Journal of Marketing and Consumer Research
ISSN 2422-8451 An International Peer-reviewed Journal
Vol.43, 2018

Rice technology and its market value in Guinea: A case of Faranah Prefecture

Siba Kolin Koivogui[1,2]*, Umuhoza Karemera Josiane Noella[1,] Emmanuel Tolno[2]
1. College of Humanities and development study, China Agricultural University PO box 100083, Beijing Haidian, Qinghua DongLu, P.R. China
2. Higher agricultural and veterinary institute of Faranah, Republic of Guinea,
* E-mail of the corresponding author: Sibakolinkoivogui@gmail.com

Abstract

Rice *(Oryza spp.)* is one of the major food crops on which global food security depends. Although most rice is produced in Asia, it is an important food crop in many other parts of the world, including West Africa (WARDA, 2007**).** This research aims to assess the economic performance of rice processors in terms of net income and productivity from rice technology in Faranah prefecture, republic of Guinea. The study has used gross margin analysis to identify the total production cost, gross revenue, net income and benefit cost ratio (BCR) of each rice processors through which the statistics descriptive analysis had been used. The marketing of paddy and net rice in our production area is illustrated by this circuit which is subdivided into three main steps: A, B and C through which rice is sold from producers, buyers-steamers and machine owners to wholesalers, retailers and consumers. It was observed that transportation cost/ bag, food cost, husking cost and price of wood were also high (800; 103.68; 91 and 78 US$ respectively. However, tax, other charge and water were judged low (17.96; 41.47 and 15 US$) respectively. In husking, it was observed that the higher average values were wages, diesel, lubricant, repairs (324, 306.72, 134.4, and 115 US$) respectively followed by wear piece, tax and other charge (75.32, 32.4 and 25 US$). Comparting these two actors, the buyer-steamers expend more (2932.92 US$) than the machine holders with (1012.84 US$). This channel is dominated in terms of economic performance by producers (Small, medium and large) and processors (buyers-steamers and machine holders) respectively.
Keywords: Rice technology, market value, marketing, Parboiling, Husking, stakeholders

1. Introduction

Among the major staple foods in South Saharan Africa (SSA), rice consumption is growing most rapidly (Diagne, 2010). There are a number of reasons which makes rice to be an important convenience food. It requires less time and energy to cook than most of the other staples such as beans, cassava, banana and potato. This is an important attribute given the increased participation of women in the labor market and the importance of food consumption growth from the household. Other desirable features include its ease storage and handling, and its long shelf life. These make it a highly desirable food in urban areas. Furthermore, when processed, rice gives several

useful by-products, which can be used in the animal feed sub-sector, breweries and other industries. Food is a key to sustaining life, as it provides essential and healthy nutrients for the maintenance of good health, improvement of wellbeing, and Labour productivity. Food insecurity is a global issue that seems to be most severe in Africa and especially in sub-Saharan region of Africa. For instance, during the periods 2014 and 2016, the level of undernourishment in sub-Saharan Africa rose to about 220 million when compared to 180 million recorded between 1990 and 1992 (Food and Agricultural organization 2015). If past trends continue, consumption will reach close to 44 million tons (Mt) in 2020 compared with 23 Mt of milled rice production. This will imply a self-sufficiency ratio of only about 52%. However, this growing imbalance is based on past trends and does not have to reflect the future. Africa has a number of advantages that may put it in a better position. Production has been increasing, in part spurred on by the food crisis of 2007– 2008, and a number of pro-active measures have been taken.

The fact that most rice is grown under rainfed conditions means that there is substantial potential for investment in irrigation, and a consequent increase in yields up to 7 t/ha or more. Furthermore, the new NERICA varieties developed by the Africa Rice Center for rainfed cultivation mean that gains in yields are not limited to irrigated rice. Finally, a number of studies suggest that SSA has a comparative advantage in rice production in competition with imports, and that comparative advantage appears to be growing, especially given the price increases since 2005 (Lançon and Benz, 2007).

Growth of rice consumption in SSA has been outstripping that of rice production. Between 1961 and 2005, rice consumption in SSA grew at 4.52% annually, compared with growth of production of 3.23% (WARDA, 2007). Imports increased dramatically to fill the gap, as the self-sufficiency ratio (production/consumption) declined from 112% in 1961 to 60% in 2005. The international market thus supplied 40% of SSA's rice needs, and this share is continuing to increase.

