4th ICAAAE 2013 SEPTEMBER 22-25, Hammamet Tunisia
4th International Conference of the African Association of Agricultural Economists
icaaae.org aaae-africa.org

Analysing policy-induced effects on irrigated rice performance

Ali A. Touré* [a], Jan Groenewald [b], Papa Abdoulaye Seck [c], and Aliou Diagne

Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists, September 22-25, 2013, Hammamet, Tunisia

Analysing policy-induced effects on irrigated rice performance

Ali A. Touré* [a], Jan Groenewald [b], Papa Abdoulaye Seck [c], and Aliou Diagne [d]

[a c d] Africa Rice Center (AfricaRice), Cotonou, Benin

[b e] Department of Agricultural Economics, University of the Free State, Bloemfontein, South Africa

[a*] Post Doctoral Fellow, Program 3: Policy, Innovation Systems and Impact Assessment, Africa Rice Center (AfricaRice), 01 BP 2031, Cotonou, Benin. Tel: (229) 21 35 01 88. Fax: (229) 21 35 05 56. E-mail: a.toure@cgiar.org (corresponding author)

[b] Professor of Agricultural Economics, Department of Agricultural Economics, University of the Free State, Bloemfontein, South Africa. E-mail: groenewald@netralink.com

[c] Africa Rice Center (AfricaRice), 01 BP 2031, Cotonou, Benin. Tel: (229) 21 35 01 88. Fax: (229) 21 35 05 56. E-mail: P.Seck@cgiar.org

[d] Program Leader and Impact Assessment Economist, Program 3: Policy, Innovation Systems and Impact Assessment, Africa Rice Center (AfricaRice), 01 BP 2031, Cotonou, Benin. Tel: (229) 21 35 01 88. Fax: (229) 21 35 05 56. E-mail: a.diagne@cgiar.org.

ANALYSING POLICY-INDUCED EFFECTS ON IRRIGATED RICE PERFORMANCE

Abstract

Improving local rice production capacity is a key element in the agenda of most countries in the West African Economic and Monetary Union (WAEMU). There are several reasons for this drive: (1) the high levels of rice imports that constitute a burden on the countries' financial resources; (2) the relatively high contribution of the commodity to national food-security programmes; (3) income generation for smallholder farm communities; and (4) the contribution of rice to the improvement of nutritional status. The policy analysis matrix approach was used to evaluate the policy-induced effects of the WAEMU common external tariffs on the performance of irrigated rice production systems in Niger. The results showed that the irrigated rice production system receives little protection and retail rice marketing channels is even less protected. The negative net policy effects indicated that greater incentives are needed for enhanced system's performance.

1 INTRODUCTION

World price hikes for imported milled rice constitute a strong signal for tapping the important domestic rice production resource base in West Africa, particularly for countries with high potential to boost rice productivity and profitability. Such endeavours should aim at viewing the problem in a holistic manner – from farm to consumption – but most observers are urging that, as a prerequisite, efforts should focus on ways to reduce the production costs observed across rice-growing ecologies in a number of West African countries. Irrigated rice production, which uses high levels of inputs (including water), is viewed as the principal candidate for cutting production costs. The strategies adopted by various countries have

focused on research and technology transfer, technical assistance to rice producers, and various institutional arrangements to promote linkages among rice-sector stakeholders and effective service delivery. Despite the sector's farm-level profitability, the high level of investments devoted to irrigated rice warrant study of its efficiency in order to assess various policy outcomes.

Rice is one of the most important commodities that have seen several policy and institutional changes that have not always been in favour of the sector. In most sub-Saharan African countries the development of rice production did not happen in isolation from other agricultural enterprises: the rice sub-sector has evolved within a changing agricultural environment and macro-economic setting. Initial research has shown that the competitiveness of local rice production depends not only on technical efficiency (farm-level productivity), but also on several economic factors, including input and output prices, non-price factors such as the type of irrigation system (electric pumping, gravity, diesel pump), and postharvest and rice quality management. The cost of producing local irrigated rice – and hence, its profitability – is obviously extremely important when considering its competitiveness. Locally produced rice in West African countries in general, and Sahelian countries in particular, comes from different rice production systems that involve different levels of tradable and non-tradable resources (inputs, labour and capital). These costs are, in turn, a function not only of the prices of the resources used in production, but also of the circumstances under which the rice is grown and the managerial expertise of the producers. Thus, the competitiveness of local irrigated rice is contingent on several factors, including farm-level productivity, the economic environment, and product quality; the latter, in turn, depends on postharvest activities. In their search for better strategies to provide incentives to the various stakeholders (producers, processors, traders and consumers), countries implement trade policy measures – both domestic and border measures – that differentially affect the

various channels of the sector (production, processing, distribution, consumption and trade) and the economic agents operating in those segments. The Nigerien irrigated rice sub-sector evolves within such a socio-economic context.

