment has led the organisations into the decision to follow up the activities of the target beneficiaries to ensure the sustainable use of the knowledge transferred during the

### **Section E Research Activities (15-20 pages)**

This section should include a description of all the research activities (research studies, surveys etc.) conducted to achieve the outputs of the project analysed against the milestones set for the implementation period.

Information on any facilities, expertise and special resources used to implement the project should also be included.

### **Project Output 1.**

Promotional strategies to introduce suitable technologies and practical solutions for the improvement of locally parboiled rice refined and developed, with a view to increasing the income of all stakeholders in the production chain and improving product quality and safety

#### **Activities**

**Coalition Meetings:** Coalition meetings were held regularly in Accra and in all the main project centres. The meetings were chaired by the managing partner and attended by all the Ghanaian coalition partners. These meetings usually reviewed activities in the preceding quarter and planned activities for the impending quarter. Deliberations at the meetings were free and lively and all members spoke the mind without any hindrance. Decisions were always taken on consensus after elaborate

discussions. The working relationships between the different coalition partners were very cordial and contacts were maintained between meetings by fax, email and telephone communication.

**Development of Training Manuals:** Five “Rice Quality Training Manuals”, on the various aspects of rice quality were developed jointly by members of the coalition and a UK based consultant. The different aspects were shared among the coalition members who prepared drafts and submitted them for editing by the Managing partner and the consultant. Communication with the consultant was by email. The final version of the manuals was reviewed by all members before it was published.

**Designation of best practice sites and selection of trainees:** This was carried out by all the Ghanaian coalition partners during a joint visit to the project areas. The main criterion for designating a best practice site was the existence of a reasonable number of farmers, parboilers and mill operators within a township or community. The beneficiaries in these areas were then interviewed to assess their willingness to link up and work together as a team as well as the ability and willingness to adopt the new technologies being proposed by the coalition.

**Modification of some existing mills:** It was originally planned that as many mills as possible that could be modified to improve milling efficiency would be modified. The modification was primarily to include an aspirator so that the separation of milled rice and bran will be enhanced resulting in a better milled product. However, it was later discovered that most of the mills were in such a state of disrepair that this kind of modification was not possible. As a result, only 4 of such mills could be modified. The aspiration units were assembled at FRI and the modification was carried out by FRI engineers and MOFA staff in the project areas.

**Training of Trainers programme:** This activity was carried out in the northern, upper east and upper west regions for agricultural extension staff and leaders of the best practice groups and selected mill operators. The training took 3 days in each region and it included theory and practical sessions. After the training programme, copies of the training manuals were given to the respective District Directorates of Agriculture where the trainees came from to be used as reference materials.

**Training in local water purification and establishment of woodlots:** This activity was carried out by ADRA, the coalition partners with expertise in this area. It was also carried out in northern, upper east and upper west regions

One of the major problems identified in the chain of problems leading to the poor quality of parboiled rice was the quality of water used in parboiling. The need to improve the quality of water, which is worse in the Northern region led to the identification of the *Moringa* plant, which has been known to assist the sediments in water to settle.

The *Moringa* plant grows well in the Northern, Upper East and Upper West Regions. The main purpose of the workshop was to teach the women how to use the *Moringa* plant in treating water for par boiling and other domestic activities.

The training methodologies used were based on participatory workshop training methodologies. This allowed for full participation from all participants in the collection and processing using the purification agent, sharing of ideas and experiences; thus enriching the learning process. Adult learning principles were applied and as a result, only the knowledge and skills that the participants would use in real life was transferred to them. This included lectures, interactive learning, questions and answers sessions, group work and direct hands – on training

The total number of participants who attended the workshops was 115.

## **Project Output 2.**

Extension workers, rice farmers, processors and mill operators trained in Good Agricultural Practice and Good Manufacturing Practice to ensure improvement in the overall quality and safety of locally parboiled rice.

### **Activities**

**Extended training programme:** An extended training programme for target beneficiaries was carried out in small groups with the help of the previously trained extension staff and leaders of best practice sites. This training took place in the designated communities in the northern, upper east and upper west regions. A total of 1400 farmers, 400 parboilers and their assistants, 50 mill operators and assistants and about 200 rice marketers and assistants.

**Installation of new mills in target communities:** Seven new mills were installed by the FRI project engineer in selected target communities with the help of MOFA and TNS. The criteria for selecting beneficiary mill operators was drawn up by TNS and MOFA and approved by all members of the coalition. Beneficiaries were to subject themselves to training in record keeping, have active bank accounts and be capable of continually operating the mills after the termination of the project. The project engineer and MOFA continued to provide technical support to these mills throughout the lifespan of the project.

**Monitoring of the quality of rice from target beneficiaries:** Milled rice samples were collected from target beneficiaries analysed quarterly to monitor quality. The level of broken grains was determined using a TRG 05A Satake Testing Rice Grader (Satake, Japan). The physical quality of the rice samples was determined by hand sorting, according to the AACCC Approved Method 28-10 (1986). A 100g sample was examined in an enamel tray by hand sorting for levels of chalky, mouldy and discoloured grains, unshelled paddy, red rice, insect damage on kernels and extraneous materials. The results were reported as percentages of the total sample weight.

## **Project Output 3.**

Benefits and constraints to the adoption of improved practices faced by target beneficiaries documented and evaluated.

### **Activities**

**Validation of socio-economic baseline information from Project 7543:** This activity was accomplished with the collection of both primary and secondary data. Primary data was collected through informal group discussions and the use of structured questionnaires in sample surveys and case studies.

Discussions were held with target groups generally to ascertain current practices among the stakeholders. In addition, groups of parboilers at Zebilla, Bawku and Navrongo, who were using the parboiling vessel on trial basis, gave their assessment of the performance of the vessel.

Secondary data on production (National and Regional), imports, and prices were also collected. Information about ongoing development projects on rice was also collected from the Directorates of Agriculture in the three regions.

The data revealed the importance of rice in the three northern regions, the significant role of women in the processing of parboiled rice, and the lack of good agricultural practices that affect the quality of parboiled rice. Imports are growing despite government attempts to reduce imports by 30%. The Lowland Rice Development Project

was identified as a project, which aimed at increasing productivity in rice production and quality of paddy and milled rice.

**Assessment of benefits and costs of transferred technologies:** Qualitative and quantitative assessment of the benefits and costs of the parboiling vessel were made. For tarpaulin and improved mills, only qualitative assessments were made. The following was discovered in relation to the parboiling vessel:

1. The vessel had a larger capacity than the traditional pot this allowed them to parboil a bag at a time rather than in several pots.
2. Fuel savings of 30% - 50%
3. Reduced drudgery in the parboiling process
4. Vessel allowed uniform heating and therefore better quality product
5. Better quality meant quick turnover because the product sells faster.

The cost of the vessel at the time of the survey was about 1,500,000cedis at the time of the survey. Additional costs would be incurred in improving or acquiring good drying floors. Financial analysis of the parboiling by the women processors with the improved vessel, acquired with a loan at 20% interest, gave a monthly margin of 71,000cedis (about 2,400cedis/day) at the best scenario. At the same prices, the processor using traditional technology earns about 38,000cedis per month (1,300cedis/day).

Users of the vessel and other women expressed the desire to acquire the vessel although outright purchase by some would be difficult due to liquidity constraints.

**Assessment of constraints limiting adoption of transferred technologies**  
**adoption constraints:** The methodology for assessing constraints to adoption was changed from a quantitative assessment to a qualitative one because of the limited scope of the dissemination of the technologies. The method (LOGIT model) proposed in the project document is applicable where a technology has been widely disseminated and the potential beneficiaries have had the chance to test it and made decisions about to adopt or not adopt the technology.

Instead, analysis of the Strengths, Weaknesses, Opportunities and Threats (SWOT) of the introduced technologies was carried out.

**Assessment of effects of technologies on livelihoods:** The quantitative assessment of benefits and costs of the interventions especially the parboiling vessel was difficult as the commercial value of the prototype was not known. It was still being supplied to the beneficiaries at the "production cost"

Due to the limited scope in the interventions, in terms of numbers of equipment and duration of the project, the extent of diffusion of the technologies was not to the extent required to make widespread impact on livelihoods. However the following proxy indicators of livelihood effects were identified discussions with users of the technologies, These indicators had an indirect effect on livelihoods through their effects on net income and time.

- Changes in rates of production (processors can double batch size with the vessel and sell milled rice faster because of the better quality)
- Cost savings in fuel wood (Processors reported reductions of up to 50% in the cost of fuel wood.

Drudgery in processing is reduced significantly and less time is spent

#### **Project Output 4.**

Urban consumers and marketers sensitised to the advantages of eating locally parboiled rice to increase demand and market value

#### **Activities**

**Price sensitivity of consumers of rice in Ghana:** Associations between consumer acceptability and price are complex. Little has been reported for rice. Chen 2002 used the contingent valuation method to estimate how much Taiwanese people (professional and lay) would be willing to pay for domestic rice per month, based on international rice prices. The questionnaire also asked the respondents to consider three scenarios based on changes in environmental factors relating to land use. In this study however, price was used as a relative term as opposed to specific values. Miller *et al.*, 2001 evaluated consumer price thresholds for beef tenderness for consumers in the USA based on the price of beef steak and used this to estimate how much consumers would pay for products of guaranteed quality. This approach gave a value to the premium that consumers would pay.

Five samples of rice selected for the study and some characteristics are as follows:

- a) US (United States) imported raw rice (US No 5) - widely available in Ghana
- b) US imported parboiled rice (Tilda) - premium product limited to a few supermarkets
- c) Parboiled rice purchased in Accra, Ghana - average quality local product that has undergone limited sorting and clean-up
- d) Local raw rice purchased in Accra, Ghana - average quality local product that has undergone sorting and clean-up
- e) Improved parboiled rice produced in the Northern region –quality local product that has undergone sorting and clean-up

Rice samples (300 g) were washed in water (300 ml) of water and drained for five minutes. The samples were cooked in 450 ml boiling salted water (3 g salt in 1000 ml water) until the rice was soft in a rice cooker (Iris, details of make of rice cooker and cooking times). Cooked rice was kept in a heated box ( $60^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ) for up to one hour until served to the sensory panel.

Consumers (105) were interviewed Accra, in Ghana using the method of central location testing. Consumers were selected according to income group, gender and ages from 18 to 70 years. The consumer interviews were carried out to elicit socio-economic information, acceptability of raw rice, the price of the improved parboiled rice and affordability of rice.

During testing, raw rice samples were presented to consumers. Consumers scored the acceptability of rice using a 9-point hedonic box scale (Meilgaard *et al.*, 1987) from 'dislike extremely' to 'like extremely'. The six cooked rice samples were coded with 3-figure random numbers and presented simultaneously, but in random order, to each consumer on white paper plates.

After scoring the acceptability of the rice, consumers were interviewed. This recorded information on gender, age, occupation, how often they consumed rice, where they eat rice, which rice they prefer to purchase (local or imported), their preferred staple and who purchases rice in their household. The interview lasted about 30 min.

Consumers also were asked how much they would pay for the improved prototype parboiled rice produced through this project. The prices of reference locally available rice was given as a reference. These were:

- Parboiled rice purchased in Accra, Ghana - average quality local product that has undergone limited sorting and clean-up – mean price of 3,200cedis;

- Local raw rice purchased in Accra, Ghana - average quality local product that has undergone limited sorting and clean-up – mean price of 6,300cedis.
- US (United States) imported raw rice (US No 5) – mean price of 9,000cedis.

Consumers were shown the reference uncooked rice in the same form that it would be sold in local markets along with the mean local price. Based on this they were asked to give a price for the prototype rice. They were also asked how likely they would purchase the reference samples at the given prices using a seven point scale of 7 = Extremely affordable, 6 = Very affordable, 5 = Moderately affordable, 4 = Neither affordable or unaffordable, 3 = Moderately unaffordable, 2 = Very unaffordable, 1 = Extremely unaffordable

The same rice samples prepared for the consumers were scored by a semi-trained sensory panel using a modified version of quantitative descriptive analysis (QDA) since standards were not provided (Meilgaard *et al.*, 1987; Bainbridge *et al.*, 1996). The sensory panel (10 panellists) was conducted at the Food Research Institute (FRI), Accra, Ghana under controlled temperature (air conditioned) and lighting. The panel was comprised of staff from the Food Research Institute who had been screened for perception of the basic tastes (sweet, sour, bitter and salty), familiarity with the product and ability to determine differences between rice samples. Sensory attributes for uncooked (visual and odour) and cooked (visual, odour, taste and texture) rice were generated during a preliminary focus group session guided by the panel leader. A total of 16 uncooked and 14 cooked sensory attributes were developed for which the group had a consensus. Sensory attributes generated for the uncooked product were uniform colour, black specks, white heads, yellow colour, brown colour, cream colour, brightness, translucence, clean appearance, chalky appearance, unshelled paddy (not completed hulled), whole grain shape (as opposed to broken), long shape, oval shape, size and slender. Sensory terms for the cooked rice were brown colour, yellow colour, whitish appearance, black specks, uniform appearance, typical rice odour, sweet taste, sour taste, creamy flavour, sticky texture, grainy texture and hard texture.

The six rice samples were tested in triplicate by the panel over a three day period and the order in which they were cooked was random. At each session, three rice samples (coded with 3-figure random numbers) were served in random order to each panellist (there were two sessions on each of the three days). Samples (40 g) were close to room temperature (25°C to 30°C) and panellists rinsed their mouth with mineral water before tasting each sample. Intensity was scored on a 100 mm unstructured scale, anchored with the terms ‘not very’ at the low end and ‘very’ at the high end.

**Production of rice recipe album:** This was developed at FRI. Sensory and catering experts at the Institute developed a range of 16 new recipes from parboiled rice. The dishes were cooked and subjected to sensory evaluation by a sensory panel at FRI. The sensory methodologies used are similar to those used for the price sensitivity study above except that here, the panel were not asked questions regarding to the price of the product. They simply had to indicate preference or otherwise of the product.

## **Section F Project effectiveness**

This section of the evaluation report uses the rating criteria for the purpose and your outputs previously used in your annual reports.

	<b>Rating</b>
--	---------------

<p><b>Project Goal</b> National and regional crop-post harvest innovation systems respond more effectively to the needs of the poor.</p>	<b>3</b>
<p><b>Project Purpose</b> Enhance rural livelihoods in selected communities in Northern Ghana through promotion of improved rice post-production technologies and marketing systems.</p>	<b>2</b>
<p><b>Project Output 1.</b> Promotional strategies to introduce suitable technologies and practical solutions for the improvement of locally parboiled rice refined and developed, with a view to increasing the income of all stakeholders in the production chain and improving product quality and safety.</p>	<b>1</b>
<p><b>Project Output 2.</b> Extension workers, rice farmers, processors and mill operators trained in Good Agricultural Practice and Good Manufacturing Practice to ensure improvement in the overall quality and safety of locally parboiled rice.</p>	<b>1</b>
<p><b>Project Output 3.</b> Benefits and constraints to the adoption of improved practices faced by target beneficiaries documented and evaluated.</p>	<b>2</b>
<p><b>Project Output 4.</b> Urban consumers and marketers sensitised to the advantages of eating locally parboiled rice to increase demand and market value</p>	<b>2</b>

1= completely achieved

2= largely achieved

3= partially achieved

4= achieved only to a very limited extent

X= too early to judge the extent of achievement (avoid using this rating for purpose and outputs)

### Outputs (5 pages)

**What were the research outputs achieved by the project as defined by the value of their respective OVIs? Were all the anticipated outputs achieved and if not what were the reasons? Your assessment of outputs should be presented as tables or graphs**



**rather than lengthy writing, and provided in as quantitative a form as far as is possible.**

For projects aimed at developing a device, material or process, and considering the status of the assumptions that link the outputs to the purpose, please specify:

- a. What further market studies need to be done?
- b. How the outputs have been made available to intended users?
- c. What further stages will be needed to develop, test and establish manufacture of a product by the relevant partners?
- d. How and by whom, will the further stages be carried out and paid for?
- e. Have they developed plans to undertake this work? If yes, what are they? If not, why?

