Directorate of Crop Services – Ministry of Agriculture
Food Security and Rice Producers Organization Project (FSRPOP)
French Agency for Development (AFD)

STUDY REPORT

Study and training on the Ghanaian rice commodity chain

Final report

Célia Coronel (IRAM)
Frédéric Lançon (CIRAD)

February 2008

Content

List of tables and figures

Executive summary

Presentation of the study

Background

The Food Security and Rice Producers' Organisations Project (FSRPOP) project has been promoting the Ghanaian rice sector through support to the Ghana Rice Inter-professional Body (GRIB) that was established to contribute to the setting up of an effective policy dialogue between stakeholders and the Government of Ghana.

One objective of the project is to contribute to strengthen the capacities of GRIB members and MoFA in analysing rice sector issues and in terms of policy formulation and impact assessment, in a view to backstopping an effective policy dialogue.

Objectives of the study

The study and training on rice commodity chain has three main objectives:

- To increase the capacities of GRIB executives in assessing rice sector issues and to formulate their own strategy for action.
- To train Ghanaian experts and research officers in commodity chain analysis, through direct participation in the study.
- To update and complete a study on the rice commodity chain in Ghana, with a focus on the economic performances of the chain.

As part of a strategy to increase value of Ghanaian rice one specific task was to investigate the opportunities and constraints to promote quality improvement.

The whole study and training process is based on a participatory methodology designed to provide a background on commodity chain analysis, the formulation of strategic guidelines and planning, monitoring and evaluation of actions.

Method

The method was based on the administration of questionnaires to a sample of stakeholders. The interviews aimed at identifying the functions and operations, the locations of origin and destination as well as costing the operations and describing relations between stakeholders.

A total of 142 interviews were carried out, including 71 producers, 58 traders and 18 millers. For producers, the survey was carried out in 5 production areas (Volta region, South, North, Upper East and Ashanti) trying to cover a diversity of cropping systems. For traders, we tried to cover the expected diversity of functions within the commodity chain in the main

production areas as well as in the major urban consuming areas (Accra, Kumasi and Tamale markets). For millers, we identified different types of milling technology and business size in the same production areas as for farmers.

Progress of the mission

The study took place from October to December 2007. In October, a first 3-day session of general training for GRIB executives and staff was organised including the introduction of the basic concept of commodity chain, a general overview of the rice sector in Ghana and the main issues to be addressed by the study. Then a 5-day training was held for local experts on commodity chain approaches and the methodology to implement the study. From mid-October to mid-November, the experts carried out the field surveys and data processing. In December, a debriefing workshop was organised with the experts (2 days). Finally a 3-day workshop with GRIB executives was held to report on the outcomes of the study and discuss the possible strategic orientations for GRIB.

Main outcomes

Overview of the rice sector

The total population of Ghana is estimated at 21,3 million in 2005, growing at 2.5 % per annum (2000 to 2005). The urban population increases faster (4% in 2000 and 3,2% in 2005). This rapid urbanization, as well as the growth in income per capita, leads to structural changes in consumers' behaviour and to an increase in the demand for rice.

In 2005, the total rice consumption of Ghana in 2005 amounted to 450,000 to 500,000 tons (JICA, 2007). The estimates for rice per capita consumption range from 38 kg in urban areas and 9 kg in rural areas (average annual consumption of 22 kg per capita) according to JICA (2007) to 43 kg for regional capitals and 41 kg for district capitals according to Post Agric Associates (2007).

The most recent statistics from MoFA indicate that paddy production amounts to 250,000 to 300,000 tons (150,000 to 180,000 tons of milled rice) for an area of 118,00 ha. Rice production growth has been slower in the recent years: it has increased of 25% between 1995 and 2005 in parallel with the expansion of cultivated area, whereas it had been multiplied by 2,5 in the previous 10-year period (1985-1995).

We can distinguish four major rice production systems on the basis of water management:

- Irrigated systems, which usually produce two crops per year and can yield up to 4,6 tons per ha and per cropping season. They represent 16% of the domestic production.
- Lowland systems, where rice is grown in flood prone areas, in some cases with a control of the flooding (0.5 to 1.5 tons per ha); and valley bottom or inland valleys systems,

where rice is also either rainfed or benefits from simple water catchments and bunding (2 to 3 ton per ha). As a whole, they represent 78% of the domestic production.

- Upland systems (0.5- 1.5tons/ha), where rice is rainfed but grows on free draining soils (less than 1 ton per ha). They represent 6% of the domestic production.

Imports of rice in Ghana have been rising in recent years, to reach a level of about 300,000 tons at present, according to JICA estimate. Domestic rice production then accounts for about 30% of the total rice supply in Ghana.

The projections of the growth in rice demand suggest that the total demand in 2015 will reach 820,000 tons or 30,7 kg per capita according to JICA study and 1,789,576 tons or 67 kg per-capita according to Post-agric study. If the domestic production continues to increase at a low rate, the level of self-reliance of Ghana will keep deteriorating. This might not be acceptable in the long term because it mobilizes an increasing share of currency reserve and means that Ghanaian farmers will not be able to benefit from the potential income opportunity associated with the rice market expansion. Furthermore, this dependency on the world market should be economically and socially less bearable in a context where the price should remain at a high level on the world market.

Identification of the main rice marketing routes

For the study, the study team selected a limited number of marketing channels, which were considered the most representative:

- Local and regional channels deal with the rice supply of rural or urban consuming centres surrounding production areas: Northern region to Tamale, Ashanti region to Kumasi, Volta region to Hohoe, Southern region to Ketu.
- Inter-regional channels deal with the rice supply of major urban consuming centres, from areas, which have rice surplus areas, which are in deficit: Northern region to Kumasi and to Techiman, Volta region to Accra, Southern region to Accra.

Production

The sample for the survey was designed to capture the maximum diversity of systems. The regions were the interviews took place were selected in the main production areas: Upper East (Kassina Nankana), North (Tolon/Kumbungu, Savelugu/Naaton, Tamale), Ashanti (Ahafo Ano South, Ejisu-Juaben), Volta (Hohoe) and South (Dangme West, Ketu).

The results of the survey confirm that rice is a significant cash crop for many farmers: in our sample, the calculated average for selling paddy is 50% globally in one year. Of course, this covers a large range of situations: some farmers sell more than 90% of their production, some less than 20%. In Southern Ghana, North and Volta, farmers sell paddy, whereas in Ashanti in most cases farmers sell rice they have first milled at the local mill. On our sample,

an additional 37% is given away to traders as reimbursement of a credit contracted during the cropping campaign to buy inputs or pay hired labour and to landlords as payment of the land rent. Lastly, home consumption and gifts accounted for 13%.

The survey showed that farm storage is rather developed among farmers. Indeed, 3 out of ten respondents mentioned that they store paddy at home for 6 months on the average. And 5 out of 10 mention that they sell less than half of their production at harvest time[1]. We can bring several hypotheses to explain this general observation: the difficulty to sell their product because the market is saturated at harvest time, so they are obliged to store paddy for a certain time. Also, some have the means to wait for a better market price or to use paddy as a means for saving, selling small amounts when needed (school fees, celebrations etc.). Some are also able to do it because they might have other sources of income or because they have a higher level of production.

Marketing

The interviews took place in the production areas and in the main consumption centres: 5 traders in greater Accra (Dangbe West and Accra), 10 retailers in Accra, 10 traders in Volta region (Hohoe, Ketu), 7 traders in the North et Upper-East (Tamale, Navrongo, Savelugu-Nanton and Bolga), 5 traders in Ashanti (Kumaisi, Ejisu-Juabeng, Ahafo-Ano South) and 10 retailers in Kumasi.

Five categories have been distinguished, which include:

1. Local traders who supply mainly consuming centres in the surrounding of the production areas. These traders buy paddy from farmers, process it for a fee at the local milling centre and sell it either directly to consumers or to retailers. In Ashanti, local traders buy milled rice from the producers.

2. In Northern Ghana, local traders who buy paddy parboil it before milling.

3. Regional traders who have similar marketing functions but operate on larger distance.

4. Inter-regional trader who link region that have rice surpluses to major consuming centres. They also buy paddy from farmers and process it for a fee at the local milling centre, then organise transport of milled rice (either with their own truck or through contracting transport services) and sell milled rice to retailers.

5. Retailers may deal only with local rice or with both imported and local rice.

Most of the marketed rice in Ghana goes through small or very small businesses. Local traders or market women appear to deal with a maximum of 50 tons of paddy per year (a few

[1] The results might not be coherent with one another, because farmers might not answer to all questions or give approximates.

bags per week).Regional or inter-regional traders handle up to 300-500 tons of paddy per year (a few hundred bags per week).

There seem to be few bigger businesses who have capacity to influence the market and the activities of other traders. This can have a consequence in terms of implementation of marketing strategies by GRIB: a strategy, which would only rely on the involvement of large traders, would probably not be sufficient. First because they represent a global small amount of marketed rice, it appears necessary to take more into consideration the critical role of "small" traders in local rice promotion to obtain a significant impact. Second, for the large traders to really have a role in leading innovation, GRIB should consider specific actions to support smaller ones to take advantage of innovations and fair agreement and connection between them.

Processing

There are two types of milling technologies, small Engelberg mills (horizontal steel rollers) and mills based on rubber roller technology. The Engelberg mills have a recovery rate of about 55%. Their throughput can vary from 100 to 400 kg per hour. Rubber roller mills have a recovery rate of about 65%. The theoretical throughput for such machines ranges from 150 to 4000 kg per hour.

The mills, especially rubber roller mills, work under-capacity. One of the major constraints for the milling business is to attract enough customers and regularly throughout the year and thus process a large volume of paddy in order to recover the value of the costs that have been invested. Mills have an intense activity during harvest period, which falls to a very low level the rest of the year.

Millers process for a fee, irrespective of the quality of the output, although the fee can be higher when the miller proposes extra services (one or two pass, destoning, cleaning, drying…). But besides milling technology and know how cropping and post-harvest practices also influence the quality of milled rice.

Under the current coordination regime of rice marketing and processing there is limited incentive to improve the quality management along the rice marketing chain. The introduction of incentive to reward any investment in better milling services should be considered, provided that adequate incentive do prevail at the retailing stage to justify a change in trader and miller relation. This is typically an issue that should be addressed in a holistic approach and where GRIB could make a difference.

Rice market segmentation and market opportunities

Quality of rice plays an important role in consuming patterns. Surveys of consumers' preference confirm that key criteria for purchasing rice are: cleanliness, uniform and unbroken grains, taste and capacity to expand when cooked. According to these criteria and

as a whole, local and imported rice are different products and therefore they reach different market targets. Imported rice generally gets a retail price that is 20% higher. For both origins, long grain and perfumed rice is well known and get a higher price. Parboiled rice is equally an important segment and represents 50% of the consumption of local rice in the North but is virtually absent in the South. Yet, the segmentation of rice market offers opportunities for different types of rice and there is room for improving the quality of "undifferentiated" local rice: removing foreign matters form the grain, making homogeneous batches of rice.

Marketing channels are rather regionalized and therefore also segment the local rice market. Surplus Volta rice or Afife rice is mainly going to Accra and not much to Kumasi. Rice form the North is mainly going to Techniman and Kumasi and not much to Accra. So one type of rice will be found in no more than one or two regions.

It appears that there are large marketing opportunities in the main consuming centres. In particular and as a first step, there is room to gain market shares in Kumasi because of the large rice deficit in that area compared to rice demand and there are stakeholders already involved in the trade business between the main production areas of the North and Kumasi.

Pre-financing of activities within the chain and constraints to innovation

From the interviews, we can note that a majority of transactions at all levels of the commodity chain between one supplier and one customer, are made by cash. This means that they do not agree in advance on the conditions of the transaction (notably price) and the type of product that must be supplied. This also implies that for the pre-financing of their activities of purchase and sale, most people must count on their own capital, which can be limiting.

Besides this general situation, we can observe other noteworthy tendencies, revealing of the type of relation between stakeholders and therefore the level of performance of the whole system. Traders rarely pre-finance the crop season, except in irrigated schemes but according to some producers this practice is becoming more and more sporadic. In fact, producers seem to pre-finance relatively more the activities of traders than the reverse by providing them payment facilities. Among the respondents, a significant number mentioned that they often provide a one to two week-delay payment to the trader providing that there is trust between them.

This situation suggests that the traders, who are generally small businesses, have little financial capacity to take risks and stimulate the marketing of rice. This is a crucial issue if the production was to be promoted and increased, as this expansion should rely on stakeholders who have the capacity to develop their marketing activities.

Coordination constraints for quality management

The results of the survey indicate that stakeholders lack organisation and coordination to be able to supply the level of quality required. They suggest that stakeholders do not share the same quality criteria throughout the chain and that they are not aware of what are the criteria for others in particular those of consumers. For a farmer, quality means yield, modalities for harvest, resistance to pests etc. and in some case means strong market demand (for example perfumed rice). For a trader, the criteria might be the milling recovery rate, the marketability and in some cases, price. For a retailer, who is in direct contact with consumers, this is marketability and price. For consumers, this is taste, cleanness, length of grain, price etc.

Besides, there does not seem to be price incentives for quality criteria meeting consumers' requirements (notably cleanliness) except for some cases limited to certain types of rice, which already attract more value (perfumed and brown rice).

Producers do not seem to be aware (except those who have a closer link to the final customer) of what makes rice valuable. They lack information and are not aware of the market requirements.

The fact that there are numerous and small marketers, who are not sufficiently organised to convey information on market requirement from downstream segment to upstream segment, makes it difficult to organise supply in such a way to meet consumers requirements. In terms of private governance, there are neither enough traders who have the capacity to promote the marketing of required rice, to take financial risks and to play a role in organizing the coordination and supply.

In irrigated schemes, where there is a form of organisation and management, where rice varieties are more homogenous and where there is credit supply, traders or millers can play a role in defining production specifications. But they represent a small proportion of the domestic production (16%), and it is more difficult to achieve in other production systems.

The utilisation of units and measures for rice purchase and sale is another issue of stakeholders' coordination. Units used vary within the country and measure varies as well for a given unit in the different regions and throughout the year. This inaccuracy and variation in measurement can be an advantage for those who master how they work, but this leads to trust problems and marginalisation of some operators.

Financial analysis

The budgets have been established on the bases of data collected during the field survey. A first series of original budgets have been tabulated for each individual interview Representative budgets were developed for each type of stakeholder and clustered according to their typology. Farmers' budgets were differentiated according to their cropping system. For traders, the major discriminating factors were the type of product purchased and sold and their functions within the marketing chain. For processors, a distinction was made on

the basis of the practices and the type of technology used. A list of 32 representative budgets has been developed (13 for farmers 3 for millers and 16 for traders).

Farming

Performances of production systems depend on different factors: the ecology, the level of water management (irrigation, and for lowland and inland valleys construction or not of earthen bunds for water conservation), the level of utilization of inputs and of labour, the level of mechanization. The highest yield is achieved in irrigated systems and the lowest in upland and unbunded lowland cropping systems.

For farmers, the two major categories of cost are the payment of labour (43% on average) and the purchase of inputs such as fertilizer and other chemicals (34% on average). The category "services" (utilization of machines), which are mainly used in the North in irrigated and lowland rice field, comes as a substitute to the utilization of human labour.

As expected, the most input intensive system (irrigated and bunded inland valley) have the highest cost per acre and upland cropping systems have the lowest cost because they mainly rely on farmers' own labour and use little inputs.

The return to cash ratio (net income/total cost) allows to compare the profitability across the various cropping systems. The highest return to cash is recorded by the irrigated non-intensive cropping system in the North and the upland cropping system in the Volta region (limited amount of cash invested since the production technique relies mostly on farmer's own labour). In this last case the estimated return to farmer's own labour was found to be commensurate with the prevailing agricultural daily wage rate.

In lowland bunded labour intensive cropping system in the Northern region, we found that the return to farmers' own labour is lower than the local prevailing agricultural labour wage rate. Those farmers cannot really invest in paid labour or mechanization and increasing their own labour is not sufficient compensate for this shortage of production means.

In the North, irrigated systems have a higher profitability than other systems. Among irrigated systems, non-intensive systems have a higher profitability than intensive ones. It shows how difficult it is to improve at the same time yield and profitability and to promote processes of intensification among farming systems.

In addition, the representative budgets do not take into account yield variation that could be much higher in rainfed systems than in systems that can control water at least partially. Farmers make investments in particular in water control not only to increase profitability but also to reduce risks. Indeed, the profitability of low technology systems can rapidly be jeopardized by minor changes in yield or output price level, indicating that rice cultivation remain a rather risky activity in financial terms.

Marketing

The first costs for traders are costs associated with services, including transport and processing (45% of the total marketing cost on average) and to labour cost (23%). The lower marketing cost for retailers is due to the fact that they do not have to pay for processing and that they market their product locally. Traders make economies of scales in transport when the shipment distance increases, the transport cost per km for one bag decreases due to the utilization of vehicle of a higher capacity, better roads for inter-regional and possibly a higher level of competition.

The marketing costs do not vary much at short/medium-term. The profitability of the marketing activities is much more sensitive to the level of prices (purchase and selling) which may vary according to the location, the time of year and the quality and type of rice marketed. Under the current price system adopted for computing the representative budgets, the average return to cash is at 0.21 for retailers, 0.17 for local and regional traders and 0.15 for inter-regional traders. The lower return to cash invested for the larger trader is compensated by the larger volume of product marketed.

Milling

The distinction among the representative budget for mills is based on the type of technology used and the milling capacity. The total volume of paddy milled per year varies from 500 bags processed by the smaller mills, to 2000 bags per for the larger mills using the Engelberg type technology and 3000 bags for the mills using the rubber roller technology.

The higher the capacity or technical efficiency of the mills, the larger the share of costs in material inputs is because of the higher consumption rate of energy and more expensive spare parts.

The fee a miller charges to traders and farmers varies across the country and depends upon the terms of the contract (reference to the milled or the paddy rice, type of services). In the Northern region the reported custom rate for milling varies between 8,000 to 12,000 Cedi per bag of paddy. In the Ashanti region, the fee is equivalent to 13,000 Cedi per bag of paddy. In the Volta region a wider range of milling fee prevails from 18,000 C/ bag up to 40,000 C/bag of paddy. This variation is also due to the higher heterogeneity of the type of technology installed in this region, since several mills are equipped with destoner and grading devices.

Under the current estimates of cost the three types of millers make profit. In general the miller keeps the rice bran jointly produced and sells it as animal feed. This additional source of income plays a critical role in the financial viability of the milling business.

Unlike the other agents involved in the production and the marketing of rice, the profitability of milling business is not threatened by the uncertainty of variables such as yield or market

price since their cost structure and income level is rather stable at least within the span of one year. One of the major constraints for the milling business is to attract enough customers and thus process a large volume of bags in order to recover the value of the costs that have been invested. These include the fixed cost corresponding to the machine and premises but also a part of the labour cost, since the operation of the machine requires some expertise and that the operator is generally paid on a monthly basis.

Whole system

The analysis of the consolidated budget for each system indicates that under the current price system retained, rice business as a whole is a profitable activity, while there are sharp differences across sub-systems. Within a sub-system, the profitability of farming activities is the most fluctuating. Besides, price spread between the supply and consumption areas is also an influential factor.

The systems including upland cropping system and targeting the local or coastal market appear particularly profitable. Yet it should be kept in mind that upland cropping systems are uncertain activities and they primarily rely on farmers' own labour, so farmer can turn away from them if they find alternative occupation offering more income. Systems targeting Kumasi and Techiman also appear highly profitable, which is consistent with the high level of rice deficit estimated for these regions

On an annual basis, traders have the highest income level, especially because they have a high volume of operation (100's to over 1000's bag per year, compared with tens of bags for farmers for example.

The costs associated with milling represent a small share of the total cost within the system. So one can assume that investing in milling technology (increasing the global cost of the system) will not affect too much the profitability of the system, provided that those investments pay off either in terms of volume marketed or price rewards to quality at the consumer level.

Profitability of a system is one aspect to consider, but it is not sufficient to be sustainable since consumers' choice is not only determined by the level of retail price, but also with the quality of rice.

Finally, it should also be kept in mind that the surveys were carried out in a limited period of time and than certain estimates of costs would benefit from complementary investigation. A more precise estimation of price level for paddy rice and homogenous quality of rice across various sites would also bring in an additional value to the consolidated budget developed.

Recommendations

The improvement of rice quality requires a coordinated efforts at all levels of the commodity chain, from the field to post-harvest operations, milling techniques to packaging. With the objective of improving the competitiveness of the Ghanaian rice, which at present suffers from a low quality, we think that GRIB should work in priority in two directions:

1. Facilitate investment in viable technology for improving quality of local rice: select and promote strategic actions aiming at developing a proper quality management.
    - Actions tailored to local specific conditions taking into account the characteristics of the targeted market and the specific constraints of the involved stakeholders.
    - Integrated projects that will include: information to stakeholders, dialogue among involved people to set up and monitor the project, coordinated actions organise supply, improved technologies or practices to improve quality, and marketing communication to facilitate the materialization of those efforts.
    - Gather all the different stakeholders involved at a sub-system level.
    - Implementation of "pilot projects" first, for each selected priority sub-systems, with one small group of interested people, as well as monitoring and disseminating lessons learned.
    - Ensure the technical, financial and organizational feasibility of the pilot project.
2. Increase stakeholder awareness of the current status of the rice industry: set an information system that can monitor the evolution of the rice economy (update/validate the budget database), maintain GRIB's capacity to assist stakeholders to make investments decisions and develop a longer term, comprehensive and shared perception of the rice market. The information system can create link among members and some sense of participation and effective membership, and strengthen members' awareness of the interest to work as operational interprofessional groups.

Some principles concerning the setting up of the information system:

- It should be commensurate with the available resources to set up and also to sustain such a system.
- Ensure that is contains useful information and review the information priorities through a dialogue with its members.
- Check if information can be gathered from existing sources.
- Investigate how GRIB members can be involved in the data collection.
- The means for dissemination must be adapted to the type of information.

- The format should be meaningful to stakeholders to ensure dissemination.

GRIB has some human and financial resources, but they are limited to some extent, so the institution has to select priorities in all the possible actions. So to increase the efficiency of GRIB in its contribution to the development of the rice industry, we suggest a number of principles and actions:

- Start with pilot actions to facilitate their implementation, as well as the monitoring and dissemination of lessons learnt to members and to policy makers.
- Mobilize and coordinate external and internal capacities to elaborate and implement rice development strategies (public institutions, research institutes, private sector).
- Focus as far as possible its own contribution in interprofessional actions.
- Continue to implement a program for strengthening capacities of its members and executives, as well as promoting dialogue at all levels of the organisation, to raise awareness and to balance the level of information of each one.
- Strengthen GRIB capacity to implement coordinated actions among stakeholders by diversifying membership.

Suggestions to further investigate specific issues of the rice sector:

- Financing systems for each type of stakeholders, in relation with innovations that GRIB aims at introducing.
- The quantification of the flow of rice going through each category of stakeholders.
- Farming system analysis

Introduction

The Food Security and Rice Producers' Organisations Project (FSRPOP) project has been supporting the Ghanaian rice sub-sectors through support to the Ghana Rice Inter-professional Body (GRIB) that was established to contribute to the setting up of an effective policy dialogues between stakeholders and the Government of Ghana by identifying and addressing the factor chain constraints. The project has supported several initiatives targeting the promotion of technical innovations and the development of an enabling institutional and economic environment for rice sub-sector stakeholders, such as the creation of a marketing credit line and currently advocating for the establishment of a rice development fund.

The project also contributed to improve information gathering and sharing among stakeholders. It consisted in particular in the dissemination of the output of several studies on the rice sub-sectors that have been completed during the last five years, under GRIB's supervision (summary of 10 years of studies, promotion of domestic rice, tariff policy…).

However, this set of information and data does not yet allow GRIB a comprehensive understanding of the rice sub-sector dynamic; this therefore reduces its capacity in backstopping an effective policy dialogue. In particular an economic analysis of the value chain and the margin distribution between the stakeholders still need to be completed.

Thus, it has been emphasized that discussion held within the GRIB should be backstopped by adequate analytical capacities to take into consideration the potential impact of the issues discussed on technical innovations and policy options. GRIB skills in terms of policy formulation, recommendations and impact assessment need to be strengthened, in order to select the most appropriate and viable action.

To contribute to filling these gaps in terms of analytical and institutional capacity and to improve the quality of the policy debate and of the decision making process, FSRPOP carried out (i) a study on the rice commodity chain and (ii) a training on commodity systems analysis to enhance analytical capacity of GRIB members and local experts.

This report presents the outcomes of the rice commodity chain study that was implemented between October and December 2007. Two international consultants were in charge of the training and the coordination of the study. Eight national experts where in charge of the field survey: Dr. Awere DANKYI, Crops Research Institute; Dr. Wilson DOGBE, Savanna Agricultural Research Institute; Mr. Richard DONKOH, Ministry of Food and Agriculture; Dr. Kadir Osman GYASI, Savanna Agricultural Research Institute; Dr. Akwasi MENSAH-BONSU, University of Ghana; Mrs. Ruby NEILS – PALME, Ministry of Food and Agriculture; Mr. Nortey John OKANG, Ministry of Food and Agriculture; Dr. Richard YEBOAH, University of Development Studies, Tamale.

1. Objectives and methodology

1.1. Objectives

The overall objectives of the training and study are threefold: two are pedagogical; the other is to contribute to knowledge building on the rice sector in Ghana. Strengthening capacities was as important as achieving the rice commodity chain study and the review of the development strategy.

1. To introduce to and to train selected Ghanaian experts in the application of commodity chain analysis method and in economic evaluation through the implementation of the study. Experts were selected by the FSRPOP project, among partner institutions, for the interest that such a training and fieldwork can have in their respective missions. These experts intervene either in rice production area, or more generally in agriculture economics (research, statistics, monitoring and evaluation etc.).

2. To build up the capacities of GRIB members and MoFA in commodity chain analysis, through the organisation of two training sessions, the first one to introduce the concept of commodity chain analysis, the second to discuss the results of the study. The final purpose of these training is to enhance GRIB capacity in policy elaboration and evaluation.

For more details on the implementation of these training sessions and their outcomes, the reader can refer to Progress reports 1 and 2.

3. Complete a study on the Ghanaian rice commodity chain, with a focus on economic aspects, to supplement and update the existing studies and to provide an overview of the commodity system to GRIB executives.

The study is primarily intended for the GRIB executives and secretariat, so they can have an overview of the situation, related issues and challenges of the commodity chain and, thus, enhance their capacity is selecting and prioritizing the most relevant actions to support the development of the Ghanaian rice economy. The study also aimed to provide them with a background they can further refine. Another valuable contribution is to provide a framework for dialogue among GRIB members, with other stakeholders and partners.

The main tasks were to gather together the existing knowledge on the commodity chain and enrich it notably with economic aspects, through the financial analysis (costs and margins) of the main stakeholders. The study also examined specific issues that are crucial for the development of the rice sector, notably quality issues and coordination between stakeholders. Finally, the study consisted in recommendations to GRIB in relation with their work plan for 2008.

1.2. Methodology for the study

1.2.1. Method

a. A commodity chain analysis

The concept of commodity chain consists is a systemic conception of the economy based upon the analysis of the relation between agents (individuals or institutions), who interact along a sequence of operations (up-stream to down-stream) where different inputs and services are combined to deliver a final output (Lançon, 2005)

A commodity chain approach focuses specifically on the interaction between agent to produce one final output and cannot address thoroughly trade-off between different type of economic activities for a given agent. Other types of methods exist based upon other concepts, such as the micro-economic approach (individual agent behaviour and decision making), including farming system analysis, and macro-economic analysis, which does not take into consideration the different agents.

Different types of issues will command different types of analyses. A commodity chain analysis does not aim at elucidating all issues. Yet one interest of it is to identify crucial ones to be investigated with adapted tools.

In the presentation of the study, we will try to make the rationale and the methodological steps as transparent as possible, as well as the hypotheses that were made, to facilitate the ownership of the study and to show where the remaining information gaps are, so the study and training can be useful to GRIB secretariat for further investigation.

b. Characterization of the system, issues and information gaps

The first step was to draw up the boundaries of the rice commodity system, to identify the main issues related to its functioning and performances and to point out the main information gaps to be filled by the study.

Some information was already accessible from literature, notably the 2001 MAPS study on rice production, as well as information gathered by the FSRPOP project. The second source of information was the discussion with GRIB executives during the first training session.

Two others studies were made available towards the end the present work, which brought useful information: the study on the Promotion of Domestic Rice in the Republic of Ghana (JICA/MOFA) and the first status report on study on rice marketing (Post Agric Associates).

This initial set of information allowed to produce a preliminary characterization of the commodity chain, in terms of location of the main production and consumption areas and derived major marketing routes, and to identify several key stakeholders and functions.

c. Setting of surveys and training of experts

The second step was to train the Ghanaian experts in charge of the realisation of the study and to set the surveys, on the bases of the synthesis of the literature review.

- Selection of regions and types of stakeholders to be interviewed
- Elaboration of questionnaires
- Sample of interviews
- Schedule and distribution of tasks
- Formatting and tabulation of information collected for preliminary analysis

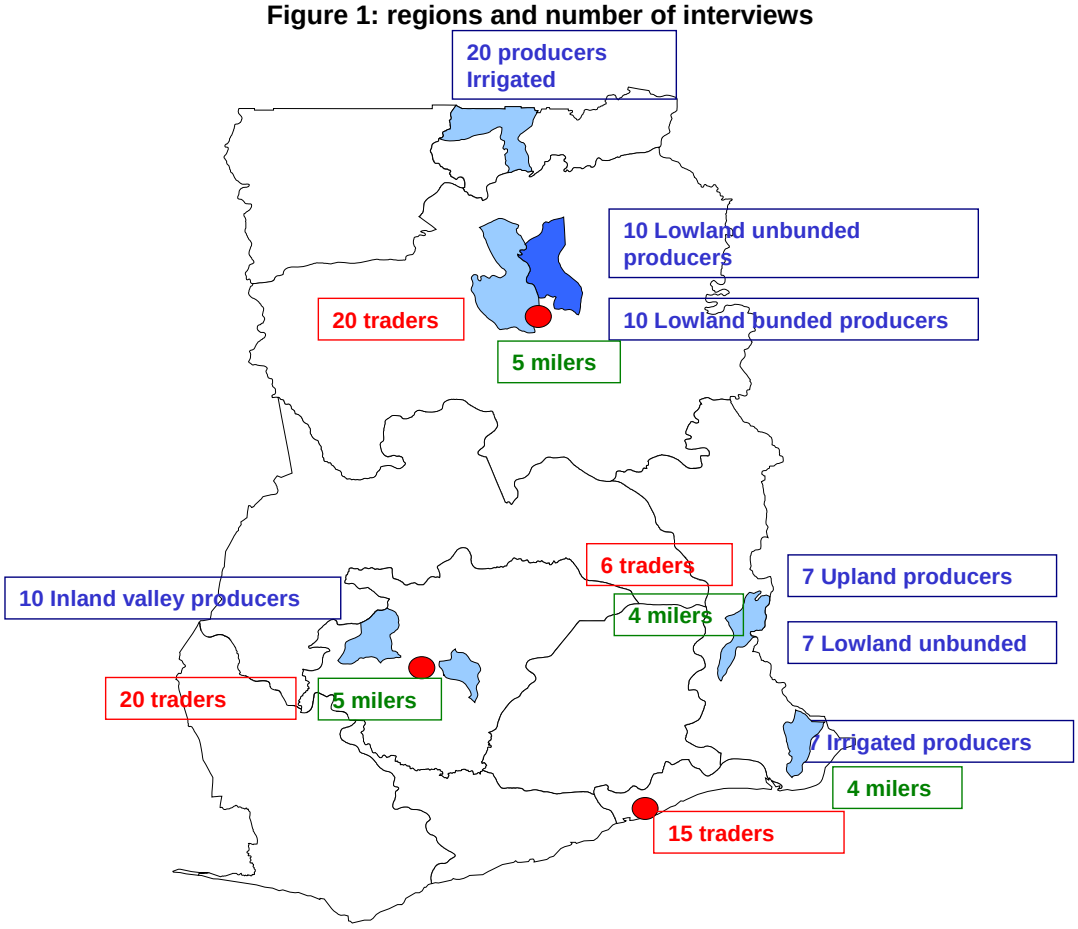
A 5-day training session was organized with the experts; 3 days were used to introduce the concept of commodity chain analysis and review the different tools to collect and analyse data; 2 days were used to test in the field (in Ashaiman) the questionnaires interviewing some stakeholders (producers of the irrigated scheme, millers and retailers).

d. Field survey

The national consultants carried out field surveys in the selected regions from the 15th of October to the 25th of November, for a total of 82 days of work (10,25 days of work per person on the average). The surveys were based on the administration of questionnaires that were prepared during the training session. For each stakeholder interviewed (depending on the distribution of tasks, producers, traders, millers), the consultants computed individual budgets and keyed in qualitative information in Excel format.

