The rice processing units at the Niger Office in Mali

Yacouba Mamadou Coulibaly[1*] and Michel Havard[2]

(1. *Nyeta conseils, BP 11, Niono, Mali ;*
2. *CIRAD, UMR Innovation, 34398 Montpellier, France*)

Abstract: The Niger Office (NO) was created in 1932 and is one of the major irrigated areas of sub-Saharan Africa. Its irrigated lands are primarily intended for rice growing since cotton cultivation was abandoned in 1971.With the generalization of intensive rice growing and expansion of the irrigated areas, paddy production doubled between 1999 and 2012 (650,000 tonnes), which greatly increased rice processing requirements. This article analyses the development of rice processing units, then identifies prospects and opportunities for the stakeholders in this important sector for food security in the country. The institutional reforms at the beginning of the 1990s and the increase in volumes to be processed encouraged the transfer of rice processing to new players (farmers, farmer organizations, private operators)using hullers. This resulted in lower processing costs, to the detriment of marketed rice quality, as the hullers only gave ungraded rice, whereas the industrial rice mills offered several qualities of milled rice. But those hullers could not meet the growing demand for quality rice from urban consumers in the country and in the sub-region. Consequently, some private operators and farmer organizations opted to procure more efficient rice processing equipment: mini rice mills carrying out cleaning, hulling, whitening, sorting and bagging operations, etc. However, their prices are 10 to 15 times higher than those of hullers. In addition, technical, organizational, commercial and financial constraints limit the possibilities for processors to capture the national and sub regional quality rice market. Lastly, improving the quality of local rice calls for combined harvesting, threshing, storage and processing initiatives, with consequential support from research, training and advisory bodies.

Keywords: rice, processing, rice mill, stakeholders, profitability, competitiveness, Mali

Citation: Coulibaly, Y. M. and M. Havard. 2015. The rice processing units at the Niger Office in Mali. Agric Eng Int: CIGR Journal, 17(2):176-184.

1 Introduction

Mali produces about 1.6 million tonnes of paddy rice (2009) and imports 45% of traded rice to cover its needs. And rice consumption growth averages 7.5% per year since 1995 (Barris, 2005).The competitiveness of the Malian rice supply chain comes up against constraints linked to paddy production (access to inputs, respect of crop management sequences, harvesting and threshing losses, etc.), and to storage and processing (lack of infrastructures, inefficient processing equipment, etc.). Equipment in the processing sector mostly comprises hulling units operating on small to medium scales. The rice product by these units contains impurities, broken rice, etc.On the other hand, the mini rice mills installed over the last ten years or so give a better quality hulled rice (few or no impurities, separation of head rice and broken rice, and by-products), more effectively corresponding to consumer demand. Whatever equipment used, hulling yields vary depending on the paddy varieties, harvesting conditions, storage quality, paddy moisture content, and the condition of the processing equipment (Havard, 2003). Today, the marketability of Malian rice is poor, with high broken rice rates, and insufficient cleaning and sorting of marketed paddy. And the continual increase in Malian rice volumes on the markets means that different rice qualities need to be proposed in order to more effectively meet consumer requirements. That search for quality means improving production, harvesting, threshing, storage and processing conditions for the paddy produced in Mali.

This paper focuses on rice processing at the Niger Office (NO). In the following parts,the first one shows

Received date: 2014-08-25 **Accepted date:** 2015-05-05
***Corresponding author: Yacouba Mamadou Coulibaly,** Nyetaconseils, BP 11, Niono, Mali, Tel : 0022376428449. Email: yaccly2003@yahoo.fr.

the development of rice production in the ON for 25 years. The second part describes the different types of processing units and processed products. The third part focuses on the main constraints to rice processing, and the fourth part on the opportunities and prospects for rice processing. In the end of the paper there was a conclusion about the whole study.

