

# ECONOMICS IN WEST AFRICAN IRRIGATED-RICE PRODUCTION

A. A. TOURE<sup>1</sup>, J. GROENEWALD<sup>2</sup>, P. A. SECK<sup>1</sup>, A. DIAGNE<sup>1</sup> and B. GROVE<sup>2</sup>

<sup>1</sup>Africa Rice Center (AfricaRice), 01 BP 2031, Cotonou, Benin. E-mail : a.toure@cgiar.org

<sup>2</sup>Department of Agricultural Economics, University of the Free State, Bloemfontein, South Africa.

## ABSTRACT

The main objective of this investigation is to contribute to the ongoing debate on the effects of the West African Economic and Monetary Union (WAEMU), common external tariff (CET) measures on the competitiveness of the irrigated-rice production system in Niger. The policy analysis matrix (PAM) approach was used to evaluate the various policy effects, based on farm-level, postharvest and rice-marketing data, as well as the financial and economic parity prices of different brands of imported-rice. Results from the PAM base-scenario model showed that under the evaluated CET policy irrigated rice production, activities were competitive and private operators had positive financial gains, meaning that private profitability was positive. Moreover, the irrigated-rice production enterprise revealed positive economic profitability for both retailers and wholesalers. Thus, it generated a net positive income for the national economy per unit of land devoted to this activity. One can argue that the irrigated rice system under the CET was generally competitive (positive private profitability) and had a potential for growth (positive economic profitability). Despite its competitiveness and efficiency, the irrigated rice production system still performs below potential because it lacks additional incentives. Some sensitivity analyses were performed with single-factor and simultaneous changes of several factors, which confirmed the necessity of providing further incentives to the system. The research results suggest that greater incentives should be given in terms of improving marketing channels, especially for retail rice marketing in which a great number of women rice traders are active.

**Key words :** Policy analysis, irrigated rice production, comparative advantage, social profitability, private profitability.

## RESUME

### ECONOMIE DU RIZ IRRIGUE EN AFRIQUE DE L'OUEST

*L'étude vise à contribuer au débat relatif aux effets du tarif extérieur commun (TEC) de l'Union économique et monétaire Ouest-Africaine (UEMOA) sur la compétitivité du riz irrigué au Niger. La Matrice d'analyse des politiques (MAP) a été utilisée pour évaluer les différents effets, sur la base de données relatives à l'exploitation agricole, les activités post-récolte, la commercialisation, ainsi que les prix paritaires financiers et économiques de différents types de riz importés. Avec le TEC, les résultats du modèle de base de la MAP ont montré que la production de riz irrigué a été compétitive et que les acteurs de la chaîne de valeurs ont bénéficié de gains financiers importants (rentabilité financière positive). Par ailleurs, la production de riz irrigué a été une activité économiquement rentable, aussi bien pour les commerçants-détaillants que pour les grossistes. Par conséquent, par unité de terre dévolue à cette activité, le riz irrigué a généré des revenus pour l'économie nationale. Avec le TEC, le système de production de riz irrigué a été généralement compétitif (rentabilité financière positive) et a eu un bon potentiel de croissance économique (rentabilité économique positive). Cependant, malgré, sa compétitivité et son efficacité, la performance du système de production de riz irrigué reste en deçà de son potentiel, du fait du manque d'incitations additionnelles. Des analyses de sensibilité ont été effectuées avec le changement de niveau d'un seul facteur, et de plusieurs facteurs à la fois. Ces analyses confirment la nécessité de mesures incitatives, en termes d'amélioration des circuits de commercialisation, notamment le circuit des détaillants qui implique un nombre assez important de commerçantes.*

**Mots clés :** Analyse des politiques, production de riz irrigué, avantage comparatif, rentabilité économique, rentabilité financière.