<b>Evaluation of Project Outputs</b>	
<b>Output</b>	<b>Objectively Verifiable Indicators</b>
1	<p>Promotional strategies to introduce suitable technologies and practical solutions for the improvement of locally parboiled rice refined and developed, with a view to increasing the income of all stakeholders in the production chain and improving product quality and safety</p>
	<p>(a) Appropriate dissemination materials for extension worker training produced by June 2003.</p>
	<ul style="list-style-type: none"> <li>• Five training manuals were produced. These covered the following areas: General requirements for good quality rice, The Role of Farmers, The Role of Parboilers, The Role of Millers and The Role of Marketers. The text of the manuals was completed on schedule in July 2003 and 100 copies of each manual were subsequently produced into booklets and printed in colour for dissemination. The Minister of Agriculture highly commended the manuals and decided to personally launch them officially in October 2004.</li> </ul>
	<p>(b) Suitable means of delivery identified in at least 5 sites in the 3 northern regions for the three target groups: farmers, parboilers and millers by June 2003.</p>
	<ul style="list-style-type: none"> <li>• FRI, MOFA and TNS agreed on a schedule for training of Agricultural Extension Frontline staff, farmers, parboilers and millers in the improved practices outlined in the manuals in July 2003. This was slightly delayed as the planned period coincided with the peak farming season and most of the proposed trainees were busy on their</li> </ul>

2	Extension workers, rice farmers, processors and mill operators trained in Good Agricultural Practice and Good Manufacturing Practice to ensure improvement in the overall quality and safety of locally parboiled rice	(a) Adaptations to demonstration mill completed by June 2003.
	<ul style="list-style-type: none"> <li>- An aspiration system fabricated at FRI was fitted to a demonstrational mill at Navrongo in the Upper East region to improve its efficiency in July 2003. This activity was slightly delayed as the original design had to be considerably altered to suit local conditions. 5 other already existing mills were adapted in various locations in the project area to improve milling efficiency as well.</li> </ul>	
		(b) Workshops for extension workers held in 5 sites by June 2003
	<ul style="list-style-type: none"> <li>- Forty extension staff and a total of 50 representatives of farmers, parboilers, millers and marketers were trained at 5 separate workshops in the Northern, Upper East and Upper West regions on the prescribed practices in the training manuals between August and September 2003. This was also slightly delayed as it coincided with the main cropping period in the target communities of the project.</li> </ul>	
		(c) "Best Practice" leaders trained and demonstration sites established linking farmers, parboilers and millers by June 2003.
	<ul style="list-style-type: none"> <li>• The training of the "best practice" site leaders was held concurrently with the training of the agricultural extension agents. The need to buy paddy from farmers that are known to be carrying out "Good agricultural practice" was emphasised to the parboilers. They were also encouraged to mill their parboiled paddy at designated mill carrying out GMP. This activity, carried out in September 2003, was also slightly delayed as it coincided with the main cropping period in the target communities of the project</li> <li>• Women processors were trained in tree planting and after-care of the plants. About 115 registered women planted over 2,000 <i>Moringa</i> plants. In addition 16,000 seedlings, mainly <i>Cassia</i> were planted in woodlots</li> <li>• TNS trained a total of 10 women on record keeping. This training focused on group leaders and beneficiaries were trained to track their revenues, costs and profits. The records kept were reviewed monthly by TNS and MOFA.</li> </ul>	
		(d) Seven (7) demonstrational mills installed at best practice sites by Dec. 2004

	<ul style="list-style-type: none"> <li>Seven demonstrational mills have been installed at best practice sites by December 2004. Due to the seasonal nature of the availability of paddy for milling in the project areas, the full impact of these mills on local product quality may not be realised until at least 12 months after the termination of this project. TNS, MOFA and DAE will continue to monitor the progress of the mills.</li> </ul>
	(e) Best Practice sites producing consistently high quality rice which will be evaluated against ISO standards and monitored quarterly from Dec. 2003
	<ul style="list-style-type: none"> <li>Samples of milled parboiled rice were taken from women using the prototype parboilers as well from other women using the traditional parboiling system every quarter from December 2003 for quality analysis. Results of this analysis showed that rice from the prototype was a higher physical quality than that from the traditional system. The level of brokens of rice from the prototype was consistently below 15% averaging 11.5%. On the other hand, level of brokens from the traditional system varied widely from 15% to 42%.</li> </ul>
3	<p>Benefits and constraints to the adoption of improved practices faced by target beneficiaries documented and evaluated.</p> <p>3.1 Existing socio-economic baseline data validated by June 2003.</p>
	<p>This activity was completed on schedule and the main findings were as follows:</p> <ul style="list-style-type: none"> <li>There is an upward trend in the margin of price of imported rice over local rice; government policy on rice is to reduce imports by 30% by 2004. Interventions to achieve this however are concentrated at the farm level.</li> <li>Parboiling as an income generation activity is undertaken solely by women in their thirties and forties.</li> <li>Production is on small scale averaging 160kg of paddy per week.</li> <li>Main cost item is paddy and lack of liquidity to purchase paddy is the limiting factor on scale of production.</li> <li>Majority of women interviewed have good drying floors but access to drying floors could also be a limiting factor to expanded scale of production.</li> <li>Processors buy paddy either directly from farmers or from traders within their village.</li> <li>Profitability estimates vary across communities; some estimates are negative when labour costs are imputed as part of costs.</li> <li>The average age of millers in study sites was about 44 years with an average of 9 years experience in the business.</li> <li>Mills are old, with capacities of 6hp to 25hp and are mostly electric powered.</li> </ul>

	<ul style="list-style-type: none"> <li>• Average daily output of mills was about 2.3Mt.</li> <li>• Sixty-nine percent of mill operators had never received any form of technical training.</li> </ul>
	<p>3.2 Cost-Benefits of transferred technologies and practices assessed by Oct.2003</p>
	<p>Qualitative and quantitative assessment of the benefits and costs of the parboiling vessel were carried out. For the use of tarpaulins in threshing by farmers and the use of improved mills, only qualitative assessments were made.</p> <p>Findings on the assessments of benefits of parboiling vessel are as follows:</p> <ul style="list-style-type: none"> <li>- The cost of the vessel at the time of the survey was about 1.5 Million Cedis at the time of the survey. Additional costs would be incurred in improving or acquiring good drying floors. Financial analysis of the parboiling by the women processors with the improved vessel, acquired with a loan at 20% interest, gives a monthly margin of 71000 Cedis (about 2400 Cedis/day) at the best scenario. At the same prices, the processor using traditional technology earns about 38000 Cedis per month (1300 Cedis/day). Although the daily margins (residual payment to labour) are lower than daily minimum wage, the use of improved vessel improves earnings in the first year. After the first year, earnings are expected to increase as the loan will have been repaid.</li> <li>- The following disadvantages were identified by the women. Some of the problems were actually due to the improper use of the vessel.</li> <li>- Weak handles (This means that women try to lift the vessel when it is filled despite having been advised against this by the technologists).</li> <li>- Vessel is too deep and this makes it difficult to scoop heated paddy from it.</li> <li>- Vessel requires a level stand to keep the water level uniform.</li> <li>- Base of the vessel is light and can get perforated.</li> </ul> <p>Newly installed mills were assessed for their performance in terms of cost reduction and quality of milled rice.</p> <ul style="list-style-type: none"> <li>- The key finding is that quality of milled rice is much better (it is white and bright). However there is no differentiation in the rates charged for using the new and old mills. This is partly because the millers operate both types of mills and partly because they fear loss of customers if they were to raise their rates above the going market rate.</li> </ul>
	<p>3.3 Constraints faced by target beneficiaries in adoption of transferred technologies evaluated by May 2004</p>

	<p>This activity was delayed by 2 months as it coincided with the peak farming season and the respondents were all busy on their farms.</p> <p>The methodology for assessing constraints to adoption was changed from a quantitative assessment to a qualitative one because of the limited scope of the dissemination of the technologies. An analysis of the Strengths, Weaknesses, Opportunities and Threats (SWOT) of the use of tarpaulins in threshing and prototype parboiling vessel was carried out.</p> <p>For the Parboiling Vessel;</p> <ul style="list-style-type: none"> <li>- <b>Strengths:</b> Capacity is consistent with current batch size; provides superior product quality; saves fuel; reduces drudgery associated with the traditional system</li> <li>- <b>Weaknesses:</b> It is expensive; only a limited number is available; a few technical problems are still associated with the vessel</li> <li>- <b>Opportunities:</b> High local demand for quality parboiled rice (there is a general preference for parboiled rice over white rice in the rural areas; national policy to reduce importation of rice can reduce competition from imported rice; presence of development projects in Northern (LRDP) and Upper East (LACOSREP) regions</li> <li>- <b>Threats:</b> Limited availability of the vessel ; lack of price premium for the higher quality rice produced with the vessel; lack of access to credit; high interest rates where credit is available; limited duration of the project</li> </ul> <p>For the use of tarpaulins in threshing;</p> <ul style="list-style-type: none"> <li>- <b>Strengths:</b> The main strength of the tarpaulin technology is that farmers recognise that it improves the quality of paddy.</li> <li>- <b>Weaknesses:</b> The main weaknesses are that it has a life span of about 3 farming seasons and some farmers prefer to have larger size tarpaulin than what is available now.</li> <li>- <b>Opportunities:</b> The growing awareness of the need to produce good quality paddy is an opportunity for use of tarpaulin</li> <li>- <b>Threats:</b> However the threat is that it is generally not available locally and farmers are not committed to purchasing the product without some kind of external support</li> </ul>
	<p>3.4 Effect of transferred technologies on livelihoods of target beneficiaries assessed by October 2004.</p>
	<p>Due to the limited scope in the interventions, in terms of numbers of equipment and duration of the project, the extent of diffusion of the technologies was not to the extent required to make widespread impact on livelihoods within the duration of the project. However the following proxy indicators of livelihood effects were identified discussions with users of the technologies, These indicators have an indirect effect on livelihoods through their effects on net income and time.</p>

	<ul style="list-style-type: none"> <li>• Changes in rates of production (processors doubled batch size with the vessel and sold milled rice faster because of the better quality)</li> <li>• Cost savings in fuel wood (Processors reported reductions of 20%-30% in the cost of fuel wood).</li> <li>• Drudgery in processing is reduced significantly and less time is spent attending to the process.</li> </ul> <p>Livelihood impacts of the use of the tarpaulin by farmers and of the new mills on millers could not be tangibly assessed within the duration of the project. The will be followed by DAE and MOFA after the termination of the project.</p>		
4	<table border="1" style="width: 100%;"> <tr> <td data-bbox="313 573 789 789">Urban consumers and marketers sensitised to the advantages of eating locally parboiled rice to increase demand and market value</td> <td data-bbox="789 573 1346 789">(a) Price sensitivity and promotion pathways evaluated by Jan 2004.</td> </tr> </table>	Urban consumers and marketers sensitised to the advantages of eating locally parboiled rice to increase demand and market value	(a) Price sensitivity and promotion pathways evaluated by Jan 2004.
Urban consumers and marketers sensitised to the advantages of eating locally parboiled rice to increase demand and market value	(a) Price sensitivity and promotion pathways evaluated by Jan 2004.		
	<p>The activity was delayed to coincide with the local harvest time when there was plentiful supply of paddy.</p> <ul style="list-style-type: none"> <li>- Rice (prototype, local and imported) was evaluated by 109 consumers in the unpacked form for acceptability and affordability. The most acceptable rice comprised the prototype, imported parboiled and imported US No 5 followed by the local white and lastly the locally sold parboiled rice.</li> <li>- The majority of consumers interviewed ate rice either every week or every day and purchased imported white rice (5kg) every month from local markets.</li> <li>- Majority (70%) of consumers received information (through TV and radio) promoting rice. Promotions were reported to emphasise taste, quality and nutritional benefits. However, only 45% were aware of the potential benefits.</li> <li>- Most consumers (87%) mentioned they would like to receive more information and that the most popular medium mentioned was the TV followed by radio</li> <li>- Compared to the other similar types of rice commonly sold in Accra, the mean price of the prototype estimated by the consumers was 7773cedis and this varied between 2500cedis and 12000cedis.</li> <li>- Consumers considered to be in a high affordability group gave the prototype rice a price that was 70% greater than the low affordability group.</li> <li>- The higher affordability group were younger, more likely to be working full time, have additional sources of income, more likely to own their accommodation or live in detached accommodation, have achieved a higher level of education, own a vehicle, and have received information promoting rice.</li> <li>- The prototype rice would probably sell at a lower price (approximately 6000cedis) in the markets if sold in the unpackaged form. The prototype rice could however be sold at a higher price (10,000cedis) if targeted at the higher affordability group.</li> </ul>		

		(b) Promotional packaging and marketing material designed and developed by June 2004.
	<ul style="list-style-type: none"> <li>- This activity was delayed for 3 months because the original planned date coincided with a period of low availability of paddy and consequently parboiled rice on the market.</li> <li>- Packaging materials of different sizes from polythene and polypropylene bags were produced and distributed to selected parboilers producing a product of acceptably high quality. Trial marketing of the packaged product is continuing and will be monitored by TNS and FRI after the termination of the project.</li> </ul>	
		(c) Urban consumers sufficiently sensitised by Oct. 2004
	<ul style="list-style-type: none"> <li>- This activity was completed on schedule. A rice recipe album containing 16 new recipes from rice was produced. A panel from FRI tasted the different foods and highly commended them. A public sensitisation programme was begun and this will be continued after the termination of the project by FRI and MOFA.</li> </ul>	

**Purpose (2 pages)**

**Based on the values of your purpose level OVIs, to what extent was the purpose achieved? In other words, to what degree have partners/other users adopted the research outputs or have the results of the research been validated as potentially effective at farmer/processor/trader level?**

Seven “best practice sites were duly established in the target communities during the lifetime of the project. In each of these sites there were farmers, parboilers and mill operators who had been trained in GAP and GMP. They trained beneficiaries were encouraged to form a link whereby the trained farmers sold their paddy to the trained parboilers who in turn milled at the designated mill. This worked well during the peak supply period but there was the tendency for the parboilers to buy from any available source when paddy supply was low. A total of about 1400 farmers, 450 parboilers and their assistants, 60 mill operators and their assistants as well as 180 rice marketers were trained during the lifetime of the project.

Due to the limited scope in the interventions, in terms of the duration of the project and the numbers of equipment available in the communities, the extent of diffusion of the technologies was not to the extent required to make widespread impact on livelihoods of entire communities. However the following proxy indicators of livelihood effects were identified during discussions with users of the technologies. These indicators had an indirect effect on livelihoods through their effects on net income and time.

- Changes in rates of production (processors doubled batch size with the vessel and sold their milled rice faster because of the better quality produced with the prototype vessel).

- Cost savings in fuel wood (Processors reported reductions of 20%-30% in the cost of fuel wood.
- Drudgery in processing is reduced significantly and less time is spent attending to the process.

Livelihood impacts of use of tarpaulin by farmers and of the new mills on millers were not immediately apparent. Farmers will begin to realise increased margin when in due course paddy that is clean and free of stones begin to attract a higher market price than contaminated paddy.

Since much of the impact on livelihood of all stakeholders involved in the supply chain of parboiled rice depends very much on expanded market opportunities, a qualitative assessment of consumer perceptions in the rice market about parboiled rice and the quality characteristics that consumers prefer carried out. The market survey was conducted among cooked rice sellers in Accra, as well as retailers of milled rice in the project area.

The retailer survey in the project area revealed the following:

1. Most sold white (raw-milled) rice. Average quantities sold per week were 120 bags for imported parboiled rice, 150 bags for local parboiled, 160 bags for local white rice and 260 bags for imported white rice.
2. According to retailers, consumers preferred imported rice because of the following quality characteristics:
  - a. Colour (uniform)
  - b. Shorter cooking time
  - c. Pleasant aroma
  - d. Low percentage broken
  - e. Soft texture
  - f. Swelling
  - g. "Sweet" taste
3. The most desirable characteristics of local white rice were its suitability for certain popular local dishes. Although good taste, texture and swelling ability were also characteristics mentioned in respect of local rice, these were mentioned by fewer traders (15%-20%).
4. Local parboiled rice was patronised more by food vendors, housewives and people with low income.

The implication of these preferences and biases is that demand for local parboiled rice can only be expanded to the urban markets and middle classes when a massive awareness campaign is carried out to improve the image of the commodity.

Consequently a "Rice recipe book" was produced cataloguing a number of attractive food preparations that can be prepared from local rice. Some of these have been prepared and exhibited at the Africa Regional celebration of the "International Year of Rice" in Accra in September 2004. The popularisation of the rice recipes will continue after the termination of this project and will be carried out by FRI and MOFA.

### **Goal (1 page)**

#### **What is the expected contribution of outputs to Project Goal?**

The project fell under the "focussed" category of poverty reduction. Partnership between the coalition and the target beneficiaries worked effectively during this project as the



beneficiaries were involved at every important decision making stage. They therefore saw themselves as part-owners of the project. Knowledge developers like FRI and NRI, the Ministry of Food and Agriculture and some agricultural NGOs, namely Technoserve and ADRA were important members of the coalition. The technical expertise available to the coalition ensured that there was a constant flow of information from the research institutions, through the extension agents to the end users. The members of the coalition also had a long term interest in the development of the local rice industry. The kind of coalition ensures that the needs of the poor are effectively responded to in the development of innovation systems in the national agricultural extension system in general and the rice sub-sector in particular.

## **Section G – Uptake and Impact (2 pages)**

### ***Organisational Uptake (max 100 words)***

***What do you know about the uptake of research outputs by other intermediary institutions or projects (local, national, regional or international)? What uptake by which institutions/projects where? Give details and information sources (Who? What? How many? Where?)***

The French Cooperation's rice project (FSRPOP) requested for 20 parboiling vessels for introduction within their project areas. When launching of the Rice Quality Training Manuals on 1<sup>st</sup> October 2004, the Minister of Food and Agriculture requested the coalition to work closely with the ministry to ensure that knowledge in the manuals is made widely available to relevant agricultural extension staff. The Ghana Rice Inter-professional Body contacted the coalition for advice on improving the milling efficiencies of 5 mills in October 2004. The managing partner was contacted by WARDA in September 2004 for the exchange of ideas on rice post production handling based on the experiences of the coalition.

