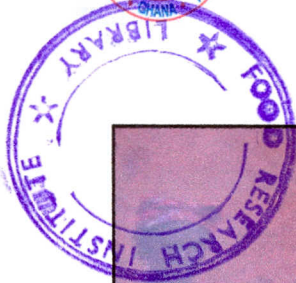




# **FOOD RESEARCH INSTITUTE**

**(COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH)**



## **PARBOILED RICE QUALITY IMPROVEMENT PROGRAMME IN SOME SELECTED COMMUNITIES IN THE NORTHERN REGION OF GHANA**

**(FINAL REPORT)**

*For:* FRENCH EMBASSY / FOOD SECURITY AND RICE PRODUCERS ORGANISATION PROJECT

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## BACKGROUND

### Summary

The pilot project on Parboiled Rice Quality Improvement in some communities around Tamale began with a presentation on an earlier feasibility study carried out. Selected farmers from the four communities signed contracts that contained some terms and obligations bothering on Good Agricultural Practices (GAP). Under the terms of the contract each farmer was to sell one ton of clean paddy to the Apex body at an agreed price of ₵135,000 per bag (83kg). The Food Research Institute (FRI) contracted a Tamale based Agricultural Non Governmental Organization (NGO), Zang Ti Wuni Farmers Association (Zafarms) to supervise the communities to observe the terms of the contract and to report monthly on the situation on the ground.

Land preparation was done for the farmers, cracks and breaks in bunds were repaired and bund heights were raised to make water management in the fields more efficient. The rice variety used for this pilot project was TOX 3107 and this was supplied by the Seed Unit of Ministry of Food and Agriculture (MoFA). Training sessions were organized for Farmers, Processors and Millers to equip them with the requisite knowledge to produce good quality rice that would sell for a good price.

To facilitate the procurement of paddy and the processing part of the project, there was supply of some technical inputs. These included two sack sewing machines, spare needles and twines and two (200kg) scales. Ten parboiling vessels were also supplied to selected processors. Repair work was done on the drying floors of the processors to put all of them in good shape. In addition two selected mills were rehabilitated to improve their milling efficiencies. Due to unfavourable weather, the yields in the communities were generally below expectation. Coupled with the refusal of the Gbalahi community to sell most of their paddy, it became urgent for Apex body to buy additional paddy of good quality from the open market to make up the paddy originally targeted for the processing. Processing of the paddy was done by two groups of women processors at two centres; Tamale and Kumbungu. Sensory quality of rice samples from these centres was assessed by trained panellists using descriptive analysis.

In spite of the training and monitoring, it was apparent that the quality of parboiled rice produced by the women processors under this programme was not equal the quality produced by processors from Upper-East (control sample) as desired though it was far above the quality generally produced in Tamale and its environs. The project was generally successful but some lessons were learnt and therefore some recommendations were suggested for future similar projects.

## **BACKGROUND**

The Lowland Rice Development Project (LRDP) in the Northern Region of Ghana was funded mainly by the government of the Republic of France and aimed to demonstrate the viability of rice production in the treated lowlands of the Northern Region. The specific purpose of the project was to “establish lowland rice production and processing methods which are economically viable and sufficiently attractive for Farmers and the Women Processors responsible for processing and commercialising this production. The production and processing system must be sufficiently flexible for it to be reproduced and transferable to other regions.” The project commenced in February 1999 and ended in December 2003.

The project had the following objectives:

- To develop 1040 ha of lowland in three valleys situated in the vicinity of Tamale.
- To increase rain-fed rice yields from 1 t/ha (using traditional methods) to 3.3 t/ha through planning and intensification (improved varieties, high-quality seeds, use of fertilisers and herbicides, animal traction).
- To improve the quality of parboiled rice in order to command a better price and increase the income of the women involved in processing.
- To organise the producers and into solid, autonomous groups capable of providing input, obtaining and supervising credit, marketing products and ensuring the upkeep and management of the hydraulic infrastructure.
- To implement a micro-credit programme, managed by the Agricultural Development Bank (ADB), capable of providing durable

access to credit for small-scale and female transformers through their organisation into mutual guarantee groups.

On the termination of the LRDP, the government of the Republic of France, in furtherance of its commitment to helping the rice sector in Ghana, set up the Food Security and Rice Producers Organisation Project (FSRPOP) which is also hosted by the Ministry of Food and Agriculture (MOFA). FSRPOP initiated a "Parboiled Rice Quality Improvement Programme" in the northern region in the 2004-cropping season with the following objectives:

- To produce on a pilot-basis in 4 selected communities located around Tamale, high quality parboiled and milled rice, using improved equipment and designing appropriate programmes of schedules (list of good practices) for Producers, and small-scale rice Processors, with close field supervision and technical support.
- Under an additional and adequate FSRPOP marketing support programme, the high quality parboiled and milled rice produced shall then be bought by the Union of Lowland Rice ' cooperatives in order to be bagged in 3-kg sachets, branded, advertised and displayed nationwide at a price equivalent to the Asian imported rice (about ₵4,000 per kilo).
- Extra incomes generated by the sale of this rice shall be distributed equitably among the different stakeholders (Farmers, Parboilers and Millers) and therefore constitutes incentives to follow the designed programmes of schedules.