A total of 142 interviews were carried out, including 71 producers, 58 traders and 18 millers. With the limited time and resources available to collect primary data, it was decided to build a purposeful sample covering as much as possible the diversity of stakeholders involved in the rice business instead of increase the size of the sample per type of stakeholders and to limit the survey to fewer areas. For producers, the survey was carried out in 5 production areas covering the existing ecologies (i.e. irrigated, lowland, inland valley and upland) and trying to cover a diversity of cropping systems, in terms of technologies used for water control and level of intensification (use of machinery, use of chemical inputs, labour). For traders, we tried to cover the expected diversity of functions and situation within the commodity chain, in the main production areas as well as in the major urban consuming areas (Accra, Kumasi and Tamale markets). For millers, we tried to identify different types of milling technology and business size in the same production areas as for farmers.

Figure 1: regions and number of interviews



e. Analysis

The rice commodity chain study draws upon different types of analysis to characterize products, agents who are involved in the operations needed to produce, process and market rice, the existing interactions between them, as well as assessing the economic performance of the whole system:

Market and policy environment: to set up the global picture in which the commodity chain operates, through analysis of the market structure, supply and demand trends, imports.

Functional and organisational analysis: description of the different forms of the product, operations (functions) and operators; description of the conditions under which agents are interacting (coordination) and organising their activities.

Financial analysis: benefit-cost analysis, through the building of individual budget for each agent; building of the consolidated account of the value chain, share of revenues, sensitivity analysis etc

This analysis of processed information allowed discussions as follows:

- The distribution of net revenue or profit within the rice value chain;

- The constraints and assets to develop the rice sector and generate addition income;
- The market opportunities and their characteristics.

f. Validation of the analysis

A debriefing meeting was organized in December to validate the analysis derived from the processing of the questionnaires. The eight Ghanaian consultants participated in the debriefing, as well as the Executive Secretary of GRIB. As the time span for completing the study was shorter than initially planned, there was less opportunity to achieve the full processing and analysis of data in a group work, so the international consultants first prepared a set of results to be discussed with the national consultants. So there were two objectives to the debriefing session: the first was to finalize, amend and validate the data analysis, the second was to give opportunity to the national consultants to review the methodology that was used, so they can have a complete picture of what a value chain analysis is.

Then a three-day meeting was organized with GRIB executives to present, discuss and amend the results of the study. Then they had a discussion, facilitated by the international consultants, on the types of actions GRIB should implement to contribute to the development of the rice industry and to bring useful services to its members. Finally, the executives prepared the presentation of the main outcomes of the study to the General Assembly to introduce a debate on GRIB work plan 2008.

1.2.2. Progress

1. End of September 2007: review of existing studies
2. 4-6th of October 2007: first session of general training for GRIB executives and staff from MoFA, including: basic concept of commodity chain analysis; rice in Ghana: general structure, state of the art, identification of main issues; identification and formulation of the issues to be addressed by the study.
3. 8-12th of October 2007: training for local experts on commodity chain and the methodology to implement the study.
4. October- November 2007: field surveys by national experts, data processing and backstopping by international consultants.
5. 10–12th of December 2007: workshop with local experts.
6. 13-15th of December 2007: workshop with GRIB executives to report on the outcomes of the study and prepare GRIB general assembly.
7. January 2008: report writing.

1.2.3. Comments on the method

One difficulty of this type of study was to balance capacity building objectives and research objectives. Thus, there was no opportunity to carry out joint fieldwork for the consultants and the facilitators, or to work in a group for the data processing and analysis. For a future work of this nature, we then recommend to more closely associate the different tasks, with a more substantial or regular backstopping throughout the study implementation, so facilitators can have a better benefit of the field experience of the consultants to analyse information, and the consultants can better rely on methodological backstopping.

Given the set schedule, there was no occasion to do a preliminary rapid survey to first precisely identify stakeholders, before going into the financial analysis. Moreover, the consultant had little the possibility (because of financial constraints) to go back on the field after the initial survey to complete missing information.

Yet, the interest of this study laid on several strengths: an adequate coverage of the diversity of systems, in particular for production systems; a fair consistency of the results of the survey, cross-checking with other sources and with information available for other countries.

Most importantly we estimate that, even if in some cases, information should be refined or crosschecked, the study provided a consistent framework for dialogue within GRIB members. Besides, it provides a ready-made tool for computing that will give GRIB the possibility to update and upgrade data when necessary.

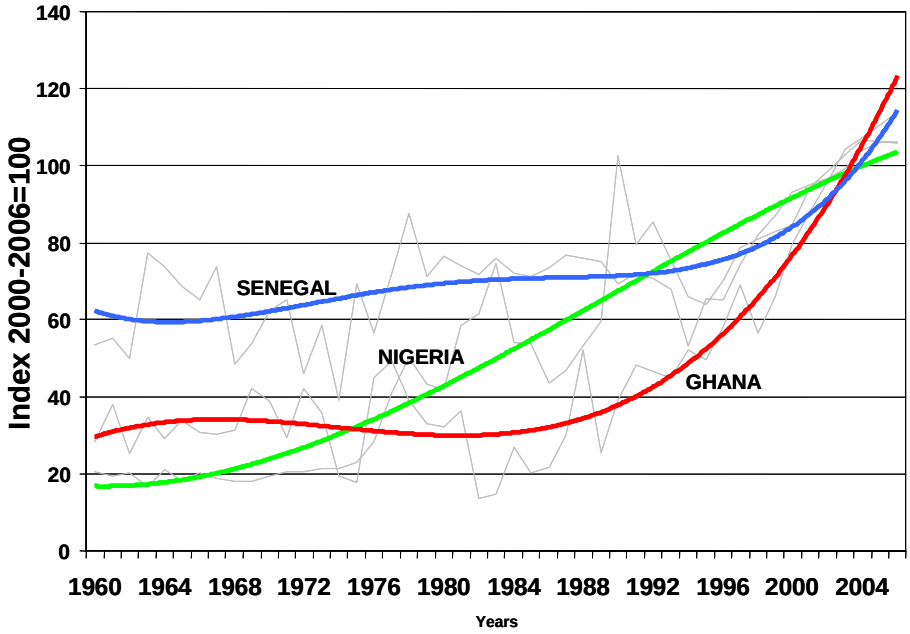
2. Overall view of the Ghanaian rice sector

2.1. Supply and demand structure

2.1.1. Evolution of rice demand

The total population of Ghana is estimated at 21,3 million in 2005, of which about 63 % live in rural areas. Population growth rate is estimated at 2.5 % per annum from 2000 to 2005, while the urban population grows at 4% in 2000 and 3,2% in 2005 (CIRAD, 2007). Now about 15% of the population live in Greater Accra. Population growth as well as a rapid urbanization and growth in income per capita, lead to structural changes in consumers' behaviour and an increase in the demand for rice. This "rice diet transition" is a phenomenon, which has been observed in other West African countries in some cases as early as the 1970s (Nigeria) and has started in Ghana in the early 1990s.

Figure 2: The rice diet transition (evolution of rice consumption) 1960-2004



Source: CIRAD, 2007 (computed from USDA PS&D)

Since the early 1990s in Ghana, rice consumption has sharply increased, doubling up to 14.5 kg per capita per year in 2000 compared to the period 1982 to 1985 (WARDA 1986; MOFA 2004). In 2005, the total rice consumption of Ghana in 2005 amounted to 450,000 to 500,000 tons, which is equivalent to an average (JICA, 2007). From its Baseline Survey conducted in 2006 (interviews of 25 consumers in major four cities), the JICA study (JICA, 2007) gives an estimate of urban annual consumption at 38 kg and a rural consumption at 9 kg per capita (average annual consumption of 22 kg per capita). The same study indicates that rural population accounts for less than one fourth of the total consumption. Two regions, Greater Accra and Ashanti, are large consumption areas in Ghana, sharing about 25% and 21% of the total rice consumption.

In the recent marketing study requested by GRIB and implemented by Post Agric Associates in 2007 (1,350 consumers were interviewed in 5 regional and district capitals, the per-capita yearly consumption of urban population was found to be 43 kg for regional capitals and 41 kg for district capitals with as much as over 50 kg for Accra.

2.1.2. Domestic production

The most recent statistics indicate that rice production amounts to 250,000 to 300,000 tons for an area of 118,000 ha. Rice production is the third most important cereal next to maize and sorghum in Ghana. In 2006, statistics from MOFA point out that the volume of paddy production is one-fourth is that of maize (1,189,000 tons) and a little below sorghum (315,000 tons).

Rice production has increased of 25% from 200,000 to 250,000 tons between 1995 and 2005 in parallel with the expansion of cultivated area from 105,000 to 120,000 ha, whereas it had been multiplied by 2.5 in the previous 10-year period (1985-1995). Domestic production development has thus been relatively stagnant in the recent years, concomitantly with the acceleration of rice import since 2000.

The table below indicates the level of production of rice in the last ten years from MoFA estimates. JICA study (2007) gives an estimate of 290,000 tons in 2006.

Table 1: Level of production of rice (1996-2006) in tons

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Paddy	215,720	197,100	193,600	209,750	214,600	253,200	280,000	238,810	241,800	236,500	250,000
Milled rice*	129,432	118,260	116,160	125,850	149,220	164,757	168,000	143,286	145,084	172,200	150,000

Source: MOFA. * The volume of milled rice has been estimated on the basis of a recovery rate of 60%

2.1.3. Imports

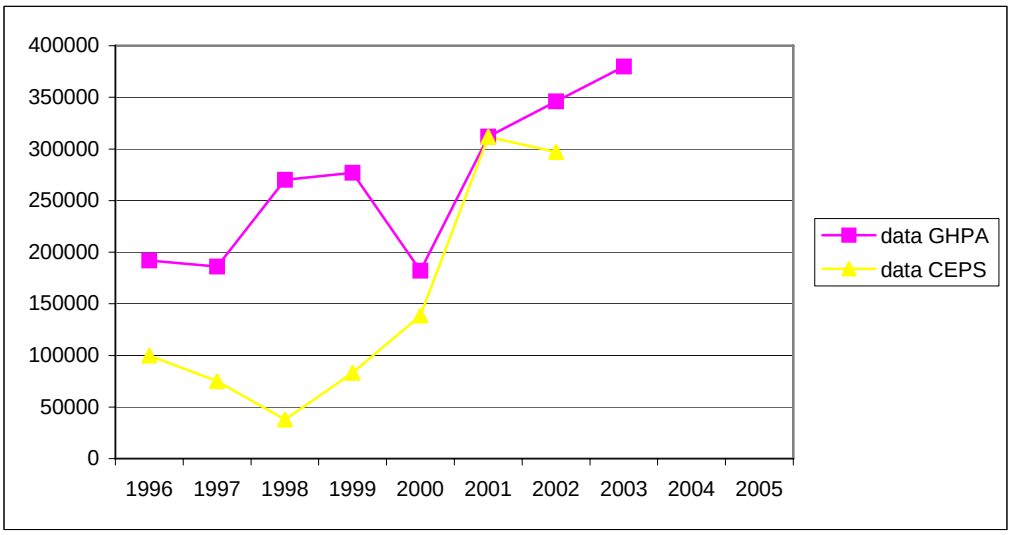
Imports of rice in Ghana have been rising in recent years, to reach a level of about 300,000 tons at present, according to JICA estimate. Yet data on imports are subject to controversy, as the available information differs to a large extent according to different sources (Table 2).

Table 2: Estimation of volumes of rice imports in Ghana

YEAR	DOF	GPHA	CEPS	MOTI	GSS	USDA
1992		224,527		216,142	271,841.144	
1993		244,365		255,481	394,614.061	
1994	92,316.95	154,046		281,112	151,810.055	
1995	59,311.05	175,031		113,020	94,268.92	
1996	53,572.2	192,137		99,758	35,034.19	
1997	92,603.3	186,290		75,135	37,519.498	
1998	79,177.25	270,205	37,868	37,868	781,849.7	
1999	145,543.7	277,609	83,207	83,207	69,142.269	
2000	121,967.2	182,711	138,543	138,543	168,268.4	
2001	182,810.9	312,311	311,513	311,513	30452.905	
2002	138,078.7	346,142	296,953	296,953	104,196.18	
2003	241,172.6	380,270	346,100	346,100		
2004			711,300	711,300		
2005			704,400	704,400		440
2006						340

Sources: Ghana Ports and Harbours Authority (GPHA), Customs Excise and Preventive Service (CEPS), Ministry of Trade and Industry (MOTI); Ghana Statistical Service (GSS).

Figure 3: Evolution of rice imports in Ghana (1996-2003) in tons



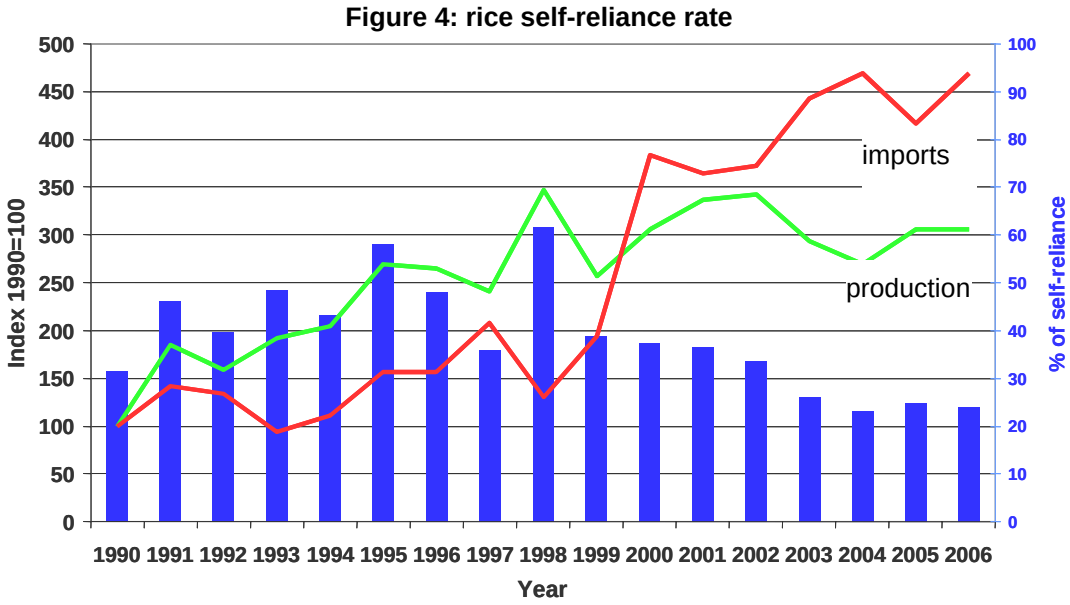
Long grains (perfumed and non-perfumed) are the main type of rice imported. The major sources are the USA and Thailand.

2.1.4. Rice food balance

Considering the available production statistics and if we retain the imports estimations given by JICA, the total supply of rice in Ghana represented by domestic production and imports, amounts to 450,000 tons. Domestic rice production is about 150,000 tons, which account for about 30% of the total supply

Table 3: Total supply of rice (2005)

	Domestic production	Imports	Total supply
Volume (tons)	150,000	300,000	450,000
% of total supply	33	67	100



Source: CIRAD, 2007 (computed from USDA PS&D)

The JICA study estimates the evolution of rice demand, taking into account present population growth (2,48% per year) and a calculated per-capita consumption growth[2] (2,67% per year). Accordingly, the projected level of rice demand will reach 820,000 tons by 2015 or 30,7 kg per capita. Post-agric (2007) uses the non-revised rate (8,9% per year), to estimate the level of per capita consumption at 67 kg in 2015, corresponding to 1,789,576 tons.

Whatever the estimate is, considering the rising trend of consumption as well the present stagnating development of the production, it is expected that rice imports should continue to increase, deteriorating the level of self-reliance of Ghana (Figure 4). This might not be acceptable in the long term because it mobilizes an increasing share of currency reserve and means that Ghanaian farmers will not be able to benefit from the potential income opportunity associated with the rice market expansion. Furthermore, this dependency on the world market should be economically and socially less bearable in a context where the price should remain at a high level on the world market.

2.2. Domestic production structure

Two recent studies funded by ODI-MAP (2001) and JICA (2007) identify four major rice production systems on the basis of water management:

[2] A first 8,9% per year was calculated on the basis of estimates of average rice consumption in 1999-2001 and 2002-2004, which was then reduced by 60% taking into account hypotheses on price fluctuation, supply volume in the international rice market and purchasing power of consumers.

- Irrigated systems, which usually produce two crops per year. The Ghana Irrigation Development Authority was established in 1977 and developed large-scale irrigation schemes for the production of rice that depended on elaborate water channelling and pumping and mechanical harvesting, as well as focussing on high-input rice varieties. These systems can yield up to 4,6 tons per ha per cropping season (JICA, 2007).
- Lowland systems, where rice is grown in flood prone areas, the water coming from rain, river flooding or other sources. In some cases, there is a control of the flooding, through the construction of earthen bunds in order to keep water. The yields in these systems can fluctuate from 0.5 to 1.5 tons per ha.
- Valley bottom or inland valleys systems, where rice is either rainfed or benefits from simple water catchments and bunding. Water is retained in the soil due to its hydromorphic nature and topography. These systems are said to yield from 2 to 3 ton per ha depending on the level of water control and input use.
- Upland systems (0.5- 1.5tons/ha), where rice is rainfed but grows on free draining soils. These systems are mainly found in the mountainous areas of Volta Region. These systems yield usually less than 1 ton per ha.

Inside each category, one can further distinguish systems according to the level of utilization of agricultural inputs (fertilizers, herbicides) and labour and the level of mechanization, all which do not entirely depend on the ecology.

The table below (JICA, 2007) gives an estimate of the importance of different rice production systems in terms of planted area, yield and total production. Lowland rainfed stands for the addition of the above described "lowland" and "valley bottom" systems.

Table 4: Importance of the different rice production systems

	Lowland rain-fed	Upland rain-fed	Irrigated	Total
Planted area (ha)	89,000 (77%)	19,000 (15%)	10,000 (8%)	118,000
Yield (ton/ha)	2,5	1,0	4,6	2,5
Production (ton)	225,000 (78%)	19,000 (6%)	46,000 (16%)	290,000

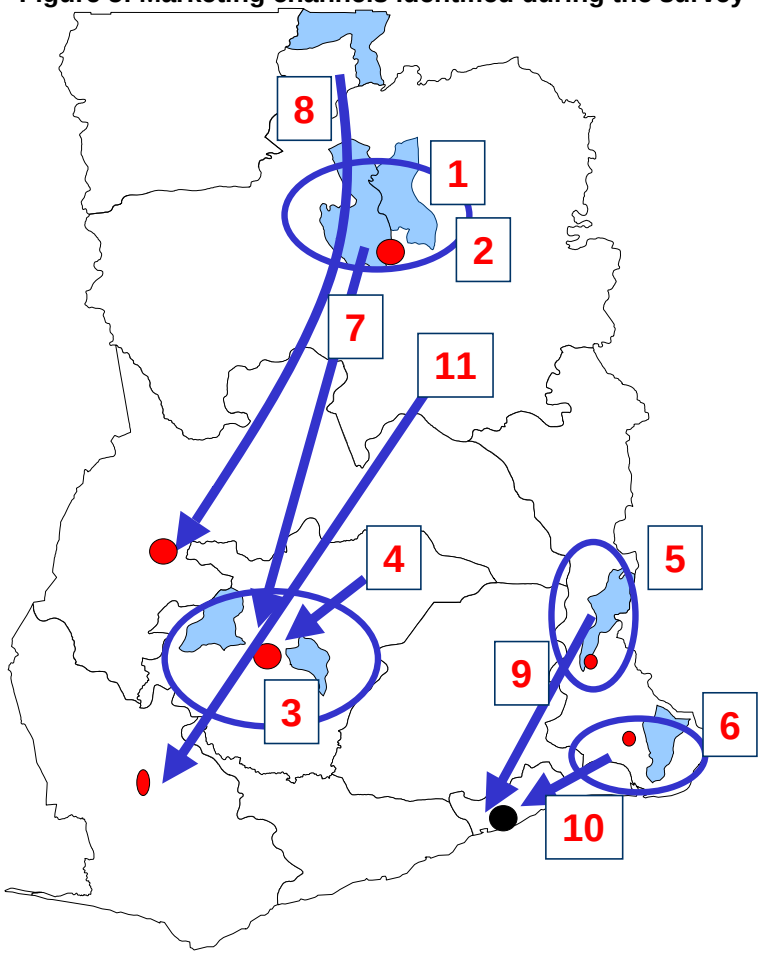
Source: JICA, 2007.

3. Description of the rice commodity chain

3.1. Commodity chain structure and channels

Among the marketing channels that have been identified from the literature review, the study team selected a limited number, which were considered the most important, to be analysed in more details. The marketing chain structure (types and number of stakeholders involved) was built on the basis of the interviews of different stakeholders (location of purchase and sale; type of product - paddy, straight milled, parboiled; functions and operations).

Figure 5: Marketing channels identified during the survey



The survey allowed identifying up several channels (Figure 5), which are considered as representative of different situations for producing and marketing rice in Ghana, even if the purpose was not to carry out a comprehensive survey which can provide a dataset that will be statistically significant.

- **Local and regional channels (map: 1-2-3-4-5-6)**

These channels deal with the rice supply of rural or urban consuming centres surrounding production areas (corresponding to district or region boundaries). Local traders (or "brokers" as the majority of farmers call them) buy paddy from producers, make it milled at the local mill and sell either directly to consumers or to retailers, either on the local or surrounding market.

- **Inter-regional channels (map: 7-8-9-10-11)**

These channels deal with the rice supply of major urban consuming centres, from areas, which have rice surplus areas, which are in deficit. There, inter-regional traders operate on longer distance (above 100 km). Traders buy paddy from producers and make it milled, sell to traders who organize transport to larger urban centres and resell to retailers.

It seems that the number of operators in one channel limited to 2 marketing stages (one trader buying paddy and milling it, one trader selling it to consumers) or maximum 3 (one trader buying paddy and milling it, one trader transporting it and selling it to retailers, who sell it to consumers).

3.2. Brief description of stakeholders

3.2.1. Producers

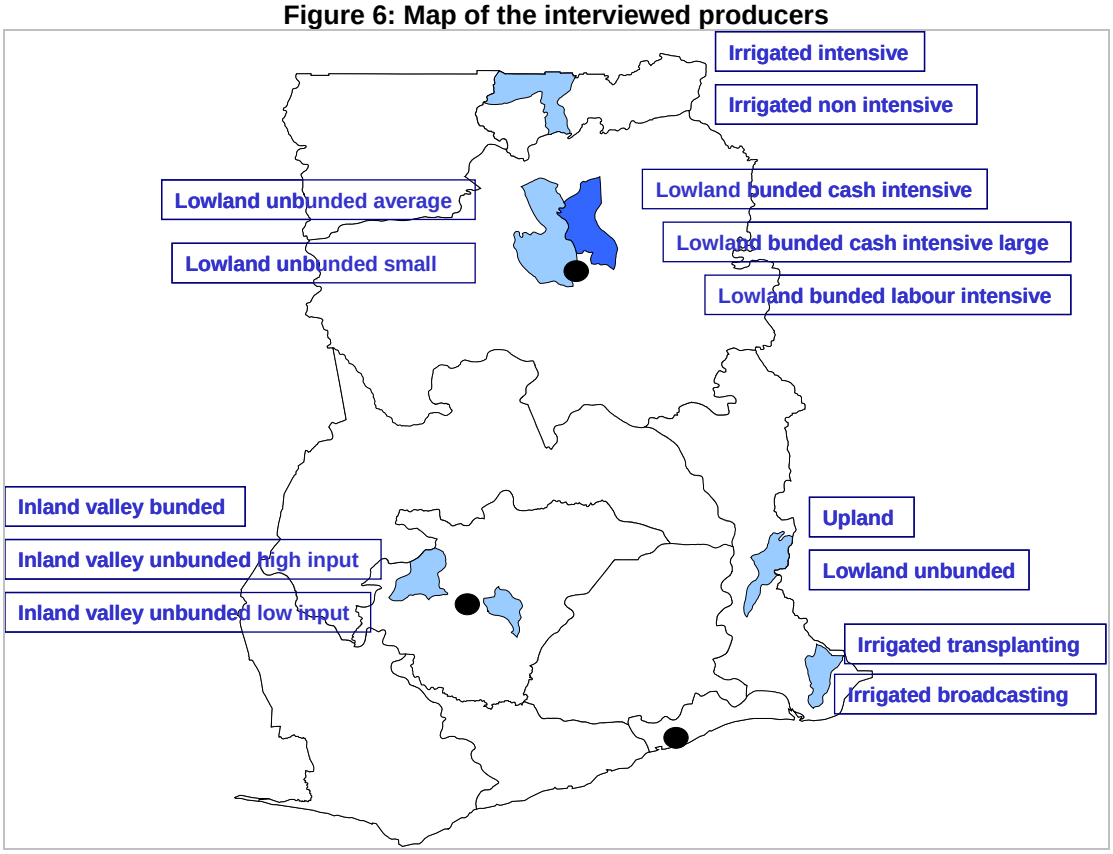
a. Preliminary comment of the methodology

The objective of the survey was to characterize the different rice production systems in a commodity chain analysis perspective. This implies that the questionnaires mainly dealt with rice production and marketing costs, without taking into account the interactions between rice and the other crops or other activities within the farm, nor the functioning of the farming system as a whole. To our knowledge, such farming system analyses are not available yet from literature.

The purpose of the surveys was then to capture the performance of each different production system, though identifying and costing the different operations in the field. Then a typology was made to categorize them roughly in terms of level of water management, of utilisation of inputs and labour (technical criteria that a priori influence most the performances).

The sample for the survey was designed to capture the maximum diversity of systems. The regions where the interviews took place were selected in the main production areas (Figure 6): Upper East (Kassina Nankana), North (Tolon/Kumbungu, Savelugu/Napaton, Tamale), Ashanti (Ahafo Ano South, Ejisu-Juaben), Volta (Hohoe) and South (Dangbe West, Ketu).

Figure 6: Map of the interviewed producers



b. Identified rice production systems

Setting up the questionnaires, we had first distinguished, from the literature review, 4 different ecologies (irrigated schemes, lowland, inland, upland), with two levels of water management for lowland and inland valleys (construction or not of earthen bunds for water conservation) and two levels of utilization of inputs and labour (intensive, non intensive). It should be noted that the qualification "intensive" and "non intensive" is defined through observing the actual practices in the fields and comparing them inside a given system, and not in normative terms.

For instance in the same cropping system, we distinguished sub-systems according to the level of utilisation of fertilizers; we separated farmers using mainly their own labour and the ones that rely mainly on hired or contracted labour and according to the quantity of labour put into the cropping operations; we finally distinguished sub-systems where operations mainly rely on mechanization or mainly done manually.

At the end 15 different production systems were identified and categorized (Table 5), taking into account 6 different criteria (region, ecology, level of water control, level of utilization of inputs, type and quantity of labour used –family and/or hired). The objective was not to characterize standard rice cropping system per main ecologies but rather to take into account in the analysis the diversity of conditions in which rice is produced.

Table 5: Types of rice cropping systems that were surveyed

Region	Ecology	Water control	Nb crop cycle/year	Inputs	Labour	Other	Average yield bags of 90 kg per acre
Upper East	Irrigated scheme	Irrigated	2	3 bags fertilizers per acre	Hired + family labour Mechanized land preparation		16.6
				30% more agric inputs	Capacity to hire additional labour Mechanized land preparation		21.1
South	Irrigated scheme	Irrigated	2	180 kg fertilizers	Mainly hired labour Mainly manual	Broadcasting	18.5
					Mainly hired labour, more labour than above Mainly manual	Transplanting	18.5
North	Lowland	Bunded	1	3 bags fertilizers per acre	Intensive in family labour Mechanized land prep		8.3
				3 bags fertilizers per acre + herbicide	Intensive in hired labour Mechanized land prep		11.1
				1,5 bags fertilizers per acre	Mainly hired labour Mechanized land prep	Larger scale (5-10 ha)	9.3
North	Lowland	Unbunded	1	1,3 bags fertilizers per acre	Family + hired labour Mechanized land prep and harvest	10 acres	7.7
				1,8 bags fertilizers per acre	More intensive (family + hired) labour Mechanized land prep and harvest	6 acre	9.2
Volta	Lowland	Unbunded	1 1	No agric inputs	Manual Family + hired labour		6.6
				1 bag fertilizers per acre + herbicide	Family + hired labour Mechanized land prep		11.1
Ashanti	Inland valley	Bunded	1	3,5 bags fertilizer per acre + herbicide	Family + hired labour Manual		15.5
Ashanti	Inland valley	Unbunded	1	2,5 bags fertilizers per acre + herbicide+ insecticide	Manual		11.1
				No agric inputs	Manual		6.6
Volta	Upland	-	1	No agric inputs	Intensive in family labour Manual		6.6

c. Some elements of characterization of the cropping systems

The following elements of characterization of the cropping systems are given in order to understand the performances that has been analysed (please refer to 4.1.2 Rice farming profitability). They do not replace a proper farming system analysis, that GRIB could be interested in completing in the future.

- Land preparation and sowing: operations carried out on the field are specific to each system. For the land preparation of flooded fields, farmers plough and harrow, while they cut and burn the vegetative cover in upland systems. In irrigated systems, two techniques exist for sowing: nursery + transplanting or direct broadcasting of seeds. Though we did not observe any difference in the yield, this has an implication in terms of manpower needed (transplanting is more labour intensive). In lowland and inland valleys, farmers broadcast seeds. In free draining fields (upland), dibbling is the commonly used technique.

- Level of mechanization: in irrigated systems and more generally in flooded fields, land preparation is mostly done using a tractor-drawn disc-plough or a rotovator, and farmers usually use the service of a contractor to do this (these contacts include the remuneration of the operator, the consumption of fuel and the wear of the machine). The other operations are mostly done manually or without hiring large machinery: sowing, chemical application (manual sprayer), harvesting, threshing, winnowing and transport of paddy to the farm. Some mechanical and combine harvesters are in use in Northern Ghana and on the various irrigation projects, but most of the paddy in the country is harvested manually, using a sickle. Threshing is also mostly done manually, using sticks on tarpaulin spread on the ground.

- Level of input utilization: in general, farmers use little agricultural inputs. The price and availability of inputs explains this situation, as well as the low level of water control, which makes the investment rather uncertain. In irrigated systems and in lowland systems with some water control (bunded fields), the level of utilization of inputs is higher. In our sample, the utilization of fertilizers ranged from 1,3 to 3 bags per acre (NPK and sulphate of ammonia). In addition, most farmers were using some herbicide (except for upland farmers) in early stages of the crop season (before sowing or at pre- or post-germination), but this is always supplemented by hand weeding, which is quite labour intensive.

It seems that in certain ecologies (cf. survey in Volta region) – i.e. in some lowland fields-, the utilisation of fertilizers is not indispensable, because of the run-off from surrounding hills. Farmers then will use top dressing only when necessary (nitrogen supplement in the form of sulphate of ammonia).

In the upland systems, farmers normally restore fertility by installing a tree or shrubby fallow, the nutritional elements of which (captured by trees in the deeper levels of the soil) are restored to the superficial level of the soil when the trees are cut down and burnt. Of course this works well enough if the fallow is given several years to grow, which might be difficult in the case of

increasing population density which increases the pressure on the land tenure. It appears that some upland farmers, who in addition own lowland fields to grow rice, are more able to leave their upland fields in fallow for a sufficient period of time, because they still can produce rice in the meantime. The utilization of fertilizers is then not necessary in those fields.

- Yield: the reported yield from interviews is 600 kg per acre (1,500 kg per ha) in upland systems, as well as non-intensive lowland and inland valley. This is higher than the level reported in the JICA study (1000 kg per ha). In more intensive lowland and inland valleys, the average observed yields ranges from 800 to 1000 kg per acre (2,000 to 2,500 kg per ha). In irrigated systems, the observed yield amount to 1,500 kg per acre (3,750 kg per ha), which is less than reported by JICA study (4,600 kg per ha).

d. Selling of rice

It should be noted that the resources and time available did not allowed to design a survey for statistically assessing the respective weight of various type of farmers' practices; the objective was rather to identify issues and situations in qualitative terms to formulate hypotheses for further investigation with different types of surveys.