Increasing the performance of local rice production is crucial and constitutes an important element in the agenda of most countries in the West African Economic and Monetary Union (WAEMU, which identified rice as a priority crop. There are several reasons for this drive: (1) the high levels of rice imports that constitute a burden on the countries' financial resources; (2) the relatively high contribution of the commodity to national food-security programmes; (3) income generation for smallholder farm communities; and (4) the contribution of rice to the improvement of nutritional status.

For the irrigated rice sub-sector in Niger, the major issues at stake include improving farm productivity and efficiency, market linkages, postharvest processes and handling, quality for increased value addition, and overall competitiveness through enabling policies. The irrigated rice sub-sector has been affected by several policy changes (structural adjustment policy, management transfer, CFA currency devaluation, WAEMU common agricultural policy, and domestic policies). The changing economic environment has affected the performance of the sub-sector, necessitating regular reviews of its performance. The potential effects of the implementation of trade policy measures need to be investigated in order to identify their impact on production incentives and economic efficiency. This study reviews agricultural trade policy measures with a focus on the effects of agricultural trade-distorting measures and customs tariffs on agricultural performance in Niger. The aim of the study was to assess the effect of common external tariffs (CET) on the competitiveness of the irrigated rice sub-sector with the policy analysis matrix and to estimate the indicators of policy effects.

2 DATA AND METHODOLOGY

In using the policy analysis matrix (PAM) to analyse the irrigated rice enterprise in the Niger River valley of western Niger, we must consider several critical elements in the production chain from the farm to product marketing in order to evaluate related costs and revenues for each segment. For each segment, the important sub-systems can easily be identified by considering the related costs and revenues, thereby contributing to the development of the PAM models. For this purpose, the main steps taken into account to describe the commodity production sub-systems were: (1) farm-level production systems; (2) postharvest activities, including the assembly of the product, processing and marketing; and (3) macro prices and the trade policy elements. The costs and returns at farm level and post-harvest need to be evaluated so that we can develop the accounting budgets of the crop enterprise. As stated by Randolph (1998), the use of the PAM approach may reflect whole farm systems or commodity systems, and it provides a powerful framework for planners trying to understand the fabric of their agricultural sector and to identify opportunities for improving its efficiency and enhancing growth. The development of the PAM models, however, requires detailed knowledge of the commodity systems and the policy elements that affect their activities. The main purpose of this paper is to present the detailed procedure and steps followed in the development of PAM models for the Nigerien irrigated rice systems.

2.1 Data

The Policy, Innovation Systems and Impact Assessment program of the Africa Rice Centre (AfricaRice) contributed to the collection of rice data and information through a multi-country policy study, conducted in collaboration with national partners in Burkina Faso, Mali, Niger and Nigeria. Information from Niger from this database was used in the PAM. These data and information were collected in the Niger River valley of western Niger in selected irrigated

rice schemes in collaboration with the department of rural economy of Niamey University. Additional data and information collected through previous studies by various development projects (e.g. Programme d'Amélioration de la Filière Riz, PAFRIZ) were also used. The basic information needed for compiling a PAM are yields, input requirements, and the market prices of inputs and outputs (Monke & Pearson, 1989; Yao, 1997). Data on transportation cost, processing cost, storage cost, port charges, production and input subsidies, and import and export tariffs are also required to derive the social prices.

2.2 Methodology

Several indicators of protection are reported in the literature and can be accurately generated through the PAM. The CET is a price-based trade policy measure and its effects on the competitiveness of irrigated rice activity can be investigated using the PAM. The indicators generated by the application of the PAM have been the subject of various research publications, which provide detailed reviews of the computations, use, interpretation and their potential limitations (Monke & Pearson, 1989; Masters, 1995; Yao, 1997; Mucavele, 2000; Pearson *et al.*, 2003). In this paper, we first review the PAM and discuss the various indicators and policy incentives. Next, we discuss the implications of the indicators in assessing the CET impacts on the performance of the irrigated rice sub-sector and its competitiveness. Third, we discuss the potential limitations of the model.