### ***End user uptake (max 100 words)***

***What do you know about the uptake of research outputs by end-users? Which end-users, how many and where? Give details and information sources***

40 agricultural extension agents of MOFA were trained in Good Agricultural Practice and Good Manufacturing Practice as outlined in the Rice quality Training Manuals. They in turn helped in the training of a total of about 1400 farmers, 450 parboilers and their assistants, 60 mill operators and their assistants as well as 180 rice marketers in the northern, upper-east and upper-west regions of Ghana. Practical courses were also organised for the rice parboilers and these were all well received by the end-users. A parboiled rice recipe book was produced for the dissemination to restaurants and households.

### ***Knowledge (max 100 words)***

***What do you know about the impact of the project on the stock of knowledge? What is the new knowledge? How significant is it? What is the evidence for this judgement?***

The rice parboiling vessel is a new introduction to the rice industry in Ghana and so far 2 groups of users have received awards at the Annual Farmers' Day Celebration of MOFA for producing a product of consistently high quality. The Rice Quality Training Manuals and the Rice Recipe Book are innovations that helped in effectively disseminating the knowledge

developed during the project and will continue to be utilised after the termination of the project.

***Institutional (max 100 words)***

***What do you know about the impact on institutional capacity? What impact on which institutions and where? What change did it make to the organisations (more on intermediate organisations). Give details and information sources.***

The capabilities of the partner institutions were enhanced in relation to their abilities to work together as a coalition to provide information to and training target beneficiaries. Intermediate organisations like Eurometal Works (Equipment manufacturers) and Poly Products Ghana Limited (polypropylene sheet producers) worked with the coalition in fabricating the parboiling vessels and threshing tarpaulins. These organisations are now in a position to produce the vessels and the tarpaulins independently without any help from the coalition.

***Policy (max 100 words)***

***What do you know about any impact on policy, law or regulations? What impact and where? Give details and information sources***

The Minister of Food and Agriculture was given copies of the dissemination materials, namely the Rice Recipe Album and the Quality Training Manuals. He subsequently decided to personally launch the training manual and asked the senior Directors of the ministry to be present at the launching. He requested that the coalition to work closely with the ministry officials to draw up a programme for the eventual integration of the manuals into the national agricultural extension system. He also assured the coalition of the ministry's cooperation in the coalition's bid to popularise the rice recipe album in the urban centres.

***Poverty and livelihoods (max 100 words)***

***What do you know about any impact on poverty or poor people and livelihoods? What impact on how many people where? Give details and information sources.***

The rice parboiling vessels reduced the amount of fuel used in parboiling by 50% and water use by 30%. This considerably reduced the production cost of rice parboiling and increased the profit margins of the rice parboilers. Financial analysis of the parboiling by the women processors with the improved vessel, acquired with a loan at 20% interest, gave a monthly margin of 71,000cedis (about 2,400cedis/day). At the same prices, the processor using traditional technology earns about 38,000cedis per month (1,300cedis/day). Although the daily margins (residual payment to labour) are lower than daily minimum wage, the use of improved vessel improves earnings considerably.

***Environment (max 100 words)***

***What do you know about any impact on the environment? What impact and where? Give details and information sources.***

The prime source of fuel for parboiling in Ghana is wood cut from the environment. The reduction in the fuel use by about 50% is a major contribution to the preservation of the local environment. Also the planting of over 15,000 tree seedling to be harvested and used in parboiling is a further contribution to reducing the negative environment impact of cutting wood from the surrounding vegetation to be used as fuel-wood.

**Signature**

**Core Partners** .....

**Managing Partner** .....

**Date**

...30<sup>th</sup> December 2004.....

...30<sup>th</sup> December 2004.....

## ANNEXES

- I Copies of the stakeholder, gender, livelihoods and environmental form included with the concept note.
- II Project Logical Framework
- II Partner (user) organisations workplan for adopting project outputs
- III Copies of diaries, coalition meeting reports etc
- IV Feedback on the process from Partners(s) and users (where appropriate)
- V Tabulated description of disseminated outputs (format from green book) – same as given in the PCSS and should include all published, unpublished and data sets. If any of the reports included in this annex has not been submitted to the programme previously, please include a copy (preferably an electronic copy or if not available a hard copy)

## ANNEX 1: LIVELIHOODS ANALYSIS

### Table 1

#### **1. Which interest group(s) is your work intended to benefit and where are they?**

- The 3 northern regions produce 60% of total rice produced in Ghana. Of this amount about 99% is parboiled. Marketing is entirely in country. There are about 50,000 peasant rice farmers, 100,000 artisanal rice parboilers and 4,000 rice mill operators in the 3 northern regions of Ghana. The total population of these 3 regions is estimated at nearly 5 million and these as well as an increasing number of people in other parts of the country are potential consumers of good quality parboiled rice. The above groups of people as well as artisans involved in repair and maintenance of local rice mills are potential beneficiaries of the outputs of the project in the long term.

#### **2. In what way can they be defined as 'poor'? State your source(s).**

- According to the Ghana Living Standards Survey report (Ghana Statistical Service 2000), the Northern, Upper East and Upper West regions are amongst the poorest regions in terms of both incidence and depth of poverty. In general, these regions appear poorer than the others, consistently falling below the national average although relative ranking of these regions may change from one index to the other. These regions are also among the remotest areas of the country, large sections of which are inaccessible during the rainy season.

#### **3. What livelihood problem or opportunity are they experiencing and how many people are affected? State your evidence.**

Locally parboiled rice has a variable quality and consequently commands a lower market price. Project R6688 found out that whereas post harvest quantitative losses are low, qualitative losses are very high for rice in northern Ghana. The presence of stones in the paddy is a major contributing factor to the loss of quality and the education of farmers on appropriate handling techniques will enhance quality and the eventual market price for the paddy. Introduction of the prototype developed under R7543 and the education of the parboilers in its use will reduce drudgery, water and fuel use as well as the time required to parboil rice. The introduction of aspirators on the mini rice mills will improve the milled rice quality and eliminate the drudgery and time spent by the women in winnowing rice after milling.

**4. What contribution will your work make to this, over the timeframe of the project?**

By the end of the project, at least 30% of parboiled rice from target areas will be of consistently high quality. This will in turn result in a product of higher quality that will command a higher market price. Net incomes of target beneficiaries will improve through higher net margins being obtained from their produce.

Livelihood improvement through less drudgery and time savings as well as energy and water savings through wider adoption of the prototype rice parboiling vessel developed under project R7543.

**5. What external factors need to be in place for impacts to be sustained and extended after the project has ended?**

- Increased urban demand for parboiled rice
- Interest of local artisans in the fabrication and marketing of the new rice parboiling vessel so that it is available to the parboilers on demand
- Continued interest of the Ministry of Food Agriculture and NGOs in the extension of the developed technologies beyond the target communities.

Government policy remains unchanged. Credit facilities available to target beneficiaries from local banks and under agencies like the FAO and the International Fund for Agricultural Development (IFAD).

**6. What other initiatives (research or development) would your project complement/ add value to?**

- There are other initiatives on rice in Ghana like projects of the Agence France de Developpement (AFD), the Japanese International Co-operation Agency (JICA) and the International Fund for Agricultural Development (IFAD) that this project will complement. The major deficiency in most of these projects is their weak post-harvest component. When relevant information from this project is fed into the others, the eventual quality of milled rice from these projects will be enhanced.

**7. On what basis was the work that you propose identified?**

This work was identified on the basis of the Ghanaian government's stated objective of reducing rice imports by at least 30% within the shortest possible time. The improvement of the quality of locally produced rice is main avenue to achieving this objective

There was a tremendous demand for the prototype parboiling vessel and other technologies developed under project R7543 by the target beneficiaries.

The CPHP West African Regional workshop on project priority setting identified project R7543 as one that stood a great chance of making maximum impact within the next 2 years if properly packaged and extended to target beneficiaries.

**8. Who stands to lose from your work, if it is adopted/ implemented on a large scale?**

- Local businessmen who import rice and large scale rice traders.

## **ANNEX 2: GENDER ANALYSIS**

### **Table 1**

#### **1. How does the research problem/opportunity that you have identified affect men and women differently?**

The rice industry in northern Ghana can be divided into farming, parboiling and milling sectors and each has its peculiar gender dynamics. Although men own most rice farms, a lot of women are employed as farm labourers and activities such as harvesting and threshing are exclusively female activities. The introduction of new technologies to rice farmers will therefore involve dealing with both men and women although men will make most of the decisions and financial commitments here.

Rice parboiling is an exclusively female activity. Women make all the decisions and commitments in this sector. However, in cases where loans have to be contracted, the approval of the husband is often sought.

Rice mill operation is a male occupation and females are rarely found in this sector. Men usually make all decisions and commitments here.

Men and women will therefore be dealt with during various activities under the project and will benefit accordingly

#### **2. How will your expected results impact differently on women and men?**

**Rice farm owners (mostly men) will be educated on the most appropriate time to harvest the crop to maximise quality. They will also be encouraged to acquire tarpaulins on which the paddy will be threshed. Women who are usually employed to thresh paddy will be educated to avoid contamination with stones during threshing.**

Women parboilers will be encouraged to acquire improved vessels for parboiling and be educated on ways to produce a product of consistently high quality.

The male rice mill operators will be encouraged to fit aspirators on their mill to improve product quality and be educated on other steps to take to obtain a product of consistently high quality.

#### **3. What barriers exist to men's and women's involvement in project design, implementation and management decisions?**

Most women may have difficulties obtaining their husbands consent to contract large loans so all efforts will be made to keep the cost of the introduced technologies as low as practicable



(government officials)	rice importation in Ghana.	achieve its objective of reducing rice imports.
Consumers	Could influence the demand for parboiled rice.	Will find locally produced rice more acceptable to consume.
IFAD/ FAO	Could influence the amount of funding available to complimentary projects.	Would be encouraged to continue funding complimentary projects.
External consultants	Could provide valuable advice during the development and implementation of the project.	
<b>Parboilers</b> Local artisans Farmers Mill Operators	The collaboration of these stakeholders is essential for the success of the project. They are essentially the target beneficiaries and their refusal to co-operate essentially kills the project	The project will transfer knowledge to these stakeholders to enable them produce a product that can compete better on the market and subsequently increase their earnings over time.

## Stage 2: Roles and relationships

### **Table 2a: Proposed roles of coalition members in the project**

*Taking the proposed coalition members listed in Table 1a, consider what their role will be in the project and at which stage. They may be involved at all stages, or only one; it will depend on their capacity and interests. We are not interested for now in who might manage the project. You must not only agree but be able to justify each member's inclusion in the coalition and their proposed role. For example, if an individual has particular skills or an institution has the capacity to house and maintain a piece of equipment.*

<b>Stage of Research Process</b>	<b>Proposed coalition member</b>	<b>Proposed role(s) in project</b>	<b>Justification of role</b>
<b><i>Identification (CN stage)</i></b>	1. FRI 2. NRI 3. ADRA 4. MOFA 5. Univ. of Ghana (DAE) 6. Technoserve	All coalition members are to contribute ideas and information in the development of the concept note.	All coalition members should be in agreement with the basic ideas expressed in the concept note.
<b><i>Design and development (PMF stage)</i></b>	1. FRI 2. NRI 3. ADRA	All coalition members are to contribute ideas and information in the	All coalition members should be in agreement

	4. MOFA 5. Univ. of Ghana (DAE) 6. Technoserve	development of the project memorandum.	with the roles assigned them in the project memorandum.																		
<b>Implementation and Monitoring</b>	1. FRI 2. NRI 3. ADRA 4. MOFA 5. Univ. of Ghana (DAE) 6. Technoserve	<table border="0"> <tr> <td><b>Activity</b></td> <td><b>Coalition partners</b></td> </tr> <tr> <td>Stakeholder meetings</td> <td>All partners</td> </tr> <tr> <td>Evaluation of marketing Chain for parboiled rice to identify Safety and quality constraints.</td> <td>FRI, NRI, DAE</td> </tr> <tr> <td>Develop and refine promotional Strategies to enhance incomes of Producers and marketers of Parboiled rice.</td> <td>FRI, DAE, ADRA Technoserve.</td> </tr> <tr> <td>Optimisation and Validation of Prototype parboiling vessel.</td> <td>FRI, ADRA, MOFA</td> </tr> <tr> <td>Production and validation of Training manuals</td> <td>FRI, ADRA, MOFA</td> </tr> <tr> <td>Evaluation of the benefits and Constraints faced by target groups in adopting technologies</td> <td>FRI, NRI, DAE</td> </tr> <tr> <td>Training of parboilers and mill Operators to produce a product of consistently high quality</td> <td>FRI, MOFA, ADRA.</td> </tr> <tr> <td>Initiation of woodlot establishment.</td> <td>ADRA.</td> </tr> </table>	<b>Activity</b>	<b>Coalition partners</b>	Stakeholder meetings	All partners	Evaluation of marketing Chain for parboiled rice to identify Safety and quality constraints.	FRI, NRI, DAE	Develop and refine promotional Strategies to enhance incomes of Producers and marketers of Parboiled rice.	FRI, DAE, ADRA Technoserve.	Optimisation and Validation of Prototype parboiling vessel.	FRI, ADRA, MOFA	Production and validation of Training manuals	FRI, ADRA, MOFA	Evaluation of the benefits and Constraints faced by target groups in adopting technologies	FRI, NRI, DAE	Training of parboilers and mill Operators to produce a product of consistently high quality	FRI, MOFA, ADRA.	Initiation of woodlot establishment.	ADRA.	The expertise that each coalition member is bringing to the project is outlined under question 4 in the main section of the concept note.
<b>Activity</b>	<b>Coalition partners</b>																				
Stakeholder meetings	All partners																				
Evaluation of marketing Chain for parboiled rice to identify Safety and quality constraints.	FRI, NRI, DAE																				
Develop and refine promotional Strategies to enhance incomes of Producers and marketers of Parboiled rice.	FRI, DAE, ADRA Technoserve.																				
Optimisation and Validation of Prototype parboiling vessel.	FRI, ADRA, MOFA																				
Production and validation of Training manuals	FRI, ADRA, MOFA																				
Evaluation of the benefits and Constraints faced by target groups in adopting technologies	FRI, NRI, DAE																				
Training of parboilers and mill Operators to produce a product of consistently high quality	FRI, MOFA, ADRA.																				
Initiation of woodlot establishment.	ADRA.																				
<b>Evaluation</b>	1. FRI 2. NRI 3. ADRA 4. MOFA 5. Univ. of Ghana 6. Technoserve	All coalition members will provide relevant information for effective evaluation of the project.	Coalition members are expected to collaborate in the final evaluation of the project.																		

**Table 2b: External stakeholders and relationships with coalition**

Consider your key external stakeholder list in Table 1b and decide how you will relate to them during the process of the research. Complete Table 2b by thinking about at what stage (the rows) and in what way/ to what degree they will be involved in your research project (the columns).

Stage of Research Process	Degree of Participation		
	<b>Inform</b>	<b>Consult</b>	<b>Collaborate</b>
<b>Identification (CN stage)*</b>	Parboilers Farmers Mill operators		
<b>Design and development (PMF stage)</b>	Government officials	Consultants Mill operators Parboilers Farmers Private sector engineers	
<b>Implementation and Monitoring</b>	Government officials	Consultants	Processors Parboilers Farmers Private sector engineers
<b>Evaluation</b>	Government		Processors



	officials		Parboilers Farmers Private sector engineers
--	-----------	--	---

#### **ANNEX 4:ENVIRONMENTAL SCREENING SUMMARY NOTE (ESSN)**

*This form is a DFID requirement. At this stage, please pay especial attention to Questions 5 and 6. We recognise that you may only be able to provide very brief answers to 7 and 8 and will ask you to develop these answers more fully at PMF stage.*

1. Project Title:

**Enhancing rural livelihoods through a new coalition arrangement for the dissemination of improved rice post-production and marketing technologies in Northern Ghana.**

2. Project Cost:

3. Duration: 2 years

4. Country: Ghana

**5. What are the potential significant environmental impacts (both positive and negative) of the proposed research activities?**

The prototype rice parboiling vessel reduces fuel use by about 50%. This will reduce the pressure on the fuel-wood resources of the target beneficiaries that are already threatened. The prototype also reduces the amount of water used and will help in water conservation in the target communities. The proposed initiation of woodlots will help conserve the environment by providing an alternative to the crop residues and trees used as fuel material.

The disposal of rice husk is a major problem in rice processing areas of Ghana and no environmentally friendly way of disposal is in use in Ghana.

**6. What are the potentially significant environmental impacts (both positive and Negative) of widespread dissemination and application of research findings?**

Wide scale utilisation of the rice parboiling vessel will significantly reduce the amount of wood that is generally used as fuel in rice parboiling in northern Ghana and slow down the rate of depletion of the wood resources of northern Ghana. Significant reduction in the amount of water used in parboiling will free more water for agricultural and other domestic uses. The proposed initiation of woodlots will also help in the long term to conserve the environment by providing an alternative to the crop residues and trees used as fuel material.

Although the problem of proper disposal of rice husk will not be as a direct of this project but of rice processing in general, it is bound to become of major concern as more local rice is processed in country for consumption in the long term.

**7. What follow-up action is required to minimise potentially significant negative Impacts?**

Policy makers in the Ministries of Food and Agriculture and Environment and Science

will be sensitised on the need to commission research into environmentally friendly ways of rice husk disposal.