In furtherance of the above aims, the Embassy of the Republic of France commissioned the Food Research Institute (FRI) to carry out a

feasibility study on a shortlist of communities recommended by the FSRPOP in order to design precisely the modalities and budget of this quality improvement programme. The terms of reference of the feasibility study were as follows:

- Final selection of the pilot communities.
- Estimation of the volume of production in Mt (paddy and milled rice) and number of Parboilers to be part of the programme.
- Design of appropriate programmes of schedules (specifications) for Farmers, Processors and Millers.
- Costing of the needed inputs, equipments and/or infrastructure to be introduced.
- Description and costing of supervision & monitoring.
- Economic assessment of the sharing of profit (price formation) between Farmers, Women Processors and Millers based on the 2003 sell price.
- Proposal of a new sharing of profit assuming that the selling price of the improved quality rice shall be ₱4,000 per kilo.
- Physical and sensory evaluation of samples of Lolandi and regular samples of rice (variety, TOX) from the LRDP fields in order to determine the quality gap to be filled.

## **1.0 INTRODUCTION**

The pilot project begun with a presentation of findings on the feasibility study carried out in April, 2004 on Parboiled Rice Quality Improvement in some communities around Tamale. Present at the presentation were farmers, members of the Apex Body, the FSRPOP representative in Tamale among others. Selected farmers from four communities namely Kumbungu, Kukuuo, Gbalahi and Sahakpaligu later signed contracts that contained some terms and obligations. These terms were Good Agricultural Practices (GAP) which when adhered to would ensure the production of quality paddy. Under the terms of the contract each farmer was to sell one ton of clean paddy to the Apex body at an agreed price of ₵135,000 per bag (83kg). The Food Research Institute (FRI) contracted a Tamale based Agricultural Non Governmental Organization (NGO), Zang Ti Wuni Farmers Association (Zafarms) to supervise the communities to observe the terms of the contract and to report monthly on the situation on the ground.

## **2.0 LAND PREPARATION AND PLANTING**

Land preparation in some of the communities like Gbalahi was delayed. The delay (for about two or three weeks) was primarily due to getting the services of tractor operators. Ideally graders are best suited for this kind of land preparation but the cost involved is rather on the high side. On the whole the ploughing and harrowing were well done in all the communities except Gbalahi where about 80% of the farmers had to re-plough because the tractor operators could not do a good job initially. Bunds had to be reshaped by way of repairing cracks and breaks and raising heights to make water management in the fields more efficient. Selected farmers on each field were grouped together to make monitoring easier and efficient. The rice variety used for this pilot



project is TOX 3107 and this was supplied by the Seed Unit of Ministry of Food and Agriculture (MoFA).

### **3.0 AGRONOMIC PRACTICES**

The farmers accepted the prescribed agronomic practices both in principle and practice. This included weed control, fertilizer application, water management and rouging of undesired varieties. The initial rains were very heavy so germination was negatively affected. It was discovered that in all the communities some farmers had their seed adulterated with another rice variety. It must be said here that this was not too alarming. Fortunately this variety showed physical characteristics that were entirely different from the TOX variety. It started bearing paddy ahead of the TOX itself and had virtually grown taller than the TOX variety. It was therefore quite easy to identify. Rouging was therefore employed over time by all affected farmers to get rid of the unwanted varieties. At different times farmers weeded their farms and applied fertilizer when the time was due. It must be stated here that some of the fields experienced floods and affected some of these agronomic practices such as timely weeding and fertilizer application. During these times, the local NGO, Zafarms continued its routine monitoring of all the farmers in all the communities to ensure that all the prescribed agronomic practices were followed. FRI visited the communities regularly to find out at first hand what the situation on the ground was.

### **4.0 TRAINING**

Training sessions were organized for Farmers, Processors and Millers from October 26 to November 4, 2004. A team from the Food Research Institute (FRI) was in Tamale from October 26 to November 4, 2004 to train all the selected rice farmers and processors of the pilot project in the various communities. The purpose was to equip them with the

requisite knowledge to produce good quality rice that would sell for a good price. Prior to the training sessions, the FRI team held discussions with the FSRPOP representative at Tamale and to present the programme of activities as regards the training.

#### **4.1 Training of Farmers on Production of Quality Paddy**

A two-day training workshop was organized for the farmers on October 28 and 29, 2004 at two locations; Kukoo and Gbalahi respectively. The Kukoo workshop combined Kumbungu and Kukoo communities while that of Gbalahi brought together Sahkpaligu and Gbalahi communities.