Rice (*Oryza* spp.) is one of the major food crops on which global food security depends. Although most

rice is produced in Asia, it is an important food crop in many other parts of the world, including West Africa, especially Guinea, where rice is the staple food. With a per capita consumption of 69 kg per year, Guinea is the second largest consumer of rice in West Africa after Sierra Leone (WARDA, 2007). Despite production growth of 5.3% (2001–2005), this still cannot meet the local demand: 40% of the rice consumed is imported (MAEF, 2007a). Increasing domestic rice production is a priority in Guinea (MAEF, 2007b), as well as in other African countries. like any crop, seed availability and quality are considered bottlenecks in developing competitive agricultural sectors (Bam *et al.*, 2007; McDonald, 1998). Like many countries in the region, Guinea has tried to establish a formal national seed system, with several projects addressing seed production, multiplication and distribution (SNPRV, 2001). However, such efforts have yielded little success: only 8% of the rice farmers have access to seed from the formal sector (SNPRV, 2001). Most smallholder farmers, as in most developing countries, rely on the informal seed system (Almekinders and Louwaars, 2002; SNPRV, 2001; Tripp, 2001) and depending on the region and crop, 60–100% of the seed is locally produced and exchanged (Almekinders *et al.*, 2007; Duijndam *et al.*, 2007; Ndjeunga, 2002; Nuijten, 2005; Okry, 2005).

Rice occupies 10% of the total land under cereal production and it represents 15% of the total cereal production (FAOSTAT, 2006). Approximately 20 million farmers in SSA grow rice and about 100 million people depend on it for their livelihoods (Nwanze *et al*., 2006). Between 1961 and 2003, the annual consumption of rice increased annually by 4.4% and among the major cereals cultivated, rice is the most rapidly growing food source in SSA (Kormawa *et al.,* 2004).

Despite the apparent importance of rice in SSA, the production level is still far below the consumer demand. As a result, rice imports keep growing at an alarming rate. In 2006, SSA accounted for 32% of the global rice imports with a record level of 9 million tons (WARDA/FAO/SAA, 2008). In some sub-Saharan African countries like The Gambia and Guinea, rice is the most important staple food crop and source of calories in terms of consumption. Its production is one of the main agricultural activities and an important source of income for a large number of women farmers in the country.

In Sierra Leone and Guinea, imports constitute less than 25% of total rice consumption. Guinea's milled rice production of 1.2 million tons would only need to be expanded by one-third to eliminate the roughly 400,000 tons of imports and fully meet the needs of the 12 million citizens. Rural Guineans eat rice that they parboil and dry in the sun. There are almost no automated mills with parboiling and drying using husk-fueled boilers and furnaces as in India. A small coterie of private rice importers with import licenses benefit from low duties granted by government officials who fear the slightest rise in the price of a staple food could lead to mass demonstrations as happened in a number of West African countries in 2008.

2 Review bibliographic

2.1 Rice market network

Market information for producers, buyers, and sellers of agricultural produce in Guinea is not consistently available or available in a timely manner. Prices paid for farm produce are announced on weekly radio broadcasts through the "radio rural" system but most data is not current given the difficulty in collecting prices at the farm and local markets and subsequent transmission of the data through existing communication channels. Officials at the Agricultural Commercial Agency (ACA) noted their plans to increase personnel in the field for data collection, improve data processing techniques, acquire information technologies, and lobby for more frequent transmission of price information to all agricultural productions zones. ACA needs assistance to improve their coverage of production zones as well as the means to process and disseminate market information in a timely manner. The Assessment team was advised that the local chamber of agriculture would also undertake the development of marketing information systems for the benefit of producers. Greater efforts must be undertaken by the government with assistance from donors where appropriate, to improve market information with an overall objective of strengthening agricultural produce markets throughout Guinea

The majority of sellers in the sample, 78%, sell their rice to the village. The remaining 22% seek to earn more by marketing in a more distant market. In particular, it is the weekly markets where the traders collect. The field price ranges from 2000 to 3000 Franc Guinean (FG) kilogram of paddy and 6000 to 8000 FG per kilogram of net rice (0.21 to 0.34 US $ of paddy rice kilogram and 0.64 to 0.84 US $ of net rice kilogram.

2.2 Rice parboiling

Parboiling is a transformation process that enhances the physical, chemical and organoleptic quality of rice. In Benin, Guinea and in many other West African countries, rice parboiling is exclusively done by women and girls from rice producing villages and surrounding areas. In Guinea particularly, parboiling is become the activity which is reserved to women called buyer-steamers in the villages but also in the cities intensively. Rice production and processing tasks are divided on the basis of gender, with women being responsible for much of the work involved in processing (Norman & Kebe, 2006). Rice processing is a viable vehicle to empower women by providing them with livelihood and micro-enterprise opportunities. Thus, better processing technologies may directly improve the lives of women and advance their position and respect in rural

communities. However, the prevailing traditional methods result in low milling yield and poor quality (Houssou & Amonsou, 2004). To enhance the quality of parboiled rice, researchers from Africa Rice Center (Africa Rice, ex-WARDA) collaborated with local artisans and female rice processors to develop an improved parboiler with local materials and equipment: Africa Rice subsequently developed a video where rural women explain how to use this improved technology and its benefits (Van Mele, 2006). Studies on consumer preferences and acceptability of parboiled rice are, however, scarce. Tomlins et al. (2005) investigated consumer preferences for locally produced versus imported parboiled rice and relate sensory attributes with consumer acceptability of rice through consumer surveys and sensory panels in three urban centers in Ghana. Heinemann et al. (2006) analyzed acceptability and consumer attitude towards parboiled rice in Brazil using sensory panels and consumer surveys.