- **Who will be responsible for ensuring this action is taken?**

Members of the coalition

- **What form of monitoring/objective verification?**

Through seminars and workshops.

#### **8. How can positive impacts be enhanced/ extended cost-effectively?**

The monitoring and evaluation team of ADRA and the extension services of the Ministry of Food Agriculture who are permanently on the ground in the target communities will be responsible for sustaining the positive impacts after the duration of the project

This Note completed by (applicant):

**Name:** ...John T. Manful.....

**Institution:** Food Research Institute.

**Date:** .....14<sup>th</sup> August 2002

Endorsed/modified by Programme Manager:

.....

Date: .....

#### **Project summary:**

A coalition-based approach will validate, optimise and disseminate findings made and technologies developed in previous projects.

Promotional strategies to introduce suitable technologies and practical solutions for the improvement of locally parboiled rice will be refined and developed, with a view to increasing the income of all stakeholders in the production chain.

Quality improvements will be introduced via locally active agencies using a variety of training materials and demonstrations of Best Practice.

Consumer awareness of the improved product as an alternative to imported rice will be promoted, providing stakeholders with an opportunity to access more lucrative sectors of the local market.

#### **Keywords:**

Rice, parboiling, quality, post production, processing, market awareness

### 3. Project LogFrame:

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Risks
<b>Goal</b>			
National and regional crop-post harvest innovation systems respond more effectively to the needs of the poor.	By 2005, an evolving range of different institutional arrangements that improve access to post-harvest knowledge and/or stimulate post-harvest innovation to benefit the poor have emerged in West Africa.	Project evaluation reports. Partners' reports. Regional Coordinators' Annual Reports. CPHP Annual Reports. CPHP Review 2005.	National and regional crop-post harvest innovation systems have the capacity to develop and promote innovations to poor people during and after programme completion.  Livelihood analysis provides accurate identification of researchable opportunities that lead to poverty reduction.

<b>Purpose</b>			
Enhance rural livelihoods in selected communities in Northern Ghana through promotion of rice post-production technologies and marketing systems	<p>Post-harvest practices for parboiled rice in 7 selected communities in Northern Ghana disseminated to 2500 farmers, processors and marketers by the end of 2004.</p> <p>Effects of the technologies and practices on the livelihoods of target beneficiaries evaluated by Dec 2004</p> <p>By Oct 2004, urban consumers sensitized on merits of consuming good quality locally produced parboiled rice.</p>	<p>Best Practice Demonstration sites established.</p> <p>Quarterly and Annual Reports.</p> <p>Socio-economic review reports</p> <p>Marketing and Consumer acceptability reports</p>	<p>Beneficiary uptake</p> <p>Internal conflict</p> <p>Enabling environment exists for uptake of new knowledge</p> <p>Government Policy remains supportive of local product</p>
<b>Outputs</b>			
Promotional strategies to introduce suitable technologies and	(a) Appropriate dissemination materials for extension worker training produced	1.1 Dissemination materials available	Favourable agro-climatic conditions prevail

<p>practical solutions for the improvement of locally parboiled rice refined and developed, with a view to increasing the income of all stakeholders in the production chain and improving product quality and safety.</p> <p>Extension workers, rice farmers, processors and mill operators trained in Good Agricultural Practice and Good Manufacturing Practice to ensure improvement in the overall quality and safety of locally parboiled rice.</p> <p>3. Benefits and constraints to the adoption of improved practices faced by target beneficiaries documented and evaluated.</p> <p>4. Urban consumers and marketers sensitised to the advantages of eating locally parboiled rice to increase demand and market value</p>	<p>by June 2003.</p> <p>(b) Suitable means of delivery identified in at least 5 sites in the 3 northern regions for the three target groups: farmers, parboilers and millers by June 2003.</p> <p>2.1 Adaptations to demonstration mill completed by June 2003.</p> <p>2.2 Workshops for extension workers held in 5 sites by June 2003</p> <p>2.3 "Best Practice" leaders trained and demonstration sites established linking farmers, parboilers and millers by June 2003</p> <p>2.4 Seven (7) demonstrational mills installed at best practice sites by Dec. 2004</p> <p>2.5 Best Practice sites producing consistently high quality rice which will be evaluated against ISO standards and monitored quarterly from Dec. 2003</p> <p>3.1 Existing socio-economic baseline data validated by June 2003.</p> <p>3.2 Cost-Benefits of transferred technologies and practices assessed by Oct.2003</p> <p>3.3 Constraints faced by target beneficiaries in adoption of transferred technologies evaluated by May 2004</p> <p>3.4 Effect of transferred technologies on livelihoods of target beneficiaries assessed by October 2004.</p> <p>4.1 Price sensitivity and promotion pathways evaluated by Jan 2004</p> <p>4.2 Promotional packaging and marketing material designed and developed by June 2004.</p> <p>4.3 Urban consumers sufficiently sensitised by Oct. 2004.</p>	<p>1.2 Schedule of training programmes / workshops available</p> <p>2.1.1 Adapted mill operational.</p> <p>2.1 .2 Technical drawings available.</p> <p>2.2 Training packs and workshop report available</p> <p>2.3 Best Practice sites operational.</p> <p>2.4 Demonstrational mills operational</p> <p>2.5.1 High quality rice being marketed.</p> <p>2.5.2 Quality analyses results available</p> <p>3.1. Updated market information</p> <p>3.2 Survey report</p> <p>Report on participatory assessment of constraints</p> <p>Report on participatory assessment of livelihood effects</p> <p>4.1 Consumer survey report</p> <p>4.2 Promotional materials available</p> <p>4.2 Report on uptake of promotional products</p> <p>4.3 Press statements, media transcripts.</p>	<p>Political stability continue to prevail in the project area</p> <p>The current government agricultural policy remains unchanged.</p> <p>Good bilateral relations continue to exist between Ghana and UK to enable UK to continue to support this project.</p> <p>Coalition partners remain at post during the life of the project and thereafter to ensure sustainability.</p> <p>Cooperation of target groups</p> <p>Cooperation of target groups</p> <p>Cooperation of target groups</p> <p>Cooperation of target groups</p>
--	--	---	---

Activities			
<p>1.1 Inception coalition meeting held to plan activities 1.2, 1.3 and 2.1 (Jan 03)</p> <p>1.2 Training materials for training workshops developed and produced (Jun 03)</p> <p>1.3 Relevant linkages between different operatives within the parboiled rice production chain initiated (Jun 03)</p> <p>2.1 Adaptation of engleberg dehuller to mill parboiled rice more effectively (Jun 03)</p> <p>2.2 Coalition meeting to review progress and plan activities 2.4, 2.5 , 2.6 (Mar 03)</p> <p>2.3 Survey of mills in planned best practice sites to assess suitability for adaptation (May 03).</p> <p>2.4 Encouragement of parboilers to establish woodlots at best practice sites for use as fuel in parboiling (starting May03)</p> <p>2.5 Training workshops for 50-60 extension workers held over 5 locations to emphasise the need for GAP and GMP throughout the entire production chain. (Jun 03)</p> <p>2.6 Establishment of sites of Best Practice for parboiling in at least 7 locations. To include both traditional method and use of the improved parboiling vessel. (Jun 03)</p> <p>2.7 Coalition meeting to review progress and plan activities 2.8 and 2.9 (Jun 03)</p>			<ul style="list-style-type: none"> <li>- Beneficiaries' interest in forming linkages.</li>   <li>- Rice millers' willingness to have their mills modified.</li>   <li>-</li>   <li>-</li>   <li>- Consumer response to promotional strategies</li> </ul>

<p>2.8 Establishment of sites of Best Practice for milling in at least 7 locations. To include training in GMP and adaptation of mills, where applicable. (August 03)</p> <p>2.9 Stakeholders meetings to select farmers for best practice sites and collection of basic data. (Sept. 03)</p> <p>2.10 Coalition meeting to review progress and plan activities 2.11 , 3.1 (Sept 03)</p> <p>2.11 Physical quality of samples from Best Practice sites evaluated against ISO standards and monitored quarterly (Starting Oct 03)</p> <p>2.12 Mid-term meeting to review progress and plan activity 2.13 , 4.1 (Dec 03)</p> <p>2.13 Establishment of additional sites of Best Practice for harvesting in at least 7 locations. To include training in, monitoring and follow up visits (Jan 04)</p> <p>3.1 Validation of previous socio-economic baseline study and assessment of benefits-costs of transferred technologies (June 03)</p> <p>3.2 Coalition meeting to review progress and plan activity 3.3 , 4.2 (Mar 04)</p> <p>3.3 Assessment of constraints of adoption of transferred technologies. (Oct 04)</p> <p>3.4 Coalition meeting to review progress and plan activities 3.5, 4.3 (Jun 04)</p> <p>3.5 Assessment of the effects of transferred technologies on livelihoods of target beneficiaries. (Nov 04)</p> <p>4.1 Determination of price sensitivity and promotional pathways of consumers (Jan 04).</p> <p>4.2 Design and development of appropriate packaging materials for parboiled rice (Jun 04)</p> <p>4.3 Public sensitisation of the advantages of eating parboiled rice via media (electronic and print) (Oct 04)</p> <p>Final workshop and dissemination of project outcomes to Ministers of Agriculture and Environment and Science. (Dec 04)</p>			
---	--	--	--

## **Proceedings of a Coalition Workshop on “Improving the Efficiency of Artisanal Rice Parboiling in Northern Ghana”**

**Mensvic Hotel, East Legon, Ghana  
23–24 September 2003**

### **Summary**

The Food Research Institute (FRI), Accra, Ghana and the Natural Resources Institute (NRI-University of Greenwich), Kent, UK and other partners have been carrying out work towards improving the efficiency of the local parboiled rice industry for past five years. This two-day workshop was held to share results with those Ghanaian Institutions actively working in this field and aimed to formulate an effective way of using project

outcomes to improve the rice sector in Ghana. Appendix I contains the workshop programme.

Twenty one people attended the workshop, representing FRI, NRI, Non-governmental organizations (NGOs), Ministry of Food and Agriculture (MOFA), University of Ghana, Technology Consultancy Centre (TCC-University of Science and Technology Kumasi), and Natural Resources International Limited (NRIL – Project Management). A full list of participants is contained in Appendix II

Following an introduction to the project by the Director of the FRI, and an outline of the role of the NRIL as project managers, six technical presentations were given. The presentations covered rice quality, a review of project activities, development and design of equipment for rice parboiling, cost of equipment and impact on livelihoods of rice parboilers, and technology transfer issues.

The workshop was chaired throughout by the Managing partner and discussion among participants was encouraged both during and after each presentation. At the end of all the presentations an open forum was held and, following lively discussion and exchanges of view, resulted in six resolutions being proposed and agreed upon. These resolutions sum up the main features of the project which concerned the participants:

- equipment cost,
- choice of equipment manufacturers,
- training of both equipment manufacturers and rice parboilers – the latter by targeting the more “progressive” beneficiaries,
- access to credit lines for equipment purchase,
- strengthening linkages between institutions working on rice in Ghana, and
- appropriate mechanisms for transferring technology in Ghana.

Responsibilities for following-up these issues were also designated. A summary table is contained in Appendix III.



## APPENDIX I

### WORKSHOP: IMPROVING THE EFFICIENCY OF ARTISANAL RICE PARBOILING IN NORTHERN GHANA

Mensvic Hotel, East Legon, Ghana  
23 – 24 SEPTEMBER 2003

The Food Research Institute and the Natural Resources Institute of the University of Greenwich (UK), in collaboration with other partners have been carrying out the above project over the past three years. This two-day Workshop aims to share results and formulate an effective way of using the results to further rice parboiling in Ghana.

#### *Programme*

#### **Tuesday 23 September**

<b>Time</b>	<b>Activity</b>
10.00	Video showing rice parboiling operations in Ghana
10.30	Opening ceremony. Presentation by <b>Dr W Plahar</b> - Introduction to the project
<b>10.45</b>	<b>Refreshments</b>
11.00 <b>NRIL</b>	Overview of Crop Post-harvest Programme in West Africa. <b>B Dadzie,</b>
11.30	Rice quality – a team effort: <b>Joseph Gayin, Food Research Institute.</b>
12.30	Review of project activities: <b>John Manful, Food Research Institute.</b>
<b>13.30</b>	<b>Lunch</b>
14.30	Development and design of equipment. Ali Sampare: <b>Food Research Institute.</b>
15.30	Cost of rice parboiling equipment – is it affordable?. <b>Ramatu Al Hassan: University of Ghana</b>
16.30	Discussion

#### **Wednesday 24 September**

<b>Time</b>	<b>Activity</b>
9.30	Rice parboiling: whose livelihoods depend on the process? <b>Ramatu Al Hassan: University of Ghana</b>
<b>10.30</b>	<b>Refreshments</b>

11.00 Technology transfer – Issues and implementation. **Peter Donkor:**  
**University of Science and Technology**

12.30 Open forum: resolutions. End of Workshop.

<b>APPENDIX II</b>				
<b>Participant</b>	<b>Designation</b>	<b>Address</b>	<b>E-mail</b>	<b>Telephone</b>
Dr Wisdom Plahar	Director	Food Research Institute	<a href="mailto:fri@gh.com">fri@gh.com</a>	00 233 21 777330
John Manful	Team Leader, Rice projects	Food Research Institute	<a href="mailto:cereal@africaonline.com.gh">cereal@africaonline.com.gh</a>	00 233 21 500459 Mobile 00 233 (0)24 367591
Joseph Gayin	Food technologist	Food Research Institute	<a href="mailto:paakweezi@yahoo.com">paakweezi@yahoo.com</a>	00 233 21 500459 Mobile: 00 233 (0)24 744901
Seidu Ali Sampare	Plant Engineer	Food Research Institute	<a href="mailto:udies@yahoo.co.uk">udies@yahoo.co.uk</a>	00 233 21 500470 Mobile: 00233 (0)208166674
Apollonius Nyako	Technical Officer	Food Research Institute		00 233 21 500470 Mobile: 00233 (0)24 616028
Vincent Akoto	Post-harvest specialist	Agricultural Engineering Services Department (MOFA)	<a href="mailto:vincentakoto@hotmail.com">vincentakoto@hotmail.com</a>	Mobile: 233 20 8174954
J K Boamah	Director,	Agricultural Engineering Services Department (MOFA)	<a href="mailto:jkboamah@yahoo.com">jkboamah@yahoo.com</a>	233 21 7010262
Olivier Maes	Agricultural Economist	MOFA/French Embassy	<a href="mailto:maes.olivier@africaonline.com.gh">maes.olivier@africaonline.com.gh</a>	Mobile: 233 (0)24 755167

<b>APPENDIX II (continued)</b>				
<b>Participant</b>	<b>Designation</b>	<b>Address</b>	<b>E-mail</b>	<b>Telephone</b>
Chris Bakaweri	Agricultural Economist, Small Business Development	Technoserve, Tamale	<a href="mailto:tnsta@africaonline.com.gh">tnsta@africaonline.com.gh</a>	233 (0)71 23206/7
George Kpor	Information Support Officer	Division of Agricultural Extension Services, MOFA	<a href="mailto:gkpor@yahoo.co.uk">gkpor@yahoo.co.uk</a>	233 (0)24 774309
Ramatu Al-Hassan	Agricultural Economist	Department of Agricultural Economics, University of Ghana, Legon	<a href="mailto:ramatu@ghana.com">ramatu@ghana.com</a>	233 (0)20 8154570
Peter Donkor	Director	Technology Consultancy Centre, University of Science and Technology, Kumasi	<a href="mailto:petdonkor@yahoo.com">petdonkor@yahoo.com</a>	233 (0)20 8121337
Roderick Daddey-Adjei		Food and Drugs Board, Accra	<a href="mailto:kobivik@yahoo.com">kobivik@yahoo.com</a>	233 (0)21 779838 Mobile: 233(0)20 8125860
James Atarigiya	Post-harvest specialist	MOFA, Box 3, Bolgatanga		233 (0)72 22750
Patrick Quansah	Engineer	Gratis Foundation, PO Box CO151, Tema	<a href="mailto:gratis@ighmail.com">gratis@ighmail.com</a>	233 (0)22 204243 233(0) 22 207610

<b>APPENDIX II (continued)</b>				
<b>Participant</b>	<b>Designation</b>	<b>Address</b>	<b>E-mail</b>	<b>Telephone</b>
Alhaji Issah Salifu	Project officer	Lowland Rice Development Project, Tamale		233(0)71 22061
Abdul-karim Ziblim	Extension agent	Amasachina, PO Box 798, Tamale	<a href="mailto:acod@africamail.com"><u>acod@africamail.com</u></a>	233 (0)71 22805
Mari-Joelle Kodjovi	Economist	French Cooperation	<a href="mailto:mariejokodjovi@hotmail.com"><u>mariejokodjovi@hotmail.com</u></a> <a href="mailto:kodjovi@ensam.inra.fr"><u>kodjovi@ensam.inra.fr</u></a>	233 (0)24 868029

### APPENDIX III: RESOLUTIONS AGREED AT THE WORKSHOP

Item	Resolution	Person/Institute responsible
1	Urgent need to strengthen the relationships between the FRI/NRI projects and other rice projects in Ghana. These include: <ul style="list-style-type: none"> <li>• Lowland Rice Development Project (MOFA)</li> <li>• Special Programme for Food Security Project on the Evaluation of NERICA (New Rice For Africa) Varieties (MOFA/FAO)</li> <li>• Agricultural Sector Services Investment Project Rice Programme –AgSSIP (MOFA/CSIR)</li> </ul>	John Manful, Team Leader, Rice Projects, FRI
2	More attention and support should be provided to the more “progressive” target beneficiaries of all rice projects especially the current FRI/NRI projects. Such beneficiaries include: <ul style="list-style-type: none"> <li>• Rice parboilers</li> <li>• Rice millers</li> <li>• Farmers</li> <li>• Those involved in rice marketing</li> </ul>	FRI Technoserve MOFA NRI GRATIS ITTU University of Ghana ADRA TCC
3	FRI must work more closely with GRATIS, TCC and MOFA to ensure that the cost of the rice parboiling vessel is kept to a minimum.	Ali Sampare, FRI, Patrick Quansah, GRATIS, and Peter Donkor TCC
4	Collaboration between FRI and the Ministry of Women’s and Children’s Affairs (MOWACA) should be established.	John Manful, Ramatu Al-Hassan and Abigail A Sam (ADRA)
5	Finalise a list of rural beneficiaries of rice milling equipment to be supplied via the project “Enhancing rural livelihoods through a new coalition arrangement for the dissemination of improved rice post-production and marketing technologies in Northern Ghana”.	Chris Bakaweri, Technoserve, A R Salifu (MOFA)

#### Minutes of Coalition Meeting Held on December 9, 2003 at Room D4, Food Research Institute, Accra.

##### Attendance

- |                        |             |
|------------------------|-------------|
| 1. Gayin Joseph        | FRI         |
| 2. Victor Antwi        | Technoserve |
| 3. A-R. Z. Salifu      | MOFA        |
| 4. Ramatu Al-Hassan    | DAE (UG)    |
| 5. Chris Bakaweri      | Technoserve |
| 6. Seidu Ali Sampare   | FRI         |
| 7. John Manful         | FRI         |
| 8. Abigail Abandoh-Sam | ADRA        |

The main agenda for the meeting was for the various coalition members to report on activities of the current quarter and to plan for the next. The CPHP Regional Coordinator, Dr. Ben Dadzie was present at the opening of the meeting and gave some remarks on the effective running of the coalition.

