EFFECTS OF CUSTOMS UNION TARIFFS ON DOMESTIC RICE COMPETITIVENESS: THE CASE OF IRRIGATED RICE IN NIGER

By

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DECLARATION

I declare that the thesis hereby submitted by me for the PhD degree in Agricultural Economics at the University of the Free State is my own independent work and that I have not previously submitted the same work for a qualification in another University/faculty. Moreover, I concede copyright to the University of the Free State.

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ABSTRACT

Niger's irrigated rice production system was evaluated within the context of the country's common external tariff regime. The effects of the common external tariff (CET) on the performance of the irrigated rice production system were evaluated at various comparison points where local rice enters into competition with imported rice and by considering the main rice marketing systems (retail and wholesale markets). These comparisons were made taking into account the various brands of imported rice that are commercialised in the country. The results of the policy analysis matrix (PAM) base scenario for the irrigated rice system under the CET show that the system is generally competitive (positive private profitability) and has potential for growth (positive economic profitability). These results are disaggregated by type of rice quality, type of rice market (retail or wholesale) and by two points of comparison (Niamey and Tillabery).

At both points of comparison, the PAM indicators show positive financial profitability, indicating that the system is generally competitive and that operators are making some financial gains. Moreover, the 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 maintained that despite the fact that the inputs used in irrigated rice production are affected by the various common external tariff (CET) measures, the activity still performs to a level that permits the various actors to earn some positive income and sustain their businesses. Despite its competitiveness and efficiency, however, irrigated rice production still performs below potential because it lacks certain additional incentives.

To investigate this issue, various sensitivity analyses were performed, using single factors as well as simultaneous changes in several factors. These sensitivity analyses were performed in order to diagnose the effects of possible policy changes on elements such as financial and social profitability, production incentives, and protection coefficients. The sensitivity analyses show that private and social profits, *ceteris paribus*, are sensitive to improvements in technological factors such as farm-level productivity and post-harvest techniques that enhance the milling conversion rate of paddy into milled rice. The incentives and protection coefficients are also found to be sensitive to possible policy changes. Furthermore, private and social profits, including incentives and protection coefficients, are sensitive to changes in economic factors relating to the reduction of import duties on inputs, as well as to increases in import duties on imported rice and changes in exchange rates.

Niger's irrigated rice system generally performs well under the CET regime, but because certain resources are diverted away from it, the system is in fact being taxed. There is a need to provide greater incentives to everyone active in the system, in the form of technological improvements (farm-level productivity improvement and post-harvest quality enhancement). Greater incentives should also be given in terms of improving marketing channels, especially retail marketing, where a great number of women rice traders are active. More research needs to be conducted on this aspect.

Key words: Private profits, social/economic profits, incentives, protection coefficients, net policy transfer, revenues, costs, comparative advantage, trade policy, competitiveness, irrigated rice, Niger, irrigation management transfer.

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ACRONYMS AND ABBREVIATIONS

ADRAO	Association pour le Développement de la Riziculture en Afrique de l’Ouest
AfricaRice	Africa Rice Center
APAP	Agricultural Policy Analysis Project
ASI	ADRAO SAED ISRA
CA	Centrale d’Approvisionnement
CEDEAO	Communauté Economique des Etats de l’Afrique de l’Ouest
CET	Common External Tariff
CFA	Communauté Financière Africaine
CGE	Computable General Equilibrium
CIF	Cost Insurance Freight
DRC	Domestic Resource Cost
EDI	Economic Development Institute
EPC	Effective Protection Coefficient
FAO	Food and Agriculture Organization
FASID	Foundation for Advanced Studies on International Development
FCFA	Franc Communauté Financière Africaine
FED	Fonds Européen de Développement (European Fund for Development)
FOB	Free on Board
FUCOPRI	Fédération des Unions de Coopératives Rizicoles (Union of Cooperatives and Rice Producers)
GSS	General Support Staff

INRAN	Institut National de Recherches Agronomiques du Niger (National Agronomic Research Institute of Niger)
IPTRID	International Programme for Technology and Research in Irrigation and Drainage
IRM	Integrated Rice Management
ISRA	Institut Sénégalais des Recherches Agricoles
IV	Improved Variety
IWMI	International Water Management Institute
MV	Modern Variety
NARS	National Agricultural Research Systems
NPC	Nominal Protection Coefficient
NPCI	Nominal Protection Coefficient on Tradable Inputs
NPCO	Nominal Protection Coefficient on Tradable Outputs
NSP	Net Social Profitability
OECD	Organization for Economic Co-operation and Development
ON	Office du Niger
ONAHA	Office National des Amenagements Hydro-Agricoles
ONBAH	National Organisation for Dams and Agro-Hydraulic Facilities
OPVN	Office des Produits Vivriers du Niger
ORYZA-S	ORYZA Simulation
PAFRIZ	Programme d'Appui a la Filière Riz
PAM	Policy Analysis Matrix
PC	Profitability Coefficient
PCC	Prélèvement Communautaire de la CEDEAO
PE	Partial Equilibrium
PSE	Producer Subsidy Estimate

RIDEV	Rice Development
RINI	Riz du Niger (société de transformation du Riz)
RMM	Rice Market Monitor
SAED	Société Nationale d'Aménagement et d'Exploitation des Terres du Delta et des Vallées du Fleuve Sénégal et de la Falémé
SCB	Social Cost-Benefit
SOTAGRI	Société de Transformation de la Commercialisation des Produits Agricoles
SRP	Subsidy Ratio to Producers
SSA	Sub-Saharan Africa
SSL	Société Seyni Saley Lata
T & V	Training and Visit
TVI	Taxe de Vérification des Importations
UEMOA/WAEMU	Union Economique et Monetaire Ouest Africaine / West African Economic and Monetary Union
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
USD	United States Dollar
VAT	Value Added Tax
WARDA	West Africa Rice Development Association
WITA	WARDA IITA
WTO	World Trade Organisation

CHAPTER 1: INTRODUCTION

1.1 Background

As a response to the chronic food deficit engendered 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 has since then constituted the backbone of various endeavours undertaken by the Nigerien decision makers to develop the irrigated agriculture sub-sector. This strategy consists of three main components: investments in irrigation infrastructure development; development of institutions in charge of providing technical assistance and support services to farmers; and general agricultural policy relating to irrigated agriculture, namely rice. The development of modern irrigation infrastructure (called irrigated perimeters) which supplies the quasi totality of the domestically produced rice in Niger, has essentially constituted the prime foundations of public investments devoted to the development of irrigated agriculture. To facilitate the gradual development of the rice *filière* (rice sector), a series of accompanying measures were also put in place at an early stage of the construction of these rice production facilities, and these involved the creation of three public services: ONAHA (Office National des Amenagements Hydro-Agricoles), which is the national agency for the maintenance of the public irrigated schemes and in charge of providing technical assistance to the rice farmers, RINI (Riz du Niger), a modern, large-capacity rice mill, and the CA (Centrale d'Approvisionnement), which is the national central store for agricultural inputs and equipment. Different institutional arrangements exist between these public service bodies. The primary aim of these arrangements is to help rice farmers to produce, process, and market their rice. In this framework, the enhancement of the irrigated agriculture sub-sector was initially thought to be the central engine for promoting rural communities' livelihoods.

The irrigated rice infrastructures are mostly located in the Niger River valley of western Niger. There are more than 39 irrigated schemes along the Niger River valley, totalling an estimated developed land of 8,424 ha mostly used for rice production. However, for the country as a whole the total number of irrigated schemes is 50, with 12,934.7 ha of developed land of which 8,706.7 ha are devoted to irrigated rice and 4,228 ha to vegetables. In most irrigated rice schemes, the cropping intensity is almost 200 %, which means two cropping seasons per year: dry season and wet season cropping. Average irrigated rice yield is estimated at 4.5 tons/ha, while total paddy rice production averages 60,000 to 70,000 tonnes per year representing an added value of more than 6.6 billion FCFA, i.e. over 12.5 million US dollars (Moussa, 2004). At their early stage of operations, the irrigation infrastructures were managed by public service bodies or parastatals that provided technical assistance to the water users associations (cooperatives), who were not quite familiar with the rules and requirements needed for the system to become fully operational. Secondly, before the implementation of the structural adjustment programmes, the production activities in these facilities were subsidised (particularly inputs such as fertilisers, pesticides, and credit). The essential part of the activities in irrigated agriculture in Niger involves small-scale rural producers with an average irrigated plot size varying between 0.25 ha and 0.33 ha. Enhancing the productivity of these activities can significantly improve the livelihoods of these rural communities. Hundertmark and Touré (2003) stated that institutional arrangements and the quality of support service provisions are important issues associated with the system performance analysis. Performance can be assessed in various domains (agronomic, financial, resource use, institutional, etc.) and at different times. This enables verification of the degree to which targets and objectives are being realised (Abernathy *et al*., 2000).

The management of the irrigated rice perimeters in the Sahelian countries is done collectively by cooperatives. The cooperative plays a key role in input delivery and facilitates rice commercialisation by negotiating with private businesses or financial institutions for credit provision. The cooperative or systems' management bodies assist farmers or groups of farmers with the distribution of inputs, mostly fertiliser, herbicides, pesticides, and with rice marketing. Inputs are distributed to farmers on a seasonal loan basis, generally to be reimbursed after one cropping season but in a number of cases loans are carried over to other seasons (due to lack of payments). With regard to seed, the seed multiplication farm of Saguia (located in Niamey) supplies foundation seeds to all irrigated rice schemes of the Niger River valley. This farm is operated by a cooperative (an association of farmers) in collaboration with ONAHA (Office National des Amenagements Hydro-Agricoles). Water distribution is also made through a management committee that is also in charge of the operation and maintenance of the hydraulic infrastructure.

The operations of the rice irrigation facilities include not only the task of providing water distribution from the main water source to the farmers' plots (via primary, secondary and even tertiary canals) but also the conduct of some activities in accordance with the cropping calendar. Other important support services include delivery of inputs (fertilisers, pesticides, and herbicides), paddy/milled rice commercialisation, water users' fees collection and other loan recovery. This highlights the first performance related issue: the complexity of the tasks to be executed by the management body.

The second performance related issue is that the characteristics of the irrigated rice systems within the country differ in terms of the area of land under production, the number of producers, the cropping calendar and the quality of support service providers, among others. This therefore constitutes the first layer of differentiation materialised by Niger's specific macro-economic situation, its agricultural policy, and its related rice sector development policy. This study therefore intends to analyse the performance of Niger's irrigated rice production system within the larger, or macro-economic setting.

The village communities are the primary beneficiaries of irrigated rice production, and the land used for this purpose becomes common property from which they derive their livelihood. Another layer of performance-related issues thus encompasses the fact that this common property requires common agreement for its operation, maintenance, repairs or rehabilitation. In sum, irrigated rice schemes are public utilities and as such need to be fully efficient in order to generate sufficient benefits for the communities that are the primary users. Collective action is now seen to be crucial in many aspects of agricultural production, natural resource management, and rural development programmes in developing countries, and there is a need for research on factors that encourage and sustain such cooperation among the various agents (Meinzen-Dick *et al.,* 2004).

In the case of irrigated rice schemes, some decisions are taken at the level of the scheme and associated communities and these concern mostly the management of the schemes' operations, the inputs delivery systems, various transactions and negotiations with private dealers or credit institutions, and rice commercialisation. These decisions are taken through the cooperatives in relation to the various associations of the village to which it adheres. Other decisions that relate to the households concern the execution of field operations, disposal of the production and payment of loans. The end result of these household decision making processes are the final results obtained in normal years in terms of yields, net operating revenues and proportion of production sold to the market.

In conclusion, the country's specific macro-policy setting, agricultural policy and related rice sector policy, the agro ecology and physical characteristics of the irrigated systems, the micro level (village or community level) institutional and organisational conditions, and the household level situation all form the complex policy, institutional and organisational setting in which the irrigated rice systems operate. This complexity in dealing with collective action is reported by Meinzen-Dick *et al*. (2004).

1.2 Problem Statement

Because they are engaged in a capital-intensive system, producers of irrigated rice need to make efficient use of their resources and generate some income by marketing their goods. In other words, these small-scale producers need to have some linkage with the markets in order to fulfill their functions of income generating activity and food security. More effort therefore needs to be made to create an efficient link with the markets. In the past, with problems of internal organisation and social conflict, exacerbated by an inefficient system of commercialising their product, the rice cooperatives started facing problems in dealing with the daily management requirements of their irrigation facilities from water distribution to input delivery and water users' fees collection. The fact is that, although they were initially thought to be an engine for promoting rice production activities and a source of income for rural families, Niger's irrigated rice schemes have in a number of cases failed to give the expected results.

In this part of the world, rice has always been a commodity that has attracted substantial attention from both government officials and sub-sector stakeholders (producers, producer associations, rice traders and millers, businesses, and decision makers). Several national workshops, stakeholders meetings and donor commissioned reviews of the sub-sector have been made, trying to provide answers on how to contribute to improving the performance of the sector. Among the various constraints that have been highlighted is the low competitiveness of locally produced rice compared to imported rice. Imported rice is said to compete with local rice for many reasons, including low tariffs applied. Tariffs levels are judged to be insufficiently high to prevent entry into the country of cheap imported rice. In fact, with the liberalisation of markets, consumers get access to cheap rice markets originating mostly from Asian countries, accelerating the trend in rice imports and providing alternatives to rice consumers in terms of the quality of rice (brands, whole grain, and broken grain). Between 1991 and 2000, milled rice imports into Niger grew by 81 % compared to an increase of 1.76 % for West Africa as a whole (WARDA, 2008). This shows the great increase in demand for rice. In the same period, however, Niger's local paddy rice production decreased by 2.49 %.

The real picture is that general policy prescriptions relating to the rice sector have evolved over time. To date, the most important of these is the application of the West Africa Economic and Monetary Union (WAEMU) common external tariffs. Niger is a member of the West African Economic Union (WAEMU) known under its French acronym UEMOA. The West African Economic and Monetary Union (WAEMU) was created in 1994 and is located in Ouagadougou, Burkina Faso. Its member countries are Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo. After the devaluation of the CFA[1] Franc (FCFA) in 1994, emphasis was put on sound macroeconomic management (World Bank, 2006). In 2000, a customs union was established, with a common external tariff (CET). This was followed by the establishment in January 2001 of a common agricultural policy.

[1] the CFA Franc (Fcfa) stands for Communauté Financière Africaine (or African Financial Community). It is the currency used by several Francophone countries in West and Central Africa.

The customs duties applied by these countries are formulated within the framework of the common external tariff (CET). This entailed a substantial reduction in border tariffs (FAO, 2003a). Under the CET, milled rice imports from third countries are subject to a 10 % import duty and various fees of 2 % (statistical tax and solidarity tax). UEMOA common external tariffs and other duties are applicable to the CIF value. Irrigated rice production makes use of various inputs – both traded and non-traded inputs. The CET prescription contains other tariffs that relate to these traded inputs employed in domestic rice production. Hence, one policy measure of interest is the CET or common external tariff implemented in the UEMOA countries and assessment of its impact on the competitiveness of the rice sector (and irrigated rice in particular). This has become a priority, especially due to the fact that there is a contention that the lower border tariffs have contributed to the import of cheap milled rice which competes with locally produced rice. The major part of the locally produced rice comes from the irrigated rice perimeters. With the pursuit of food security goals and the use of rice as a component of this strategy, it is imperative to shed light on how the dominant rice production system responds to overall macro policy changes. In other words, given the implementation of the external common tariff, a fundamental question of interest is how competitive the irrigated rice sub-sector is.

One main objective of this research is to contribute to shedding light on this debate of the level of CET and farmers'/producers' inability to take advantage of market opportunities. The study aims at determining clearly the effects of the custom union's tariffs on the competitiveness of irrigated rice production in Niger and the economic incentives that benefit rice producers.

1.3 Objectives

The general objective of the study was to assess the effect of the custom union's tariffs (CET) policy measure on the performance of the irrigated rice sub-sector in Niger. Specific objectives include:

1. Assess the effect of CET on the competitiveness of the irrigated rice sub-sector with the policy analysis matrix;

2. Estimate the indicators of policy effects and their implications for national rice research and development;
3. Review the comparative advantage of the sub-sector in relation to national food policy strategy; and
4. Evaluate the policy implications for regional rice trade perspectives.

1.4 Motivation

The competitiveness of an activity determines whether or not it can attract workers and other resources and this is therefore most useful for predicting whether or not new firms would engage in the activity (Masters 2003). In the current case, it determines whether or not the irrigated rice sub-sector is profitable for the actors (rice farmers and other businesses involved) and what the prospects are for increased production and productivity.

Masters (2003) pointed out that recent decades have seen dramatic improvements in economic modelling and policy analysis; with increasingly detailed data and increasingly sophisticated model structures, economists have developed increasingly precise analyses of a wide range of phenomena. The development of sophisticated models to evaluate trade-related policies implies an urgent need to quantify the potential impact of these policies at national, regional, and international levels. The implementation of trade-related policies or trade liberalisation agreements can have wide-ranging effects on the economy, the environment and society (UNEP, 2001). The agricultural sector is a good example. As the world moves to the tune of globalisation, countries face the reality of having their economies impacted by the world economy. Depending on the level of the country's agricultural sector development, the potential impact generated through market liberalisation could be less or more important. Africa has been a major growth market for rice in the past decade, absorbing some 28 % of world trade in 2000-2002; the rice inflow to the region was also facilitated by the openness of the markets (FAO, 2003a).

Defining and understanding trade-related policies and their impact on the agricultural sector is a must, especially for the developing world, not only in order to take full advantage of the gains from trade but also to anticipate potential negative impacts. In fact, understanding the transmission channel of a policy reform is an important element in the approach for impact analysis (Paternostro and Beddies, 2002). These authors highlight the fact that the impact may be transmitted through various indicators, such as employment and wages, prices (production, consumption), access to goods and services, assets (physical, natural, financial, human, and social), and transfers and taxes. However, an adequate representation of policy instruments is essential in applied trade models, with tariffs and quantitative restrictions such as quotas constituting two important types of trade policy instruments (Tongeren *et al.,* 2000). With market liberalisation, conditions are favourable for price transmission, which in turn impacts on both producers and consumers of goods and services that are subject to trade. The same reality applies in the case of agricultural commodities, especially the case of rice, which is an internationally traded good.

Apart from this regional policy measure, to which the country adheres for economic integration purposes, the question as to how household rice demand and local rice commercialisation behaves in the context of this market liberalisation is also of great interest. Specific research questions to be addressed are the following:

- With the application of the common external tariff, how does the irrigated rice sub-sector perform in terms of private and economic incentives?
- Under the CET regime, has the comparative advantage of irrigated rice production improved? Or if not, what happened to it?
- What are rice producers' responses regarding these macro-economic changes?
- What are the policy implications for rice research and development?

1.5 Research Methodology

To assess the potential impact of the common external tariff (CET) policy measure on the performance of the irrigated rice sub-sector necessarily implies some interrelation between the micro and macro levels within the sub-sector. This is because most of the actors of the *filière* (rice sector) would be affected. The policy analysis matrix (PAM) constitutes a useful analytical tool to analyse the impact of the policy measure related to the implementation of the common external tariff on the performance of the irrigated rice sub-sector. The policy analysis matrix is a product of two accounting identities. One defines profitability as the difference between revenues and costs and the other measures the effects of divergences (distorting policies and market failures) as the difference between observed parameters and parameters that would exist if the divergences were removed (Monke and Pearson, 1989). According to Yao (1997), the primary objective of constructing a Policy Analysis Matrix is to derive a few important policy parameters for policy analysis. The PAM methodology enables the computation of costs (traded and non-traded goods), revenues at market and reference prices. The computation of profits can similarly be done. On the basis of these results, important policy indicators can be derived relating to private profitability, social profitability, protection coefficients, and policy divergences. PAM as an analytical tool has been used by Africa Rice Centre (AfricaRice) ex WARDA/ADRAO to help the national agricultural research and extension partners to better assess the impact of the various economic policies on the agricultural sector in general and the rice sub-sector in particular (Randolph, 1998). From 1995 to 1998, PAM analyses were conducted in Nigeria, Sierra Leone, Senegal, and Mali; some training sessions were conducted in Ivory Coast, Senegal, and Mali (Lançon, 2001b).

A template was developed to allow easy computations of the various policy indicators, the private and economic incentives (Randolph, 1998). Presented in an Excel spreadsheet format, the PAM template is made up of four different budgetary components: farm-level crop budgets, budgets for collection of paddy rice from farm to place of processing, processing enterprise budgets, and transport from market to commercialisation budgets. Thus, a holistic approach (chain analysis) was used to assess the impact at the various levels.

1.6 Data Used

The rice policy and market development unit of the Africa Rice Centre (AfricaRice) ex WARDA/ADRAO contributed to the collection of rice data and information through its multi-country policy study, conducted in collaboration with national partners in countries such as Niger, Mali, Burkina Faso, and Nigeria. Information in this database was used for the processed data and information in the Policy Analysis Matrix (PAM) with regards to data and information from Niger. The data and information were collected in the Niger

River valley of western Niger in some selected irrigated rice schemes in collaboration with the department of rural economy of Niamey University. A field visit was made in Niger from 26 February to 4 March 2007 to finalize the study implementation with our principal partner in Niger, Dr Koré Harouna of Niamey University and participate in the launching of the field data collection in some of the selected sites. By November 2007, the data collection was completed. Data entry and analysis started early 2008. Additional data and information collected through previous studies by various development projects (for example, 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 and Pearson, 1989; Yao, 1997). The data of transportation cost, processing cost, storage cost, port charges, production/input subsidies, and import/export tariffs are also required to derive the social prices.

1.7 Outline of the Thesis

After discussing the main issues of interest in this introduction (Chapter 1), Chapter 2 discusses general research work on rice policy development and the competitiveness of rice production in West Africa with a particular focus on Niger, as well as the related research methodologies. Next, the study makes an in-depth review of the general literature and theoretical frameworks for assessing the comparative advantage and competitiveness of farming systems and agribusiness, focusing particularly on customs tariffs and other measures that distort agricultural trade (Chapter 3). Chapter 4 considers the relevance of the policy analysis matrix (PAM) as an adequate tool to serve the purposes of this study. This is followed by Chapter 5, which models the irrigated rice system in Niger using the methodology of the policy analysis matrix. Chapter 6 gives a detailed presentation of the results of this analysis of Niger's irrigated rice system. Lastly, Chapter 7 summarises the major findings of the research and proposes some recommendations and the policy implications of the research.

CHAPTER 2: RICE POLICY DEVELOPMENT AND IRRIGATED RICE PRODUCTION IN WEST AFRICA

2.1 Introduction

From the 1950s through the 1970s, massive investments in irrigation development led to a substantial expansion in the area of irrigated agricultural land throughout the world (Svendsen and Vermillion, 1994). These efforts involved irrigation infrastructure development and many research projects to identify constraints hindering the performance of irrigated perimeters and to identify ways to improve this performance. A large number of donor commissioned reviews and studies were also conducted. The irrigated perimeters benefited from technical assistance, support services provision, and training and capacity building. From an international perspective, donor agencies and international agricultural research centres have played pivotal roles in providing a better understanding the operations, functions, rules, and performance indicators of irrigated perimeters in which West African irrigated rice is produced. The roles played by these organisations have facilitated not only a better understanding of the functions and performance indicators of irrigated agriculture, but have also shed light on related policy and institutional frameworks. In addition to this, a large number of irrigated rice sector studies have been conducted in West Africa by country specific programmes, donor funded development projects, bilateral cooperation agencies, the World Bank, etc. Apart from these studies and research activities, seminars, workshops, and conferences at both national and regional levels have also been organised. One common feature to all these endeavours relates to the performance of irrigated rice in view of national food policy, public investment priorities, economic efficiency, and water policy in general. What are these policy developments? What are their end results? And how have these policies impacted on production incentives and rice sector performances as a whole?

These policy developments and irrigated rice competitiveness analyses are made in relation to irrigated rice growing conditions by taking into account three major factors: irrigated rice production infrastructure development, policy and institutional development, and the performances of the irrigated rice perimeters. In this chapter, we analyse the rationale for the development of irrigated rice systems in West Africa – with a special focus on the Sahelian region – discuss their performance, and analyse the effectiveness of rice policies that were aimed at raising the output of these systems and the rice sector as a whole.

2.2 Rationale for Irrigated Rice Development

The irrigated rice production facilities were developed by countries in order to secure agricultural production through adequate water supply, control, and management. In environments – as in the Sahel Region – characterised by insufficient rainfall which makes rainfed agriculture risky, irrigated agriculture becomes a priority contingent upon the availability of financial resources to build and maintain irrigation infrastructure. There is no doubt that irrigated systems have the potential to produce the highest yields, and breeding rice plants for these systems has useful spin-offs for the remaining lowlands with less than complete water control (WARDA, 2002). In investing in irrigated agriculture, particularly irrigated rice, governments and donor agencies have set forth three major objectives: contribution to food security, income generation and diversification, and rural labour employment. The FAO (1996a) reports that irrigated agriculture has made a major contribution to food production and food security throughout the world. According to the same report, much of the impressive growth in agricultural productivity over the last 50 years could not have been achieved without irrigation. This highlights the substantial contribution of irrigated agriculture in world food supply. This importance is shown by the fact that irrigated agriculture is much more productive than rain-fed agriculture and contributes nearly 40 % of world food production on 17 % of cultivated land (FAO, 1996b).

Several research studies have shown that increased food production in Asia was mainly the result of the development of irrigation, accompanied by the use of a combination of high inputs and high yielding varieties, and which contributed to the realisation of the Green

Revolution. As indicated by Byerlee *et al*. (1997), past growth in grain production in irrigated areas of Asia has been achieved largely by adopting modern varieties (MVs) of rice and wheat, accompanied by intensifying the use of modem inputs and by heavy investment in irrigation. Svendsen and Vermillion (1994) averred that without the expansion in irrigated area and intensified production in existing irrigated lands, the green revolution could not have achieved the impact it had by increasing the world's food supply. Water availability, control, and management alone do not constitute sufficient factors to achieve the high gains in productivity levels achieved with the development of irrigated agriculture. Additional technological packages need to follow; as reported by FASID (2003), many African studies find that improved varieties (IVs) have recently become available and adopted by farmers and if irrigation is available, significant yield gains tend to be achieved.

The successes in Asian irrigated agriculture have certainly stimulated efforts to emulate it in Sub-Saharan Africa and particularly in the West Africa region where governments also embarked on the development of the sector. In Senegal for instance, the development of irrigation in the Senegal River basin has remained a major goal of national governments and has been supported by donor agencies (Dia *et al*., 1996). Haefele *et al*. (2002) indicated that in the Senegal River valley, 70,000 ha have been developed for irrigated agriculture, of which 60,000 ha could be used immediately without major rehabilitation costs. The policy and institutional developments relating to irrigated rice production and commercialisation in the West African region could not be done without referring to the Sahelian irrigated rice schemes and particularly to the irrigated rice infrastructure located in the Office du Niger (Mali), the Senegal River valley (Senegal), the Niger River valley, and the irrigated rice schemes in Burkina Faso. The 'Office du Niger' in Mali and the Senegal River valley are the most important ones in terms of the actual irrigated land area developed, the diversity of practices in terms of crop management and rice product commercialisation as materialised by the relatively high degree of market participation by producers.

Market participation highlights one important function that irrigated rice plays: rice commercialisation is a means of livelihood creation and improvement in the small rice communities in the Niger River valley. Rice commercialisation involves all processes undertaken by individuals or groups of producers to link farm output to consumption. It is simply defined as the activities undertaken in order to link production to consumption (Koré, 2004). These activities involve assembly, transport, processing, storage and distribution, constituting important channels of the value chain development. Depending on the commodity, the sequences of channels vary from simple to relatively complex, rendering it imperative to select the appropriate approach to investigate the processes and assess their effects on farmers' livelihoods.