PAM enables the evaluation of price-based trade policy affecting an agricultural system by comparing enterprise outcomes at market prices with outcomes at social prices. The difference between the two outcomes represents the policy effects, which in PAM methodology are called 'actual policy transfers' between actors in the economy. The main assumption made in conducting such a comparison is that reference prices are the best proxy for the scarcity value of resources used in the commodity production process, while market

prices reflect the trade policy effects. The scarcity values of resources used constitute best alternative uses of resources mobilized in the system's related activities. The best alternative uses of resources indicate resource use efficiency, which implies technical efficiency, i.e. an optimal mix of inputs and factors of production that enable the generation of maximum output. It is therefore a system which enjoys adequate performance levels and which does not need a particular policy measure to remain competitive.

Policy interventions to alter the competitiveness of an agricultural system create distortions that are measured by various indicators of protection that reveal the effects of the policy on agricultural system performance (revenues, costs and profits). A body of literature deals with the theoretical foundations, method of estimations, and potential limitations of the PAM (Bruno, 1972; Pearson, 1976; Monke & Pearson, 1989; Masters, 1995, 2003; Beghin & Fang, 2002; Anderson, 2003). Other case studies have demonstrated the usefulness of these indicators in evaluating the impact of governmental policies, particularly those related to agriculture (Masters & Winter-Nelson, 1995; Yao, 1997; Fang & Beghin, 2000).

In the PAM approach, Monke & Pearson (1989) define several indicators of policy transfers and protection coefficients that indicate the policy effects on agricultural systems producing one commodity and agricultural systems producing different commodities. These are categorized as output transfers (I), tradable input transfers (J), factor transfers (K) and net transfers (L). The protection coefficients are used to evaluate the protection offered by policy intervention and can also be used to make comparisons between agricultural systems producing different outputs. The protection coefficients are ratios that are free of currency or commodity distinctions. The common protection indicators are: the nominal protection coefficient (NPC), effective protection coefficient, producer subsidy estimate (PSE), subsidy ratio to producers (SRP), the net transfer, and the profitability coefficient (PC). The NPC is

the ratio between the observed market price (P) paid to producers of a given product and the good's underlying social opportunity cost (P*): NPC = P/P*. This indicator can be calculated in the case of tradable outputs to obtain the nominal protection coefficient on tradable outputs (NPCO). It can also be calculated in the case of tradable inputs to get the nominal protection coefficient on tradable inputs (NPCI). In the PAM approach, NPCO is obtained by dividing revenues at market prices by revenues at social prices, which indicates the extent of output transfer – i.e. the calculated ratio compares the private revenue of the system to its comparable social revenue. NPCI is obtained by comparing the cost of the tradable inputs at market prices to their comparable social prices in order to highlight the degree of tradable inputs transfer. If NPCO < 1, the product produced by the system is taxed. When NPCO > 1, that means that the system is favoured by the policies in place indicating an indirect subsidy associated with the production of the commodity. Also, if NPCI > 1, the domestic input cost is higher than the input cost at world prices and the system is taxed by policy; but if NPCI < 1, the domestic price is lower than the comparable world price and the system is subsidized by policy.

Another important measure of policy incentives is the effective protection coefficient (EPC), which takes account of multiple distortions such as interaction among different tariffs in determining the incidence of protection (Mucavele *et al.*, 2000). Its relevance depends on reference prices and input/output coefficients (Masters, 2003). The EPC is a ratio that compares the value added in market prices with the value added in world prices. The EPC is useful in measuring the combined effect of policy affecting both products and inputs (Monke & Pearson, 1989; Masters, 2003; Pearson *et al.*, 2003), in contrast to the NPC, which measures only output transfers. Masters (2003) reports that the EPC is useful for comparing products with very different levels of input use. An EPC > 1 indicates that producers are protected, while an EPC < 1 indicates that producers are taxed. However, the EPC ignores the

transfer effects of factor market policies and thus it is not a complete indicator of incentives (Monke & Pearson, 1989). For this reason, the concept of the profitability coefficient (PC) was introduced: PC is the ratio of the net revenue at market prices to the net revenue evaluated at social prices. The PC measures the incentive effects of all policies and serves as a proxy for the net policy transfer (Monke & Pearson, 1989). Therefore, the PC can be formulated as representing the ratioof private profits to economic profits, and indicating the proportion of incentives provided to producers through policy effects.