They concluded that the majority of consumers do not reject the parboiled rice solely based on its sensory properties, but because of not being familiar with it and so, unaware of its characteristics and advantages. In a follow up study, Behrens et al. (2007) used cluster and correspondence analysis to identify and profile consumer segments and he observed that a positive attitude was a reflection of habit and liking, while a negative attitude seemed to be due to previous negative experience and misconceptions about the product. Their findings corroborate the need for marketing efforts and information campaigns in order to inform consumers about the nutritional value and convenience of parboiled rice.

3 Research design

3.1 Materials and methods

This research aims to assess the economic performance of rice processors in terms of net income and productivity from rice technology in Faranah prefecture, republic of Guinea, republic of Guinea. More specifically, the study aims to: 1. Identify the income generated by the buyers-steamers and huskers in the local rice treatment; 2. Discuss with these two stakeholders the benefits of rice processing and difficulties associated with its technology and its added value.

3.2 Data collection and analysis

The data were collected in the nine (9) rural communes (Bagna, Beindou, Urban Community, Heremakono, Nialia, Passayah, Sandenia, Songoyah and Tiro) through an interview scheduled of January to June, 2016 by an intensive survey; quantitative and qualitative methods were used. From these initial activities, all the data collected were verified, coded and introduced into the computer for analysis and interpretation using Microsoft Excel and the statistical tool for the social sciences (SPSS) and origin 8 (analysis software). The Statistics such as mean, standard errors, minimum and maximum were used to describe the selected characteristics of the respondents and to summarize the variables of the study.

3.3 Gross margin analysis

The Gross margin analysis was adopted in this research following Nwaobiala, (2010). The following expression was used for the gross margin analysis

$$GM = \Sigma p_i (Q_i - \Sigma p_j X_i) \quad (1)$$

Where:

GM = Gross Margin; P_i = Unit price of output; Q_i = Quantity of each output; P_j = Unit of each input; X_i = Quantity of each input.

$$NR = GM - TC \quad (2)$$

$$BCR = TR / TC \quad (3)$$

Where:

NR = Net Revenue; TC = Total fixed costs derived by depreciation of fixed costs;
TR = Total Revenue; TC = Total Costs.
BCR = Benefit Cost Ratio