The questionnaires were designed to capture the proportion[3] of paddy or rice intended for: marketing, paying labour or other production factors, reimbursing credit, paying the land rent, gifts and home consumption. The results of the survey confirm that rice is a significant cash crop for many farmers: from a number of 46 answers (66 questionnaires), the calculated average for selling paddy is 50% of their paddy being globally sold in one year. Of course, this covers a large range of situations: some farmers sell more than 90% of their production, some less than 20%. A farming system analysis should be able to clarify the rationale behind those differences.

On our sample, an additional 37% is given away to traders as reimbursement of a credit contracted during the cropping campaign to buy inputs or pay hired labour and to landlords as payment of the land rent. Lastly, home consumption and gifts accounted for 13%. This suggests that not only for farmers in irrigated schemes rice is a cash crop, also for farmers who have a lower level of production[4].

The form of the rice given away is variable from one region to another. In Southern Ghana, North and Volta, farmers sell paddy, whereas in Ashanti in most cases they sell milled rice they have first milled at the local mill.

In the questionnaires, we tried to have a better idea of the market forces and in particular the position of farmers in this market. So we asked them at which period they normally sell their production, whether they store paddy for a period of time and whether they have to buy paddy at

[3] From one field in each farm, which was the basis of the listing and costing of field operations

[4] There was no difference between irrigated farms and others

some point. About 4 out of ten respondents[5] said they sell 80 to 100% of their production at harvest time and half of them said they sell at least half of their production at harvest time.

FRSOP carried out a survey in the North in 2006, including 60 farmers in 6 communities. The results of the study indicated a larger proportion of farmers selling paddy just after harvest:

- 78% of the farmers interviewed say they sell paddy in bulk. Only 26% of the farmers sell paddy by bit during different transactions and 89% of the transactions concern paddy and not rice.
- 78% of the farmers say they sell most of their paddy just after harvest, in November and December; 12% sell most in January and only 8.5% sell it from February going.

In many regions or countries, farmers generally do no have much market power, meaning that they cannot choose the right moment to sell farm produce, because they usually need the cash rapidly (end of lean period, credit reimbursement etc.). Here, the result of the interviews suggests that farmers sell a significant amount of rice a later date during the year (since only 4/10 respondents say the sell most of their paddy at harvest time). Indeed, a number of respondents[6] mentioned that they store paddy at home up to 8 months time, with an average of 6 months. We can bring several hypotheses to explain this general observation, taking into consideration that different types of farmers can face various situations:

- The difficulty to sell their product because the market is saturated at harvest time, so they are obliged to store paddy for a certain time. For example, study expert in Hohoe reports that around October – November cheaper rice from Afife and Nkwanta, among others, floods the Hohoe market; hence farmers are unable to sell the Hohoe rice and have to hold on. Besides, as most traders are small size businesses, which do not have the capacity to take risks, buy paddy and either store it or shift it to a distant market when the local market is saturated.
- Some have the means to wait for a better market price or to use paddy as a means for saving, selling small amount for when needed (school fees, celebrations etc.). They are able to do it because they might have other sources of income or because they have a higher level of production.

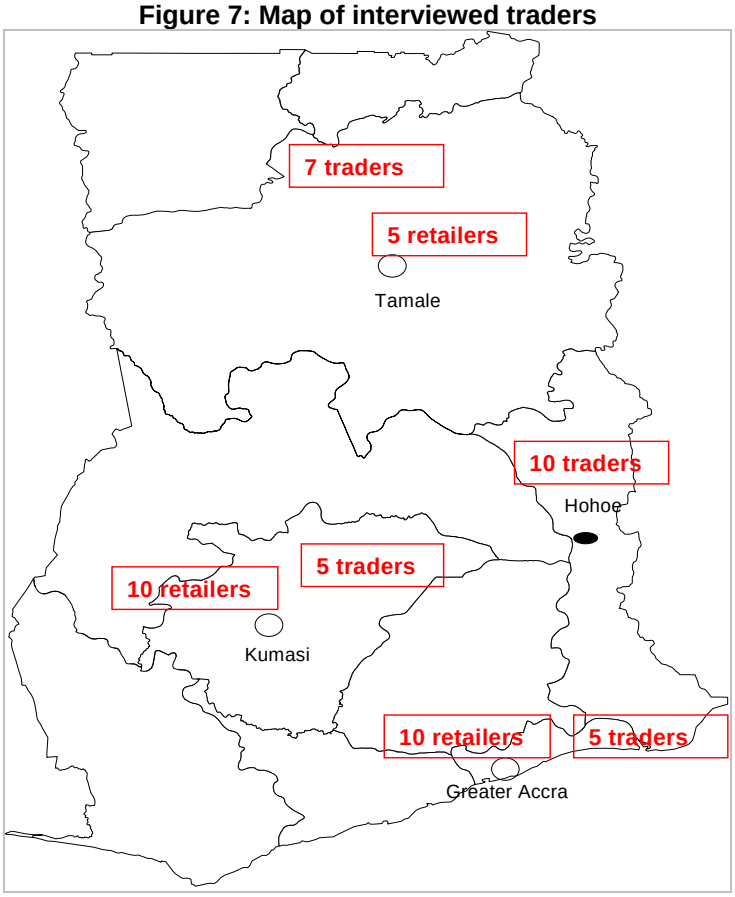
[5] The number of respondents among farmers who sell paddy 56 in total. The number of respondents among farmers who usually sell milled rice was 10 in total.

[6] 3 out of ten respondents said they store paddy, but did not indicate the share of paddy rice compared to paddy sold immediately. Yet, we know from another answer that about half of the respondents sell less than 50% of their production at harvest time.

3.2.2. Traders and retailers

a. Traders

Figure 7: Map of interviewed traders



The interviews took place in the production areas and in the main consumption centres: Accra, Kumasi and Tamale: 5 traders in greater Accra (Dangme West and Accra), 10 retailers in Accra, 10 traders in Volta region (Hohoe, Ketu), 7 traders in the North et Upper-East (Tamale, Navrongo, Savelugu-Nanton and Bolga), 5 traders in Ashanti (Kumaisi, Ejisu-Juabeng, Ahafo-Ano South) and 10 retailers in Kumasi.

b. Identified categories of traders

Five categories have been distinguished, which include:

1. Local traders who supply mainly consuming centres in the surrounding production areas. These traders buy paddy from farmers and process it for a fee at the local milling centre, either directly to consumers or to retailers. In Ashanti, local traders buy milled rice from the producers.

2. In Northern Ghana, local traders who buy paddy, parboil it before milling. In the North of the country, most of the paddy is being parboiled before milling (mainly because of the dry harvest conditions, which make paddy more prone to breakage at milling, while

parboiling prevents it). Whereas some market women consider themselves more like parboilers (even if they buy and sell rice), larger traders rather hire women to parboil paddy for them.

3. Regional traders who have similar marketing functions but operate on larger distance.
4. Inter-regional trader who link region that have rice surpluses to major consuming centre. They also buy paddy from farmers and process it for a fee at the local milling centre, then organise transport of milled rice (either with their own truck or through contracting transport services) and sell milled rice to retailers.

Those traders are responsible for bringing rice to consuming markets, for the processing of paddy, either themselves (parboiling) or for a fee (milling). In many cases when there is some cleaning of the product, they take this operation in charge (winnowing), which is time consuming.

Many people in interviews, especially farmers, or within GRIB, call a person who buy paddy from producers, a "broker" but we found that, as mentioned above, the situation is different in terms of commodity chain analysis, when this person sells directly to consumers at the local market, or when he sells in the regional or inter-regional market to other traders. That is one reason why we chose not to speak of "brokers" but rather describe the functions of the different types of marketers. Besides, in the general sense of this word, a broker is someone who acts as an intermediary to facilitate a transaction between a vendor and a client and does not buy or sell the product himself.

Women marketers are usually found in the first or second category (local trader) but there are also women in the regional and inter-regional trade business.

In general, a trader who buy from a trader and sell to another trader is called a wholesaler, a type of trader that we have not been able to trace in our sample and who might represent only a very few number of rice trader in Ghana. It should be underlined that according to the season and market conditions a trader may shift its position in the marketing chain. For instance a local trader may expand its range of operation to the regional level and may deliver milled rice to consumers and retailers as well.

5. Retailers may deal only with local rice or with both imported and local rice. They are located in large consuming areas as well as in smaller rural markets. In the present survey, only retailers in Accra, Tamale and Kumasi were interviewed. The interviewed retailers of local rice at the Kumasi Central Market and also in Accra are all of Northern decent (Northern, Upper East and West) and sell mostly produce from the northern regions, such as millet, groundnuts, and cowpeas. This could be attributed to the fact that they are related to traders there, who can grant them some form of assistance during business transactions, such as delayed payment when the need arises.

The table below presents the different types of traders who were interviewed for the computation of individual budgets (see also 4.1.3)

Table 6: types of interviewed traders

Category	Practice	Region	Nb of bags of paddy per year
Local	Milled rice local trader (rural areas)	Ashanti	100
Local	Paddy - improved parboiled milled rice trader	North	200
Local	Processing Paddy to Milled trader	South	1000
Local	Processing Paddy to Milled trader	Volta	400
Regional	Processing Paddy to Milled trader trader local	Ashanti	400
Regional	Processing Paddy to Milled trader local	North	7000
Regional	Parboiler-trader	North	2315
Regional	Processing Paddy to Milled trader	South	1000
Inter-regional	Inter-regional Milled rice trader	Accra	1000
Inter-regional	Processing Paddy to Milled trader (own transport)	Ashanti	6160
Inter-regional	Parboiler-trader	North	4500
Inter-regional	Processing Paddy to Milled trader	Volta	1000
Retailer	Milled rice	Accra	60
Retailer	Milled rice	Ashanti	150
Retailer	Imported rice	Ashanti	300
Retailer	Parboiled milled rice	North	80

c. Characteristics and constraints

☞ Rice marketing businesses are numerous and rather small businesses

Most of the marketed rice in Ghana goes through small or very small businesses. From the interviews, we found that the capacity of traders ranges from a few bags to a few hundred bags per week (300 to 500 tons per year). Local traders or market women appear to deal with a maximum of 50 tons of paddy per year. Regional or inter-regional traders handle up to 300-500 tons of paddy per year. Yet the total number of bags marketed per year is not necessarily determined by the category of trader, as regional traders can report a total volume of bag marketed comparable or even higher than inter-regional traders. Finally, the retailers appear to market less than 10 tons of milled rice per year.

The characteristic of rice marketing also suggests that there are few bigger businesses (wholesalers), who have capacity to influence the market and the activities of other traders. This can have a consequence in terms of implementation of marketing strategies by GRIB: a strategy, which would only rely on the involvement of large traders, would probably not be sufficient. First because they represent a global small amount of marketed rice, it appears necessary to take more into consideration the critical role of "small" traders in local rice promotion, to obtain a significant impact. Second, for the large traders to really have a role in leading innovation (which appears realistic given their financial capacity), GRIB should consider specific actions to support

smaller ones to take advantage of innovations and fair agreement and connection between large scale and small-scale traders.

☞ They are not specialised in rice

People who trade rice, in many cases, have other activities; in particular they are also farmers or deal with other commodities. Their interest in rice trade depends on existing opportunities as well as the period of the year. The survey reports that many of them complain that they face difficulties finding rice to run their business , especially for the local (rural) traders. All the traders and retailers interviewed indicate that they do not get enough paddy rice to process or sell all year round. However, the quantity they can purchase during the peak periods depends on their financial capacities and on the marketability of local rice.

☞ Limited role in storing paddy

The result of the survey suggests that "medium-long term" storage of paddy is very limited if not non-existent. This is due to several reasons: the low financial capacity of those small traders, which makes them have to make their capital revolve rapidly; and the low seasonal variation of prices for paddy, which makes it not really feasible to speculate on rice. Available price series (2000-2006), show that the price vary at a maximum of 12% between the peak and lowest season (4.2.3) which is not enough to cover storing fee and loan rates which are above 20% per annum.

3.2.3. Processing

a. Types of milling technologies

The survey identified two types of milling technologies, small Engelberg mills (horizontal steel rollers) and mills based on rubber roller technology with a higher throughput (quantity of paddy rice milled per hour).

The Engelberg mills. This type of machine removes the husk and the bran in one operation. Their recovery rate is about 55% (55 kg of milled rice obtained from 100 kg of paddy). Because the batches of paddy are generally heterogeneous, the machine generates a high percentage of broken grains (for example, if the machine is set for round varieties, thinner grains are not well husked and the longer grains are being broken). Over-dried grains also generate a higher rate of broken grains, but this can be mitigated through parboiling paddy before milling it. This type of machine also uses quite a lot of energy, but on the other hand is relatively inexpensive to buy, robust (it has few moving parts to wear out) and readily repaired. Probably a more thorough investigation on the stock of Engelberg mills should be carried out to assess their state of maintenance.

Their throughput can vary from 100 to 400 kg per hour. In the mills that were studied, the hourly milling capacity was 250 kg per machine while some workshop may use more than one machine.

The results of the survey indicate that the utilization of their capacity for this type of miller ranges from 500 bags per year (40 tons) to 2000 bags per for the larger mills.

Rubber roller mills were generally installed by projects in irrigated schemes. Some of them have been given up to private businesses after the end of the project. The theoretical throughput for such machines range from 150 to 4000 kg per hour depending on the type of machine. In the survey, milling throughput has been estimated at 1,000 kg per hour. Their level of operation is in general larger than the one of Engelberg mills, up to 3,000-4,000 bags per year (240-320 tons) for the interviewed millers. Yet, most of them appear to be working under-capacity, since they have difficulty to have enough volume to use the equipment at its optimum level.

Their recovery rate is about 65%[7], provided the grain passed through is clean and homogeneous. The machine also produces fewer broken grains and generally better quality of rice than Engelberg mills. One constraint of this type of machine is its fragility, for the rubber rollers need to be changed every 100 to 200 tons of paddy. The larger more sophisticated mills integrate in addition side machinery such as destoners, pre-drying machine (Asutsuare), polishers and/or winnowers.

b. Elements of characteristics and constraints

☞ There is no incentive for quality milling

The millers usually do not buy paddy but process it for a fee, which varies from one region to another, from 1 GH to 3 GH per bag of paddy, depending on the unit use and the form of rice (paddy or milled) used as the reference and the service provided (one or two pass, destoning, cleaning, drying…). Some charge their client per bag of paddy (in the North), others per bag of milled rice (in the South). But most of the milling centres do not have extra services, such as cleaning rice, and charge their customer according to the quantity milled and not the quality of the final product.

But to assess and charge for quality of milled rice would also be tricky, because quality is also greatly influenced by cropping and post-harvest practices. For example, when paddy is over-dried or mixed with soil particles and stones. Moreover, much of the rice is grown from mixed varieties, resulting in uneven maturity at harvest, as well as heterogeneity in size and shape of grains, which adversely affects the quality of milled rice. Threshing is usually done on bare floors, under direct sunshine, and also on the roadsides. Consequently, soil particles and stones become mixed with the paddy, which in turn damage milling equipment and down grade the quality of the rice.

☞ They work under-capacity

One of the major constraints for the milling business is to attract enough customers and regularly throughout the year and thus process a large volume of paddy in order to recover the value of the

[7] The recovery rate (i.e. the quantity of milled rice obtained for a given quantity of paddy rice) can also vary depending upon the homogeneity, cleanliness, dryness and the type of paddy rice processed (shape…)

costs that have been invested. Mills have an intense activity during harvest period, which falls to a very low level the rest of the year. This issue is more crucial in larger mills using rubber roller technologies, than in smaller mills using Engelberg technology (see also 4.1.4)

Under the current coordination regime of rice marketing and processing there is limited incentive to improve the quality management along the rice marketing chain. The introduction of incentive to reward any investment in better milling services (destoning paddy rice, higher recovery ratio and grading rice) should be considered, provided that adequate incentive do prevail at the retailing stage to justify a change in trader and miller relation. This is typically an issue that should be addressed in a holistic approach and where GRIB could make a difference.

3.3. Market structure and coordination

3.3.1. Market structure

a. Segmentation of the rice market and consuming patterns

Quality of rice plays an important role in consuming patterns. Surveys of consumers' preference confirm that rice cleanliness and taste are key criteria for purchasing. JICA Consumer's Preference Survey on Rice (2007) indicates that consumers are willing to pay more for a clean product (no stones or foreign matter), with uniform and unbroken grains. They also require rice that has capacity to expand when cooked, which imported rice can readily do, because it is usually stored for a longer period, and therefore dryer, than local rice.

According to these criteria and as a whole, local and imported rice are different products and therefore they reach different market targets. Imported rice generally gets a retail price that is on average 20% higher. JICA report also indicates that certain category of imported rice might be sold at a lower price than certain category of local rice. Given the segmentation that prevails on rice world market it might be possible for importers to find batches of rice at low price. Yet the critical point is that, beyond disparities in term of quality the local rice gets on average a lower price than the imported rice.

There is some differentiation of products among domestic rice as well as among imported. For both origins, long grain and perfumed rice is well known and get a higher price. Some wholesalers of local rice claim they are willing to pay their suppliers a little more (up to 10%) for clean rice, but this is not the general rule (see 3.3.2.b). What remains unclear is whether there is differentiation among local non-perfume rice or not (the Post Agric Associate study categorizes them as Short grain rice and White rice).

Parboiled rice is equally a well-identified segment, especially in northern areas where people traditionally consume parboiled rice. The market for parboiled rice represents more than 50% of the consumption of local rice in the North (Post Agric Associates, 2007) but is virtually absent in the South.

Apart from perfumed rice, parboiled, and also brown rice, which has a specific market, it is more than likely that consumers do not make any difference between "ordinary" local rice. Because it does not have any salient intrinsic characteristic (colour, sent) and in retailing stalls it is mainly presented in open containers (like bowls), the prominent criteria for buying it is its cleanliness. When asked, retailers mention names of rice they know, which all are "special" rice (perfume, brown, parboiled) but are not able to name any others. This suggests that they do not make any difference among other type of local rice. As one retailer said, he is only able to "tell between perfumed and others".

Marketing channels are rather regionalized and therefore also segment the local rice market. Starting from each production area, we can observe that, apart from local and rural marketing systems, rice production is channelled through to one or at most two consuming centres. Surplus Volta rice or Afife rice is mainly going to Accra and not really to Kumasi. Rice form the North is mainly going to Techniman and Kumasi and not really to Accra. So one type of rice will be found in no more than one or two regions.

b. Product flows

The quantification of the flows of imported and domestic rice within the country was estimated by JICA, using statistics of production and consumption per region from SRID and the result of their baseline survey and market survey.

JICA baseline survey and market survey approximated for each region how much rice is going in and how much is going out, as well as the market share in each region for imported and domestic rice. The market share of imported rice depends on several factors: the proximity of Tema Port, the accessibility of the market (conditions of the roads) and the consumers' preferences (habits of the urban and rural dwellers).

Table 7: Estimation of the local rice production, consumption and exchanges

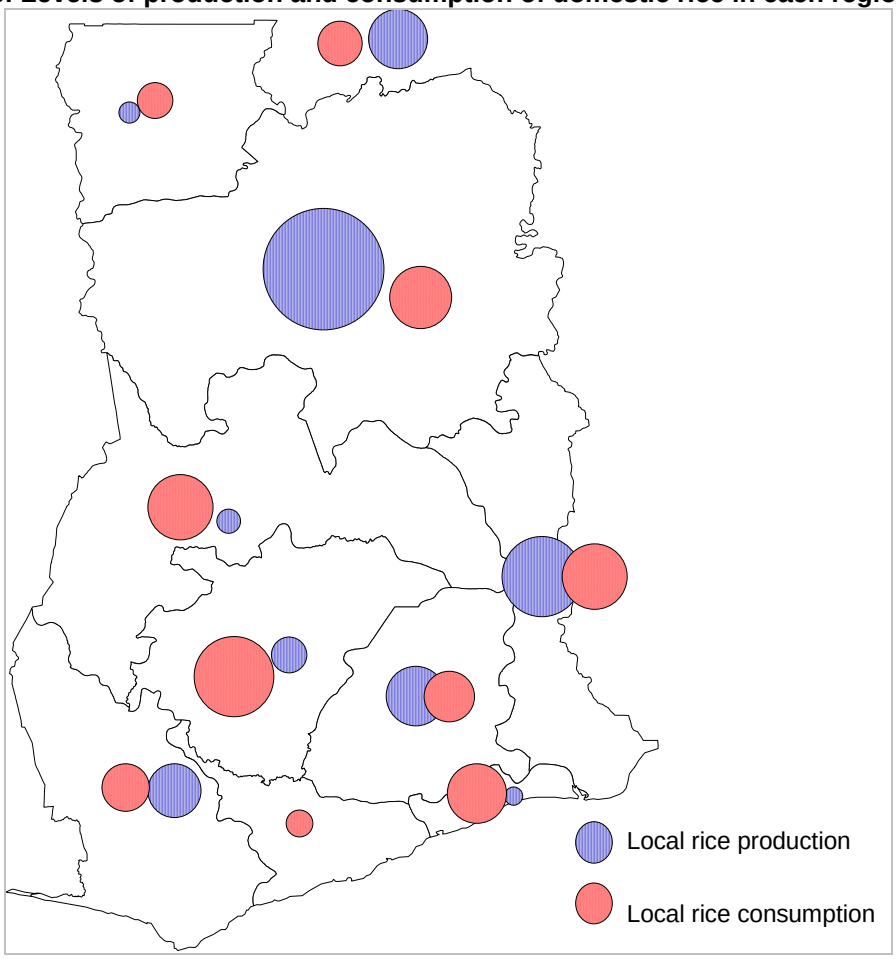
Region	Production (1000 tons)	Consumption (1000 tons)	Balance	Flow in (1000 tons)	Flow out (1000 tons)
Upper West	2.3	6.7	-4.4	4.4	0
Upper East	16.7	10	6.7	0	6.7
Northern	56.4	18.4	38	4.7	42.7
Brong-Ahafo	3.6	18.6	-15	15	0
Ashanti	7	28.2	-21.2	21.2	0
Eastern	16.4	12.1	4.3	1	5.3
Western	13.3	11.6	1.7	1	2.7
Central	0	3.9	-3.9	3.9	0
Greater Accra	2	16,9	-14,9	14,9	0
Volta	28,1	19,4	8,7	0	8,7
Total	146,7	146,7		66,1	66,1

Source: compiled from JICA (2007)

Five regions are exporters of domestic rice (Northern, Upper East, Volta, Eastern and Western) (Figure 8). The Northern region for example, has a production of 56,000 tons of rice, among

which only 18,000 tons are consumed locally, out of a total rice consumption of 33,000 tons in the region (SRID, 2003). All production is not consumed locally because part of the consumers' choice is transferred to imported rice, which better meets their preference. So the region has a marketable surplus, which is also enhanced by the surpluses coming from another region (Upper East). Traders of local rice have then to look for a market other regions. In other cases, for example in Volta, even if the local production cannot satisfy the local demand in quantity, the region still exports local rice, in particular specific varieties (perfumed rice), which has avenues in the urban markets like Accra.

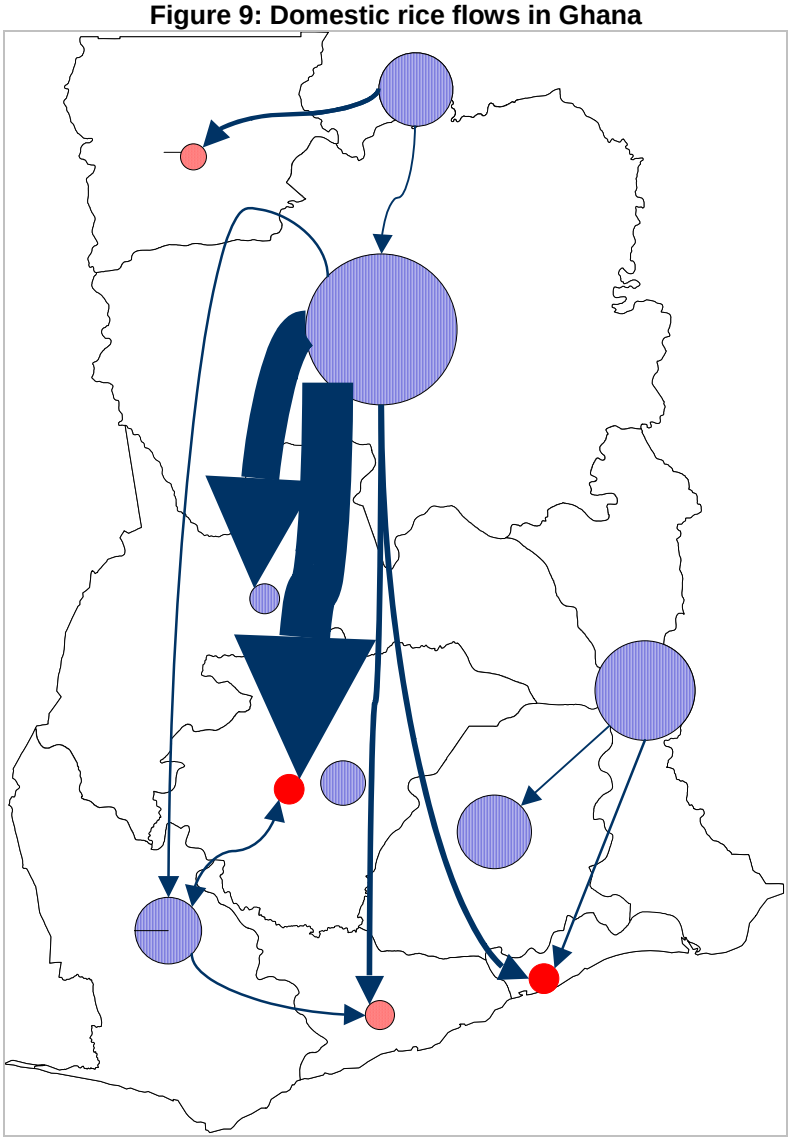
Figure 8: Levels of production and consumption of domestic rice in each region (2003)



Source: SRID compiled by JICA

To gauge the direction and the level of the flows of rice from one region to others, we made the assumption that the outflow is going in priority to the neighbouring region (and the inflow coming from the neighbouring region), which is in deficit of local rice (that is, where there is a market for local rice), then to the next closest region. This calculation was backed up by the field survey identifying the different main marketing routes. The following figure represents the main rice flows within the country.

Figure 9: Domestic rice flows in Ghana



The figure is quite revealing of why domestic rice is rarely found in markets in the South of the country, because most of the available surplus is first absorbed in large markets of rice deficit areas such as Ashanti (Kumasi) and Brong Ahafo (Techiman) and to some extent in the Western and Central regions, which are closer to the exporting northern regions. Those important consuming regions are closer (or more accessible) to the northern areas where are major surplus areas of domestic rice. Thus, about 40,000 tons of rice should be brought from the northern areas to the central areas and only 1,000 tons to Accra.

The study carried out by Post-Agric Associates mention that a higher proportion of marketers deal only in imported rice (more in urban areas than in rural and production areas) as shown in the table below. Large shops also tend to be more specialized in selling imported rice (66% of them only deal with imported rice, 21% deal with both types of rice). Smaller businesses (market women) tend to be less specialized, since 60% of them deal with both imported or domestic, depending on the opportunities.

		Type Sold (%)		
		Local	Imported	Both
General	Market Woman	12	28	60
	Average Shop	16	41	43
	Large Shop	13	66	21

This is due mainly to its seasonal nature, poor quality and storage characteristics. Many of the marketers declare that it is unavailable for procurement. However recently, some traders have entered the domestic rice market in producing relatively high quality rice packaged and branded for marketing. These brokers supply rice mainly to institutions (school, civil government administrations…) and some upper class shops (Post Agric Associates, 2007).

3.3.2. Coordination between agents

Information on coordination between stakeholders comes mainly from the processing of the questionnaires. While the sample of interviewed persons was relatively small and some of the data non-processable, it is important to take the figures not as statistical reference but more as tendencies and indicators of the existence of situations that GRIB might be interested to further investigate when preparing to take actions.

a. Types of transaction

From the answers given to the questionnaires, we can note that a majority of transactions[8] at all levels of the commodity chain between one supplier and one customer are made by cash. This means that they do not agree in advance on the conditions of the transaction (notably price) and the type of product that must be supplied. This also implies that for the pre-financing of their activities of purchase and sale, most people must count on their own capital.

Besides this general situation, we can observe other noteworthy tendencies, revealing of the type of relation between stakeholders and therefore the level of performance of the whole system.

Considering the producers, traders rarely pre-finance the crop season, except in irrigated schemes, where credit for inputs is common because harvest is less uncertain (considering the level of water control and the utilisation of chemical inputs) and therefore the loan less hazardous. But according to some producers, this practice is becoming more and more sporadic.

In fact, producers seem to pre-finance relatively more the activities of traders than the reverse, by providing them payment facilities. Among the respondents, a significant number[9] mentioned that

[8] For the sale of paddy: 46 out of 75 producers sell cash at 100% and + 19/75 sell partially for cash. For sale of milled rice: 24 producers out of 41 sell cash at 100%. For retailers, 16 out of 19 respondents buy cash, but for traders, only 18 respondents out of 43 sell cash at 100% and 7 out of 43 sell partially for cash to retailers.

[9] 7 out of 77 (9%) producers indicate that they sell paddy on credit, 17 out of 41 (41,5%) indicate that they sell milled rice on credit. Concerning traders, at least 25% of the respondents indicate that they buy rice on credit.

they often provide a one to two week-delay payment to the trader, providing that there is trust between them.

Additionally the FSRPOP conducted a survey in the Northern region in 2006, with 60 farmers in 6 communities. Some of the results presented below confirm the present observations:

- 22% of the paddy is sold on credit. Indeed, 83% of the processors and 32% of the market women purchase paddy on credit.
- The time between purchase and payment is of 23 days on average but covers a great variety of situation, from 1 week to 2 to 3 months. The longer time of expectation concerns the purchase of more than 10 bags.
- A problem formulated buy farmers are the lack of adequate broker (who buys at high price AND in cash) and the inadequate price. 13% of the farmers complain about the lack of mill.

In turn, traders can, in some cases, sell rice on credit to other traders and retailers, which is also the case with wholesalers, who has the financial capacity to do so. Finally retailers provide payment facilities only to regular customers (food vendors, institutions).

This situation suggests that the traders, who are generally small businesses, have little financial capacity to take risks and stimulate the marketing of rice. Furthermore, this is a crucial issue if the production was to be promoted and increased, as this expansion should rely on stakeholders who have the capacity to develop their marketing activities. Eventually, the producers have a pivotal role for pre-financing the whole system, more than other stakeholders (except for some large wholesalers but who are not many). Another circumstance illustrates this situation: storage of paddy is more developed by farmers than by traders. One-third of the farmers interviewed mention that they store paddy for a time that can go up to 6 months. By releasing paddy by small quantities throughout the year (and by supporting the costs associated to storage), producers contribute to smooth supply and to regulate the system.

b. Quality criteria, price and information

The issue here is to understand to what extent quality rice, meeting consumers' requirements, is remunerated within the commodity chain and to what extent information on market demand is conveyed to suppliers. The objective was also to assess what are the obstacles to a better coordination and what are the room for improvement.

In the field survey, we tried to evaluate first if different stakeholders have the same perception of what is quality, which is a first sign of an efficient coordination between them. We asked open question on which quality criteria they distinguish different types of rice. Then, considering the consumer's criterion of rice cleanliness, we asked to each type of stakeholders whether they got higher prices for supplying rice corresponding to this criterion. The basic assumption is that in theory, the higher the quality is, the higher the price is at consumers' level and in turn at other stakeholders' level.

We have seen that there is a clear segmentation among local rice, at least such segment as perfumed rice and brown rice for example. Those types of rice are effectively more remunerated at all levels and in particular, producers discriminate them well enough.

But what about the bulk of domestic rice, which is more undifferentiated in terms of flavour, sent, shape etc.?

The processing of the questionnaires for producers, traders and retailers suggests that stakeholders do not share the same quality measure throughout the chain and that they are not aware of what is the measure of others. This is materialized by the fact they do not have the same quality reference and that there is no price incentive for rice, which meet consumers' requirements (cleanliness, homogeneity, unbroken grains).