Other important indicators include the PSE, SRP and the net policy transfer . The PSE is calculated as net transfer divided by total revenue at market prices and includes policy effects on all inputs and factors. It is the level of producer subsidy that would be necessary to replace the array of actual farm policies used in the country in order to leave farm income unchanged (Mucavele, 2000). The SRP is formulated as a ratio of the net policy transfer to total social revenues. It includes policy effects on all inputs and factors, and enables comparison of the extent to which the net effect of all policy subsidizes agricultural systems. The net transfer is an overall measure of the difference between financial (private) and economic (social) valuations of revenues and costs. It represents the sum of output, tradable inputs and factor transfers. Therefore, it is an overall measure of the difference between private and social profits – it measures the overall effects of policies. For that reason, if efficient policies exactly offset market failures and all distorting policies are removed, divergences disappear and the net transfer becomes zero (Pearson *et al.*, 2003).

The set up of the PAM base scenario model involved several key elements relating to farm-level production and postharvest activities, rice marketing, macro prices and the CET elements. The farm-level technical coefficients include not only the fixed cost but also variable costs for labour and inputs. The fixed costs relate to farm equipment – mostly hand

tools, including knife, sickle, winnowing tool, machete and hoe. The cost involved in farm equipment use during a particular cropping season is evaluated on the basis of the equipment's life expectancy, capital and initial purchase costs, and depreciation for ware. The labour cost is the actual cost paid by the farmer to hire seasonal labour and is estimated per unit of land and per field operation. The inputs costs are also estimated on the basis of information provided by the farmers. Final farm product relates to paddy production per unit of land (4.3 tonnes/ha). Four main categories of costs relating to processing were considered: labour, inputs, raw material and fixed costs.

3 RESULTS

The summary results of net policy transfer are presented in table 1 indicating the policy-induced effects evaluated per unit of cultivated land and per unit of final output produced. Table 2 presents the summary results of protection coefficients and incentives for the PAM base scenario models.

Table 1: Summary results of net policy transfer

Port of importation	Point of comparison	Markets	FCFA / hectare	FCFA / tonne of milled rice
Cotonou	Niamey	Retail	–48 158	–17 230
		Wholesale	–63 625	–22 764
	Tillabery	Retail	–242 251	–86 673
		Wholesale	–119 672	–42 817
	Total	Retail	–145 204	–51 951
		Wholesale	–91 649	–32 790
Tema	Niamey	Retail	–51 326	–18 364

		Wholesale	–90 599	–32 415
	Tillabery	Retail	–272 556	–97 516
		Wholesale	–148 535	–53 143
	Total	Retail	–161 941	–57 940
		Wholesale	–119 567	–42 779

N.B.: 480 FCFA = 1 US$.

Table 2: Summary results of protection coefficients and incentives for PAM base scenario models

Port of importation	Point of comparison	Type of market	NPCO	EPC	PC	PSE	Equivalent producer subsidy
Average Cotonou	Niamey	Retail	0.98	0.92	0.85	–0.06	–0.07
		Wholesale	0.96	0.88	0.77	–0.09	–0.10
	Tillabery	Retail	0.76	0.64	0.41	–0.29	–0.38
		Wholesale	0.90	0.81	0.68	–0.15	–0.17
	Total	Retail	0.87	0.78	0.63	–0.17	–0.23
		Wholesale	0.93	0.85	0.73	–0.12	–0.14
Average Tema	Niamey	Retail	0.98	0.92	0.85	–0.06	–0.07
		Wholesale	0.93	0.84	0.71	–0.12	–0.14
	Tillabery	Retail	0.73	0.61	0.38	–0.31	–0.43
		Wholesale	0.87	0.78	0.63	–0.18	–0.21
	Total	Retail	0.85	0.76	0.62	–0.19	–0.25

		Wholesale	0.90	0.81	0.67	–0.15	–0.18

N.B.: 480 FCFA = 1 US$.

NPCO = nominal protection coefficient on tradable outputs ; EPC = effective protection coefficient; PC = profitability coefficient; PSE = producer subsidy estimate.