## INTRODUCTION

As a response to the chronic food deficit in the 1970s, brought about by erratic rainfall and poor rainfed agricultural production, Niger (a semi-arid Sahelian country) put in place a strategy to develop its irrigated agriculture. Contribution to national food security, securing adequate rural employment and income generation have subsequently constituted the backbone of various endeavours undertaken by Nigerien decision-makers to develop the irrigated agriculture sub-sector. The strategy consisted of three main components : (1) investments in developing irrigation infrastructure ; (2) development of institutions in charge of providing technical assistance and support services to farmers ; and (3) general agricultural policy relating to irrigated agriculture (rice is the most important irrigated crop). The development of modern irrigation infrastructure (called 'irrigated perimeters'), which supplies almost all of the domestically produced rice in Niger, benefitted from significant public investments. It was estimated that more than FCFA 120 billion was invested for the construction of the irrigated perimeters before FCFA franc devaluation with support from donors including the European Development Fund (FED) (Djido, 2004). To facilitate the gradual development of the rice sector, a series of accompanying measures was also put in place at an early stage of the construction of these rice production facilities. These involved the creation of three public services : Office National des Aménagements Hydro-Agricoles (ONAHA), the national agency for the maintenance of public irrigated schemes and in charge of providing technical assistance to rice farmers ; Riz du Niger (RINI), a modern, large-capacity rice mill ; and Centrale d'Approvisionnement (CA), the national central store for agricultural inputs and equipment. Different institutional arrangements exist among these public-service bodies. The primary aim of these arrangements is to help rice farmers to produce, process and market their rice.

National average irrigated rice yield is estimated at 4.5 t/ha, and total paddy rice production averages between 60,000 and 70,000 t per year. The value of the national production is estimated at FCFA 5 - 7 billion per year (Koré, 2005 ; Mahaman, 2004).

The irrigated rice sector underwent several policy changes, including the structural adjustment

policy, management transfer, CFA currency devaluation, the West African Economic and Monetary Union (WAEMU) common agricultural policy, and domestic policies. This changing economic environment has affected the performance of the sector, necessitating regular reviews of its performance for appropriate policy interventions.

A customs union was established in 2000 with a common external tariff (CET). In January 2001, the WAEMU member countries adopted a common agricultural policy framework. The customs duties applied by these countries are formulated within the framework of the CET, which entailed a substantial reduction in border tariffs (FAO, 2003). Under the CET, milled rice imports from countries outside of WAEMU are subject to a 10 % import duty and various fees amounting to 2 % (statistical tax and solidarity tax). The CET and other duties are calculated on the basis of the 'cost, insurance and freight' (CIF) value of the imported good. Irrigated rice production uses various inputs, both traded and non-traded, which are affected by the CET. The CET also contains other tariffs that relate to these traded inputs used in domestic rice production.

Rice as a crop evolves within a socio-economically diverse and highly competitive environment at both national and international levels, so the strategies to reach these important objectives (i.e. food security, rural employment and income generation) differ from country to country. Some countries placed emphasis on rice research, and attempted to put in place various institutional arrangements and policy frameworks. In order to evaluate the effects of the customs union's tariffs on the competitiveness of irrigated rice production and the economic incentives for irrigated rice producers, we need to conduct an assessment of the CET impact on the performance of the rice sector. In any particular WAEMU member country, to trace the effects of the CET on the competitiveness of irrigated rice production and the economic incentives for irrigated rice producers, we need to conduct an assessment of its impact on the performance of the rice sector. The relationship of the irrigated sector with this trade policy (CET) is complicated, as traded goods - such as inputs, small agricultural machinery and postharvest technologies used in the production processes - are all subject to their own tariffs.

Another factor through which the irrigated sector interacts with trade policy is through rice imports

- imported rice is the competing good. The interaction of trade policy with the irrigated rice sector is first to be viewed at the production level in relation to economic incentives (or disincentives) offered by the policy measure and the profitability of the activity. Second, as the commodity is subject to trade, the indicators of comparative advantage need to be determined in order to assess the overall effect of the policy measure. Within the country's economic context, the prevailing input and output prices reflect the dynamics of the country's macro-policy in which the irrigated rice sector evolves. Thus, the output generated and income derived through the operation of the irrigated rice perimeters are signals associated with the country's policies relating to both agriculture and trade.

In this research, we focused primarily on evaluating the impact of the agricultural policy and related rice-sector policy on the competitiveness of the irrigated rice schemes in the Niger River valley of western Niger. The effects of the CET on the performance of the irrigated rice production system were evaluated using the policy analysis matrix (PAM). The reason we have focused on this particular policy instrument is that, even though the general policy prescriptions relating to the rice sector have evolved over time, the most important of these is the application of the WAEMU CET.