These workshops were well patronized by the farmers. Topics discussed included land preparation, planting, weeds control, fertilizer application and water management. Besides these, harvesting of paddy, threshing and winnowing of paddy, weighing and packaging of paddy rice were also discussed in detail. The workshop was made interactive to enable farmers contribute by answering questions and sharing their experiences as rice farmers over the years.

The obligations in the farmers' contract were spelt out again to the farmers. In addition some modalities/arrangements for paddy procurement by the Apex body and other issues concerning the farmers' role in the pilot project were discussed. The two-day workshop was comprehensive and successful. At the end of the session the farmers appreciated the fact that in order to arrive at good quality milled rice, farmers have a big role to play i.e. producing good quality paddy.

The storage structures at Kukuo and Gbalahi which were to be used as warehouses to store paddy before processing were inspected. The one at Gbalahi needed some structural changes to improve upon ventilation. The farmers in that community promised to work on it to give it a face-lift.

## 4.2 Training of Parboilers on Production of Quality Rice

On the 30<sup>th</sup> and 31<sup>st</sup> October 2004, the FRI team inspected the drying floors of some women processors at Kumbungu and Tamale. In addition to the drying floors other factors such as experience in parboiling and reliability were considered. The FRI team finally selected five in each of the locations. The selected processors were then introduced to the terms of the contract and what their role is in the entire project. All other issues concerning paddy supply, quality of parboiled rice expected and incentives were thoroughly discussed. Training of the selected processors took place at Kumbungu and Tamale from the 1<sup>st</sup> to 4<sup>th</sup> November 2004. The training centered on the role parboilers can play to produce good quality rice. All the unit operations in the parboiling process were looked at and analyzed to see the effect they could have on the final



Fig 1: Participants washing paddy at Tamale

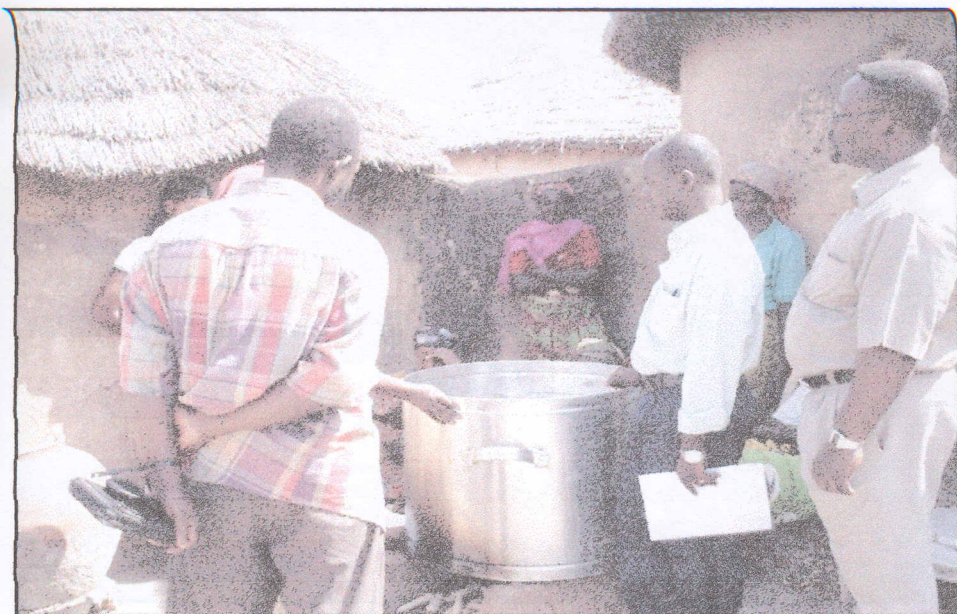


Fig 2: FRI team demonstrating positioning the parboiling vessel

quality of the rice. Critical unit operations such as thorough washing to remove immature grains, steaming and drying were emphasized. After ~~the theoretical session, the participants were taken through a practical~~ session. All the unit operations from washing of paddy to drying were demonstrated by the FRI team to the participants.



Fig 3: Participants from Kumbungu observing heating of paddy during a practical session



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*Fig 3: Participants from Kumbungu observing heating of paddy during a practical session*



*Fig 4: A participant scooping steamed paddy for drying*



*Fig 5: Drying of steamed paddy at Tamale*

After drying the processors were taken to a rice mill to go through the milling process and also to learn a few important things with regards to how milling can affect rice quality. The FRI-contracted field officer, Mr. P.S.Yakubu and one of his field workers were present throughout all the training sessions and were introduced to all the selected processors as

FRI representatives who would be monitoring their activities to conform to the obligations spelt out in the contract.