2 rice production at the Niger Office over the last 25 years

Cultivated rice with total water control is the only relatively secured crop in terms of production. The areas judged suitable for irrigation have been estimated at almost 2,200,000 ha, of which only 20% are actually being used. The NO forms the main rice production area in Mali. The NO is an irrigated area in the inner delta of the Niger river in the Ségou region. Its creation dates back to 5 January1932 with the construction of the Markaladam serving as the starting point for the gravity irrigation of over 1 million ha.

Over the last 25 years, the area, production and yields have increased substantially (Table 1). This resulted in a significant increase in paddy processing needs.

Table 1Production, areas and paddy yield in the NO zone

	89/90	2000/2001	2005/2006	2010/2011	2011/2012
Area/ ha	44 000	64 037	85 207	99 101	111 649
Yield/(kg/ha)	2 400	6 100	6 070	6 038	6 078
Production/T	106 000	310 000	450 000	600 000	670 000

Source: ON, 2008 ; ON, 2011 ; ON, 2012

A distinction is made between seven production zones: Niono, Molodo, N'Débougou, Kouroumari, M'Béwani, Kolongo and KéMacina. Numerous projects are planned to extend the irrigated area. Some have already begun, such asthe Alatona irrigated area funded via the Millennium Challenge Corporation (MCC/USA), in the municipalities of Diabaly and Dogofri, covering an area of 5,200 ha. There are 55,212family farms, 3,290 of which are run by women for a population of 389,904inhabitants (ON, 2012).The dominant farming system is rice growing with full water control practiced in the wet season and hot dry season. However, the populations also practise market gardening and livestock farming.

3 Rice processing units in the NO area

The institutional reforms of recent decades (restructuring in 1994, drafting of a development master plan) have modified the number, quality and roles of the different stakeholders in the NO rice supply chain. This has resulted in greater accountability for producers and their organizations, and in greater involvement of the private sector.

In recent decades, this is particularly true in the rice processing sector. It has evolved in several stages that have enabled a gradual move from the pre-90s industrial rice mills to the hullers and mini rice mills of today, as is shown in Table 2.

Table 2 Distribution of rice processing units in the NO zone in 2012

Zones	Number of "private" hullers	Number of mini rice mills
Macina	280	2
Kouroumari	305	2
Molodo	122	2
N'Débougou	342	2
Niono	86	1
M'Bewani	37	2
Total	1172	11

Source: ON, 2012.

3.1 The NO industrial rice mills

Up to the beginning of the 90s, the NO rice mills processed the paddy marketed by farmers, while the production intended for self-consumption was processed by hand and by hullers. Those rice mills offered several qualities of milled rice for sale on the Malian market: RM40 (Malian rice, 40% whole rice), RM25, ELB (whole, long, whitened), BB (white broken rice), etc. (Havard, 2003).At the beginning of the 90s, the

In the late 80s, the gradual growth in paddy production, which is shown in Table 1, increased the demand for rice processing, both for sale and for consumption. The NO industrial rice mills, which were in financial difficulty, were no longer able to keep up with the demand. The rice hullers then increased rapidly.

agricultural structural adjustment programme led to liberalization of the supply chain, gradual state withdrawal, and the emergence of new stakeholders (Producer organizations (PO) and private operators) providing services for producers. In the rice processing sector, these new stakeholders mostly invested in hullers that only carried out hulling, but which were less expensive than the industrial rice mills, which stored, cleaned and hulled paddy, then proceeded to whiten, sort and package it, see Figure 1.