##### CPHP Regional Coordinator’s Remarks

- The Coordinator informed the meeting that for any product or procedure developed pictures and other valuable information should be captured and documented. It is also important to document the cost effectiveness as well.
- The Coordinator had an opportunity to represent DFID on a meeting of different agencies supporting the rice industry in Ghana made up of JICA, the French Cooperation, ADB, CIDA, EU, DFID, USAID and IFAD. At the meeting it was realized that most assistance was geared towards production with very little to support post harvest activities. After his presentation of what DFID had been supporting JICA and the French Cooperation expressed interest to be part of what was going on particularly how to sustain the technology and make the parboiling vessels more affordable and quickly disseminated. MoFA and the Ministry of Women and Children's Affairs (MOWACA) were two ministries mentioned that could collaborate in this effort.

### **Highlights of the Programme Manager's visit.**

The Programme Manager, Mr. Tim Donaldson during his recent visit was able to meet all the coalition teams of the various projects in Ghana. In connection with the rice project, the regional coordinator thought that a visit to the project sites for first hand information would be a better option.

MoFA and TNS assisted in Mr. Donaldson's visit to the project sites. At Tamale the rice processors at Lamashegu were visited and their activities were found to be impressive especially their record keeping of operations. However packaging and marketing of product were two areas identified where they still needed help. At Savelugu the team was not too happy with the group's activities because electricity supply was a problem and for that matter milling was affected. At Navrongo, the Minyila group was visited and their activities were found to be very encouraging. The ICOUR farmers were also visited. The use of the polypropylene sheets for threshing had gone down well with them and many expressed interest in having some of their own. Some were willing to pay for the sheets with paddy if the appropriate arrangements could be made. The team agreed that record keeping should be stepped up and encouraged among target beneficiaries. A stronger link between farmers and processors needed to be established.

Before leaving the regional coordinator brought the attention of the coalition to the following:

That it was possible to ask for supplementary budget to cover some specific activities such as provision of more vessels and tarpaulins for distribution to processors and farmers respectively. Micro-financing institutions should also be contacted to find out if processors and farmers could be helped to acquire some inputs.

### **Activities of the Various Coalition Members**

The various coalition members reported on the work done since the last meeting as follows:

#### **FRI**

The following activities had been carried out or were on-going

- Six rice mills had been purchased and transported to Tamale for later distribution to the project sites. The 7<sup>th</sup> mill and other accessories such as belts, starters and electric motors were yet to be transported to the project sites and this will be done as soon as transportation arrangements are completed.

- Seven more improved parboiling vessels had been constructed and transported to Tamale
- Thirty (30) polypropylene sheets were ready for distribution to Farmers
- Sensory analysis had been carried out on 18 rice samples (respondents were trained to score on both raw and cooked samples)
- Nine rice based recipes had been developed in FRI's test kitchen and photographs taken. 100% rice flour was used in 8 of them. The last incorporated wheat flour. The products were *rice tatho, rice biscuits, queen cakes, rice bread, rice puffs, rice moulds, rice strips, rice agidi, rice & banana fritters and rice pancakes.*

### **Technoserve**

- Key processors at the "best practice sites" had been trained to keep records of their operations according to a format developed by TNS
- Guidelines have been prepared for the revolving loan scheme in collaboration with the prospective beneficiaries.
- Packaging material to be used in the sale of the improved parboiled rice had been designed. Some initial bagging had started and the market was being studied.
- Entrepreneurs were being selected to take up mill ownership and management
- Sample collection from the various projects sites were on-going

It was reported that there was the need to stockpile for processors to continually be in business. After some discussion it was agreed that one or two sites could be selected for a trial but a detailed investigation needs to be done before any move in that direction. Technoserve also suggested that the project should be extended to a location called Gushiegu where god quality paddy is produced.

### **DAE (UG)**

- A baseline socio-economic study of the locations where there are improved parboiling vessels had been done. An earlier study done was on randomly selected sites
- Verification of weights used in the rice business had been done.
- Cost and benefit assessment has been more on vessels than the mills since mills have not installed yet
- In spite of good quality women were not able to sell at higher prices
- Affordability of the vessels is still a problem for the women

### **ADRA**

- 115 participants trained on how to protect seedlings sown (to be used as woodlots) – *Acacia* and *Moringa*
- Provision of technical assistance on managing the seedlings was on-going.

### **MoFA**

- 120 farmers were trained in the use of polypropylene sheets. Sixty of the sheets had been distributed and monies were still being collected.
- At a farmers' day held in the North parboiled rice from the improved vessel was showcased
- A modified mill brought up from Accra was satisfactorily test-run at a mill house in Navrongo
- Assisted the Programme Manager and the Regional Coordinator on their recent visit to the project sites



## **Other Matters**

The meeting later agreed on the mill locations as follows:  
Kumbungu, Lamashegu, Zebilla, Garu, Navrongo and Wa.  
Distribution of the vessels was to be as follows: Lamashegu (2), Salifu(2), Savelugu(1), Garu (1). The rest were to be decided on later.

## **Minutes of Coalition Meeting Held on 24<sup>th</sup> February 2004 at Technoserve, Tamale**

### **Attendance**

Joseph Gayin	FRI
S.A Sampare	FRI
Chris Bakaweri	Technoserve
I. A. Rahman	Technoserve
Lambert Dandelbo	Technoserve
A.S. Iddrisu	MoFA
Dr. Ben Dadzie	DFID/CPHP
Lynda Hammond	Consultant
John Manful	FRI
John Yelyen	Technoserve
S.A. Tagoe	FRI

The main agenda for the meeting was to assess the project with reference to the logframe and to make amends where necessary. The timing of the meeting was not convenient for Mr. A.R.Z Salifu who was on a course at GIMPA, Accra. However there was a representative from MOFA to report on the activities of MoFA. The managing partner informed the meeting that Mrs. Lynda Hammond had been invited to give an independent assessment of the activities carried out so far by the coalition.

### **Installation of Mills**

The project leader announced that all seven new mills earmarked to be installed under the project were now available and installation was progressing. At an earlier meeting it was agreed that the distribution of the mills be as follows:

Northern Region	-	3
Upper-East Region	-	3
Upper-West Region	-	1

At Kumbungu and Lamashegu the structures to house the mills had not been completed so the installation of the mills had not carried out.

At Zebilla the unit to house the mill was ready. The foundation to hold the mill had been dug and concrete cast. A two- week period was needed to allow concrete to dry well. However the mill was yet to be installed. Power is yet to be connected to the unit so that test running of the mill can be done.

At Navrongo one adapted mill has been installed but it was detected that there was a slight problem with its performance. The problem has been identified and the project engineer will rectify it during his current visit to the site.

At Wa, an the prospective mill operator has been given 4 weeks to get a structure

ready to house the mill to be installed. This is to be located close to women processors using the new parboiling vessel.

### **Par boiling vessels**

The number of parboiling vessels in the field is currently 19 and the distribution is as follows:

Northern Region	-	5
Upper-East Region	-	11
Upper-West Region	-	3

It was decided that the Upper East Region has enough of the vessels for now so any more vessels that may be produced should be located in the Northern and Upper-West Regions. It was also suggested that training sessions be organized for other women so they could have access to any vessels that may be constructed. Ten women at a time over three-day period was suggested.

### **Establishment of woodlots**

70 women have been trained in the handling of seedlings and given 20 seedlings each. At Nyankpala and Kumbugu 300 seedlings each were planted and 8,000 at Savelugu. But at Savelugu fire swept through the plantation and destroyed most.

### **Other Matters**

After the presentations some observations and suggestions were made as follows: That installation of the mills is too slow. This may be due to

- strict conditions attached to owning mills
- commitment on the part of beneficiaries to put up structures to house the mills
- Commitment on the part of beneficiaries to pay back

### **Training for women processors in the Northern Region**

The rice processor at Lamushegu was to be used as a facilitator. There is still an impression among the processors that the vessel is free. It is therefore necessary to value the vessel and let the various groups pay for them. It was further suggested that a deadline be given so those who show interest could be given the opportunity to purchase. The price of a vessel now is fixed at 1,700,000 cedis. However concern was raised on those already in the system and whether they should be discounted. It was realized that at Nyankpala though some women processors have been trained no parboiling vessels were available there. This was however explained to be due to the lack of good quality water. It was therefore suggested that training in the use of *Moringa* in water treatment be carried out there to enable the processors purify water to be used for the soaking process.

It was suggested that the Regional Director of MoFA at Tamale be invited to have a look at the parboiling vessel in use.

The team could not meet the processors in Kumbungu because they had been summoned for another meeting with the local Chief and the structure to house the mill was still under construction. At Savelugu the team was able to talk to a cross section of the processors. They gave their impressions about the vessels and the problems they encountered with milling in the town. A new mill could not be installed there because the strength of the electric power in the locality was the appropriate for the efficient running of the mill.

At Garu the unit to house the mill was not ready yet. The prospective owner of the mill gave assurance of completion of the structure. Then after a cross section of the women processors met the team and gave their feed back on the use of the vessel. Among other things they mentioned less drudgery, use of less fuel wood and good quality rice as some advantages with the vessel. They expressed interest in individually owning one and accordingly asked of the price. They were referred to the MOFA contact person on the coalition who would make the necessary arrangements to facilitate this.

**Report of the Workshop for the Launching of Rice Quality Training Manuals on 1<sup>st</sup> October 2004 at Miklin Hotel, Accra.**

**Workshop Programme**

9.00 am – 9.30 am	Arrival and Registration	All Participants
9.30 am – 9.40 am	Introduction of Chairman & Opening Remarks	John T. Manful
9.40 am – 9.50 am	Welcome Address	Dr. W. A. Plahar (Director – FRI)
9.50 am – 10.20am	VIDEO SHOW – THE PROBLEM	
10.20 am – 10.50 am	Keynote Address & Launching of Manuals	Hon. (Major Rtd.) C. Quashigah Minister - MOFA
10.50 am – 11.20 am	COFFEE BREAK	
11.20 am – 11.50 pm	Presentation of Manuals – What is Good Quality Rice?	John T. Manful
11.50 am –12.00 noon	Discussions	Participants
12.00 am – 12.30pm	Presentation of Manuals – The Role of Farmers	A-R. Z. Salifu
12.30pm – 12.40pm	Discussions	Participants
12.40pm – 1.10 pm	Presentation of Manuals – The Role of Parboilers	John T. Manful
1.10 pm – 1.20 pm	Discussions	Participants
1.20 pm – 2.20 pm	LUNCH	
2.20 pm - 2.50 pm	Presentation of Manuals – The Role of Millers	Seidu Ali Sampare
2.50 pm – 3.00 pm	Discussions	Participants
3.000 pm – 3.30 pm	Presentation of Manuals – The Role of Marketing	Joseph Gayin
3.30 pm – 4.00 pm	General Discussions	Participants
4.00 pm – 4.05 pm	Closing Remarks	Chairman
4.10 pm	Vote of Thanks	

## **1.0 Background and Objectives**

### **Introduction**

The Food Research Institute of the Council for Scientific and Industrial Research (CSIR) together with the other members of the Rice Quality Improvement Coalition Project convened a one-day Workshop for the Launching of Rice Quality Training Manuals. The workshop was an output of the DFID/CPHP/FRI Project on “Improved Rice Post Production and Marketing in Northern Ghana” The workshop provided a platform for discussing the content and launching of five Training Manuals on Rice Quality.

### **The workshop**

The workshop started with an opening ceremony which included a welcome address by the Chairman and remarks by the West African Regional Director of CPHP/DFID. This was followed by a video presentation and a keynote address and launching of the manuals by the Honourable Minister of Food and Agriculture. There were two Technical Sessions. The first Technical Session dealt with the presentations and discussions of manuals. The second Technical Session was on general discussions and recommendations.

***Parboiled Rice*** Parboiled rice is a manufactured product. This means that raw materials undergo certain processes to produce the final product. *The quality of any manufactured product is only as good as the quality of the raw materials and the controls exercised during processing.* The quality of parboiled rice produced in Ghana is very variable, even though the same raw materials and processes are used throughout the three northern regions of Ghana.

### ***Rice Quality Improvement Project***

Currently more than 50% of the rice consumed in Ghana is imported. Imported rice is perceived to be of higher quality and consequently commands a high market price. For the local rice industry to be able to survive, it has been suggested that it must be able to compete with imported rice on the liberalised Ghanaian Market. Quality issues are therefore of fundamental importance to the future of the Ghanaian Rice Industry. Since the quality of any processed product is limited by the quality of the raw materials, it is important to look at the entire production chain to see where quality is being compromised.

The Food Research Institute in collaboration with the Department For International Development (DFID) of the UK and other Ghanaian collaborators have been carrying out the Rice Quality Improvement Project aimed at enhancing rural livelihoods in selected communities in Northern Ghana through promotion of improved rice post-production technologies and marketing systems. Five training manuals covering general quality, farming, parboiling, milling and marketing have been produced under this project. The workshop was organized to launch these manuals.

## **2.0 Opening of Workshop**

The workshop began with a brief opening remarks and the introduction of the chairman by John Manful, the Project Leader. Dr. W. A. Plahar, Chairman for the opening ceremony and the Director of the CSIR-Food Research Institute gave the welcome address. This was followed by a short address from Dr. Ben Dadzie of the DFID/CPHP. Dr. Dadzie gave brief remarks on the Crop Post-harvest Programme (CPHP). He mentioned that CPHP funds both research addressing problems and opportunities of: crop storage, processing, marketing, food safety and nutrition, and institutional context of post-harvest science; and non-research activities to improve access by poor to relevant science. He expressed the hope that all stakeholders present would take advantage of the workshop to contribute actively, so that ideas would be garnered to help promote the aims and objectives of the project and to identify and agree on areas where new knowledge is required to ensure impact on livelihoods of target beneficiaries.

A video documentary detailing the problems faced by Rice Parboilers in Northern Ghana was shown. The documentary described the situation of Rice parboiling before the project initiation and proposed some interventions in alleviating the problem. The Honourable Minister of Food and Agriculture, Major (RTD) Courage Quashigah delivered the keynote address and launched the Rice Quality Manuals.

### **2.1 Welcome Address**

The Honourable Minister for Food and Agriculture, Directors of the Various Departments of MOFA, Invited Guest, Distinguish Members of the Press, Colleague Scientists, Ladies and Gentlemen

I am happy to be the chairman for this occasion and also as my duty to welcome you to this workshop. On behalf of the CSIR-Food Research Institute, and the Crops Post-Harvest Research Programme of the Department For International Development of the UK, I wish to welcome you all to this workshop for the launching of Rice Quality Training Manuals.

As indicated in your invitation letters, The Food Research Institute in collaboration with the Department For International Development (DFID) of the UK and other Ghanaian collaborators have been carrying out the Rice Quality Improvement Project aimed at enhancing rural livelihoods in selected communities in Northern Ghana through promotion of improved rice post-production technologies and marketing systems. I must hasten to add that the project is in line with our mission of providing scientific and technological support to the growth of the food industry and the agricultural sectors of the national economy to help ensure food and nutrition security and alleviate poverty.