As stated by Pasteur (2001), policy analysis for sustainable livelihoods consists – in addition to investigating what policies – of attempts to understand the relationship between policy and the livelihoods of poor people. The manner in which rice commercialisation is conducted by producers and traders and understanding the market characteristics (rice market structure, typology of rice traders, types of rice products, consumers' preferences) become critical elements for this function to play its livelihood-improving and economic development role in the region. This function involves several actors (both public and private) and transactions, implying the use of some level of financial resources (volumes of rice sold or purchased, transport and storage costs, processing, maintenance, and capital costs) devoted to the irrigated rice enterprise. Thus, through this process, conditions for value addition are initiated. Success also depends on several other factors, namely: how efficient is this value addition process? What are the determining factors for successful operation of rice commercialisation functions? Prior to the decision by the producer to commercialise part (or all) of his production, another equally important element is the production stage, constituting the basis or first channel of the process. This particular level of the sector remains conditional on several necessary factors (irrigable land, labour, finances, technology, water, fertilisers and other inputs, small farm tools and machinery, support services, farmers' know-how/managerial capacity). At this level, two elements come into play: high output for a given level of inputs (technical efficiency) and lower costs of production (economic efficiency). A sequential segment of the chain (intermediary stage) that needs attention is the processing of paddy rice to milled rice. This segment involves several important actors within the sector. The final stage, consumption, is also of importance and this stage is directly linked to the first three stages of production, processing, and commercialisation. Value addition, livelihood improvement, economic development and food security are among the critical elements that guided the countries' strategies to develop the irrigated rice perimeters in the West African region.

2.3 Evolution of Irrigated Rice Production infrastructure Development

Looking back at the evolution of irrigated rice infrastructure development in West Africa necessitates a review of the background to the Sahelian irrigated rice context, which is characterised by major critical issues involving the following elements: the institutional development processes of the facilities, the organisational and management set up, and the support systems in place (inputs delivery, water services, technical assistance, training, and rice commercialisation). Irrigated rice in the Sahel is cultivated on about 200,000 ha, with a potential yield of 8-9 tons/ha; average farmers' yields are significantly lower, at 4-5 tons/ha (WARDA, 1995). The expansion of the irrigated rice production base was started by the development of irrigated rice production infrastructure through important public investments which were coupled with institutional development processes. Investment in irrigated agriculture by governments and aid agencies has been very substantial in recent decades, and has been seen as an essential element in the "modernisation" of agriculture. These irrigation schemes have relied mainly on family-based farms (Bélières *et al*., 2002).

Since the early 1960s, West African countries have devoted particular attention to irrigation activities and particularly to rice irrigation. Several motives explain the development phases of irrigated agriculture in West Africa, including rural employment, income generation, food security purposes (Fraval *et al*., 2001; Abernathy *et al*., 2000; IPTRID, 2004) and also the desire to reduce rice imports (IPTRID, 2004). Depending on the countries' strategies, these objectives present some differences. In Burkina Faso, the objectives of the government for the promotion of irrigation are to achieve food self-sufficiency, ensure a dependable supply of basic agricultural products, stabilise the rural population and avoid a rural exodus through job creation and poverty alleviation (Dembele, 1998). In Mali, the Office du Niger (ON), located in the heart of Mali and created in 1930, is the oldest and largest irrigation scheme in Sub-Saharan Africa and was initially created to: 1) supply the French textile industry with a large share of its needs in cotton, and 2) significantly contribute to food security for the whole Sahelian region with a modern and commercial rice production system (World Bank, 1996). Unfortunately, due to a number of factors, the Office du Niger failed to meet all assigned objectives. As reported by World Bank (1996), in 1982, fifty years after its creation, the ON was far from meeting these objectives. The reasons for the initial failure were explained by viewing its development process. At first, and up to the 1970s, the ON was controlled by the state, but underwent significant reform in the 1980s, including the privatisation of many functions previously carried out by parastatals, and price liberalisation (Mariko *et al*., 2001). According to these authors, the reforms implemented did not have much impact on productivity in the 1980s, with yields remaining below 2.5 tons/ha, but in the 1990s efforts to restore the irrigation infrastructure, coupled with macroeconomic reforms such as market liberalisation, tax reforms and the 1994 devaluation of the CFA franc, stimulated productivity gains, with average yields reaching 4 to 5 tons/ha and aggregate production of paddy rice rising to 300,000 tonnes in 1999.

This successful rehabilitation of the 'Office du Niger' was also reported by World Bank (1996). It was stated that the overall result of the rehabilitation was an impressive turnaround between 1983 and 1994, which gave average paddy yields of 5 tons/ha that compared favourably with the Green Revolution achievements in Asia. The factors of success were twofold (World Bank, 1996): technical and institutional/economic. The technical factors included water management (as well as use of high yielding varieties, effective use of fertilisers and labour-intensive practices), availability and extension of a comprehensive package of improved technological messages (including a T & V system), and appropriate agricultural mechanisation. The institutional and economic factors include the liberalisation of paddy marketing and processing, land tenure security, access road construction, institutional reforms and new partnership with farmers. These reasons certainly constituted the foundation of the success of ON, echoed in several instances. In fact, the 'Office du Niger in Mali' is regarded as one of the rare success stories of irrigated rice farming in West Africa, and it is therefore worth exploring its history and development (Kater *et al*., 2000).

In the case of Niger, the irrigated rice infrastructures are mostly located in the Niger River valley of western Niger. The majority of them have been designed on the assumption that rice was be the dominant crop, and in most cases, the only crop (Abernathy *et al*., 2000). The reason behind the development of the irrigated facilities for rice production in Niger was the development and intensification of irrigated agriculture and this constitutes a major element of the Nigerien government's policies to achieve national food security, poverty alleviation, rural labour employment and rural sector infrastructure development. Chetima and Mossi (1998) noted that in order to compensate for the rainfall deficit and guarantee a minimum food security, Niger has been readjusting its agricultural policy since the 1970s and decided to transform the irrigated component of its agriculture into a priority axis for the reinforcement of food security. It was estimated that more than 120 billion CFA were invested for the construction of the irrigated perimeters before franc FCFA devaluation with support of donors among which the FED, European Fund for Development (Djido, 2004). These irrigated perimeters were mostly constructed during the 1970s and 1980s and are considered among the most expensive in the West Africa region (Randolph *et al*., 1995). But in other non-Sahelian countries, irrigated rice underwent different development processes. For example, irrigated rice cultivation in Nigeria has a long history dating back to the colonial era, but it was not until the droughts of the early-to-mid 1970s that concerted efforts were made to spur irrigation development in the country (Kebbeh *et al*., 2003). Musa (1997) cited by Kebbeh *et al*. (2003) indicated that a substantial government investment of more than US $ 200 million was put into irrigation development between 1976 and 1990.

From this, it can clearly be understood that the irrigated perimeter policy underwent several stages: 1) an initial development stage which concerned the introduction of irrigation as a new and modern technology in an environment where communities are not well familiar with irrigation practices; 2) the second phase is mostly the rehabilitation phase which consisted of rebuilding the infrastructure so as to let them constitute an appropriate physical operating system (irrigation canals, reorganisation, etc.); 3) introduction of new production technologies (better varieties and better crop management practices), introduction of mineral fertiliser use, and 4) finally changes in irrigation systems management. This latter has evolved as irrigation management turnover also known as transfer of irrigation management services or transfer of services in the water sector to groups of farmers or schemes' users. All these stages of development of irrigated systems have been subject to substantial research activities and studies around the world.

2.4 Policy and Institutional Development

The irrigated rice perimeters evolved from heavy state involvement in management of the schemes to a stage in which users are much more involved in the operation and management of the facilities. This gradual process is called irrigation management transfer and was the focus of a large body of literature that reported diverse experiences in both Asian and African contexts (FAO, 1999a; Frederiksen and Vissia, 1998; Svendsen and Vermillion, 1994). The transfer of management of the irrigated systems came as a transitional phase in the development process of the irrigation systems, mostly as a problem solving strategy to ensure more involvement in systems' operation and organisation by systems users or beneficiaries. It has attracted particular interest from donors and farmers' organisations operating in the irrigated systems as an opportunity for these water users' associations to take control of the system operations. The international workshop on 'gestion paysanne des perimeters irrigues' held in Ouagadougou in Burkina Faso in September 1996 gathered several research scholars, extension workers and practitioners and farmers to debate the issue. However, Samad and Vermillion (1999) have shown that irrigation management transfer alone did not on its own bring about significant improvements in the quality of irrigation or agricultural productivity levels, but that improvements in agricultural productivity were noted in schemes where both management transfer and physical rehabilitation had occurred.

The management of the schemes in the Sahelian countries is done collectively by cooperatives. The cooperative or systems' management bodies assist farmers or groups of farmers with the distribution of inputs, mostly fertiliser, herbicides and pesticides and with rice marketing. Inputs are distributed to farmers on a seasonal loan basis to be reimbursed generally after one cropping season but in a number of cases loans are carried over other seasons due to lack of payment. This difficulty in the management of irrigated schemes was reported by Kormawa and Touré (2004). Water distribution is also made through a management committee which is also in charge of the operation and maintenance of the hydraulic infrastructure. The cooperatives' functions include water delivery service, agricultural production planning, inputs delivery service, and agricultural product marketing. For example, in Burkina Faso, the government delivers its support through a parastatal organisation, ONBAH (National Organisation for Dams and Agro-Hydraulic Facilities) and other decentralised irrigation agencies, but since 1982, self-management of irrigated areas has been an important component of the government's irrigation development strategy (Dembele, 1998). Compaoré (1998) noted that this experience of transferring management responsibilities to farmers' organisations really started in 1993 in Burkina Faso in the Sourou River valley and has undergone a number of crises that were however necessary in order to reach the targeted objective which was the creation of a new generation of farmers with an entrepreneurial spirit and who are capable of mastering an intensive production system conducive to a decent standard of living. In the case of Niger, the development of irrigation on a large scale along the Niger river valley is the result of a relatively recent political and economic option in Niger that reaffirms the national will to mobilise and to exploit the country's water resources in order to achieve food security (Assahaba, 1998). Efforts were also developed towards the promotion of private irrigation. In addition to the high investments in public irrigated agriculture infrastructure, the government of Niger has taken the decision to commit itself to the promotion of private irrigation through a World Bank funded project (Diallo, 1998).

2.5 Performance of Irrigated Rice Perimeters

Review of the evolution of irrigated rice infrastructure development indicates that major critical issues evolved around the following elements: 1) technical aspects relating to both agronomic performance and irrigation infrastructure maintenance, 2) socio-economic aspects relating to profitability of the various crop enterprises practiced, financial viability of the management bodies of the systems, sustainability of the overall system, and 3) economic efficiency of the rice sector. Performance refers to whether an irrigation system is achieving its objectives or meeting the users' expectations (Merrey, 1996). As discussed earlier, primary objectives of irrigated rice perimeters involve food security, poverty alleviation, and rural labour employment for the benefit of the farm communities that operate within these systems. Thus, performance of the irrigated systems could be measured from several perspectives: financial, irrigation management and agricultural productivity levels (Samad and Vermillion, 1999). The interrelation among these objectives highlights the high interactivity existing between the decision-making processes of the farm households to reach these objectives. As stated by Sakthivadivel *et al*. (1999), many variables influence the performance of irrigated agriculture and these are: infrastructure design, management, climatic conditions, price, availability of inputs and socio-economic settings. They pointed that this influence among variables makes the comparison of performances across systems difficult. Haefele *et al*. (2003) also found that a multitude of factors influence the performance of irrigated rice systems in the Sahel. Among the factors reported are the available technologies or recommendations (optimal timing of fertiliser applications or timely harvest), imperfect farmers' knowledge of existing recommendations and the supply and the accessibility of agricultural inputs (quality seed and fertiliser).

The research paper by Rao (1993) relating to the review of selected literature on indicators of irrigation performance provides a set of performance indicators which relate to: 1) water delivery systems, 2) irrigated agriculture systems, 3) agricultural economic systems, and 4) other indicators (social criteria, sustainability, and systemic descriptors and process indicators). The economic indicators provided include: gross revenue from crop production, gross value added, net income for farmers, and average labour productivity.

In collaboration with several technical partners and donors, IPTRID conducted a project entitled "Identification and Dissemination of Good Practices in Irrigated Schemes in West Africa", which aimed to provide an overall view of rice production in West Africa. The study was carried out over one to three cropping seasons on twelve irrigated schemes in five West African countries (Burkina Faso, Mali, Mauritania, Niger and Senegal). The objectives included the identification, characterisation and evaluation of practices, and the dissemination of good practices (IPTRID, 2004). The results documented in the final project report stated that the conclusion is in contrast to the pessimistic view of irrigated agriculture in Sahelian Africa. Furthermore, they found that average economic and hydraulic results were encouraging even though farmers' skills in hydraulics remain insufficient to achieve efficient, productive and sustainable irrigation (IPTRID, 2004). Results of the comprehensive study stated overall that while the financial sustainability of these schemes is rarely ensured, irrigated agriculture activities can under certain conditions be financially viable and that irrigation improves family food security with a minimum yield. These results indicate that irrigated rice performance indicators imply several dimensions: technical, economic, social, and institutional. In the West African context, the International Water Management Institute (IWMI) also contributed to understanding the West African irrigated perimeters operation, management, and the determinants of these performances.

2.6 Technical aspects relating to agronomic performance and water management

Major research achievements include early research results relating to the development of the irrigated rice perimeters as well as diagnostic and decision tools with regards to water management (Legoupil *et al.*, 1998 ; Hundertmark and Touré, 2003; IPTRID, 2004); crop planting and management tools development known as RIDEV and ORYZA-S. ORYZA-S and RIDEV were developed by Africa Rice Centre (AfricaRice) ex WARDA/ADRAO for the Sahelian and Sudanese savanna agro-ecological regions of West Africa; in these models, yield gaps were determined as the difference between actual farmers' yield and simulated potential yield (Haefele *et al.*, 2003). Extension staff in Senegal and Mauritania already use RIDEV to advise irrigated rice farmers (Wopereis *et al.*, 1999). RIDEV is the result of research work conducted in the Senegal River valley by Africa Rice Centre (AfricaRice) ex WARDA/ADRAO in collaboration with various partners (SAED and ISRA). Due to the fact that irrigated rice makes intensive use of water resources, which is a highly critical issue in the Sahelian context, researchers devoted substantial energy and resources to improve water use efficiency at system levels. As stated by Nijman (1991), irrigation water management is considered the primary irrigation activity and this management perspective requires the combination of irrigation engineering and management science.

With respect to the technical aspects of the irrigated rice perimeters, a substantial part of the research put emphasis on agronomic practices and varietal improvement and adaptation to irrigated rice conditions. The major issues of concern included the yield differential between actual and potential yields, soil fertility and nutrient management, soil degradation (salinity) and other constraints such as drought, cold, diseases, and pest management. Yield gaps were determined as the difference between actual farmers' yield and simulated potential yield (Haefele *et al.*, 2003). Since the irrigated perimeters' conditions vary within and across perimeters, for example in the Senegal River valley, this variability impacts on rice productivity. Production in irrigated rice systems is characterised by large variability in productivity, management practices and production constraints (Becker and Johnson, 1999) and consequently the quantification of the variability in rice yield and the identification of its determining factors are prerequisites to the development of site-specific recommendations and to improved targeting of technologies. Becker and Johnson (1999) found that age of seedlings at transplanting, timeliness of operations and application of P fertiliser were correlated to yield and explained 60 % of the observed variability, while grain yield was correlated with N uptake but not with N application rate. Furthermore, they found that while improved water management was associated with substantial rice yield increases, the timeliness of transplanting, weeding and N fertilisation appear to be the key to increased rice yields in the forest zone of West Africa. Becker *et al*. (2003) made an analysis of the rice yield gaps in irrigated systems along an agro-ecological gradient in West Africa by conducting on-farm trials on 191 irrigated lowland fields in the humid forest, the savanna and the Sahel. They found that improved weed control is likely to have the highest pay-off in the Sahel, while improved management of fertiliser N was most beneficial in the forest and savanna environments. Other important studies focused on issues relating to socio-economic aspects of the irrigated rice, yield gap analysis, and nutrient use efficiency in the Sahel. Wopereis *et al*. (1999) analysed agronomic factors contributing to farmers' fertiliser-use efficiency and productivity, given current farmer practices in three different irrigated rice systems in West Africa (Senegal, Mali, and

Burkina Faso). The results were very informative as a contributing research work in the yield gaps issue. These authors found that the yield gap between actual farmers' yield and simulated potential or maximum attainable farmers' yield ranged from 0.6 to 5.7 tons/ha in Burkina Faso, 1.8 to 8.2 tons/ha in Senegal, 0.3 to 6.3 tons/ha at the Office du Niger in Mali, to 0.8 to 5.7 tons/ha in Senegal, indicating considerable scope for improved yields. The reasons are variable, depending on the situation in the irrigated systems regarding the timing of nitrogen fertiliser applications, transplanting of relatively old (>40 days) seedlings, unreliable irrigation water supplies, delayed start of the growing season, weed problems, and late harvesting. Haefele *et al*. (2003) used combined socio-economic and agronomic surveys conducted with a group of irrigated rice farmers in Northern Senegal River valley. They concluded that if farmers are given better access to information, improved rice technologies, inputs and decision making, rice production on irrigated land in West Africa may leap forward rapidly, as potential production gains are still large. They found yield gaps ranging between 0 and 4.3 tons/ha. Soil fertility management and fertiliser use in irrigated rice systems were also investigated (Donovan *et al*., 1999). A major conclusion made in their study is that a value/cost ratio of 1.5:2.0 was considered desirable for farmer adoption under West African conditions. Major conclusions of the study stated that overall, agronomic efficiency and profitability were strongly related and that farmers with high nitrogen-use efficiency also had high net returns to fertiliser use.

2.7 Socio-economic aspects relating to profitability of the various crop enterprises

Profitability analysis of irrigated rice activity conducted has shown various results depending on irrigated rice type. A summary of performance findings obtained for the Niger River valley irrigated systems (Abernathy *et al.*, 2000) showed that performances differ among the various systems studied in this part of Niger. The findings indicate that in normal years, without severe flood or drought events, annual production values of 900,000 to 1,000,000 FCFA per developed hectare are achieved at the Saga and Tillakaina irrigated schemes; 750,000 to 800,000 FCFA at the Kourani-Baria II irrigated scheme, and 650,000 to 700,000 FCFA at Kourani-Baria I. These are valued at the post-devaluation price levels of 1995, according to the authors. This shows the costs involved in irrigated agricultural activity and highlights the importance of credit availability for resource-poor farmers to enable them to perform their field activities on a timely basis.

Mariko *et al*. (2001) used pre-devaluation and post-devaluation crop budget data to analyse irrigated rice profitability and productivity for several farms operating in the Office du Niger region. The sample of farms was subdivided between small, medium and large sized farms and they also distinguished among rehabilitated and non-rehabilitated zones. This was done in order to take into account differences in resource levels such as labour, animal traction, credit, etc. The studies concluded that prices and market competitiveness were good incentives to explain the described strategies of farmers and that after the devaluation of the CFA franc local rice became more competitive in the Bamako market as compared to imported rice. It can be noticed that in the Office du Niger financial indicators are not the same when distinguishing between the pre- and post-devaluation eras and rehabilitated and non-rehabilitated zones. Recent findings from a comparative study of several irrigated rice perimeters in three West African countries (Burkina Faso, Mali, and Niger) concluded that the irrigated rice schemes' performances vary across countries and schemes type (Kormawa *et al.,* 2005). This study proposes that recommendations on irrigated rice production in West Africa should be specific on the type of energy source, the institutional arrangements in place for farmers within the scheme, and access to markets.

With regard to rice sector efficiency, studies using DRC (domestic resource cost ratio) were conducted to assess the comparative advantage of the rice activity. The decreasing trend of the DRC ratios over time in various countries indicates an overall enhancement of the competitiveness of the rice economy (Lançon, 2001a); the improvement of the DRC is related to several factors, such as the level of technology, post-harvest and processing technologies, location and targeted market.

2.8 Irrigated Rice Development in Niger, Food Security, and Rice Commercialization

Rice potential, policy developments, commercialisation and competitiveness in Niger have been the subject of a body of literature (Randolph *et al.*, 1995; Koré, 2004; Koré, 2005;

Boukar *et al*., 2002; Djido, 2004; Dioffo *et al*., 2006; Mahaman, 2004; Morou, 1989; Sido *et al*., 2005). Nigerien rice production mainly occurs under irrigation, and the government has devoted substantial investments to developing irrigation infrastructure. From 1974 to 1994, the irrigated rice area expanded from a low of 2,036 ha to a maximum of 8,431 ha (Koré, 2005; Mahaman, 2004). The various rice-growing systems in Niger include the traditional rice production system, private rice irrigation, and the full water control system (Djido, 2004; Mahaman, 2004; Hassane, 2008). The literature reports various figures with regard to the actual areas covered by these systems; the irrigable potential also varies but is estimated at a total of 270,000 hectares (Djido, 2004). This author reported a cultivable rice area of about of 24,000 ha essentially located in the Niger River valley of western Niger.

In terms of total agricultural production, rice production occupies a secondary place compared to total cereal production (Koré, 2005). Niger annually produces an average of 70,000 tonnes, constituting one third of the national rice demand, estimated at 200,000 tonnes per year. The value of the national production is estimated at 5 to 7 billion FCFA per year (Koré, 2005; Mahaman, 2004). About 86 % of the Nigerien population eats rice. The rice area represents 0.25 % of the 5.1 million hectares of total cultivated land in Niger. In terms of irrigated crops, rice occupies second place after onions. Rice represents 29 % of irrigated crops in Niger. This implies important, as yet underexploited, potential for irrigated rice. Rice policy development in Niger has included several phases. Most elements of importance were related to rice production infrastructure development (1976-1985), reforms undertaken within the structural adjustments policy (1984-1985), capacity development policy and research, rice commercialisation and credit policy, and rice sector protection (Koré, 2005).

Boukar *et al*. (2002) identified two main phases in local rice commercialisation. The first phase involved the marketing of paddy rice mainly by the cooperatives, the managing bodies of the irrigated rice perimeters. Rice producers exploiting these perimeters use a proportion of their paddy rice, which could reach up to 45 %, to make in-kind payment for water users' fees. The second phase in local rice commercialisation relates to local milled rice marketing. Previous studies conducted on rice commercialisation in Niger (Koré, 2004) identified three main rice marketing channels, one of which is a formal (official) marketing system; the remaining two are private – formal and informal. The actors within the chain of the formal rice marketing channel are the producers, cooperatives, the large public rice millers, stores, rice retailers, and consumers. The private formal rice marketing channel is composed of producers, the cooperatives, the artisanal rice dehullers, rice wholesalers, rice traders, and consumers. The third rice marketing channel is an informal private channel which trades in local parboiled rice and is composed of actors such as wholesalers of local rice, rice retailers, artisanal dehullers, retailers, and consumers. This last channel is said to attract low and irregular quantities of rice due to its low financial capacity. But the private channels contribute to boosting the supply to the markets of local rice products. Koré (2004) indicated that these rice marketing channels exhibit some deficiencies that reduce their performance. The national support programme for rice sector development (called PAFRIZ) organised a national forum on the rice sector in Niger. The main conclusions of this forum relating to rice commercialisation deficiencies were that five major problems hinder the performance of these activities: 1) a flow of imported rice that inundated local markets, 2) the absence of a suitable credit system, 3) the non-existence of sustainable rice commercialisation channels, 4) the lack of an adequate marketing and lobbying system, and 5) high costs of local rice production.

A recent study conducted by Touré *et al*. (2008) on “Rice Commercialization Case Studies from Western Niger” reported that the main features of the rural rice markets surveyed are that the majority of the rice traders are women rice retailers who mostly run their businesses as private ventures started with own capital. The main supply source is the village paddy rice producers. Generally, the product is sold in the form of parboiled or milled rice in the village market or weekly markets. Another feature of the rural rice market is that there are seasonal paddy price variations, which in turn are reflected in the prices of processed rice. A market structure characterised by these main features (dominant rice retailers, low sales volumes, and seasonal price variations) make the market quite unreliable to efficiently meet the demand. However, rice marketing margins are positive for all rice products, meaning that the activity is profitable. The sales indices are variables from one producer to another one and from one locality to another one. Several factors could explain the variable sales volumes: farm household production conditions (production level, production orientation, and farm characteristics), market environment, and particularly the seasonality induced by paddy price variations, which affect the price of milled rice. Thus, the seasonal paddy price variation and the volume of rice marketed constitute factors that influence rice commercialisation activity. The variations in paddy prices over time and across sites imply different degrees of rice marketing activities, but these also reflect varying degrees of household production activities. Touré *et al*. (2008) also reported that the sources of supply (purchase points) are diverse, implying diverse form of rice transactions. Semi-wholesalers and wholesalers can supply other rice traders' categories in rice but the retailers can also supply rice to other rice retailers. Mostly, rice traders purchase their rice in the village (40 %) and from weekly rice markets (32 %). Transactions originating from the village imply that individual forms of arrangement exist between individual rice producers and rice traders (mostly women rice traders).

Table 2.1: General Characteristics of Rice Traders in the Survey Areas

Characteristics	Frequency	Percent
Category of rice Traders		
Wholesale	6	12
Semi-wholesale	14	28
Retail	30	60
Total	50	100
Education level		
None	37	74
Primary	5	10
Junior High School	2	4
Koranic Studies	4	8
Others	2	4
Total	50	100
Start up Initial Capital		
own funds	31	62
financial assistance	10	20
Micro finance house	2	4
Other	7	14
Total	50	100
Ownership of sales point		
Owner	30	60
Tenant	11	22
Relative to owner	8	16
Total	49	98
NA*	1	2
Total	50	100

Source: Touré A. Ali, H. Kore, I. Bamba. 2008.
*NA: Not available

2.9 AfricaRice's strategic Role in Enhancing Irrigated Rice Productivity

Africa Rice Centre (AfricaRice) ex WARDA/ADRAO devoted a substantial part of resources on research and development activities, focusing on irrigated rice in the Sahel. Since 1997, interest was given to the irrigated rice in the savanna and forest. Through a solid partnership with the national agricultural research systems (NARS) of the member countries, AfricaRice's major contribution in irrigated rice include several aspects encompassing the development of high yielding improved varieties with improved crop and inputs management practices but also the development of improved thresher-harvesters (ASI). AfricaRice has also played a critical role in generating a knowledge base relating to the effects of institutional and policy arrangements on irrigated rice production and commercialisation. AfricaRice developed strong partnerships through multi-country policy studies in order to contribute to the formulation of a conducive policy environment for the development of the rice sector as a whole. Several training sessions for the benefit of NARS partners were also organised as part of capacity building in improved agronomic practices. Irrigated rice varieties were developed: Sahel 108, Sahel 201 and Sahel 202 were all disseminated in the Senegal River valley and irrigated rice perimeters in Mauritania. These varieties, released in the Sahel in 1994, show a 10% yield advantage over popularly grown varieties. WITA irrigated rice varieties were released in Cote d' Ivoire, Niger, and Nigeria. Countries cultivate in common improved rice varieties, which is due to the efforts of regional collaborative research activities between AfricaRice and national agricultural research systems (NARS). Regional collaborative research activities are geared mostly through the breeding task force.

AfricaRice has also worked on sustainability issues (soil fertility, alkalinity, salinity). Moreover, AfricaRice has conducted activities relating to integrated rice management (IRM), focusing on the need to bridge yield gaps and to increase cropping intensity. As reported by Wopereis *et al*. (2007), the outcome of the yield gap surveys, the encouraging results on the test plots and the stimulating debates in farmers' fields stimulated AfricaRice ex WARDA/ADRAO scientists to develop a set of integrated rice management (IRM) options that encompass the entire rice growth cycle, from the initial planning phase to the harvest and post-harvest stages. According to these authors, the IRM is based on agro-ecological principles and holistic thinking; new practices are complementary and not necessary alternatives to conventional management.

The focus is now moving towards water use efficiency, improving grain quality and value chain research activities, besides work on varietal development.

2.10 Chapter summary

The chapter made an in-depth review of the irrigated rice policy developments in West Africa with a focus on understanding the various policy developments and their rationale. The irrigated rice production facilities were developed by countries in order to secure agricultural production through adequate water supply, control, and management. In investing in irrigated agriculture, particularly irrigated rice, governments and donor agencies have set forth three major objectives: contribution to food security, income generation and diversification, and rural labour employment. The expansion of the irrigated rice production base started with the development of irrigated rice production infrastructure through important public investments which were coupled with institutional development processes. In the West Africa region, the major irrigated rice schemes (*Office du Niger* in Mali and Senegal River Valley) have shown that irrigated rice schemes perform well and contribute substantially to farmers' livelihoods. The performance indicators imply several dimensions: technical, economic, social, and institutional. Research outputs and institutional changes in terms of the schemes management and governance have contributed to the observed performance. Additional efforts in terms of market development and rice commercialization need however to be done.