4 Results and Discussions

4.1 Local rice marketing in study area

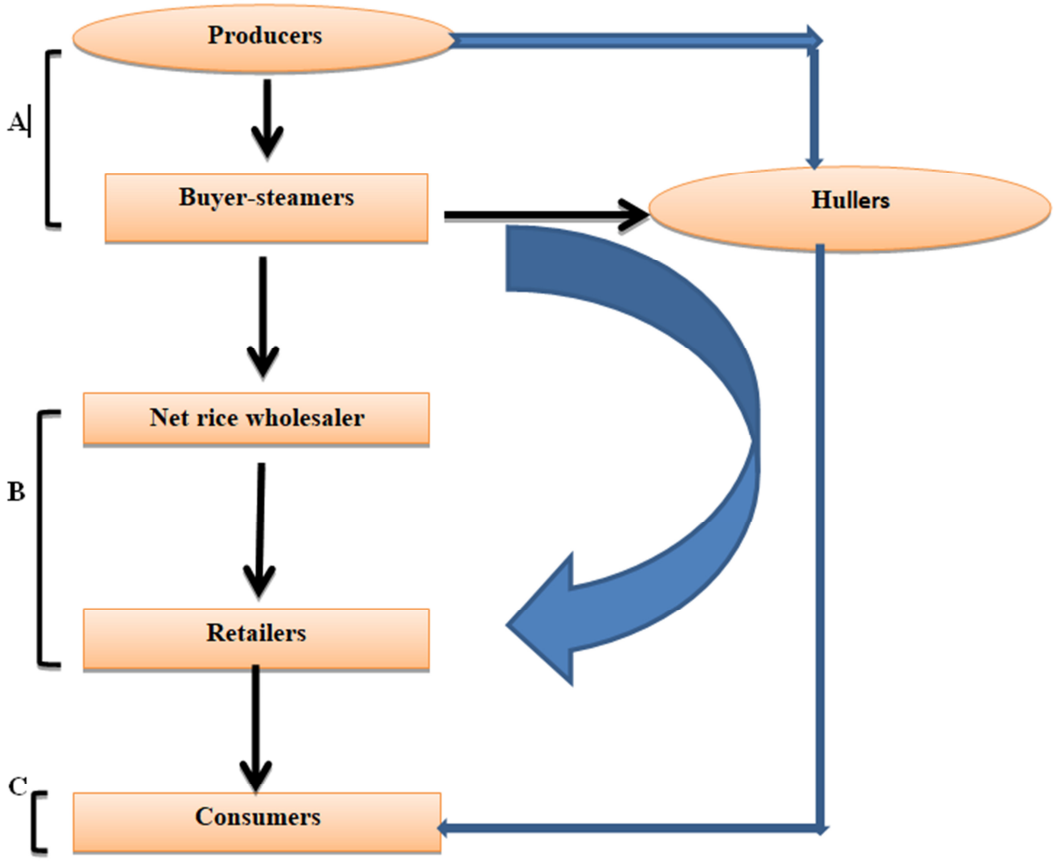

Figure 1: The marketing network of local rice

The local Guinean rice technology is taking on new importance given the consumer demand for quality rice. This net rice must meet certain conditions such as: steaming, good taste and not broken. This steamed rice is recommended for people suffering from diabetes, blood pressure, regular constipation, body weakness and so many other diseases. Following all these advantages, local rice is the preferred food of the Guinean population and makes it more expensive than the imported white grain rice from Asia.

The marketing of paddy and net rice in our production area is illustrated by this circuit (Figure1) which is subdivided into three main steps: A, B and C. Thus A is the direct circuit from which the surplus paddy rice of the producers is purchased by the steamer women called buyer-steamers. At the level of this stage, these women proceed to the technology of their stock by vaporizing a certain quantity of rice and then drying it for processing in the machines (paddy rice in net rice) remove completely the envelopes. This quantity of rice already processed must be sold by wholesalers, who pay large amounts of net rice to store and resell when the price per kilogram goes up of the country or in the mining areas where they benefit from great advantages in terms of prices, in this logic, they can drain their stock in the surrounding countries (Liberia, Sierra Leone, Mali, Senegal) before leaving the remain in the hands of secondary market retailers, where consumers of all categories buy their food. In conclusion, we can say the producer sells his paddy rice to the buyer – steamers who use technology (parboiling) and must sent their stock in net rice for the wholesalers where many details will come to buy rice for selling it further to consumers

The next step is B, where buyer-steamers and sheller are selling one part of their net rice to wholesaler

and retailers. Through this one step, it was revealed that net rice great quantities are provided to wholesaler who could every time buy and while waiting the good selling opportunities. The third stage is C, in which hullers pound paddy rice from not only the buyer-steamers but also directly from accumulated amounts of producers and sell their and paid them in net rice to consumers. This activity becomes very intense in the difficult times (July, August and September) and in which the villages seem to be in food insecure in terms of net rice and against which the price per kilogram is negotiated at 0.84 US$.

We can notice that between these three steps, B is the best way to the producers as it permit them to benefit more from rice production grace of the fact of their self-processing of paddy and selling the net rice to the consumers. However, the step A directly gives the process of delivery of net rice, from producers to consumers, to wholesalers and retailers where paddy is bought at the wrong price (low price: US $ 0.21 / kg) during the harvest period and is the real time, where producers lose more profit from their production activities. Continuing in this logic, the step C is not also benefit to the producer because net rice is from Sheller and Buyer-steamers to wholesaler and rets

4.2 Different costs related to rice technology

Table 1: The annual average cost operating of rice processors in US$
Source: Calculated from survey data (2016)

Processors	Operations	Costs
Bayer - steamers	Price of paddy rice purchased	1785
	Transportation cost/bag	800
	Price of wood	91.8
	Food costs	103.68
	Tax	17.96
	Water	41.47
	Other charge	15
	Husking costs	78
	Total cost	**2932.91**
Husking	Lubricant	134.4
	Diesel	306.72
	Wear piece	75.32
	Repairs	115
	Tax	32.4
	Wages	324
	Other charge	25
	Total cost	**1012.84**

As regards from Table 1, it should be noted that the processing of rice comes from two actors (buyer-steamers and hullers) where purchased rice made an average of 1785 US$, which is the largest amount spent during paddy rice purchasing and parboiling. In these activities; it was observed that transportation cost/ bag, food cost, husking cost and price of wood were also high (800; 103.68; 91 and 78 US$ respectively. However, tax, and other charge and water were judged low (17.96; 41.47 and 15 US$) respectively due to the status of these activities. After analyzing all of these activities, it was clear that the total operating cost of paddy rice, (buying parboiling and husking is estimated at 2932.92 US$.

About husking, it was observed that the highers average values were wages, diesel, lubricant, repairs (324, 306.72, 134.4, and 115 US$) respectively followed by wear piece, tax and other charge (75.32, 32.4 and 25 US$). It was concluded that the total amount spent by the hullers was estimated at 1012.84 US$. It should be noted that wages are highly observed because of the many difficulties endured by the technicians who work from the aging of those machines (many old machines).