Under the project, several studies were undertaken and some technologies developed aimed at improving the quality of Ghanaian parboiled rice. Five training manuals covering general quality, farming, parboiling, milling and marketing have been produced under this project. This workshop is being organized to launch these manuals. We are so much honoured to have the Honourable Minister of Food and Agriculture here to launch these manuals for us.

This week witnessed the Celebration of the Pan-African year of rice, a programme which has highlighted the role of rice in addressing Food Security issues of our

country and sub region. For consumers to accept the consumption of our locally produced rice over imported rice, one aspect that must be looked at is the quality. This is what makes the launching of these five training manuals on improving the quality of Ghanaian parboiled rice timely and important.

The second section of the workshop will be dedicated to presentations and discussions on the manuals with the following objectives

1. To investigate the factors that affect rice quality and to determine who is responsible for producing good quality rice.
2. To investigate the role farmers play in producing good quality paddy and also look at current practices and explore ways in which they can be improved.
3. To investigate the role parboilers play in producing good quality parboiled rice and also look at current practices and explore ways in which they can be improved.
4. To investigate the role millers could play in the production of good quality parboiled rice and look at current practices and explore ways in which they can be improved.
5. To briefly investigate the role market traders and other interested parties could play in the production of good quality parboiled rice.

With these remarks, I wish to welcome you once again to this workshop and hope that we will have very fruitful and purposeful deliberations.

## 2.2 Keynote Address

Mr. Chairman, Director CSIR-Food Research Institute, Representatives of Institutions and Agencies in the Rice Sector, Distinguished Guests, Invited Guests, Ladies and Gentlemen

I am indeed honoured and privileged to be asked to give the keynote address and perform the formal launching of the Rice Quality Training manuals developed by the Food Research Institute (FRI) of CSIR and other collaborators.

In Ghana, rice has become increasingly important as a food source and as an economic commodity which requires the needed attention in attaining food security.

Mr. Chairman, I wish to reiterate my Ministry's deep commitment to ensuring food security for our people and important crops like rice are being promoted through pragmatic policies.

Rice is one of the rapidly growing food sources in Ghana and for most times, the domestic demand has exceeded the country's annual rice production capacity. Under the circumstance, we are forced to import large quantities of rice into the country, presently estimated at about US\$100m per annum, in value.

This situation is against the background that Ghana has a high potential for expanding rice production, having been endowed with large areas of wetlands that can be developed for that purpose.

Mr. Chairman, the coastal wetlands, inland basins, river flood plains and the inland valleys of the country are all available which can be developed for both irrigated and rainfed lowland production systems. In addition, improved upland rice production systems are being considered seriously by my Ministry in the bid to expand rice production in Ghana.

The Government is desirous of supporting farmers in several ways to ensure food security at the household level as one of the major ways of reducing poverty. If rice-based production systems are expanded, then their resultant or associated post-harvest operations will employ some people in rural areas, leading to increased household incomes.

My Ministry is making the necessary effort to implement programmes and other donor-supported investments that expand opportunities for the vulnerable groups in our rural communities, especially where there are high potentials for rice production.

Mr. Chairman, under such circumstances, I see the launching of these five manuals which highlight information on rice production and utilization as extremely timely. Such efforts by our allied institutions and stakeholders give me a great relief and pleasure. We have a common goal and exerting our shared influences in informing our farmers and other investors in the rice sub-sector is very laudable.

These manuals, I believe, are holistic in nature, since I am told cover information in general rice quality, farming, parboiling, milling and marketing.

We cannot deny the fact that, for most times, attention has been given to rice production relative to post-harvest operations. I hope the aspects of the manuals which address rice post-harvest operations will be used extensively to inform operators in that area of expertise.

Mr. Chairman, since I assumed office as the Minister of the Ministry of Food and Agriculture, I have been quite emphatic on the consumption of “good quality nutritious food, hygienically packaged and attractively presented.” The food that we eat, including the commodity we are discussing now – rice, should reach our table in a desirable state – quality-wise. The processing and packaging must be done right.

Permit me at this stage to take the opportunity to thank the Department for International Development (DFID) for supporting us in this direction. I also wish to congratulate the Food Research Institute of the CSIR and other Ghanaian collaborators for their varied contributions in developing these manuals.

Mr. Chairman, I am informed that the Rice Quality Improvement Project is already ongoing and is aimed at enhancing rural livelihoods in selected communities in Northern Ghana through promotion of improved rice post production technologies and marketing systems. My understanding therefore, is that the information in these manuals is already being disseminated to the intended target groups and the coverage will be expanded from here on.

Let me give you the assurance that the Government will continue to create the enabling environment that will encourage progress towards the attainment of food security, with attention to important crops like rice, for which we have a collective responsibility of promoting.

The vision of the NPP Government is to ensure that all people living in this country, at all times, will have physical and economic access to sufficient, safe and nutritious food for a healthy and active life. Let us therefore put our collective efforts together, especially in the rice sector, so that we make our marks in ensuring national food security.

Let us make sure that these manuals are available where they are needed to support and promote rice production, processing, marketing and consumption in Ghana. Let us also ensure that the manuals are in simple language that can be read and understood by all the operators in the industry. The Ghana Rice Interprofessional Body should also be conversant with these manuals and should support their distribution to stakeholders in the rice industry for the promotion of quality local rice.

Mr. Chairman, Ladies and Gentlemen, it is with great honour and pleasure that I now declare the Rice Quality Training Manuals formally launched.

Thank you.

### **2.3 Closing remarks**

In his closing remarks the chairman thanked the Minister for his address. He also expressed his appreciation to the participants for their cooperation.



**Technical Session I**  
**Presentation and Discussion of Rice Quality Training Manuals**

**3.0 Training Manual on what is Good Quality Rice?**

**Presented By**  
**John T. Manful**

**Objective**

The objective of this session is to investigate the factors that affect rice quality and to determine who is responsible for producing good quality rice

**Parboiled Rice**

- Parboiled rice is a manufactured product: This means that raw materials undergo certain processes to produce the final product.
- *The quality of any manufactured product is only as good as the quality of the raw materials and the controls exercised during processing.*
- The quality of parboiled rice produced in Ghana is very variable, even though the same raw materials and processes are used throughout the three northern regions of Ghana.

**Which Factors Affect Quality?**

- Rice quality is assessed by a number of factors, some of which can be attributed to the grain itself, these are known as *intrinsic factors*.
- Other quality factors are introduced by the way the grain is grown, handled and processed, these are known as *induced factors*
- Climate, fertiliser application, harvesting practices, storage, parboiling processes, milling, transport and marketing can all have an effect on quality.

<b><i>Intrinsic factors (genetically controlled)</i></b>	<b><i>Induced factors (introduced during handling and processing)</i></b>
<ol style="list-style-type: none"> <li>1. Yield</li> <li>2. Density</li> <li>3. Size</li> <li>4. Composition</li> <li>5. Colour</li> <li>6. Scent</li> <li>7. Dormancy</li> </ol>	<ol style="list-style-type: none"> <li>1. Yield</li> <li>2. Foreign matter</li> <li>3. Mixed varieties</li> <li>4. Maturity</li> <li>5. Infestation/infection</li> <li>6. Cracked grain</li> <li>7. Sprouted grain</li> <li>8. Milling degree</li> <li>9. Physical damage</li> <li>10. Parboiled grain</li> <li>11. Age</li> </ol>

**Who is Responsible for Rice Quality?**

- Everyone involved in the production chain!
- If rice quality is to be improved it must be a team effort

**So, who is Involved in the Rice Quality Team?**

Breeders, Farmers, Traders, Millers, Parboilers, Market traders, Consumers

**Anyone Else?**

Policy makers, Economists, Food Technologists, Agronomists, Extension workers, Standards Board, Funding Agencies, Engineers

**How can we Produce Better Quality Parboiled Rice?**

- If the quality of local parboiled rice is to be improved it is vital that everyone in the production team is “quality aware”.
- Everyone in the team must play his or her part.
- There are two ultimate goals:
  - i. To maintain or increase the quantity of rice available for sale
  - ii. To ensure that it is acceptable to consumers.
- Both are of equal importance.
- Everyone in the production team has an important part to play in order to achieve those goals.
- Successful teams communicate and plan their tactics together!
- That is why workshops such as this are so important.
- They make sure that everyone involved in the production of parboiled rice understands the difficulties experienced throughout the chain and can play an important part in seeking solutions to those problems.

***Good Manufacturing Practice (GMP), Good Agricultural Practice (GAP) and the HACCP Approach to Product Safety and Quality.***

- There is no single person responsible for product quality.
  - i. Changing legislation,
  - ii. competition from imported products,
  - iii. Increased consumer expectations mean that all members of the production chain should be looking at how to control and improve their part of the chain.
- This can be achieved by adopting the principles of Good Manufacturing Practice (GMP)
- All manufacturers (and members of the manufacturing team) should:
  - i. Have a moral responsibility to produce safe, good quality food
  - ii. Comply with relevant legal requirements regarding quality and safety
  - iii. Satisfy customer requirements
  - iv. Be aware of cost constraints
  - v. Try to minimise differences (both intrinsic and induced) in the raw materials used
  - vi. Ensure that processing is carried out safely and effectively
- Farmers should be aware of the principles of Good Agricultural Practice (GAP).
  - i. Correct use of pesticides, herbicides and fertilisers (agro-chemicals)
  - ii. Proper land preparation (especially in irrigated and banded fields)
  - iii. Ensure that each field has a uniform stand of crop (to facilitate harvesting)
  - iv. Timely draining of fields prior to harvesting (principally in irrigated fields)
- Farmers should be aware of:
  - i. Timely harvesting
  - ii. Do not let harvested paddy touch the ground
  - iii. Do not over-dry paddy (if drying after harvesting is required)
  - iv. Paddy should only be threshed on concrete floors or on tarpaulins
  - v. Protect from insects and rodents in storage

***Rice Parboiling in Ghana***

- Rice parboiling in Ghana is predominantly a “cottage industry”
- It is estimated that in excess of 100,000 women are actively involved in the parboiling process alone.
- This means it is very difficult to control all the processors to ensure that a uniform product is made.
- There is one very large parboiling plant in Ghana.
- This venture has not been successful due to difficulties in supply and control of the raw materials.

- In large manufacturing plants such as this, the owners usually adopt a HACCP approach to product quality and safety.
- This means Hazard Analysis at Critical Control Points and is a systematic approach to identify and control a hazard.
- Many countries now have legislation that requires manufacturers to apply HACCP principles to the production of all food products.
- HACCP analysis must be carried out on every individual process and requires detailed records to be kept.
  - i. This is clearly impractical for the present parboiled rice production system in Ghana.
- HACCP evolved from the implementation of GMP, GHP and GAP
  - i. Implementing these throughout the production chain is a good place to start!
- In the following presentations we will examine each stage of the production chain to identify where the difficulties are and make recommendations for improvement.

### **Conclusion**

- In order to define quality we must now decide which quality attributes are important at each stage of the production and marketing chain.
- In order to understand and improve quality we must also look at all the factors which have contributed to the (lack of quality) of the product so that problem areas can be identified and addressed.

### **3.1 Discussion of Presentation on “What is Good Quality Rice?”**

**Question:** Emmanuel Tetteh Bio, MOFA

I want to know if the presentation on quality issues is on parboiled rice?

**Response:** J.T. Manful, CSIR/FRI

The project is on parboiled rice. However, the presentation is on rice production in general.

**Question:** P. Adu-Amankwa, CSIR/FRI

I had a look at the manuals. However the presenter said the processes are different. Could the presenter explain?

**Response:** J.T. Manful, CSIR/FRI

The main processes are the same. But there are differences in certain unit operations such as soaking and steaming. Different areas have different ways of processing.

**Question:** P. Adu-Amankwa, CSIR/FRI

At the end of the day, different processes make it difficult to control rice quality. Is it not possible to have some body to monitor to make the same quality and brand?

**Response:** J.T. Manful, CSIR/FRI

We want to bring in the Department for Agricultural Extension of MOFA, people who live with the processors and eat with them to effect best practices

**Question:** P. Adu-Amankwa, CSIR/FRI

All rice is not the same.

**Response:** J.T. Manful, CSIR/FRI

There are indeed 1001 rice varieties representing different characteristics. Basmati is a special case. The name implies it is a

variety from the Punjab. But the Americans are growing it. There are indeed differences.

Wilson Dogbe (SARI)

Varieties in Ghana are not different from the Asian rice. But we call it local rice. But at the end of the day the quality is not so good.

**Question:** Isaac Akpabi, DAES, MOFA

Changes come with some cost. I suggest that when changes are being suggested the cost element should be stated. Fertilizer is good but now the cost is high.

**Response:** J.T. Manful, CSIR/FRI

We are indeed taking note of the cost implication of any changes.

**Question:** Adomako Osei-Frimpong, DAES

The presenter said he had problems with stakeholders in the North. Please explain.

**Response:** J.T. Manful, CSIR/FRI

What we wanted to do was to link parboilers and millers. You can only succeed if you get the farmers to do the right thing. We want to demonstrate what works

**Question:** Adomako Osei-Frimpong DAES

Maybe your approaches were not right?

**Response:** J.T. Manful, CSIR/FRI

We have done a lot of baseline studies. At this point we want the Ministry of Food and Agriculture to own the process. We want to find the right way to disseminate the information.

#### 4.0 Training Manual on “The Role of Farmers”

*Presenter: A-R. Z. Salifu*

##### **Objective**

The objective of this session is to investigate the role farmers’ play in producing good quality paddy. We will look at current practices and explore ways in which they can be improved.

##### **What does Quality Mean to Farmers?**

- If you asked a farmer to say which characteristics were most important to him, he would probably suggest the following:
  - i. Yield
  - ii. Price
- He would be aware of many of the quality issues but as far as he is concerned how much crop he grows and the price he gets are his primary concerns.
- Unlike many other paddy producing countries, Ghanaian paddy is not graded and sold at different prices for each grade.
- If this was the case farmers would be far more quality aware.
- As it is, they have no financial incentive to produce the best possible quality paddy.
- This project plans to establish “sites of best practice” where farmers, parboilers and millers will work together to produce good quality parboiled rice.

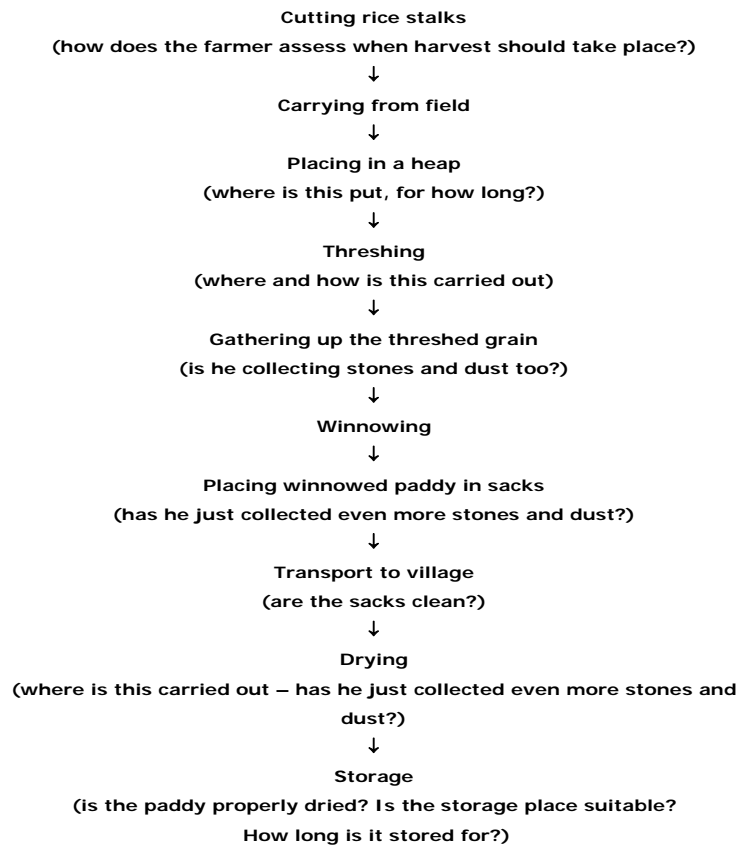
##### **What Impact Could A Farmer Have On Paddy Quality?**

- **What will influence paddy quality at point of harvest?**
  - i. Intrinsic qualities
  - ii. Weather
  - iii. Agricultural practices:

The farmer has no control over two out of three of these influencing factors, but if we look at some of the quality issues we can see that by following **Good Agricultural Practices** the farmer does have some control over quality attributes and can do much to ensure that the paddy he harvests is of good quality.

<b>Quality attribute</b>	<b>Intrinsic quality</b>	<b>Influenced by weather</b>	<b>Influenced by agricultural practices</b>
Density	(		
Size	(	(	(
Shape	(		
Composition	(	(	
Colour	(		
Aroma	(		
Foreign matter			(
Mixed varieties		(	(
Maturity		(	(
Infestation/infection			(
Cracked grain		(	(
Sprouted grain		(	(
Moisture content		(	

The flow chart will probably look something like this:



- Every step of this process can have an impact on paddy quality and therefore on the ultimate quality of the parboiled rice.
- The two major post-harvest quality factors which farmers have influence over are:
  - i. Foreign matter
  - ii. Fungal damage
- In countries where paddy and milled rice are subject to inspection and grading for quality standards, the quality inspections are carried out throughout the production chain but particularly:
  - i. At harvest
  - ii. When the milled rice is marketed
  - iii. By the consumer
- The farmer is therefore the most important link in the production chain.
  - i. If the paddy (raw material) he produces is of poor quality this will affect the final quality of the parboiled rice.
  - ii. No matter how well controlled the processing stages are they will not be able to produce a good product if the basic raw material is of poor quality.