Fig 6: Selected women processors from Tamale just before training session

#### Selected Processors

##### Tamale

Halimatu Zachariya

Fuseina Abubakar

Maimunatu Salifu

Salamatu Alhassan

Aminatu Zachariya

##### Kumbungu

Zaliyatu Abu

Maimunatu Abdul Rahaman

Amina Bawa

Sanatu Ibrahim

Abiba Mohammed

Zuwaira Imoro

### 4.3 Training of Millers on Rice Milling

The two millers selected were taken through lectures/discussions on good manufacturing practices and good hygienic practices. Other areas discussed were maintenance and safety guidelines and the obligation that millers must pass the rice two times through the mill.



Fig 7: Milling parboiled rice at Kumbungu

#### 4.4 Technical inputs

FRI gave two sack sewing machines, two (200kg) scales, spare needles and twines to the FSRPOP representative at Tamale. The two scales were to be sent to the paddy procurement centres (Kukuo and Gbalahi). It was anticipated that the use of the scales will ensure fairness to all parties involved. Ten parboiling vessels were also supplied to the selected processors. A mason was contracted to work on the drying floors of the processors to put all of them in good shape.

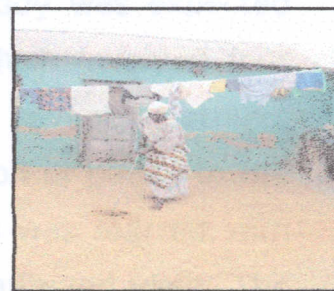


Figure 8: Before (with a lot of cracks) and after (smooth) conditions of drying floors



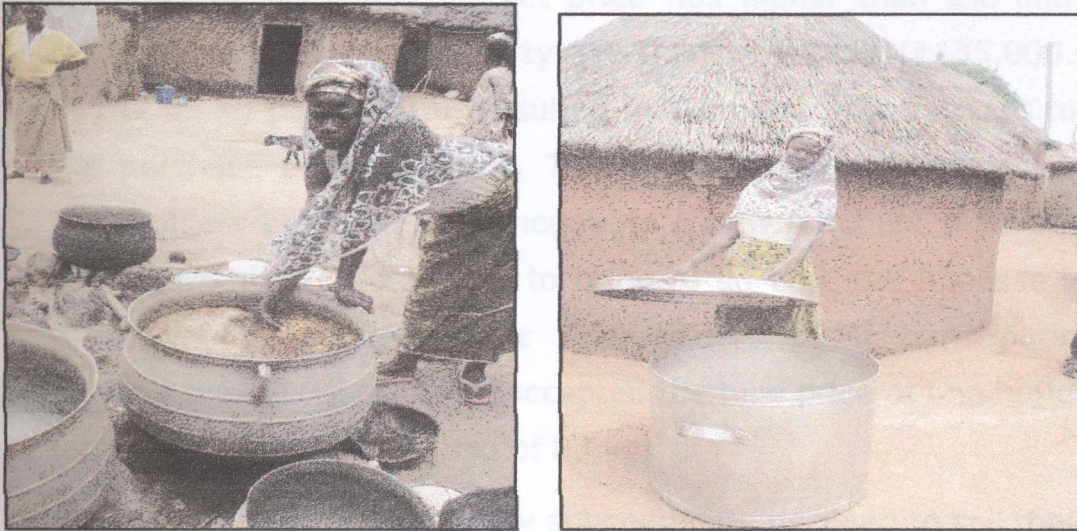


Figure 9: Traditional (Before) pot and Improved Vessel (After)

## 5.0 Rehabilitation of Mills

The mills in the two selected mill houses were rehabilitated after the mill operators had been trained by FRI staff. Shafts bearings and screens were replaced and the electrical wiring replaced or corrected as required. These were intended to improve the milling efficiency of the mills.

## 6.0 Paddy Harvesting and Procurement

An estimated seventy (70) tons of good quality paddy was expected from the farmers at the end of the pilot project which involved four selected communities. With a total of about seventy farmers participating, each farmer was expected to sell one ton of paddy to the Apex body under contract. Unfortunately the season was marred with unfavourable weather conditions and this generally affected yield. The average yield for the selected farmers under the project was about ten (83kg) bags per acre. The generally poor season resulted in the market

price of paddy rising very high since the demand was high. That is to say that the prevailing market price was higher than the initial fixed price of one hundred and thirty-five thousand Cedis (¢135,000.00) per bag of 83 kg paddy. This resulted in a protest from farmers to review the purchase price upwards. This necessitated a meeting of the all stakeholders to discuss and negotiate a new purchase price since that was apparently the only way to bring to an end, the impasse between the farmers and the other stakeholders. All participating pilot communities except Gbalahi accepted the new price of one hundred and forty thousand cedis per bag of 83 kg.

The farmers of this community subsequently declined to sell their paddy to the APEX body under the pretext that they would not be able to recover what they had invested because they had to twice plough their land before planting.