Comparting these two actors, the reason is that the buyer-steamers expend more (2932.92 US$) than the machine holders (1012.84 US$). That of the total cost is because the buyer-steamers made three big processes such as buying, steaming and husking and where must expend every times. On the other hand, it was noted that at the level of the machine owners, the maintenance activities and the payment of technicians' salaries constituted the major part of the expenditure.

Table 2: Depreciation of materials used in US$

Item	Rice processors	
	Duration	Depreciation
A. Buyer-steamers		
Basin	5	2.6
Cask	3	9.36
Large bowls	5	8
Kettles	2	5.2
Tarpaulins	3	15.4
Empty bag	2	8.25
Total depreciated		**48.81**
B. Hullers		
Machine	10	102.6
Shovels,	5	1.54
Shelter	5	27
Tarpaulins	3	15.4
Total depreciated		**164.54**

Source: Calculated from survey data (2016)

Table 2 shows that rice processing tools can be depreciated over time and must be taken into account in the calculation of the revenue generated by the actors. The objective is to know the total of the amounts resulting from the depreciation to extract in the total obtained to know the real value of the net income of the actor. Then, through our study, it was indicated that the total average of buyer-steamers 'depreciation was 48.81 US$ and to know that the materials such as basin, large bowls have a duration of 5 years however, empty bag, and kettles are taking 2 the small duration (2 years). It was conclude that; the total average of buyer-steamers' depreciation value was US $ 48.81 was qualified as no high amount because the actor do not use the high-cost tools.

For sheller or hullers, it was noted that the total amount of hullers 'depreciation was estimated at 164.54 US$ which was qualified as high value due to the presence of certain tools such as decorticator machine and shelter. Comparing the depreciation values between these two actors, we should say that for machine holders 'depreciation value is highly superior to buyer-steamers because of the difference in materials using.

4.3 Economics performance of rice stakeholders

Table 3: Rice processors 'economic performance in US$/ha

Items	Processors descriptive	
	Bayer-steamers	Sheller
Processing total cost	2981.72	1177.38
Net rice output (Kg)	8000	3500
Gross margin	6720	2940
Net income	3787.09	2487.16
BCR	2.25	2.50

Source: Calculated from survey data (2016); 1 kg of net rice = 0.84 US$

From this table 3, the results shows processors 'economic performance where the variables such as processing total cost, gross margin and net income were analysed. If we take buyer-steamers, it observed that the processing cost was very high due to the multiple loads (purchasing paddy rice, paddy rice steaming and pounding) and which include considerable expenses at each level. For a year, the total net rice output was about 8000 kg where it was generated 6720 US$ as gross margin and where net income generated was estimated at 3787.09 US$ which produces a benefice cost ratio in the order of 2.25.

As regarding to the economic performance of the machine owners or decorticators, it was revealed that

the quantity of net rice produced was 3500 kg for a total treatment cost estimated at 1177.38 US $. Logically, the result shows that rice husking generated a gross margin equal to 2940 US$ where net income was 2487.16 US$ producing a benefit cost ratio at 2.5.

It should be conclude that, in this economic performance of rice processors, the buyer-steamers was getting highly advantage from rice activities than machine owners in terms of net income generated, whether 3787.09 US$/ 2487.16 US$ due to the great quantity of net rice produced (8000 kg), but in terms of benefit cost ratio (BCR), the hullers still got more with 2.5 than the buyer (2.5).

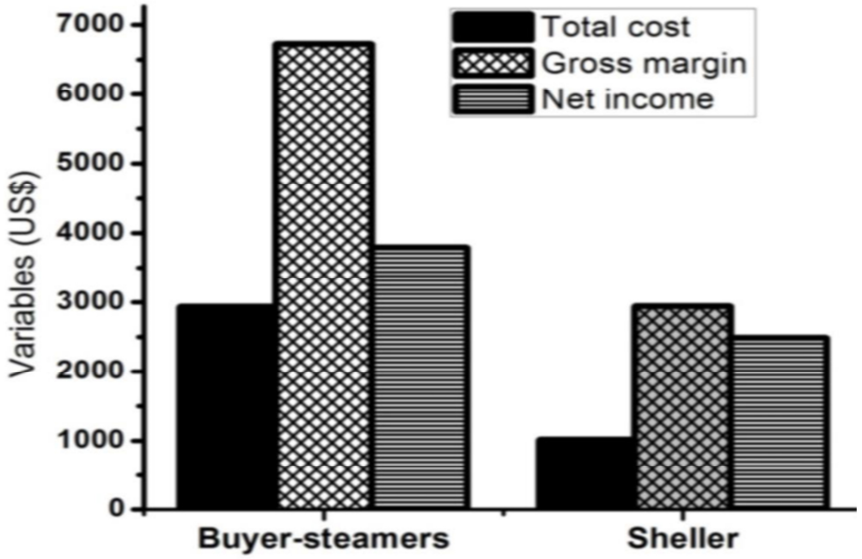

Figure 2: Economic performance of rice processors in US$

This figure 2 shows that rice processing was done in our study area by two actors which were the buyer-steamers and machine owners or huskers. It was indicated that the means variables were the total cost, gross margin and net income generated by each actors during the year. The figure shows that, the economic performance of the buyer-steamers was highly appreciated than machine holders due to the fact that women buy rice at low prices with producers during the harvest period and store largely to await the end of paddy rice abundance in the market before processing and sell the net at a higher price (See the figure 2 for all precision). For the rest, this figure is explained on the same way that the table 3, the different part is net rice output and the benefit cost ratio (BCR) of each actor.