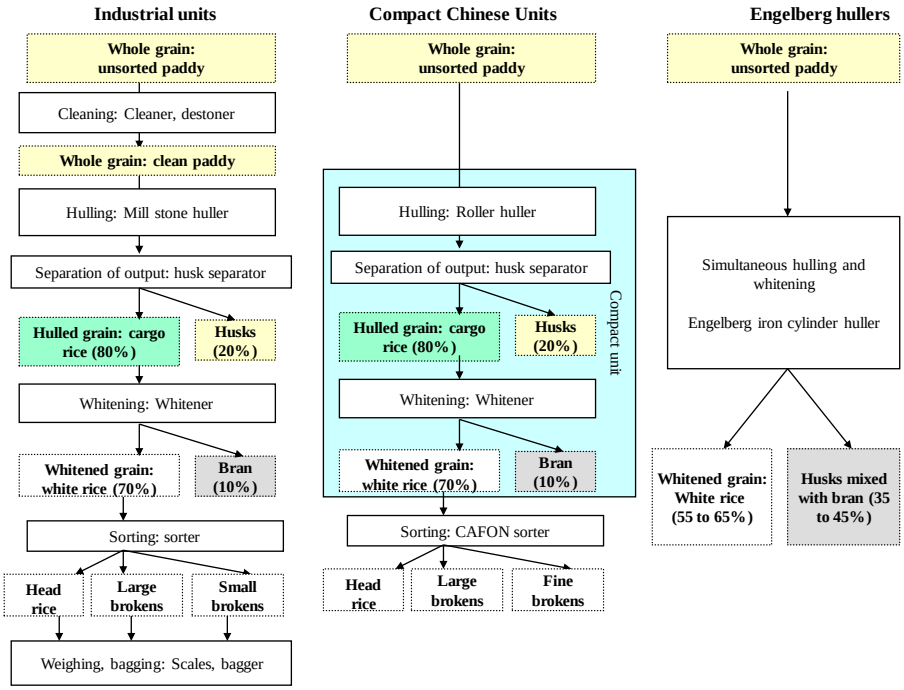

Figure 1 The different units and stages in paddy processing

3.2 Rice huller

Fixed or mobile hullers, mostly of the Engelberg type, which had relatively low throughputs (200 to 400 kg/h) and were inexpensive at between1 and 3 million CFA F (1 US$ = 520 CFA F) purchased by farmers, private operators and producer groups (PG). The hullers consist of a grooved iron roller which hulls and whitens the rice in one go (Figure 2). They are suitable for processing small amounts. They can be moved from producers to transform paddy production for family consumption. They are also used by traders who buy paddy producer and resell the rice market.

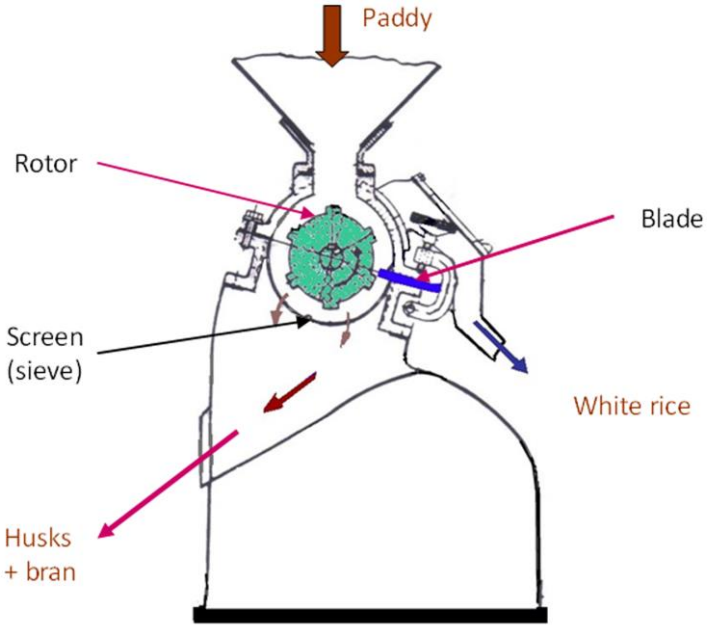

Figure 2Diagram of Engelberg huller

With these machines, shelling rate is low (between 55% and 60%) and rice (ungraded rice) is of low quality (high broken rice rate, existence of impurities, inadequate whitening, etc.).The product should be cleaned before consumption, and sorted before being sold in the markets. Increasingly Malian consumers, and in the sub region, particularly in Côte d'Ivoire, consider the poor quality because the broken rice rate is high (CAE, 2001;NyetaConseils and AfriqueVerte, 2000). This growing search for quality in recent years has promoted the installation of mini rice mills.