Consequently, the total quantities of paddy produced by and purchased from the farmers at the selected communities were as follows:

**Table 1: Paddy Produced by the Various Communities**

Community	Total bags produced	Average yield bag / acre
Kumbungu	138	11.5
Kukuo	237	10.3
Sahakpaligu	72	10.3
Gbalahi	Not known	3 acres failed but others supposed to be above 10
<b>Total</b>	<b>447</b>	

### 6.1 Purchase of Additional Paddy

Because of the refusal of the Gbalahi community to sell most of their paddy it became urgent for the Apex to buy additional paddy of good

quality from the open market to make up the paddy originally targeted for the processing. As of that time, prices on the open market was around ₱160,000 per bag a paddy. In all, forty eight (48) bags weighing 83kg each of paddy were purchased from Tonjing and Jana. This additional purchase amounted to 4,482kg.

**Table 2: Paddy Purchased from the Various Communities**

Community	83kg bags sold to Apex Body	Total weight (kg)	% of paddy produced sold to Apex Body
Kumbungu	97	830	70%
Kukuo	134	10,956	57%
Sahakpaligu	49	4,067	68%
Gbalahi	6		Very small
Other communities	48 (40 from Jana and 8 from Tonjing)	4,482	
<b>Total</b>	<b>334</b>	<b>27,805</b>	<b>Around 60% of paddy produced delivered (Gbalahi excluded)</b>

The FRI installed 2 manually operated winnowers and further winnowed the paddy before parboiling. After winnowing, there were only 318 bags left: 222 in Kukuo and 96 in Tamale.

## 7.0 Processing

In March the processing of the paddy into parboiled rice commenced at the two centres; Tamale centre represented by five women processors based in Lamashegu and another five member women group based in Kumbungu. The Tamale based processors worked on

paddy from Sahakpaligu and the additional paddy purchased from Jana and Tonjung while the Kumbungu processors started with the processing of the paddy produced by the Kukuo and Kumbungu farmers. In order that the processing was effectively and smoothly executed, discussions were held with the processors and millers to encourage them to produce the very best quality milled parboiled rice that could be easily marketed. On their part the processors accepted the challenge and assured other stakeholders of their readiness to produce high quality milled rice. The increase in the amount of service charges to the processors had to be renegotiated. This directly had to do with the increases in petroleum products by 50% countrywide. This gave rise to price increases in almost all products and services and for that matter fuel wood used by the processors as energy source.

The Tamale processing group was able to parboil 10,458kg (126 bags of 83kg each) of paddy. This yielded 6,179kg (approximately 62 bags of 100kg each) of milled rice. The average recovery rate of this group was therefore 59%.

On the other hand, the Kumbungu processing group parboiled a total of 15,936kg (192 bags of 83kg each) of paddy. This yielded 9,352kg (approximately 93.5 bags each) of milled rice. Thus, the processing recovery of this group was 58.7%.

The recorded processing recoveries were lower than expected. Processing recoveries of between 60 and 65% was expected. This observed situation could be attributed to a number of possible reasons.

It was reported earlier that the cropping season for that year was bad and the crop did not get enough water. This could have resulted in the grains not being fully filled thus giving them a higher than expected husk:grain ratio resulting in a lowered processing recovery. It should be pointed out that paddy with a high husk:grain ration could be judged as good until processed. This could also be due to improper winnowing after harvest but there is evidence that most of the purchased paddy was properly cleaned before purchase.

Also the low processing recovery could be due to pilfering by the processors as they were being paid on custom-basis. It is also worth noting that poor milling is more likely to result in high levels of brokens rather than lowered milling recovery.

**Table 3: Amended Price List for Tamale Processors**

ITEM	CHARGEABLE FEES	
	Old	New
1. Fire wood (per 83kg bag paddy)	3,780	7,500
2. Water (per 83kg bag paddy)	2,000	3,000
Transportation		
Paddy Rice (from ware house to processing point )	4,000	6,000
Parboiled paddy (from processing point to miller)	0	0
Milled Rice (milling point to warehouse)	2,600	3,600
Processing Equipment depreciation (per 83kg paddy bag processed)	1,623	1,600
Total amount to be paid (first stage)	14,000	21,700
Amount to be paid to miller by NILRIFACU cost per 83kg per boiled paddy bag	12,500	12,500
Labour to be paid offer service one person per bag	20,000	20,000
Total. Service charge per 83kg paddy bag	46,500	54,200

**Table 4: Amended Price List for Kumbungu Processors**

ITEM	CHARGEABLE FEES	
	Old	New
1. Fire wood (per 83kg bag paddy)	3,780	7,500
2. Water (per 83kg bag paddy)	2,000	2,000
Transportation		
Paddy Rice (warehouse to processing point)	4,000	5,000
Milled Rice (milling point to warehouse)	2,600	3,000
Processing Equipment depreciation (per 83kg paddy bag processed)	1,623	1,600
Total amount to be paid (to facilitate processing)	14,000	19,100
Amount to be paid to miller by NILRIFACU cost per 83kg per boiled paddy bag	12,500	12,500
Labour to be paid offer service one person per bag	20,000	20,000
Total. Service charge per 83kg paddy processes	46,500	51,600