## MATERIALS AND METHODS

### COMPARATIVE ADVANTAGE IN RICE PRODUCTION

The notion of comparative advantage has been investigated in relation to development policy (Chenery, 1961) and to its application to developing country agriculture (Goldin, 1990). The challenges that prompted many countries to undertake studies relating to the determination of the comparative advantage, particularly of agricultural production systems, were mostly the changing economic environment characterized by the trade liberalization process, structural adjustment policies, and countries' adoption of particular economic management strategies such as exchange-rate policy. Masters (1995) defines 'comparative advantage' as an activity's marginal contribution to national income (or 'social profits'), while 'competitiveness' is its marginal contribution to the net

income of its owner or manager ('private profits'). Therefore, an activity that generates positive social profits is said to be 'economically efficient', and to have some 'comparative advantage' relative to others.

One major purpose of efficiency studies of irrigated rice has been to assess its comparative advantage, its ability to make best use of the domestic resources devoted to its production given prevailing production technologies, inputs and output prices. In the current case, it will determine whether or not the irrigated rice sub-sector is profitable for the actors (rice farmers and other businesses involved) and also determine the prospects for increased production and productivity.

Studies using domestic resource costs were conducted to assess the comparative advantage of the rice production. Several studies carried out across West Africa have assessed the comparative advantages of different types of rice-based systems and the subsequent results are compared on the basis of the domestic resource cost ratios (DRCs) that were calculated for different rice commodity systems (Lançon, 2001 ; Kormawa and Akande, 2008). Pearson *and al.* (1981) used a framework for analysing the economic efficiency and comparative advantage of rice production in West Africa. The approach compares estimates of private profitability with estimates of social profitability. The reasoning behind this approach is that, in the absence of distortions, market and accounting prices coincide, resulting in social benefits equalling social costs for all activities (Page and Stryker, 1981). The criteria used to measure economic efficiency are the net social profitability (NSP), DRC, and the social cost-benefit (SCB). Pearson *and al.* (1981) investigated major economic and political influences on the expansion of rice production and the efficiency of existing and proposed methods of growing, milling and marketing rice in five West African countries (Côte d'Ivoire, Liberia, Mali, Senegal, Sierra Leone) by using an approach that incorporated analysis of issues relating to the efficiency of farm production and comparative effectiveness of alternative policies. Their main conclusions were that Mali clearly had a strong comparative advantage in domestic production as a substitute for rice imports and also for export to other West African countries. Sierra Leone had higher costs than Mali, resulting from a relatively low level of productivity, but production was still profitable because wages

were very low. Furthermore, Sierra Leone could export rice more profitably than Mali because of lower transport costs to neighbouring markets. The conclusions further indicated that Côte d'Ivoire and Liberia had comparative disadvantages in producing rice for their national markets, while Senegal occupied an intermediate position.

#### THE POLICY ANALYSIS MATRIX (PAM) APPROACH

The PAM approach was used to evaluate the effects of CET on the competitiveness of irrigated rice production systems in Niger, given the prevailing input and output market prices that enter into the various activities of the commodity chain (from farm production to consumption). The PAM was developed as an analytical tool to measure the impact of government policy on the private profitability of agricultural systems and on the efficiency of resource use (Monke and Pearson, 1989 ; Masters, 1995). Three principal practical issues can be investigated through the PAM approach : (1) the impact of policy on competitiveness and farm-level profits ; (2) the influence of investment policy on economic efficiency and comparative advantage ; and (3) the effects of agricultural research policy on changing technologies.

With the PAM methodology, the costs of traded and non-traded goods and their revenues are calculated using different categories of prices, which include market and reference prices. Policy effects are estimated by a comparison of the existing levels of private (actual market) to social (efficiency) revenues, costs and profits. On the basis of these results, important policy indicators can be derived relating to private profitability, social profitability (including comparative advantage indicators), and policy transfers (protection coefficients). The reference prices represent prices which would prevail in the absence of policy effects. Thus, the main empirical task in the approach is to construct the accounting matrices of revenues, costs and profits (Monke and Pearson, 1989), making the PAM a product of two accounting identities. The first, profitability, is defined as the difference between revenues and costs, and the second measures the effects of divergences (distorting policies and market failures) as the differences between observed parameters and parameters that would exist if the divergences were removed. Caballero *and al.* (2000) indicate that measuring policy interventions requires establishing a

benchmark against which to compare domestic prices. For traded goods, the normal practice is to use the international price adjusted as needed in order to derive the financial and economic parity prices.