### ***How Can We Assess If Paddy Is Of Good Quality?***

- When grading standards are enforced the determination of paddy quality is assessed by visual examination.
- The categories which are examined are:
  - i. Broken grain
  - ii. Organic matter (straw, weed seeds etc)
  - iii. Inorganic matter (stones)
  - iv. Fungal damage
  - v. Infestation
  - vi. Type admixture (mixed varieties)
  - vii. Immature grains
  - viii. Discoloured (yellow) grains

### ***Improving The Quality Of Parboiled Rice – What Can Farmers Do?***

- Use good quality seed
  - i. Try to make sure that it is of a single variety.
  - ii. Prevent cross contamination in the field by harvesting at the correct time,
  - iii. preventing cross contamination during threshing/winnowing and drying by making sure the surface is clean (much easier with a tarpaulin or threshing box)
- Never let paddy touch the ground.
  - i. Use a concrete pad, tarpaulin or polypropylene sack for heaping /threshing/ winnowing and drying.
  - ii. The use of tractors for threshing should be discouraged.
- Clean the paddy thoroughly
  - i. Make sure winnowing is effective. Try to prevent lodging
- Make sure the paddy quality is maintained during storage
  - i. Make sure it is dry before storage, be aware of storage pests, store in a suitable place.
- Grow suitable varieties
  - i. Parboilers and consumers know which varieties they prefer – talk to them!
- Concrete pads can be used for threshing as long as they are well-maintained and are swept clean of stones
- Do not use roads for threshing - they are a major source of contamination with stones
- Tarpaulins or polypropylene sheets are easy to keep clean and free from stones. Small scale farmers in Tanzania are very quality conscious and always use polypropylene or tarpaulin to keep their paddy stone-free
- Polypropylene sheet are used by some farmers for threshing in Northern Ghana

#### **4.1 Discussion of Presentation on “The Role of Farmers”**

**Question:** Dr. Ernest Asiedu

Consumer acceptability is in fact a key criterion for the release of any crop variety. It is therefore not true that the right varieties are not released to farmers since breeders conduct on-farm variety testing and participatory variety testing in collaboration with farmers, extension officers and consumers. Breeders are not working in isolation are they?

**Response:** J.T. Manful, CSIR/FRI

Breeders are not working in isolation. At FRI, we can predict consumer preferences. We have done different assessments. It will take 2-3 years for the farmer to accept consumer preferences. Consumer acceptability is one of the key criteria for the release of varieties

Salifu, A.K.

The issue of quality in the Northern sector is a complicated issue. It is difficult for the farmer to even improve quality. The miller is looking for volume. Sometimes it depends on the parboiler. It is the parboiler who determines what people should grow or eat. You cannot sell by weight. We need a good processing system in the North. Southerners will not buy rice with the smallest thing in it but 60% of rice is from the North.

**Question:** David Crentsil, AESD, MOFA

How do we ensure getting extension materials to all the stakeholders who matter in ensuring quality of rice since MOFA is mandated to work with farmers and to some extent with agro processors?

**Response:** Adomako Osei-Frimpong, DAES, MOFA

The MOFA has established processes to look at all the problems involved. We cannot take away the activities of women. We need to empower the women parboilers to be able to procure varieties that consumers prefer for their business. Empowerment can be done through capacity building which in many cases is critical and lacking but not only credit.

**Question:** Adomako Osei-Frimpong, DAES, MOFA

How true is the fact that parboiled rice is more nutritious than the polished rice?

**Response:** J.T. Manful, CSIR/FRI

We can work together to help the project. Parboiled rice has much more water-soluble minerals like Vitamin B because they are in the bran. In soaking and rehydration some of the vitamins go out in soak water and go into grain. We can therefore find four times riboflavin in parboiled rice than other rice. Some say parboiled rice is more digestible.

**Question:** Dr. Benjamin Dadzie, DFID

How can the Ministry assist in helping artisans fabricate this parboiling vessel?

**Response:** Ali Sampare, CSIR, FRI

The local artisans are not ready to fabricate the FRI parboiling vessel yet. The technology of aluminium welding is available but due to the cost of the Argon gas and the welding machine, many local artisans cannot afford it.

J.T. Manful, CSIR/FRI

We would be hoping to find some other substitute materials that are not toxic which can be used to fabricate the FRI parboiling vessel.

Dr. Benjamin Dadzie

We are interested in getting the vessel out of research hands.

Mr. Victor Antwi, Technoserve

The issue of commercializing the production of improved parboiling vessels will be resolved through good market for rice produced by these women who are using the equipment at the pilot stage. With a good market, they will be motivated to procure the improved equipment and this will therefore generate market for the equipment manufacturers. So the issue is how to improve on the market for the parboiled rice.

Salifu A-R. Z.

The project has a credit component



## 5.0 Training Manual on “The Role of Parboilers”

*Presented By John T. Manful (Project Leader)*

### **Objective**

The objective of this session is to investigate the role parboilers play in producing good quality parboiled rice. We will look at current practices and explore ways in which they can be improved.

### **What does Quality Mean to Parboilers?**

- Most parboilers are “quality conscious”
  - i. Because good quality parboiled rice attracts a better market price.
  - ii. Women in the Upper East are able to identify and exercise control over more quality attributes than women from the Northern Region.
- **At face value the process looks the same wherever it is carried out in Ghana,**
  - i. There are subtle differences in processing which have a profound influence on the quality of the final product.
  - ii. Parboilers like farmers are able to influence some of the characteristics of milled rice

### **Quality and Market Price**

- **To achieve the best market price parboilers look for a product which has:**
  - i. A good colour (white)
  - ii. No stones
  - iii. Properly dried
  - iv. No odour
  - v. No husk
  - vi. No black grains
  - vii. Few broken grains
  - viii. Well milled

### ***Parboilers Contribute to improving quality***

<b>Quality attribute</b>	<b>Intrinsic quality</b>	<b>Influenced by parboiling</b>
Density	(	
Size	(	
Shape	(	
Composition	(	
Colour	(	(
Aroma	(	(
Foreign matter		(
Mixed varieties		(
Maturity		
Infestation/infection		
Cracked grain		
Sprouted grain		
Moisture content		(
Broken grain		(

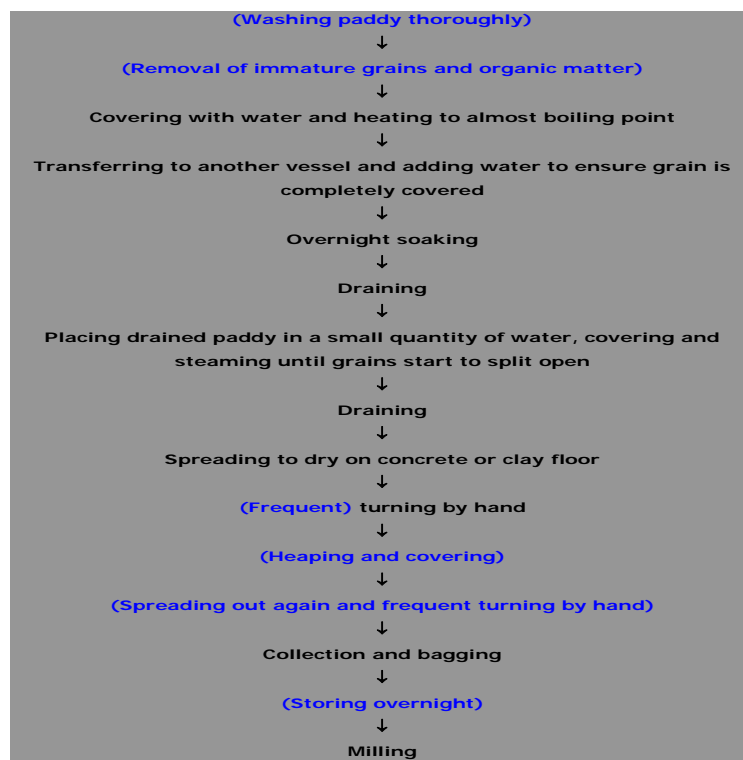
What is Parboiling?

- Parboiling is a hydro-thermal process (that simply means it uses water and heat) which is carried out for a number of reasons:

- i. To reduce breakage on milling
- ii. To change the cooking characteristics
- iii. To impart different eating characteristics

#### The Parboiling Process

- In Ghana parboiling is carried out using simple household items;
  - i. cooking pots,
  - ii. wood fires,
  - iii. baskets,
  - iv. Oil drums/large clay pots.
- The resources available govern the amount of paddy parboiled.
- Many women can only parboil about 30 kg in each batch.
- The work is very time-consuming and arduous
- In order to address this problem, a recent DFID project has introduced a simple parboiling vessel to enable batches of up to 100kg to be processed at a time and exercise more control over the process.
- Apart from making it possible to parboil more paddy at a time, the vessel also has the following additional advantages:
  - i. Less firewood is used (about half the amount of the traditional method).
  - ii. Discoloration that results when truncated oil drums are used is avoided.
  - iii. Drudgery is reduced (there are fewer unit operations and the presence of the drain-pipe eliminates draining with baskets).
  - iv. The presence of the separating mesh ensures that no paddy is in direct contact with water during the steaming phase.
  - v. Less water is used in the parboiling process.



- The parboiler uses two raw materials,
  - i. water
  - ii. paddy
- Several different processes are used to achieve good quality parboiled rice.

- Not all parboilers carry out the processes shown in brackets.

***How current parboiling practices in Ghana affect quality***

<b>Quality defect</b>	<b>Current practices</b>
Broken grain	Grain which has not been properly soaked, steamed sufficiently or dried correctly will be susceptible to breakage
Organic matter (straw, weed seeds, immature grains etc)	Thorough washing is required to remove all extraneous matter. Some women are very skilled at skimming all debris from the top of the washing water.
Inorganic matter (stones)	Some women accept stones as normal. Others go to great lengths to remove them during the washing stage and by hand picking them out through all subsequent processes, particularly drying and turning. Some stones are present when the paddy is purchased, others can be introduced during the parboiling process. The drying surface is very important – it must be swept clean before the paddy is spread to dry. Children, animals and parboilers may introduce stones from their feet when they walk on the drying paddy.
Type admixture (mixed varieties)	Parboilers tend to buy and use one sack of paddy at a time and keep each batch separate, this problem is therefore not usually within their control
Immature grains	If immature grains are not removed they turn black on parboiling
Paddy/husk	This is usually a milling problem. We will look at milling in the next session. Some women have to winnow their parboiled rice after milling, their skill in doing so will help to remove these.
Under-milled rice	Again a milling problem, over which the women have little control.
Heat-damaged grains	This is a result of over-steaming when grains split open

***Improving the Quality of Parboiled Rice – What Can Parboilers Do?***

*Use good quality raw materials*

- Paddy
  - Women often have little choice in the paddy they buy, simply purchasing whatever is available locally.
  - Whenever possible they should try to buy clean paddy with as few stones as possible and avoiding paddy that has lodged (dirty paddy).
  - Whenever possible they should buy paddy of a single variety, which has been correctly dried and stored.
- Water
  - In some areas clean pipe water or well-water is readily available.
  - In other areas water is difficult to come by and can be of very variable quality.
  - Whenever possible water should be treated with alum or *Moringa* seeds before use.

***Control Processes***

- Washing/cleaning
 

All paddy should be washed carefully to remove residual dirt and stones.
- Removal of floating debris

Careful removal of floating immature grains will reduce the number of blackened grains in the final product.

➤ Soaking

- i. Paddy should be covered in water and brought almost to boiling point and then transferred to another vessel (in the traditional method) for overnight soaking.
- ii. Extra water must be added to the soaking vessel to ensure that all grains will still be covered in water the following morning.
- iii. If this is to be done, the water must be hot water.

➤ Steaming

- i. If traditional pots are used the amount of water used needs to be carefully controlled.
- ii. Too little and the pot will boil dry, too much and significant portions of the paddy grains will be boiled not steamed.
- iii. The new parboiling vessel overcomes this problem by separating the grains completely from the boiling water.
- iv. The surface of the paddy should be covered to ensure even steaming.
- v. Steaming is complete when 25% of the surface paddy has just split open, many women over-steam the paddy resulting in damaged kernels.

➤ Drying paddy

- i. The surface of the drying floor is critical, ideally it should be a concrete pad with no cracks etc. In reality the drying surface is either beaten clay or badly maintained concrete.
- ii. It must be as well maintained as possible and swept clean before each use.
- iii. The paddy should be spread in an even, thin layer as soon as it has been drained.
- iv. Some women in the Northern region leave hot, steamed paddy in a heap for some time before spreading. This practice should be discouraged.
- v. Constant turning to allow even drying of the paddy is important. This is usually done by hand and the women can also pick out any stones/debris whilst they are doing this. Women in the Upper regions tend to turn the paddy very frequently whilst those in the Northern region tend to take less care at this stage.
- vi. Drying in the middle of the day should be discouraged as the heat intensity can lead to cracking.
- vii. The paddy should be heaped in a shady place and covered with sacks; then be re-spread for final drying later in the afternoon or the following morning.
- viii. Children and animals should be discouraged from walking on drying paddy both for reasons of hygiene and to prevent further introduction of stones.
- ix. It may be possible to construct a band of rice husk around the edge of the drying area, walking over this effectively removes dirt and stones from the soles of the feet.

➤ Milling

The choice of mill may be critical to milled rice quality. This will be discussed more fully in the next presentation

- There was a pictorial presentation of best practices

## 5.1 Discussion of Presentation on the Role of Parboilers

**Question:** Dr. Benjamin Dadzie  
Do we produce rice the consumers want? My preference as a consumer is rice that is well packaged and rice that does not stick together after cooking.

**Response:** Wilson Dogbe (SARI)  
From my experience in Northern Ghana, the preference of the parboiler and the consumer are not always the same. The parboiler is looking for varieties that will give him more profit whilst the consumer is more concerned with taste.

J. T. Manful, CSIR/FRI

It is true that parboilers and consumers have different preferences. When we talk to them we do not get one picture.

**Question:** David Crentsil- AESD, MOFA  
I seek clarification of the various roles played by the different stakeholders: farmers, parboilers and millers in the production of good quality rice. How is trading of rice carried out? Is it that the farmer after producing sends it to the parboiler who after parboiling sends it to the miller?

**Response:** Salifu, A-R. Z.  
There are different operations. The farmer, the parboiler and the miller are doing separate businesses.

**Question:** Paul Sono, ADRA  
Since the consumer has the ultimate say or determines what to take from the producer why don't we consider the consumers preferences and work back towards to the parboiler and the farmer?

**Response:** Dr. Benjamin Dadzie, DFID  
The consumer is the one who determines what rice comes to the market.

**Question:** Dr. Benjamin Dadzie, DFID  
The parboiling process seems too long. Could it be reduce to half a day?

**Response:** J. T. Manful  
We can conveniently reduce the processing time for parboiling. Through research we have discovered the optimum temperature for soaking (65-70°C). It is thus possible to process three batches of rice for parboiling in one day.

**Contribution:** Edwin Sonne (MOFA)  
I have seen the Food Research Institute vessel for parboiling. It is extremely important to disseminate to technology and increase access to women processors in Northern Ghana. The second proposal I wish to make is to improve opportunities for drying parboiled paddy, by researching into the construction of movable drying racks in order to minimise contamination. Water is one of the challenges for rural development. I also wish to suggest to our NGO partners such as Technoserve and ADRA to support improvement of potable sources in parboiling communities in order to assure quality parboiled rice.

J. T. Manful, CSIR/FRI

We need to look at the example of Wa. Women groups who have been trained are rotating the use of the improved vessels for parboiling. The LACOSREP II project has acquired more vessels to train more women. The project is linking up with GRATIS to fabricate the vessels to be used as a credit support to these groups.

**Question:** James Akatse, Ghana Irrigation Development Authority  
In parboiling does the age of the paddy affect the quality or the consumer preference of the milled rice?

**Response:** J.T. Manful, CSIR/FRI  
Age does not necessarily affect quality  
Ali Sampare, CSIR/FRI  
There is a term called theatre. The women sprinkle water on the on paddy rice before milling. This tends to expand the rice before milling.

## **6.0 Training Manual on “The Role of Marketing”** ***Presented by Joseph Gayin***

### ***Objective***

The objective of this session is to briefly investigate the role market traders and other interested parties could play in the production of good quality parboiled rice

### ***What Does Quality Mean To Market Women?***

- Market women are well-aware of quality, since it affects the price they ultimately receive for the rice they sell.
- There is some evidence that they pay slightly higher prices for good quality parboiled rice and they certainly visit some of the more proficient parboilers to purchase directly from their compound.
- However the market traders purchase from a number of different suppliers and, depending on availability, each batch of rice might be of varying quality.
- There is therefore no guarantee that rice bought from a single trader in the larger markets would always be of the same quality.
- Many traders store rice until they have accumulated sufficient to take to the larger markets, storage must therefore be considered as a possible stage when quality could be compromised.
- If quality is improved throughout the production chain and this project realises its aims to form linkages between the primary producers and processors to raise quality awareness and improve the quality of locally parboiled rice, it must also include the traders.