CHAPTER 3: TRADE POLICY MEASURES AND COMPETITIVENESS OF IRRIGATED RICE PRODUCTION SYSTEMS

3.1 Introduction

Recent world price hikes for imported milled rice clearly 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. Certainly, such endeavours should aim at viewing the problem in a holistic manner – from farm to consumption – but most observers are urging that, as a pre-requisite, 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 related costs, is viewed as the principal candidate with regard to production cost issues. The strategies adopted by various countries have focused on research and technology transfer related activities, technical assistance to rice producers, and various institutional arrangements to promote rice sector stakeholders linkages and effective services delivery. As the sector's farm-level profitability alone could not justify the investments devoted to irrigated rice, it was also found necessary to study its efficiency in order to analyse the sector's overall competitiveness and to assess various policy outcomes. 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 differently affect the various channels of the sector (production, processing, distribution, consumption, and trade) and the economic agents operating in those segments. The potential effects of the implementation of trade policy measures need to be well investigated in order to identify their impact on production incentives and economic efficiency. This chapter reviewed agricultural trade policy measures with a focus on the effects of agricultural trade distorting measures and customs tariffs on agricultural performance. This section supplied some definitions of trade policy measures, their intended objectives and effects, and the tools to measure policy effects. Thereafter, a few examples of competitiveness studies of irrigated rice production systems and their related methodologies were reviewed. The chapter concluded with the major issues at stake with regard to irrigated rice competitiveness.

3.2 Trade Policy Measures, Economic Efficiency, and Comparative Advantage

3.2.1. Definition of concepts

Trade policy measures, economic efficiency, and comparative advantage have been investigated by numerous economists in order to contribute to a clearer understanding of the concepts but also to create a solid basis for explaining agricultural trade developments between countries. Before getting to the trade policy instruments and their effects, it would be good to define the concepts and the different types of policies used by government to introduce changes in the overall economy. The FAO (1999b) defines trade policy as all policy measures which set the conditions for the movements of goods, services and capital across country borders. Policies themselves are the instruments that governments can use to change economic outcomes (Pearson *et al*., 2003). Therefore, from these two definitions, one can state that trade policies are the instruments that governments can use to influence, and which set the conditions for the movements of goods, services and capital across country borders in order to change economic outcomes. Several trade policy instruments are used by governments to induce changes for purposes of the economic management of a specific economic sector. Their implementation involves some level of interaction between a country's economy and the rest of the world. This is to say that, depending on the trade policy instrument, various economic agents operating in the sector of interest could be involved. Hence, the policy measures are varied and include instruments such as import tariffs, export subsidies and a host of different government payments to farmers. Many of these policies share the common feature that they transfer money to farmers, and thereby impact on production decisions, incomes, international trade and the environment (OECD, 2004). In sum, typical trade policies are: tariffs, non-tariff barriers, and regulations concerning capital exports and imports. The tariffs include *ad valorem* and non-*ad valorem* import and export taxes or subsidies. Non-tariff barriers most commonly used are: quotas, subsidy regime, standards – health, safety and environment (Adhikari, 2005). Norton (2005: 21) indicated that the divisions among the classes of policies are not cut and dried. In addition, their implementation can have wide-ranging effects on the economy, the environment and society (UNEP, 2001). This means that the use of a particular instrument with an intended objective could have a spillover effect and affect other economic agents.

3.2.2 Principal categories of policies affecting agriculture and related impacts

National governments are adopting numerous and diverse policy instruments to restrict international trade, to control or modify the quality of imported products, or to guarantee domestic objectives such as specific price levels for either consumers or producers (Bouet, 2008). These constitute the trade policy instruments applicable to all sectors within which a country can make a choice in order to reach certain objectives. In terms of agriculture, three principal categories of policies are used to bring about change: 1) agricultural price policies, 2) macro-economic policies (fiscal, monetary, exchange-rate and the domestic factors policies), and 3) public investment policies (Pearson *et al*., 2003). The domestic factors include wages, interest rates, natural resource, and land use. These instruments are used by governments within national food and agriculture frameworks in order to reach some predefined objectives by inducing some changes (impacts) on a variety of economic variables. As discussed in Pearson *et al*. (2003), all agricultural price policy instruments create transfers either to or from the producers or consumers of the affected commodity and the government budget and these include taxes and subsidies, international trade restrictions, and direct controls. The macro-economic policies influence the level of economic activity and the rate of price inflation in the national economy, with foreign exchange rate policies directly affecting agricultural prices and costs while factor price policies directly affect agricultural costs of production. The key economic and agribusiness variables on which major impacts of policies can be traced are: government revenue and expenditures, inflation, agribusiness investments and output, agricultural exports, agribusiness employment, domestic competition, and agribusiness productivity (Ender, 2002). However, in the pursuit of specific objectives through the implementation of a particular trade policy instrument, specific or chain effects may be observed, i.e. a spillover effect which may impact on other economic variables. Such a situation is observed in the case of agricultural production where a commodity chain involves several actors, each pursuing the satisfaction of a certain utility (household consumption, income generation and diversification). This highlights the direct link between governments' undertakings in the various spheres of the economy and the choice of a particular policy instrument.

Governments intervene in agricultural trade by means of direct and indirect instruments and with various objectives (FAO, 2000). The objectives are varied and range from raising tax revenue, supporting producers' incomes, reducing consumers' food costs, attaining self-sufficiency and countering interventions from other countries. Rice, as an agricultural commodity, which is a traded good world wide, constitutes a good example illustrating this situation because the sector, as an economic activity, interacts with the country's overall economy (food security, national economic development strategies, and local agro-industries) and also exchanges with the rest of world's economy by making use of outputs generated by other countries' economies. These processes or exchanges are the economic dynamics that induce a movement or transformation of resources (or services) between agricultural activities and other parts of the country's economy (or international markets), highlighting the linkages between agriculture and trade policies. These linkages affect the performance of the agricultural sector by offering economic incentives to producers or by generating some market distortions. Most distortions to industries producing tradables come from trade measures, such as a tariff imposed on the CIF import price or an export subsidy imposed on the FOB price at the country's border (Anderson *et al*., 2007). A distortion can be defined as something that governments impose to create a gap between the marginal social return to a seller and the marginal social cost to a buyer in a transaction (Anderson, 2006a) and consequently, a distorting policy, implemented to further non-efficiency objectives (equity or security), prevents the most efficient allocation of resources and thus creates divergences (Pearson *et al*., 2003). In other words, the implementation of specific trade policies implies various interlinks between other macro-economic policy spheres, the agricultural sector, and the rest of world, rendering it necessary to understand trade-related policies; this explains the great degree of interest and literature with regards to the subject. As reported by Anderson (2006a), the total effect of distortions on the agricultural sector will depend not just on the size of the direct agricultural policy measures, but also on the magnitude of distortions generated by policy measures in other sectors and it requires an economy-wide view to estimate the size of distortions in agriculture relative to those in other sectors, such as those resulting from industrial import tariffs and non-tariff barriers. There is consequently a need to distinguish between direct distortions to agricultural incentives and indirect ones.

3.2.3 Trade policy measurement

This literature is rich in its diversity and its substantial contribution to better understanding the concept itself and particularly its impact on a variety of aspects with respect to agricultural trade development. Enormous progress has been made in the past two decades in using economy-wide models to estimate the economic effects of past and prospective trade-related policy regimes (Anderson, 2006b). Major concerns involved the policy distortions and the structure of economic incentives considered as direct outcomes of the implementation of trade-related policies; these have attracted the attention of numerous economists and scholars who have invested great efforts in the development of analytical tools, ranging from simple to highly complex and sophisticated, for trade policy measurement. As stated by Masters (2003), recent decades have seen dramatic improvements in economic modelling and policy analysis and with increasingly detailed data and increasingly sophisticated model structures; economists have developed increasingly precise analyses of a wide range of phenomena. The precision in the analyses of potential policy impact is materialised by the rich and extensive literature on the subject and refinement of the various policy impact indicators (Tongeren *et al*., 2001; Warr, 2001; Anderson, 2003; Anderson, 2006b; Masters, 2003). Anderson (2003) made a detailed review and analysis of the measurement of the effects of trade policy distortions; distortions which can be due to taxes or subsidies on imports or exports, or quantitative restrictions on trade volumes (including trade bans) or values, interventions in foreign exchange markets, and by several domestic interventions such as output, input and factor taxes and subsidies. This implies that the trade policies alter domestic prices and quantities of the targeted agricultural commodity. However, the most common trade distortionary measure and certainly the one most studied by international economists is the import tax known commonly as the tariff (Anderson, 2003); such a tariff on imports is the equivalent of a production subsidy and a consumption tax expressed as a percentage of the border price (Anderson, 2006a; Anderson *et al*., 2007). The end results are that advances are made on how to accurately measure the indicators of tariffs or extent of protection. These measurements evolved starting from the concept of effective rate of protection which was developed and popularised in the 1960s by various authors such as Corden, Johnson, and Balassa (Anderson, 2003; Masters, 2003). More specifically, in the review of the measurement of the effects of trade policy, Anderson (2003; 2005) revealed several measurement indicators: aggregate tariff level indicators, intra-sectoral resource re-allocation indicators (the effective rate of protection), indicators of consumer price distortions, trade restrictiveness indicators, indicators of the extent of non-tariff trade barriers, and indicators of the extent of indirect protection via exchange rate distortions. Thus, the protection measures introduce some forms of distortions that can affect the normal functioning of the markets in terms of pricing efficiency and affect the structure of incentives of the different economic agents. Furthermore, the protection measures have an associated cost which refers to the losses imposed by all policy-induced distortions directly affecting the tradable-producing sectors of the economy (Anderson, 2003).

In summary, it appears that in trade-related policies analysis, several issues have been found to be of great importance including the definition of the concepts, the analytical tools and indicators, and the determination of the associated cost. Moreover, the understanding of the transmission channel of a policy reform is an important element in the approach for impact analysis (Paternostro and Beddies, 2002). However, an adequate representation of policy instruments is essential in applied trade models, with tariffs and quantitative restrictions such as quotas constituting two important types of trade policy instruments (Tongeren *et al*., 2000). In their paper, which made a detailed review and assessment of global models applied to agricultural and trade policies, Tongeren *et al*. (2001) provided a comparative assessment of alternative modelling approaches, considering a total of 16 partial equilibrium and general equilibrium models. Thus, the modelling exercise of an agricultural sector could be complex and highly demanding in terms of data requirements. For such a situation, Bouet (2008) indicated that partial equilibrium models are highly appropriate for analysing complex instruments such as policy instruments aiming at restricting international trade, to control or modify the quality of imported products or to guarantee domestic objectives (such as specific price levels for either consumers or producers). Simple alternative models do exist, such as the policy analysis matrix (PAM), which can be a useful tool to evaluate impacts of trade policy instruments such as tariffs. However, aspects relating to income distribution, public revenue and the impact of taxes or subsidies on production and consumption are not evaluated by tools such as the PAM (Croppenstedt *et al*., 2007). This implies that PAM is a static, not a dynamic model. Modelling policy instruments in global models can take two forms (Tongeren *et al*., 2001). The first consists of developing a direct structural representation of the policy instruments through the incorporation of its mechanisms. The second approach is more indirect and measures the policy-induced distortions through a price-transmission (policy-response) relationship linking international and domestic prices. Warr (2001) used an empirically based, applied general equilibrium model to study the welfare and distributional effects of an export tax, demonstrating that a general equilibrium model can be used to find the optimal value of a tax or subsidy. For the particular case of rice, the approaches to quantitative analysis of policy reform typically involve a partial equilibrium (PE) or computable general equilibrium (CGE) approach, or variants of these, such as those that relax the assumption of perfect competition (FAO technical note N.12).

3.2.4 Customs unions and irrigated rice production activities

In the pursuit of common objectives, several countries may form a customs union. In a customs union, members adopt a common tariff against imports from the rest of the world in addition to eliminating tariff barriers among themselves (FAO, 2003b). The relationship of the irrigated sector with trade policy is outlined by several factors including the use of traded goods – particularly inputs and small agricultural machinery and post-harvest technologies that are used in the production processes. Thus, the key elements of focus are the import regime of these traded goods, i.e. the import tariffs that are applied. Another factor through which the irrigated sector interacts with trade policy is through rice imports; imported rice is the competitive good. The trade policy measure's interaction with the 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. Secondly, 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. Prevailing input and output prices reflect the context of the country's macro policy realm pertaining to the irrigated rice sector in general and its agricultural policy in particular. 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.

The West African Economic and Monetary Union (WAEMU) was created in 1994 and is located in Ouagadougou, Burkina Faso. Its member countries include Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo. After the devaluation of the CFA Franc in 1994, emphasis has been put on sound macroeconomic management (World Bank, 2006). A customs union was established in 2000 with a common external tariff (CET). In January 2001, the member countries adopted a common agricultural policy framework. The customs duties applied by these countries are formulated within the framework of the common external tariffs (CET) which entailed a substantial reduction in border tariffs (FAO, 2003b). Under CET, milled rice imports from third countries are subject to a 10 percent import duty and various fees of 2 % (statistical tax and solidarity tax). The common external tariff and other duties are applicable to CIF value. Irrigated rice production uses various inputs, both traded and non-traded, which are affected by CET, which also contains other tariffs that relate to these traded inputs employed in domestic rice production.

Improving local rice production capacity is an important and key element in the agenda for most WAEMU countries as shown by the recent agricultural commodities studies commissioned by WAEMU and which have identified rice as a priority crop for which the member countries should develop special efforts to further its performance (UEMOA, 2005). There are several reasons for this drive: 1) the important quantities of rice imports that constitute a burden for the countries' financial resources, 2) the relatively significant contribution of the commodity to national food security programmes, 3) income generation for smallholder farm communities, and 4) revealed contribution to the improvement of nutritional status. Rice is a crop that evolves within a socio-economic and highly competitive environment at both national and international levels and for these reasons the strategies to reach these important objectives differ from country to country. While putting the emphasis on rice research, some countries attempt to put in place various forms of institutional arrangements and policy frameworks. Tracing the effects of the customs union tariffs on the competitiveness of irrigated rice production and the economic incentives for irrigated rice producers implies conducting an assessment of their impact on the performance of the rice sector.

3.2.5 Framework for analysing economic efficiency and comparative advantage

The notion of comparative advantage has been investigated in relation to development policy (Chenery, 1961) and to its application to developing agriculture (Goldin, 1990). Although many of the key principles relating to comparative advantage are as old as economics itself, the principles have been strengthened by recent challenges (Masters, 1995). As stated by Goldin (1990), the notion of comparative advantage as a determinant of international trade was popularised by Ricardo and reading the literature on comparative advantage reveals the continuity of theoretical development from Ricardo via Mill and Marshall to Hecksher, Ohlin and Samuelson. The recent challenges that prompted many countries to undertake studies relating to the determination of the comparative advantage, particularly of agricultural production systems, are mostly the changing economic environment characterised by the trade liberalisation process, structural adjustments policies, and countries' adoption of particular economic management strategies such as exchange rate policy.

Pearson *et 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 (difference between returns and costs in actual prices facing farmers, millers, or traders) with estimates of social profitability (residual remaining when costs and returns are evaluated in social prices). 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), domestic resource cost ratio (DRC), and the social cost-benefit (SCB). Net social profitability uses only opportunity costs to assess the activity's level, by comparing the social value of its output to the social opportunity cost of the commodities and factors of production employed in producing it. The technique is said to be efficient if the social value is equal to or greater than the social opportunity cost. Activities with a DRC less than one are efficient in the sense that the domestic factors employed by them produce more value added at world prices than they would in the activities from which they are withdrawn. Alternatively, activities with a DRC larger than one are inefficient because they employ domestic factors whose opportunity cost is greater than the net income produced. 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 which accurately replicates farming activities (Mucavele, 2000).

One major purpose of irrigated rice efficiency studies has been to assess its comparative advantage, its ability to make best alternative uses of the domestic resources devoted to its production given prevailing production technology and inputs and output prices. Masters (1995) defines comparative advantage to be 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'). An activity that generates positive social profits is said to be 'economically efficient', and to have some 'comparative advantage' relative to others. In other words, the comparative advantage of a country or region indicates how a new project or policy change will affect the whole economy, while the competitiveness of an activity determines whether or not it can attract workers and other resources and is therefore most useful for predicting whether or not new firms would engage in the activity (Masters, 1995). In the current case, it determined 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. As discussed in the previous chapter (Chapter 2), the irrigated rice sector underwent several policy changes (structural adjustment policy, management transfer, CFA currency devaluation, UEMOA common agricultural policy, and domestic policies). This changing economic environment has affected the performance of the sector, necessitating regular reviews of the performances for policy interventions. This was even accentuated as the question arises as to whether governments should continue investing limited public funds into the development of irrigation schemes.

3.2.6 Analytical and theoretical framework of the effects of different trade policy measures

In the previous section the different trade policy measures and the various effects that their implementation can introduce in the country's economy were discussed. This section deals with the analytical and theoretical framework of the effects of these trade policy measures on competitiveness, general economic welfare and economic development. The analytical and theoretical framework of the effects of different trade policy measures have attracted the attention of trade policy analysts, scholars, and practitioners (Caballero *et al*., 2000; Navaretti and Epifani, 2004; Anderson, 2003). Main points highlighted include the different protection indicators that were developed to measure the protection and support provided to producers, and these differ in their scope and their method of calculations. Graphical representations were also used in the theoretical analysis to help further understand these effects and to portray their various directions and magnitudes.

3.2.6.1 Analytical framework of different trade policy measures

In the context of an open economy, the economic factors that influence tradable goods between a particular country and the rest of the world are prices on the international markets, exchange rates, international transportation costs, domestic prices, and other factors, namely the trade policy measures in place that influence the import/export prices of tradable goods. Changes in any of these economic factors will impact on the levels of trade flows of the tradable goods and thus impact on the livelihoods of the economic agents operating in the sector of activity. The objectives sought by various trade policy measures are varied and differ depending on the instrument of trade policy in place. In the presence of a specific trade policy measure, effects are evaluated by considering first the type of instrument, the economic agents involved or beneficiary group, and the type of commodity. Relating to this aspect, Pearson *et al*. (1989) made a summary of the major criteria to be considered in evaluating a specific trade policy measure. The first criterion in defining the type of instrument is the distinction between subsidy policies and trade policies, since a subsidy is a payment from the government treasury while a tax is a payment into the treasury (a negative subsidy). Most importantly, they highlighted three main differences between trade policy and subsidy policy: 1) they both have implications for the government budget; 2) the number of alternative subsidy and trade policies (table 3.1.); and 3) another difference concerns the extent of their applicability. The second criterion is whether the policy is intended to benefit producers or consumers since a subsidy or trade policy both cause transfers among producers, consumers, and the government treasury. Finally, the last criterion is the distinction between importables and exportables.

Table 3.1: Main instruments of protection

Direct Interventions	Indirect Interventions
Tariffs	Exchange rate management
Import and export quotas	Commodity programmes
Export subsidies	Marketing supports
Sanitary and phytosanitary	Inputs subsidies and tax exemptions
	Long-term investment assistance

Source: Caballero J-M. *et al*, 2000

In our discussion that follows, particular emphasis is given to the major direct trade policy instruments. Later on, the main focus was put on the tariffs aspect, which is the central issue of our dissertation. Referring back to the definition of trade policy as a restriction placed on imports or exports of a commodity, a restriction can be applied to either the price of a tradable commodity (price-based measure) or its quantity (with a trade quota) to reduce the amount traded internationally and to drive a wedge between the world price and the domestic price. The wedge created induces some price changes of which three main effects are of interest in agricultural policy analysis (Pearson *et al*., 1989): 1) the quantities of the commodity that are produced, consumed, and traded (imported or exported), 2) the income transfers to or from producers, consumers, and the government budget, and 3) the efficiency losses in production or consumption. The transfers are accompanied by efficiency losses, meaning that gainers gain less than losers lose. Hence, the benefits for one group (producers, consumers, or the government treasury) are less than the sum of the losses for the other groups. Furthermore, the analysis of the trade policy measures takes into account the type of economy of the country, whether in the context of a closed or open economy, as this fundamental situation better explains the issues related to the gains from trade.

To illustrate this, we refer to the discussion on taxes and subsidies in Varian (1992: 228). The implementation of a tax regime in a system means that there are two prices: the demand price and the supply price. The demand price, p_d, is the price paid by the demanders of a good, and the supply price, p_s, is the price received by the suppliers of the good: they differ by the amount of the tax or subsidy. A quantity tax is a tax levied on the amount of a good consumed meaning that P_d is greater than p_s: $p_d = p_s + t$ (1). A value tax is a tax levied on the expenditure of a good and is expressed as a percentage amount. A value tax at rate r gives (2): $p_d = p_s * (1 + r)$. Subsidies have a similar structure: a quantity subsidy of amount s means that the seller receives s dollars more per unit than the buyer pays, so that $p_d = p_s – s$ (3).

The typical equilibrium condition is that demand equals supply and leads to:

$D (p_d) = S (p_s)$ with $p_d = p_s + t$ (4). Solving either $D (p_s + t) = S(p_s)$ or

$D(p_d) = S(p_d – t)$ (5).

The inverse demand and supply functions can also be used leading to:

$P_d (q) = P_s (q) + t$ (6), or $P_s(q) = P_d(q) – t$ (7).

As discussed earlier, the main effects of interests to be evaluated are the prices and quantities relationship under a trade policy measure. Such information could be derived from the above equations to get the equilibrium prices and quantities. Once, this is done, the utility of consumption accruing to the consumer at the equilibrium x^* is $u(x^*) – p_d x^*$. This measures the difference between the 'total benefits' from the consumption of the x-good and the expenditure on the x-good. The profits accruing to the firm are $p_s x^* – c(x^*)$. Finally, the revenues accruing to the government are $tx^* = (p_d – p_s) x^*$ (8). The net welfare is (9): $W (x^*) = u (x^*) – c (x^*)$. This represents the area below the demand curve minus the area below the marginal cost curve (figure 3.1.). The difference between the surplus achieved with the tax and the welfare achieved in the original equilibrium is known as the deadweight loss which measures the value to the consumer of the lost output. This triangle representing the deadweight loss is also referred to as the welfare loss of policy intervention (Caballero *et al.*, 2000) and in this case it is the tax policy.

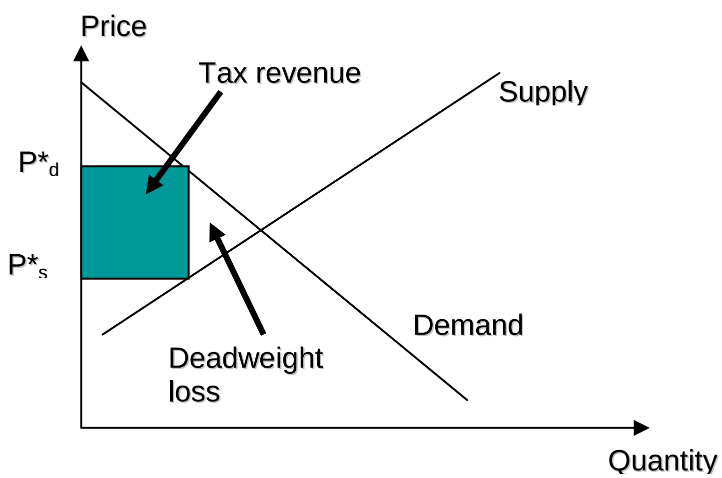

Figure 3. 1 : Tax revenue and deadweight loss

Using this framework as a baseline analysis and referring to the different criteria necessary to be known when evaluating a specific trade policy measure, we can derive the various effects of different policy measures, the economic impact, and the appropriate indicators. Prior to these reviews, an important notion for this analysis that needs some review is the one related to prices, which constitute the central element inducing behavioural reactions from the various economic agents involved in the economic transactions. In the context of an open economy (the country opens to trade), this lead us to refer to those instruments of trade policy involving price based measures: tariffs, export subsidies, and export taxes. As suggested by Caballero *et al*. (2000), when the country opens to trade, there is a need to adjust the price of the commodity in the international market in order to be able to compare it meaningfully with the domestic price received by producers. These international prices adjusted are the financial parity prices. The starting point for this process is the border price, which for imports is the CIF price and for exports the FOB price. Both the CIF and FOB prices are expressed in local currency. For an exportable commodity, the financial export parity price is calculated while for importable goods, it is the financial import parity price which needs to be calculated. However, for an assessment of the economic impact of trade policy measures using the indicators of protection, the economic parity prices are also calculated, and these are derived from the financial parity prices. The difference between the financial parity prices and economic parity prices are that the latter do not include those elements of market distortions present in financial parity prices. Detailed calculations procedures of these prices are discussed in the next chapters.

3.2.6.2 Effects of different policy measures

Conceptually, the three effects are analysed using the concepts of producer and consumer surplus (Caballero *et al*., 2000; Navaretti and Epifani, 2004). Thus, the welfare impact of trade policy measures is evaluated through the changes induced in the consumers' surplus and the producers' surplus. The overall effect or net effect is evaluated as the aggregate effects induced on all agents involved. The theoretical foundations of the effects are better understood when first referring to how the equilibrium price and/or quantity changes, as the trade policy measure is introduced with graphical representations (Caballero *et al*., 2000; Navaretti and Epifani, 2004).

3.2.6.2.1 Effects of a tariff

Tariffs are price based measures and could be either specific ($p= p_f + t$) or *ad valorem* ($p = (1+ t)* p_f$. P_f refers to the price of the tradable commodity in free trade. A tariff raises the price of imports to home consumers, increases government revenue, and tends to increase the price for domestic producers of the import-competing commodity, thus providing an incentive for them to increase production and replace imports (Caballero *et al*., 2000; Navaretti and Epifani, 2004). Tariffs, therefore, increase the income of producers and government at the expense of consumers, and tend to make the domestic production of the good greater than it would have been in the absence of the protective measure. It is noted, however, that the effects differ slightly when considering the case of a small country versus a large country (Navaretti and Epifani, 2004). For both cases, the effects on consumers and producers are the same but in the case of a large country, the government revenues increase more than in the case of a small country because they are partly paid for by foreign exporters as world prices decline. In the case of small country, the net welfare effect is negative because consumers subsidise inefficient producers and there is loss of opportunities for beneficial consumption (dead weight loss in consumers' surplus). But the welfare effects are ambiguous in the case of large country.

3.2.6.3 Economic effects of tariffs

The economic effects of trade policy instruments are analysed through various methods as discussed in earlier sections. This evaluation is made assuming market equilibrium in an open market, implying that the country opens its borders to trade. As tariffs are the trade policy instrument of interest in our study, an *ad valorem* tariff example is used to analyse the economic effects using a graphical representation to portray the various prices and quantities relationship (figure 3.2.).

In the absence of a price-based measure, the price prevailing domestically is the international price of the importable commodity. At equilibrium, the domestic price equals the international price P_w. With the introduction of a trade policy measure, the tariff t agents react in the new market context to reach a new state of equilibrium. These effects are summarised as follows (Caballero *et al*., 2000):

- the domestic price increases from P_w to $P_w*(1+t)$;
- domestic production increases from s_0 to s_1;
- domestic consumption decreases from d_0 to $d_{1;}$
- the imported quantity decreases from $(d_0 – s_0)$ to $(d_1– s_1)$;
- government obtains a revenue equal to the shaded area in figure 3.2;
- producers benefit from a higher price, which encourages them to increase production, the government collects some tariff revenue, dependency on rice imports decreases, and consumers lose because of the higher price, which moves them to reduce consumption.

Similar trade effects can be expected if a government imposes an import quota equal to $d_1 – s_1$ (figure 3.2.).