So, criteria of rice that serve as reference for retailers are not the same than those of traders or producers. Producers refer to variety names, with a great diversity between regions (the 60 respondents named 34 different types of rice and only 3 of them were common to all regions). Traders may also refer to variety names and also to what appear more like brand names. In addition, they refer more to generic appellation, such as "perfumed rice". Retailers speak of a smaller number of types of rice (20 respondents named 16 types of rice)[10], more to brand names or at least different from what the traders and producers know. They know perfumes rice, brown rice and parboiled. But they do not discriminate inside the category "perfumed" for example, because this criteria is more influential than where the rice come from or which variety it is for example. The rest is probably undifferentiated and was therefore unnamed in the questionnaires.

This means that producers have specific reference (rice variety) while retailers have other (taste, sent…). Traders seem to have both but the link between the end stakeholders does not seem to be functioning. For a farmer, variety means yield, modalities for harvest, resistance to pests etc. and in some case means strong market demand (farmers usually know that there a high demand for perfumed rice) and this is how he discriminates between different rice. For a trader, the criteria might be the milling recovery rate, the marketability and in some cases, price. For a retailer, who is in direct contact with consumers, this is marketability and price. For consumers, this is taste, cleanness, length of grain, price etc.

In cases, we have made the observation that parboiling rice can modify the criteria usually used for discriminating paddy. If paddy is parboiled, then traders will refer to it as "parboiled" with other criteria such as the taste, the existence of black grains etc. rather to the specificity of its variety. There were examples, where a paddy variety is highly praised for its taste when straight milled (and reach relatively high price), but its taste will change when parboiled. As far as we are aware, taste is a very important criterion for parboiled rice (even is there are other criteria as well, such as length of grain). But most farmers do not have this information, so they are not aware of that fact and are not able to judge their production in the same way the final buyer will do.

---

[10] Some data are still pending from Tamale surveys

Of course, even if not sharing the same quality criteria, the preferences of the different stakeholders can happen to converge on the same type of rice, but they probably do not know it. The problem lies more in the fact that the information on the reasons why each stakeholder prefers one type of rice is not properly disseminated.

So producers may not be aware (except those who have a closer link to the final customer) of what makes rice valuable. Besides, there does not seem to be price incentives for cleanliness, except for some cases, limited to certain types of rice, which already attract more value.

The fact that there are numerous and small marketers, who are not sufficiently organised to convey information on market requirement from downstream segment to upstream segment, makes it difficult to organise supply in such a way to meet consumers requirements. In terms of private governance, there are neither enough traders who have the capacity to promote the marketing of required rice, to take financial risks and play a role in organizing the coordination and supply.

In irrigated schemes, where there is a form of organisation and management, where rice varieties are more homogenous and where there is credit supply, traders or millers can play a role in defining production specifications. But they represent a small proportion of the domestic production (16%)[11], and it is more difficult to achieve in other production systems.

c. Units and measures for transaction

The utilisation of units and measures for rice purchase and sale is another issue of stakeholders' coordination. Units vary within the country: bag, bucket, bowl, olonka, tin etc. What is more, measure varies as well for a given unit: a bag does not contain the same weight of rice if you are in different regions and more importantly because these measuring devices can be inaccurate given the variation of other factors (the density of rice, the content in foreign matter, but also jute bags become slack after a while for example). The measure also varies throughout the year, depending on how much the container is filled (metal containers are also put out of shape, so the declared price remains the same, while the corresponding weight is reduced or increased).

This inaccuracy and variation in measurement can be an advantage for those who master how they work, but this leads to trust problems and marginalisation of some operators. For example, the issue of weight and measurement in milling activities has been raised during the field survey. Since the unitary fee is calculated per bag, conflicts arise between millers and their customers, on the weight of the rice that is milled (from 70 to more than 100 kg). In some cases, there is a way of re-weighing using a common measure, but customers often refuse to comply.

[11] There is no information available on which proportion of the marketed rice they represent..

3.3.3. Concluding remarks

Consumers' preferences are now well identified through field surveys (JICA, 2007; Post Agric Associates, 2007). They go for clean, homogeneous rice in priority.

Yet, the segmentation of rice market offers opportunities for different types of rice and there is room for improving the quality of "undifferentiated" local rice: removing foreign matters form the grain, making homogeneous batches of rice.

But the stakeholders face a lack of information of the market requirements. They are not sufficiently organised to be able to supply the level of quality required. At present, there is not much price incentive to improve the quality of local rice (except for the perfumed and brown types).

For example, it appears that there are large marketing opportunities in the main consuming centres, namely Accra and Kumasi. But Kumasi market seems more accessible as a first step, given the existing marketing routes. Thus, there is room for organising the stakeholders already involved in the trade business between the main production areas and Kumasi.

In addition, we have seen from the description of stakeholders, that there are distinct issues for separating types of rice and different regions or ecologies. This militates for actions that are not standard actions for all regions and products, but rather to reflect and built strategies at more relevant levels, yet taking into consideration the coherence of the whole.

Therefore, independently from the orientations the GRIB can select, we suggest the actions should be motivated by at least two principles:

- Specific and localized strategies, adapted to differentiated issues
- Integrated strategies, including information to stakeholders, collective action (organisation) to coordinate actions and organise supply, improved technologies or practices to improve quality, and marketing communication to facilitate the materialization of those efforts.

4. Financial analysis

The lack of up-to-date information on the current profitability of the various agents involved in the rice commodity chain was identified as a major constraint for assessing the viability and relevance of the various technical and organisational options discussed within GRIB to strengthen the sustainability and the development of the rice economy.

In order to fill this gap, a series of budget has been computed for the different categories of agent in order to assess the profitability of the rice business at the individual level and at the sub-system level through the consolidation of individual budgets into a unique budget.

4.1. Profitability of rice production, marketing and processing

4.1.1. Methodological considerations.

a. Data collection and format

The budget has been established on the bases of data collected during field survey through interviews. A first series of original budget have been tabulated for each individual interview taking into account the following accounting categories:

- Fixed costs: all the expenditure related to the purchase of equipment that last for more than one year of operation.
- Operating costs: all the other costs regarding the production, processing or marketing of rice.

These operating costs were subdivided into:

- Labour cost: payment of manpower under various type of contract (daily, monthly wages, contract on task basis)
- Services: payment of services, which include both manpower and the utilisation of specific equipment. This includes for instance contract for land ploughing using tractor, transportations cost, milling cost…
- Material input: purchase of all material input related to the selected activity (fertilizer, fuel wood, electricity…)
- Other cost: this sub-category include all the cost that were not classified elsewhere such as tax, levies and the rent paid for using equipment.

The revenue was computed on the bases of the output produced for one agricultural campaign for farmer or for a given volume of operation for trader or processors (a batch of bag marketed, processed…)

For each budget line, as far as possible, the data collected included the physical quantity of input purchased, or the number of day paid for (i.e. the technical coefficient) and the corresponding price from which was derived the value for each cost item. When the respondent was not able to provide the detailed information the aggregated value was collected.

b. Sorting out original budget

Representative budget were developed on the bases of the original budget. The original budgets were primarily sorted out on the bases of variations in the practice followed or the technology used by each agent.

For instance for a same cropping system, farmers' budget were grouped according to the use or non-utilisation of agricultural input, along the same line the dataset was processed separately for farmers using mainly their own labour and the ones that rely mainly on hired or contracted labour; a distinction was made for farmers using different sowing technique (broadcast, dibbling or transplanting).

In the case of traders, the major discriminating factors were, the type of product purchased and sold (i.e. paddy rice or milled rice), the length of the marketing chain on which they operate. When the function of the trader in the marketing chain was obvious, such as for retailers, these original budgets were processed separately.

For processing activities, a distinction was made on the basis of the practices followed for parboiling activities, while for milling the major criteria was the type of mill used (Engelberg or rubber roller type of mills) and the capacity of the mill.

c. Computation of representative agent budget

Representative budgets were then established by comparing the data set among the original budgets of the same cluster, cost item by cost item, discarding outliers and missing data, rather than computing an arithmetic average, which would not be meaningful given the size of the sample, the objective was more to get data set that was realistic.

The major issue for computing farmers' representative budgets is to assess as accurately as possible the quantity of input used and the yield achieved that can vary significantly among individuals, whereas the unit price for labour contract or major inputs are less variable. Provisional budgets were discussed with various resources persons (national consultant, GRIB EC members) and corrections were made on the basis of their observations and using data available from literature. For instance yield levels have been adjusted to better reflect the long-term average production by rice cropping system.

For traders, there is limited scope for variations in terms of practices. For instance, the prices for loading and unloading bags from a truck are fairly standard for a given location. The same apply to transport cost when a trader hires the services of transporters, or public transports. In the case of traders, the major issue is to apply purchase and selling prices for the traded item that are close as possible to the reality (cf. 4.2.3).

Milling costs are largely determined by the technology used and less subject to variations than other activities although the recovery rate (i.e. the quantity of milled rice obtained for a given quantity of paddy rice) can vary depending upon the homogeneity, cleanliness, dryness and the type of paddy rice processed (shape…). In the case of milling, one difficulty was to get a comprehensive list and frequency of purchase of the spare parts that represent a major cost item. The problem was overcome by comparing the aggregated maintenance cost for processing one bag across the different original budget. The same method was applied to assess the energy cost.

The consistency of the primary data collected and computation have been checked and adjusted on the basis of available technical documentation and other study on rice milling.

A list of 32 representative budgets has been derived from the original budgets computed from the interview. It includes 13 farmers' representative budget, 3 representative budgets for milling operations and 16 representative budgets for paddy and mille rice activities. An example of a representative budget is given in Table 8. The complete list of budget is given in Appendix 2.

Table 8: Farmer representative budget - unbunded lowland average. Northern region

Fixed input						
Items	*Quantity*	*Unit price*	*Purchase value*	*Shelf life*	*Used share*	*Value*
Bags	85	6 000	510000	2	0.5	127 500
Warehouse	1	4 000 000	4000000	12	0.66666667	
Operating costs						
		Family labour	*Quantity*	*Unit*	*Unit price*	*Value*
Labour						
Basal fertilizer app 15.15.15		1	8	bag	25 000	200 000
Herbicde app		1	10	acre	25 000	250 000
Broadcasting		1	10	bag	20 000	200 000
Second fertilizer app		1	5.00	bag	15 000	75 000
Second Herbicde app		1	10.00	acre	25 000	250 000
Rouging		1	30.00	day	30 000	900 000
Handling		1	85.00	bags	7 000	595 000
Bagging		1	85.00	bags	1 500	127 500
Services						
Land ploughing		1	10	acre	120 000	1 200 000
Land prepeartion harrowing (x 2 time)		1	10	contract	80 000	800 000
Harvesting		1	20.00	paddy bags va	200 000	4 000 000
Storage cost			85.00	bag	3 000	255 000
Material input						
Seeds			10	bags	220 000	2 200 000
NPK			8	bags	215 000	1 720 000
Urea			5	bags	170 000	850 000
Herbicide Stamp			9	liter	100 000	900 000
Weedicide Starmpropernol			9	liter	60 000	540 000
Rope for bagging			85	bags	1 000	85 000
Other cost						
Revenue						
Paddy rice			85	bag (83)	200 000	17 000 000

4.1.2. Rice farming profitability

The major characteristics of the 13 representative budgets computed for rice farming are listed in Table 9.

Four representative budgets have been developed for irrigated systems. Two in the North, based on the degree of intensification (more resources allocated to land preparation, plant establishment and higher quantity of input use) and 2 in the South, distinguished on the bases of the planting method (transplanting, broadcasting).

The major cropping systems in the Northern region, unbunded and bunded lowland have been split into respectively 2 and 3 systems. Two unbunded lowlands have been distinguished on the bases of the size of cropped areas (2 acres for the small category and around 4 acres for the average category). Three budgets have been developed for the bunded lowland cropping system based on the type of cultural practices (labour intensive or mechanized) and the size of the plot.

In Ashanti region, the survey focused on inland valley cropping system. Three budgets have been developed, one regarding the most intensive systems were the field is bunded and two budgets for unbunded inland valley, discriminated on the bases of the quantity of agricultural input use.

The dataset collected for upland cropping system didn't allow identifying various agricultural practices for this ecology and thus only one budget has been developed.

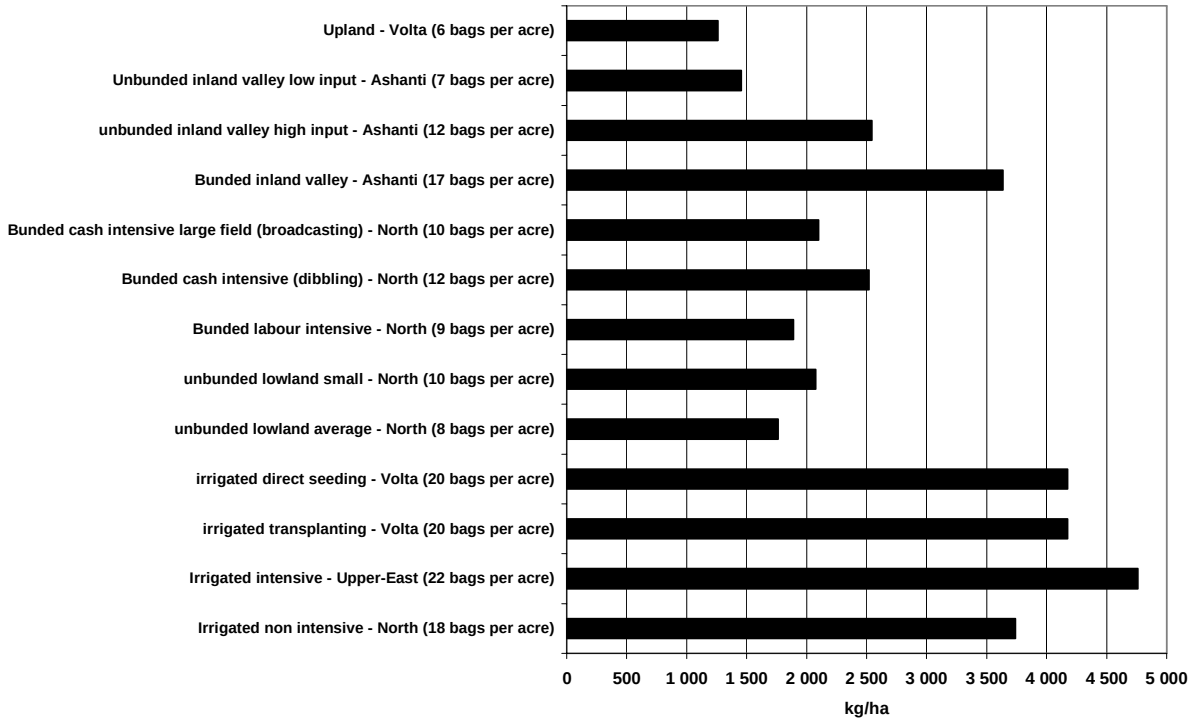
Table 9: List of farmers' representative budgets

Ecologies	Cultural practices	Region	Location	Yield Kg/Ha
Irrigated	Irrigated non intensive	North	Tolon/ Kumbungu	3,740
Irrigated	Irrigated intensive	Upper-East	Kassina Nankana	4,760
Irrigated	Irrigated transplanting	Volta	Afife	4,175
Irrigated	Irrigated direct seeding	Volta	Afife	4,175
Unbunded lowland	Unbunded lowland average	North	Nanton	1,764
Unbunded lowland	Unbunded lowland small	North	Nanton	2,075
Bunded lowland	Bunded labour intensive	North	Tolon/ Kumbungu and Nanton	1,890
Bunded lowland	Bunded cash intensive (dibbling)	North	Tolon/ Kumbungu and Nanton	2,520
Bunded lowland	Bunded cash intensive large field (broadcasting)	North	Nanton	2,100
Bunded inland valley	Bunded inland valley	Ashanti	Ahafo Ano south	3,636
Unbunded inland valley	unbunded inland valley high input	Ashanti	Ejisu Jauben	2,545
Unbunded inland valley	Unbunded inland valley low input	Ashanti	Ejisu Jauben	1,455
Upland	Upland	Volta	Hohoe	1,260

In term of productivity per area, Figure 10 shows the value of the yield that has been retained for each type of system. The yields are consistent with the degree of intensification, the highest yield

being achieved in irrigated systems and the lowest in upland and unbunded lowland cropping system.

Figure 10: Yield retained in farmer's representative budget



The cost structure computed from each representative budget is consistent with the type of cultural practices followed (Figure 11). Fixed cost represents only a minor share of the total cost (on average 4%) with the exception of unbunded inland valley low input system where the share of fixed cost is relatively higher due to the limited amount of cash invested in rice cultivation. Other costs are only accounted for in irrigated systems and include the payment of irrigation fee. The two major categories of cost are the payment of labour (43% on average) and the purchase of material inputs such as fertilizer and other chemical (34% on average). The category "services" mainly includes the payment for the utilization of machines (tractor, combine harvester), which are mainly use in the Northern region on irrigated and lowland rice field, as a substitute to the utilization of human labour.

Figure 11: Farmer cost structure

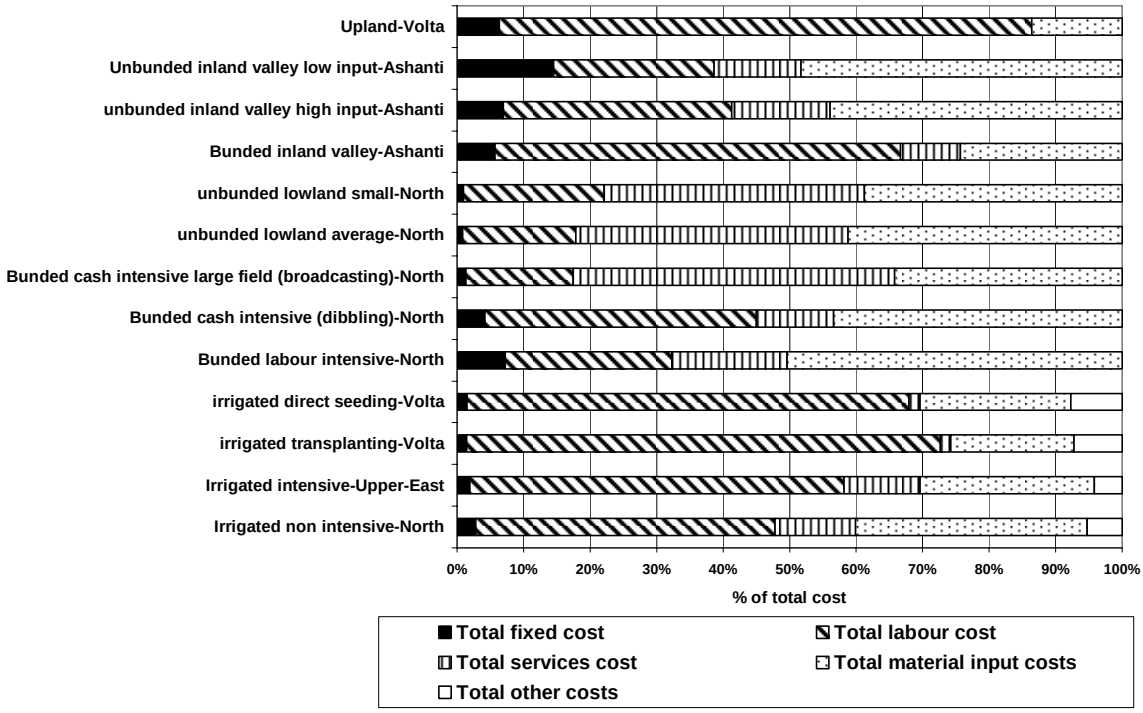


Table 10 presents the total cost, revenue and derived net income (i.e. total revenue – total cost) obtained from each representative budget. As expected, the highest cost per acre are recorded for the most input intensive system (irrigated and bunded inland valley) with an amount that varies from 2,100,000 Cedi/acre up to 5,500,000 Cedi/acre. For less intensive cropping systems, the amount paid per acre remains below 2,000,000 Cedi/acre, the lowest cost being achieved by the upland cropping systems which rely mainly on farmers' own labour and use a limited amount of agricultural input. It is worth noting that total cost for irrigated rice is much higher in the South than in the North. This is due to the higher price paid to perform some agricultural operation (land preparation), the highest cost for labour (around 15,000 Cedi/day in the north against 20,000 Cedi in irrigated areas in the South) and the payment of some agricultural operations that are carried out by the farmer himself in the North (nursery preparation).

Table 10: Farmers major financial indicators

Main type	System	Region	Total cost per acre	Total revenue per acre	Net income per acre	Return to cash
Irrigated	Irrigated non intensive	North	2,115,783	3,872,000	1,756,217	0.8
Irrigated	Irrigated intensive	Upper-East	3 622 983	4,928,000	1,305,017	0.4
Irrigated	Irrigated transplanting	Volta	5 536 039	5,566,667	30,627	0.0
Irrigated	Irrigated direct seeding	Volta	5,152,551	5,566,667	414,115	0.1
Bunded lowland	Bunded labour intensive	North	1,151,570	1,800,000	648,430	0.6
Bunded lowland	Bunded cash intensive (dibbling)	North	1,982,210	2,400,000	417,790	0.2
Bunded lowland	Bunded cash intensive large field (broadcasting)	North	1,489,500	2,400,000	910,500	0.6
Unbunded lowland	Unbunded lowland average	North	1,527,500	1,700,000	172,500	0.1
Unbunded lowland	Unbunded lowland small	North	1,610,000	2,000,000	390,000	0.2
Bunded inland valley	Bunded inland valley	Ashanti	4,230,000	4 500,000	270,000	0.1
Unbunded inland valley	Unbunded inland valley high input	Ashanti	2,395,500	3,150,000	754,500	0.3
Unbunded inland valley	Unbunded inland valley low input	Ashanti	1,160,000	1,800,000	640,000	0.6
Upland	Upland	Volta	777,433	1,500,000	722,567	0.9

The return to cash ratio (net income/total cost) allows to compare the profitability across the various cropping systems. The highest return to cash is recorded by the upland cropping system in the Volta region and the irrigated non-intensive cropping system in the North (Figure 12).

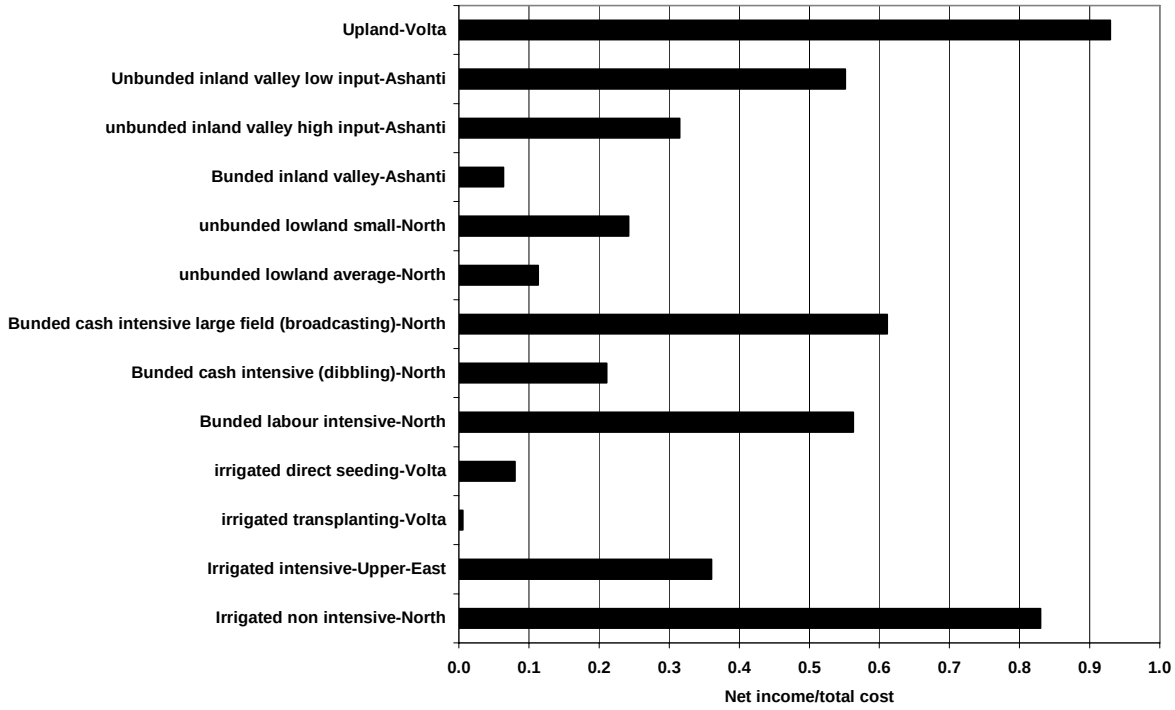
In the case of the upland, the high return to cash invested is due to the limited amount of cash invested since the production technique relies mostly on farmer's own labour. Thus in this case, the return to farmers' own labour is a better indicator of the profitability of the system. In the Upland Volta system, the estimated return to farmer's own labour is at 14,000 Cedi per day of labour, which is commensurate with the prevailing agricultural daily wage rate (15,000 Cedi per day).

In the case of the bunded labour intensive cropping system in the Northern region, the computed return to farmers' own labour is at 9,000 Cedi per day, which is lower than the local prevailing agricultural labour wage rate (varying from 15,000 to 20,000 cedi per day depending upon the type of task). This gap suggests that the lack of capital for investing in complementary means of production (paid labour, mechanized ploughing…) cannot be compensated only by a higher contribution of farmers' own labour.

The return to cash ratio remains very low for irrigated system in the South and bunded inland valley system in the Ashanti region, indicating that the additional resources invested in those capital intensive systems are not covered by a commensurate production and revenue increase. In other words, the value of the income generated by the production increase obtained through investment in water control technique, is inferior to the value of additional costs associated with these cropping systems, compared to low input system such as unbunded inland valley.

In the North, even though irrigated systems have a higher profitability than low input technologies, it is worth noting that the intensive irrigated system has a lower profitability (return to cash 0.4) than the non-intensive irrigated cropping system (return to cash 0.8) which is another illustration of the constraint faced by intensification process in combining both yield and profitability improvement.

Figure 12: Return to cash invested by cropping system



Besides productivity increase, risk management is another justification pursued by investing in improved technologies, in particular for water management. The level of profitability computed from the representative budget are by definition a static image of the corresponding cropping system performance and do not take into account yield variation that could be much higher in

rainfall-dependent systems than in systems that can control water at least partially. In order to reflect the sensitivity of each cropping system to yield or price variation, break even points have been computed for major cropping system (Table 11) The break even point is the value of given variable (yield, paddy rice price) for which the net income is nil. The sensitivity of each cropping system to yield or price variation is consistent with the level of profitability, the higher the profitability, the higher yield or price decrease can be absorbed by the cropping system before making losses. Besides the most profitable systems (irrigated non-intensive, bunded lowland and upland), the profitability of the other systems can rapidly be jeopardized by minor changes in yield or output price level, indicating that rice cultivation remain a rather risky activity in financial terms.

Table 11: Break-even value for yield and output price for selected cropping system

Ecologies	System	Region	Price of output	Yield Kg/Ha	Break even output price	Break even yield	Variation
Irrigated	Irrigated non intensive	North	220,000	3,740	110,236	1,963	-50%
Irrigated	Irrigated direct seeding	Volta	280,000	4,175	259,578	3,690	-6%
Bunded lowland	Bunded labour intensive	North	200,000	1,763	81,777	405	-59%
Bunded lowland	Bunded cash intensive (dibbling)	North	200,000	2,075	160,000	798	-19%
Unbunded lowland	Unbunded lowland average	North	200,000	2,520	173,000	1,571	-13%
Bunded inland valley	Bunded inland valley	Ashanti	450,000	3,636	422,000	3,394	-6%
Unbunded inland valley	Unbunded inland valley high input	Ashanti	450,000	2,545	342,214	1,867	-23%
Upland	Upland	Volta	250,000	1,260	129,572	653	-48%

4.1.3. Rice marketing profitability

A series of 16 representative budgets have been developed for marketing activities as displayed in Table 12. The corresponding traders have been primarily differentiated on the bases of the geographical scope of their activity, as transport cost is a major determinant of the total cost of

any marketing activities. Four categories of trader have been retained from the initial typology (cf 3.2.2), which includes:

- Local trader that operates within a range of 50 km corresponding more or less to a district boundaries and who supplies mainly consuming centres and market hubs from the surrounding rural areas.
- Regional trader operates on larger distance (below 100km) corresponding broadly to a region administrative boundaries, having a position rather similar to the one fulfilled by local traders in terms of marketing functions.
- Inter-regional trader operates on longer distance (above 100 km). This category of trader is in charge of linking region that have rice surpluses to major consuming centre.
- A fourth group of budgets has been specifically computed for retailers that operate exclusively in major urban consumers market on a daily basis. While three retailer budgets have been computed from original budget based on trader interviews, a fourth retailer representative budget has been developed for parboiled rice retailing in Tamale in order to fully represent the marketing chain from the farmer to the consumers. This fourth budget is derived from other retailer budget adjusted to take into account the prevailing price in the Northern region for specific marketing operation (bag loading and unloading, transport…) that has been recorded for other category of trader in the same area.

The second criteria retained for differentiating among the representative budgets are the type of product purchased and sold (Paddy rice, Milled rice, Parboiled milled rice). Rice parboiling being considered as embedded within marketing activity, they have been included in the representative budget of traders operating in the North. This option allows limiting the number of broad categories of agent to be taken into consideration. When the original budget reported that the trader resales indifferently Paddy or Milled rice, representative budget was developed for each product sold separately.

The reported total volume of bag marketed per year is not necessarily determined by the category of trader, as regional traders can report a total volume of bag marketed comparable or even higher than the quantity of bag marketed by inter-regional trader. On average the representative budget developed assume that a retailer handle around 148 bags of milled rice (a bag 50kg), while a local trader would handle 425 bags of paddy (a bag of 84 kg), a regional trader 2600 bags of paddy rice and a inter-regional trader 3100 bag of Paddy rice.

Table 12: List of trader representative budgets

Category	Practice	Region	Total output per year	Total out unit
Retailer	Retailer Milled rice	Accra	60	Bags/year
Retailer	Retailer Milled rice	Ashanti	150	Bags/year
Retailer	Retailer Imported rice	Ashanti	300	Bags/year

Category	Practice	Region	Total output per year	Total out unit
Retailer	Retailer - Parboiled milled rice	North	80	Bags/year
Local	Local - Milled rice local trader (rural areas)	Ashanti	100	Bags/year
Local	Local Paddy - improved parboiled milled rice trader	North	200	Bags/year
Local	Local - Paddy - Milled rice trader	South	1000	Bags/year
Local	Local - Paddy - Milled rice trader	Volta	400	Bags/year
Regional	Regional - Paddy - milled rice trader local	Ashanti	400	Bags/year
Regional	Regional- Paddy rice trader local	North	7000	Bag/year
Regional	Regional - Paddy - parboiled milled trader	North	2315	Bag/year
Regional	Local - Paddy- milled rice trader	South	1000	Bag/year
Inter-regional	Inter-regional Milled rice trader	Accra	1000	Bag/year
Inter-regional	Inter regional - Paddy - milled rice (own transport)	Ashanti	6160	Bag/year
Inter-regional	Inter-regional - Paddy - parboiled milled rice trader	North	4500	Bag/year
Inter-regional	Inter-regional - Paddy - milled rice trader	Volta	1000	Bag/paddy

As expected, the purchase of the product being marketed by the trader represents the largest share of the total costs associated with the marketing activities (Figure 13). When marketing activities do not involve any processing operation (parboiling, milling), such as in the case of retailers or local trader buying and selling milled rice, the share of the rice purchase represents around 95% of the total marketing cost, while in the case of trader purchasing paddy rice and selling milled rice the share of paddy rice purchase represent on average 85%.

Figure 14 presents the structure of the marketing cost without the paddy or rice milled purchases, which provides a more accurate illustration of the resources mobilized for marketing rice. Payment for services, including transport and processing (milling), represents on average 45% of the total marketing cost (without rice purchase), followed by labour cost (23%) while the purchase of material inputs (beside rice purchase), others costs and fixed cost represent on average 10%.