## 7.1 Physical and Sensory Evaluation of Samples from Tamale and Kumbungu

**Table 5: Results of Physical Quality Analysis**

Sample	% broken	% stones	%immature grains	% paddy	% red rice	% mouldy	% heat damaged	% dis-coloured	%white centred
Tamale 1	22.23	0	0		0	6.2	0.21	0.4	
Tamale 2	24.22	0	0		0	7.1	0.94	0.17	
Kumbungu 1	29.16	0	0		0.45	6.37	0.11	0.45	0
Kumbungu 2	29.49	0	0		0.97	7.15	0.21	0.62	0.51
CONTROL	13.63	0.05	0.3	0	0.05	2.9	0	0	0

It is worth noting from Table i that the levels of broken grains were rather high for both samples from Tamale and Kumbungu. Levels of brokens in parboiled should ideally not be more than 10 to 15%. This is an indication of the fact the processors and millers in the Kumbungu and Tamale performed below expectation. On the part of the parboillers, it can be said that their drying regimes were not appropriate. This supported also by the high levels of mouldy grains in

samples from both Tamale and Kumbungu. The recorded mouldy grain level of 6.2 to 7.1% is rather high for good quality parboiled rice. The level of heat damaged grains in all the samples was below 1% and this is acceptable for parboiled rice. This means that the paddy was not over-heated during parboiling.

**Table 6i: Results of Colour Determination**

SAMPLE	L	a(+)	b (+)
Tamale 1	67.58	1.31	10.69
Tamale 2	66.29	1.52	10.72
Kumbungu 1	66.13	1.84	13.14
Kumbungu 2	66.15	1.80	12.77

The Hunter (L, a, b) colour scale is one of the most widely used by the food Industry. It is based on the opponent-colours theory that states that the red, green and blue human eye cone responses are re-mixed into black-white, red-green, and yellow-blue, opponent coders as they move up the optic nerve to the brain. The L, a, b type of scale simulate this as:

- **L** (lightness) axis – 0 is black, 100 is white
- **a** (red-green) axis – positive values are red; negative values are green and 0 is neutral
- **b** (yellow-blue) axis – positive values are yellow; negative values are blue and 0 is neutral

Whiteness is a colour index by which a sample is judged to approach the preferred white. It is important because in many cases observer ratings of whiteness correspond to consumer preferences for products such as rice and flour. Visual judgement of whiteness is primarily dependent on how light a sample is and the presence or absence of blue or yellow tint.

The 'a' values representing red colour were very low for all the samples and can therefore be approximated to neutral. The 'b' values also

indicate that there was a slight yellow taint with all the samples. The L value refers to the degree of lightness (whiteness) and as can be seen from the results the *Tamale* and Kumbungu samples did not vary significantly from the control sample from Navrongo. This means that the appearances of all the samples were quite attractive.

## **7.2 Sensory Evaluation of Rice Samples**

Sensory quality of five rice samples was assessed by trained panellists using descriptive analysis. These samples comprised two (2) samples each produced under the FSRPOP project from Kumbungu and Tamale as well as a control sample processed in Navrongo

### **7.2.1 Materials and Methods**

5 samples of rice were assessed in the raw state and cooked to determine sensory acceptability as evaluated by trained panellists using descriptive analysis.

Descriptive analysis (using a 10cm structured scale) was used for sensory analysis of all 5 rice cultivars.

#### ***Sensory Panel***

Panellists were FRI staff who were selected based on interest, time available and lack of allergies to the rice products present in the study. They were trained in descriptive analysis of rice.

#### ***Test Area:***

The analysis was conducted in a sensory evaluation laboratory area with partitioned booths illuminated by standard white fluorescent light.

#### ***Descriptive analysis:***

15 trained panellists evaluated visual, flavour, and texture, attributes of the rice samples. Both raw and cooked rice were evaluated. Electronic



rice cookers were used to cook the rice samples. All the rice samples were prepared using 300g of rice in 600ml of water. These were emptied into the rice cooker and cooked for 20 minutes. After the rice was cooked, the samples were removed from the cooking chamber and kept in a food warmer.

A 3-digit random number was assigned to each of the five samples. The order of the samples was also randomized for presentation to the panellists, the samples were served in a white Styrofoam plates

Panellists scored all attributes on a continuous linear 10-cm intensity scale using paper ballots. Crackers and water were provided for panellists to rinse their palates between samples.

#### **Data analysis:**

All data were subjected to analysis of variance (ANOVA) Means were analyzed for significant differences using the Duncan Multiple Range Test. Statistical significance was set at the 0.05 probability level

#### **7.2.2 Results and Discussions**

Table 1 shows the sensory characteristics of raw rice cultivars.

Kumbungu 2 had the least uniform appearance, more black specks, more brownish colour. This is probably related to impurities in the sample. It also had the lowest overall acceptability rating of 37.0% with the Tamale samples having an acceptability rating of about 55%. Navrongo which was the control was evaluated as best sample with the least amount of black specks, highest whole grain percentage, very clean and highest overall acceptability of 94.73%.