3.3. Mini rice mills

To meet consumers' demands, some processors have chosen to acquire more efficient mini rice mills than hullers, but also more expensive (15 to 35 million CFA francs) (Table 3). Roller hullers are the linchpin of mini rice mills which also have a whitener, and sometimes a paddy cleaner and a rice sorter, see Figure 3.Rice produced with mini rice mills is clean, and different qualities (whole rice, broken rice) ready for sale. The milling yield with a roller huller is 5% better than that achieved with an Engelberg huller (Cruz, 2001).The milling yield varies with the variety. A higher milling yield was obtained with the BG 902 (70%) than with the Kogoni 911 (65%) also called Gambiaka which produces fewer broken rice and is preferred by merchants.

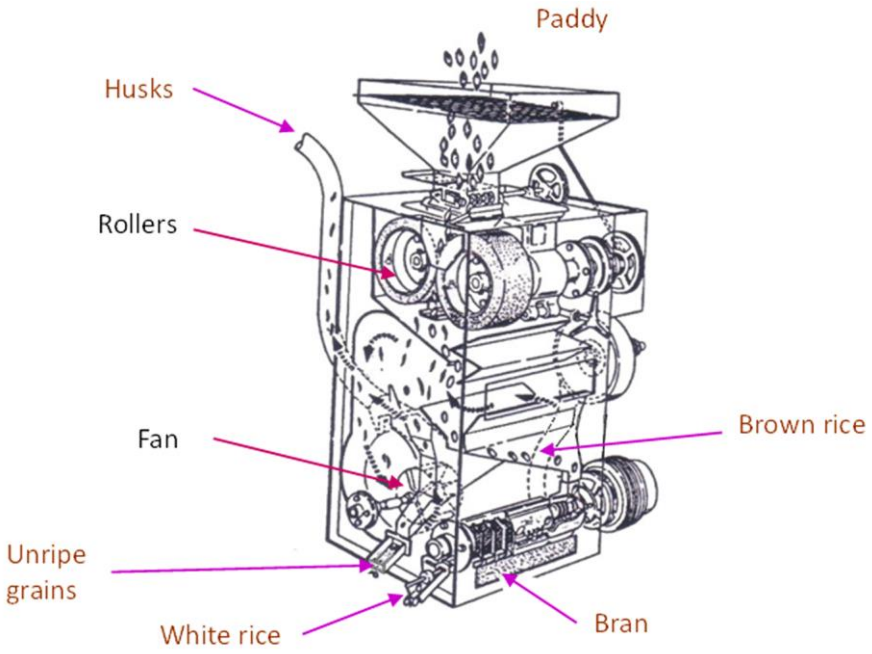

Figure 3 Diagram of roller huller

The annual processing capacity of a mini rice mill is estimated at around 2,000 tonnes of paddy. A dozen of mini rice mills distributed throughout the 6 NO rice production zones.Some are manufactured by *Société Coopérative Artisanale des Forgerons de l'Office du Niger* (SOCAFON)(Djiré, 2009).