Private profitability' is defined as the difference between gross revenues and total costs (tradable and domestic factors costs), all valued at market prices following the PAM methodology. Positive private profitability indicates that the crop enterprise is competitive, making some financial gains that help the business to sustain itself and thus become financially viable. However, negative private profitability indicates that the private business is not competitive and thus may need some form of intervention to continue its operations. A low cost-benefit ratio testifies to the good profitability of the enterprise, indicating that the related costs involved are smaller than the corresponding benefits - a ratio less than 1 indicates a profitable enterprise, while a ratio greater than 1 indicates a non-profitable enterprise.

Social profitability is evaluated in the same way as private profitability, with the difference that all budget items (revenues and costs) are evaluated at their social opportunity cost, which reflect scarcity values or reference prices. Social profitability is an efficiency measure because both outputs and inputs are valued at prices that reflect the scarcity values or social opportunity costs (Monke and Pearson, 1989). Therefore, positive social profitability indicates an efficient enterprise, while negative social profitability indicates a non-efficient enterprise that would require some intervention to remain in business. Following the same reasoning, an efficient enterprise creates income for the whole economy, and thus has a comparative advantage, while a non-efficient enterprise does not. In the PAM indicators, the comparative advantage is evaluated by the DRC: a DRC less than 1 indicates that an irrigated rice enterprise has a comparative advantage in producing local rice using domestic resources, while a DRC greater than 1 indicates that the irrigated rice enterprise does not have a comparative advantage and thus requires particular policy interventions in order to perform better. The DRC indicator is calculated as a ratio of domestic factor costs (i.e. land, labour, capital) to value added, both calculated at social prices. 'Value added' is defined as the difference between the gross revenues generated by the activity and its related tradable input costs evaluated at their social prices.

Another important indicator of comparative advantage is the SCB, which measures the ratio of the sum of tradable input costs and domestic factor costs to gross revenue, all valued at reference prices. Thus, an SCB of less than 1 means that irrigated rice production has a comparative advantage, while an SCB greater than 1 indicates that the costs are higher than the benefits and the enterprise is not efficient. Net social profitability uses only opportunity costs to assess the activity's level - comparing the social value of its output to the social opportunity cost of the commodities and factors of production. The technique is said to be efficient if the social value is equal to or greater than the social opportunity cost. The SCB uses the same data as the DRC and NSP within a slightly different formula and is a measure that unifies the policy-analysis and cost-benefit traditions of measuring comparative advantage into a single indicator that can be used equally well for both purposes (Masters, 1995) and it is the only ratio that accurately replicates farming activities (Mucavele, 2000).

The various analyses were performed using farm-level data in combination with data and information relating to postharvest activities, rice marketing, and macro-economic information relating to the CET. In addition, both the financial and economic parity prices of different brands of imported rice were estimated for the comparison points (Niamey urban markets and Tillabery region) at which imported rice and locally produced rice compete. The type of market was also considered: wholesale and retail markets. The four rice brands used for the comparison were Pakistani rice (25 % broken), Thai rice (25 % broken), Thai parboiled rice (100 % broken) and Indian rice (25 % broken). The financial and economic parity prices of these brands differ depending on the port of importation. For this reason, the two main ports, Cotonou (Benin) and Tema (Ghana), were also taken into consideration. For each point of comparison, the combination of types of market (2), rice brands (4) and ports of importation (2) resulted in 16 PAM base-model scenarios. Thus, with the two points of comparison, a total of 32 PAM base-model scenarios were finally developed.

#### SENSITIVITY ANALYSES

Sensitivity analyses were performed on technological improvements that can enhance

the conversion rate of paddy into milled rice (from 65 % to 75 %) and increase farm-level productivity (increased yield to 6 t/ha). Sensitivity analyses were also done to consider macro-economic changes in relation to the import duty levels of CET (from 10 to 20 %) affecting the financial parity prices of imported rice. Sensitivity analyses were also performed on simultaneous changes in either technology or farm-level productivity in relation to import duties. All the sensitivity analyses were performed using two imported rice brands, namely, Pakistani rice (25 % broken) and Thai parboiled 100 % broken.