Descriptive sensory analysis of the cooked rice samples indicated that the control sample from Navrongo had highest aromatic strength of 89.60% and highest acceptability score of 88.73%.

The Tamale and Kumbungu samples (1 & 2) had attributes that need improvement to increase acceptance of the samples. However, it should

be noted that between the Tamale and Kumbungu samples, the Tamale samples were more preferred from a sensory perspective. While the overall sensory acceptability of the Tamale was about 50%, that of the Kumbungu samples was about 43%.

**Table 7:** Descriptive sensory characteristics of raw rice samples

Attributes	Tamale-1	Tamale-2	Kumbungu-2	Kumbungu-1	Navrongo (control)
Uniform Colour	63.06	56.20	50.86	58.00	91.20
Black Specks	24.33	25.53	23.20	19.47	5.20
White Specks	8.40	7.26	20.86	9.66	14.26
Yellowish Colour	31.80	28.33	33.00	28.26	35.20
Brown	20.26	28.33	31.73	36.53	20.20
Brightness	52.33	38.40	37.00	37.00	86.60
Translucent	44.00	40.00	27.73	31.13	65.06
Clean	60.00	53.00	48.33	48.66	90.26
Creamy	41.33	38.26	36.80	39.13	70.13
Chalky	19.26	21.06	36.26	26.66	19.53
Polished	56.33	51.00	51.00	53.00	89.20
Unshelled	15.66	15.26	25.99	17.20	10.66
Whole grain	68.33	59.13	47.66	57.00	86.13
Long Shaped	64.66	66.33	58.33	62.40	82.22
Size	57.33	55.73	56.00	63.53	64.86
Slender	47.80	54.20	58.73	52.66	70.40
Overall Acceptability	56.33	54.73	37.00	48.66	94.73

Sensory characteristics are expressed using the linear intensity scale of 0 to 100 where 0 is the lowest intensity and 100 is the highest intensity.

**Table 8: Descriptive sensory characteristics of cooked rice cultivars**

Code	828	853	447	572	615
Sample name	Tamale -1	Tamale -2	Kumbungu-1	Kumbungu-2	Navrongo
Aroma	60.33	68.67	63.86	56.47	89.60
Strength	47.00	51.33	46.80	46.46	66.67
Sweet taste	55.13	58.33	56.33	46.53	81.00
Sour taste	25.60	32.46	27.26	22.66	10.80
Creamy	27.80	35.80	33.47	27.06	68.33
Yellowish	10.67	13.26	16.46	16.60	16.67
Whitish	70.33	63.33	66.33	55.33	82.60
Brownish	11.26	13.67	17.53	15.60	13.06
Black specks	18.60	17.13	21.00	18.26	7.33
Uniform	61.20	55.67	52.80	58.33	93.46
Hard	41.26	46.20	41.66	42.26	19.53
Gritty	38.93	53.93	37.06	39.20	24.80
Sticky	30.00	34.66	27.67	32.60	57.13
Overall acceptability	51.73	49.80	44.53	42.73	88.73

Sensory characteristics are expressed using the linear intensity scale of 0 to 100 where 0 is the lowest intensity and 100 is the highest intensity.

### 7.2.3 Conclusion:

The most important factors used in determining the acceptance of rice in the market are colour, flavour and texture (hardness and stickiness). Navrongo was well accepted. Tamale samples (1 and 2) and Kumbungu samples (1 & 2) need improvement in the colour, reduction in black specks and increase in acceptability. However, the acceptability of the Tamale samples was better than the Kumbungu samples in both the raw and cooked forms and consequently would be easier to market on the basis this analysis.

## GENERAL OBSERVATIONS AND LESSONS LEARNT

1. More often than not setting up a fair price for farmers' produce at the beginning of a cropping season will limit the market risk for farmers, because a lot of factors are taken into consideration in fixing or negotiating these prices. However depending on the prevailing market conditions at harvest, particularly in the event of a generally poor harvest which invariably results in higher market prices, farmers are likely to go back on the previously agreed prices. This is actually what happened during this programme. It is interesting to note that once the negotiated price is below the prevailing market price it would be difficult to persuade farmers to sell their produce at the lower price. Farmers are likely to ignore any assistance offered them in terms of inputs like agro-chemicals, land preparation or even training. Not even contracts signed by farmers served as a deterrent.

Under these circumstances it is advisable to wait till the harvest time so that prices can be negotiated so that any unforeseen circumstances are taken into consideration.

2. It has also been observed that farmers are generally unlikely to sell their total harvest. This is because farmers use part of their harvest as security to raise funds for emergency situations. Part of the total harvest is also kept as seed for the following cropping season. This is done even if there is a good market offer at harvest.
3. At the beginning of the project it was thought it would be rather very risky to allow women processors to handle huge sums of money to be used for purchasing paddy for processing hence the decision for them to be paid on service-basis. This is because there was a tendency for the processors to use the funds for other purposes.