Table 3Characteristics of a few mini rice mills in the NO zone

Promoters	Type of unit	Comments
Number 1 (private) (NDébougou zone)	SOCAFON mini-ricemill 1,500-2,000 kg/h	*Installation*: 2005-2006. The promoter is part of a PO which farms over 250 ha of rice. *Paddy supplies*: Repayment in kind (paddy)of input credits and members' transplanting costs, without any formal contract. *Grading*: ELB and broken rice *Sale price*: 400 CFA F/kg for ELB and 350 CFA F/kg for broken rice *Packaging*: Bags (50 and 25 kg) bearing a logo. *Target market*: Ségou, Bamako
Number 2 (private) (Niono zone)	Large SB 30 type huller 400-500 kg/h	*Installation*: 2000-2002 *Paddy supplies*: Paddy purchase according to quality with POs (no contract), service providing *Grading*: ELB and broken rice *Packaging*: bags (50 and 25 kg) bearing the logo *RizEtoile du Delta* *Sale price*: 400 CFA F/kg *Target market*: Ségouand Bamako
Number 3 (FO) (Molodo,Macina, Kouroumari zones)	Chinese mini rice mill 700-800 kg /h	*Installation*: Three mini rice mills in 2009 MacinaMolodo (Chinese), Kouroumari (SOCAFON) on behalf of the member cooperatives. The federation seeks input credits for the POs. *Paddy supplies*: Repayment in kind (paddy) of credits by the members. *Grading*: No *Sale price*: Depends on market prices *Packaging*: 50-kg bags *Market*: Bamako, Ségou
Number 4 (private) (Niono zone)	Chinese mini rice mill 700-800 kg/h	*Installation*: 2000 *Paddy supplies*: Service providing only *Grading*: No
Number 5 (private) (Niono zone)	Large SB 30 type huller 400-500 kg/h	*Installation*: 2000-2002 *Paddy supplies*: Service providing only *Grading*: No
Number 6 (FO) (KouroumariandNDébo ugou zones) (ND2)	SOCAFON mini ricemill 1,500-2,000 kg/h	*Installation*: Two rice mills in 2010 (KouroumariandNDébougou) on behalf of member cooperatives. The federation seeks input credits for the POs. *Paddy supplies*: Repayment in kind (paddy) of credits by members. *Grading*: No

Legend : FO : Farmer Organisation

4 Constraints in the no rice processing sector

So far, the results of the NO rice processing sector have not lived up to expectations:

1) processing costs have been considerably reduced, but the rice quality achieved has been affected;

2) the diversity of consumer demands in terms of rice quality cannot be satisfied;

3) many processing units are in difficulty because of competition, but also inappropriate choices of equipment, and an absence of any monitoring and management tools;

The constraints faced by the NO rice processing sector are linked to the quality sought, be it for paddy or for rice, and to the performance of the equipment and the processing units. It concerns the production sector just as much as the processing sector.

4.1 Achieving good quality paddy and rice in the Niger Office zone

The quality of white rice depends on the quality of the paddy. The parameters to be controlled for paddy are varietal purity, cleanness (no straw, no foreign bodies, clods of earth, pebbles, wood or metal), the paddy must have a moisture content of between 12%and 14%, and must be ripe at harvesting time. If one of these parameters is not observed, it may lead to the production of poor quality rice. In fact, a heterogeneous mixture makes machine settings difficult and poor grain filling gives a lower milling yield.

Rice quality does not have the same meaning for all stakeholders in the supply chain. White rice merchants and consumers are increasingly demanding as regards to colour, cleanness, grain uniformity and the broken rice rate. A quality rice is clean, white, with a whole grain rate exceeding 60%.A rice of lower quality is not as white and contains under 50% whole grains. For those who buy and process paddy, the milling yield is higher with a rice containing more broken rice. For processors, quality begins with the paddy, which must not contain stones and must not be wet, in order to achieve good equipment throughput, with the fewest possible broken rice.

Obtaining quality paddy and rice comes up against the following technical constraints:

1) paddy production, harvesting, threshing and storage practices not meeting the above-mentioned paddy quality parameters; this results in a drop in producer income, see Figure 4;

2) inefficient and inappropriate processing equipment, which affects milling yield and end-product quality;

3) failure to respect processing rules: no paddy cleaning, mixture of varieties, moisture rate too high or too low, no grading.