Figure 13: Traders - Cost structure

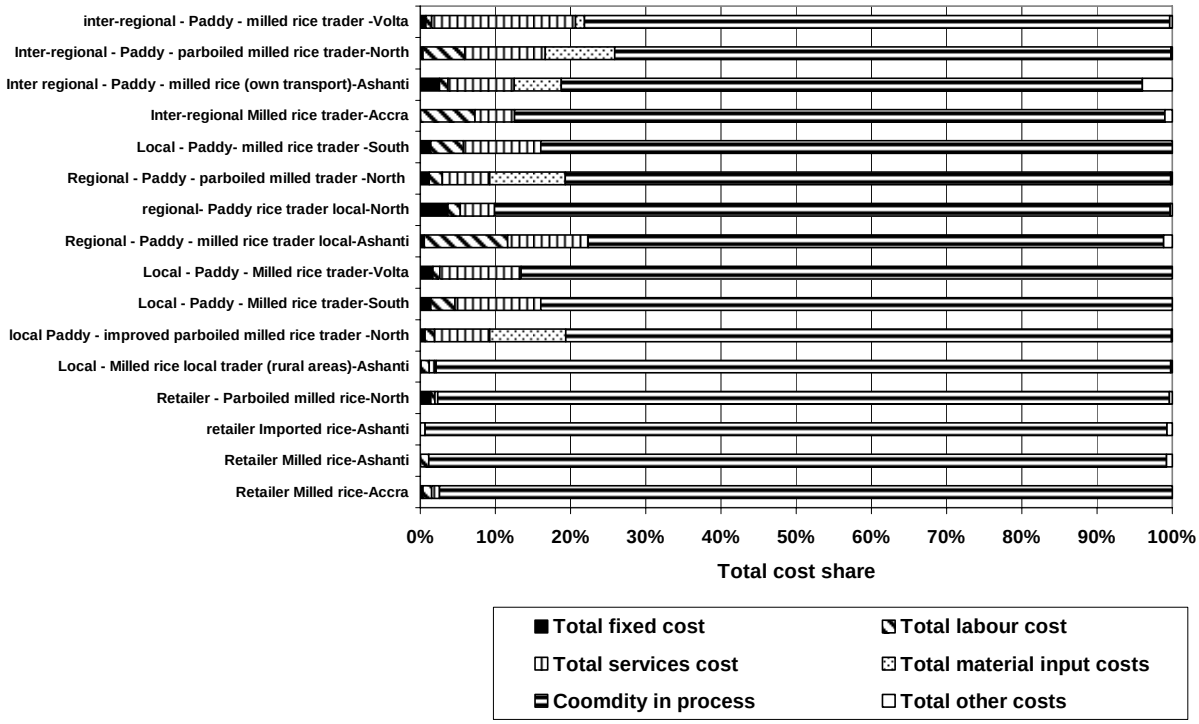
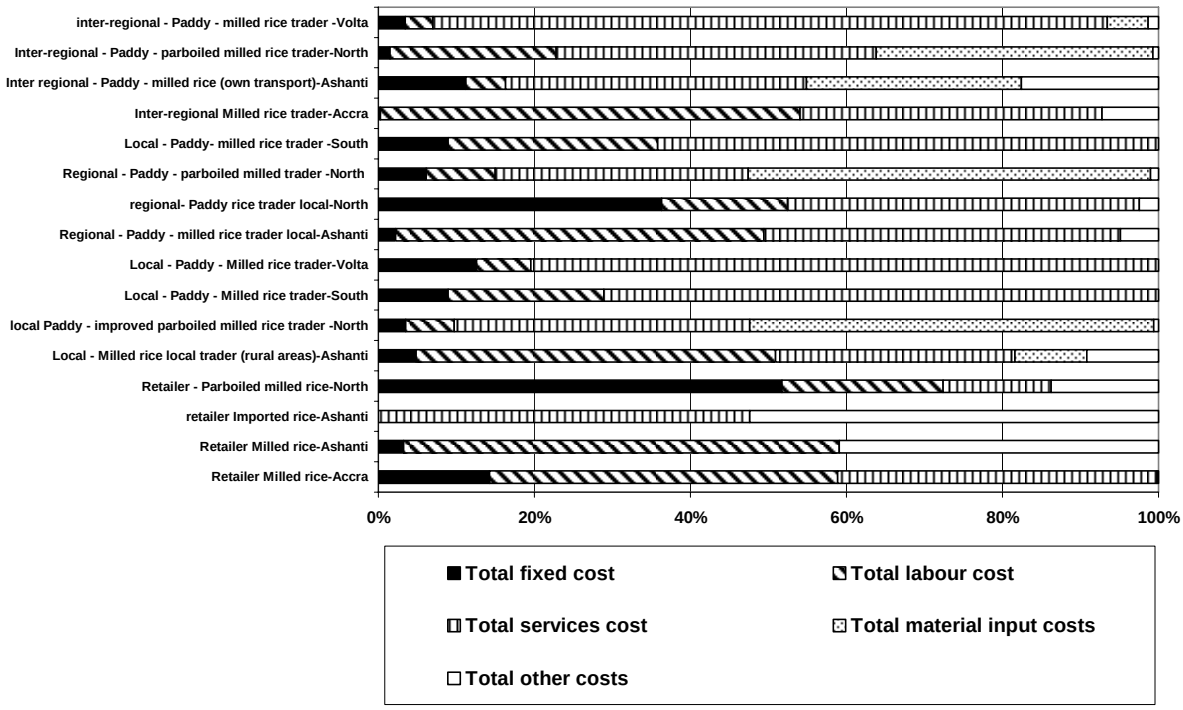


Figure 14: Trader – Cost structure without Paddy or Milled rice purchase



The average marketing cost per bag, without rice purchases varies from an average of 9,500 Cedi/bag for the retailer 38,000 Cedi/bag for the local trader, 46,000 Cedi/bag for the regional trader and up to 65,000 Cedi/bag for inter-regional trader. The lower marketing cost for retailers

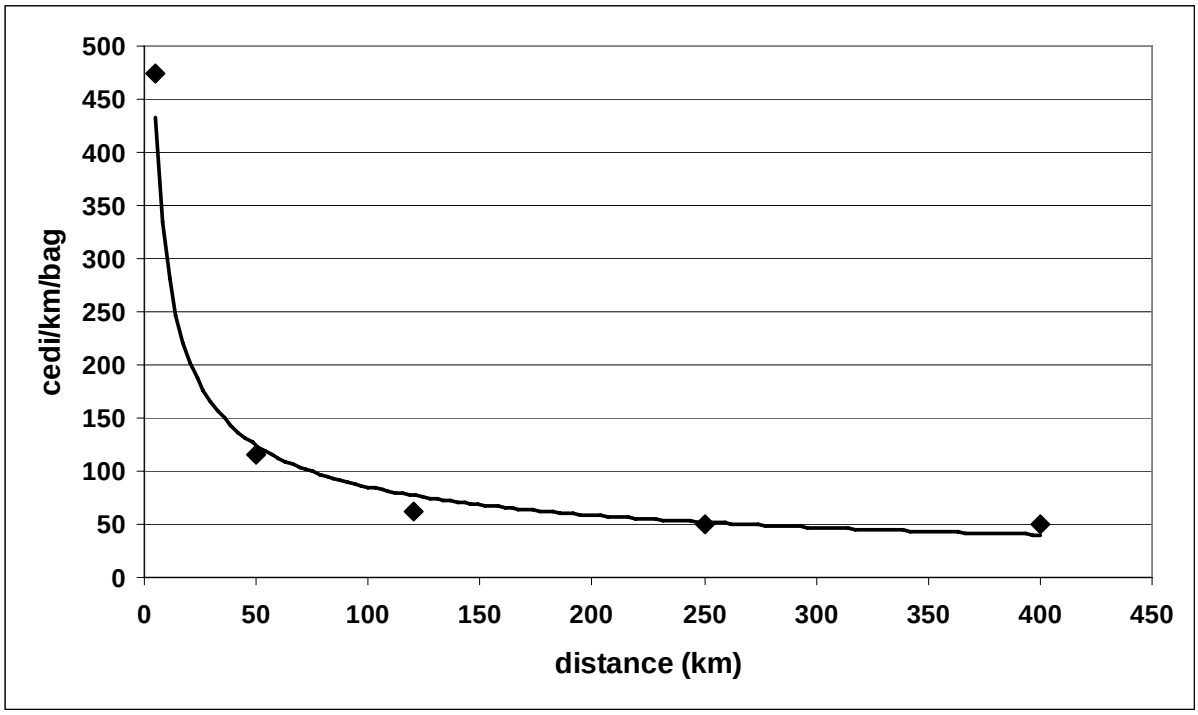
is due to the fact that retailer do not have to pay for processing and market their product on short distance.

The differences between the marketing costs per bag for the other category of traders are less important because there are economies of scales in transport. Based on the various transport cost recorded during the surveys, an average cost per kilometre per bag was computed for three clusters of distance (Table 13 and Figure 15) indicating that when the shipment distance increases, the transport cost per km for one bag decreases due to the utilization of vehicle of higher capacity, better roads for inter-regional and possibly a higher level of competition. Transport cost in traders representative budgets have been computed on the bases of these unit price per kilometre for the shipment of one bag.

Table 13: Transport cost per bag per kilometre per shipment distance

Distance	Cedi	Unit
0 km - 5 km	500	Cedi/km/bag
5 km - 50 km	100	Cedi/km/bag
100 km and more	50	Cedi/km/bag

Figure 15: Transport cost per bag and distance



The marketing cost without the rice purchase, represents the most stable component of the trader's cost structure, since transport rates and milling fee level do not vary suddenly and are rather fixed at short/mid-term. Therefore the profitability of the marketing activities is much

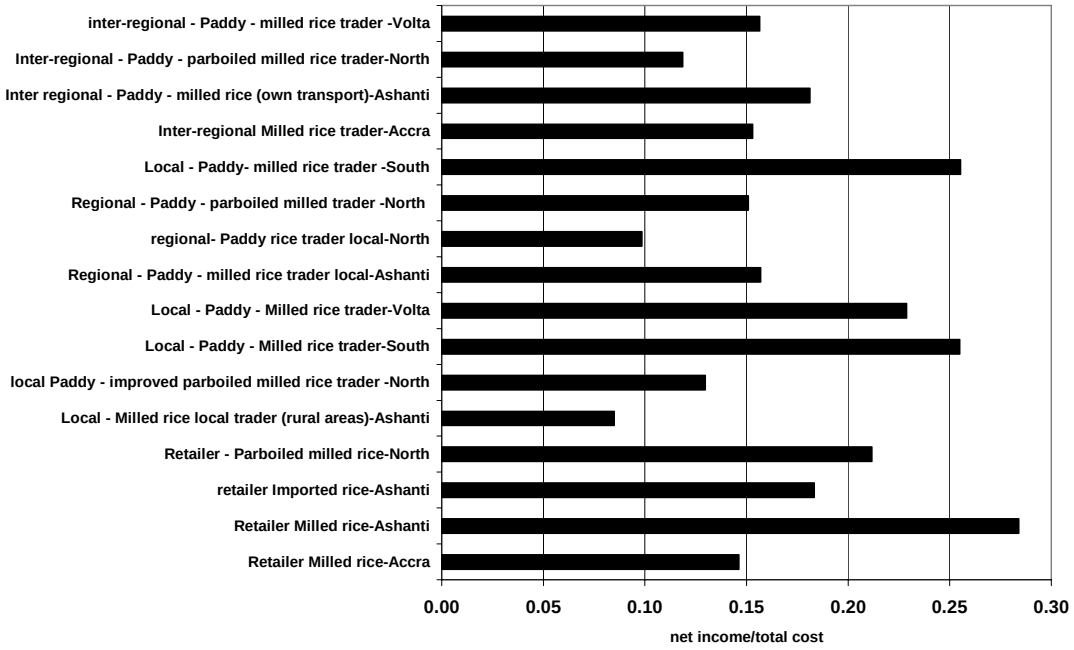
more sensitive to the margin between the rice purchasing price and selling price which are much less stable. The ratio of return to cash derived from the representative budget varies between 0.08 up to 0.26 (Table 14 and Figure 16). These figures are subject to variation depending upon the prices selected for the paddy rice purchase and selling which may vary according to the location, the period of reference and the quality and type of rice marketed (straight milled, parboiled). Under the current price system adopted for computing the representative budgets (4.2.3) the average return to cash is at 0.21 for retailer, 0.17 for local and regional trader and down to 0.15 for inter-regional trader, which is consistent with the ranking observed in other similar marketing systems. The lower return to cash invested for the lager trader is compensated by the larger volume of product marketed.

Table 14: Trader Major Financial indicator

Main type	System	Region	Total cost	Total revenue	Total net income	Return to cash	Marketing cost per bag (without rice purchases)
Retailer	Retailer Milled rice	Accra	20 937 700	24,000,000	3,062,300	0.15	8,962
Retailer	Retailer Milled rice	Ashanti	84 112 500	108,000,000	23,887,500	0.28	10,750
Retailer	Retailer Imported rice	Ashanti	91 260 000	108,000,000	16,740,000	0.18	4,200
Retailer	Retailer - Parboiled milled rice	North	42 760 000	51,809,524	9,049,524	0.21	14,500
Local	Local - Milled rice local trader (rural areas)	Ashanti	46 085 833	50,000,000	3,914,167	0.08	10,858
Local	Local Paddy - improved parboiled milled rice trader	North	49 656 333	56,100,000	6,443,667	0.13	48,282
Local	Local - Paddy - Milled rice trader	South	333 534 000	418,600,000	85,066,000	0.26	53,534
Local	Local - Paddy - Milled rice trader	Volta	115,529,200	141,960,000	26,430,800	0.23	38,823
Regional	Regional - Paddy - milled rice trader local	Ashanti	104,582,500	121,000,000	16,417,500	0.16	61,456
Regional	Regional- Paddy rice trader local	North	1,401,804,787	1,540,000,000	138,195,213	0.10	20,258
Regional	Regional - Paddy - parboiled milled trader	North	575,237,792	662,090,000	86,852,208	0.15	48,483
Regional	Local - Paddy- milled rice trader	South	333,465,333	418,600,000	85,134,667	0.26	53,465
Inter-regional	Inter-regional Milled rice trader	Accra	346,900,000	400,000,000	53,100,000	0.15	46,900

Main type	System	Region	Total cost	Total revenue	Total net income	Return to cash	Marketing cost per bag (without rice purchases)
Inter-regional	Inter regional - Paddy - milled rice (own transport)	Ashanti	1,993,172,262	2,354,352,000	361,179,738	0.18	73,567
Inter-regional	Inter-regional - Paddy - parboiled milled rice trader	North	1,216,961,667	1,361,250,000	144,288,333	0.12	70,436
Inter-regional	Inter-regional - Paddy - milled rice trader	Volta	321,050,000	371,280,000	50,230,000	0.16	71,050

Figure 16: Trader – return to cash by type of trader



4.1.4. Rice milling profitability

Three representatives budgets have been developed for paddy milling activities, two concerning the most simple technology (Engelberg horizontal steel roller) and one for the more sophisticated milling technique based on rubber roller (table 8). Based on information collected from resources persons and literature, the corresponding recovery rate has been fixed to 55 kg of milled rice obtained from 100 kg of paddy rice in the case of the Engelberg technology and to 65 kg of milled rice from 100 kg of paddy rice for the rubber roller technology (Inpho FAO database).

The distinction among the representative budget for the Engelberg mill is based on the milling capacity. In the Northern region the representative budget refers to a mill with two milling

machines with a combined hourly capacity milling capacity of 500 kg of paddy rice, while the representative budget for the Engelberg mill in the Ashanti region refers to a smaller workshop where only one machine operates with an hourly milling capacity of 250 kg/hours. The representative budget for the rubber roller technology is based on a milling throughput of 1000 kg per hours, although the same technology can be used for lower or higher capacity.

The total volume of paddy milled per year by each workshop varies according to their size, with 500 bags processed by the smaller mill, 2000 bags per for the larger mill using the Engelberg type technology and 3000 bags for the mill using the rubber roller technology. These figures are in line with the level of activity observed and recorded during the survey in each region and for each type of technology, although the level of capacity utilization varies sharply from one mill to another, certain mill being able to process more than 5000 bags of paddy per year while others only processed a few hundreds.

Table 15: Millers representative budget

Main type	System	Region	Milling throughput (kg/hour)	Recovery rate Milled rice/Paddy rice	Volume processed per year (bags)
Small-scale	Small mill (Engelberg) 1 line	Ashanti	250	55%	1000
Small-scale	Small mill (Engelberg) - 2 processing line	North	500	55%	2000
Large-scale	Medium mill (Rubber roller)	Volta	1000	65%	3000

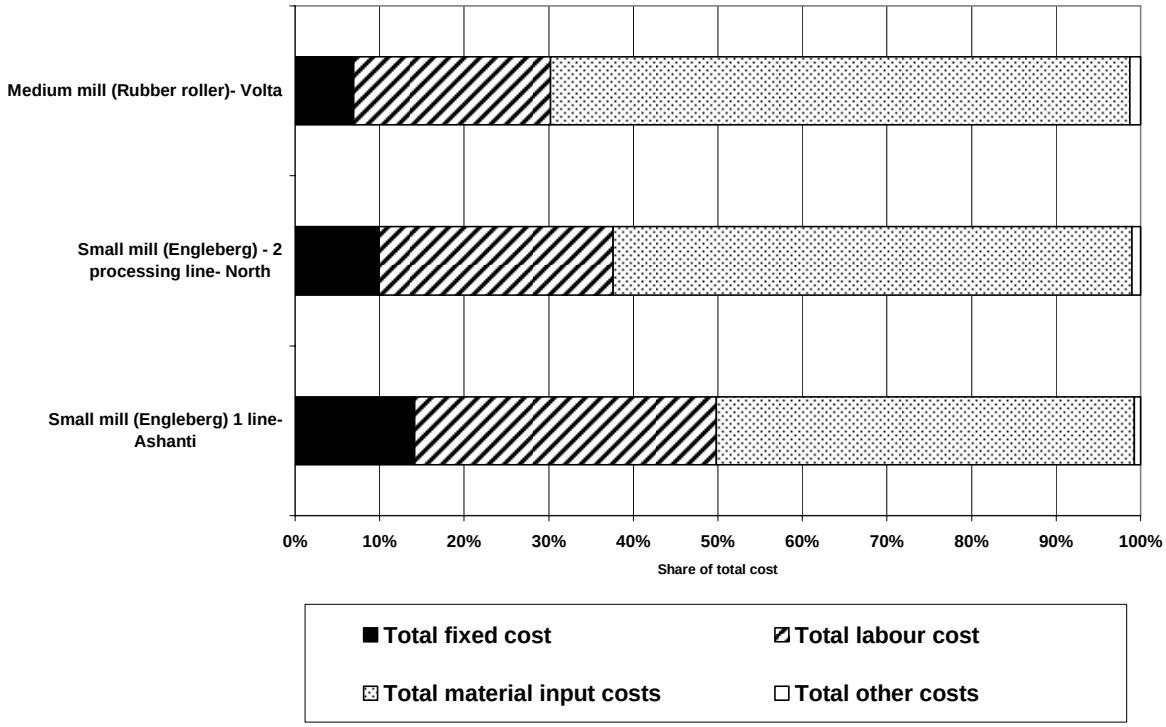
The cost structure for each type of mill is presented in the Figure 9. The share of material input cost increases with the level of capacity or technical efficiency of the mill (from 50% to 70%). The increasing throughput of the machines and the higher total quantity of bags processed increase the productivity of the labour allocated to the mill. For instance, the operation of a rubber roller mill with a capacity of 1,000 kg/hour does not require to multiply the number of permanent employees by 4 compared to the manpower required to operate a 250 kg/hours Engelberg mill. The increasing share of material input cost which includes mainly energy cost and spare parts purchase is also due to the fact that spare parts are more expensive in the case of rubber roller technique, because they are imported, than for the Engelberg mill because they can be produced locally.

The recording of the spare parts purchases was uneven among interviews, as it is determined by the miller practices, the current condition of the equipment, the quality of the paddy processed (foreign matter content for example), the origin (locally made or imported) of the spare part purchased. Rather than attempting to develop a comprehensive list of spare part and lubricant purchased for each type of mill, an aggregated value has been computed on the bases of the original budget, divided by the number of bags processed on annual. It is assumed that the normal wearing out of the spare parts is commensurate with the actual utilization of the equipment and therefore with the number of bags processed. For the Engelberg mill the cost of

spare parts and lubricant purchase was estimated at 2,000 C per paddy rice bag processed, while for the rubber roller the cost was estimated at 10,000 C per bag to reflect the higher cost of the spare parts, and also their faster deterioration, since according to information provided by millers this equipment is more sensitive to the quality of the raw material.

The cost of energy was estimated on the bases of the hours of operation reported in the original budget. For the Engelberg technology, the energy price was estimated at 15,000 Cedi /hour, while for the rubber technology the energy cost was estimated at 40,000 Cedi/hour to reflect the higher level of energy required.

Figure 17: Miller cost structure



The fee paid to the miller by traders or farmers to process its paddy into milled rice varies across the country and depends upon the terms of the contract (quantity processed, reference to the milled or the paddy rice). In the Northern region the reported custom rate for milling varies between 8 000 to 12 000 Cedi per bag of paddy rice. In the Ashanti region, since the paddy is in many cases, milled by the farmer before marketing his product, the reference used is the quantities of milled rice retrieve (10000 C per bucket of 32 kg of milled rice) which is equivalent to 13000 Cedi per bag of paddy (Table 16). In the Volta region a wider range of milling fee prevails from 18000 C/ bag up to 40000 C/bag of paddy rice. These variations are also due to the higher heterogeneity of the type of technology installed in this region, since several mills are equipped with destoner and grading devices. However the information collected did not allow to clearly associate the level of the fee with the type of processing services provided by the miller. The representative budget for the rubber miller technology is based upon a milling fee of 25 000 cedi/ bag of paddy rice.

Table 16 presents the cost and revenue computed from the three representative budgets. Under the current estimations of cost and income on the bases of which the budgets have been developed the three millers make profit. It should be noted, however, that in the three systems, the milling fee is almost equal to the processing cost per bag. In general the miller keeps the rice bran jointly produced through the paddy milling and sold it as animal feed. This additional source of income plays a critical role in the financial viability of the milling business.

Table 16: Miller financial indicator

System	Region	Total cost	Total revenue	Total net income	Processing cost per bag	Milling fee	Unit of reference for the milling fee	Equivalent to paddy bag
Small mill (Engelberg) 1 line	Ashanti	15,260,000	17,119,048	1,859,048	15,260	25,000	Rice bag 80 kg	13,000
Small mill (Engelberg) - 2 processing line	North	23,140,000	26,857,143	3,717,143	11,570	10,000	Paddy bag 84 kg	10,000
Medium mill (Rubber roller)	Volta	70,396,667	91,500,000	21,103,333	23,466	25,000	Paddy bag 84 kg	25,000

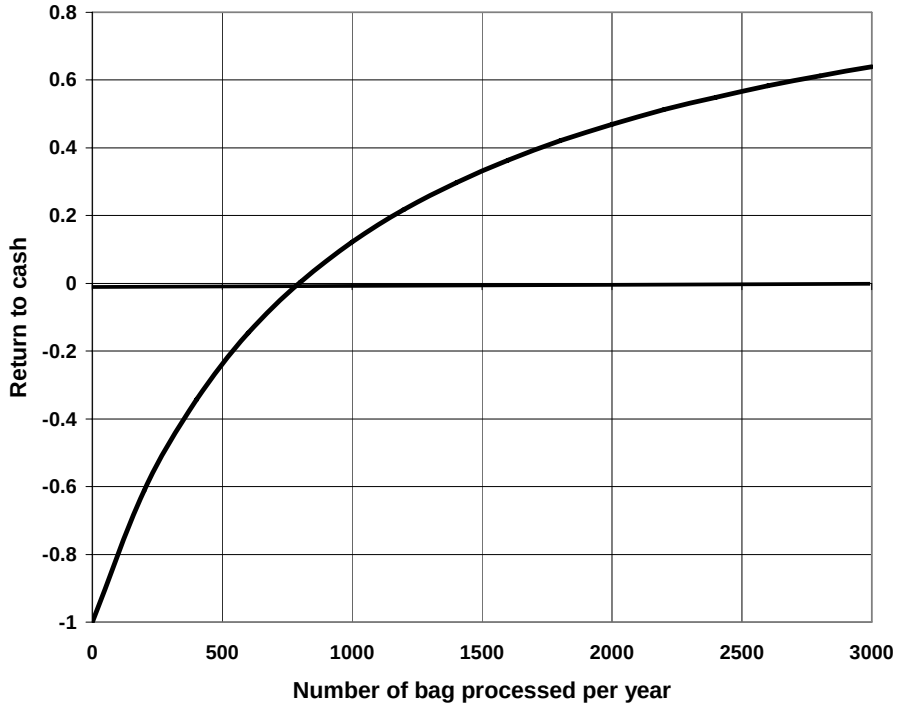
Unlike the other agents involved in the production and the marketing of rice, the profitability of milling business is not threatened by the uncertainty of variables such as yield or market price since their cost structure and income level is rather stable at least within the span of one year. One of the major constraints for the milling business is to attract enough customers and thus process a large volume of bags in order to recover the value of the costs that have been invested to offer the service. These cost that the millers have to bear before starting its operation are qualified as "sunk costs". They includes the fixed cost corresponding to the machine and premises but also a part of the labour costs, since the operation of the machine requires some expertise and that the operator (which is not necessarily the owner of the mill) is generally paid on a permanent basis (monthly wages). For the larger installation, additional employee might be recruited such as watchman, clerk… In certain cases, even unskilled labourers used for handling the bags are also paid on a monthly basis rather than on a bag basis.

The sensitivity of the profitability of each type of mill to the number of bags processed is presented in Table 17. Under the current costs and incomes level on the basis of which the representative budget has been developed, the small mill would not recover its sunk costs if the number of bags processed per year decreases by 21% in Ashanti region and 32% in the Northern region. The higher return to cash derived from the current representative budget explains that the rubber roller mill can sustain a larger reduction of the volume processed, from 3000 bags down to 1677 bags. The figure below illustrates the same constraint in a more dynamic perspective by showing the return to cash achieved for different volume of bags process during the year.

Table 17: Miller return to cash and break-even points in terms of capacity utilisation

System	Region	Return to cash	Current volume processed (bag per year)	Number of bag required to break-even	Variation
Small mill (Engelberg) 1 line	Ashanti	0.12	1,000	795	-21%
Small mill (Engelberg) - 2 processing line	North	0.16	2,000	1359	-32%
Medium mill (Rubber roller)	Volta	0.37	3,000	1677	-44%

Figure 18: Impact of the level of millers' capacity utilization on profitability (Small mile Engelberg 250 kg/hour capacity)



4.1.5. Concluding remarks

The objective pursued by the costing of the different operations associated with production, marketing and processing of rice is to provide a basis for analyzing the current level of profitability achieved by the various agents. The development of representative budget for various practices, technology and location offers a comprehensive framework that allows to further identifying key issue that are determinant for the profitability of each operation. In the case of rice farming yield and output price are critical variables, while it is the price differential in the case of marketing activity and the capacity utilization in the case of rice milling.

The reliability, the accuracy and comprehensiveness of the dataset collected to develop these representative budgets impact on the reliability of the ratio computed and were subject to the

short time available to collect the primary data and build the original budget. While the quality of the data and the derived profitability ratio can be further improved, this set of representative budget provides a consistent initial base of costs to further analyze the financial performance of the various commodity sub-systems identified.

4.2. Profitability of rice commodity chain representative systems

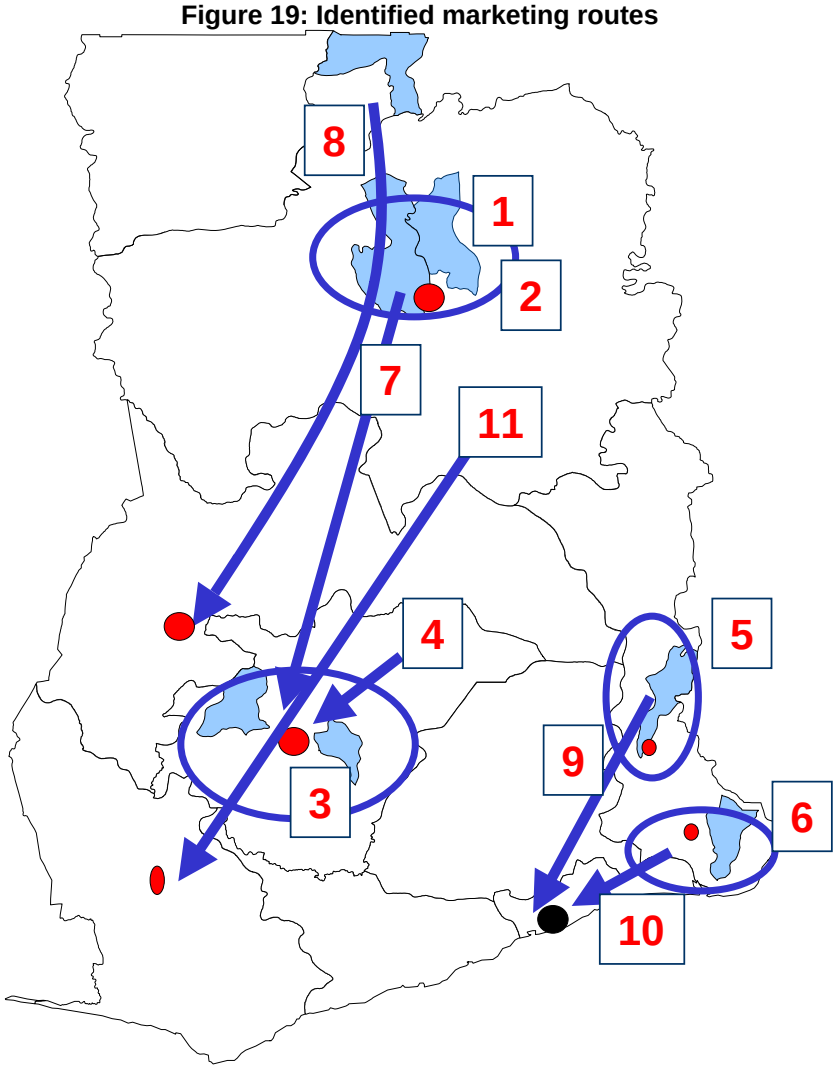
The commodity chain concept refers to the interdependence between farming, marketing and processing activities considered as one system integrating the successive technical operations required delivering milled rice to the consumers. Therefore, the analysis of the performance of the rice economy should take into account the profitability of the various systems that constitute the whole local rice economy.

After introducing the characteristics of the systems that has been retained for the analysis, the method applied to build up consolidated budget at the system level and the price system used as a reference, this section will present, compare and discuss the profitability and the cost structure of the selected rice systems.

4.2.1. Selected representative systems

The systems retained for the financial analysis correspond to the various marketing routes identified through the characterization of the rice commodity chain. Eleven systems combining a set of agents have been selected as displayed on the Table 18. The systems are numbered according to marketing route displayed in Figure 19.

Figure 19: Identified marketing routes



Each system is composed of one type of rice farmer, one or two traders, depending upon the distance and the marketing conditions, and a rice milling technique. For each major market area (North, Ashanti and the southern part of the country) the selection intends to represent various range of marketing from the local (short distance), to the regional (medium distance marketing) and up to the inter-regional marketing (long distance).

In each area one type of cropping system at the farm level has been selected based on the discussion held with the various resource persons and information available in the literature. In the Northern area the "unbunded lowland average area system" and the non intensive irrigated system" have been selected, while "unbunded inland valley high input" has been retained for the Ashanti region; "upland" and " irrigated direct seeding" for the Volta based production areas. A larger set of cropping system could have been included, but this would have increased the computation load without necessarily bringing in any particular additional knowledge then the outcome of the comparison of cropping system financial viability based on the analysis of the representative system (cf. 4.1.2 of the financial analysis).

On the bases of these types of rice farm, each system includes one or two type of traders selected according to their range of operation (local, regional, inter-regional) and on their functions. Retailer have been included in the case of systems supplying major urban market whereas for systems linking farmers to consumers based in rural areas or to less densely populated urban fringes, no retailer have been included in the system. The milling system has been selected on the bases of the location of the selected rice farm, as the long distance paddy rice trade seems to be very seldom.

In the case of parboiled paddy rice for the local Northern market, two systems have been included to take into account the different processing technique for parboiling.