Table 4: Economic performance by Anova descriptive

Processors	Mean	Standard Error	Minimum	Maximum
Buyer-steamers	4496.27	1146.82	2981.72	6720
Sheller	2146.66	528.48	1177.38	2940

Source: Calculated from survey data (2016)

This descriptive table 4 was done to explain how rice processors got the advantage of this rice processing activities. The table shows that between buyer-steamers and sheller, the standard error was various with the proportion of 1146.86 and 528.48 which conform in terms of maximum and minimum (6720; 2981.72) to buyer-steamers. However, the situation was less for the sheller where we had 2940 and 1177.38.

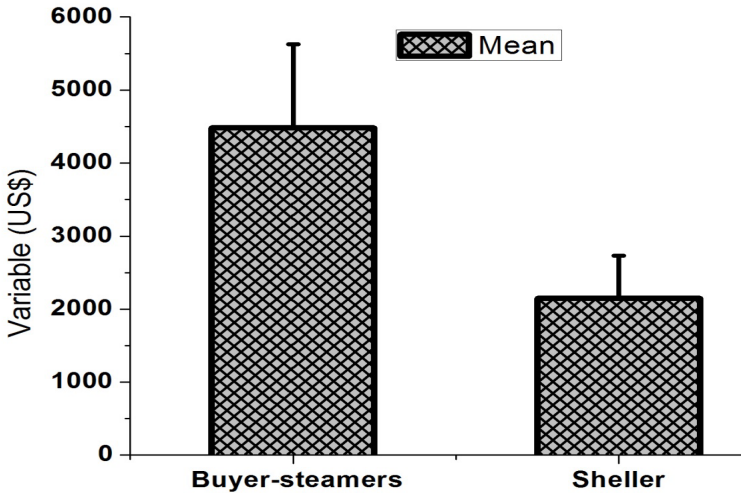

Figure 3: LSD test of Rice processors (Buyer-steamers, Sheller)

Through this figure 3, it is revealed that the LSD test was to make clear the differences in the meaning of the variable of these two processor actors. It should be pointed out that steamer buyers had a high level of significance estimated at 4496.27 for 1146.82 as standard error, which may imply that this category of processors will be able to significantly improve their technological activities and life living conditions. It is also clear that machine owners or hullers can take into account their activities which were not bad in terms of income generates because in this work, the average was estimated to be about 2146.66 where the standard error was 528.48.

Table 5: Economic performance comparative of rice stakeholders in US$/Ha

Actors	Comparative descriptive				
	Total cost	Quantity produced/Kg	Gross margin	Net income	BCR
Small producers	77115	194901.6	149445	71817	1.93
Medium producers	79961	176447	139920	59372	1.67
Large producers	116057	148924	163657	48031.41	1.41
Buyers-steamers	2932.91	8000	6720	3787.09	2.25
Shellers	1012.84	3500	2940	2487.16	2.5

Source: Calculated from survey data, 2016

Table 5 shows all the actors of rice in the production area, ie producers (small, medium and large) plus processors (buyers and holders of machines). This synthesis descriptive related that the small producers engaged 77,115 US$ as the total of annual average production cost producing an amount of 194,901.6 kg of paddy rice and which generated a gross margin at 149,445 US$ to 71817 US$ as net income and where the benefit cost ratio was 1.93. The small producer spends less total production costs but produced more and also generated higher incomes due to the land size of and nature considered very small but good than those who are large and commit a lot of money to their improvement. At the level of medium producers, it was indicated that the annual production total cost was 79961 US$ where the quantity of production was 176,447 kg and generated a gross margin at 139,920 US$ which had obtained 59372 US$ as annual net income. The large producers were credited as those who had more expend in annual total cost estimated at 116,057 US$ for a total paddy rice of 148924 kg which had allowed a gross margin of 163657 US$ and generated 48031.41 US$ to 1.41 as productivity score (BCR).