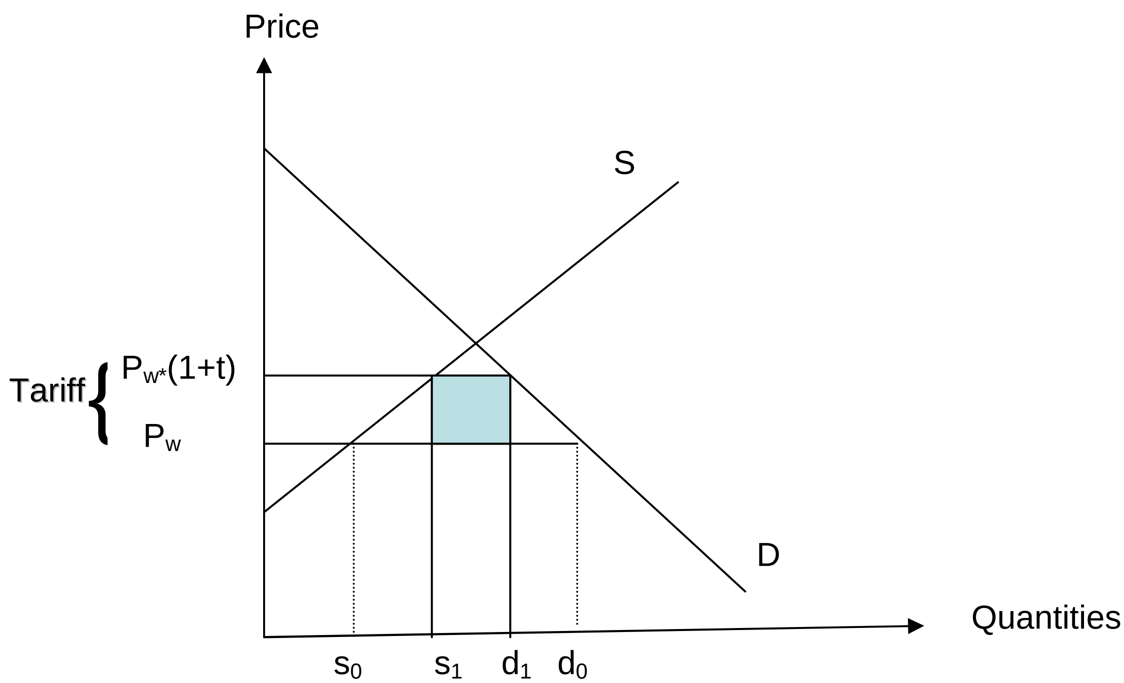

Figure 3.2: Effects of Tariffs and Imports Quotas

3.2.6.4 Welfare effects of tariffs

The classical tool for measuring welfare changes is the consumer surplus (Varian, 1992:163) and this measures the area to the left of the demand curve between a price p_0 and p_1. In other words, it measures the difference between the amount a consumer is willing to pay for a unit of a good and the amount actually paid. In the case of producers, the producer surplus constitutes the measure of welfare change, which is a symmetrical concept to that of the consumer surplus (Caballero *et al*., 2000). Caballero *et al*. (2000) further state that the welfare analysis of trade interventions consists in examining and measuring how these interventions increase or decrease the consumer and producer surplus, as well as generate fiscal revenues or costs and quota rents. A restriction on imports through the imposition of an *ad valorem* tariff benefits producers by raising the domestic price facing both producers and consumers, P_d, above the world price P_w by the amount of tariff t thereby allowing domestic output to expand, and resulting in a reduction in imports (reflecting the increase in local supply) and a decrease in local demand (consumption).

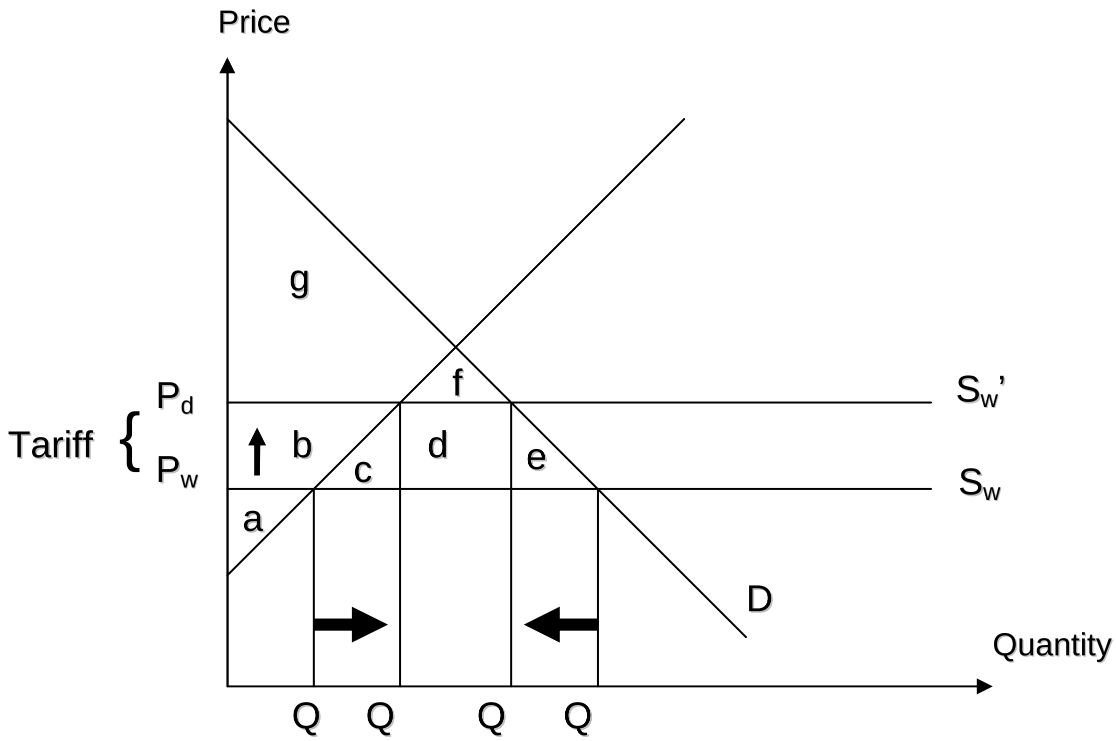

Figure 3.3: Welfare Implications of a tariff

The welfare implications of a tariff represented in figure 3.3 and summarised in table 3.2 are that changes occur in magnitude in the various indicators, namely the consumer surplus, producer surplus, government tax revenue, and the total surplus, implying welfare gains and losses of the various groups consisting of the consumers, producers, governments and the net welfare effect for society. Caballero *et al*. (2000) indicate that the monetary magnitude of these indicators depend on the elasticities of the supply and demand curves, the import price of the good, the quantities produced, consumed and imported, and the size of the tariff. As shown in table 3.2, the consumer surplus decreases, indicating a loss of consumers' welfare, while the producer surplus increases, implying welfare gain. The tariff generates some revenue for the government budget.

Table 3.2: Summary of the welfare effects of a tariff

Indicators	Without Tariff	With Tariff	Change in welfare
Consumer surplus	b+c+d+e+f+g	f+g	-(b+c+d+e)
Producer surplus	a	a+b	+b
Tariff revenue	None	d	+d
Total surplus	a+b+c+d+e+f+g	a+b+ d+f+g	-(c+e)

Source: Source: Caballero J-M. et al, 2000

3.2.6.5 Trade policy measures, competitiveness and general economic development

Putting together the gains and losses, however, does not compensate for the magnitude of losses, indicating a net welfare loss that is induced by the trade policy measure. Thus, the economic impact is that transfers are enabled among economic agents permitting some beneficiaries to gain more than others, and the losses are not totally compensated for by the gains, thereby creating some inefficiencies in overall economic performance as compared to the case of a free trade situation. But, as discussed in the economics literature, the concept of *pareto* efficiency tells us that a measure, by creating incentives for some economic agents, means that others have to give up some benefits. As discussed by Navaretti and Epifani (2004), in general, import protection as well as export promotion distort production and consumption decisions, therefore, they are generally welfare reducing. Furthermore, trade policy has effects on the distribution of income. Thus, due to the distortions that are introduced by trade policy interventions, tariff reductions constitute a hot topic at WTO discussions and negotiations. Even when trade policy reduces national income and causes serious inefficiency in the economic system, it always benefits some firms or individuals at the expense of the rest of society (Navaretti and Epifani, 2004). Gibbs (2007) indicated that there has been little consensus on the relationship between trade and short- to medium-term economic growth – and even less on its role in long-term economic development. However, in his analysis, Gibbs (2007) indicated that the common thread in the different theories relating to trade is that it can contribute to growth by expanding markets, facilitating competition and disseminating knowledge.

3.2.6.6 Framework for analysing the impact of customs tariffs

Tracing the effects of the customs union's tariffs on the competitiveness of irrigated rice production and the economic incentives for irrigated rice producers implies conducting an assessment of its impact on the performance of the rice sector. As shown above, trade policy measures impact on several economic indicators (market prices and quantities of tradables) and introduce changes in the welfare of the different economic agents. This is to say that the trade policy measure, as a policy intervention, introduces some distortions which are referred to as deviations between the actual set of prices in an economy and a set of ideal long-term equilibrium prices for that economy (Caballero *et al.,* 2000). The protection indicators measure the extent of these distortions and thus they measure the effect of policy interventions. Several indicators of protection are reported in the literature and these indicators can accurately be generated through the policy analysis matrix. Therefore, the impact of the common external tariff's effects on the competitiveness of the irrigated rice activity can also be investigated using the policy analysis matrix. Detailed discussion of the indicators of protection, formulas for the standard measures, and other important policy indicators form the substance of Chapter 4.

3.3 Earlier studies on the competitiveness of irrigated rice production systems in West Africa

Since the 1980s, a number of studies have been conducted on rice-based systems in order to assess the performance of the systems and its impact on rural communities' livelihoods. Africa Rice Centre (AfricaRice) ex WARDA/ADRAO pioneered several studies through its task forces. Specifically, socio-economic related studies were conducted by the economic task force group, policy support and production economics units. Other major technical studies were also conducted by the FAO.

The book of rice information published by FAO (2002) reported a series of selected countries' performance indicators. The information was given by year and for each rice-growing ecosystem (irrigated, upland, rainfed lowland, deepwater) and countries in sub-Saharan Africa (SSA). Important aspects to highlight were that the performance indicators vary first by major rice growing ecosystem and secondly within a single rice growing ecosystem; the indicators vary depending on the year and also by locality. These aspects of the performance indicators reveal the impact of a combination of a number of factors (biophysical, technical, and social) including the spatial variation of growing conditions. Another aspect is that in those countries for which data and information exist over different periods of time, there is a tendency in yields improvement that could be linked to better technology diffusion (crop varieties and crop management techniques).

Beginning in the mid-90s, the Africa Rice Centre (AfricaRice) ex WARDA/ADRAO conducted several studies on rice-based systems through its various task forces. The data period spans from 1994 to 1998 and relates to major rice ecosystems found in the West African region. The performance indicators presented include yields, gross revenues, total production, and net revenues. Highest yield data is obtained in irrigated rice ecosystems (4.68 tons/ha) in the Senegal River valley while lower yields (less than 2 tons/ha) are observed for the cases of developed lowland, upland, and flood plains. However, the gross revenue figures do not follow the same pattern for various reasons which cause yields and price levels to differ. Yield data has a somewhat mixed trend, implying various forms and levels of managerial expertise in crop management techniques, and different levels of technology diffusion. The various production costs across the different rice growing ecologies indicate not only different input use levels but also differences in price levels, thus also affecting the net revenue indicators.

Recent findings concerning different countries' irrigated rice performance indicators relate to financial performances based on rice crop budgets which were developed using indicators such as: current year input and output prices, household costs of production relating to land preparation, inputs, and fertilisers. These performances differ across countries and among the various irrigated systems (tables 3.3 and 3.4).

Table 3.3: Summary Cross Country Results

Hypothesis: Rice Double cropped	Burkina Faso	Mali	Niger
Annual Average Yield, Kg/ha	2,981	3,650	3,679
Hired Labor Cost, US $ / tonne	71	57	93
Production Cost, US $ / tonne	175	182	224
Fertiliser Cost, US $ / tonne	61	45	60
Water Cost, US $ / tonne	33	39	71
Net Cash Revenue, US $ / Ha	574	1,896	619
Net Revenue per capita, US $ / Year	42	144	73
Net Revenue per adult agriculture Worker, US $ / Year	96	304	255
Quantity of paddy produced per adult agricultural Worker, kg/year	1,091	1,762	1,641
Average irrigated rice plot, Ha	1.047	1.724	0.826
Average paddy price, US $ / Kg	0.23	0.42	0.24

Source: Africa Rice Center (WARDA). 2007.

To analyse rice sector efficiency, studies using domestic resource costs (DRC) were conducted to assess the comparative advantage of the rice activity. Several studies carried out across the sub-region have assessed the comparative advantages of different types of rice based systems and the subsequent results are compared on the basis of the level of domestic resource cost ratios (DRC) that were computed for different rice commodity systems (Lançon, 2001a; Kormawa and Akande, 2005). The seminal research work conducted with regard to rice competitiveness in West Africa is the book written by Pearson *et al*. (1981), which 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 (Cote d' Ivoire, Mali, Liberia, Sierra Leone, Senegal) by using an approach that incorporated analysis of issues relating to the efficiency of farm production and comparative effectiveness of alternative policies. Main concluding remarks were that Mali clearly has a strong comparative advantage in domestic production as a substitute for rice imports and also for exports to other West African countries. Sierra Leone has higher costs than Mali, resulting from a relatively low level of productivity, but production is still profitable because wages are very low. Furthermore, Sierra Leone can export rice more profitably than Mali because of lower transport costs to neighboring markets. The conclusions further indicated that Ivory Coast and Liberia have a comparative disadvantage in producing rice for their national markets, while Senegal occupies an intermediate position between Mali and Sierra Leone, on the one hand, and the Ivory Coast and Liberia, on the other.

Other rice efficiency studies obtained various DRC indicators. The decreasing trend of the Domestic Resource Cost (DRC) ratios over time in various countries indicates an overall enhancement of the competitiveness of the rice economy (Lançon, 2001a). The improvements of the DRC are related to several factors such as technology level, post-harvest and processing technologies, location and targeted markets (table 3.4).

Table 3.4 :DRCs by Rice Growing Ecologies

Country	Year	Irrigated		Lowland rainfed		Upland rainfed		Mangrove		Flooded
		High	Low	High	Low	High	Low	High	Low	Low
Côte d'Ivoire	1978	2.99	1.74	1.67		1.51	1.35			
Liberia	1978			1.57	1.48	1.99	1.78			
Mali	1978	0.58		0.65	0.72					0.87
Senegal	1978	1.99		1.26		1.04				
Sierra Leone	1978			0.88	0.8	0.98	0.98	0.86		0.87
Nigeria	1990	1.01	1.49	0.62	0.51	0.67	0.72			
Côte d'Ivoire	1993	1.01		0.89	0.89	1.11	1.05			
Côte d'Ivoire	1995	0.8		0.69	0.47	0.9	0.59			
Niger	1995	0. 56	0. 91							
Sierra Leone	1995				0.71		0.53		0.27	
Mali	1996	0.4								
Senegal	1996	1.16			0.98					

Source: Lançon, F.2001a.

3.4 Major issues at stake with regard to irrigated rice competitiveness

Rice constitutes one of the most important commodities that has undergone several (sometimes contradictory) policy and institutional changes. It is a reality for most sub-Saharan African (SSA) countries that the development of rice production was not made 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, motopump diesel), and post-harvest and rice quality management. The type of irrigation system affects mostly the water cost, and this then affects the water-user fees paid by producers. The producers lack public support in marketing their paddy and milled rice. Furthermore, their links to local markets are not well developed, in the sense that only a small proportion of the rice produced actually gets to the market. Thus, privately sold rice quantities are less important. The reason for this is that farmers' production is used to satisfy several needs: household consumption, in-kind payment for water fees, future reserves, and arrears for water fees.

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, in their turn, are a function of the prices of resources used in production, but also of the circumstances under which the rice is grown and the managerial expertise of producers. This renders the competitiveness of local irrigated rice contingent on several factors, including farm-level productivity, the economic environment and product quality, which in turn depends on post-harvest activities.

In conclusion, major issues at stake include improving farm productivity and efficiency, enhancing market linkages, improving post-harvest processes and handling and also quality for increased value addition, and overall competitiveness through enabling policies.

Masters (1995) explained that the value of defining competitiveness and comparative advantage in terms of profitability is its immediate policy implications: expanding socially profitable activities raises national income, while expanding privately profitable ones may not. With the application of the policy analysis matrix, the impact of policy variables of interest was assessed.

With adequate support of the scheme management, better organisation of activities will be facilitated and the system would function at an acceptable performance level for both productivity and financial sustainability. This would necessitate better institutional arrangements for enhanced productivity of the irrigated systems, and thus involve the key role of private entrepreneurship, especially regarding critical domains such as the marketing of locally produced rice, inputs supply, credit, and the provision of technical assistance to producers. Furthermore, with a proper and well maintained infrastructure in place, better product quality and performance along the chain can be reached, and overall competitiveness of the sector achieved.

3.5 Chapter summary

The chapter discussed the main theme of the thesis under its various aspects including the definitions of trade policy measures and its economic and welfare impact. Specifically, the chapter discussed the trade policy measures and competitiveness of irrigated rice production. After the definition of the trade policy measures, a particular focus was put on the tariffs aspect, which is the central issue of the dissertation. The trade policy measures takes into account the type of economy of the country, whether in the context of a closed or open economy, as this fundamental situation better explains the issues related to the gains from trade. The policy measures are varied and include several instruments. The typical trade policies are: tariffs, non-tariff barriers, and regulations concerning capital exports and imports. In terms of agriculture, three principal categories of policies are used to bring about change: 1) agricultural price policies, 2) macro-economic policies (fiscal, monetary, exchange-rate and the domestic factors policies), and 3) public investment policies. These instruments are used by governments within national food and agriculture frameworks in order to reach some predefined objectives by inducing some changes (impacts) on a variety of economic variables. In other words, the implementation of specific trade policies implies various interlinks between other macro-economic policy spheres, the agricultural sector, and the rest of world, rendering it necessary to understand trade-related policies. Throughout the literature, it has been shown that trade policies alter domestic prices and quantities of the targeted agricultural commodity. This means that the use of a particular instrument with an intended objective could have a spillover effect and affect other economic agents. The irrigated rice production system faces major issues which include the improvement of farm productivity and efficiency, the enhancement of market linkages, the improvement of post-harvest processes, handling and overall competitiveness through enabling policies. Tracing the effects of the customs union's tariffs on the competitiveness of irrigated rice production and the economic incentives for irrigated rice producers implies conducting an assessment of its impact on the performance of the rice sector. The use of the Policy Analysis Matrix (PAM) was found appropriate tool to investigate these issues.

CHAPTER 4: THE POLICY ANALYSIS MATRIX AND THE COMPETITIVENESS OF IRRIGATED RICE SYSTEMS

4.1 Introduction

The previous chapter reviewed the different trade policy measures and related measurement methods, the economic impacts on both supply and demand of traded commodities, including the relationship between price and quantity, and the transfers induced among different economic agents. The chapter also emphasised welfare effects, with particular reference to tariffs that involve direct price-based interventions that induce various forms of distortion in the economy and that can be traced through the different indicators of protection (incentives) provided to producers. Such protection indicators measure the extent of these distortions and thus they measure the effects of policy interventions.

Several indicators of protection are reported in the literature and can be accurately generated through the policy analysis matrix. The common external tariff is a price-based trade policy measure and its effects on the competitiveness of the irrigated rice activity can also be investigated using the policy analysis matrix. The indicators generated through the application of the policy analysis matrix (PAM) have been the subject of various publications, which made a detailed review of the computations, use, interpretation and their potential limitations. In this chapter, we first made a review of the policy analysis matrix and discuss the various indicators: policy incentives and comparative advantage indicators. Next, we discussed the implications of the indicators in assessing the common external tariff impacts on the performance of the irrigated rice sub-sector performance and its competitiveness. Third, we discussed the potential limitations of the model.

4.2 The Policy Analysis Matrix (PAM): Analytical framework for Policy Evaluation

The Policy Analysis Matrix (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). 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.

From its theoretical background, the method contains a number of theoretical assumptions and empirical simplifications and it allows the measurement of the effects of policy on producers' income as well as identification of transfers among key interest groups involving producers in agricultural systems, consumers of food, and policy-makers who control allocations of government budgets (Monke and Pearson, 1989). The underlying theoretical assumption is that policy options influence the returns and costs of agricultural production through prices of agricultural inputs and outputs. These agricultural inputs used in the process of agricultural production include tradable inputs and domestic factors (capital, labour, and land), the levels of which differ depending on the agricultural production systems. Intensive agricultural production systems use high input levels that are mostly traded inputs, and this is precisely the case with irrigated rice production. With the PAM methodology, the costs of traded and non-traded goods and their revenues are computed using different categories of prices, which include market and reference prices. The reference prices represent prices which would prevail in the absence of policy effects. Thus, the main empirical task in the PAM approach is to construct the accounting matrices of revenues, costs, and profits (Monke and Pearson, 1989), making the policy analysis matrix a product of two accounting identities. The first one, profitability, is defined as the difference between revenues and costs and the second one 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 *et al*. (2000) indicated 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. Through PAM methodology, 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 could be derived relating to private profitability, social profitability (including comparative advantage indicators), and policy transfers (protection coefficients). Table 4.1 gives the policy analysis matrix.

Table 4.1: The Policy Analysis Matrix (PAM)

	Benefits / Gross Revenues	Costs		Net Profit
		Tradable Inputs	Domestic Factors	
Budget at Market Prices (Private Prices)	$A= \sum P_x Q_x$	$B= \sum P_i Q_i$	$C= \sum P_j Q_j$	$D=\sum P_x Q_x - \sum P_i Q_i - \sum P_j Q_j$
Budget at Social Prices (Social Opportunity Costs)	$E= \sum P^*_x Q_x$	$F= \sum P^*_i Q_i$	$G= \sum P^*_j Q_j$	$H = \sum P^*_x Q_x - \sum P^*_i Q_i - \sum P^*_j Q_j$
Divergences	$I = \sum P_x Q_x / \sum P^*_x Q_x$	$J = \sum P_i Q_i / \sum P^*_i Q_i$	$K =\sum P_j Q_j / \sum P^*_j Q_j$	$L = \sum P_x Q_x - \sum P_i Q_i - \sum P_j Q_j / \sum P^*_x Q_x - \sum P^*_i Q_i - \sum P^*_j Q_j$

Source: Monke and Pearson, 1989; Masters, 1995.

The matrix entries A, B, and C are the sum of products of market prices (P) and quantities (Q), representing all of an activity's outputs (with subscript x), tradable inputs (subscript i) and non-tradable domestic factor inputs (subscript j). Entries E, F, and G use the same quantities but are valued at social opportunity costs or shadow prices (P^*). The bottom row is the difference between the other two rows; the last column is benefit minus costs. The term 'private' refers to observed revenues and costs reflecting actual market prices received or paid by farmers, traders, or processors in the agricultural system. On the other hand, the social prices measure comparative advantage or efficiency in the agricultural commodity system. Monke and Pearson (1989) stated that efficient outcomes are achieved when an economy's resources are used in activities that create the highest levels of output and income; therefore the social profits (H) are an efficient measure because outputs (E) and inputs (F and G) are valued at prices that reflect scarcity values or social opportunity costs (social prices). Social prices are defined as prices that would result in the best allocation of resources and thus lead to the highest income generation (Pearson *et al*., 2003). The scarcity values or social opportunity costs are estimated based on comparable international market prices, i.e. international CIF or FOB. As stated by Masters (1995), in the estimation of opportunity costs of traded crops and inputs, a key choice is that between the use of foreign price observations, (suitably corrected for international marketing costs) and the use of local observations of import and export prices. For an importable, the import price indicates the opportunity cost of obtaining an additional unit to satisfy domestic demand while for an exportable, the export price is a measure of the opportunity cost of an additional unit of domestic production. In order to make a meaningful comparison, these prices are converted into local currency and the exchange rate comes into play. Thus, in applying the PAM methodology to estimate policy effects on production systems, two important aspects are to be considered: 1) a price adjustment process in order to estimate both the financial and social import parity prices of tradable goods and services, and 2) the use of an appropriate exchange rate to convert international prices to local currencies. The exchange rate constitutes one of the major links between the national and world economies. Other important factors are international prices of tradables, international transport costs, domestic prices and trade policy measures, implying that, apart from the price adjustment process, other important data and information are highly necessary for the development of an accounting matrix along the various segments of the commodity chain. As stated by Yao, (1997), the basic information needed for compiling a PAM are yields, input requirements, and the market prices of inputs and outputs. The data of transportation costs, processing costs, storage costs, port charges, production/input subsidies, and import/export tariffs are also required to derive the social prices.

Rice is an import substituting commodity and therefore the calculation of the financial import parity prices is of interest. As described in Caballero *et al*. (2000), the financial import parity price is calculated by first choosing a domestic wholesale reference market (capital city market) where imported goods compete with locally produced goods. Then, to the border price (CIF) are added all port charges after the import touches the dock, any domestic tariffs and other taxes or fees, duties or subsidies, and the transport and marketing costs from the port to the market of reference, and this gives the import parity price at the market of reference. The farm-gate import parity price is obtained by subtracting the transport and marketing costs that producers have to pay to put their produce on the market of reference. In a case in which there exists any industrial transformation, the paddy equivalent is calculated using the conversion rate of paddy into milled rice, and the cost of milling is deducted. The economic parity prices are derived from financial parity prices, but as discussed by Caballero *et al*. (2000), there are three ways in which market distortions may affect financial parity prices and these need to be taken into account in calculating the economic price: 1) exchange rate, 2) fiscal or trade policies (taxes, subsidies, tariffs and quotas), and 3) market failures or income transfers like indirect taxes and subsidies that alter the transport and marketing costs of the commodity from the border point to the farm-gate level.

The policy analysis matrix (PAM) has been used in a number of studies to assess the effects of policies and policy changes on agricultural production systems characterised by the growing ecology, location, technology use, and crop management (levels of inputs use). Yao (1997) states that the primary objective for constructing a PAM is to derive a few important policy parameters for policy analysis. This author has used the analytical tool to estimate various indicators of comparative advantage and policy distortions to assess the costs and benefits of production diversification in Thailand. In their seminal book, *Rice in West Africa, Policy and Economics,* Pearson *et al*. (1981) applied the PAM methodology to make an assessment of rice sectors and various related policies in several West African countries. The PAM approach was used by WARDA and its partners to assess various rice production systems' competitiveness in different countries. From 1995 to 1998, studies on the PAM were conducted in Nigeria, Sierra Leone, Senegal, and Mali; and some training sessions were conducted in the Ivory Coast, Senegal, and Mali (Lançon, 2001b). The PAM was also used to study the competitiveness of rice production systems in Guinea and has very recently been used as a decision-making tool in a rice and maize stratification project (Ncho *et al*., 2008). In East and Southern Africa, several studies have made use of the PAM to assess the competitiveness of different commodities (Hassan *et al*., 1999; Mucavele, 2000).

4.3 Common Indicators of Comparative Advantage, Agricultural Protection and Policy Distortion

As shown in table 4.1, three principal measures can be generated from the PAM approach and these include private profitability, social profitability, and policy transfers (divergences), and these measures are determined by several indicators. Table 4.2 provides a summary of the common indicators for private profitability, comparative advantage, and policy transfers. In terms of policy analysis, the indicators convey specific information relating to policy effects on the performance of the agricultural system being investigated.

4.3.1 Private profitability

PAM methodology enables specific policy evaluation of agricultural production systems that can take into account differences in crop growing ecologies and levels of technologies, given prevailing market conditions. Thus, it allows judging the profitability of the crop enterprise based on profits generated at market prices (D) in order to determine whether the enterprise is competitive (positive profits) or non-competitive (negative profits). The private profit D = (A – B – C) indicates competitiveness under existing policies. A competitive firm by definition is one that takes the market price of output as given and outside of its control and in well-behaved cases, the supply function of a competitive firm is the upward sloping part of the marginal cost curve, which lies above the average variable cost curve (Varian, 1992: 216-17). A profitable enterprise is then expected to grow, while a non-competitive enterprise is expected to contract over time. With positive earnings, the enterprise can make new investments for further expansion. Therefore, competitiveness means that the owner of the enterprise is supplying output to the market at a competitive price (P = Marginal unit cost). However, this may not be the case as the market prices do not always reflect the true marginal production cost, implying some market distortion or market failure.

As indicated by Pearson *et al*. (2003), a market failure occurs when a market fails to provide a competitive outcome and an efficient price. The common types of market failures are monopolies, externalities, and factor market imperfections while a distorting policy is a government intervention that forces a market price to diverge from its efficient valuation; these forces include taxes/subsidies, trade restrictions, or price regulations. The private cost ratio (PCR) is the ratio of domestic factor costs (C) to value added in private prices (A – B). The value added indicates the difference between the value of output and the costs of tradable inputs and shows how much the system can afford to pay domestic factors and still remain competitive. In other words, a private cost ratio larger than one (>1) indicates that the value added is lower than the domestic factors costs and thus such a system is not competitive. When this ratio is less than one (<1), it implies that value added is greater than domestic factor costs and that the operator is making profits. A ratio just equal to one (=1) implies that the enterprise is operating at break even point, since C/(A – B) = 1 means that C + B = A, or A – B – C = D = 0).