Table 18: Characteristics of the selected systems

Nb	System name	Marketing range	Origin	Destination	Farmer	Trader 1	Trader 2	Milling system
1	Northern to Tamale local improved paraboil	Local	Tolon/ Nanton	Tamale	Unbunded lowland average	Local Paddy - improved parboiled milled rice trader	Retailer - Parboiled milled rice	Small mill (Engelberg) - 2 processing line
2	Northern to Tamale regional normal paraboil	Regional	Tolon/ Nanton	Tamale	Unbunded lowland average	Regional - Paddy - parboiled milled trader	Retailer - Parboiled milled rice	Small mill (Engelberg) - 2 processing line
11	Northern to Central	Inter-regional	East Gonja	Central region	Unbunded lowland average	Inter-regional - Paddy - milled rice trader local	Retailer Milled rice	Small mill (Engelberg) 1 line
8	Upper east to Techiman	Inter-regional	Kassina	Techiman	Irrigated non-intensive	Inter-regional - Paddy - parboiled milled rice trader	Retailer Milled rice	Small mill (Engelberg) - 2 processing line
7	Northern to Kumasi	Inter-regional	Tolon/ Nanton	Kumasi	Unbunded lowland average	Inter-regional - Paddy - parboiled milled rice trader	Retailer Milled rice	Small mill (Engelberg) - 2 processing line
3	Ashanti local market	Local	Ahafao / Ejisu	Ashanti rural market	Unbunded inland valley high input	Local - Milled rice local trader (rural areas)		Small mill (Engelberg) 1 line
4	Ashanti regional to Kumasi	Regional	Ahafao / Ejisu	Kumasi	Unbunded inland valley high input	Local - Milled rice local trader (rural areas)	Retailer Milled rice	Small mill (Engelberg) 1 line
5	Volta local market	Local	Hohoe	Hohoe	Upland	Local - Paddy - Milled rice trader		Medium mill (Rubber roller)
9	Volta to Accra	Inter-regional	Hohoe	Accra	Upland	Inter-regional - Paddy - milled rice trader	Retailer Milled rice	Medium mill (Rubber roller)
6	South local market	Local	Afife	Akatsi	Irrigated direct seeding	Local - Paddy- milled rice trader		Medium mill (Rubber roller)
10	Afife to Accra	Inter-regional	Afife	Accra	Irrigated direct seeding	Inter-regional - Paddy - milled rice trader	Retailer Milled rice	Medium mill (Rubber roller)

4.2.2. Consolidation method

The development of a consolidated budget to compute the profitability of each system and its cost structure rely on the representative budget developed for each type of agent. A specific format has been developed on Excel to speed up the computation process and ensure homogeneity and consistency in the computation method. A simplified version of the spreadsheet organization and computation rationale is presented in Table 19.

Converting the representative budget in homogenous unit

Since each individual budget can be developed in reference to various unit and scale of production such as a planted areas or the average volume of product marketed for one rotation or one year, it is important to convert them into the same unit of measure. Therefore the corresponding value for each major accounting category is divided by the volume of product that is sold by the agent in kilogram and reported in the column "Kg budget 1, 2, 3".

Converting the budget value into one common product of reference

The commodity system follow the process through which the raw material (paddy rice) becomes a product that can be used by the consumers (milled rice) and hence include the various form under which the commodity is traded along the chain. It is therefore necessary to convert all the accounting value into a common equivalent product, which is usually the final output of the system, i.e. the milled rice purchase by the final end users (consumers, street food vendors, restaurant, school, institutions…). This is done by applying the conversion rate between the Paddy rice and the milled rice. In the example hereafter, the producer budget has been developed for the production of paddy rice, while the traders' budget (Marketing 1 and Marketing 2) has been developed for the marketing of milled rice (the paddy rice is processed into milled rice at the marketing 1 stage). Therefore the conversion into common equivalent product (i.e. milled rice) is necessary for the producer Budget. Since the conversion rate from the paddy rice to the milled rice is of 0.55 kg of milled rice from 1 kg of paddy, it means that we need 1.81 kg of paddy rice (1/0.55) to get 1 kg of milled rice. The accounting value per kg of paddy rice in the producer budget are converted accordingly (multiplied by 1.81) and reported in the column (kg of final output). No conversion is needed for the marketing budgets since their output is milled rice.

Consolidation of the accounting value

The consolidation process consist in aggregating all the cost converted into the same equivalent and to excluded, to avoid double counting, the value related to the transactions that occur between the agents of the systems which include on one side the purchase of paddy or milled rice (the budget item "Commodity in process") and on the other side the sale of paddy or milled rice to another agent of the system (i.e. the budget item "revenue"). The selected values for the consolidation are reported in the last column of the Table 19. The sum of all the cost and profit of the last column are equal to the revenue earned by the last agent of the system which is at the same time the revenue of the agent and the value of the final output of the system).

Table 19: Example of consolidation method

Budget 1: Producer

Accounting categories		*Quantity*	*Unit*	*Unit price*	*Value*	Kg budget 1	Kg final outp	System revenue breakdown
TOTAL FIXED INPUT					147 458	40	73	73
TOTAL LABOUR					2 382 000	644	1 172	1 172
TOTAL SERVICES					640 000	173	315	315
TOTAL MATERIAL INPUT					1 600 000	433	787	787
TOTAL OTHER COST					280 000	76	138	138
REVENUE	Paddy rice	44	85 kg bag	210 000	9 240 000	2 500	4 545	
PROFIT					4 190 542	1 134	2 061	2 061
	Paddy rice volume	*3 696*	*kg*					

Budget 2: Marketing 1

Accounting categories		*Quantity*	*Unit*	*Unit price*	*Value*	Kg budget 2	Kg final outp	
TOTAL FIXED INPUT					174 800	23	23	23
TOTAL LABOUR					2 500 000	324	324	324
TOTAL SERVICES					4 820 000	625	625	625
TOTAL MATERIAL INPUT					4 166 667	540	540	540
TOTAL OTHER COST					83 500	11	11	11
COMMODITY IN PROCESS	Paddy rice	167	85 kg bag	210 000	35 070 000	4 545	4 545	
REVENUE	Milled parboiled rice	92	85 kg bag	530 000	48 680 500	6 310	6 310	
PROFIT					1 865 533	242	242	242
	Milled parboiled rice	*7 715*	*kg*					
	Conversion rate Paddy to millec		*0.55*					

Budget 3: Marketing 2

Accounting categories		*Quantity*	*Unit*	*Unit price*	*Value*	Kg budget 3	Kg final outp	
TOTAL FIXED INPUT					52 500	4	4	4
TOTAL LABOUR					150 000	12	12	12
TOTAL SERVICES					450 000	36	36	36
TOTAL MATERIAL INPUT					0	0	0	0
TOTAL OTHER COST					120 000	10	10	10
COMMODITY IN PROCESS	Milled parboiled rice	150	85 kg bag	530 000	79 500 000	6 310	6 310	
REVENUE (Final output)	Milled parboiled rice	30 000	tin of 0.42 l	2 900	87 000 000	6 905	6 905	
PROFIT					6 727 500	534	534	534
	rice volume	*12 600*	*kg*	345 238				

SYSTEM total revenue	6 905

The consolidated account of the system is computed by aggregating the accounting value by categories as displayed in the Table 20. The system is represented as unique entities where all the cost related to the whole chain of operation from the paddy field to the retailer stall are aggregated into one account.

Table 20: Example of system consolidated budget

Accounting categories	Value (cedi)
TOTAL FIXED INPUT	99
TOTAL LABOUR	1,508
TOTAL SERVICES	975
TOTAL MATERIAL INPUT	1,327
TOTAL OTHER COST	158
REVENUE (Final output)	6,905
PROFIT	2,837

The milling activities are not included directly into the consolidation as it is a service provided to the farmer or the trader for a fee, thus the milling cost are included into the Service accounting

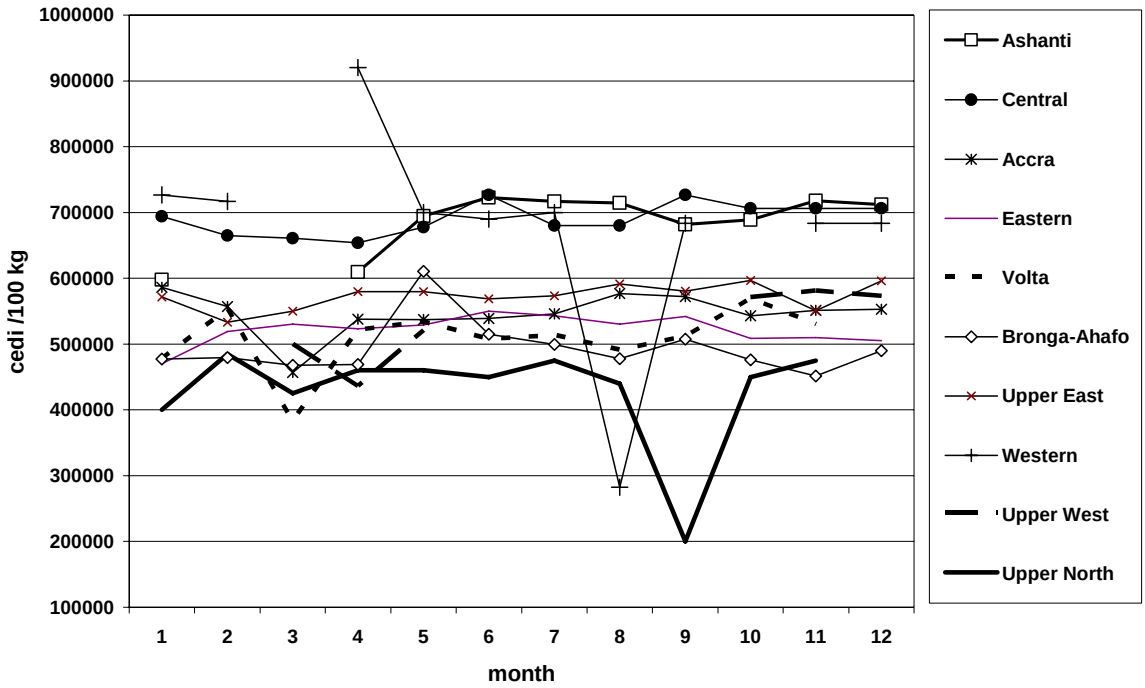
category of the consolidated budget. However, since milling is a critical operation for the overall viability of the rice economy (issue of quality, homogeneity, and cleanliness of the milled rice) the value of the milling cost paid by the farmer or the trader will be decomposed into the cost and the profit associated with the milling operation to take them into consideration in the analysis.

As already underlined in the presentation of the agent representative budget, the value of the cost associated with the sequence of operations included are rather stable at short term, whereas the price associated with the purchase and sale of paddy or milled rice between the system's agent are more variable. To ensure consistency, in the accounting the selling price of the output should be the same as the purchase price (commodity in process) of the following agent as displayed by the shaded and box cells and arrows in the Table 19. The price value inputted in the budget for the sale and purchase of paddy and milled rice has a direct impact on the value of profit level and profit share acquired by each agent. A higher price selected for the farm gate price of paddy rice sold by the farmer will increase the farmer profit and simultaneously reduced the trader's profit if the price at the retailer stage remains the same. The following section will present the bases on which the various price used in the consolidation system have been selected.

4.2.3. Price system elaboration

Price statistics are usually considered as the most relevant source of information to select the prices that will be used as references for the consolidation of the systems accounts. The analysis of the price data collected and processed by SRID (Statistics, Research and Information Directorate) for the year 2006 where not fully conclusive in terms of price spread between the various regions. The limited number of years available didn't allow assessing for any recurrent pattern in the variation of the price and the price spread between different regions. However the available dataset display in the Figure 20 provides some indications about the price level across the various regions. Two regions, Ashanti and Central acknowledge a higher price than the other regions across the whole year, which corroborates the regional supply-demand balance sheet approach (cf. 3.3.1.b). On the other side, the Northern region has the lowest price, which is consistent with the position of the region in the rice economy as the major surplus area. Most of the other regions price varies between these two extreme upper and lower price patterns. The position of the of the Upper West region is rather peculiar as it display a high level of variation between peak and lean production seasons, while the Northern region price variation also display as seasonal pattern but with a price trend of a lower value.

Figure 20: Average regional monthly wholesale price for local milled rice in urban market



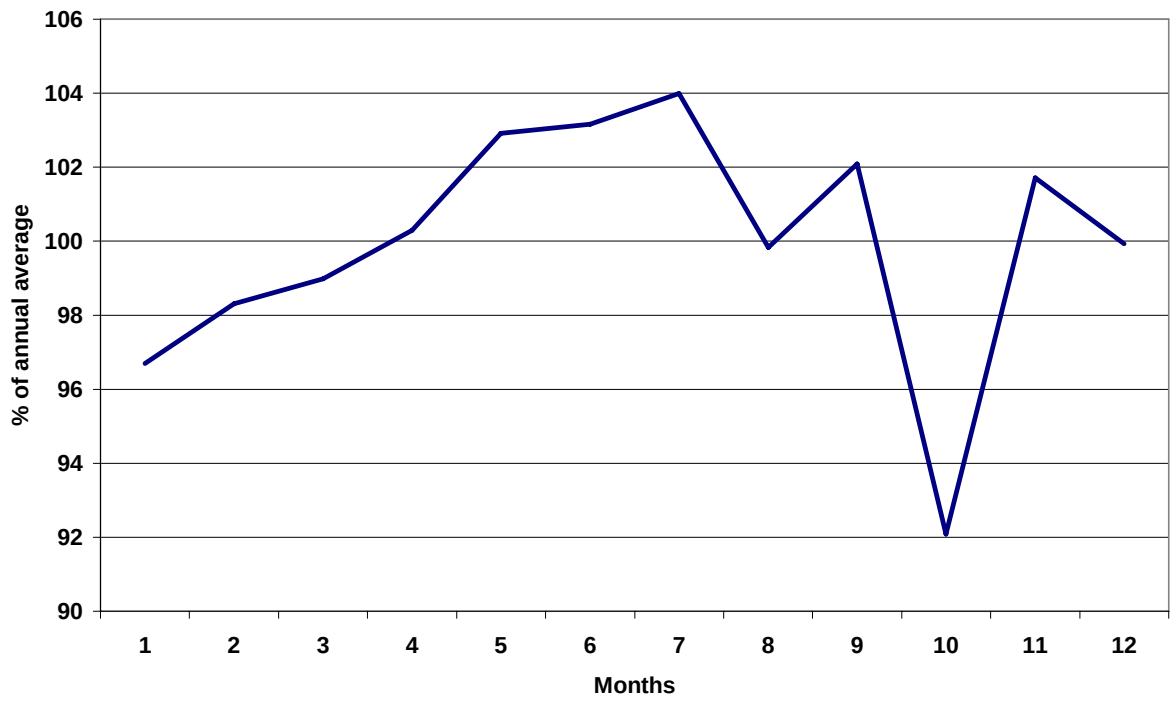
Source: computed from SRID data, 2006.

The utilization of the SRID data set is also limited by the type of product covered, since rice price are recorded only for the milled rice and do not include the paddy rice which is a major variable for the computation of the consolidated account. SRID also records price data on the rural market, but limited also to milled rice. The comparison between urban and rural areas milled rice price didn't bring any conclusive information. Beyond the differentiation between paddy and milled rice, the SRID dataset do not take into account the price variations observed between different types, quality of milled rice (cf. 3.3.2.b), which can also affect the consistency of the data set produced.

Another issue that should also be taken into account for the definition of the price used as a reference in the consolidated budget is the seasonal variation of the price. The consolidated budgets are computed with reference to an "average annual situation" while prices may vary significantly across the year. Seasonal index for the local milled rice has been computed using a longer time series (year 2000 to 2006) but at the national level. The nominal price have been deflated using the consumer price index to take into account the high level of inflation experienced in the last years which bias the computation of the seasonal index. The seasonal index computed presented in the Figure 21 do not exhibit a high variation between the lean season and the pick season (harvest). The index value of 100 correspond to the average annual price and the lowest value reached by the index is 92 in November, meaning that on average, the November price will be equal to 92% of the average annual price. Conversely the highest price is reach in July and is equal on average to 104% of the annual average price. The range of the price variation across the year is therefore of 12% (104%- 92%), a rather low magnitude of variation.

The real price variation is probably higher since the seasonal index was computed on the basis of an average national price, which smoothes down the price variations observed in a specific region and probably in rural areas.

Figure 21: Seasonal index for milled rice at the national level

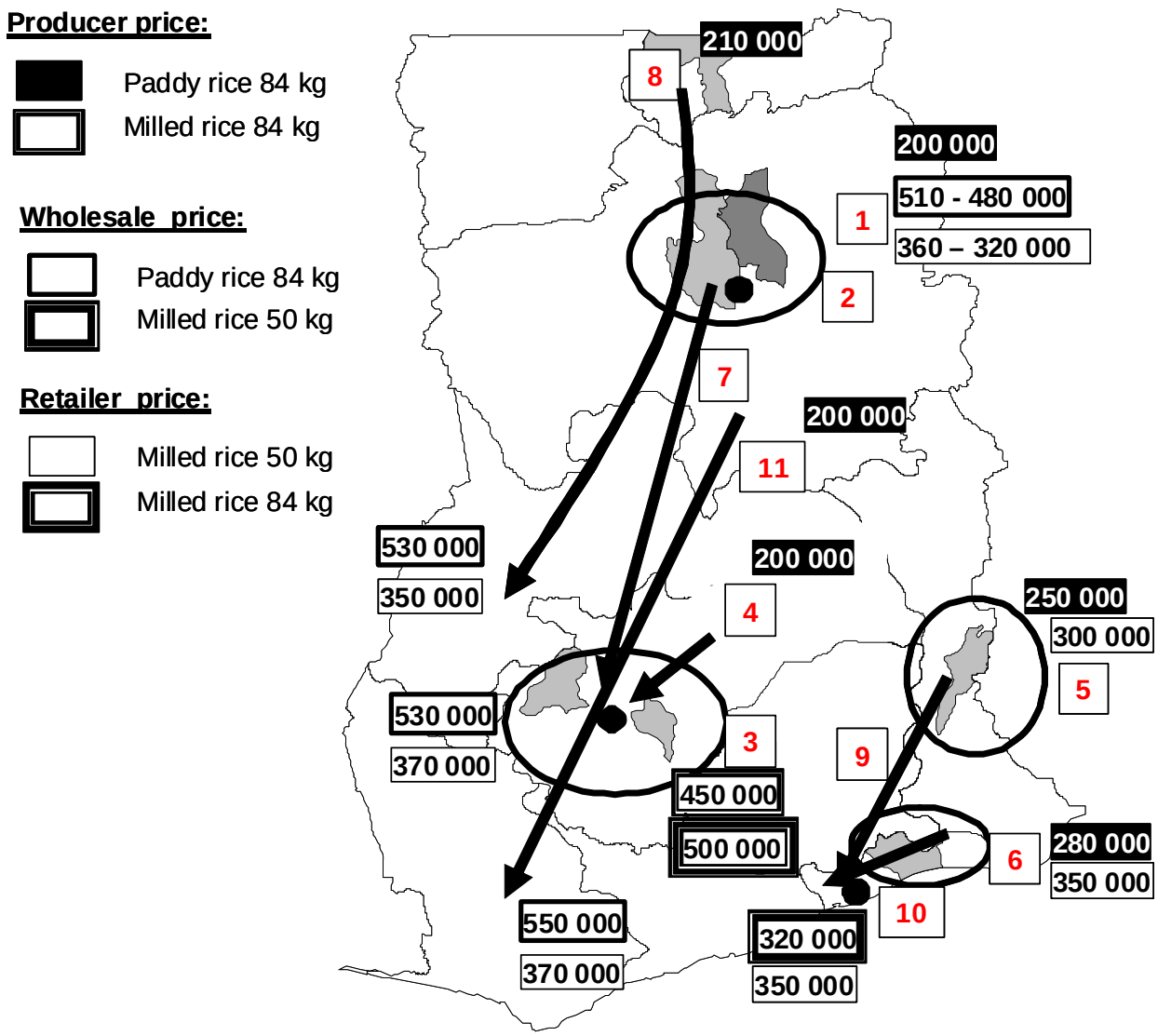


Source: Computed from SRID

The low seasonality of the local rice price variation might be an outcome of imported rice, which is available through out the years and therefore has a stabilizing role for the whole rice economy, and therefore, reduce the range of variation for the local rice price.

Eventually the price system used in the consolidation was elaborated on the bases of the average paddy and milled price computed by the JICA study on the bases of the primary data collected in 2006 (JICA, 2007) and cross with information collected during the survey carried out for this study. The price system includes a set of price for paddy rice bag at the farm level, milled rice bag at the wholesale level and milled rice bag at the retailer level (corresponding to an equivalent to the small unit of volume used for selling rice at the retail level). The price level reflects the hierarchy of value across region observed from the different sources as displayed on the Figure 22.

Figure 22: Price system selected for account consolidation



4.2.4. Representative systems profitability and cost structure

Under the current value (prices and costs) retained in the budget, all the systems are profitable.

However, the return to cash (profit/total cost) computed for the eleven systems show a large variation (Table 21 and Figure 23), ranging from 90% in the case of "Volta local market" down to 20% for the "Afife to Accra" system. Like for any financial analysis the consolidated budget allows to compute a break even point for each system, corresponding to milled rice price at the consumer level that will just covers the total cost (i.e. profit nil). As expected, the capacity of each system to bear a price decrease is inversely related to the level of profitability achieved. While most of the system would not be profitable if the milled rice price decrease by 20%, four systems can absorb a larger price fluctuation (above 40%). This indicates that the overall profitability of the rice economy can be put at stake by a rather low downward variation of the milled rice price.

The average return to cash ratio by group of marketing range (local, regional and inter-regional) show no significant variations between groups. The relation between the spatial configuration of the rice marketing chain (starting, ending point and range) and the level of profitability is more complex as display by the Figure 24, where the level of profitability has been represented on the map of the system.

Systems starting from the Volta upland area (5 and 9) show the highest return to cash cost (90%) whether or not they target the local or the Accra market. On the lowest side of the profitability, the system starting from the coastal areas (6 and 10) have a low profitability (22%) whether or not they target the local or inter-regional market. Systems targeting the Ashanti and the Bronga-Ahafo (8,4,3,7) regions show a relative high level of profitability (58%), while the profitability of the Northern based local and regional systems (1,2) is rather lower (33%). Finally it is worth noting that the system 11 linking the surplus areas of the North to the coastal region show a rather lower level of profitability compared to other the inter-regional systems such as 8 or 7. This is due to the combination of higher transport cost associated with the longer distance and the lower milled rice retailing price compared to the Ashanti region, which may result from the imported rice wide diffusion in those coastal areas.

Table 21: Consolidated budget by system in kg of milled rice

System	Northern to Tamale local improved paraboil	Northern to Tamale regional normal paraboil	Northern to Central	Upper west to Techiman	Northern to Kumasi	Ashanti local market	Ashanti Regional	Volta local market	Volta to Accra	South local market	Afife to Accra
Marketing range	Local	Regional	Inter-regional	Inter-regional	Inter-regional	Local	Regional	Local	Inter-regional	Local	Inter-regional
Fixed input	158	270	67	99	59	296	297	155	191	155	112
Operating cost:	0	0	0	0	0	0	0	0	0	0	0
Labour	762	780	1,361	1,508	1,057	1,487	1,699	1,950	2,026	3,386	3,178
Services	2,025	1,969	2,625	975	2,446	485	273	572	1,195	662	941
Material input	2,144	2,109	1,603	1,327	1,634	1,827	1,827	322	397	1,069	1,144
Other cost	30	11	117	158	20	12	87	11	18	366	384
Profit	2,024	1,313	1,608	2,837	2,165	1,776	3,198	2,989	3,174	1,362	1,161
System revenue	7,143	6,452	7,381	6,905	7,381	5,882	7,381	6,000	7,000	7,000	6,920
Return to cash	40%	26%	28%	70%	42%	43%	76%	99%	83%	24%	20%
Break even price	5,119	5,139	5,773	4,068	5,216	4,107	4,183	3,011	3,826	5,638	5,759
% changes	-28%	-20%	-22%	-41%	-29%	-30%	-43%	-50%	-45%	-19%	-17%

Figure 23: Return to cash by system

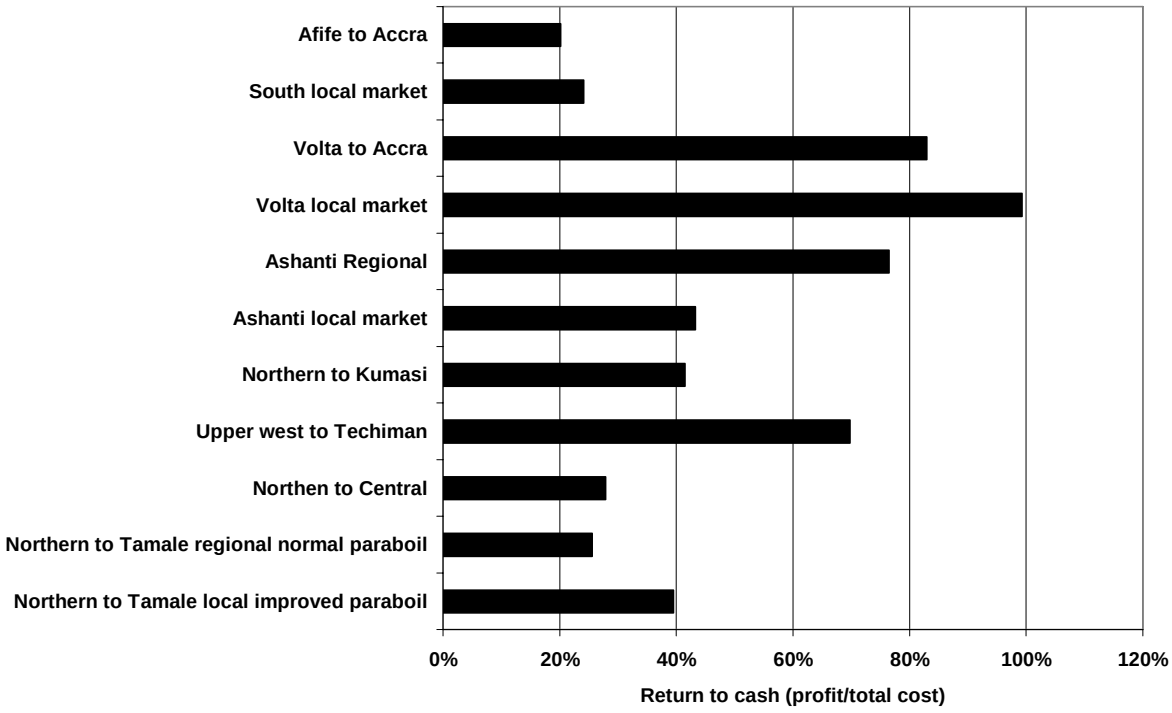
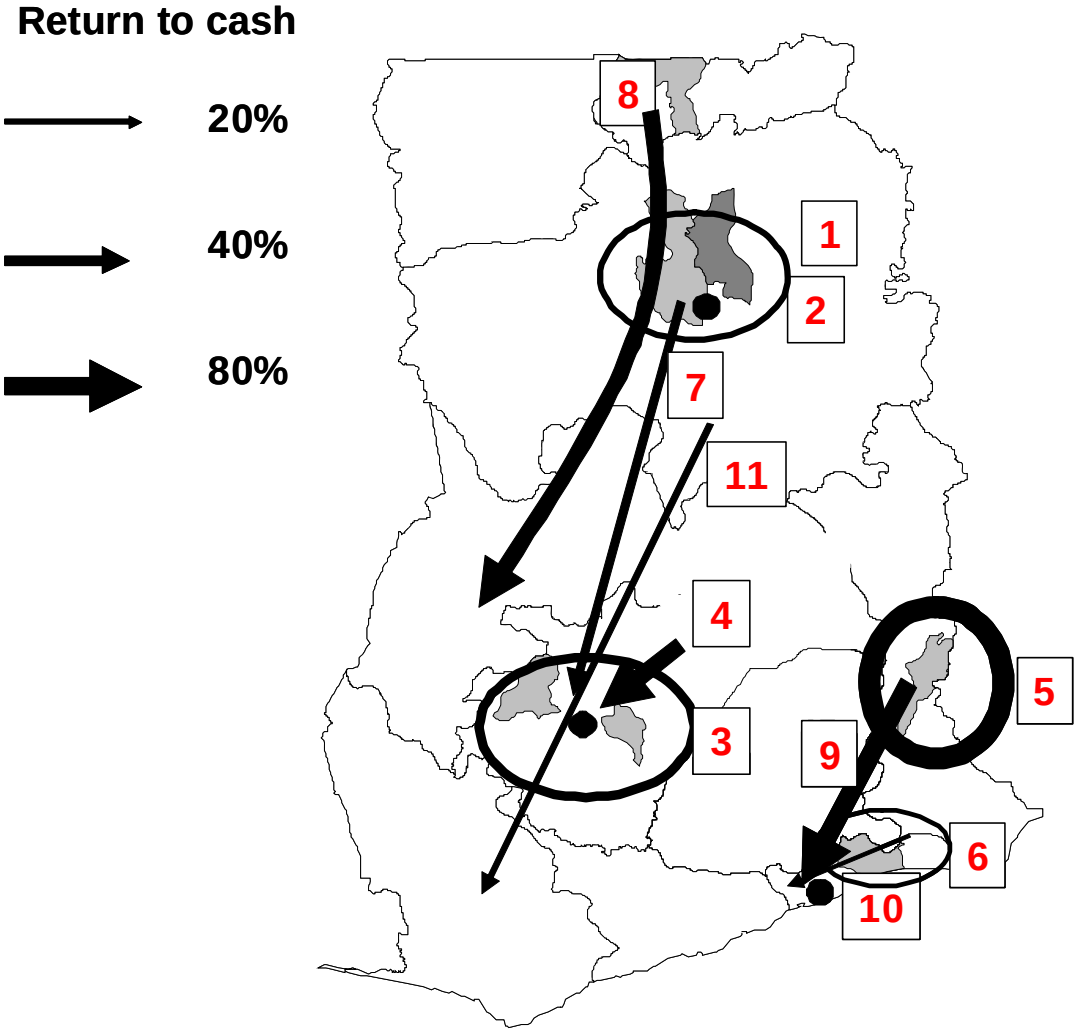


Figure 24: Localization of Return to cash by major system



Factors that affect the overall profitability of the system can be further analyzed by looking at the share of each agent in the total cost of the systems (Table 22 and Figure 25).On average the paddy rice production at the farm level represent 77% of the total system costs, while the wholesale trade (Trader 1) represent 21% and the retailing (Trader 3) only 3%. The break down by marketing range does not changes these order of magnitude, although, as expected the share of the cost associated with marketing operations increase from local marketing range to inter-regional marketing range. The milling cost (without taking into account the profit made by the miller) represent only on average 8% of the systems total cost.

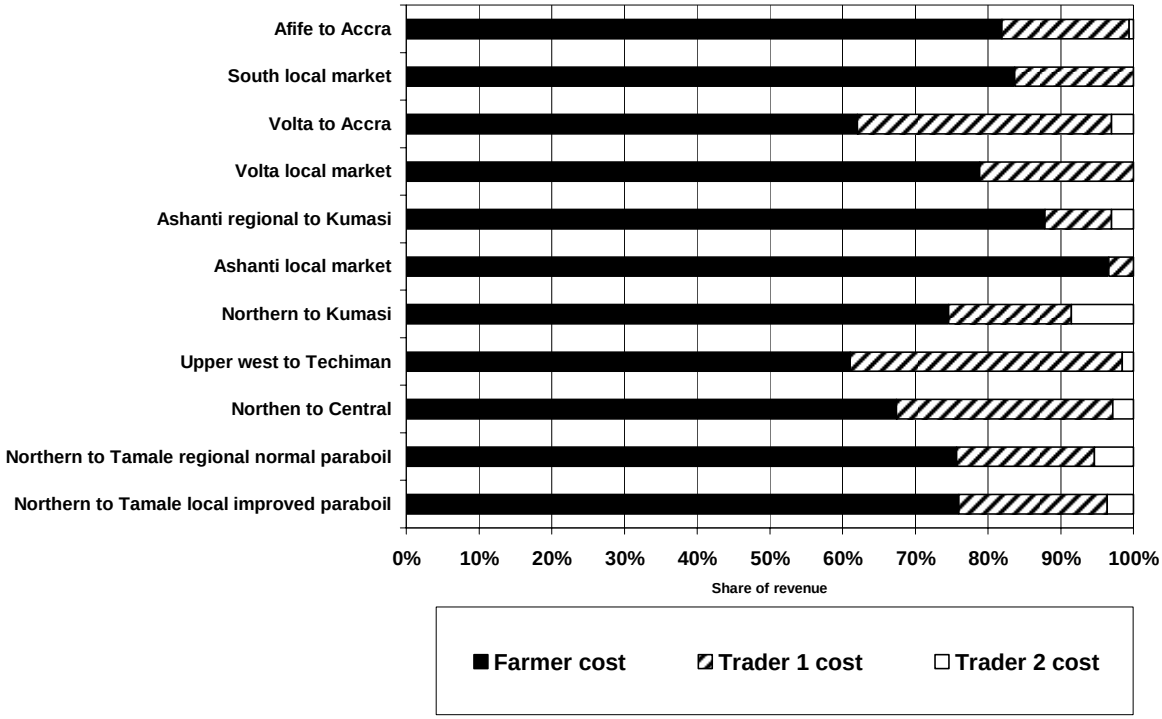
Table 22: Agent share of the total system cost by marketing range

Marketing range	Farmer cost	Trader 1 cost	Trader 2 cost
Local	84%	15%	1%
Regional	82%	14%	4%
Inter-regional	69%	27%	3%
All system	77%	21%	3%

The analysis of the agents' share of the total cost indicates that the total cost of each system is determined to a large extent by the farming cost for producing the paddy rice. Therefore the systems including the lower farming cash cost and high profitability (upland) are logically the most profitable, while systems including cropping systems that are less profitable (such as irrigated cropping systems in the south) exhibit a lower level of consolidated profitability.