In this comparative study, it was necessary to have access to the various actors of the paddy processing to perceive which of the five actors realizes a significant advantage of this agricultural activity which motivates more the farmers in these different localities invested by our study.. Our observation was that buyers-steamers generated an estimated annual production cost of US $ 2,932.91 spent solely as the cost of acquiring paddy rice when harvested by producers who do not understand that their products will eventually be sold while themselves needed them for deess and food and they will need them for seed and food. These actors will therefore transform the paddy rice into net rice and will sell it at double or triple the cost of purchase.8000 kg of net rice are produced and generate either, US $ 6720 in terms of gross income which will enable them to obtain a net income of US $ 3787.09 for a productivity of 2.44.Finally, at the level of owners of machines or hullers, the activity was interesting because the annual cost of production is still low 1012.84 US $ for a production of 3500 kg which

will enable them to obtain 2940 US $ of gross margin and generated a net profit of 2487.16 for a ratio of the costs of the advantage to 2 5.

Table 6: Anova analysis of stakeholders' net income in US

Items	Mean	Std. Error	Minimum	Maximum
Small producers	99459	25039.75	71817	149445
Medium producers	93084.33	24160.30	59372	139920
Large producers	109248.47	33551.38	48031.41	163657
Buyer-steamers	4480.	1146.82	2932.91	6720
Sheller	2146.66	581.78	1012.84	2940

Source: Calculate from survey data (2016)

This table 6 shows the realized combination of the variables in the Anova analysis through which the LSD test was made to know more about the significance of these five rice actors in Faranah prefecture. It was observed that the large producers possess the higher average with 109,248.47 to 33,551.38 as standard error due in fact to the high production cost revealed in the table 5. That means that at the level of large producers, the priority was for large production but they do not adequately cover cultural techniques to maximize production and this explained the low quantity of rice and its low net income compared to small producers who counter their efforts on their small areas exploited while minimizing production costs for significant yields.

We can conclude by supporting that this chain of rice actors in our study area was characterized by the level of the quantity produced also by the income generated. Thus, our study has made it possible to understand that small producers produce better and generate high returns and higher net income, followed by medium producers and large producers. After these producers, come the processors (buyers-steamers and machine holders). The sheller, who close the margin, made a good score of productivity because they spend less on production costs than all other actors (BCR = 2.5).

5. Conclusion and discussions

The marketing of paddy and net rice in our production area is illustrated by this marketing channel (figure 1) which is subdivided into three main steps: A, B and C. This activity becomes very intense between July and September and in which the villages seem to be in food insecure in terms of net rice and against which the price per kilogram is negotiated at 0.84 US$. Regarding Table 1, it should be noted that the processing of rice comes from two actors (buyer-steamers and hullers). It was observed that transportation cost/ bag, food cost, husking cost and price of wood were also high (800; 103.68; 91 and 78 US$ respectively. However, tax, other charge and water were judged low (17.96; 41.47 and 15 US$) respectively due to the status of these activities. About the second actor such as the husking, it was observed that the higher average values were wages, diesel, lubricant, repairs (324, 306.72, 134.4, and 115 US$) respectively followed by wear piece, tax and other charge (75.32, 32.4 and 25 US$). Comparting these two actors, that the buyer-steamers expend more (2932.92 US$) than the machine holders with (1012.84 US$).

Table 2 shows that rice processing tools can be depreciated over time and must be taken into account in the calculation of the revenue generated by the actors. Then, through our study, it was concluded that the total average of buyer-steamers' depreciation value was US $ 48.81 which was qualified no high amount because the actor do not use high-cost tools.

For Sheller or hullers, it was noted that the total amount of depreciation was estimated at 164.54 US$ which was qualified as high value due to the presence of certain tools such as decorticator machine and shelter. Comparing the depreciation values between these two actors, we should say that machine holders 'depreciation value was highly superior because of the difference in materials using.

From the table 3, it was concluded that, the buyer-steamers got highly advantage from rice activities than machine owners in terms of net income generated, whether 3787.09 US$/ 2487.16 US$ due to the great quantity of net rice produced (8000 kg), but in terms of benefit cost ratio (BCR), the hullers got more with 2.5 than the buyers (2.2) due to the low production cost.

The table 5 shows all the actors of rice in the production area, i.e. producers (small, medium and large) plus processors (buyers-steamers and the holders of machines). In the comparative study between all rice stakeholders, it was concluded that buyers-steamers engage an estimated annual production cost of US $ 2,932.91 as the cost of acquiring paddy rice for 8000 kg of net rice produced generating a net income of US $

3787.09 while profitability is about 2.44 (CBR). Comparing to the owners machines or hullers, the annual cost production was 1012.84 US $ for a net income of US$ 2487.16 to a cost benefit ratio at 2 5.

We can conclude that this channel of rice actors in our study area was characterized by the level of the quantity produced also by the income generated; the small producers produce better and generate higher net income, followed by medium producers and large producers. After these producers, come the processors (buyers-steamers and machine holders). The Sheller, who close the margin, make a good score of productivity because they spend less on production costs than all other actors with a benefit cost ratio at 2.5 level.