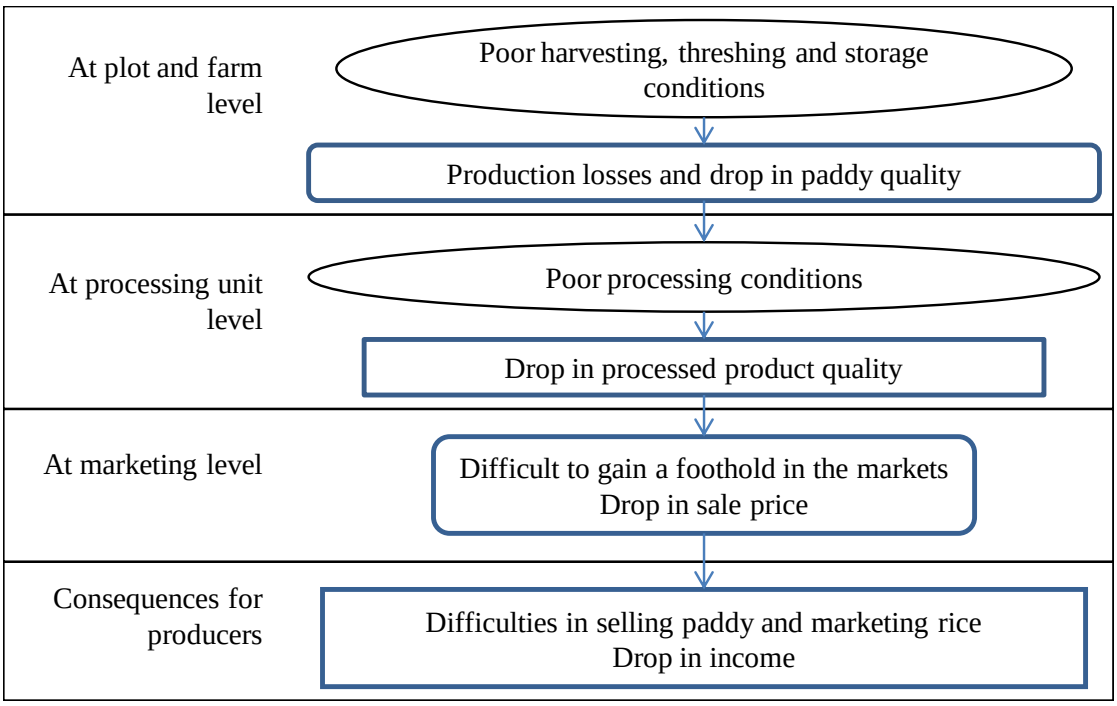

Figure 4 Consequences for producers of poor paddy harvesting, threshing, storage and processing

4.2 Improving the technical and economic performance of rice processing units in the NO zone

Owners need to improve the management of their processing units, with a view to making them more technically and economically efficient.

First, the management of a processing unit requires regular daily operation over a long period. Also, it is important, during harvest periods, to buy large quantities of paddy quality at affordable prices, and stored under good storage conditions. The quantities stored must be sufficient to operate the unit for several months until the next harvest when possible.

Second, the unit must operate in the best possible conditions. Technically, the different equipment (cleaners, hullers, sorters, etc.) must be appropriate, properly adjusted and well maintained in order to obtain quality products that meet consumer needs. Financially, the operation of the unit must be profitable, that is to say, the selling price should cover the running costs of the unit and the purchase price of paddy. Finally, the staff must be competent and well trained.

Third, the unit's products (rice, bran) to be sold, if possible, the best prices, according to packaging adapted to consumer demand. So this is for the unit to search for markets, buyers interested in the quality of the products obtained and their packaging.

The performance of a rice processing unit depends on many factors. First, the equipment (cleaners, hullers, whiteners, sorters, etc.) must be adapted to quantities to be processed and infrastructure (buildings, storage areas for paddy and processed products) must be properly sized. Currently, paddy storage areas of the units are often not sufficient and well-protected from the weather.

Second, the organization of the daily operation must enable the unit to run at its optimum, at least 8 hours/day or more as needed. The paddy must be clean, homogeneous (avoid long rice mixtures and round rice) and of good quality (humidity between 12% and 14% to reduce the chip rate). And the staff employed must have sufficient mastery of equipment and infrastructure. The low level of literacy and education of staff and managers is a major constraint.