The other major determinant of the system profitability is the price spread between supply and consuming areas. The high deficit acknowledge for local rice in the Ashanti region generate a high level of price which strengthen the profitability of the rice marketing between the northern supply areas and Kumasi.

Figure 25: System cost share by agent



The distribution of the consolidated profit generated by each system across agents follow the same ranking as the one observed with the cost (Table 23 and Figure 26) but with a more balanced distribution. The profit earned by the farmer represents on average 46% of the system total profit, while the trader 1 share represent 31% and the trader 2 share represent 20%. The share of the retailer (trader 2) is higher in the inter-regional system since the distance increase the cost associated with wholesaler activity (trader 2) while the retailer cost are not affected by its integration into a regional or an inter-regional system. Putting into perspective the share of profit retained by the farmers and the level of profitability of the system, Figure 27, show that, the higher the profitability of the system, the larger the share of the profit allocated to the farmer. This relation confirm the that farmer performance is a

critical factors to explain variations across systems whereas the cost and profit associated to marketing activities are less heterogeneous from one system to the other.

It worth underlining again that these values are determined to a large extent by the price level retained in the price systems on the bases of which the consolidated budgets have been developed. A lower price for the final output (milled rice retail price) would reduce sharply the profit share of the traders.

Table 23: Distribution of total system profit across age

Marketing range	Farmer	Trader 1	Trader 2	Miller
Local	49%	38%	11%	3%
Regional	46%	32%	17%	4%
Inter-regional	43%	25%	28%	4%
All systems	46%	31%	20%	4%

Figure 26: Profit share by agent

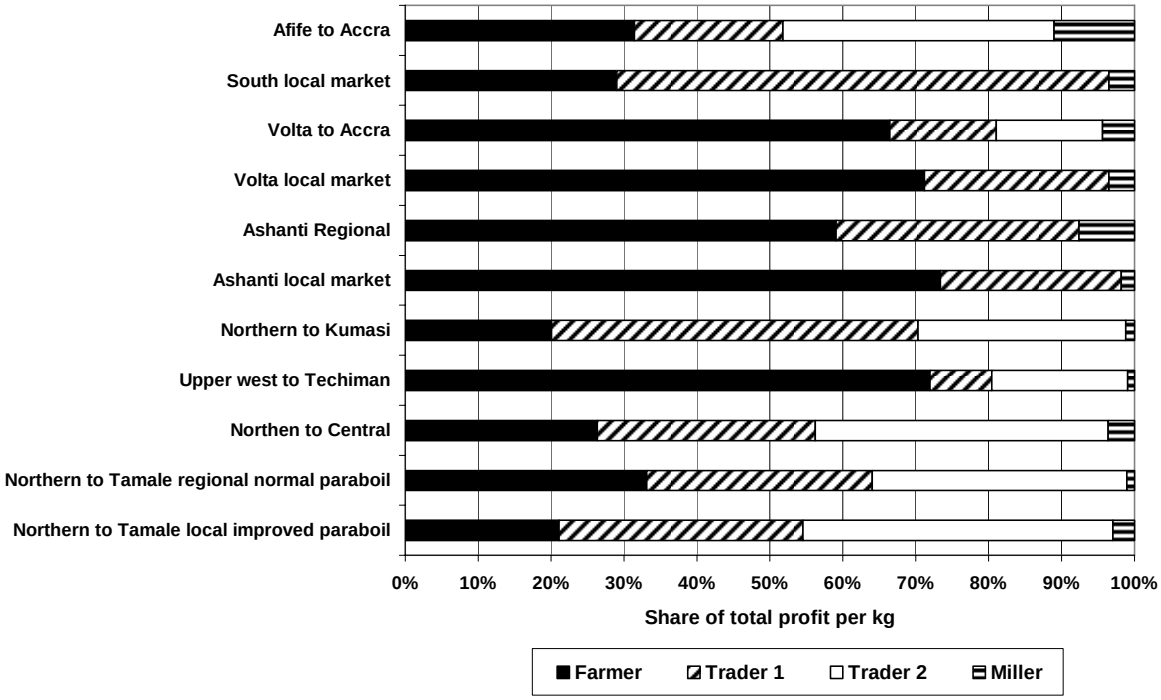
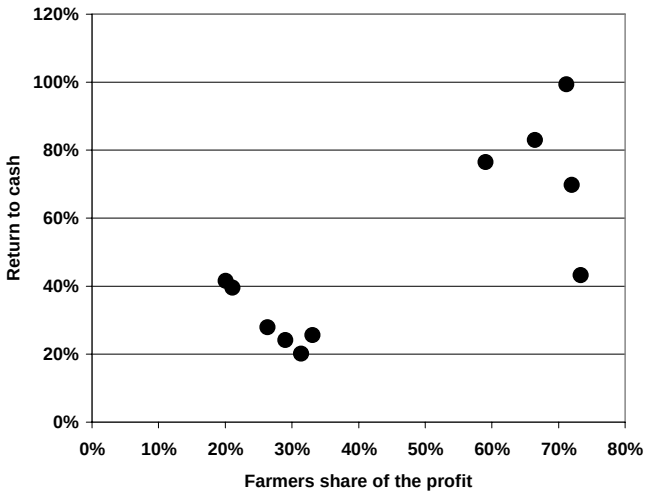


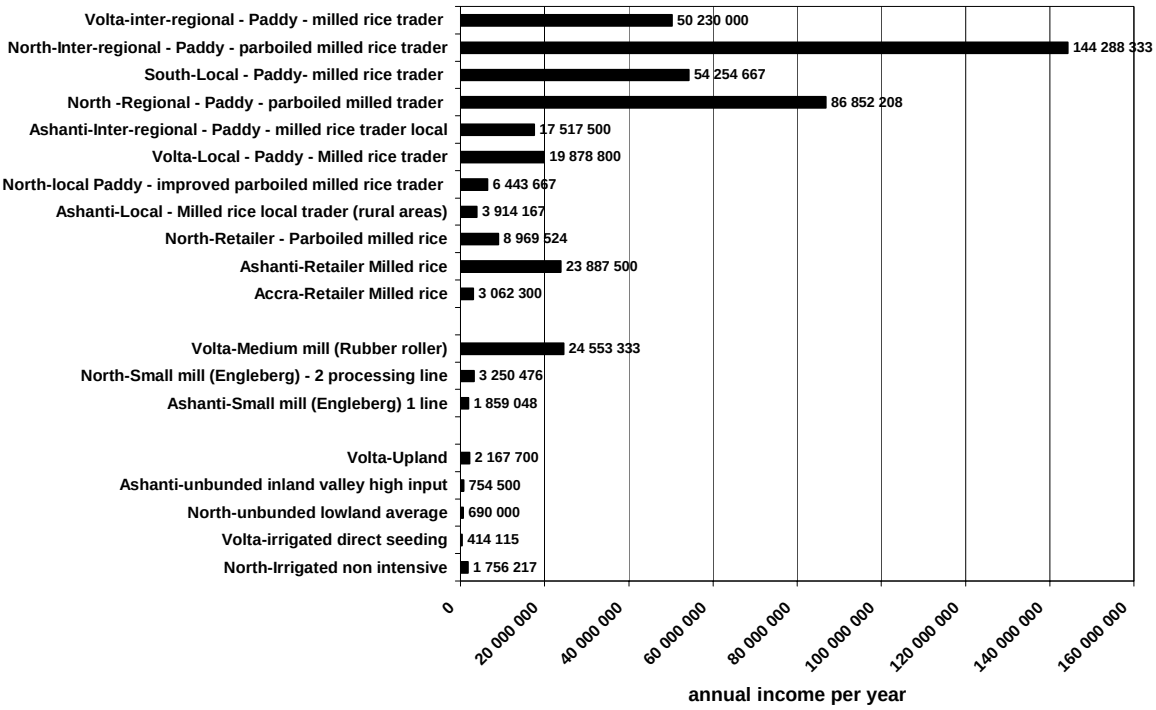
Figure 27: Relation between farmers' share of the total profit and the return to cash



The distribution of the profit share among the agents is difficult to assess in terms of equity as such. The lower value of the trader share is an outcome of the higher productivity of the trader function in terms of bags traded per year compared to the number of bag produced by the farmer during one year, which means that less resources is needed to market a bag than

to produce a bag of paddy rice, hence the income generated on kilogram basis is lower. In order to balance the perspective offered by the profit distribution Figure 28 presents an estimation of the total annual income earned by each agent from their activity. These estimations are based on profit computed from each agent representative budget and the estimated level of activity in terms of number of bags handled by traders or cropped areas for farmer. The figure clearly demonstrates the gap in term of income generated by each category agents induced by the different scale of operation.

Figure 28: Estimated annual net income per agent



Another way to illustrate this unequal position is to estimate the number of agent involved for each functions of the system. An estimate has been carried out for the Northern region on the basis of the regional balance sheet estimated by JICA (Table 24). Making the assumption that a farmer will produce on average 15 bags of paddy, the total number of rice producers can be estimated at 47,000. After deduction of the paddy rice put aside for home consumption, seeds and losses (i.e. assuming 20% of the production) the local/regional market volume can be estimated at 7 120 ton while the inter-regional trade starting from the region is about 38,000 tons. Assuming that a local trader will market on average 100 bags per year and inter-regional trader on average 2000 bag per year, the number of traders can be deducted as display in the table. While farmers would represent more than 90% of the total number of agents involved in the Northern rice economy they would perceive only around 50% of the total income generated.

Table 24: Estimation of the relative number of trader and farmer in the Northern region

Supply and demand at various scale	Volume in '0000 t	Volume in 84kg bag	Agent	Number of bag per agent	Number of agent	Share of total agent	Hypothesis and source of information
Production	56,400	671,429	Farmers	15	44,762	95.7%	
Home consumption	11,280	134,286					20% of the production is for home consumption
Local and regional consumption	7,120	84,762	Local/regional trader	100	848	1.8%	Total region consumption is 18 400 000 (JICA study estimate)
			Retailer	50	932	2.0%	
Inter-regional trade	38,000	452,381	Inter-regional trader	2 000	226	0.5%	

4.2.5. Concluding remarks

The analysis of the consolidated budget for each system indicates that under the current price system retained, rice business as a whole is a profitable activity, while there are sharp differences across sub-systems. This differentiation can be firstly attributed to the efficiency of the farming activity, which determined to a large extent the profitability of each system and secondly to the price spread between the supply and consumption areas.

The upland systems, which exhibit a high level of financial profitability, provide the foundation for particularly profitable system targeting the local or coastal market. It should be kept in mind however that farmers interest in those system depend upon the income that alternative occupation could offered since upland rice production rely primarily on farmers' own labour and that the profitability of the system varies according to climatic conditions which affect directly the level of production.

The consolidated budget analysis also corroborates the position of the Ashanti and the Bronga-Ahafo regions within the rice market configuration that has been identified on the basis of the balance sheet analysis and the information collected. Marketing systems targeting these regions from northern surplus areas show a relative high level of profitability compared to other marketing routes, which is consistent with the high level of deficit estimated for these regions.

The share of the consolidated profit that goes to the farmers, on a kilogram of milled rice basis, is largely determined by its own efficiency, since the marketing cost and processing cost are much more stable. In terms of income disparity by agents (on per capita basis) the

higher level of income achieved by traders on an annual basis reflects the higher scale of operation observed for rice marketing (100's to over 1000's bag per years) compared to the average farmers output (a tens of bags).

Its should be kept in mind that the profitability of the selected systems is a necessary but not a sufficient conditions to ensure the long term sustainability of the Ghanaian rice economy, since consumers choice is not only determined by the level of milled rice retail price. The low share of the cost associated with the milling activity show that there is room for investing into quality improvement provided that those investment pay off either in terms of volume marketed or price rewards to quality at the consumer level. Indeed, increase in the cost of milling would not affect drastically the profitability of the system.

Finally, it should also be kept in mind that the results presented in this section are derived from surveys carried out in a limited period of time and than certain estimations of costs would benefit from complementary investigation to corroborate the value on the bases of which the budget have been developed. A more precise estimation of price level for paddy rice and homogenous quality of rice across various sites would also bring in an additional value to the consolidated budget developed.

5. Recommendations to GRIB

5.1. Actions for improving competitiveness of Ghanaian rice

Baseline surveys have now well identified consumers' preferences for clean and homogeneous rice. They also show their inclination for perfumed rice. Yet, it is worth noting that the segmentation of rice market offers opportunities for different types of rice, including non-perfumed local rice, provided that its quality is improved.

The improvement of rice quality requires a coordinated efforts at all levels of the commodity chain, from the field (choice of varieties, cropping techniques...) to post-harvest operations (dry and thresh rice on adequate material, remove stones, make batches of the same type of rice…), milling techniques to packaging (standard, clean bags). But the lack of information and the weak quality management among stakeholders, as well as the limited price reward to quality transmission from downstream segment (retailing) to upstream segment (farmer) do not provide any incentive to invest in a better quality management and to supply the level of quality required. In addition, the terms of the issue are not the same for the different types of rice marketed (in particular straight milled and parboiled rice) and different regions or ecologies.

There is a stable difference in price between the average imported and average local rice price (imported being 20% higher) because of this quality issue, but also because of the high level of prices on the world market. The estimation of the profitability of the various sub-systems identified indicates that for a large number of there is room for investing additional resources without jeopardizing their financial viability. Therefore, there is an opportunity that the Ghanaian rice stakeholders can seize to make the adequate investments to improve quality of local rice, which can still be profitable.

Therefore, with the objective of improving the competitiveness of the Ghanaian rice, which at present suffers from a low quality, we think that GRIB should work in priority in two directions: promote and disseminate innovation in terms of quality management and disseminate information and raise awareness on the rice development issues.

1. Facilitate investment in viable technology for improving quality of local rice

GRIB, through its knowledge of the status of the commodity chain and through its membership composition, is in a good position to select and promote strategic actions aiming at developing a proper quality management. Quality management is not only about milling technology, but also identifying all the crucial operations that influence the quality of rice (see above) and setting up the roles of the different stakeholders as well as anticipating their improved remuneration for that.

We suggest that these projects should have the following characteristics:

- Actions that are tailored to local specific conditions taking into account the characteristics of the targeted market and the specific constraints of the involved stakeholders (no standard actions for all regions and products). For example, parboiled chain and straight milled chain involve different activities and problems, so there might be a specific project for stakeholders involved in producing and marketing parboiled rice.
- Integrated projects that will include at the same time: information to stakeholders, dialogue among involved people to set up and monitor the project, coordinated actions organise supply, improved technologies or practices to improve quality, and marketing communication to facilitate the materialization of those efforts.
- Gather all the different stakeholders involved. The more efficient would be to work at a sub-system level (a combination of one type of product, one production area and one target market) and consider specific issues for quality management. For example, gather producers and millers from the northern areas with Kumasi traders and retailers because they have strong linkages within the commodity chain. Also, involving a group of people, not only one person, will facilitate ownership, monitoring and dissemination of information. These groups should be formed with

an operational perspective and on the basis of people willing to actually work together (not necessarily on the basis of the institutional local representation of GRIB).

- Implement "pilot projects" first, for each selected priority sub-systems, with one small group of interested people. But it is very important to set first monitoring procedures and to ensure the dissemination of the lessons learned from those pilot projects (see infra). GRIB should have an active role in promoting success stories, through large information and fund raising for example.
- Ensure the feasibility of the project. Technical, financial and organizational feasibility should be taken into consideration before an action is carried out. GRIB secretariat and also members can collect information on the proposed new practices (these can be any sort of innovation, including tools, machinery as well as manual operations) in terms of price, additional labour involved, delay of delivery, maintenance costs, organisational constraints etc. so they can assess the implications of the project for each stakeholder. For financial analysis, GRIB can use the individual and system budgets that have been elaborated for the present study (cost-benefit analysis).

The organization should be discussed beforehand among the group of people involved, including roles and responsibilities, organisation of the supply of products, timing, as well as monitoring procedures, modalities for assessing and disseminating the results of the project at the end.

2. Increase stakeholder awareness of the current status of the rice industry

During the workshop with GRIB executives, we have discussed that some information can be critical to the stakeholders and in turn to the functioning of the rice industry. It appeared that GRIB as an interprofessional body has an added value as a resource centre on the commodity chain because of its structure and membership. GRIB can have a critical role to play in disseminating information and in raising awareness among stakeholders on the rice industry development issues.

Setting an information system can serve simultaneous objectives: to monitor the evolution of the rice economy (update/validate the budget database…) to maintain GRIB's capacity to assist stakeholders to make investments decisions or make evolve their day to day practices, but also to develop a longer term, comprehensive and shared perception of the rice market.

Considering members, the information system can create link among them and some sense of participation and effective membership, and strengthen members' awareness of the interest to work as operational interprofessional groups. From an institutional point of view,

it should also contribute to increase the visibility of the GRIB as a major player and reference in the rice policy dialogue.

Types of information can be either quantitative or qualitative and could include (not exhaustive…):

- Regular information: prices by specific type of rice well known by the stakeholders in one market location, prices of inputs, of equipment etc.;
- Information on existing different rice production and marketing systems across the country;
- Information on norms as to raise awareness of rice market conditions: unit of weight and measure, market requirement;
- Other information useful to elaborate strategies and advice people on their activities: studies or analysis on specific issues (credit for example); success and failure story etc.

We can enumerate a few principles concerning the setting up of the information system (see also handouts delivered during the training session, in progress report 2):

- It should be commensurate with the available resources to set up and also to sustain such a system. It will not be possible to collect and process information on everything, so information collected should be limited and properly selected. GRIB members should express their priorities (or find specific resources).
- Ensure that is contains useful information: GRIB should review the information priorities through a dialogue with its members and assess those on the basis of their contribution to their objectives.
- Check if information can be gathered from existing sources (MoFA, MoT, projects etc.) and how information could be shared or else supplemented with what is really missing through collection from the field.
- Investigate how GRIB members can be involved in the data collection, to ensure cost-effectiveness and ownership of the whole process.
- The means for dissemination must be adapted to the type of information that will be shared: bulletin, newsletter, leaflets, whiteboard etc.
- The format should be meaningful to rice stakeholders to ensure an efficient dissemination

Of course, the information system can evolve in time, according to the availability of new resources, to changes in priorities etc.

5.2. Other actions to increase the efficiency of GRIB

To increase the efficiency of GRIB in its contribution to the development of the rice industry, we suggest a number of principles and actions, which have been discussed during the workshop with GRIB executives:

GRIB has some human and financial resources, but they are limited to some extent, so the institution has to select priorities in all the possible actions, but also there is certainly some room for organisational and technical capacity strengthening, which would facilitate the implementation of actions. When resources are limited, multiplying actions appear to be rather unproductive, especially when the level of organisation of members is low and much so far has to be taken on by the secretariat.

- Start with pilot actions to facilitate their implementation, as well as the monitoring and dissemination of lessons learnt to members and to policy makers. Thus GRIB can make the most of its role in promoting innovation. A pilot action is meaningful provided it has been prepared on the basis of a coherent strategy and above all that GRIB should organise monitoring and evaluation and disseminate the lessons learnt. GRIB then can play a role in facilitating the change in scale through experience sharing among members and through partnerships with public institutions and projects.
- Mobilize and coordinate external and internal capacities to elaborate and implement rice development strategies. GRIB is not the only institution or organisation to be involved in the development of the rice industry (or more generally in the economic development). Public institutions, research institutes, as well as the private sector (input and equipment dealers, NGOs etc.) have also an important role to play. GRIB should make every effort to find synergy with them, in relation to analyzing rice commodity chain issues, as well as implementing strategies.

In our view, GRIB would be more efficient and gain authority in focusing as far as possible its own contribution in interprofessional actions. GRIB should give priorities to action addressing constraints that results from weak coordination between stakeholders or that cannot be addressed by other organizations or institutions (producers organization, NGOs, local government, private sector….) GRIB could consider addressing constraints that are specific to one stakeholder only if cannot be taken into account by another institutions and if this constraint represents a major obstacle to implement an action that concerns other stakeholders.

In parallel, GRIB should continue to implement a program for strengthening capacities of its members and executives, as well as promoting dialogue at all levels of the organisation, to raise awareness and knowledge of he current situation of the rice industry and to balance the level of information of each one.

Outcomes of the training and capacities of GRIB

One objective of the mission was to enhance GRIB capacity in policy elaboration and evaluation. The present study and training was an introduction to commodity chain analysis and for GRIB executives it was a new way of looking at issues related to the rice industry. Some parts were probably difficult to assimilate, such as the interrelation of constraints and benefits among stakeholders and the specific role of an interprofessional body for example. The debriefing and assessment that was done on the last day of the training have really shown the difficulty of such an exercise and that executives need other opportunities to get more familiar with this type of analysis and reasoning. Besides, not all the executives did attend the two training sessions. Still we felt an interest among GRIB executives who were here.

So it seems very important to continue the capacity building process for executives as well as members, through organising other occasions to explain and put the outcomes of the present study into debate, in order to go further in the analysis as well as in the dissemination of information and experience sharing.

- Strengthen GRIB capacity to implement coordinated actions among stakeholders by diversifying membership. GRIB executives and members should consider and discuss the inclusion of new categories of stakeholders among the most important (consumers, retailers, large traders…). This implies to better define the different categories of stakeholders according to their different types of problems and needs. Of course this inclusion can take different forms, which should be discussed (formal members, type of partnership, dialogue etc.)
- Strengthen GRIB capacity to analyse issues and propose strategies trough collaboration with other institutions. GRIB human resources being limited and have to be allocated in priority to the governance of the body, coordination and monitoring of the action plan. GRIB should therefore continue to strengthen its resources for analytical and strategic planning (enhancement of its decision making capacity) through the establishment of closer partnership with other institutions (research and academic institutions…) or resources persons.

5.3. Suggestions to further investigate specific issues of the rice sector

- ☞ Financing systems for each type of stakeholders, in relation with innovations that GRIb aims to introduce: quantification and qualification of the demand and of the existing supply, conditions and costs of credit
- ☞ The quantification of the flow of rice going through each category of stakeholders (different types of producers, of millers, of traders): a way to weigh the role of each type

of stakeholder and assess the weight of their specific issues in the elaboration of strategies.

- ☞ Farming system analysis: interactions between rice and the other crops or other activities within the farm, nor the functioning of the farming system as a whole

Appendix

Appendix 1: bibliography

BMOS Agro-Consults Ltd, 2004. Tariffs and rice development in Ghana. FSRPOP/MoFA

FASDEP II/MOFA, 2007. Food and agriculture sector policy

FSRPOP, 2003. Synthesis « 10 years of studies on Ghanaian rice sector"

JICA, 2007. Study on the promotion of domestic rice in the republic of Ghana. Progress report. 2

Lançon, David Benz, 2007. Rice imports in West Africa: trade regimes and food policy formulation.

Lançon, 2005. Commodity Chain Analysis Methodological Note. ADENI project, National Agricultural Extension and Research Liaison Service.

Multy-agency partnerships (MAPS) for technical change in West African agriculture project. An overview of RICE PRODUCTION IN GHANA

Post-Agric Associates Ltd, 2007. First status report study on rice marketing. FSRPOP/MOFA Directorate of Crop Services.

Appendix 2: list of budgets

Numb	Category	System	Region	Location	Commodity in process	Origin	Destination	Distance km	Output name	Output	Unit
1	Producer	Irrigated intensive	North	Kassina Nankana					Paddy rice	4 760	kg/ha
2	Producer	Irrigated non intensive	North	Tolon/ Kumbungu					Paddy rice	3 740	kg/ha
3	Producer	Bunded labour intensive	North	Tolon/ Kumbungu and Nanton					Paddy rice	3 360	kg/ha
4	Producer	Bunded cash intensive	North	Tolon/ Kumbungu and Nanton					Paddy rice	3 360	kg/ha
5	Producer	Bunded cash intensive large	North	Nanton					Paddy rice	2 520	kg/ha
6	Trader	Improved parboiling	North	Tamale	Paddy	Tamale region	Tamale	5	Parboiled Milled rice	3 400	Bowls
7	Milling	Small Engleberg	North	Tamale					Milled rice	457	bag
8	Producer	unbunded lowland average	North	Nanton					Paddy rice	2 698	kg/ha
9	Producer	unbunded lowland small	North	Nanton					Paddy rice	2 421	kg/ha
10	Trader	Paddy rice trader	North	Tamale	Paddy	Navarango; Vea; Nabogu	Tamale	140	Paddy rice	300	bag
11	Trader	Paddy milled paraboiled rice trader	North	Tamale	Paddy	Nabogu	Techiman	300	Milled paraboiled rice	90	bag
12	Trader	Paddy rice retailer	North	Tamale	Paddy	Nabogu, Dalong, Wussei	Tamale	100	Milled paraboiled rice	13	bag
13	Producer	Bunded inland valley	Ashanti	Ahafo Ano south					Paddy equivalent and milled for bag	2 645	kg/ha
14	Producer	Unbunded inland v. high input	Ashanti	Ejisu Jauben					Paddy equivalent and milled for bag	1 400	ha
15	Producer	Unbunded inland v. low input	Ashanti	Ejisu Jauben					Milled rice	800	ha
16	Trader	Small paddy rice trader	Ashanti	Kumasi	Paddy	East Gonja	Kumasi (?)	200	Milled rice	60	milled rice bag

17	Trader	Small rice trader	Ashanti	Kumasi	Miled rice	Ahafo Ano south	Ahafo Ano south	20	Milled rice	15	milled rice bag
18	Milling	Small Engleberg	Ashanti	Ahafo Ano south						500	bag
19	Milling	Medium Satake	Volta	Hohoe						4 000	bag
20	Producer	Irrigated intensive transplanting	South	Afife					paddy	1 670	kg/acre
21	Producer	irrigated intensive broadcasting	South	Afife					paddy	1 670	kg
22	Producer	Upland	Volta	Hohoe					paddy	600	kg
23	Trader	Small paddy rice trader	South	Dangme West	Paddy	dangme west	dangme west		milled rice	1 545	kg
24	Trader	Paddy rice trader	South	Ketu	Paddy	Afife	Akatsi	15	milled rice	51	ton
25	Trader	Small paddy rice trader	Volta	Hohoe	Paddy	Hohoe	Hohoe	20	milled rice	19	ton
26	trader	Paddy rice trader	Volta	Hohoe	Paddy	hohoe	Accra	230	milled rice	62	ton
27	Trader	milled rice trader	Accra	Accra	Miled rice	Afife et Hohoe	Accra	230	milled rice	50	ton
28	Retailer	milled rice trader	Accra	Accra	Miled rice	Accra-Nima	Accra-Mallam Atta	qq	milled rice	3 000	kg
29	Wholesaler	Paddy rice trader	Ashanti	Kumasi	Paddy	partout	Kumasi	?	milled rice	3 192	ton
30	Retailer	milled rice trader	Ashanti	Kumasi	Miled rice	Techiman Ejura Tamale	Kumasi	120 100 382	milled rice	15	ton
31	Retailer	imported rice	Ashanti	Kumasi	Miled rice	importé	Kumasi	?	milled rice	8	ton
32	producer	Lowland unbunded	Volta	Hohoe							

Appendix 3: price system

Farmers gate price					Wholesale price					Retail price				
Location	rural/ urban	Product	Price	Unit	Location	rural/ urban	Product	Price	Unit	Location	Rural /urban	Product	Price	Unit
Northern	rural	Paddy rice	200 000	Bag 84 kg	Tamale	urban	Parboiled Milled rice	510 000	Bag 84 kg	Tamale	urban	Parboiled Milled rice	360 000	Bag 84 kg
Northern	rural	Paddy rice	200 000	Bag 84 kg	Tamale	urban	Parboiled Milled rice	480 000	Bag 84 kg	Tamale	urban	Parboiled Milled rice	320 000	Bag 84 kg
Northern	rural	Paddy rice	200 000	Bag 84 kg	Central	urban	Milled rice	550 000	Bag 84 kg	Central	urban	Milled rice	370 000	Bag 50 kg
Upper West	rural	Paddy rice	210 000	Bag 84 kg	Techiman	urban	Parboiled Milled rice	530 000	Bag 84 kg	Techiman	urban	Parboiled Milled rice	350 000	Bag 50 kg
Northern	rural	Paddy rice	200 000	Bag 84 kg	Kumasi	urban	Milled rice	530 000	Bag 84 kg	Kumasi	urban	Milled rice	370 000	Bag 50 kg
Ashanti	rural	Milled rice	450 000	Bag 85 kg						Ashanti	rural	Milled rice	500 000	Bag 85 kg
Ashanti	rural	Milled rice	450 000	Bag 85 kg	Kumasi	urban	Milled rice	530 000	Bag 85 kg				370 000	Bag 50 kg
	rural	Paddy rice	250 000	Bag 84 kg						Volta (Hohoe)	rural	Milled rice	300 000	Bag 50 kg
Volta (Hohoe)	rural	Paddy rice	250 000	Bag 84 kg	Accra	urban	Milled rice	320 000	Bag 50 kg	Accra	urban	Milled rice	350 000	Bag 50 kg
Volta (Afife)	rural	Paddy rice	280 000	Bag 84 kg						Volta (Afife)	rural	Milled rice	350 000	Bag 50 kg
Volta (Afife)	rural	Paddy rice	280 000	Bag 84 kg	Accra	urban	Milled rice	320 000	Bag 50 kg	Accra	urban	Milled rice	350 000	Bag 50 kg

Appendix 4: list of systems

Nb	System name	Origin	Destination	Agent 1	Agent 2	Agent 3	Milling system
1	Tamale local improved paraboil	Tolon/ Nanton	Tamale	4	6		7
				8			
2	Tamale local normal paraboil	Tolon/ Nanton	Tamale	4	12		7
				8			
3	Ashanti local	Ahafao / Ejisu	local market	13	17		18
				15			
4	Ashanti regional	Ahafao / Ejisu	Kumasi	14	16		18
				15			
5	Volta local market	Hohoe	Hohoe	22	25		19
6	South local market	Afife	Akatsi	20	23		19
				21	24		
7	North Ashanti	Tolon/ Nanton	Kumasi	3	11	30	7
				8			
8	Upper west - Techiman	Kassina	Techiman	1	11	30	7
9	Volta Accra	Hohoe	Accra	22	26	28	19
					27		
10	Afife Accra	Afife	Accra	20	26	28	19
11	North Ashanti Central	East Gonja	Western	8	16	30	18

Appendix 5: individual representative budgets and sub-systems consolidated budgets

See excel file attached

Appendix 6: consolidation template

See excel file attached

Appendix 7:guidelines for using the Standard format for consolidation

This note provides guidelines for the using an Execel template that has been developed to compute the consolidated budget of rice based commodity systems in order to facilitate the (i) update and revision of data used for estimating profitability of the system and profit sharing among the agent and to assist decision maker in (ii) assessing the financial profitability of proposed investment for improving the competitiveness of rice commodity chain.

1. General structure of the spreadsheet

1.1. Sheet: Budget

1.1.1. General organization

The format can manage a combination of three agents including from the top to the bottom.:

Budget 1: Producer

Budget 2. Marketing 1

Budget 3. Marketing 2

The milling activities are recorded on a separate fourth budget at the bottom of the sheet.

5.3.1. Description of the budget structure

Each budget is spitted into major accounting heading along the following sub-blocks:

- **Fixed input**
- **Operating cost:**
  - Labour
  - Services
  - Material input
  - Other Cost

- Commodity in process.

- **Revenue.**

Note: There is no Commodity in Process heading for the Producer budget.

A specific line has been inserted in the Service budget for recording the Milling activities (direct link to the Milling budget where the milling cost are detailed).

5.3.2. Computation and consolidation

The data are keyed in for any reference in terms of volume.