Overall, for a base scenario that compares the locally produced rice in the retail markets with imported rice brands brought into the country through Cotonou port (table 1), the net policy transfer is on average –145 204 FCFA/hectare (–302.51 US$/ha) and –51 951 FCFA/tonne (–108.23 US$/t). In the wholesale markets, the net policy transfer is evaluated at –91 649 FCFA/ha (–190.94 US$/ha) and –32 790 FCFA/t (–68.31 US$/t). For the base scenario that compares the locally produced rice in the retail markets to rice brands imported through Tema port, the net policy transfer is on average –161 941 FCFA/ha (–337.38 US$/ha) and –57 940 FCFA/t (–120.71 US$/tonne). In the wholesale market, the net policy transfer is –119 567 FCFA/hectare (–249.1 US$/ha) and –42 779 FCFA/t (–89.12 US$/t).

Table 3: Detailed PAM base scenario results: Protection coefficients

Port of importation	Imported rice brands to which local rice is compared	Point of comparison	Type of markets	NPC	EPC	PC	PSE	Equivalent producer subsidy
Cotonou	Pakistan rice	Niamey	Retail	1.01	0.95	0.91	–0.04	–0.04
			Wholesale	0.92	0.82	0.65	–0.13	–0.14
		Tillabery	Retail	0.79	0.67	0.46	–0.26	–0.33
			Wholesale	0.95	0.88	0.80	–0.09	–0.09
	Indian Rice 25 per cent	Niamey	Retail	1.01	0.94	0.90	–0.04	–0.04
			Wholesale	0.91	0.82	0.64	–0.14	–0.15
		Tillabery	Retail	0.78	0.67	0.45	–0.26	–0.33
			Wholesale	0.95	0.88	0.79	–0.09	–0.10
	Thai rice 25 per cent	Niamey	Retail	0.84	0.74	0.53	–0.20	–0.24
			Wholesale	0.88	0.78	0.59	–0.17	–0.19

Port of	Imported rice	Point of	Type of	NPC	EPC	PC	PSE	Equivalent
		Tillabery	Retail	0.76	0.64	0.42	–0.29	–0.38
			Wholesale	0.92	0.84	0.73	–0.12	–0.14
	Thai parboiled	Niamey	Retail	1.08	1.04	1.08	0.03	0.03
			Wholesale	1.13	1.11	1.21	0.08	0.07
		Tillabery	Retail	0.70	0.57	0.30	–0.34	–0.50
			Wholesale	0.76	0.64	0.40	–0.28	–0.37
	Average	Niamey	Retail	0.98	0.92	0.85	–0.06	–0.07
			Wholesale	0.96	0.88	0.77	–0.09	–0.10
		Tillabery	Retail	0.76	0.64	0.41	–0.29	–0.38
			Wholesale	0.90	0.81	0.68	–0.15	–0.17
		Total	Retail	0.87	0.78	0.63	–0.17	–0.23
			Wholesale	0.93	0.85	0.73	–0.12	–0.14
Tema	Pakistan rice	Niamey	Retail	0.97	0.90	0.83	–0.07	–0.07
			Wholesale	0.88	0.78	0.59	–0.16	–0.19
		Tillabery	Retail	0.76	0.64	0.42	–0.28	–0.37

Port of	Imported rice	Point of	Type of	NPC	EPC	PC	PSE	Equivalent
			Wholesale	0.92	0.84	0.74	–0.12	–0.13
	Indian Rice 25 per cent	Niamey	Retail	0.97	0.90	0.82	–0.08	–0.08
			Wholesale	0.88	0.78	0.59	–0.17	–0.19
		Tillabery	Retail	0.76	0.64	0.42	–0.29	–0.38
			Wholesale	0.92	0.84	0.73	–0.13	–0.14
	Thai rice 25 per cent	Niamey	Retail	0.94	0.86	0.76	–0.11	–0.11
			Wholesale	0.85	0.75	0.54	–0.19	–0.23
		Tillabery	Retail	0.73	0.61	0.39	–0.31	–0.42
			Wholesale	0.89	0.80	0.68	–0.15	–0.17
	Thai parboiled	Niamey	Retail	1.04	1.00	1.00	–0.00	–0.00
			Wholesale	1.09	1.06	1.11	0.05	0.04
		Tillabery	Retail	0.67	0.54	0.28	–0.37	–0.55
			Wholesale	0.74	0.62	0.37	–0.30	–0.41
	Average	Niamey	Retail	0.98	0.92	0.85	–0.06	–0.07
			Wholesale	0.93	0.84	0.71	–0.12	–0.14

Port of	Imported rice	Point of	Type of	NPC	EPC	PC	PSE	Equivalent
		Tillabery	Retail	0.73	0.61	0.38	–0.31	–0.43
			Wholesale	0.87	0.78	0.63	–0.18	–0.21
		Total	Retail	0.85	0.76	0.62	–0.19	–0.25
			Wholesale	0.90	0.81	0.67	–0.15	–0.18

NPC = nominal protection coefficient; EPC = effective protection coefficient; PC = profitability coefficient; PSE = producer subsidy estimate.