## RESULTS

### PRIVATE PROFITABILITY IN IRRIGATED RICE PRODUCTION

On average, irrigated rice production is an activity that generates positive financial gains in all types of markets and at all points of comparison where locally produced rice enters into competition with imported rice brands. This financial gain was evaluated per tonne of local milled rice and per hectare, given a particular port of importation of imported rice (Table 1). On average, when the locally produced rice was compared to a brand of imported rice which enters into the country through Cotonou port, with a wholesale price of FCFA 231,000 (US\$ 481.25) per t local rice production generates for all operators a financial gain of FCFA 84,861/t of milled rice (\$176.73). This financial gain amounts to FCFA 237,188/ha (\$494). The financial cost-benefit ratio was calculated at 0.54, indicating high profitability for the activity. With a retail price of FCFA 239,000/t of milled rice, the financial profitability gains amount to FCFA 78,736/t of milled rice (\$164) and FCFA 220,068/ha (\$458.475). Here, the financial cost-benefit ratio is 0.56. These results compare well with those obtained for individual points of comparison (Niamey or Tillabery), with a financial cost-benefit ratio of between 0.50 and 0.62.

When the locally produced rice was compared with an imported rice brand entering into the country through Tema port, with a wholesale price for locally produced rice of FCFA 240,625/t of milled rice, the financial gains were FCFA 84,861/t (\$176.80) and FCFA 237,188/ha (\$494), with a cost-benefit ratio of 0.54, also indicating good profitability of the activity for all operators involved.

**Table 1** : Summary results of average private profitability indicators and financial cost-benefit ratio of locally produced rice.

Résumé des résultats des moyennes des indicateurs de rentabilité financière et des ratios coûts-bénéfices financiers du riz produit localement.

Port of importation	Point of comparison	Type of market	Selling price for local milled rice	Financial profitability		Financial cost-benefit ratio
			(FCFA/ tonne of milled rice)	(FCFA/ tonne of milled rice)	(FCFA/ ha)	
Cotonou	Niamey	Retail	266,250	98,636	275,689	0.50
		Wholesale	239,250	80,636	225,379	0.56
	Tillabery	Retail	211,750	58,836	164,448	0.62
		Wholesale	223,750	89,086	248,997	0.52
	Total	Retail	239,000	78,736	220,068	0.56
		Wholesale	231,500	84,861	237,188	0.54
Tema	Niamey	Retail	266,250	107,636	300,844	0.47
		Wholesale	239,250	80,636	225,379	0.56
	Tillabery	Retail	211,750	58,836	164,448	0.62
		Wholesale	242,000	89,086	248,997	0.52
	Total	Retail	239,000	83,236	232,646	0.54
		Wholesale	240,625	84,861	237,188	0.54

Note : FCFA 480 = US\$ 1

#### SOCIAL PROFITABILITY AND COMPARATIVE ADVANTAGE

In retail markets, average economic profitability was FCFA 130,688 (\$272) per tonne of milled rice when comparing local milled rice to imported rice brands originating from Cotonou (Table 2). In wholesale markets, it was FCFA 117,652/tonne of milled rice (\$245). The comparison of local milled rice with the imported rice brands originating from Tema port showed an economic profitability of FCFA 141,176 per tonne (\$294.11) in retail markets and FCFA 127,640/t (\$265.92) in wholesale markets (Table 2).

Following a similar analytical procedure using a per-hectare comparison basis, locally produced milled rice was compared to imported rice brands arriving through Cotonou port. The social profitability was FCFA 365,273/ha (\$761 US \$/ha), assuming that the milled locally produced rice was sold in retail markets. The figure was FCFA 328,836/ha (\$685) when the local milled rice was sold in wholesale markets. When the locally produced rice was compared to imported rice brands arriving through Tema port, its economic profitability was FCFA 394,587/ha (\$822.06) and FCFA 356,755/ha (\$743.24) for rice sold in retail and wholesale markets, respectively.

This economic profitability is also supported by the low DRC and SBC. In summary, these ratios, evaluated at different points of comparison

(Niamey and Tillabery) and different markets (retail and wholesale), are generally lower than 1, indicating the economic profitability of locally produced rice. Overall, the DRC ratio is 0.4 and 0.43 for the retail and wholesale markets, respectively. This assertion is supported by the SCB ratio which is evaluated overall at 0.53 and 0.56 for the retail and wholesale markets, respectively.

#### SENSITIVITY ANALYSIS

An improvement in the milling rate would provide even greater incentives to the system, allowing it to perform with greater overall efficiency, and giving private operators greater economic benefits. In addition, improvement in the paddy milling conversion rate would enhance the efficiency of the retail marketing system.