Third, marketing activities are crucial in the profitability of a processing unit. It is as much to purchase paddy in good conditions in terms of price and quality, but to sell the unit's products (rice and bran) at the best price and the best moments. Current processing units do not have sufficient quantities and do not control the price and quality of the paddy purchased. Often they have no marketing strategy to the finished products.

Fourth, funding must be sufficient and available at the right time. Indeed, the unit must have significant funds to purchase and store paddy at harvest time but also cash to ensure the daily operation: paying staff, maintenance and repair of facilities, etc.

5 Opportunities and prospects for the no rice processing sector

The major potential for increasing rice production in the NO zone augurs well for some good prospects in the processing sector, which has an important role to play in improving the competitiveness of local rice.The installation of mini rice mills shows that it is possible to produce several rice qualities, corresponding to consumer expectations, and to improve the technical and economic efficiency of the processing installations. The aim is to improve the quality of marketed paddy, by introducing good practices. However, the success and viability of the processing units calls for assistance (advice and training) on the following points:

1) Detailed technical and economic feasibility studies of rice processing unit projects. Which items of equipment should be chosen, how should they be combined, how can they be made cost effective?

2) Assistance for unit managers to improve the quality of the service provided, their management of paddy supplies, and the technical and economic efficiency of the units.

3) Capacity building for acquirers and managers regarding the technical and economic aspects of processing unit operation.

The existence of skills, expertise and experience within local organizations (e.g. *Nyeta Conseils* and SOCAFON) in the NO rice processing sector, is an asset for developing manufacturing, training and support-advice activities. For instance, SOCAFON has designed some

adapted equipment: huller, mini rice mill. *Nyéta Conseil* has developed some:

1) computerized decision-support tools for processing unit projects enabling economic feasibility studies to be conducted for such projects

2) computerized management-support tools for processing units: drawing up liquidity plans, estimating working capital requirements, technical and economic monitoring of the units, etc.

3) specific management advice, and technical and economic training modules for the different types of units: huller, mini rice mill, industrial rice mils.

6 Conclusions

Development of rice growing in Mali is warranted by its effects on macroeconomic balances, on food security and on poverty. Rice processing is an activity that is attracting increasing numbers of private investors. However, given consumer expectations, the need to improve local rice quality calls for combined initiatives for production, harvesting, threshing, storage and processing, with consequential support from research, training and advisory bodies.

This endeavour to improve rice processing quality raises some questions to be dealt with in further studies:

1) Does the introduction of good practices for good quality paddy production lead to an increase in production costs and in what proportions? From what sale price is quality paddy production cost-effective?

2) What additional costs are linked to good quality and graded milled rice production? What types of equipment and processing units are adapted and profitable for which types of processed rice? What would be a profitable sale price for the different rice qualities sold?

References

Barris.2005. La filière riz au Mali: compétitivité et perspectives de marchés. Paris, Agence Française de Développement (AFD).

CAE.2001. Test d'amélioration de la qualité du riz produit en zone Office du Niger. CAE, Bamako, 15 p.

Cruz, J.F.2001. Transformation du riz au Mali. Rapport de mission URDOC à Niono, 22 au 26 janvier. CIRAD, Montpellier, 8 p.

Djiré, O.2009. La fabrication locale d'équipements agricoles : l'expérience de la Socafon au Mali. *Grain de Sel* 48 : 27.

Havard, M.2003. Conseil de gestion aux petites et moyennes entreprises de décorticage du riz auprès de l'URDOC-2. Compte-rendu de mission au Mali, 20 avril au 3 mai 2003. CIRAD, Montpellier, 37 p.

Nyèta Conseils andAfrique Verte. 2000.Test d'amélioration de la qualité du riz en zone Office du Niger au Mali. Nyeta Conseils, Afrique Verte, Niono, Mali.

ON. 2008. Rapport bilan de campagne 2007/2008. Office du Niger, Ségou, Mali.

ON. 2011. Rapport bilan de campagne 2010/2011. Office du Niger, Ségou, Mali.

ON. 2012. Rapport bilan de campagne 2011/2012. Office du Niger, Ségou, Mali.