Table 4.2: Summary of the common indicators for private profitability, comparative advantage, and policy transfers

Principal Measure Category	Common Indicators	Calculation method
Private profitability	Private Profit	D = (A-B-C)
	Private Cost Ratio (PCR)	PCR = C / (A – B)
Social Profits	Net Social Profit	NSP= H = E – F – G $= \sum P^*_x Q_x - \sum P^*_i Q_i - \sum P^*_j Q_j$
	Domestic Resource Cost	DRC = G / (E – F) $= \sum P^*_j Q_j \ / \ (\sum P^*_x Q_x - \sum P^*_i Q_i)$
	Social Cost Benefit	SCB = (F + G) / E $=(\sum P^*_i Q_i + \sum P^*_j Q_j) / \sum P^*_x Q_x$
Policy Transfers	Nominal Protection Coefficient on tradable output	NPCO= A / E = $\sum P_x Q_x / \sum P^*_x Q_x$
	Nominal Protection Coefficient on tradable input	NPCI = B / F = $\sum P_i Q_i / \sum P^*_i Q_i$
	Effective Protection Coefficient	EPC = (A – B) / (E – F) $= (\sum P_x Q_x - \sum P_i Q_i) / (\sum P^*_x Q_x - \sum P^*_i Q_i)$
	Profitability Coefficient	PC = (A – B – C) / (E – F – G) = (D / H) $=(\sum P_x Q_x - \sum P_i Q_i - \sum P_j Q_j) /$ $(\sum P^*_x Q_x - \sum P^*_i Q_i - \sum P^*_j Q_j)$
	Producer Subsidy Estimate	PSE = L / A
	Subsidy Ratio to producers (Effective Subsidy Coefficient)	SRP = ESC = L / E
	Output Transfers	I = A – E
	Input Transfers	J = B – F
	Factor Transfers	K = C - G
	Net Transfers	L = D – H = I – J

Adapted from Monke and Pearson (1989) and Masters (1995).

4.3.2 Social profitability and comparative advantage

Three fundamental indicators measure the comparative advantage of a particular agricultural system. These comparative advantage indicators also constitute a measure of the efficiency of the system. First, the net social profit (NSP), which measures the economic profitability of the agricultural system, is obtained by the difference between gross revenues and costs of traded inputs and non-traded factors, both valued at reference prices or social opportunity costs; thus, it is computed by the formula: NSP = E – F – G. The net social profit (NSP) is an accurate measure of comparative advantage and is used to compare similar types of activities (Monke and Pearson, 1989; Masters 1995; Mucavele 2000). It illustrates the benefit to the economy of producing a given commodity; positive social profits imply efficient use of scarce resource and indicate that the enterprise has a comparative advantage because it produces at social costs that are less than the social benefits. Negative social profits indicate that the system is operating at social costs higher than the social revenues and such a system cannot survive unless there are some incentives given to it through particular government policies directed towards traded inputs or domestic factors, since the social costs include both traded inputs and domestic factor costs. Net social profitability (NSP) and domestic resource costs (DRC) are conceptually related, since each can be derived from the other (Pearson, 1976). The main difference is that the domestic resource cost (DRC) is computed as a ratio of the domestic factor costs (land, labour, capital) to value added, both computed at social prices; that is G/(E – F).

The second indicator of comparative advantage is the domestic resource cost (DRC), which is the major indicator of comparative advantage. It is a measure of economic efficiency that is used in developing countries to guide policy reforms (Masters and Winter-Nelson, 1995). The DRC is commonly used as a measure of comparison across countries. But the DRC can also be used to compare activities within a country (Mucavele, 2000). The DRC, defined as G/(E – F), indicates a ratio of domestic factor costs (land, labour, capital) to value added, both computed at social prices. Value added is defined as the difference between the gross revenues generated by an activity and its related tradable inputs costs evaluated at their social prices. Page and Stryker (1981) stated that minimising the resource cost ratio in activities that produce tradable goods is equivalent to maximising value added at world prices per unit of domestic resources employed. A ratio of DRC < 1 implies an efficient use of domestic resources to produce the commodity; the value added evaluated at the reference price is higher than social opportunity cost of domestic factors; more wealth is created for the country as a whole, thus contributing to national income. A ratio of DRC > 1 indicates that the agricultural system is an inefficient activity that cannot survive unless government takes further measures to provide incentives that could in some cases be non-efficiency objectives. Such an activity produces wealth that is lower than the opportunity cost of the domestic factors employed. A ratio of DRC equal to one (= 1) indicates a cut-off between efficient and non-efficient activities. Bruno (1972) indicated that the concept of DRC relates to a measure of real opportunity cost in terms of total domestic resources of producing (or saving) a net marginal unit of foreign exchange. Bruno (1972) further indicates that by comparing the DRC with some measure of the economy's 'real' or 'accounting' exchange rate, it can be used as an investment criterion, just as the internal rate of return of a project is compared with some measure of the real rate of interest. However, despite its wide use as a proxy measure of social profitability, this indicator has some limitations. The DRC is biased against activities that rely heavily on domestic factors (Masters and Winter-Nelson, 1995). This is due to its mathematical formula, which in some cases may guide resource allocations towards activities that are excessively intensive users of tradable inputs (Masters, 1998; 2003), and for this particular reason, Masters (1998; 2003) indicated that the DRC does not systematically guide policy towards socially optimal levels in a conventional tradable/non-tradable goods model. Bruno (1972), on his part, showed that actual DRCs differ from one another due to a variety of reasons, which include differences in effective tariff rates on value added, but may also be due to the existence of quantitative restrictions on trade, taxes, or subsidies on domestic production, market sharing arrangements, and finally, differences between the market and opportunity cost of primary factors of production, primarily capital. Furthermore, other important real challenges for comparative advantage analysis are: finding appropriate border prices for tradable goods, appropriate domestic opportunity costs for non-tradables, and an appropriate real exchange rate between tradables and non-tradables (Masters, 1995).

The third indicator of social profitability is the social cost-benefit ratio (SCB); $SCB = (F + G)/E$. This measures the ratio of the sum of tradable inputs costs and domestic factors costs to gross revenue, all valued at reference prices. From its formula, it can easily be seen that the SCB uses the same data as the NSP and DRC. Masters (1995) indicated that the absolute value of the SCB has little real meaning and the measure's only value is in ranking multiple activities; its accuracy, however, depends entirely on the underlying data used. A ratio of SCB greater than one (< 1) indicates that the system mobilises resources in its activities but it is not making profits; there are some efficiency losses. With a ratio of less than one (> 1), the activity gross revenues are higher than the sum of all the system's inputs and domestic factors of production. When the ratio is just equal to one (= 1), the system is performing at break even point; the system's total inputs and factor costs are equal to gross revenues (all valued at reference prices). As the DRC formula is biased against activities that rely heavily on domestic factors (land and labour), the Social Cost-Benefit (SCB) ratio is found to be a generally superior measure of social profitability and does not distort profitability rankings (Masters and Winter-Nelson, 1995).

4.3.3 Policy transfers

A means provided by the PAM to evaluate price-based trade policy, is to conduct an assessment of the agricultural system by comparing enterprise outcomes at market with social prices. As shown in table 4.1, the difference between the two outcomes represents 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 measure of the scarcity value of resources used in the commodity production process while the market prices reflect the trade policy effects. The scarcity values of resources used constitute best alternative uses of resources mobilised 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 agriculture system competitiveness create distortions that are measured, depending on the context, by various indicators of protection that reveal important information about policy effects on agricultural system performance (revenues, costs, and profits). A body of literature deals with the theoretical foundations, method of estimations, and potential limitations (Bruno, 1972; Pearson, 1976; Monke and Pearson, 1989; Beghin and Fang, 2002; Anderson, 2003; Masters, 1993; Masters, 1995; Masters, 1998; Masters, 2003). Other case studies have demonstrated the usefulness of these indicators in evaluating the impact of governmental policies, particularly those related to agriculture (Masters and Winter-Nelson, 1995; Yao, 1997; Fang and Beghin, 2000).

In the PAM approach, Monke and Pearson (1989) defined several indicators of policy transfers and protection coefficients that also indicate the policy effects on agricultural systems producing one commodity and agricultural systems producing different commodities. These are categorised into output transfers (I), tradable inputs transfers (J), factor transfers (K), and net transfers (L), as shown in tables 4.1 and 4.2. Generally, the third row of the PAM matrix is used to assess transfers introduced into an agricultural system producing similar outputs; these transfer measures are denominated in local currency units per unit of output (kg or tonne) produced. 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. As shown in table 4.2, 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 nominal protection coefficient (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*); that is NPC = P/P*. This indicator can be computed in the case of tradable outputs to get 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 A/E, which indicates the extent of output transfer; NPCI is obtained by B/F, indicating the degree of tradable inputs transfer. If NPCO < 1, the product is taxed; if NPCO > 1, there is a subsidy associated with 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 subsidised 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 (A – B) with value added in world prices (E – F). As stated by Monke and Pearson, 1989; Pearson *et al*., 2003; and Masters, 2003, the effective protection coefficient is useful in measuring the joint effect of policy affecting both products and inputs, in contrast to the nominal protection coefficient, which measures only output transfers. These authors reported that the EPC is useful to compare products with very different levels of inputs use. An EPC > 1 is an indicator that producers are protected, while an EPC < 1 indicates that producers are taxed. However, as reported by Monke and Pearson (1989), the EPC ignores the transfer effects of factor market policies and thus it is not a complete indicator of incentives. The concept of the profitability coefficient (PC) was introduced for this reason. The profitability coefficient, PC = (A – B – C)/(E – F – G), measures the incentive effects of all policies and serves as a proxy for the net policy transfer (Monke and Pearson, 1989). Therefore, the profitability coefficient (PC) can be formulated as D/H, representing the proportion of private profits to economic profits and indicating the proportion of incentives provided to producers through policy effects.

Other important indicators shown in table 4.2 include the producer subsidy estimate (PSE), the subsidy ratio to producers (SRP), and the net transfer. The producer subsidy estimate (PSE) is computed as L/A and includes policy effects on all inputs and factors. The PSE is the level of producer subsidy that would be necessary to replace the array of actual farm policies employed in the country in order to leave farm income unchanged (Mucavele, 2000). The producer subsidy ratio (SRP) is formulated as a proportion of the net policy transfer to total social revenues: SRP = L/E = (D – H)/E. It includes policy effects on all inputs and factors and enables comparison of the extent to which all policy subsidises agricultural systems. The net transfers = L = D – H = I – (J + K) = 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).

4.4 Implications of the indicators in assessing the common external tariff

In the case of trade policy involving price-based measures, effects can also be measured based on returns and costs of agricultural enterprises through the same mechanism. The use of a policy analysis matrix allowed the assessment of the common external tariff's impact on irrigated rice competitiveness given the prevailing market input and output prices that enter into the various activities of the commodity chain (from farm production to consumption). As discussed earlier, the application of a tariff creates a wedge between the price prevailing domestically and the international price of the importable commodity. With the introduction of trade policy measures, agents react in the new market context to reach a new state of equilibrium. In this case, both imported rice and the tradable inputs used in the process of production, processing, marketing, and consumption are of interest. Domestically produced rice is also considered as an import substituting good. This situation needs to be investigated along the commodity chain, since paddy rice is processed into milled rice (or in a relatively few cases into parboiled rice) and thus becomes an input at some stage in the commodity chain. It is clearly noticeable that the policy matrix development involves pricing comparison between observed prices (market levels) and opportunity costs of inputs and outputs; this assessment requires a good knowledge of the commodity chain and the various macro-economic linkages. As suggested by Caballero *et al*. (2000) and Pearson *et al*. (1989), in order to make a meaningful comparison between international market prices and domestic prices, an adjustment of the prices of the importable needs to be made. The adjustment processes enable one to make a clear distinction between financial parity prices and economic parity prices, thus allowing an assessment of pricing efficiency. With the various indicators generated, a clear assessment of the common tariff on irrigated rice production system can be made.

4.5 Limits of the model

The PAM is a double accounting system of identities with no behavioural equations (Masters, 1995). The behavioural content of the PAM is embodied in the shadow prices used and in the interpretation of the matrix. In the development of the various accounting budgets, the decision to omit some elements may bias the results, which are based on current year data and information, and thus the model is static. Due to its static nature, PAM could be biased toward government policies (Yao, 1997). Another possible limit concerns the difficulty in accurately determining economic (opportunity costs) prices and the decomposition of input costs into tradable and non-tradable components (Masters, 1995: 28; Yao, 1997: 214).

4.6 Chapter summary

The chapter discussed various issues pertaining to the Policy Analysis Matrix (PAM) which was the analytical tool used to investigate the custom union's tariffs effects on the competitiveness of the irrigated rice production system in Niger. The chapter reviewed the theoretical background of the PAM and the importance of its use when it comes to evaluate the effects of an identified policy effects on a particular agricultural production system given the technologies and market conditions.

From the review of the literature, we understood that the PAM methodology enables specific policy evaluation of agricultural production systems that can take into account differences in crop growing ecologies and levels of technologies given prevailing market conditions. We learned also that the Policy Analysis Matrix (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). In the PAM approach, Monke and Pearson (1989) also defined several indicators of policy transfers and protection coefficients that are indicators of the policy effects on the agricultural system producing one commodity and agricultural systems producing different commodities. These are categorized into output transfers (I), tradable inputs transfers (J), factor transfers (K), and the 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 which are free of currency or commodity distinctions.

This constituted the main reason that guided the choice of this analytical tool to provide answers to the research questions formulated in our dissertation. Specifically, from the review of the literature, it be can be retained that 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. The analytical tool permits the generation of a number of policy indicators through the comparison of the existing levels of private (actual market) to social (efficiency) revenues, costs, and profits in order to generate three categories of policy indicators including the private profitability, social profitability, and the policy transfers (divergences). In terms of policy analysis, the indicators convey specific information relating to policy effects on the performance of the agricultural system being investigated.

Furthermore, due to all these possibilities, the policy analysis matrix (PAM) was used in a number of previous studies to assess the effects of policies and policy changes on agricultural production systems characterized by the growing ecology, location, technology use, and crop management (levels of inputs use). In the case of trade policy involving price-based measures such as the case of the custom union's tariffs, effects can also be measured based on returns and costs of agricultural enterprises through the same mechanism. Therefore, the use of a policy analysis matrix allowed the assessment of the common external tariff impact on the irrigated rice competitiveness given the prevailing market inputs and outputs prices that entered into the various activities of the commodity chain (from farm production to consumption).

CHAPTER 5: DEVELOPING POLICY ANALYSIS MATRIX MODELS FOR AN IRRIGATED RICE SYSTEM

5.1 Introduction

An analysis of the irrigated rice enterprise as practiced in the Niger River valley of western Niger using the policy analysis matrix, necessitates the consideration of several critical elements entering into the production chain from farm-level production to the final stage of product marketing. Consideration of the various steps enables the formulation of a clear definition of the production systems in order to identify the various sub-systems (representative farm models) that can be used to develop the policy analysis matrix (PAM) models. For this purpose, the main steps taken into account to describe the commodity production sub-systems were the following: 1) farm-level production systems, 2) post-harvest activities that include the assembly of the product, the processing, and the marketing, and 3) macro prices and the trade policy elements. The evaluation of the costs and returns at farm level and the post-harvest stage is necessary for the development of 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 very powerful framework for planners trying to understand the fabric of their agricultural sector and to identify opportunities for improving its efficiency and enhancing growth (Randolph, 1998). The development of the PAM models however requires a good knowledge of the commodity systems and the policy elements that affect its activities. The main purpose of this chapter is to outline in detail the procedure and steps followed for the development of PAM models for the irrigated rice systems. In particular, the chapter first described and explained the importance of the farm-level production practices and field operations in models development. Secondly, the case of the post-harvest activities was also discussed. The third section explained the macro prices and the trade policy elements used. The last section introduced the PAM template.

5.2 Farm-Level Production Systems

In general, farming systems in the Niger River valley are characterised by dryland and irrigated rice production systems. Farmers produce under both systems, and for two reasons: 1) limited availability of irrigated land forces most farmers to do some dryland cropping, 2) combining dryland and irrigated crops can increase resource use efficiency, e.g. by using dry season labour for irrigation (Touré, 1994). The dryland activities practiced in marginal less fertile soils are characterised by various cropping systems which principally include monocropping systems of millet, sorghum, and peanut, and intercropping of millet/cowpea, millet/sorghum, and millet/sorghum/ cowpea. Irrigated rice is produced under two different systems: publicly managed irrigated rice infrastructure and privately irrigated rice production systems. Private rice irrigation is practiced outside the public irrigated rice perimeters. Besides these two irrigated rice production systems, a third type of rice production is the traditional rice production system in which rice is grown in flooded areas along the Niger River banks during the high period (June-December). For this type of rice production, irrigation is not controlled and fertiliser use is insignificant compared to the case of irrigated perimeter rice (Touré, 1994). During the rainy season, simultaneous field operations for both dryland and irrigated crops make it difficult for farmers to execute fieldwork in a timely manner.

The publicly managed irrigation infrastructures located in the Niger River valley region are mainly devoted to rice production. The documentation reviewed (Djido, 2004; Faivre-Dupaigre *et al*., 2006; Mossi and Manomi, 2007) showed the existence of 39 irrigated schemes along the Niger River valley totalling an estimated developed land of 8,424 ha mostly used for rice production with two cropping seasons per year: dry season and wet season cropping. There are up to 17 irrigated rice schemes in the Niamey region with 3,747 ha; 18 schemes in Tillabery region involving 4,406 ha of which 125 ha of vegetables and 4 schemes in the Gaya region (sharing frontier with Benin republic) encompassing 395.7 ha. Along the Niger River, public irrigation infrastructure typically consists of 4 different parts. The first part is large uniform levelling to protect the perimeter against flooding. Depending on the area of the irrigated perimeter, one or two electric powered pumps are used to pump the water from the river. Within the perimeter, water distribution is made through a set of concrete lined canals (primary and secondary canals). In some cases, a third (tertiary) canal is needed to take the irrigation water to the level of the rice plots. Lateral canals are used as drainage canals to evacuate any excess of water. Other infrastructure on the perimeters includes housing for the perimeter director, warehouses, and roads. The irrigated rice production system uses some modern technologies: modern water management and distribution infrastructure, fertilisers, improved rice varieties, small equipment, and very often, animal traction for field labour. Urea and composite fertilisers (15-15-15) are widely used but the use of pesticide and herbicides is relatively less important. Most popular grown varieties are IR 1529-680-3, BG 90-2, WITA 8, and WITA 9. These varieties are produced at the Saguia seed multiplication centre located in the Niamey region. This centre is in charge of rice seed multiplication for use in the irrigated perimeters and is operated by the Office National des Aménagements Hydro Agricoles (ONAHA) in collaboration with the cooperatives (the association of rice farmers operating in the irrigated rice perimeters) and the Union of Cooperatives and Rice Producers (FUCOPRI). Research on the irrigated rice production systems is conducted by the National Agronomic Research Institute of Niger (INRAN).

A consideration of the farm-level production systems is crucial in order to determine the main commodity production sub-systems that need to be incorporated in the policy analysis matrix development. The irrigated production systems are defined as the sequence of field operations, practices and crop management, and technologies used; these constitute important elements that enable the identification of the most important production systems in the region. This also enabled the development of the farm-level crop budgets which allowed the identification of labour costs, tradable inputs costs, and domestic factors costs related to the field operations. Earlier attempts to develop representative farm models in the region have defined three representative farm models (Touré, 1994). The criteria used are based on average land area allocated to the systems, the production systems and associated crop management practices, and level of inputs use. The first model concerned a farmer with dryland and irrigated perimeter rice fields (perimeter farmer model). The second model concerned a farmer operating both on dryland and public irrigated rice fields with the option of practicing private irrigated rice. The third model simulated the case of a farmer combining dryland and private irrigated rice (private irrigator model). Dioffo (2006) defined five categories of households based on criteria such as level of household crop diversification, agriculture production intensification, size of irrigated field plots, field operations and their sequence, and output levels. In so doing, the first important type of household combines dryland crops and irrigated perimeter rice (type 1). The second important type combines dryland crops, irrigated perimeter rice and vegetables (type 2). The third type combines dryland, irrigated perimeter rice, vegetables, and privately irrigated rice or traditional flooded rice (type 3). The fourth type of household practices essentially irrigated perimeter rice (type 4). The last type of household practices irrigated perimeter rice and vegetables (type 5). The common factor to all these typologies is that irrigated perimeter rice is central in the agriculture production strategy of the region and this is easily understandable since the public irrigated infrastructure offers several advantages: water availability, collectively planned activities, and support services for inputs delivery, short loans and rice commercialisation opportunities. In sum, the representative farm modelling efforts put an emphasis on the allocated farm size, field operations and their sequence, associated crop management practices, level of resources and technologies use and intensification, and output levels.

5.3 Post-Harvest Activities

5.3.1. Sub commodity value chain

The post-harvest (post-farm) activities include activities going from the assembly of the paddy to the processing and marketing of the product. These post-harvest activities have also been considered in other studies attempting to model the irrigated rice production systems, especially in regard to studies of rice value chains. Due to the important role played by post-harvest activities in value added, efforts were developed to better understand their organisation along the commodity production chain. Mossi and Manomi (2007) identified several value chains based principally on the commodity production, input suppliers, product processing techniques, and commercialisation channels. For the specific case of irrigated perimeter rice, these authors defined three main sub-commodities value chains (table 5.1); their main categorising factors related principally to rice processing and commercialisation channels implying the importance of these two stages in the overall rice sector value added.

Table 5.1: Sub commodity value chains (Irrigated perimeter rice)

Activity	Sub-commodity value chain 1	Sub-commodity value chain 2	Sub-commodity value chain 3
Rice Production	Producers	Producers	Producers
Inputs Supplier	Central Agricultural Warehouse	Central Agricultural Warehouse	Central Agricultural Warehouse
Rice commercialization	OPVN	OPVN	Local markets
Rice Processing	RINI (industrial rice mill)	Private Mini Rice Mill	Artisanal rice mills (dehuller)

Source : Mossi and Manomi (2007).

The inputs suppliers include also private businesses that operate in the commodity system, entertaining various forms of arrangements with perimeter cooperatives and producers.

5.3.2 Commercialization of locally produced rice

The importance of the rice commercialisation channels and processing techniques (industrial, mini rice mills, and private dehullers) in irrigated perimeter rice value chain development has been reported by other authors (Boukar and Chegou, 2002; Manomi I., 2004; Koré, 2004; Faivre-Dupaigre *et al*., 2006). These studies revealed that two principal categories of economic actors are involved in the irrigated perimeter rice commercialisation; these are private businesses and an institutional actor (state agency). The main private agents include the rice traders (wholesalers, semi-wholesalers, and retailers), irrigated perimeters cooperatives, women rice traders involved in processing (milled and parboiled rice), and rice millers (RINI, SOTAGRI, and SSL). The institutional actor is principally the state agency called 'OPVN, 'Office des Produits Vivriers du Niger', a national agency in charge of official food grain stock management and distribution.

Boukar and Chegou (2002) identified two main stages in the commercialisation of locally produced rice: 1) primary paddy rice commercialisation, and 2) milled rice commercialisation. The primary stage of paddy commercialisation involved the irrigated perimeter cooperatives, the producers, private rice traders (among which are women rice traders), and rice millers. Milled rice commercialisation involves the private channel dominated by private rice traders and the "modern" channel dominated by RINI (industrial rice mill) and mini rice mills (SSL and SOTAGRI). The working relationships existing between these economic agents are of formal and informal types. Koré (2004) identified three main rice marketing channels of which one is a formal (official marketing system) and the remaining two are private: formal and informal. The actors within the chain of the formal rice marketing are the producers, the perimeters' cooperatives, the large public rice mill (RINI), rice retailers, and consumers. This channel absorbed up to 7 % of the total of irrigated rice production. The private formal rice-marketing channel is composed of the producers, the cooperatives, the artisanal rice dehullers, the rice traders, and the consumers. This channel absorbed 3 % of the rice production from the irrigated perimeters. The third rice-marketing channel is the informal private channel which trades the local parboiled rice and is composed of actors such as the wholesalers of local rice, the rice retailers, artisanal dehullers, and the consumers. This third marketing channel mostly involves women rice traders who purchase the paddy rice and process it into parboiled rice. Manomi (2004) indicated that, in general, rice commercialisation is segmented into three main areas: 1) the Niger River valley region where imported rice is less present, 2) the Niamey urban centre (capital city) where locally produced rice is present but less so than imported rice, and 3) the remaining urban centres of the country where the presence of both categories of rice is relatively low in comparison to the main urban centre (Niamey).

Primary paddy rice commercialisation starts at the end of each cropping season during both dry and wet seasons. At the end of each cropping season, irrigation water users pay some fees to their respective cooperatives either in cash or by giving out the equivalent amount of paddy. With an average water users' fees of 101,000 FCFA/ha (202 US $) per season, the total quantity of paddy rice to be collected and commercialised by the perimeters cooperatives can be estimated at between 11,000 and 13,000 tonnes per year, assuming a per unit paddy price of 133 FCFA/kg (0.27 US $) and a cultivated irrigated rice area of 7,500 – 8,500 hectares (Faivre-Dupaigre, 2006). This quantity can amount to 28,000 tonnes of paddy by adding the equivalent amount of paddy paid as reimbursements for fertilisers purchased by producers from the cooperatives. After the producers have paid their dues to the cooperatives, the remaining part of the production is subdivided into two portions, one of which is devoted to home consumption, gifts, and other uses, while the second portion is sold to private rice traders within the village or in rural neighboring markets. On average, 30 % of the production of the perimeters is used for home consumption (Faivre-Dupaigre *et al*., 2006).

Through the formal rice commercialisation channel, the quantity of paddy collected by the perimeter cooperatives is sold to OPVN which transfers this paddy for milling to the large capacity rice mills, namely, Riz du Niger (RINI), and other medium size private rice mills (SSL and SOTAGRI). Riz du Niger is a semi-private rice milling company with 25,000 tonnes annual milling capacity. It was created in 1967 with its main mandate being to collect paddy rice, industrial paddy processing, and milled rice marketing. The company underwent a difficult financial situation and was obliged at a certain point to operate at levels well below its normal capacity. Current estimates of paddy processed are around 15 % of its annual capacity (Mossi and Manomi, 2007). The quantity of paddy processed dropped from 14,269 tonnes in 1992 (57 % of milling capacity) to about 4,100 tonnes in 2001 (16 % of milling capacity). In 2002, the company was declared bankrupt. The company was also subjected to privatisation and a final restructuring document was presented in January 2007 (Mossi and Manomi, 2007). Alternative measures were recently taken to help the company restart its activities. These measures consisted of a special agreement between RINI, OPVN, and perimeter cooperatives. Through this agreement, OPVN purchases paddy rice from the perimeter cooperatives and sends it to RINI for milling. The company processes this quantity of paddy for the benefit of OPVN. Other mini private rice mills (SSL and SOTAGRI) also process paddy rice into milled rice for the benefit of OPVN. The Seyni Saley Lata (SSL) is a private medium size milling company with an annual capacity of 2,700 tonnes. SOTAGRI, a private milling company, created in 2002 has an annual milling capacity of 10,500 to 11,300 tonnes. Mossi and Manomi (2007), estimated that an average of 6,130 tonnes of paddy rice was purchased annually by OPVN from perimeter cooperatives between 2003 and 2006. However, Faivre-Dupaigre *et* *al*. (2006) estimated the annual quantity purchased at about 6,000 to 8,000 tonnes and stated that it could reach 10,000 tonnes annually. OPVN uses the quantities of milled rice as a food security stock or sells the product to the rice wholesalers but OPVN also sells the milled rice in its own selling stands located in the regions of Kollo, Tillabery, and Niamey at market price (Faivre-Dupaigre *et al*., 2006). Women rice traders also purchase paddy rice from the perimeters cooperatives and this category of rice traders become an important segment in the primary commercialisation of paddy rice generated by the irrigated perimeters (Boukar and Chegou, 2002).