Modelled improvement in farm-level productivity also showed a positive impact on the overall irrigated rice system performance (Table 3). Increased farm-level productivity would translate into greater efficiency in the irrigated production and retail marketing systems.

The results obtained with a combination of an increase in yield (to 6 t/ha) and an increase in import duties for imported rice (20 %) showed some improvement of the various indicators for the irrigated rice production system in comparison to the base scenario (Table 4). Most importantly, all profitability indicators were much

higher than those obtained for the base model. The financial profitability would be 3.1 and 2.8 times those of the base model for retail market and wholesale markets, respectively. With such a magnitude of improvement, the financial cost-benefit ratio (private cost ratio) would be 21.7 % and 23 % for retail and wholesale markets, respectively, implying tremendous incentives for the system to become more competitive. The economic profitability would also increase in the range of 1.26 and 1.29 times those of the base model for the retail and wholesale markets, respectively, and their DRCs be, respectively, 0.309 and 0.327.

The scenario of a change in technology with an improvement of the conversion rate of paddy into milled rice (75 % rather than 65 %), combined with an increase in import duties for imported rice, generated some results that differ from those obtained with the base scenario model (Table 5). An important improvement can be seen in financial profitability, which would be greater than that of the base scenario model, although the increase in the economic profitability would be relatively very small. This is explained by the fact that the increase in import duty of the imported rice would affect the financial parity price.

**Table 2 :** Summary results of average economic profitability indicators, domestic resource cost ratio, and social cost-benefit ratio of locally produced rice.

*Résumé des résultats des moyennes des indicateurs de rentabilité économique, des coûts en ressources intérieures et ratios coûts-bénéfices sociaux du riz produit localement.*

Port of importation	Point of comparison	Type of markets	Reference price for imported milled rice (FCFA/ tonne)	Social profitability		Domestic resource cost ratio (DRC)	Social cost-benefit ratio (SCB)
				FCFA/ tonne of local milled rice	FCFA/ ha		
Tema	Tillabery	Wholesale	249,322	103,400	289,004	0.48	0.61
		Retail	285,731	145,509	406,698	0.39	0.52
		Wholesale	272,125	131,903	368,669	0.42	0.54
		Retail	273,760	130,688	365,273	0.42	0.55
	Total	Wholesale	260,724	117,652	328,836	0.45	0.58
		Retail	271,922	126,000	352,170	0.43	0.56
	Niamey	Wholesale	258,973	113,051	315,978	0.46	0.59
		Retail	296,574	156,352	437,004	0.38	0.50
		Wholesale	282,452	142,229	397,531	0.40	0.52
		Retail	284,248	141,176	394,587	0.40	0.53
	Total	Wholesale	270,713	127,640	356,755	0.43	0.56

Note : FCFA 480 = US\$ 1

**Table 3 :** Summary results for single-factor change scenarios: increase in yield and milling rate.

*Résumé des résultats des scénarios de changement de niveau d'un seul facteur : augmentation du rendement et amélioration du taux de conversion du paddy.*

	Milling rate (75 %)		Yield (6 t/ha)	
	Retail	Wholesale	Retail	Wholesale
Financial profitability (FCFA/tonne)	103,536	106,286	121,948	124,698
Financial cost-benefit ratio	0.464	0.455	0.385	0.377
Social profitability (FCFA/tonne)	147,724	134,522	164,943	151,740
Domestic resource cost	0.367	0.389	0.309	0.327
Social cost-benefit ratio	0.49	0.513	0.434	0.454

Note : FCFA 480 = US\$ 1

**Table 4 :** Average results for simultaneous changes: increased yield in combination with import duty change (20 %) per tonne of milled rice.

*Résultats moyens des changements simultanés du niveau de plusieurs facteurs : augmentation du rendement en combinaison avec le changement de la taxe du riz importé (20%) par tonne de riz blanchi.*

PAM indicator	Type of markets	
	Retail	Wholesale
Financial profitability (FCFA)	263,890	245,512
Financial cost–benefit ratio	0.217	0.23
Social profitability (FCFA)	164,943	151,740
Domestic resource cost	0.309	0.327
Social cost–benefit ratio	0.434	0.454

Note : FCFA 480 = US\$ 1

**Table 5 :** Average results for simultaneous changes of imports duties (20 %) and technology improvement (per tonne of milled rice).