Though the idea sounded good it did not work well. Obligations in the contract signed by the women processors were not followed to the letter. Because the processors worked on service charge basis they did not have any sense of ownership of the process and were therefore not very committed to the production of a product of the highest quality. This system also made room for the possible diversion of some of the milled product with consequences for the eventual declared milling recovery. It was also difficult to apply sanctions in the event of poor quality (recovery and other attributes) as specified in the contracts signed.

4. The women processors were happy with the improved parboiling equipment supplied to them. A DFID funded project in Ghana introduced this 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:
  - Less firewood is used (about half the amount of the traditional method).
  - Discoloration that results when truncated oil drums are used is avoided.
  - Drudgery is reduced (there are fewer unit operations and the presence of the drain-pipe eliminates draining with baskets).
  - The presence of the separating mesh ensures that no paddy is in direct contact with water during the steaming phase.
  - Less water is used in the parboiling process.

These advantages have been proven to be true in all the project sites where this vessel has been introduced. Women processors using this vessel generally tended to produce parboiled rice of a higher quality.

The amount of money paid to the women processors was increased from the originally suggested amount. This was as a result of the increases in petroleum products by 50% countrywide resulting in price increases in almost all products and for that matter fuel wood used by the processors as energy source.

5. The selected processors under the project were supplied with improved parboiling vessels and given training. The processors were taken through all that was required to produce a good quality product. However it is worth pointing out that experience on the job also matters a lot. In spite of the training and monitoring, it was apparent that the quality of parboiled rice produced by the women processors under this programme was not equal the quality produced by processors from Upper-East (control sample). This can only be achieved after a period of consistently applying the transferred knowledge. Although some of the processors had visited their counterparts in the Upper East region to gain first hand experience, it will be even more helpful to give this experience to many more processors in the Northern region.
6. As stated earlier, there is room for improving the quality of parboiled rice from the Northern region and this can be achieved in due course. However, any worrying factor is the high level of blackened grains in their product. The main causes of this situation are the impure varietal condition of the paddy, immature grains and inadequate washing and cleaning prior to parboiling. Impure varietal conditions results from the planted seed being mixed with other varieties or in certain fields, the presence of endemic wild rice types that grow any time the field is cultivated. Rouging helps when the physical appearance of the varieties are different but can be

problematic when the intended and unintended varieties look alike. When impure varietal paddy is parboiled, the different varieties react to the heat treatment differently and this can also result in blackened grains. This can be ameliorated by intensifying training to farmers and processors as well as manual sorting of parboiled product. On a large commercial basis, the use of a colour sorter will be of great help in ensuring that a good quality product is marketed.

7. Quality of milling – It was observed that some of the samples had a higher than expected levels of brokens. This could either be due to inappropriate drying after parboiling or incorrect feeding rate of the milling machine or a combination of both. There were no moisture meters available to the parboilers and millers to ascertain the moisture content before milling and this consequently resulted in higher than desirable levels of mouldy grains. Also in certain circumstances, millers could increase the feeding rate of the mills to enable them mill more rice in a given period and this usually results in high levels of brokens.
8. As stated earlier, FRI was responsible for the overall supervision of the programme and the FRI in turn contracted a local NGO, namely Zafarms to do regular monitoring of the project. During the course of the programme, it turned out that the amount of effort that had to go into this supervision and monitoring has been grossly under - estimated. Within the above constraint, the 2 organisations did the best that they could. A much more close supervision and monitoring if required would be much more expensive than was budgeted for under this programme.

## **RECOMMENDATIONS**

- If the project is to be continued subsequently, the Apex body could reserve part of the harvest as seed (about half bag per acre). Alternatively the Savannah Agricultural Research Institute in Nyankpala and the seed unit of MoFA could be contacted for foundation seed.
- The role of the Apex body in the processing of the paddy should be reviewed and if possible, they should not be involved as they are basically farmers and may not necessarily be interested in and understand the requirements of processing.
- The Kukuo fields have a problem with the bonds. Reshaping of bounds on these fields need serious attention. A technical solution is recommended to correct the current situation against the future.
- Institution of best farmer incentive award. It was suggested in one of the monthly reports for the institution of a best farmer award prize as a morale booster to motivate and enhance competition among farmers. The criteria for this selection should consider among others, the strict adherence to agronomic activities, ability of a farmer to lead and motivate colleagues, reaching a target of 12 bags per acre and above all the sense of commitment and honesty to terms of the contract document.
- Training for the processors should be continued, if possible with interactions between northern region and upper east region processors. Also, moisture meters could be made available to processors for them to accurately check the moisture level of the paddy before milling.
- The processing on custom basis should be discontinued and another system devised to remove the bottlenecks of this system as described in the report above.