The private rice commercialisation channel also absorbs the portion of irrigated paddy rice which goes to the market (after the producers have paid out all their dues) in addition to the paddy rice purchased from the cooperatives by women rice traders and other private rice traders. This is a clear indication that the private channels of rice commercialisation are largely dominated by private rice traders (wholesalers, semi-wholesalers, and women rice traders). The number of women rice traders was estimated at 1,500 in the region of Niger River valley and various studies (cited earlier) found that women rice traders each purchased, on a weekly basis, an average quantity of 1 to 3 bags of paddy rice (the average standard weight of a bag of paddy rice is 72 kg) which is processed into parboiled rice and sold in local markets; but sometimes they just mill the rice without prior parboiling. The women rice traders frequent on average up to three rural markets for the purpose of either selling their product or buying paddy rice. According to Faivre-Dupaigre *et al*. (2006), these women rice traders market almost 60,000 tonnes annually, which constitutes up to 80 % of the quantity of paddy commercialised in the Niger River valley region. Faivre-Dupaigre (2006) estimated that the relatively wealthier women can purchase 3 to 4 paddy bags (72 kg) per week each, meaning a maximum annual quantity of 15 tonnes of paddy per woman rice trader. With an estimated quantity of 60,000 tonnes of paddy rice commercialised annually by the women rice traders, that brings their number to about 4,000 agents, showing the importance of this private rice commercialisation segment in the Niger River valley. Faivre-Dupaigre *et al*. (2006) estimated that three quarters of the quantity of paddy rice traded by women rice traders is processed into local parboiled rice and this practice is common in the north-western part of the region (Tillabery and Ayorou) while in the southern part (Kollo and Say), it is less practiced (paddy is processed into milled white rice and sold). The technique of parboiling is practiced in order to increase milling efficiency. The conversion rate of paddy into milled rice can vary from 55 % in the case of non-parboiled rice to 66 % for parboiled rice (Faivre-Dupaigre *et al*., 2006). Other advantages in parboiling paddy rice before milling is that it reduces the percentage of broken rice and also increases the nutritional value of rice (vitamins B, mineral salts), and that, during cooking, grains do not stick to each other and have a greater swelling capacity, as well as a longer storage period.

An important aspect of the commercialisation of locally produced rice is its quality after processing. As stated earlier, there are three categories of mills where the paddy rice produced in the irrigated perimeters is milled. The RINI mill is a relatively modern industrial rice mill and produces milled rice of good quality with different brands: Riz 33, Riz 32, broken rice, etc. Riz 33 has been confirmed by several studies (Mossi and Manomi, 2007; Manomi, 2004) to be of superior quality, while Riz 32 is comparable to imported milled rice with 25 % broken rice (for example Pakistani rice 25 %). The SSL and SOTAGRI rice mills also produce the same brand as RINI. The small scale private rice dehullers produce milled rice with a relatively high percentage of broken rice but the quality of the final product is comparable to the imported milled rice brand with 25 % of broken rice, Pakistani rice 25 %. Pakistani rice 25 % is frequently found on Nigerien markets (Manomi, 2004).

To summarise, locally produced rice commercialisation in the Niger River valley largely involves private economic agents (paddy rice producers, rice traders, irrigated perimeters cooperatives, various categories of private rice mills) with different forms of working relationships; informal agreements are the dominant form. Commercialisation is performed in two principal phases: primary paddy rice commercialisation and milled rice commercialisation (milled parboiled rice and milled non-parboiled rice). Private channels are important in all these stages, with women rice traders playing an important role, including private small scale rice dehullers. Even though paddy milling involves industrial milling and medium size rice mills, a large part of this paddy generated by the irrigated perimeters is processed by small scale private rice dehullers. As stated by Manomi (2004), the small scale rice dehullers process the major part of the paddy rice produced in the irrigated perimeters but the number of operators, capacities of the machines and their technical performances have not been well investigated. Therefore, in most cases, it is this final product which competes with imported rice in the rural and urban markets (Niamey urban centre principally). The artisanal dehullers have a lower milling conversion rates (55 to 66 %) and have an annual capacity of 60 to 100 tonnes (Faivre-Dupaigre *et al*., 2006). Therefore, much of the trade policy effects can be investigated considering outcomes occurring in this particular sub-commodity value chain. For this purpose, we have considered constructing the PAM models by focusing on information generated through activities in these marketing channels.

5.4 Macro Prices and the Trade Policy Elements

Two categories of price are included in the model: market and social prices. The market prices include the prices of inputs and outputs as given in the crop budgets, processing and product marketing related costs. To be able to compare locally produced rice with imported rice considering the various qualities of product in the market, different brands of imported rice are considered namely Pakistani rice 25% , Thailand rice 25 %, Thai parboiled 100 %, Indian rice 25 %. Imported rice is brought into the country via three main ports of import used by Nigerien rice importers: the ports of Cotonou (Benin), Lome (Togo), and Tema (Ghana). The ports' charges, handling and transportation costs differ depending on the port of importation. Mossi and Manomi (2007) reported that rice imports come principally from Pakistan, China and India through the ports of Cotonou, Lomé and Tema. For this study, the ports of Cotonou and Tema are considered. The international quotations for these brands of rice (FOB) prices are obtained from the FAO Rice Market Monitoring document (RMM Oct 2008) and the average price from January to September is used for each brand of rice (table 5.2). This is because the data used are mostly for the year 2007. The main points of comparison between the imported rice and local rice are the Niamey urban centre and the Tillabery area located in the North western part of the Niger River valley; Tillabery is a major rice producing region. To obtain the financial import parity prices at these points of comparison, the international quotation (FOB price) of the imported rice quality, the port charges, marketing and transportation related costs were added together. The financial import parity prices also include all import duties and taxes. In this case, the common external tariff is applied and its structure is given in the next section. However, the social (economic) import parity prices do not include the import duties and taxes.

Table 5.2: FOB price of various types of imported rice

Types of rice	FOB Price, USD / tonne*
Pakistan Rice - 25%	275
Thailland Rice A1 Super	260
Thailland Rice 25 %	295
Thai parboiled 100 %	322
India Rice 25 %	277
Viet 25 %	286

Source: FAO (2008).
* Average of January – September 2007.

Since the international quotations of imported rice are in US dollars, a conversion rate is used to convert the US currency into the local currency, CFA. As stated by Pearson *et al*. (2003), the conversion of prices expressed in international currency to their domestic currency equivalent requires an appropriate foreign exchange rate. The official exchange rate can be used in the calculations only if it accurately reflects the true scarcity value of foreign exchange. The exchange rate used is the 2007 average of the monthly exchange rates given (on the first of every month) by various sources of foreign currency: Bloomberg, Ouanda, Ecobank, and Yahoo Finance (table 5.3). This annual value of the exchange rate (480 FCFA/US $) can be used as a proxy measure for the equilibrium exchange rate. Exchange rate fluctuations have an impact on the financial and economic parity prices of the commodity and this aspect is taken into account in the sensitivity analyses of the exchange rate variations. In this case, the 2008 annual value of the exchange rate, maintaining constant the international quotations for imported rice qualities, was used.

Table 5.3.: Averages exchange rates

Month	Rates, FCFA / USD
Jan	496
Feb	504
March	496
April	491
May	482
June	487
July	486
Aug	480
Sept	481
Oct	460
Nov	454
Dec	448
Average	480

Source: Africa Rice Center (AfricaRice) ex WARDA/ADRAO. Finance Office.

* Average of the monthly exchange rates given (first of every month) by various sources of foreign currency: Bloomberg, Ouanda, Ecobank, and Yahoo Finance.

Trade policy elements that are used relate to the structure of the common external tariff (CET). Under CET, milled rice imports from third countries are subject to a 10 % import duty and various fees of 2 % (statistical tax and solidarity tax). Milled rice belongs to Category 2 of products while rice seeds are in Category 1. In addition to this tariff structure, WAEMU member countries apply other taxes such as the PCC CEDEAO of 0.5 % (Niger applys 1 %) and Niger also applies the TVI COTECNA of 1 %. Fertilisers, pesticides and herbicides belong to Category 1. The provision of these inputs is made through the cooperatives, private businesses, and sometimes through informal arrangements between rice traders and producers.

Table 5.4: Common external tariff structure

Product Category	Customs tariff	Statistical tax	Solidarity tax
0	0%	1%	1%
1	5%	1%	1%
2	10%	1%	1%
3	20%	1%	1%

Source: UEMOA, www.uemoa.int (accessed May 2009)

The UEMOA common external tariff and other duties are applicable to CIF value. By taking the product value as a base of calculation (100 %), the consolidated tariffs on imported rice is 135.09 of the CIF value. The rates do not take into account the special measures applied during the 2008 food crisis. In March 2008, during the food crisis period, special measures were taken, namely, a lifting of imports tariffs on imported rice.

Table 5.5: Tariffs and other taxes applied to imported rice in Niger

	Rate*, %	Cumulative*
Value of product (base)		100
Custom tariffs	10	110
Statistical tax	1	111
Value added tax (VAT)	19	132.09
PCS UEMOA	1	133.09
PCC CEDEAO	1	134.09
TVI COTECNA	1	135.09

Source : UEMOA and personal communication with Niger 'Service des Douanes' (August, 2008).

As irrigated rice production is capital intensive, the interest rate used for all capital invested in the activity is 15 % at market price; this is within the range of interest rates applied by local commercial institutions. Faivre-Dupaigre *et al*. (2006) indicated that the interest rates applied by the major commercial banks (SONIBANK, BIA, BOA) range from 10.5 to 15 %, depending on the amount of the loan, the time period, and the risk. We estimated the interest rate at reference price to be 12.75 %, computed as an average of the lower range of interest rates applied by the banks.

5.5 The representative farm model

As the Tillabery region involved more than 50 % of the irrigated rice area, a representative farm is chosen, based on available data and information within this site. Such a representative farm has an average irrigated field size of 0.64 hectare and produces an average of 4.3 tonnes of paddy rice per cropping season, which is sold at 127 FCFA/kg of paddy (0.265 US $/kg). The farm uses fertilisers and other modern inputs, and various field operations are also practiced. After harvest, the paddy is collected on the farm before being transported to a storage place in the household. After deduction of the dues, the remaining part of the production is sold either to local markets or directly to local village or neighboring village rice traders. The rice traders process the paddy into milled rice or parboil the rice before milling. Data and information on parboiled rice is gathered from the study by Dioffo *et al*. (2006) on post-harvest technologies and milling of paddy rice in the Niger River valley.

5.6 The Policy Analysis Template

Application of the policy analysis matrix to assess the competitiveness of rice production systems in West Africa has a long history. The Policy Analysis Matrix (PAM) was introduced as a basic analytical tool within the framework of strengthening policy analysis capacity in West Africa, and several institutions have contributed to this effort, among which are the Economic Development Institute (EDI) of the World Bank, USAID (under the APAP project), the West Africa Rice Development Association (WARDA), and the African Development Institute of the African Development Bank (Randolph, 1998). To this end, technical support needed to be provided to the various policy analysts of the region and this was given by the WARDA policy unit. The development of a pioneer template was made possible by active partnerships between countries, using national rice sector studies that provided a practical example to follow (Randolph, 1998). The template was developed to allow easy computation of the various policy indicators, including private and economic incentives. Presented in an Excel spreadsheet format, the PAM template is made up of four different budgetary components: farm-level crop budgets, costs of collection of rice paddy from farm to the place of processing, the processing enterprise budget, and transport costs from market to commercialisation. This means that a holistic approach (chain analysis) is used to assess the impacts at the various levels. A summary table gives the final results of the PAM. The early PAM template developments and applications were facilitated by Randolph (1998).

5.7 Chapter summary

The main purpose of chapter 5 was to provide the foundation ground for the development of the various Policy Analysis Matrix (PAM) models for the irrigated rice systems. As explained throughout the chapter, the farm-level production practices and field operations were important steps in the models development including the data and information relating to the post-harvest activities. A consideration of the farm-level production systems was crucial in order to determine the main commodity production sub-systems that needed to be incorporated into the PAM scenarios. The complete PAM scenario development required also the inclusion of data on the macro prices and the trade policy elements used.

The chapter emphasized also the importance of a good knowledge of the commodity production systems and the policy elements affecting its activities. Clearly, the chapter identified the main steps taken into account to describe the commodity production sub-systems: 1) farm-level production systems, 2) post-harvest activities that include the assembly of the product, the processing, and the marketing, and 3) macro prices and the trade policy elements. The evaluation of the costs and returns at farm level and the post-harvest stage was necessary for the development of the accounting budgets of the crop enterprise. In the Niger River valley, a large part of the paddy generated by the irrigated perimeters is processed by small scale private rice dehullers. Therefore, in most cases, it is this final product which competes with imported rice in the rural and urban markets (Niamey urban centre principally) and much of the trade policy effects can be investigated considering outcomes occurring in this particular sub-commodity value chain.

Two categories of prices were included in the model: market and social prices. The market prices included the prices of inputs and outputs as given in the crop budgets, processing and product marketing related costs. To be able to compare locally produced rice with imported rice considering the various qualities of product in the market, different brands of imported rice were considered namely Pakistani rice 25% , Thailand rice 25 %, Thai parboiled 100 %, Indian rice 25 %. Imported rice is brought into the country via three main ports of import used by Nigerien rice importers: the ports of Cotonou (Benin), Lome (Togo), and Tema (Ghana). The ports' charges, handling and transportation costs differ depending on the port of importation. Therefore, the port of importation was also found important in the parity price estimation of imported rice brands.

The PAM template was developed to allow easy computation of the various policy indicators, including private and economic incentives. Presented in an Excel spreadsheet format, the PAM template was made up of four different budgetary components: farm-level crop budgets, costs of collection of rice paddy from farm to the place of processing, the processing enterprise budget, and transport costs from market to commercialization.

CHAPTER 6 : THE EFFECTS OF CUSTOMS UNION TARIFFS ON THE COMPETITIVENESS OF IRRIGATED RICE PRODUCTION IN NIGER: POLICY ANALYSIS MODEL (PAM) RESULTS

6.1 Introduction

The policy analysis approach was used to evaluate the effects of common external tariffs on the competitiveness of irrigated rice production systems in Niger. The various analyses were performed using farm-level data in combination with data and information relating to post-harvest activities, rice marketing, and effects of the common external tariffs. 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 are Pakistani rice (25 %), Thai rice (25 %), Thai parboiled rice (100 %) and Indian rice (25 %). Depending on the port of importation, the financial and economic parity prices of these brands differ and 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 sixteen (16) PAM base models scenarios. Thus, with the two points of comparison, a total of thirty (32) PAM base models scenarios were finally developed.

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 tonnes per hectare). Sensitivity analyses were also done to consider macro economic changes in relation to the import duty levels of common external tariffs (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. Finally, another macro economic change simulation was a change in the exchange rate (FCFA into US $). All the sensitivity analyses were performed using two imported rice brands, namely, Pakistani rice (25%) and

Thai parboiled 100 %. This chapter discusses the various results obtained with regards to private profitability, social profitability, indicators of comparative advantage, the policy transfers and protection coefficients. Next, the sensitivity results are presented in detail. The final section provides some concluding remarks.

6.2 Base scenario summary information

The set up of the base scenario model involved several key elements relating to farm-level production and post-harvest activities, rice marketing, macro prices and the common external tariff elements.

6.2.1 Farm level technical coefficients

The base scenario set up involved various farm-level technical coefficients which include not only the fixed cost but also variable costs for labour and inputs (table 6.1). The fixed costs relate to farm equipment, which is mostly hand tools, including knives, sickles, winnowing fans, machetes, and hoes. The cost involved in the use of farm equipment in a particular cropping season is evaluated according to equipment life-time, capital and initial purchase costs, and used-up value. The labour cost is the actual cost paid by the farmer to hire seasonal labour and this is estimated per unit of land and per field operation. Other input costs are also estimated, based on information provided by the farmers. Final farm product relates to paddy production per unit of land (4.3 tons/ha).

6.2.2 Processing (post-harvest activities)

Four main categories of costs relating to processing were considered: labour, inputs, raw materials, and fixed costs (table 6.2). The artisanal dehullers have lower milling conversion rates (55 to 66 %) and have an annual capacity of 60 to 100 tonnes (Faivre-Dupaigre *et al*., 2006). The technical characteristics considered for small-scale rice milling machines are: a capacity of 80 tonnes per year and a technical performance of 65 % of conversion rate (table 6.3) with an operating time of 3,120 hours per year.

6.2.3 Transport to market and marketing

For this channel, the standard elements considered related to labour cost for handling (315 FCFA/ bag in Niamey region and 180 FCFA/bag in Tillabery region) and transport from rural areas to urban markets (200-350 FCFA/bag).

Table 6.1: Farm Level Budget Information

Fixed Factors	Life-Time, years	Used up Portion	Capital Cost, %		Initial Cost	Residual Value
			Market	Reference	FCFA	FCFA
	3	0.167	15.0	12.8	1,250	1,042
Sickle	2	0.250	15.0	12.8	650	488
Hoe	3	0.167	15.0	12.8	1,000	833
Bag	1.5	0.333	15.0	12.8	500	333
Packing thread	1	0.500	15.0	12.8	300	150
Winnowing fan	1.5	0.333	15.0	12.8	500	333
Knife	1.5	0.333	15.0	12.8	500	333
Labor	Cost, FCFA /ha					
Nursery preparation and plants uprooting	6,061					
Transplanting	10,313					
Filling (re-transplanting)	1,172					
First Weeding	11,113					
Fertiliser Application	750					
Second Weeding	8,272					
Guarding	10,973					
Harvesting	11,233					
Gathering	9,458					
Drying	11,817					
Threshing	14,311					
Winnowing	16,288					
Transport	8,381					
Inputs	Cost, FCFA /ha	Quantity	Total, FCFA / ha			
Seed	4,937.5	-	4,938			
Urea (bags of 50 kg)	13,033	3.94	51,328			
Fertiliser – NPK (bag of 50 kg)	13,033	4.69	61,092			
Herbicides (liters)	5,786	3.125	18,081			
Phyto-sanitary products (kg)	4,125	0.77	4,125			
Water users' fee (FCFA/ha per season)	104,000		104,000			
Products	Unit Price, FCFA	Yield, tons/ha	Total, FCFA			
Paddy	127,000	4.3	546,100			

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007)

Table 6.2: The Processing (conversion of one tonne of paddy into milled rice)

Fixed Factors	Life-Time, number of years	Used up part of capital (Proportion used up in the activity)	Capital Cost, %		Initial Cost (purchased cost), FCFA	Residual Value, FCFA
			At market price	At reference price		
Milling machine	15	0.0003333	15.0	12.8	1,200,000	1,199,600
Spare parts	3	0.0016667	15.0	12.8	60,000	59,900
Labor (milling machine operator working time)	Salary, FCFA / Month	Used up part of machine operator labor	Equivalent value of machine operator labor used up, FCFA			
Machine operator	40,000	0.15	6,000			
Inputs (for milling machine)	Price, FCFA	Quantity, Liters	Total, FCFA			
Gas oil	450	3	1,350			
Raw Material (product to be milled)	Price, FCFA / tonne	Equivalent quantity (tonne) of paddy to obtain one tonne of milled rice with a 0.65 conversion rate of paddy into milled rice	Cost of the equivalent quantity of paddy derived, FCFA			
Paddy	127,000	1.5384615	195,385			

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.3: Other Processing information

Items	Characteristics
Milling Capacity (tonnes per year)	80
Operating (hr/year)	3,120
Conversion rate (%)	65

6.2.4 Tariffs and duties on imported rice

By taking the product value as base of calculation (100 %), the consolidated tariff on imported rice is 135.09 % of the CIF value, i.e. 35.09 % import duty and taxes. These rates do not take into account the special measures applied during the 2008 food crisis. In March 2008, during the food crisis period, special measures were taken, namely, the lifting of import tariffs on imported rice.

6.2.5. Tariffs and taxes on inputs

Based on information provided on UEMOA web site and in Faivre-Dupaigre et al. (2006), page 91, we tried to estimate the cumulative rates of inputs, milling machine, and spare parts. The cumulative rates vary between 27 % (for mostly fertilisers, herbicides, pesticides, and milling machinery spare parts) to 32 % for gas oil (which is used by the rice milling machines).

6.3 Private profitability

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 policy analysis matrix (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 interventions 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. As a rule, a ratio less than 1 indicates a profitable enterprise while a ratio greater than 1 indicates a non-profitable enterprise.

Tables 6.4 and 6.5 give the various private profitability indicators of irrigated rice production in the Niger River valley of western Niger. The summary information provided in table 6.4 shows that, on average, irrigated rice production is an activity which 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. On average, when the locally produced rice is compared to a brand of imported rice which enters into the country through the Cotonou port, with a whole price of 231,000 FCFA (481.25 US $) per tonne, the activity generates for all operators a financial gain of 84,861 FCFA/ tonne of milled rice (176.73 US $/tonne). This financial gain amounts to 237,188 FCFA/hectare (494 US $/ha). The financial cost-benefit ratio was evaluated at 0.54, implying a high profitability level for the activity. With a retail price of 239,000 FCFA/tonne of milled rice, the financial profitability gains amount to 78,736 FCFA/tonne of milled rice (164 US $/tonne) and 220,068 FCFA/hectare (458.475 US $/ha). In this scenario, the financial cost-benefit ratio is 0.56. These results compare well with those obtained by individual points of comparison (Niamey or Tillabery), with a financial cost-benefit ratio varying between 0.50 and 0.62. Similarly, when the locally produced rice is compared to an imported rice brand entering into the country through the Tema port, the results are quite enlightening. With a wholesale price for locally produced rice of 240,625 FCFA/tonne of milled rice, the financial gains were 84,861 FCFA/tonne (176.80 US $/tonne) and 237,188 FCFA /hectare (494 US $/ha), with a cost-benefit ratio of 0.54, implying also good profitability of the activity for all operators involved. 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.

In sum, the private profitability indicators, being the results of the sum of outcomes of farm profits and post-farm activities (collection, processing and marketing) indicates 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 common external tariffs to major inputs such as fertilisers, pesticides, herbicides, other agricultural equipment and post-harvest activities. It can therefore be concluded that operators in the various segments of the system earn positive profits.

Table 6.4: Summary Results of Average Private Profitability Indicators and Financial Cost-Benefit Ratio of Locally Produced Rice

Port of importation	Point of Comparison	Type of Markets	Selling Price for Local Milled rice	Financial Profitability		Financial Cost-Benefit Ratio
			FCFA / tonne of milled rice	FCFA / tonne of milled rice	FCFA / Hectare	
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

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.5: PAM Base Scenarios Results: Financial Profitability and Financial Cost-Benefit Ratios

Port of importation	Imported Rice Brands to which local rice is compared	Point of Comparison	Type of Markets	Selling Price for Local Milled rice FCFA / tonne	Financial Profitability		Financial Cost-Benefit Ratio
					FCFA / tonne of milled rice	FCFA / Hectare	
Cotonou	Pakistan rice	Niamey	Retail	255,000	99,661	278,551	0.489
			Wholesale	219,000	63,661	177,931	0.600
		Tillabery	Retail	213,000	63,361	177,093	0.594
			Wholesale	250,000	100,361	280,508	0.480
	Indian Rice 25 %	Niamey	Retail	255,000	99,661	278,551	0.489
			Wholesale	219,000	63,661	177,931	0.600
		Tillabery	Retail	213,000	63,361	177,093	0.594
			Wholesale	250,000	100,361	280,508	0.480
	Thai rice 25 %	Niamey	Retail	255,000	63,661	177,931	0.600
			Wholesale	219,000	63,661	177,931	0.600
		Tillabery	Retail	213,000	63,361	177,093	0.594
			Wholesale	250,000	100,361	280,508	0.480
	Thai parboiled	Niamey	Retail	300,000	131,564	367,722	0.429
			Wholesale	300,000	131,564	367,722	0.429
		Tillabery	Retail	208,000	45,264	126,513	0.680
			Wholesale	145,000	55,264	154,463	0.635
Average		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

Port of importation	Imported Rice Brands to which local rice is compared	Point of Comparison	Type of Markets	Selling Price for Local Milled rice FCFA / tonne	Financial Profitability		Financial Cost-Benefit Ratio
Tema	Pakistan rice	Niamey	Retail	255,000	99,661	278,551	0.489
			Wholesale	219000	63,661	177,931	0.600
		Tillabery	Retail	213,000	63,361	177,093	0.594
			Wholesale	250,000	100,361	280,508	0.480
	Indian Rice 25 %	Niamey	Retail	255,000	99,661	278,551	0.489
			Wholesale	219,000	63,661	177,931	0.600
		Tillabery	Retail	213,000	63,361	177,093	0.594
			Wholesale	250,000	100,361	280,508	0.480
	Thai rice 25 %	Niamey	Retail	255,000	99,661	278,551	0.489
			Wholesale	219,000	63,661	177,931	0.600
		Tillabery	Retail	213,000	63,361	177,093	0.594
			Wholesale	250,000	100,361	280,508	0.480
	Thai parboiled	Niamey	Retail	300,000	131,564	367,722	0.429
			Wholesale	300,000	131,564	367,722	0.429
		Tillabery	Retail	208,000	45,264	126,513	0.680
			Wholesale	218,000	55,264	154,463	0.635
Average		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

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.4 Social profitability and comparative advantage

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 (reference prices), which reflect scarcity values or reference prices. As stated by Monke and Pearson (1989), social profitability is an efficiency measure because both the outputs and inputs are valued at prices that reflect the scarcity values or social opportunity costs. Therefore, positive social profitability indicates an efficient enterprise while negative social profitability indicates a non-efficient enterprise that would necessarily require some interventions to remain in business. Following the same logical reasoning, an efficient enterprise creates income for the whole economy, thus it has a comparative advantage, while a non-efficient enterprise does not. In the PAM indicators, the comparative advantage is evaluated by the domestic resource cost (DRC) ratio. A DRC less than 1 indicates that an irrigated rice enterprise has a comparative advantage in producing local rice using domestic resources. A DRC ratio greater than 1 indicates that the irrigated rice enterprise does not have a comparative advantage in producing local rice 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 computed 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 social cost-benefit ratio (SCB) which measures the ratio of the sum of tradable input costs and domestic factor costs to gross revenue, all valued at reference prices. From its formula, it can easily be noted that an indicator of SCB less than 1 means that irrigated rice production has a comparative advantage while a ratio greater than 1 indicates that the costs are higher than the benefits and implies that the enterprise is not efficient.

In retail markets on average, economic profitability is 130,688 FCFA per tonne (272 US $ per tonne) of milled rice when comparing local milled rice to imported rice brands originating from port of Cotonou (table 6.6). In wholesale markets, it is 117,652 FCFA/tonne of milled rice (245 US $ per tonne). The comparison of local milled rice to the imported rice brands originating from Tema's port shows an economic profitability of

141,176 FCFA per tonne (294.11 US $ per tonne) in retail markets versus 127,640 FCFA/tonne (265.92 US $/tonne). The economic profitability indicator is relatively higher in the Tillabery region than in the Niamey capital urban (table 6.6). 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.

Table 6.6: Summary Results of Average Economic Profitability Indicators, Domestic Resource Cost Ratio, and Social Cost-Benefit Ratio of Locally Produced Rice.

Port of Importation	Point of Comparison	Type of Markets	Reference Price for Imported Milled rice FCFA / tonne	Social Profitability		Domestic Resource Cost (DRC) Ratio	Social Cost Benefit (SCB) Ratio
				FCFA / tonne of Local Milled Rice	FCFA / Hectare		
Cotonou	Niamey	Retail	261,789	115,867	323,847	0.45	0.58
		Wholesale	249,322	103,400	289,004	0.48	0.61
	Tillabery	Retail	285,731	145,509	406,698	0.39	0.52
		Wholesale	272,125	131,903	368,669	0.42	0.54
	Total	Retail	273,760	130,688	365,273	0.42	0.55
		Wholesale	260,724	117,652	328,836	0.45	0.58
Tema	Niamey	Retail	271,922	126,000	352,170	0.43	0.56
		Wholesale	258,973	113,051	315,978	0.46	0.59
	Tillabery	Retail	296,574	156,352	437,004	0.38	0.50
		Wholesale	282,452	142,229	397,531	0.40	0.52
	Total	Retail	284,248	141,176	394,587	0.40	0.53
		Wholesale	270,713	127,640	356,755	0.43	0.56

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Following a similar analytical procedure using a per hectare comparison basis, locally produced milled rice is compared to imported rice brands originating from Cotonou port. The results showed that the social profitability stands at 365,273 FCFA per hectare (761 US $/ha), assuming that the milled locally produced rice is sold in retail markets. This figure is evaluated in the range of 328,836 FCFA/hectare (685 US $/ha) when the locally produced milled rice is sold in wholesale markets. Furthermore, when considering the points of comparison (Niamey or Tillabery), it can be seen that the social profitability at Tillabery is relatively higher than the economic profitability that would be earned at

Niamey. In this case, 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. But, 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. As reported by Touré *et al*. (2008), rice commercialisation in the Niger River valley is dominated by rice retailers who actively prospect all marketing channels to sell their product. When the locally produced rice is compared to imported rice brands originating from Tema's port, its economic profitability per hectare is 394,587 FCFA (822.06 US $/ha) and 356,755 FCFA/ha (743.24 US $/ha), assuming rice is sold in retail and wholesale markets respectively.