*Résultats moyens pour les changements simultanés de la taxe du riz importé (20 %) et l'amélioration technologique (par tonne de riz blanchi).*

PAM indicator	Type of markets	
	Retail	Wholesale
Financial profitability (FCFA)	245,478	227,100
Financial cost–benefit ratio	0.258	0.273
Social profitability (FCFA)	147,724	134,522
Domestic resource cost	0.367	0.389
Social cost–benefit ratio	0.49	0.513

Note : FCFA 480 = US\$ 1

## DISCUSSION

### FINANCIAL PROFITABILITY OF IRRIGATED RICE

When considering the individual comparison points, the low cost-benefit ratios testify to the good profitability of irrigated rice activities, not only for the paddy producers but also for the traders and processors. This shows that the irrigated rice production system in the Niger River valley is competitive and generates positive financial gains for the economic agents involved in the sector. The private profitability indicators, being the results of the sum of outcomes of farm profits and post-farm activities (collection, processing and marketing) indicate that, under existing policies, the irrigated rice production activities are competitive and that private operators are making positive financial gains. The existing policies include the application of

CET to major inputs such as fertilizers, pesticides, herbicides, other agricultural equipment and postharvest activities. It can therefore be concluded that operators in the various segments of the system earn positive profits.

### SOCIAL PROFITABILITY AND COMPARATIVE ADVANTAGE

The economic profitability indicator is relatively higher in the Tillabery region than in the capital urban area (Niamey). This is explained by the fact that Tillabery is a producing region and, by comparison, when transportation and other marketing costs are added, economic profitability is reduced in Niamey. Furthermore, when considering the points of comparison (Niamey or Tillabery), it can be seen that the social profitability at Tillabery is higher than the economic profitability that would be earned at Niamey. Here, transportation costs and other



marketing costs play a role. The economic profitability is also different when considering the types of markets, with retailers making a relatively higher economic profit. This is due to the fact that selling prices are higher for the retailers than for the wholesalers. The retailers and wholesalers get their supplies from the same producers or sometimes the retailers get their supplies from wholesalers. Rice commercialization in the Niger River valley is dominated by rice retailers who actively prospect all marketing channels to sell their product (Touré *et al.*, 2008). In sum, the local irrigated rice production enterprise reveals positive economic profitability for both retailers and wholesalers. Therefore, as an economic activity, it generates net positive income for the national economy per unit of land devoted to this activity. It can be claimed that, despite the fact that the inputs mobilised into the activity are affected by the various CET measures, the activity still performs to a level that permits the various actors to earn some positive income, and allows them to sustain their businesses.

Overall, the low DRC for both retail and wholesale markets implies that the value added (the difference between the gross revenues generated by the activity and its related tradable input costs, evaluated at their social prices) generated by the irrigated rice enterprise is higher than the opportunity cost of domestic resources used in the irrigated rice production system. Thus, it is an economic activity that uses domestic resources efficiently. This assertion is supported by the low SCB ratios evaluated overall at 0.53 and 0.56 for the retail and wholesale markets, respectively. In other words, the SCB ratio shows that the sum of tradable-input and domestic-factor costs are less than the gross revenue when the final product is sold either in retail or wholesale markets under the prevailing output and input market conditions. Therefore, in order to boost economic profitability (and contribute to national income), further improvement of the productivity of this enterprise is needed. An alternative is an improvement in the use of the domestic resources involved.

#### POLICY IMPLICATIONS

The sensitivity analyses show that private profits are sensitive to improvements in technological factors such as farm-level productivity and postharvest techniques that enhance the milling

conversion rate of paddy into milled rice. Private profits are also sensitive to changes in economic factors relating to reduction of import duties on inputs, and increase of import duties on imported rice. The irrigated-rice system performs well under the CET regimes, but the system is being taxed due to the fact that some resources are diverted away from it. There is a need to provide greater incentives for the system in the form of technological improvement (farm-level productivity improvement and postharvest quality enhancement). Greater incentives should also be given, in terms of improving marketing channels, particularly the retail marketing channel, where a great number of women rice traders are active. Further research needs to be conducted on this aspect. The best way to assess the constraints facing countries in their efforts to increase rice production is to estimate both the costs required to overcome shortages of necessary resources and the capacity of the public sector to intervene (Pearson *et al.*, 1981). Therefore, we suggest that, depending on the objective that is favoured, a careful analysis of the alternatives provided by the results of this study is required in order to study the costs and benefits of these alternatives.