4 DISCUSSION

4.1 Policy transfers

In general, the PAM base results show that the net policy transfer indicators are negative per unit of land and per unit of final output produced (milled rice) for all scenarios (types of market and comparison points). This clearly indicates 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 that are in effect. Since the net policy transfers are also an indication of the sum of the system's output transfer, tradable inputs transfer, and domestic factors transfer, the negative net policy transfers also mean that the overall policy transfers for output, inputs and domestic factors are negative.

4.2 Protection coefficients and incentives

The summary results of protection coefficients and incentives support the fact that policy outcomes do not provide sufficient incentives to the system. First, the NPCOs in both retail and wholesale markets are less than 1, indicating that the market price is lower than the comparable world market price. This is verified at all points of comparison at which local milled rice enters into competition with imported rice brands. On average, retail market prices represent 87 per cent of comparable world market prices of rice brands imported through Cotonou port, while the wholesale market prices represent 93 per cent of the reference price of the comparable imported rice type. When rice brands are imported through Tema port, the domestic retail market prices represent on average 85 per cent of the comparable world market price, while the domestic wholesale price constitutes 90 per cent of the comparable world market price. These results confirm that domestic output prices are lower than comparable world market prices, and that there is an implicit tax on producers and the system

is not protected by policy. Thus, economic agents operating in the system do not receive sufficient incentives and, on average, retail channels receive fewer incentives than wholesale channels.

The absence of incentives is further shown by the EPCs. As in the previous cases, the EPCs differ according to the point of comparison of locally milled rice with imported rice brands, the port of import, and the type of rice market. When local milled rice is compared with rice brands imported through the port of Cotonou, the average EPC is 0.78 for the retail and 0.85 for the wholesale markets (table 2). These coefficients do not, however, differ very much from the ones obtained when the local milled rice is compared with rice brands imported through Tema port, when the average EPC is 0.76 and 0.81 for the retail and wholesale markets, respectively (table 2). The EPCs are slightly lower than the NPCs due to the fact that the slight input transfer is taken into account. As in the case of NPCO, the EPC is less than one, indicating that the value added at market prices for the irrigated rice production system is less than what the value added would be at reference prices. In other words, when all the effects of policies on irrigated rice output and input markets are considered, the value added (evaluated at market prices) is less than what it would be in the absence of these policy effects. Furthermore, on average, the policy effects tend to be more pronounced in their impact on retail markets. It also implies that the retail marketing channel of the irrigated rice production system tends to be more negatively affected by these policy effects.

5 CONCLUSION

In summary, in the majority of cases, the nominal protection coefficients for outputs (NPCOs) are less than 1, indicating that in output markets, the irrigated rice production system receives little protection; on average, the retail rice marketing channels tend to be even less well protected than the wholesale ones. However, the system focusing on the production of local

parboiled rice for both wholesale and retail markets in the Niamey urban centre constitute an exception. For this particular case of local parboiled rice, a comparison made in the Tillabery region – which is the main region producing local parboiled rice – shows that the total output of the local parboiled rice production system does not receive any protection. This same trend is observed when considering the effective protection coefficients (EPCs).

These conclusions are further supported by the results obtained for the profitability coefficients (PCs). The PC is an extension of the EPC that also includes domestic factor costs and consequently measures the impact of all transfers on private profits (Pearson *et al.*, 2003). As a measure of the impact of all transfers on private profits, the PC is also used as a proxy measure of the net policy transfer. The PCs varied from 0.38 to 0.85 (table 2), indicating that in most cases the private revenues are less than the revenues evaluated at reference prices. A comparison of local rice with rice brands imported through Cotonou port shows that in the retail rice marketing system, the PC of the irrigated rice production is on average 0.63 compared with 0.73 in wholesale market channels. Similarly, the comparison of local rice to rice brands imported through Tema port gave PCs of 0.62 and 0.67 for retail and wholesale rice marketing channels, respectively. In all cases, the PC is less than one, indicating that private profitability, even though positive, is less than the social profits evaluated at comparable reference prices. As discussed earlier, the net policy effect is negative, therefore it is expected that these profitability coefficients would also be low. This is shown by the negative subsidy ratio to producers (SRPs) and producer subsidy estimates (PSEs).