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 common external tariffs (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.

This economic profitability is also supported by the low domestic resource cost (DRC) and social benefit cost ratios (SBC) and, as shown in the summary table 6.6, 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, as shown in table 6.7, the domestic resource cost (DRC) ratio is 0.4 and 0.43 for the retail and wholesale markets respectively. This implies that the value added (the difference between the gross revenues generated by the activity and its related tradable inputs 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 constitutes an economic activity that uses domestic resources efficiently. This assertion is supported by the social cost-benefit (SCB) ratio (table 6.7), which is evaluated overall at 0.53 and 0.56 for the retail and wholesale markets respectively. In other words, the social cost-benefit ratio shows that the sum of tradable input costs 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.

Table 6.7: PAM Base Scenarios Results: Average Economic Profitability Indicators, Domestic Resource Cost Ratio, and Social Cost-Benefit Ratio of Locally Produced Rice.

Port of importation	Imported Rice Brands to which local rice is compared	Point of Comparison	Type of Markets	Reference Price for imported Milled rice FCFA / tonne	Social Profitability FCFA / tonne of Local Milled Rice	Social Profitability FCFA / Hectare	Domestic Resource Cost (DRC)	Social Cost Benefit (SCB) Ratio
Cotonou	Pakistan rice	Niamey	Retail	252,478	109,923	307,234	0.46	0.59
			Wholesale	240,455	97,900	273,630	0.49	0.62
		Tillabery	Retail	275,769	138,914	388,264	0.40	0.53
			Wholesale	262,637	125,782	351,560	0.42	0.55
	Indian Rice 25 %	Niamey	Retail	253,558	111,002	310,251	0.46	0.59
			Wholesale	241,483	98,928	276,504	0.49	0.62
		Tillabery	Retail	276,924	140,069	391,492	0.40	0.53
			Wholesale	263,737	126,882	354,635	0.42	0.55
	Thai rice 25 %	Niamey	Retail	263,273	120,718	337,406	0.44	0.57
			Wholesale	250,736	108,181	302,366	0.47	0.60
		Tillabery	Retail	287,320	150,464	420,548	0.38	0.51
			Wholesale	273,638	136,782	382,307	0.40	0.53
	Thai parboiled	Niamey	Retail	277,846	121,823	340,496	0.45	0.57
			Wholesale	264,615	108,593	303,516	0.48	0.60
		Tillabery	Retail	302,913	152,590	426,489	0.39	0.51
			Wholesale	288,489	138,166	386,173	0.41	0.54
Average		Niamey	Retail	261,789	115,867	323,847	0.45	0.58
			Wholesale	249,322	103,400	289,004	0.48	0.61
		Tillabery	Retail	285,731	145,509	406,698	0.39	0.52
			Wholesale	272,125	131,903	368,669	0.42	0.54
		Total	Retail	273,760	130,688	365,273	0.42	0.55
			Wholesale	260,724	117,652	328,836	0.45	0.58
Tema	Pakistan rice	Niamey	Retail	262,611	120,056	335,557	0.44	0.57

Port of importation	Imported Rice Brands to which local rice is compared	Point of Comparison	Type of Markets	Reference Price for imported Milled rice FCFA / tonne	Social Profitability FCFA / tonne of Local Milled Rice	Social Profitability FCFA / Hectare	Domestic Resource Cost (DRC)	Social Cost Benefit (SCB) Ratio
			Wholesale	250,106	107,551	300,605	0.47	0.60
		Tillabery	Retail	286,612	149,756	418,569	0.38	0.51
			Wholesale	272,964	136,108	380,423	0.41	0.53
	Indian Rice 25 %	Niamey	Retail	263,691	121,136	338,574	0.44	0.57
			Wholesale	251,134	108,579	303,478	0.47	0.60
		Tillabery	Retail	287,767	150,912	421,798	0.38	0.51
			Wholesale	274,064	137,208	383,497	0.40	0.53
	Thai rice 25 %	Niamey	Retail	273,406	130,851	365,729	0.42	0.55
			Wholesale	260,387	117,832	329,340	0.45	0.58
		Tillabery	Retail	298,162	161,307	450,853	0.37	0.49
			Wholesale	283,964	147,109	411,169	0.39	0.51
	Thai parboiled	Niamey	Retail	287,980	131,957	368,819	0.43	0.56
			Wholesale	274,266	118,243	330,491	0.46	0.58
		Tillabery	Retail	313,756	163,433	456,795	0.37	0.49
			Wholesale	298,815	148,492	415,035	0.39	0.52
Average		Niamey	Retail	271,922	126,000	352,170	0.43	0.56
			Wholesale	258,973	113,051	315,978	0.46	0.59
		Tillabery	Retail	296,574	156,352	437,004	0.38	0.50
			Wholesale	282,452	142,229	397,531	0.40	0.52
		Total	Retail	284,248	141,176	394,587	0.40	0.53
			Wholesale	270,713	127,640	356,755	0.43	0.56

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.5 Policy transfers and protection coefficients

The PAM methodology evaluates policy outcomes by comparing the agricultural system's performance at the market with a set of reference prices. In the sections above, we have seen that PAM analysis allows one to calculate the indicators of private profitability (indicating competitiveness in actual market prices) and social profitability (measuring efficiency or comparative advantage in efficiency prices). PAM analysis also enables an appreciation of the effects of divergences by comparing the performances evaluated at market and reference prices in order to identify how results obtained from actual market prices differ from results obtained from corresponding efficiency prices. The effects of divergences identified are the result of policy interventions; the effects of these divergences can be evaluated for the system's output (output transfer), tradable inputs (tradable input transfer), and domestic factor (factor transfer).

Output transfer occurs as a result of a divergence in output prices, so that private revenues differ from social revenues. The output transfer can be positive, indicating that the agricultural system is receiving an implicit subsidy or transfer of resources to the benefit of the system. The output transfer can also be negative, meaning that the agricultural system is being taxed or that there is diversion of resources away from the system. In a similar way, tradable input transfers occur when a divergence in tradable input prices causes private tradable input costs to differ from social tradable input costs (Pearson *et al*., 2003). The divergence causing the tradable input transfer can be positive; i.e. market prices for tradable inputs are higher than the social tradable input costs; thus there is an implicit tax or transfer of resources away from the system. When the divergence is negative, it has the opposite result, meaning market prices for tradable inputs are smaller than the social tradable input costs, thus indicating an implicit subsidy or transfer of resources in favour of the agricultural system. Factor transfers can also occur due to the influence of divergences. As in the case of tradable input transfers, the effects of divergences can be either positive (implicit tax or transfer of resources away from the system) or negative (implicit subsidy or transfer of resources in favour of the agricultural system).

Net policy transfers are indicators of the effects of policy on the agricultural system's performance (revenues, costs, and profits) and as such, the net policy effect indicates the sum of outputs, tradable inputs, and domestic factor transfers. From the policy analysis matrix, the net policy transfer indicates also the difference between private and social profits. The method leads to the computation of the profitability coefficient (PC), which is just the ratio of private profit to social profit; this therefore gives a measure of all transfers on private profits (Pearson *et al*., 2003).

6.5.1 Policy transfers

As indicated in table 6.8, the summary results give negative values for the net policy transfer. Overall, for a base scenario that compares the locally produced rice in the retail markets to imported rice brands originating from Cotonou port, the net policy transfer is on average –145,204 FCFA/hectare (–302.51 US $/ ha) and –51,951 FCFA/tonne (–108.23 US $/tonne). In the wholesale markets, the net policy transfer is evaluated at –91,649 FCFA/hectare (–190.94 US $/ha) and –32,790 FCFA/tonne (–68.31 US $/tonne). For the base scenario that compares the locally produced rice in the retail markets to imported rice brands originating from Tema port, the net policy transfer is on average –161,941 FCFA/hectare (–337.38 US $/ha) and –57,940 FCFA/tonne (–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/tonne (–89.12 US $/tonne).

Table 6.8: Summary Results of Net Policy Transfers (L) for PAM Base Scenarios Models.

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 / USD (Average of the monthly exchange rates given first of every month; all year 2007).

This diversion of resources is materialised through the results presented in table 6.9. The policy transfers are evaluated to –48,158 FCFA/ hectare (–100.33 US $/ha) and –17,230 FCFA/tonne (–35.90 US $/tonne), assuming that the locally produced rice is sold in Niamey retail markets, in comparison to imported rice brands from Cotonou port. In the wholesale markets, the net transfer is –63,625 FCFA/hectare (–132.55 US $/ha) and –22,764 FCFA/tonne (–47.43 US $/tonne). For retail markets in the Tillabery region, the scenario gives a net transfer of –242,251 FCFA/hectare (–504.69 US $/ha) and –86,673 FCFA/tonne (–180.57 US $/tonne) while the Tillabery wholesale market scenario gives –119,672 FCFA (–249.32 US $) and –42,817 FCFA (–89.2 US $), values per hectare and tonne of milled rice respectively.

Table 6.9: PAM Base Scenarios Results for Net Policy Transfers.

Port of importation	Rice brand	Point of Comparison	Markets	FCFA / Hectare	FCFA / tonne
Cotonou	Pakistan rice	Niamey	Retail	-28,683	-10,262
			Wholesale	-95,699	-34,239
		Tillabery	Retail	-211,171	-75,553
			Wholesale	-71,052	-25,421
	Indian Rice 25 %	Niamey	Retail	-31,700	-11,342
			Wholesale	-98,573	-35,268
		Tillabery	Retail	-214,400	-76,708
			Wholesale	-74,127	-26,521
	Thai rice 25 %	Niamey	Retail	-159,475	-57,057
			Wholesale	-124,435	-44,520
		Tillabery	Retail	-243,455	-87,104
			Wholesale	-101,799	-36,422
	Thai parboiled	Niamey	Retail	27,225	9,741
			Wholesale	64,205	22,971
		Tillabery	Retail	-299,976	-107,326
			Wholesale	-231,710	-82,902
Average		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	Pakistan rice	Niamey	Retail	-57,006	-20,396
			Whole	-122,673	-43,890
		Tillabery	Retail	-241,477	-86,396
			Wholesale	-99,915	-35,748
	Indian Rice 25 %	Niamey	Retail	-60,023	-21,475
			Wholesale	-125,547	-44,918
		Tillabery	Retail	-244,705	-87,551
			Wholesale	-102,990	-36,848
	Thai rice 25 %	Niamey	Retail	-87,178	-31,191
			Wholesale	-151,409	-54,171
		Tillabery	Retail	-273,761	-97,947
			Wholesale	-130,662	-46,748

Port of importation	Rice brand	Point of Comparison	Markets	FCFA / Hectare	FCFA / tonne
	Thai parboiled	Niamey	Retail	-1,098	-393
			Wholesale	37,231	13,321
		Tillabery	Retail	-330,282	-118,169
			Wholesale	-260,572	-93,228
Average		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 / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Overall, on average for both points of comparison, the net transfer values are negative and in retail markets scenario, these values are –145,204 FCFA/hectare (–302.51 US $/ha) and –51,951 FCFA/tonne (–108.23 US $/tonne). For the wholesale markets scenario, the net transfer becomes –91,649 FCFA/hectare (–190.94 US $/ha) and –32,790 FCFA/tonne (–68.31 US $/tonne). The scenarios developed to compare the locally produced rice to imported rice brands originating from Tema port also indicate negative values for the net policy transfer, as shown in table 6.9. 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). 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 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 therefore also mean that the overall policy transfers for output, inputs, and domestic factors are negative. As indicated in the summary table 6.10, the output transfers are generally negative and this explains mostly the fact that the net policy transfer is negative. In retail markets and on a per hectare basis, output transfers are –118,110 FCFA (–246.04 US $/ha) and –85,543 FCFA/ha (–178.21 US $ /ha) for wholesale markets. The output transfer evaluated per tonne of milled rice gives –42,254 FCFA in retail markets (–88.03 US $/tonne) and –30,606 FCFA (–63.76 US $/tonne) in wholesale markets.

Table 6.10: Summary of Output, Tradable Inputs, Domestic Factors, and Net Policy Transfers

Port of importation	Point of Compa-rison	Type of Markets	Transfers FCFA / Hectare				Transfers FCFA / tonne			
			Output	Tradable Inputs	Domestic Factors	Net Transfer	Output	Inputs	Factors	Net Transfer
Cotonou	Niamey	Retail	-12,686	36,186	-714	-48,158	-4,539	12,947	-255	-17,230
		Wholesale	-28,153	36,186	-714	-63,625	-10,073	12,947	-255	-22,764
	Tillabery	Retail	-206,778	36,186	-714	-242,251	-73,981	12,947	-255	-86,673
		Wholesale	-110,053	36,186	-714	-145,526	-39,375	12,947	-255	-52,067
	Total	Retail	-109,732	36,186	-714	-145,204	-39,260	12,947	-255	-51,951
		Wholesale	-69,103	36,186	-714	-104,576	-24,724	12,947	-255	-37,415
Tema	Niamey	Retail	-15,854	36,186	-714	-51,326	-5,672	12,947	-255	-18,364
		Wholesale	-55,127	36,186	-714	-90,599	-19,723	12,947	-255	-32,415
	Tillabery	Retail	-237,084	36,186	-714	-272,556	-84,824	12,947	-255	-97,516
		Wholesale	-148,837	36,186	-714	-184,309	-53,251	12,947	-255	-65,943
	Total	Retail	-126,469	36,186	-714	-161,941	-45,248	12,947	-255	-57,940
		Wholesale	-101,982	36,186	-714	-137,454	-36,487	12,947	-255	-49,179
Average	-	Retail	-118,100	36,186	-714	-153,573	-42,254	12,947	-255	-54,946
		Wholesale	-85,543	36,186	-714	-121,015	-30,606	12,947	-255	-43,297
		Average	-101,821	36,186	-714	-137,294	-36,430	12,947	-255	-49,121

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.11a: PAM Base Scenarios Results for Output, Tradable Inputs, Domestic Factors, and Net Policy Transfers, FCFA / Hectare.

Port of importation	Imported Rice Brands to which local rice is compared	Point of Comparison	Type of Markets	Output	Tradable Inputs	Domestic Factors	Net Transfer
Cotonou	Pakistan rice	Niamey	Retail	7,049	36,186	-455	-28,683
			Wholesale	-59,967	36,186	-455	-95,699
		Tillabery	Retail	-175,439	36,186	-455	-211,171
			Wholesale	-35,320	36,186	-455	-71,052
	Indian Rice 25 %	Niamey	Retail	4,032	36,186	-455	-31,700
			Wholesale	-62,841	36,186	-455	-98,573
		Tillabery	Retail	-178,668	36,186	-455	-214,400
			Wholesale	-141,811	36,186	-455	-177,542
	Thai rice 25 %	Niamey	Retail	-123,743	36,186	-455	-159,475
			Wholesale	-88,703	36,186	-455	-124,435
		Tillabery	Retail	-207,723	36,186	-455	-243,455
			Wholesale	-66,068	36,186	-455	-101,799
	Thai parboiled	Niamey	Retail	61,920	36,186	-1,492	27,225
			Wholesale	98,900	36,186	-1,492	64,205
		Tillabery	Retail	-265,282	36,186	-1,492	-299,976
			Wholesale	-197,015	36,186	-1,492	-231,710
Average		Niamey	Retail	-12,686	36,186	-714	-48,158
			Wholesale	-28,153	36,186	-714	-63,625
		Tillabery	Retail	-206,778	36,186	-714	-242,251
			Wholesale	-110,053	36,186	-714	-145,526
		Total	Retail	-109,732	36,186	-714	-145,204
			Wholesale	-69,103	36,186	-714	-104,576
Tema	Pakistan rice	Niamey	Retail	-21,274	36,186	-455	-57,006
			Wholesale	-86,942	36,186	-455	-122,673
		Tillabery	Retail	-205,745	36,186	-455	-241,477
			Wholesale	-64,183	36,186	-455	-99,915
	Indian Rice 25 %	Niamey	Retail	-24,291	36,186	-455	-60,023
			Wholesale	-89,815	36,186	-455	-125,547
		Tillabery	Retail	-208,973	36,186	-455	-244,705
			Wholesale	-67,258	36,186	-455	-102,990

Port of importa-tion	Imported Rice Brands to which local rice is compared	Point of Compa-rison	Type of Markets	Output	Tradable Inputs	Dom-estic Factors	Net Transfer
	Thai rice 25 %	Niamey	Retail	-51,446	36,186	-455	-87,178
			Wholesale	-115,677	36,186	-455	-151,409
		Tillabery	Retail	-238,029	36,186	-455	-273,761
			Wholesale	-238,029	36,186	-455	-273,761
	Thai parboiled	Niamey	Retail	33,597	36,186	-1,492	-1,098
			Wholesale	71,926	36,186	-1,492	37,231
		Tillabery	Retail	-295,587	36,186	-1,492	-330,282
			Wholesale	-225,878	36,186	-1,492	-260,572
Average		Niamey	Retail	-15,854	36,186	-714	-51,326
			Wholesale	-55,127	36,186	-714	-90,599
		Tillabery	Retail	-237,084	36,186	-714	-272,556
			Wholesale	-148,837	36,186	-714	-184,309
		Total	Retail	-126,469	36,186	-714	-161,941
			Wholesale	-101,982	36,186	-714	-137,454

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Overall, the negative trend of output transfers is observed at all points of comparison and for all brands of imported rice to which locally processed rice is compared, except for the particular case of imported parboiled rice (tables 6.11a and 6.11b). However, when the locally parboiled milled rice is compared to the imported parboiled rice in the Niamey retail and wholesale markets, the output transfer is positive, implying that private revenue is higher than social profit when the rice is sold in the Niamey urban centre because of the higher prices received.

The positive inputs transfers of 36,186 FCFA/hectare (75.39 US $/ha) and 12,947 FCFA/tonne (26.97 US $/tonne) indicate also that the market prices for inputs are higher than their comparable world prices, indicating an implicit tax of the inputs used in the irrigated rice production system and also creating a diversion of resources away from the system. However, the policy effects create a slightly lower subsidy for the domestic factors, as shown by the relatively low factors transfer.

Table 6.11b: PAM Base Scenarios Results for Output, Tradable Inputs, Domestic Factors, and Net Policy Transfers, FCFA / tonne milled rice.

Port of importation	Imported Rice Brands to which local rice is compared	Point of Compa-rison	Type of Markets	Output	Tradable Inputs	Dom-estic Factors	Net Transfer
Cotonou	Pakistan rice	Niamey	Retail	2,522	12,947	-163	-10,262
			Wholesale	-21,455	12,947	-163	-34,239
		Tillabery	Retail	-62,769	12,947	-163	-75,553
			Wholesale	-12,637	12,947	-163	-25,421
	Indian Rice 25 %	Niamey	Retail	1,442	12,947	-163	-11,342
			Wholesale	-22,483	12,947	-163	-35,268
		Tillabery	Retail	-63,924	12,947	-163	-76,708
			Wholesale	-50,737	12,947	-163	-63,521
	Thai rice 25 %	Niamey	Retail	-44,273	12,947	-163	-57,057
			Wholesale	-31,736	12,947	-163	-44,520
		Tillabery	Retail	-74,320	12,947	-163	-87,104
			Wholesale	-23,638	12,947	-163	-36,422
	Thai parboiled	Niamey	Retail	22,154	12,947	-534	9,741
			Wholesale	35,385	12,947	-534	22,971
		Tillabery	Retail	-94,913	12,947	-534	-107,326
			Wholesale	-70,489	12,947	-534	-82,902
Average		Niamey	Retail	-4,539	12,947	-255	-17,230
			Wholesale	-10,073	12,947	-255	-22,764
		Tillabery	Retail	-73,981	12,947	-255	-86,673
			Wholesale	-39,375	12,947	-255	-52,067
		Total	Retail	-39,260	12,947	-255	-51,951
			Wholesale	-24,724	12,947	-255	-37,415
Tema	Pakistan rice	Niamey	Retail	-7,611	12,947	-163	-20,396
			Wholesale	-31,106	12,947	-163	-43,890
		Tillabery	Retail	-73,612	12,947	-163	-86,396
			Wholesale	-22,964	12,947	-163	-35,748
	Indian Rice 25 %	Niamey	Retail	-8,691	12,947	-163	-21,475
			Wholesale	-32,134	12,947	-163	-44,918
		Tillabery	Retail	-74,767	12,947	-163	-87,551
			Wholesale	-24,064	12,947	-163	-36,848
	Thai rice 25 %	Niamey	Retail	-18,406	12,947	-163	-31,191

Port of importation	Imported Rice Brands to which local rice is compared	Point of Compa-rison	Type of Markets	Output	Tradable Inputs	Dom-estic Factors	Net Transfer
			Wholesale	-41,387	12,947	-163	-54,171
		Tillabery	Retail	-85,162	12,947	-163	-97,947
			Wholesale	-85,162	12,947	-163	-97,947
	Thai parboiled	Niamey	Retail	12,020	12,947	-534	-393
			Wholesale	25,734	12,947	-534	13,321
		Tillabery	Retail	-105,756	12,947	-534	-118,169
			Wholesale	-80,815	12,947	-534	-93,228
Average		Niamey	Retail	-5,672	12,947	-255	-18,364
			Wholesale	-19,723	12,947	-255	-32,415
		Tillabery	Retail	-84,824	12,947	-255	-97,516
			Wholesale	-53,251	12,947	-255	-65,943
		Total	Retail	-45,248	12,947	-255	-57,940
			Wholesale	-36,487	12,947	-255	-49,179

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

In sum, the negative net policy transfers, as indicated in table 6.10, table 6.11a and table 6.11b, are due to the fact that the output transfers are generally negative, which is an indication that irrigated rice private revenues are less than the social revenues and that there is an implicit tax on the system. In the majority of cases, the domestic price is less than the comparable world commodity price (table 6.12). The few exceptions concern the retail markets in Niamey for Pakistani rice and Indian rice 25 % and for Thai rice 25 % and Thai parboiled for both retail and wholesale markets in Niamey.

Table 6.12: Comparison of Market and References Prices by Point of Comparison and Type of Markets.

Port of importa-tion	Imported Rice Brands to which local rice is compared	Point of Compa-rison	Type of Markets	Market Prices, FCFA / tonne (1)	Reference Prices , FCFA / tonne (2)	Ratio Market Price to Reference Price: (1) / (2), (%)
Cotonou	Pakistan rice	Niamey	Retail	255,000	252,478	101
			Wholesale	219,000	240,455	91
		Tillabery	Retail	213,000	275,769	77
			Wholesale	250,000	262,637	95
	Indian Rice 25 %	Niamey	Retail	255,000	253,558	101
			Wholesale	219,000	241,483	91
		Tillabery	Retail	213,000	276,924	77
			Wholesale	250,000	263,737	95
	Thai rice 25 %	Niamey	Retail	255,000	263,273	97
			Wholesale	219,000	250,736	87
		Tillabery	Retail	213,000	287,320	74
			Wholesale	250,000	273,638	91
	Thai parboiled	Niamey	Retail	255,000	262,611	97
			Wholesale	219,000	250,106	88
		Tillabery	Retail	213,000	286,612	74
			Wholesale	250,000	272,964	92
Tema	Pakistan rice	Niamey	Retail	255,000	263,691	97
			Wholesale	219,000	251,134	87
		Tillabery	Retail	213,000	287,767	74
			Wholesale	250,000	274,064	91
	Indian Rice 25 %	Niamey	Retail	255,000	273,406	93
			Wholesale	219,000	260,387	84
		Tillabery	Retail	213,000	298,162	71
			Wholesale	250,000	283,964	88
	Thai rice 25 %	Niamey	Retail	300,000	277,846	108
			Wholesale	300,000	264,615	113
		Tillabery	Retail	208,000	302,913	69
			Wholesale	145,000	288,489	50
	Thai parboiled	Niamey	Retail	300,000	287,980	104
			Wholesale	300,000	274,266	109
		Tillabery	Retail	208,000	313,756	66
			Wholesale	218,000	298,815	73

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.5.2 Economic parity prices (import parity prices) for paddy

At each point of comparison, the economic price for domestic paddy (import parity price or border price equivalent) was evaluated by considering the type of imported rice brands (FOB price in US $/tonne) and its port of import (to include the insurance and freight costs in US $/tonne); these two elements enable the computation of CIF price at port of import (US $/tonne). The CIF was adjusted for the exchange rate (480 FCFA/US $) to estimate its local currency equivalent (FCFA/tonne) and divided by the weight conversion factor (tonne to kg) to have the CIF in domestic currency (FCFA/kg). To this the domestic transportation and marketing costs (FCFA/kg) were added in order to estimate the value before processing at the comparison point (FCFA/kg). This value before processing at the comparison point was then multiplied by the processing factor (or conversion factor) of 65 % (of paddy to milled rice) to get the equivalent import parity value of the paddy (FCFA/kg). Finally, the economic parity price of paddy at farm gate is estimated by subtracting the distribution costs to farm gate.

Table 6.13: Estimation of Paddy Economic Prices by Points of Comparison.

Port of importation	Imported Rice Brands to which local rice is compared	Point of Comparison	Paddy Economic prices, FCFA /Kg
Cotonou	Pakistan rice	Niamey	140
	Pakistan rice	Tillabery	145
	Indian Rice 25 %	Niamey	141
	Indian Rice 25 %	Tillabery	146
	Thai rice 25 %	Niamey	146
	Thai rice 25 %	Tillabery	151
	Thai parboiled	Niamey	155
	Thai parboiled	Tillabery	160
Tema	Pakistan rice	Niamey	143
	Pakistan rice	Tillabery	148
	Indian Rice 25 %	Niamey	144
	Indian Rice 25 %	Tillabery	149
	Thai rice 25 %	Niamey	149
	Thai rice 25 %	Tillabery	154
	Thai parboiled	Niamey	158
	Thai parboiled	Tillabery	163

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

The economic prices (table 6.13) range between a minimum of 140 FCFA/kg (0.29 US $/kg) and 163 FCFA/kg (0.34 US $/kg) with an average of 149 FCFA /kg (0.31 US $/kg). These economic paddy prices are much higher than the producers' paddy price 127 FCFA/kg (0.26 US $/kg). Therefore, the policy effects do not provide sufficient incentives to the system. This supports the fact that net policy transfers are negative and also the fact that the domestic price is less than the comparable world commodity price.

6.5.3 Protection coefficients and incentives

Another method to appreciate the divergence between market and reference prices is the use of ratios, which are free of currency or commodity distinctions. The nominal protection coefficient on output (NPCO) measures the output transfer and shows how much domestic prices differ from social prices (Pearson *et al*., 2003). In PAM analysis, the nominal protection coefficient on output is estimated by the ratio of private revenues (evaluated at market prices) to social revenues (evaluated at reference prices). When the ratio is greater than 1, the domestic price of rice is higher than its corresponding economic parity price (reference price of imported rice), indicating that the system is being protected. When the ratio is less than 1, the domestic price of rice is lower than the reference price for imported rice and the agricultural system is unprotected. In order to estimate the joint effect of policy transfers affecting both tradable outputs and tradable inputs, the effective protection coefficient (EPC) compares value added in domestic prices with value added in world prices. The incentives measures include the profitability coefficient (PC), the subsidy ratio to producers (SRP), and the equivalent subsidy ratio to producers. The subsidy ratio to producers, which is now called the producer subsidy estimate (PSE), is a ratio that compares the net policy transfer to the value of output in world prices, and it represents the output tariff equivalent if the net effect of all transfers were carried out solely through a tariff on output (Pearson *et al*., 2003).

The summary results of protection coefficients and incentives in table 6.14 support the fact that policy outcomes do not provide sufficient incentives to the system. First, the nominal protection coefficients (NPCO) 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 % of comparable world market prices of imported rice brands originating from Cotonou port, while the wholesale market prices represent 93 % of the reference price. When imported rice brands originate from Tema port, the domestic retail market prices represent on average 85 % of the comparable world market price, while the domestic wholesale price constitutes 90 % of the comparable world market price. These results confirm the fact that domestic output prices are lower than comparable world market prices, and that there is an implicit tax of 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 marketing channels tend to receive even fewer incentives.