### ***Improving The Quality Of Parboiled Rice – What Can Market Traders Or Small Scale Businesses Do?***

- Make sure that the quality of the rice does not deteriorate before it reaches market. Marketing outlets must ensure that:
  - i. Quality rice is not mixed with batches of rice of inferior quality
  - ii. Storage facilities must be clean and dry
  - iii. Rice is suitably transported to markets

### ***Marketing Strategies***

In many other countries entrepreneurs buy paddy, parboil and mill it and then pack it for sale under their own name. There is, therefore obviously a great incentive to maintain quality standards as their business has been established by selling good-quality rice.

### ***Aims of this Project***

- There is no reason why groups of people (farmers, parboilers and millers) should not join together to produce parboiled rice of the highest possible quality and then market it themselves.
- This project aims to form those linkages and investigate possible outlets.
- Its success will depend on everyone working together to produce a good quality product and will rely on good communication and training of those involved.
- The production chain will be comprised of: Breeders, Farmers, Parboilers, Millers and Marketers.
- Each person in this chain adds value to the original product and also needs to make a profit for their efforts. If this venture is to be successful all the members of the supply chain will need support and encouragement to improve and maintain the production of good quality parboiled rice.
- Everyone in the chain will need the following skills to a greater or lesser degree:
  - i. Communication skills
  - ii. Technical skills
  - iii. Management skills

- When a product is marketed you need to consider:
  - i. What to produce (is the rice a variety with good cooking and eating qualities?)
  - ii. How much to charge (based on a fair profit margin for everyone concerned)
  - iii. How to promote the product (how will your potential customers find out about it?)
  - iv. The most appropriate and cost effective channel of distribution

## 6.1 Discussion of Presentation on “The Role of Marketing”

**Comment:** E. Tetteh Bio, CSDF, MOFA

The problems of quality and marketing of rice in the North are that:

- i. There is no price incentive to allow farmers to produce good quality
- ii. The rice market is controlled by parboilers and not consumers
- iii. Rice trade is only by small holders (parboilers)
- iv. There are no systems for processing good quality rice commercially to enhance competition in the rice trade
- v. The sale of rice by volume instead of sale by weight is a big constraint.

The solution is to improve the Nasia processing plant to allow commercial operators to enter the rice trade in the North.

Simon Apio, GIDA/IDC

I agree that steaming should continue until 25% of the grains have split open but high heat intensity produces better quality than low heat intensity.



## 7.0 Training Manual on the Role of Millers

*Presented By Sampare Ali Seidu*

### **Objective**

The objective of this session is to investigate the role millers could play in the production of good quality parboiled rice. We will look at current practices and explore ways in which they can be improved

### **What does Quality Mean to Millers?**

- Most millers are not very quality conscious
  - i. because milling in Ghana is currently carried out on a “custom milling” basis.
  - ii. the miller charges a fixed rate for milling a quantity of rice – he therefore has little incentive to produce the best quality rice since he will not gain financially
  - iii. The miller has to invest in a mill, which often does not work for the whole day so profits are lower than could be expected.
  - iv. Servicing and repair of the equipment is seen as a loss of profit so is often not carried out as it should be, resulting in an inferior product and an increased number of breakdowns.
  - v. The quantity of grain brought by each customer is restricted by the amount that can be carried.
  - vi. If there are several mills in the same vicinity, the miller must try to attract customer, so may try to ensure that his mill is operating efficiently.
  - vii. As can be seen from the table on the next slide, the only quality attribute that is likely to be influenced by milling is the quantity of broken grains.
  - viii. Nevertheless consumers see this as a major quality attribute, so it is of great importance.

Quality attribute	Intrinsic quality	Influenced by milling
Density	(	
Size	(	
Shape	(	
Composition	(	
Colour	(	
Aroma	(	
Foreign matter		
Mixed varieties		
Maturity		
Infestation/infection		
Cracked grain		
Sprouted grain		
Moisture content		
Broken grain		(

## What Is Milling?

- Milling produces refined whole grains with their indigestible parts removed.
- Milling is a mechanical process that transforms inedible paddy grains into an attractive, marketable product.
- This is achieved in two stages:
  - i. Removal of the outer husk  
As the rice kernel grows it is protected by a hard, fibrous husk. This thick shell is totally inedible but is easily removed by milling since it splits open very easily and falls away from the kernel.
  - ii. Removal of the bran layers  
Beneath the husk is a thin layer of “bran”. This layer contains many nutrients, such as fat, vitamins and minerals and is edible. However most rice consumers prefer this layer to be removed as it alters the cooking and eating characteristics of the grain. This layer is quite firmly attached to the kernel and needs to be polished (or rubbed) off.

## **The Milling Process**

- There are two types of mill available for the small-scale processor – rubber roll mills and Steel (“Engleberg”) dehullers.
- Steel hullers, often known as Engleberg mills are used to dehusk grain such as rice whose husk is loosely attached to the grain.
- This is the most widely used type of mill in Northern Ghana

## **Operation of the Engleberg mills**

- A ribbed cylinder rotates inside a milling chamber and dehusking occurs when the grain is pinched between a metal bar and one of the ribs on the rotor.
- Polishing occurs when the dehusked kernels rub against other grains and against the rough husk.
- Dehusked grains and waste husk are often discharged together and must be separated by winnowing. Some machines have built in *aspirators* to remove the husk and bran.
- Incorrect adjustment of the blade and poor rotor condition may lead to excessive kernel breakage and therefore to reduced outputs
- This type of mill usually has the capacity to mill between 150 and 250kg per hour.
- There are many models available, both imported and locally manufactured.
- The most efficient have an aspirator to remove husk and bran.
- Others have an additional polishing unit but most mill operators in Ghana are not aware of the advantages of this additional unit and have disconnected them.

## **Rubber roll mills**

- These are used mainly in southern Ghana for milling raw (unparboiled) rice.
- *Paddy* is passed between a pair of revolving rubber-coated rolls.
- As they rotate they create a shear force that breaks open the husk, separating it from the kernel.
- The husk is removed by aspiration and is cleanly separated from the kernel
- The brown rice (dehusked paddy) subsequently goes through a polishing chamber similar to the steel huller where the bran is removed.
- The bran from such mills is ideal for animal feeding
- The capacity of rubber roll dehullers is usually 200 -500 kg per hour.
  
- There have been some attempts to introduce rubber roll mills into the northern regions – these have proved largely unsuccessful.
- A comparison of the two types of mill is shown below.
-

<b>Rubber roll mills</b>	<b>Steel hullers</b>
<ul style="list-style-type: none"> <li>• Expensive, imported mills</li> <li>• Can not be made in Ghana</li> <li>• Rubber rolls, which must be imported, need replacing very frequently – expensive and difficult to obtain in Ghana</li> <li>• Parboiled paddy wears rolls out very quickly because it is so hard</li> <li>• Bran layers not removed very effectively as husk is immediately separated from dehusked grain</li> </ul>	<ul style="list-style-type: none"> <li>• Cheaper mills – may be imported (usually from India)</li> <li>• Can be manufactured locally</li> <li>• Spare parts usually available – can be locally manufactured</li> <li>• All parts made of metal – more durable</li> <li>• Husk remains mixed in with dehusked grain for longer and helps removal of bran layers</li> </ul>

### ***Improving the Quality of Parboiled Rice – What Can Millers Do?***

#### ***Make sure mills are well maintained and safely operated***

- Many mills are poorly maintained, as previously stated this is usually because millers are reluctant to replace parts as often as they should as it cuts down their profits and they have little incentive to produce milled rice of the highest possible quality.
- Millers should be encouraged to adhere to Good Manufacturing Practices and operate in a safe, hygienic environment – after all they are manufacturing a food product!

#### ***Sensible safety precautions***

- Any moving machinery is potentially dangerous, all moving parts should be fitted with guards to prevent the entrapment of limbs or clothing.
- ALWAYS stop the machine before greasing the driving parts or carrying out any maintenance.
- Check for looseness or damage on belts, nuts and bolts at least once per day before the start of work.
- No untrained personnel should be allowed to operate machinery.
- Children and other onlookers should be kept well clear of the mill.
- Never attempt to repair machinery with the power switched on
- Always disconnect the power when the mill is not in use
- Wear appropriate clothing, safety equipment such as dust masks should be provided.
- Try to minimise the formation of dust and do not inhale any dust.
- Store fuel away from the mill
- Do not smoke near a mill
- Ensure appropriate disposal of by-products
- When two or more persons are working together each person must confirm suitable hand signals before starting work

#### ***Operator responsibilities***

##### ***The mill owner or trained operator should be responsible for:***

- Keeping the premises clean and tidy
- Carrying out routine maintenance and safety checks on the equipment
- Ensuring the safety of everyone in the mill
- Checking the quality of the grain entering the mill
- Making sure that grain is fed to mill at a suitable rate
- Adjusting the mill to produce the required product
- Checking extraction rates to ensure that the mill is operating efficiently

- Keeping records of inputs and production
- Arranging service and repair of the mill as appropriate
- Keeping records of repair and maintenance
- Ensuring a supply of raw materials (grain, fuel, packaging etc.)
- Organising the day-to-day operation of the mill

***In addition to the above the operator is specifically responsible for checking that:***

- The machine is installed on a level and stable place. Unlevelled and unstable installation will cause vibration and poor performance
- The machine and any prime mover must be correctly positioned to ensure perfect alignment.
  - ❖ The prime mover can either be an electric motor or any diesel-powered engine.
- If alignment is correctly carried out belt tensioning will be efficient and slippage of belt would be eliminated.
- All electrical connections conform to local power authority regulations
- Foundations of machines are well secured and tightened.
- Planned preventive maintenance is followed e.g. lubrication of all bearings on machine, electric motors, diesel engines etc. at appropriate time intervals
- Regular inspection, adjustment of gaps for effective and optimum operations is carried out.

***Use good quality raw materials***

The miller's only raw material is the paddy provided by his customers. Nevertheless it is in his interest to try to ensure that paddy fed into the mill does not contain any foreign matter, since stones will damage his equipment and require screens to be replaced more frequently.

***Control Processes***

- Some millers in the Upper West pass paddy through the dehuller twice, adjusting the mill setting for each pass, as they believe this reduces breakages and produces very well-milled rice.
- Mills with fitted aspirators separate the husk and milled rice effectively, meaning that the women do not have to winnow the rice before marketing it.
- This project aims to develop an aspirator which can be fitted to existing mills to improve their performance.
- Millers should be encouraged to visit the demonstration sites so that they become aware of the importance of their role in the production of good quality parboiled rice.

## 7.1 Discussion of Presentation on “The Role of Millers”

- Question:** Mr. Victor Antwi, Technoserve  
Is Nasia using robber mills or steel mills since it mills parboiled rice?
- Response:** Ali Sampare, CSIR, FRI  
Rubber rolls
- Question:** Mr. Victor Antwi, Technoserve  
I want to know if you have shared this information made in this presentation with the mill operators.
- Response:** Ali Sampare, CSIR, FRI  
To a large extent, I did train people in the Northern Region.
- Question:** Simon Apio, GIDA/IDC  
The millers and mill owners do keep records but they do not want to disclose them to others. They want to conceal their financial status from their neighbours and the district assembly to whom they pay taxes to. Has any of the private millers installed destoners alongside the rice mills in the northern sector of the country
- Response:** J. T. Manful, CSIR/FRI  
Our approach is to prevent a lot of stones as possible. But if you go to see the kind of houses, that is a problem. What is the monetary return for the millers if he should install a de-stoner? They do not keep records.
- Question:** Adomako Osei-Frimpong, Director, DAES, MOFA  
What sort of help can we give since mills are 40 years Old?
- Response:** J. T. Manful, CSIR/FRI  
We hardly got basic things to install anything  
Simon Apio, GIDA/IDC  
There is a lack of enthusiasm for the rice mills being supplied. Owners will be reluctant to take mills if metres are not included. Usually with metres, they are able to by-pass and operate at no power cost. The flat rate charged by the ECG can be too expensive to operators. If metres are there, costs are lower
- Question:** J. T. Manful, CSIR/FRI  
Are pre-paid meters three phases?
- Response:** Mr. Victor Antwi, Technoserve  
We can find out. The project can envisage taking up the initial installation cost of metres. I want to know if the project can absorb the cost of installing power at the mill. Could you have bought a diesel engine?  
Ali-Sampare, CSIR/FRI  
It is cheaper to run electric motors than diesel. Diesel cost as much as electricity. A lot of millers have moved from diesel-operated mills to electricity.
- Question:** Paul Sono, ADRA  
Can't machines/mills that use diesel be bought for the millers instead of those that use electricity?
- Response:** Simon Apio, GIDA/IDC

Friction type mills and the attrition type mills could be comparable if the adjustments are well made. Operators should be encouraged to use correct adjustments or setting if quality is to be obtained.

JICA

Friction type of mill creates heat. Rice does not get hot if attrition mills are used

J. T. Manful, CSIR/FRI

The way out is to try not to package a hot product.

## **Technical Section II**

### **8.0 General Discussions and Recommendations**

#### **8.1 General Discussions**

**Question:** Isaac Akpabi, DAES, MOFA

You mentioned millers not keeping records. Do farmers and traders also not keep records?

**Response:** J.T. Manful, CSIR/FRI

No, when Ali said mills were 40 years old, he was guessing. Record keeping is a problem. Neither the farmers nor traders keep records

Simon Apio, GIDA/IDC

The age of the rice mill should not be considered too seriously. Maintenance of the mill is very important and once this is well done, the age of the mill does not matter very much. The rice mill depends on bearings, the milling shaft and the screen.

J.T. Manful, CSIR/FRI

At the beginning of the project we went to see which mills would be fitted with aspirators. They were too old.

Simon Apio, GIDA/IDC

If metres are there, costs are lower. With flat rates costs are higher.

Ali Sampare, CSIR, FRI

Can mills be standardized? Chinese mills look better?

Adomako Osei-Frimpong, Director, DAES, MOFA

Whatever agricultural equipment that comes to Ghana is processed by the DAES of MOFA. We are expecting processing machines from china. These include rice threshers and tomato processing equipment. This project should take advantage of it.

J.T. Manful, CSIR/FRI

We would be contacting your office for further collaboration

#### **8.2 Recommendations**

1. Training of operators in use and adjustment of mills would improve rice quality.
2. Upgrading of locally fabricated spares to improve quality.
3. Mills with aspirators should be encouraged.
4. Dedicated Rice Millers Associations could provide a vehicle for discussing and introducing improve practices.
5. They could also arrange purchase and distribution of spare parts.
6. They could raise awareness of working conditions and health risks.
7. If some millers were to buy paddy and mill it for retail sales and market high quality rice then other millers might realise the importance of producing high quality rice.
8. The Training Manuals should be converted to the local dialects in collaboration with DAES of MOFA
9. Video documentaries of the manuals should be prepared to enhance technology transfer
10. The FRI Parboiling Vessels should be promoted
11. At present Ghana does not have any quality standards for either paddy or milled rice. The introduction of suitable standards is likely to raise quality awareness throughout the production chain, from farmer to Market.

Reference Type (as in NRIL green citation guidelines)	Citation Details
Training Manual	1. FOOD RESEARCH INSTITUTE (2003) - Improving the Quality of Ghanaian Parboiled Rice: Training Manual 1 - What is Good Quality Rice? Food Research Institute (FRI), Accra, Ghana. 7pp. John T. Manful (Ed).
Training Manual	2. FOOD RESEARCH INSTITUTE (2003) - Improving the Quality of Ghanaian Parboiled Rice: Training Manual 2 – The Role of Farmers. Food Research Institute (FRI), Accra, Ghana. 9pp. John T. Manful (Ed).
Training Manual	3. FOOD RESEARCH INSTITUTE (2003) - Improving the Quality of Ghanaian Parboiled Rice: Training Manual 3 – The Role of Parboilers. Food Research Institute (FRI), Accra, Ghana. 12pp. John T. Manful (Ed).
Training Manual	4. FOOD RESEARCH INSTITUTE (2003) - Improving the Quality of Ghanaian Parboiled Rice: Training Manual 4 – The Role of Millers. Food Research Institute (FRI), Accra, Ghana. 10pp. John T. Manful (Ed).
Training Manual	5. FOOD RESEARCH INSTITUTE (2003) - Improving the Quality of Ghanaian Parboiled Rice: Training Manual 5 – The Role of Marketing. Food Research Institute (FRI), Accra, Ghana. 5pp. John T. Manful (Ed).
Rice Recipe Album	6. FOOD RESEARCH INSTITUTE (2004) – Rice Recipe Album: Novel Ghanaian dishes from parboiled rice. Food Research Institute (FRI), Accra, Ghana. 19pp; John T. Manful and R.M. Yawson (Eds).
Internal Report	7. TOMLINS, K. I., MANFUL, J. T., GAYIN, J., TAMAKLOE, I. AND KUDJAWU, B. D (2004) - : Report on price threshold and consumer acceptability of rice for consumers in Accra, Ghana