The SRP compares the net policy transfer to the value of the output in world prices. In our various scenarios, we have shown that the net policy transfers are negative. Therefore, negative SRPs indicate that producers are taxed and by what proportion the irrigated rice production system's revenues are decreased. On average, in comparison with rice brands

imported through Cotonou port, the local producers' revenues were decreased by 17 per cent and 12 per cent in retail and wholesale rice marketing systems, respectively. The comparison of local rice with rice brands imported through Tema port also indicates revenues of –19 per cent and –15 per cent in the retail and wholesale rice marketing systems, respectively. The SRP is the output tariff equivalent if the net effect of all policy transfers were carried out solely through a tariff on output (Monke & Pearson, 1989). The negative net policy effects could have been removed by simply applying the equivalent ratios of SRP as tariffs on the output generated by the system. The PSEs follow the same trend as the SRP. These implicit taxes of the system are visualized through the negative SRPs, and by negative net policy transfers. Furthermore, on average, the effective profitability coefficients (EPCs) are less than 1, indicating that the system is not protected and that the prices received by producers are lower than comparable world market prices.

In conclusion, the irrigated rice system performed well under the common external tariff (CET) regimes but the system was taxed due to the fact that some resources were diverted away from it. Thus, there is a need to provide greater incentives for the system in the form of technological improvement (farm-level productivity improvement and post-harvest 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 very active.

References

Anderson, K. 2003. *Measuring effects of trade policy distortions: How far have we come?* Oxford, UK: Blackwell.

Beghin, J. and Fang, C. 2002. Protection and trade liberalization under incomplete market integration. *American Journal of Agricultural Economics* 84(3):768–773.

Bruno, M. 1972. Domestic resource costs and effective protection: clarification and synthesis. *Journal of Political Economy* 80(1):16–33.

Fang, C. and Beghin, J. 2000. Food Self-sufficiency, comparative advantage, and agricultural trade: a policy analysis matrix for Chinese agriculture. Working Paper 99-WP 223 (Revised). Ames, Iowa: Center for Agricultural and Rural Development and Department of Economics, Iowa State University.

Masters, W.A. 1995. Guidelines on National Comparative Advantage and Agricultural Trade (1995), APAP Methods and Guidelines Series 40001. Bethesda, MD: Abt Associates.

Masters, W. 2003. Policy measurement for trade negotiations and domestic reforms. West Lafayette, IN: Purdue University. www.agecon.purdue.edu/staff/masters/WillMasters-PolicyMeasurement.pdf.

Masters, W. and Winter-Nelson, A. 1995. Measuring the comparative advantage of agricultural activities: domestic resource costs and the social cost–benefit ratio. *American Journal of Agricultural Economics* 77:243–250.

Monke, E.A. and Pearson, S.R. 1989. *The Policy Analysis Matrix for agricultural development*. Ithaca, NY and London, UK: Cornell University Press.

Mucavele, F.G. 2000. Analysis of comparative advantage and agricultural trade in Mozambique. SD Publication Series. Technical Paper No. 107. Office of Sustainable

Development, USAID Bureau for Africa, [Washington, DC]. http://www.afr-sd.org/publications/mozambique107.pdf.

Pearson, S.R. 1976. Net social profitability, domestic resource costs, and effective rate of protection. *Journal of Development Studies* 12:320–333.

Pearson, S., Gotsch, C. and Bahri, S. 2003. Applications of the Policy Analysis Matrix in Indonesian Agriculture. http://www.stanford.edu/group/FRI/indonesia/newregional/newbook.pdf.

Randolph, T.F. 1998. Strengthening Policy Analysis Capacity in West Africa. The Experience with PAM. Report of the PAM Regional Workshop, Bamako, 29 June – 1 July 1998.

Yao, S. 1997. Comparative advantages and crop diversification: Policy analysis matrix for Thai Agriculture. *Journal of Agricultural Economics* 48(2):211–222.