The spreadsheet compute the opportunity cost for the fixed and the operating capital base on the selected interest rate (shelf life for the fixed asset) and duration of the production cycle for the operating costs.

Then for each budget, the cost and revenue are computed for one unit of output (kg,).

Then on the bases of the conversion rate from paddy to milled rice each budget is converted into the volume of product required to produce 1 kg of final output (i.e milled rice). For instance if the conversion ratio for the paddy milled by the trader is 0.6, it means that for 1 kg of milled rice the trader should purchase 1.67 kg of paddy (1/0.67). Therefore the Producer budget cost computed for 1 kg of Paddy rice will be multiplied by 1.67.

1.2. Sheet: Results

The sheet display selected information extracted from the Budgets sheets. A table summarizing the price used in the consolidated budget for at each stage of the system (Figure 29).

Figure 29: Price system

1.Price system				
	Budget 1	Budget 2	Budget 3	Milling
Agent / Indicators	irriagted with tranplanting	Paddy rice trader	0	VRAI
Purchase		280 000	0	
unit		bags 84 kg	0	
Selling	**280 000**	320 000	0	13 000
unit	*bags 84 kg*	*bag milled*	*0*	*bag*

A table showing the consolidated budget for the whole system on a unit basis (i.e for one kg of final output: milled rice). The last column provides the cost structure for the whole system and an additional column indicate the corresponding cost structure for the milling operation. (Figure 30).

Figure 30: Consolidated budget per kilogram

2. Consolidated budget for 1 kg of output

Direct agent						Indirect Ager
	Budget 1	Budget 2	Budget 3	Whole system	%	Milling
Agent / Indicators	unbunded lowland average	local Paddy - improved parboiled milled rice trader	Retailer - Parboiled milled rice			small scale engleberg
Fixed input	32	36	89	158	2%	23.3
Operating cost:						
Labour	661	65	36	762	11%	53.9
Services	1593	396	36	2025	28%	0.0
Material input	1603	541	0	2144	30%	119.5
Other cost	0	6	24	30	0%	2.0
Commodity in process		4329	6071			
Interest on cap&op.cst.	0	0	0	0	0%	0.0
Revenue	4329	6071	7143			259.7
Profit	439	697	887	2024	28%	61.0
System revenue				7143	100%	

A table giving the share of each agent in the cost structure of the whole system. The last line of this table provides the breakdown of each agent's share of the total profit earn by the system on a unit basis (Figure 31).

Figure 31 : Cost and profit share by agent

3.Cost and profit share by agent

	Budget 1	Budget 2	Budget 3	Whole system
Agent / Indicators	unbunded lowland average	local Paddy - improved parboiled milled rice trader	Retailer - Parboiled milled rice	0
Fixed input	21%	23%	56%	100%
Labour	87%	9%	5%	100%
Services	79%	20%	2%	100%
Material input	75%	25%	0%	100%
Other cost	0%	21%	79%	100%
Interest on cap&op.cst.	0%	0%	0%	0%
Total cost	76%	20%	4%	100%
Profit	22%	34%	44%	0%

A table providing the profit share per kg of final output for the direct agents (producer, trader) and indirect agent (miller) (Figure 32)

Figure 32 : profit share for direct and indirect agent.

4.Direct and indirect profit share				
	Budget 1	Budget 2	Budget 3	Milling
Agent / Indicators	unbunded lowland average	local Paddy - improved parboiled milled rice trader	Retailer - Parboiled milled rice	small scale engleberg
Direct and indirect profit share	21%	33%	43%	2.93%

A table providing the cost structure for each agent individually and the return to capital invested in the operation (Figure 33).

Figure 33 : Cost structure and return to cash invested per agent

5.Cost structure and profitablity by agent				
4	Budget 1	Budget 2	Budget 3	Milling
Agent / Indicators	unbunded lowland average	local Paddy - improved parboiled milled rice	Retailer - Parboiled milled rice	small scale engleberg
Fixed input	1%	1%	1%	12%
Labour	17%	1%	1%	27%
Services	41%	7%	1%	0%
Material input	41%	10%	0%	60%
Other cost	0%	0%	0%	1%
Commodity in process	0%	81%	97%	0%
Interest on cap&op.cst.	0%	0%	0%	0%
Total cost	100%	100%	100%	100%
Profit	10%	11%	12%	23%
Return to capital	11%	13%	14%	31%

A table providing the share of major categories of input into the total cost to produce 1 kg of milled rice (Figure 34)

Figure 34 : Share of major input cost in total cost

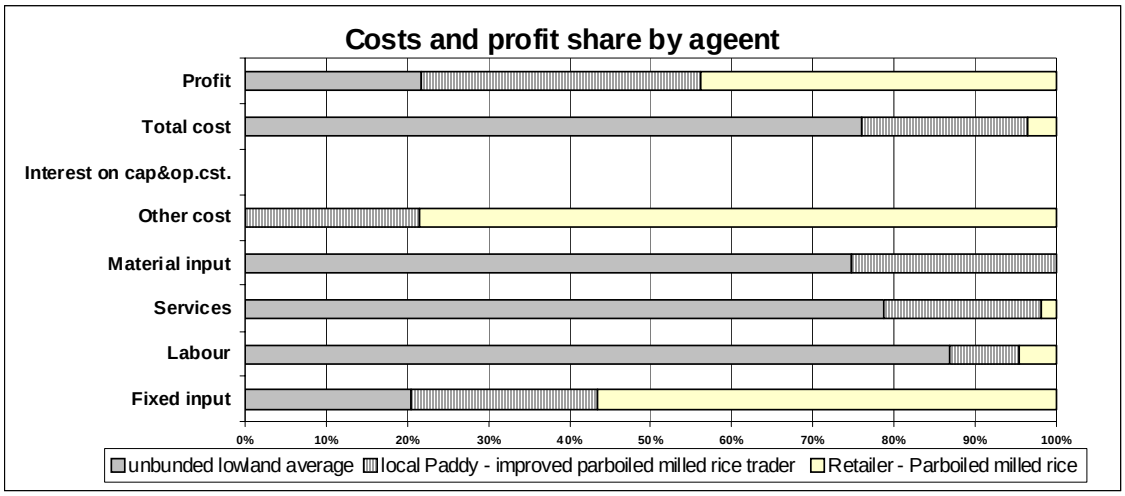
6.Share of critical input in total cost and material and service input cost (direct and indirect)				
Category of input	code	amount	share of total cost	share of material and service cost
Agricultural input	a	1 603	31%	38%
Transport	t	130	3%	3%
Energy	e	519	10%	12%

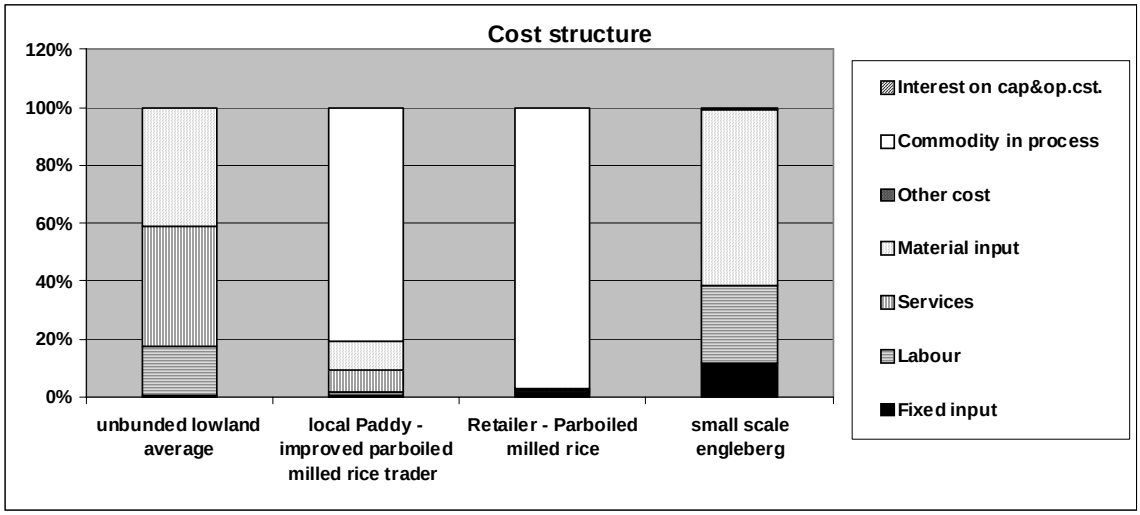
The results sheet also provide two graphs displaying agent's share in cost and profit one graph displaying the cost structure per agent (Figure 35).

Figure 35 : Graph of costs and profit breakdown by agent

System: **Northern to Tamale local improved paraboil**

Final output: **Milled parboiled rice**





2. Entering the data into the budget sheet

2.1. General principles for using the spreadsheet.

In principle the data should be entered only in the shaded cells of the budget sheet, while the non-shaded cells contain formulas that should not be modified to keep the computation integrity.

2.2. Modifying the size of the budget sheet.

The number of line per budget (shaded areas) can be modified for each sub-category by selecting the whole line and applying the "copy" command. Then the line can be duplicated by selecting the "inserted copied line". The "inserted copied line" should be applied under the first and above the last line of the shaded area, to keep the formula integrity of the spreadsheet.

Caution! Using the inserted line command will not keep the formula integrity of the spreadsheet as the formula included in the non-shaded cells would not be duplicated in the new line.

Caution! The spreadsheet is not protected as applying protection to prevent unintentional changes to a formula would not allow inserting or deleting budget line in the spreadsheet. It is therefore strongly recommended to save the file regularly.

2.3. Information to be keyed in:

2.3.1. General information.

The following data should be keyed in.

System: the name given to the system.

Interest rate: the interest rate selected as a proxy of the fixed and running capital financial opportunity cost *(the rationale for the computation of the financial opportunity cost for the fixed cost and operating cost is given at the end of the note as an appendix).*

2.3.2. For producer budget:

Technique: a descriptive field for the agent represented by the budget.

Area: location of the operation.

Field size

Interest rate if general not apply: allow to enter a separate rate of interest to compute the cost of the farmer if financial system are segmented

Average duration of operating capital immobilization: the time spent between a purchase and resale cycle in terms of fraction of a year.

Example: If a cropping system has a duration of 90 days between the 1st agricultural operation and the harvest, the corresponding coefficient will be of 90/365= 0.24

Fixed input:

Items: name of the equipment

Quantity: quantity of equipment used

Unit price: The value of the equipment purchase

Purchase value: the total value of the equipment purchase (i.e Quantity x Unit price; not computed by the spreasheet

Shelf life

Used share : Number of year of utilization of the equipment

Total value is computed by the spreadsheet in the cell corresponding to the column *Value*

Operating cost.

The same format is used for keying in the various categories of operating costs with the following information.

Item: name of the agricultural operation corresponding to the labour or service used (i.e planting, harvesting…), the type of input used (fertilizer, pesticide…), or the other cost (taxes, …)

Quantity: quantity of inputs or labour used

Unit: unit of quantity of input used (days, kg…) or reference of quantity of output/input for which the cost are estimated (i.e. labour for harvesting can be paid on the basis of bag of paddy harvested)

Unit price: Unit price of the item

Total value is computed by the spreadsheet in the cell corresponding to the column *Value*

Specific information can be added.

Family labour: Quantity of family labour allocated to each agricultural operation to be estimated in total number of days allocated.

Other column to be informed:

Breakdown: 1st column of the shaded block should be used to code each type of input for the computation of table 6 in the result sheet using the following coding: a:agric input; t:transport; e:energy. If the user wants to use another list of code, this could be changes in the column code of table 6

Timing of op: This coefficient allow to weight more precisely the duration of the running capital immobilized for each operation By default the coefficient is 1, but it can be adjusted to reflect the actual duration of the capital immobilization for a specific cost.

Example: For the land preparation the coefficient will be of 1, but for harvesting operation the coefficient will be 0 if the producer sale its output immediately.

Specific line to be informed

Milling fee: a separate line item have been inserted to keyed in the milling fee paid by either the farmer or the trader 1 or trader 2.

Revenue

Same category of data to be keyed in as for the operating cost section: Name of the output, quantity, unit, unit price,; value is computed by the spreadsheet.

Output unit: specify the corresponding value into kilogram of the unit of measure in which the output is recorded in the revenue sub-block. This would allow display the output on the Revenue section using the custom unit of measure (bags, bowl, tin…), while the corresponding value in kilogram will be computed for the consolidation process.

2.3.3. For Budget 1 and budget 3

Additional feature in Budget 1 and Budget 2 are:

Conversion rate	Commodity in process:	"quantity"	"type of input"
	Output:	"quantity"	"type of output"

This allows computing the conversion rate on the bases of which the consolidation will be made for the whole system. The user indicates the quantity of commodity in process (Paddy rice) used to obtain the quantity of output (Milled rice).

For the *Average duration of operating capital immobilization* the user should indicate the average duration of on cycle of purchase and resale, as a share of a year (i.e. for one week the ratio will be 1/52).

2.3.4. Milling budget.

The milling budget is added to take into account the profitability of the milling business and any additional investment that can be made in terms of processing to improve the quality of the milled rice.

The unit milling cost (per bag of paddy or rice) paid by farmer or trader are keyed in the farmer or traders' budgets and reported as the fee paid to the miller in the revenue part of the miller budget.

Similarly the recovery rate for milling is keyed in the trader budget. If the farmer sales milled rice there is no need to take into account a recovery rate as only milled rice is marketed trough the system.

3. Computation rationale and consistency

After entering the data on the basis of which the system's budgets will be consolidated, the user should give attention to the consistency of the unit price per kilogram computed by the spreadsheet for each budget of the system.

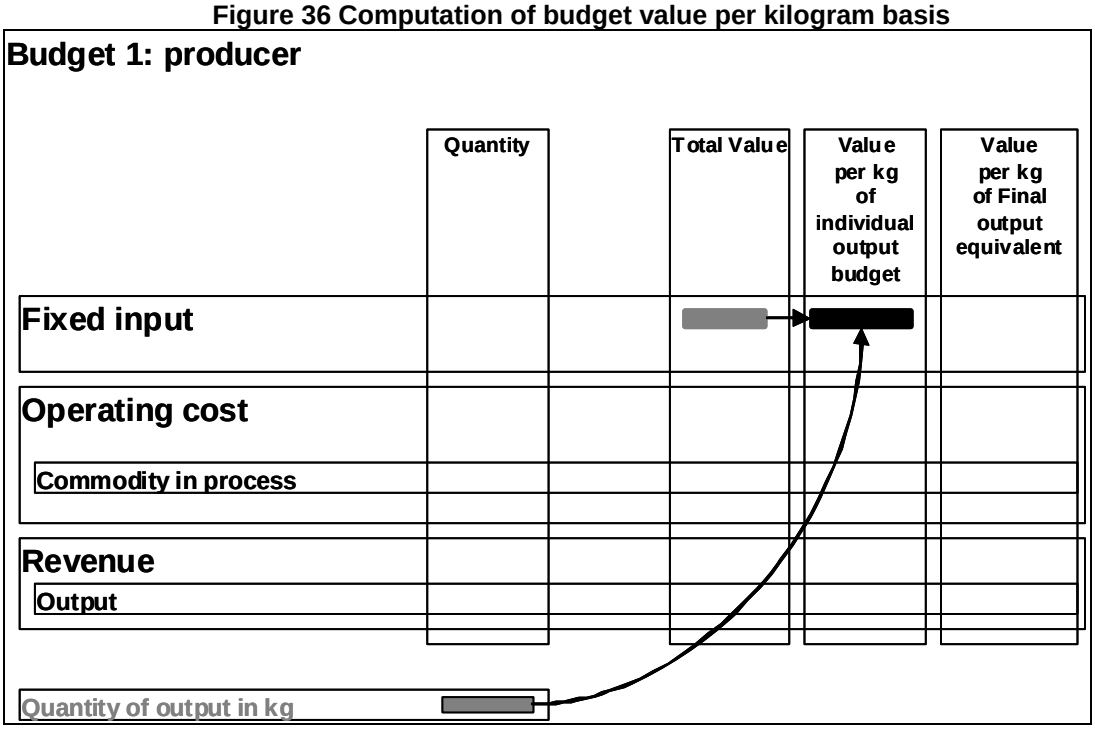
In order to clearly understand how certain value keyed could affect this consistency, a first section will present the rational of the computation carried out by the spreadsheet and then a second section will indicate the results that should be scrutinized to ensure that the output is consistent.

2.4. Budget spreadsheet computation rationale

The data keyed in each budget refer to a specific operation carried by one type of agent to produce a certain quantity of output that is keyed in under the revenue section of the budget.

The first step in the consolidation process is to convert the cost and revenue value obtained for a budget in kilogram equivalent. This is done by the dividing for each line the value of each cost and revenue budget item by the quantity in kg computed at the bottom of each budget and to report the result in the columns: kg budget 1, kg budget 2, kg budget 3. (Figure 36)

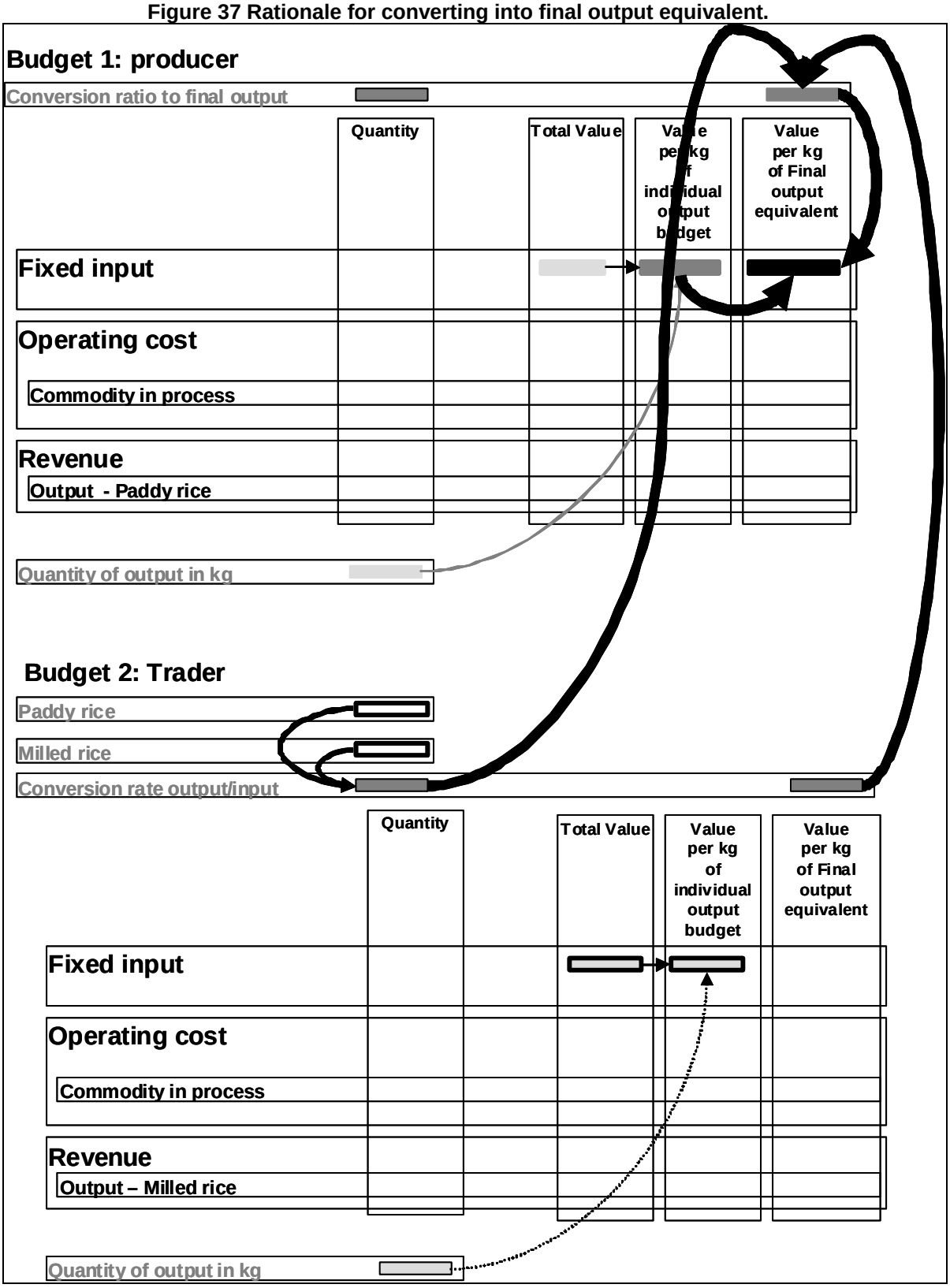
Figure 36 Computation of budget value per kilogram basis



The second step in the consolidation consist in converting the value of each budget into a common product equivalent to take into account the successive state of the product along the commodity chain(i.e. paddy rice and milled rice). The conversion rate is computed in trader's budget corresponding to the stage at which the paddy rice is processed into milled rice. Then the corresponding ratio is used to compute the equivalent volume of raw material that is necessary to produced one kilogram of milled rice.

For example, a trader purchase paddy rice and processed it into milled rice before the reselling; the corresponding conversion ratio is 0.55 kg of milled rice recovered from 1kg of paddy rice. The final output for the system is the milled rice sold out by the trader and therefore the value per kg of the budget 2 and the value per kg of final output will be the same. For the producer who have sold the paddy rice to the trader, the budget should be converted into milled rice equivalent, which means for producing 1 kg of milled rice 1.81 kg of paddy rice should be produced (i.e. 1/0.55). This is the ration that is computed and display at the top of the column kg final output. Accordingly, each value of the "per kg of output" (Kg budget 1) computed in the producer budget is multiply by this ratio to get the corresponding value in milled rice equivalent (Figure 37).

Figure 37 Rationale for converting into final output equivalent.



Then, the relevant variable are therefore summed up by the spreadsheet and reported into the result tables.

2.5. Checking for data consistency.

The consistency of the result can be initially checked by looking at the Table 2 of the results spreadsheet (Figure 38). The value of the Revenue per kg of the Budget 1 should be equal to the value of the commodity in process for the Budget 2 and so on. The value of Revenue of the last budget should be equal to the "system revenue".

Figure 38 : Cells to be compared for data consistency

2. Consolidated budget for 1 kg of output

Direct agent

	Budget 1	Budget 2	Budget 3	Whole system	%
Agent / Indicators	unbunded lowland average	local Paddy - improved parboiled milled rice trader	Retailer - Parboiled milled rice		
Fixed input	32	36	89	158	2%
Operating cost:					
Labour	661	65	36	762	11%
Services	1593	396	36	2025	28%
Material input	1603	541	0	2144	30%
Other cost	0	6	24	30	0%
Commodity in process		4329	6071		
Interest on cap&op.cst.	0	0	0	0	0%
Revenue	4329	6071	7143		
Profit	439	697	887	2024	28%
System revenue				7143	100%

If there is a divergence between these values, the user should check the data in the budget sheet looking more specifically at the following (Figure 39):

- Consistency between the prices applied for the output of the budget upstream agent (the seller) and the price for the commodity in process of the budget of the downstream (agent). The prices and the units of measure should be the same.
- The value in kilogram of the unit of measure keyed in for the conversion of the budget into kilogram.
- When the agent is reselling a processed output (milled rice) and purchased a raw material input (Paddy milled rice), the quantity sold out should be consistent with the quantity purchased in and correspond to the conversion ratio displayed at the top of budget 2 and budget 3. This is particularly the case if the unit of measure for the

purchase of the commodity in process differs from the unit of measure for the output.

Figure 39 : Checking for consistency between the values keyed in for revenue and for commodity in process.

System: Northern to Tamale local improved paraboil

Interest rate 0 per year

Budget 1: Producer

Conversion rate — *equivlent final output* *1.82*

					Financial cost	Kg budget 1	Kg final outp	Share of final outp value
Revenue								
Paddy rice	85	84 kg bag	200 000	17 000 000		2381.0	4329.0	
						0.0	0.0	
						0.0	0.0	
TOTAL REVENUE				00 000		2381.0	4329.0	
PROFIT				1 7 000		241.6	439.3	6.1%

Paddy rice — *tput unit in kg* 84 — *7 140 kg*
Total manday 8
Return to family labour 215 625

Budget 2: Marketing 1

Conversion rate 0.55 — *equivlent final output* *1*

					Financial cost	Kg budget 2	Kg final outp	Share of final outp value
Commodity in process								
Paddy rice	200	bag 84 kg	200 000	40 000 000	1	4329.0	4329.0	
Revenue								
Milled parboiled rice	110	bag 84 kg	510 000	56 100 000		6071.4	6071.4	
						0.0	0.0	
TOTAL REVENUE				56 100 000		6071.4	6071.4	
PROFIT				6 443 667		697.4	697.4	9.8%

Milled parboiled rice — *tput unit in kg* 84 — *9 240 kg*

300000

Appendix.

1. Estimation of the financial opportunity cost for fixed cost:

Capital recovery rate:

Let A be the annual payment that will repay a Z amount in investment cost,

The value of the annual payments at the end of n years life-time will be:

$$\mathbf{A}\ (1 + (1+i) + (1+i)^2 + \ldots + (1+i)^{n-1}) = \mathbf{Z}$$

With $A(1+i)^{n-1}$ as the value of the first annuity at the end of the period of utilization of the investment; $A(1+i)^{n-2}$, the value of the second annuity.

The investment must generate a return equals at least to the interest rate. The total value of the invested capital to be amortized is: $\mathbf{Z}(1+i)^n$

The total value of the invested capital to be amortized is thus:

$$\mathbf{A}\ (1 + (1+i) + (1+i)^2 + \ldots + (1+i)^{n-1}) = \mathbf{Z}(1+i)^n$$

Or :

$A = Z\left[\frac{(1+i)^n i}{(1+i)^n - 1}\right]$ with $\left[\frac{(1+i)^n i}{(1+i)^n - 1}\right]$ as capital recovery factor.

Estimation of the fixed cost value including the financial opportunity cost.

Value to be depreciated: Va

Interest rate: i

Life-time: n

Used up value: u ex : proportion of rice area in relation to total area

$$\text{CD} = \left(\frac{(1+i)^n i}{(1+i)^n - 1}\right) \times Va \times u$$

Depreciation of the fixed cost: DP= $\frac{VA}{n} \times u$

The financial opportunity cost FC for equipments is equal to the difference between the CD and DP: FC= CD-DP.

2.The Cost of revolving fund for the case of variable costs

Length of cycle since operation (but not vegetative cycle): 6 months

Annual interest rate: 0.06

Operation	Amount (a)	Number of months elapsed between operation and harvest (b)	Coefficient revolving fund: = (b)/cycle (c)	Capital invested =(a) x (c) (d)
Seeding	28 000	5	0.83	23 333
Beginning/Weeding	112 000	4	0.67	74 667
Guarding	34 588	2	0.33	11 529
Harvesting	65 882	0	0.00	0
Treshing	19 765	0	0.00	0
Total				109 529

Cost of revolving fund = annual interest rate x (cycle /12 months) x Total of revolving fund

Cost of revolving fund = $0.06 \times \frac{6}{12} \times 109\,529 = 3\,286$

Appendix 8: color sorter baseline

See excel files attached

Appendix 9: Designing feasible actions to improve rice system profitability.

The following note is based on the discussion held during the second training session carried out with EC and summarizes the main steps and issues that should be taken into consideration for identifying action that could actually respond to identified constraint and achieve the expected output.

1. Identification of the constraint and potential benefit

Before formulating any possible action, it is critical to clearly assess the nature of the issue to be addressed in order to fine tune the proposed solution.

Diagnostic and constraints identification. The local rice get a lower price at the retailing level compared to the imported rice. After additional investigation (price surveys, marketing study) even though the data collected indicates a wide variation of prices among local and imported rice, it is confirmed for an average quality of rice, local rice will get a lower price compared to the average quality of imported rice. Discussion with retailers confirmed that local rice value is hampered by its heterogeneity and low level of cleanliness (foreign material content).

Expected benefit if the constraint is alleviated: Taking into account available price and retailers' estimation, the production of clean rice would increase its value by a factor of 1.25. The price per kg at the retailer level in Kumasi would increase from 6000 to 7200 cedi.

Objectives. Improve the quality of the local rice at the retailing stage by increasing its cleanliness and heterogeneity.

Action to be taken: data and information analysis and meeting with key actors on the field.

Responsible: consultant under supervision of GRIB secretariat for data analysis, GRIB secretariat and GRIB EC members for the meeting with key players.

2. Technical issues

Identification of the adequate technology: This should take into account the initial price of the investment, its efficiency (i.e can it produce the expected output), the recurring costs (spare parts availability, technical capacity required to operate the machine) and the minimum requirement needed to operate the technology (capacity, type of input needed). After considering various type of equipment it came out that the best option is to purchase a line of equipment that can destine the paddy and grade it to discard immature grain.

Position of the proposed intervention in the current marketing chain: given the rice market configuration it is proposed to target in priority the Kumasi market where consumers are already in a position to choose between local and imported rice and which is still an important outlet for the marketing of the rice produced in the north. In order to ensure the highest value per kg of product transported it is also decided to locate the investment in Tamale, before shipping the improved local rice to Kumasi.

Action to be taken: technical information analysis and meeting with key informants and technician (equipment designer and supplier)

Responsible: consultant under supervision of GRIB secretariat for data analysis,

3.Financial analysis

Financial analysis: A budget can be developed summarizing the cost associated with various technology and added to the current milling cost. The financial analysis can be carried out by modifying the budget from one consolidated budget system produce or updated before hand, which will used as a baseline.(copy of the baseline consolidated budget and the one with additional equipment is attached hereafter as an example).

Taking into account the incremental cost associated with the integration of the destoner and grader and using the spreadsheet template it came out that at least 17000 bags of rice should be processed annually to break even (to recover the investment and operating cost) with a processing fee of 60000 Cedi per 84 kg bag of paddy rice. At least, 35 000 bags should be processed annually to maintain the level of milling and processing profitability with the new equipment at the same level that was recorded in the baseline situation (11%).

Logistic feasibility of the technology: Assuming that rice millers annual volume of activity varies between 1000 to 2000 bags, the preliminary analysis indicate that at least 30 to 15 millers should be linked with the operation of the new equipment investment, in order to provide enough paddy and milled rice to be processed and ensure a minimum profitability of the new equipment. This issue should be discussed thoroughly with trader and miller in Tamale to identify the best location for implementing the new equipments and reduce to the maximum handling cost between the mills and the grader. Another option would be to implement a full line of equipment, including a larger mill, but this may not be socially acceptable by the local rice business community.

Compatibility of the new equipment with the cost, revenue and price structure: Assuming that the new equipment can effectively be used within the current configuration of the milling activities in Tamale, it then necessary to assess to what extent it is compatible with the current price and cost structure of the rice marketing system.

Taking the baseline consolidated format, the analyst can estimate what will be the respective impact of an increase of the local milled rice price in Kumasi and of the milling and processing cost in Tamale. The following hypotheses are made:

- Increase of the retailing milled rice price from 6000 Cedi/kg to 7400 Cedi/kg,
- Increase of the milling fee from 12000 Cedi per bag to 60000 Cedi per bag.

On this bases, the selling price of the output (and the corresponding purchasing price for the next agent of the system) at each stage of the system can be adjusted to assess if these additional cost will be compensated by the additional income. The simulation can make the assumption that profit share among stakeholder should be equal before and after the investment in the new equipment. On a basis of trial and errors process, the application of price for the milled bag delivered at Kumasi of 560 000 Cedi against 460 000 Cedi in the baseline situation allows to maintain the same level of profitability per agent and an almost equal share of the total profit generated by the rice system as a whole.

Action to be taken: data and information analysis and meeting with key actors on the field.

Responsible: consultant under supervision of GRIB secretariat for financial analysis, GRIB secretariat and GRIB EC members for the meeting with key players about the technology integration within the current system.

4. Assessment of the social acceptability and feasibility of the proposed action

Once the option has been assessed as being technically and financially compatible with the current constraint, its social acceptability should be investigated through discussion with stakeholder at the various stages of the system.

Firstly, stakeholders might not see any advantage in improving the marketability of the local rice if they don't improve the profitability of their business. The possibility of increasing the volume marketed or maintaining their level of activity (expanding or keeping their share of the rice market), could however be considered as an incentive, large enough, to support the action.

In any case stakeholders' willingness to support to the proposed solution should be assessed through meetings with the different groups involved where the cost, logistics constraints and expected benefit identified through the technical and financial analysis will be discussed openly.

The discussion may lead to the definition of new technical, organisational and financial options (price for the output) that would have to be assessed again