#### CONCLUSION AND RECOMMENDATIONS

The PAM base results have shown that the net policy transfer indicators are negative per unit of land and per unit of final output produced (milled rice) for all scenarios (type of markets and comparison points). These constitute clear indications that the private profits for the irrigated rice enterprise are less than the social profits, suggesting that resources are driven away from the system due to the policies in place. The scenario simulating a change in a single factor is informative. The simultaneous changes have generated important results in comparison to the base scenario. These range from improvements in private and social profitability supported by low private cost ratios, DRC and SCB ratios.

As more attention is given to the sector, and with greater accountability on the part of producers and their organizations, the competitiveness of the irrigated rice production system can be further enhanced and the system can thus contribute to income generation, poverty reduction, rural employment, and food security.

Furthermore, with the introduction of improved irrigated rice varieties, more income could be generated, provided that appropriate cropping practices are also adopted. Adoption of better postharvest techniques that can lead to better rice quality, along with improvement in the milling rate can also contribute substantially to the efficiency of the system. Better postharvest activities will improve the efficiency of the whole value chain, thus helping to enhance the well-being of the stakeholders. Policy interventions should also appropriately target the various rice marketing channels, as we have seen that, depending on the type of policy changes, some effects would occur in each outlet market. Most importantly, the retail market channel, which employs a great number of women rice traders, should be targeted. We suggest that there should be more research on the gender aspects of rice commercialization.

## REFERENCES

- Caballero J. M., G. Calegar and C. Cappi. 2000. Instruments of protection and their economic impact. *In* : Multilateral trade negotiations on agriculture. A resource manual. Food and Agriculture Organization of the United Nations (FAO), Rome.
- Chenery H. B. 1961. Comparative advantage and development policy. *Am. Econ. Rev.* 51 (1) : 18 - 51.
- Djido M. I. 2004. Note de problématique sur la gestion des périmètres rizicoles. Presented at the Forum National sur la filière riz au Niger, Niamey, 21 - 22 January.
- FAO. 2003. Review of basic food policies. Food and Agriculture Organization of the United Nations, Rome.
- Goldin I. 1990. Comparative advantage : theory and application to developing country agriculture. OECD Technical Papers No. 16. Organisations for Economic Co-operation and Development (OECD), Paris.
- Koré H. 2005. Evolution des politiques rizicoles au Niger. Faculté d'Agronomie, Université de Niamey, Niamey.
- Kormawa P. and T. Akande. 2008. The configuration of comparative advantage in rice production in West Africa : a survey of empirical studies. *In* : P. Kormawa and A. A. Touré (Eds.). Rice policy and food security in sub-Saharan Africa. Proceedings of a workshop held on 7 - 9 November 2005, Cotonou, Benin. Africa Rice Center (WARDA), Cotonou, pp 35-47.
- Lançon F. 2001. Expected contribution of low-management rice-based systems to food security in West Africa. Paper presented at the NERICA-based Food Security in Sub-Saharan Africa Workshop, M'bé, Côte d'Ivoire, 8 - 12 April.
- Mahaman M. 2004. Diagnostic sur l'évolution de la filière riz au Niger. Paper presented at 'Atelier régional sur la compétitivité des filières riz, dynamiques commerciales et accords commerciaux régionaux et internationaux', Bamako, 10 - 14 May.
- Masters W. 1995. Guidelines on national comparative advantage and agricultural trade. Agricultural Policy Analysis Project, Phase III. USAID, Washington, DC.
- Monke E. A. and S. R. Pearson. 1989. The policy analysis matrix for agricultural development. Cornell University Press, Ithaca and London.
- Mucavele G. F. 2000. Analysis of comparative advantage and agricultural trade in Mozambique. SD Publication Series. Office of Sustainable Development. USAID, Bureau for Africa. Technical Paper N°. 107.
- Page Jr M. J. and J. D. Stryker. 1981. Methodology for estimating comparative costs and incentives. *In* : S. R. Pearson, J. D. Stryker and C. P. Humphreys (Eds.). Rice in West Africa. Policy and economics. Stanford University Press, Stanford, CA.
- Pearson S. R., J. D. Stryker and C. P. Humphreys. (Eds.). 1981. Rice in West Africa : policy and economics. Stanford University Press, Stanford, CA.
- Touré A. A., H. Koré and I. Bamba. 2008. Rice commercialization case studies from western Niger. Working Paper. Africa Rice Centre (WARDA), Cotonou, Benin.