Acknowledgements

This paper is an outcome of my Ph.D. dissertation research funded by China Scholarship Council (CSC). The dissertation was carried out at College of Humanities and Development Studies, China Agricultural University (CAU). The author likes to thank CSC for its generously financing my PhD study in China. I also like to thank Prof. Liu Yonggong, CAU for his excellent academic.

We also would thank all those involved in the research, in particular Umuhoza Karemera Noella, Emmanuel Tolno for their fruitful discussions; the Higher Agricultural and Veterinary Institute of Faranah for his great contribution. My sincere thanks also go to the farmers and surveyors who actively participate in the field data collection process. The authors would like to acknowledge the contributions of the anonymous reviewers for their comments on earlier drafts of this paper.

References

Bleoussi R, Fofana M, Bokossa I and Futakuchi K. (2011). Effects of storage on grain quality characteristics in NERICA rice. p 3.3–3.3.

Behrens, J. H., Heinemann, R. J., & Lanfer-Marquez, U. M. (2007). Parboiled rice: A study About attitude, consumer liking and consumption in São Paulo, Brazil. Journal of the Science of Food and Agriculture, 87, 992-999.

Diagne, A. 2010. Rice policy and impact research at Africa Rice. Presentation to CORAF/WECARD Meeting, 24 May, Cotonou

FAO. FAOSTAT agriculture data, Accessed on October, 19, (2010) at http://faostat.fao.org/. Innovation and Partnerships to Realize Africa's Rice Potential. Proceedings of the Second Africa Rice Congress, Bamako, Mali, 22–26 March. Africa Rice Center, Cotonou

Fall, A. A., Fall, C. A. K., Gningue, D. R., Ndir, B., & Ndour, M.,(2007). Etude sur les critères de qualité et les modes de consommation du riz au Sénégal, Rapport Projet FNRAA, No. 010/AP03M010202, Fonds National de Recherches Agricoles et Agro-alimentaires (FNRAA), Dakar, Sénégal.

Gakuru, M., winters, K., & Stepman, F., (2009). Inventory of innovative farmer advisory services using ICTs, Forum for Agricultural Research in Africa (FARA), Accra, Ghana.

Harrison, G. W., Harstad, R. M., & Rutström, E. E. (2004). Experimental methods and elicitation of values. Experimental Economics, 7, 123-140.

Houssou, P., & Amonsou, E. (2004). Development on improved equipment for paddy rice in Benin. Uganda Journal of Agricultural Sciences, 9, 617-620.Van Mele, P. (2006). Zooming- in, zooming-out: A novel method to scale up local innovations and sustainable technologies. International Journal of Agricultural Sustainability, 4, 131-142.

Heinemann, R. J. B., Behrens, J. H., & Lanfer-Marquez, U. M. (2006). A study on the acceptability and consumer attitude towards parboiled rice. International Journal of Food Science and Technology, 41, 627-634.

Lançon F and Benz HD. (2007). Rice imports in west Africa: Trade regimes and food policy formulation. Poster prepared for the 106th seminar of the European Association of Agricultural Economists, Montpellier, France, and 25–27 October.

M. Diatta, & D. Millar (Eds.), Africa Rice Congress (2010): Innovation and partnerships to realize Africa's rice potential, Bamako, (Mali, 22-26 March, 2010) pp. 128-129. Cotonou, Benin: Africa Rice Center.

Matty Demonta, Espérance Zossoub,c, Pieter Rutsaertd, Maïmouna Ndoura, Paul Van Melec and Wim Verbeke (2011) Willingness to Pay for Enhanced Food Quality: Rice Parboiling in Benin

Norman, J. C., & Kebe, B. (2006). African smallholder farmers: Rice production and sustainable livelihoods. International Rice Commission Newsletter, 55, 33-44.

Rutsaert, P., Demont, M., Ndour, M., Verbeke, W., Seck, P. A., & Tollens, E. (2010). Paying for quality: Private versus collective valuation of Senegal River Valley rice. In P. Kiepe,

Tomlins, K. I., Manful, J. T., Larwer, P., & Hammond, L. (2005). Urban consumer preferences and sensory evaluation of locally produced and imported rice in West Africa.

Food Quality and Preference, 16, 79-89.
USAID,(2009). Global food security response: West Africa rice value chain analysis, Micro Report, No. 161, United States Agency for International Development (USAID), Washington, D.C., USA.
Van Mele, P. (2006). Zooming- in, zooming-out: A novel method to scale up local innovations and sustainable technologies. International Journal of Agricultural Sustainability, 4, 131-142.
WARDA (Africa Rice Center, 2007). Africa Rice Trends: 2007 Brief – Overview of recent Developments in the sub-Saharan African rice sector. WARDA, Cotonou.
Zossou, E., Van Mele, P., Vodouhe, S. D., & Wanvoeke, J. (2009). The power of video to trigger innovation: Rice processing in central Benin. International Journal of Agricultural Sustainability, 7, 119-129.