The absence of incentives is further shown by the effective protection coefficients (EPC) presented in table 6.14. As in the previous cases, the EPC coefficients differ, depending on the point of comparison of locally milled rice to imported rice brands, the port of import and also the type of rice market. When local milled rice is compared to imported rice brands originating from the port of Cotonou, on average, the EPC varies between 0.78 and 0.85 for the retail and wholesale markets respectively. These coefficients do not, however, differ very much from the ones obtained when the local milled rice is compared to imported rice brands originating from Tema port, where the EPC varies between 0.76 and 0.81 for the retail and wholesale markets respectively. The EPC figures are slightly lower than the nominal protection coefficient (NPC) 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, it can be seen that 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 when considering 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.

Table 6.14: Summary Results of Protection Coefficients and Incentives for PAM Base Scenarios Models

Port of importa-tion	Point of Compa-rison	Type of Market	Nominal Protection Coefficient	Effective Protection Coefficient	Profitability Coefficient	Producer Subsidy Estimate	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 / USD (Average of the monthly exchange rates given first of every month; all year 2007).

In summary, in the majority of cases, the nominal protection coefficients for outputs are less than 1, indicating that in output markets, the irrigated rice production system receives little protection and, on average, the retail rice marketing channels tends to be even less well protected. 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 (table 6.15). 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, however, that the total output of the local parboiled rice production system does not receive any protection. This is shown by the respective coefficients (0.70, 0.76, 0.67, 0.74), which are all less than 1. This same trend is observed when considering the effective protection coefficients.

These conclusions are further supported by the results obtained for the profitability coefficients (PC) as shown in table 6.15. The profitability coefficient is an extension of the effective protection coefficient 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 profitability coefficient is also used as a proxy measure of the net policy transfer. The profitability coefficients vary from 0.38 to 0.85, indicating that in most cases the private revenues are less than the revenues evaluated at reference prices. A comparison of local rice to imported rice brands originating from Cotonou port shows that in the retail rice marketing system, the profitability coefficient of the irrigated rice production is on average 0.63 compared to 0.73 in wholesale market channels. Similarly, the comparison of local rice to imported rice brands originating from Tema port give 0.62 and 0.67 for retail and wholesale rice marketing channels respectively. In all cases, the profitability coefficient 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 and producers' subsidy estimates.

The subsidy ratio to producers (SRP) is a ratio that compares the net policy transfer to the value of output in world prices. In our various scenarios, we have shown that the net policy transfers are negative. Therefore, negative subsidy ratios to producers (SRP) indicate that producers are taxed and by what proportion the irrigated rice production system's revenues are decreased. On average, the results show that for a comparison of the local rice to imported rice brands from Cotonou port, the producers' revenues decreased at a rate of 17 % and 12 % in retail and wholesale rice marketing systems respectively. The comparison of local rice to imported rice brands originating from Tema port also indicate revenues of –19 % and –15 % 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 and Pearson, 1989). The negative net policy effects would have been affected through tariffs on output in the range of the various ratios of the SRP for the different scenarios if all other divergences were removed. The producer subsidy estimates also follow the same trend as the SRP.

In conclusion, Niger's irrigated rice production system is generally competitive. However, the system does not benefit from sufficient incentives. Instead resources being are diverted away from it and this creates an implicit tax of the system. These implicit taxes of the system are materialised through the negative subsidy ratios to producers, and by negative net policy transfers. Furthermore, on average, the effective profitability coefficients 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.

Table 6.15: PAM Base Scenarios Results: Protection Coefficients

Port of importation	Imported Rice Brands to which local rice is compared	Point of Comparison	Type of Markets	Nominal Protection Coefficient	Effective Protection Coefficient	Profitability Coefficient	Producers Subsidy Estimate	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 %	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 %	Niamey	Retail	0.84	0.74	0.53	-0.20	-0.24
			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	-0.12	-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

Port of importation	Imported Rice Brands to which local rice is compared	Point of Comparison	Type of Markets	Nominal Protection Coefficient	Effective Protection Coefficient	Profitability Coefficient	Producers Subsidy Estimate	Equivalent Producer Subsidy
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
			Wholesale	0.92	0.84	0.74	-0.12	-0.13
	Indian Rice 25 %	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 %	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
		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

6.6 Sensitivity analysis results

In order to scrutinise the alternatives that may provide better incentives to the system, we have performed various sensitivity analyses, using the following hypothetical scenarios:

1) Scenarios of technology improvement relating to improvement of paddy milling using 75 % conversion rates of paddy into milled rice;
2) The farm-level productivity (increased yield to 6 tonnes per hectare);
3) Macro economic changes in relation to the structure of the common external tariffs (from 10 % to 20 %,) affecting the financial parity prices of imported rice;
4) Changes in the exchange rate; the year 2008 annual exchange rate was used;
5) Changes in import duties on inputs (lowering of inputs duties);
6) Simultaneous changes: increased yield and reduction of import duties on inputs;
7) Simultaneous changes: increased yield, reduction of import duties on inputs and increased import duties for imported rice;
8) Simultaneous changes: increased yield and increased import duties for imported rice;
9) Simultaneous changes: reduction of import duties on inputs and increased import duties for imported rice;
10) Simultaneous changes: technology improvement (improvement of paddy milling using 75 % conversion rates of paddy into milled rice) and reduction of import duties on inputs;
11) Simultaneous changes: technology improvement (improvement of paddy milling using 75 % conversion rates of paddy into milled rice) and increased import duties for imported rice.

All the sensitivity analyses were performed using two imported rice brands namely the Pakistani rice (25%) and Thai parboiled (100 %). The simulations considered are independent of the port of importation and consequently we have used only one port (Cotonou) to perform our sensitivity analyses.

6.6.1 Technology improvement relating to improvement of paddy milling rate

This scenario has simulated a 75 % conversion rate of paddy into milled rice. With a higher conversion rate, the final product, i.e. milled rice, increased in quantity. The sensitivity of the base model to such improvement in milling is indicated in table 6.16.

6.6.1.1. Financial profitability

With an improvement in the paddy conversion rate into milled rice from an initial ratio of 65 % to a simulated ratio of 75 %, the final product quantity is increased. At both points of comparison, an increase in private profitability is observed for the two types of marketing channels (retail and wholesale) in combination with the port of importation of the imported rice to which the local milled rice is compared (table 6.16 and table 6.17). On average, considering the Cotonou port of import, the private profitability per tonne of local milled rice increased to 103,536 FCFA (215.7 US $/tonne) and 106,286 FCFA (221.4 US $/tonne) in the retail and wholesale markets respectively. The financial cost-benefit ratio also improved and is evaluated at 0.464 and 0.455 for retail and wholesale markets. In the base PAM model, these figures were 78,736 FCFA/tonne of milled rice (164 US $/tonne) and 84,861 FCFA/tonne of milled rice (176.73 US $/tonne), with financial cost-benefit ratios of 0.56 and 0.54 for the retail and wholesale markets respectively. Overall, on average, the financial profitability of the retail marketing channel system is less than that of the wholesale marketing channel. However, when considering the point of comparison, the results are mixed in the sense that in the Niamey urban centre the private profitability of the retailing channel is higher than that of the wholesale, while the reverse trend is observed in the Tillabery region. A hypothesis to explain this is that producers sell first their product to wholesalers before considering selling it to retailers, who in turn get their supplies from the wholesalers.

Table 6.16: Paddy Milling Conversion Rate Summary Results (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
Types of Markets	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability,	134,186	116,186	72,886	96,386	103,536	106,286
Financial Cost-Benefit	0.393	0.438	0.535	0.471	0.464	0.455
Social Profitability, FCFA	132,785	120,158	162,664	148,885	147,724	134,522
Domestic Resource Cost	0.395	0.419	0.340	0.360	0.367	0.389
Social Cost-Benefit Ratio	0.520	0.545	0.460	0.482	0.490	0.513
Transfers, FCFA	1,401	-3,972	-89,778	-52,500	-44,188	-28,236
Nominal Protection	1.044	1.023	0.739	0.858	0.891	0.941
Effective Protection	1.003	0.974	0.636	0.777	0.820	0.876
Profitability Coefficient	1.007	0.955	0.451	0.655	0.729	0.805
Producers Subsidy Ratio	0.004	-0.02	-0.30	-0.18	-0.15	-0.10
Producers Subsidy	0.003	-0.03	-0.41	-0.22	-0.20	-0.13

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.17: Sensitivity Analysis - Paddy Milling Conversion Rate Improvement (per tonne of Milled Rice)

Rice brand	Pakistan rice				Thai parboiled			
Point of Comparison	Niamey		Tillabery		Niamey		Tillabery	
Types of Markets	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	117,609	81,609	81,309	118,309	150,763	150,763	64,463	74,463
Financial Cost-Benefit Ratio	0.417	0.508	0.501	0.408	0.368	0.368	0.569	0.534
Social Profitability, FCFA	126,209	114,186	155,200	142,068	139,360	126,129	170,127	155,702
Domestic Resource Cost	0.401	0.425	0.345	0.365	0.388	0.412	0.335	0.355
Social Cost-Benefit Ratio	0.529	0.554	0.467	0.489	0.512	0.536	0.452	0.474
Transfers, FCFA	-8,600	-32,577	-73,891	-23,759	11,403	24,633	-105,664	-81,240
Nominal Protection Coefficient	1.009	0.916	0.785	0.955	1.078	1.130	0.694	0.762
Effective Protection Coefficient	0.958	0.835	0.687	0.893	1.048	1.112	0.585	0.661
Profitability Coefficient	0.932	0.715	0.524	0.833	1.082	1.195	0.379	0.478
Producers Subsidy Ratio	-0.032	-0.127	-0.254	-0.085	0.040	0.091	-0.340	-0.274
Producers Subsidy Estimate	-0.032	-0.139	-0.323	-0.089	0.037	0.080	-0.490	-0.360

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.6.1.2 Social profitability and comparative advantage

The economic profitability of the irrigated rice production system is also sensitive to an improvement of the milling conversion rate of paddy into milled rice, as final product quantity is increased as shown in table 6.16 and table 6.17. The summary results provided in table 6.16 indicate that on average, the economic profitability is 147,724 FCFA/tonne (307.76 US $/tonne) and 134,522 FCFA/tonne (280.25 US $ /tonne) in retail and wholesale marketing systems respectively. These figures compare well with the figures obtained with the base model, for which the economic profitability is 130,688 FCFA/tonne (272 US $/tonne) of milled rice in the retail markets, and 117,652 FCFA/tonne of milled rice (245 US $/tonne) in the wholesale markets. The relatively higher improvement in economic profitability is also materialised through the ratios of both the domestic resource cost and the social cost-benefit ratio. The DRC is 0.367 and 0.389 for the retail rice marketing and wholesale marketing systems while the social cost-benefit ratio is 0.490 and 0.513 respectively for the same marketing systems.

6.6.1.3 Policy transfers and protection coefficients

This scenario shows (tables 6.16 and 6.17) that an improvement in the milling conversion rate would have a positive impact on the system's overall performance in the sense that it would show a transfer of resources to the system. On average, the net policy transfer per tonne of milled rice is –44,188 FCFA (–92.06 US $ /tonne) and –28,236 FCFA (–58.82 US $ /tonne) in retail and wholesale rice marketing respectively, in comparison to –51,951 FCFA/tonne (–108.23 US $/tonne) and –32,790 FCFA/tonne (–68.31 US $/tonne), which are the results obtained in the base model. Overall, this relative transfer of resources to the system's activities would translate into a form of incentive provided to the system actors, which would play a protective role, as indicated by some figures for the nominal and effective protection coefficients being slightly greater than 1; particularly for the parboiled rice marketing system in the Niamey urban centre.

6.6.2 Farm level productivity improvement

6.6.2.1 Financial profitability

Farm-level productivity improvement from a base level of 4.3 tons/ha to an improved level of 6 tons/ha also shows a positive impact on the overall irrigated rice system's performance, with an average financial profitability of 121,948 FCFA/tonne (254.06 US $/tonne) and 124,698 FCFA/tonne (259.79 US $/tonne) for the retail and wholesale marketing systems (tables 6.18 and 6.19). The financial cost-benefit ratios are evaluated at 0.385 and 0.377 respectively. This is a clear indication that, *ceteris paribus*, an increase in farm-level productivity had an impact on private profitability and the competitiveness of the irrigated system. In the different points of comparison also, the private profitability and related financial cost-benefit ratios compare well with the results generated by the base model scenario.

Table 6.18: Summary Results - Farm Level Productivity Improvement (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
Markets	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	152,598	134,598	91,298	114,798	121,948	124,698
Financial Cost-Benefit Ratio	0.329	0.365	0.441	0.390	0.385	0.377
Social Profitability, FCFA	150,003	137,377	179,882	166,104	164,943	151,740
Domestic Resource Cost,	0.332	0.352	0.285	0.302	0.309	0.327
Social Cost--Benefit Ratio	0.462	0.483	0.406	0.425	0.434	0.454
Transfers, FCFA	2,594	-2,779	-88,584	-51,306	-42,995	-27,042
Nominal Protection Coefficient	1.043	1.023	0.741	0.859	0.892	0.941
Effective Protection Coefficient	1.009	0.981	0.649	0.787	0.829	0.884
Profitability Coefficient	1.015	0.972	0.510	0.697	0.762	0.834
Producers Subsidy Ratio	0.008	-0.013	-0.291	-0.175	-0.142	-0.094
Producers Subsidy Estimate	0.007	-0.024	-0.398	-0.219	-0.196	-0.122

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.19: Sensitivity Analysis - Farm Level Productivity Improvement (per tonne of Milled Rice)

Rice brand	Pakistan rice				Thai parboiled			
Point of Comparison	Niamey		Tillabery		Niamey		Tillabery	
Markets	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	136,646	100,646	100,346	137,346	168,550	168,550	82,250	92,250
Financial Cost-Benefit Ratio	0.346	0.418	0.410	0.337	0.311	0.311	0.472	0.443
Social Profitability, FCFA	144,053	132,030	173,044	159,912	155,954	142,723	186,721	172,296
Domestic Resource Cost,	0.335	0.354	0.287	0.304	0.329	0.349	0.284	0.300
Social Cost--Benefit Ratio	0.467	0.489	0.411	0.430	0.456	0.478	0.401	0.420
Transfers, FCFA	-7,407	-31,384	-72,698	-22,566	12,596	25,827	-104,471	-80,046
Nominal Protection Coefficient	1.009	0.917	0.786	0.955	1.077	1.129	0.695	0.763
Effective Protection Coefficient	0.965	0.846	0.700	0.901	1.052	1.116	0.597	0.673
Profitability Coefficient	0.949	0.762	0.580	0.859	1.081	1.181	0.440	0.535
Producers Subsidy Ratio	-0.03	-0.12	-0.25	-0.08	0.044	0.095	-0.34	-0.27
Producers Subsidy Estimate	-0.03	-0.13	-0.31	-0.08	0.041	0.084	-0.48	-0.35

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.6.2.2 Social profitability and comparative advantage

The social profitability is positive and on average equals 164,943 FCFA/tonne of local milled rice (343.63 US $/tonne) and 151,740 FCFA/tonne (316.12 US $/tonne) in retail and wholesale markets respectively. This relative high social profitability is sustained by the low DRC of 0.284 and 0.300, supporting the fact that increased productivity would translate into greater efficiency in the system. Such an efficient system would be more cost effective, with social cost-benefit ratios of 0.434 and 0.454 in the retail and wholesale marketing systems. The local parboiled rice marketing system would be more efficient in terms of social profitability than that of local milled non-parboiled rice. Consequently, the main producing region of Tillabery would generate the highest social profitability.

6.6.2.3 Policy transfers and protection coefficients

Considering the type of rice marketing systems and the type of final product quality, the net policy transfer is negative, apart from the case of the system producing local parboiled milled rice and sold in the Niamey urban centre, as shown in table 6.20. The net policy on average for all systems is –42,995 FCFA/tonne (–89.57 US $/tonne) and –27,042 FCFA/tonne (–56.34 US $), showing that resources are diverted from the system. This result indicates that even though increased farm-level productivity would increase the economic profitability of the system, the relatively higher productivity would not be sufficient globally to provide incentives to the various economic agents, as some channels in the system would not have enough protection. This is clearly indicated by the average nominal protection coefficient for output, the effective protection coefficient, and profitability coefficient, which are all less than 1. The average figures of the subsidy ratio to producers and producers' subsidy estimates are negative, indicating that the system is not protected.

6.6.3 Changes in relation to the import duty of the common external tariff (CET)

The change in the import duty of the common external tariff (CET) simulated is an increase of the tariff rate from 10 % to 20 %. An important result obtained with this scenario is that the net policy transfer becomes positive, i.e., the increase in the tariff rate would transfer more resources to the system in order to provide more incentives to the economic agents operating within the system (tables 6.20 and 6.21). These incentives are materialised by the average nominal protection coefficients which would be in the range of 1.37 for both retail and wholesale rice marketing systems and for all types of final product (milled parboiled and non-parboiled rice). The effective protection coefficients are in the range of 1.4, which means that an increase in the import duty rate of the CET would increase the global incentive provided to the agents. This higher incentive would also translate into higher profitability coefficients, averaging 1.74 and 1.78 for the retail and wholesale marketing systems. The system producing parboiled rice would benefit even from a protection coefficient of 1.8. Other results are the SRP and PSE, which now become positive, indicating that the system would be better protected at an SRP rate of 33 % and 24 % for PSE. A comparison of this scenario with the previous scenarios shows that the tariff measures have a far greater effect in increasing financial profitability and consequently transfer more resources in favour of the system.

Table 6.20: Increase in Tariff Rate for Imported Rice (20 % tariff) – Summary Results (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
Markets	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA/tonne	208,290	190,662	245,520	226,391	226,905	208,527
Financial Cost-Benefit Ratio	0.318	0.338	0.278	0.295	0.298	0.316
Social Profitability, FCFA /tonne	115,873	103,246	145,752	131,974	130,813	117,610
Domestic Resource Cost,	0.457	0.486	0.394	0.418	0.426	0.452
Social Cost-Benefit Ratio	0.584	0.612	0.519	0.543	0.551	0.578
Transfers, FCFA	92,417	87,416	99,768	94,417	96,092	90,917
Nominal Protection Coefficient	1.377	1.376	1.371	1.370	1.374	1.373
Effective Protection Coefficient	1.431	1.433	1.413	1.414	1.422	1.424
Profitability Coefficient	1.797	1.846	1.684	1.715	1.740	1.780
Producers Subsidy Ratio	0.331	0.328	0.329	0.326	0.330	0.327
Producers Subsidy Estimate	0.241	0.239	0.240	0.238	0.240	0.238

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.21: Increase in Tariff Rate for Imported Rice (20 % tariff) - Results (per tonne of Milled Rice)

Rice brand	Pakistan rice				Thai parboiled			
Point of Comparison	Niamey		Tillabery		Niamey		Tillabery	
Markets	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	196,194	179,454	232,119	213,940	220,386	201,871	258,921	238,842
Financial Cost-Benefit Ratio	0.327	0.347	0.285	0.302	0.310	0.329	0.271	0.287
Social Profitability, FCFA	109,923	97,900	138,914	125,782	121,823	108,593	152,590	138,166
Domestic Resource Cost,	0.465	0.494	0.400	0.424	0.450	0.478	0.388	0.412
Social Cost--Benefit Ratio	0.594	0.621	0.527	0.552	0.575	0.603	0.510	0.535
Transfers, FCFA	86,271	81,554	93,205	88,158	98,563	93,278	106,331	100,676
Nominal Protection Coefficient	1.366	1.365	1.361	1.360	1.387	1.387	1.381	1.381
Effective Protection Coefficient	1.419	1.421	1.402	1.403	1.443	1.446	1.424	1.426
Profitability Coefficient	1.785	1.833	1.671	1.701	1.809	1.859	1.697	1.729
Producers Subsidy Ratio	0.319	0.316	0.317	0.314	0.344	0.341	0.341	0.339
Producers Subsidy Estimate	0.233	0.231	0.233	0.231	0.248	0.246	0.247	0.245

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.6.4 Changes in the exchange rate

The exchange rate is used to convert the international commodity price into domestic currency; therefore fluctuations in the exchange rates affect the parity relations between the two currencies. The 2008 average annual exchange rate of the US dollar in FCFA is used. The computation procedure is the same as in the case of the 2007 exchange rate. The average 2008 exchange rate was one US dollar to 447 FCFA while in 2007 it was one US $ to 480 FCFA.

The exchange rate sensitivity results are presented in tables 6.22 and 6.23. Both average financial and economic profitability increase in comparison to the base model scenario. The most important finding of this scenario is that, on average, the system producing local parboiled rice would be favoured in the region of the Tillabery (its major production area), with protection coefficients (nominal and effective) respectively in the range of 1.12 and 1.17. The profitability coefficients range between 1.2 and 1.35 respectively for the retail and wholesale rice marketing channels, as the system benefits from a net policy transfer. The system producing standard, milled non-parboiled rice would also benefit from some protection in the retail markets of Niamey. Overall, with such scenario, the system would enjoy greatest protection in both the retail and wholesale marketing channels in the region of Niamey; the capital city, where market prices are relatively higher.

Table 6.22: Summary results – Changes in Exchange Rate (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
Markets	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	115,612	97,612	54,312	77,812	84,962	87,712
Financial Cost-Benefit Ratio	0.459	0.514	0.637	0.558	0.548	0.536
Social Profitability, FCFA	104,694	92,600	133,791	120,582	119,242	106,591
Domestic Resource Cost,	0.482	0.513	0.415	0.440	0.449	0.477
Social Cost--Benefit Ratio	0.609	0.637	0.540	0.566	0.574	0.602
Transfers, FCFA	10,918	5,012	-79,478	-42,770	-34,280	-18,879
Nominal Protection Coefficient	1.087	1.066	0.771	0.894	0.929	0.980
Effective Protection Coefficient	1.050	1.019	0.653	0.804	0.852	0.912
Profitability Coefficient	1.099	1.039	0.410	0.655	0.755	0.847
Producers Subsidy Ratio	0.040	0.017	-0.27	-0.15	-0.12	-0.07
Producers Subsidy Estimate	0.035	0.004	-0.36	-0.18	-0.16	-0.09

N.B: 447 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2008).

Table 6.23: Sensitivity Analysis Results for Changes in Exchange Rate (per tonne of Milled Rice)

Rice brand	Pakistan rice				Thai parboiled			
Point of Comparison	Niamey		Tillabery		Niamey		Tillabery	
Markets	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	99,661	63,661	63,361	100,361	131,564	131,564	45,264	55,264
Financial Cost-Benefit Ratio	0.489	0.600	0.594	0.480	0.429	0.429	0.680	0.635
Social Profitability, FCFA	99,624	88,092	127,894	115,287	109,765	97,108	139,687	125,877
Domestic Resource Cost,	0.489	0.520	0.420	0.446	0.476	0.506	0.409	0.435
Social Cost--Benefit Ratio	0.617	0.646	0.548	0.573	0.600	0.629	0.532	0.558
Transfers, FCFA	36	-24,431	-64,534	-14,926	21,800	34,456	-94,423	-70,613
Nominal Protection Coefficient	1.049	0.953	0.817	0.992	1.125	1.179	0.725	0.796
Effective Protection Coefficient	0.999	0.866	0.707	0.927	1.102	1.172	0.599	0.681
Profitability Coefficient	1.000	0.723	0.495	0.871	1.199	1.355	0.324	0.439
Producers Subsidy Ratio	0.00013	-0.10	-0.23	-0.06	0.079	0.132	-0.32	-0.25
Producers Subsidy Estimate	0.00014	-0.10	-0.28	-0.06	0.071	0.112	-0.44	-0.31

N.B: 447 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2008)

6.6.5 Changes in import duties on inputs

This rate is inflated due to value added tax (VAT), which is at a rate of 19 %. A suppression of VAT would lower the cumulative rate to only 7 %. For such a system, which is capital intensive, the impact of a suppression of VAT on the overall performance of the irrigated rice production enterprise needs to be tested. The results shown in tables 6.24 and 6.25 indicate relatively small impacts on the various indicators such as DRC, social cost-benefit ratio (SCB), effective protection coefficient (EPC), profitability coefficient (PC), producer subsidy ratio and producer subsidy estimate. In comparison to the base scenario, on average the DRC would increase by 1.4 % and 1.6 % for the retail and wholesale markets respectively. In the base scenario, the DRC ratios were 0.426 (42.6 %) and 0.452 (45.2 %) for retail and wholesale markets. With the reduction of import duties on inputs (suppression of VAT), the DRC ratios would change to 44 % and 46.8 % respectively. The ratios remain lower than 1 and thus the comparative advantage would not be greatly affected. The SCB would also increase by 2.4 % and 2.6 % for retail and wholesale markets respectively, changing on average from 55.1 % to 57.6 % for the retail market and from 57.8 % to 60.3 % for the wholesale market. This indicates that social profitability would still be less than 1 with the suppression of VAT on import duties for inputs used in producing irrigated rice. However, the economic profitability would be reduced by an average of 7,074 FCFA per tonne of milled rice (14.737 US $/tonne). Moreover, the suppression of VAT would translate into an increase in the effective protection coefficient (EPC) of 2.7 % and 3 % for retail and wholesale markets, bringing the EPC to 83.4 % as against 80.8 % for retailers and 89.4 % as against 86.4 % for wholesalers. The profitability coefficient (PC) would also increase, by 4.2 % and 5.1 % for the retail and wholesale markets, which is an indication of relative profitability. The average PC ratios would change from 68.5 % to 72.7 % for retail markets and from 76.5 % to 81.6 % for wholesale markets. VAT suppression would indeed create some incentives, as is indicated by these last two indicators of incentives (EPC and PC). Furthermore, the negative producer subsidy ratios indicate that presently the producers are taxed. However, on average, with a suppression of VAT, these ratios show that producers would be less taxed because the ratios would change from –15.1 % to –12.7 % for retailers and from –10.4 % to –7.9 % for wholesalers. Thus, the suppression of VAT would provide some incentives to producers.

Table 6.24: Summary results – Reducing Imports Duties on Inputs (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	115,612	97,612	54,312	77,812	84,962	87,712
Financial Cost-Benefit Ratio	0.459	0.514	0.637	0.558	0.548	0.536
Social Profitability, FCFA	108,799	96,172	138,678	124,900	123,738	110,536
Domestic Resource Cost (DRC)	0.473	0.504	0.406	0.432	0.440	0.468
Social Cost-Benefit Ratio	0.610	0.639	0.542	0.568	0.576	0.603
Transfers, FCFA	6,813	1,440	-84,365	-47,087	-38,776	-22,823
Nominal Protection Coefficient	1.043	1.023	0.741	0.859	0.892	0.941
Effective Protection Coefficient	1.030	1.000	0.639	0.789	0.834	0.894
Profitability Coefficient	1.058	0.998	0.396	0.634	0.727	0.816
Producers Subsidy Ratio	0.023	0.002	-0.277	-0.160	-0.127	-0.079
Producer Subsidy Estimate	0.021	-0.009	-0.380	-0.202	-0.179	-0.105

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.25: Sensitivity Analysis Results for Reducing Imports Duties on Inputs (per tonne of Milled Rice)

Rice Brands	Pakistan				Thai parboiled			
Point of Comparison	Niamey		Tillabery		Niamey		Tillabery	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	99,661	63,661	63,361	100,361	131,564	131,564	45,264	55,264
Financial Cost-Benefit Ratio	0.489	0.600	0.594	0.480	0.429	0.429	0.680	0.635
Social Profitability, FCFA	102,849	90,826	131,840	118,708	114,749	101,518	145,516	131,092
Domestic Resource Cost Ratio (DRC)	0.481	0.512	0.413	0.439	0.465	0.495	0.400	0.425
Socila Cost-Benefit Ratio	0.620	0.649	0.551	0.577	0.599	0.629	0.533	0.559
Transfers, FCFA	-3,188	-27,165	-68,479	-18,347	16,815	30,046	-100,252	-75,827
Nominal Protection Coefficient	1.009	0.917	0.786	0.955	1.077	1.129	0.695	0.763
Effective Protection Coefficient	0.983	0.853	0.694	0.912	1.076	1.147	0.584	0.665
Profitability Coefficient	0.969	0.701	0.481	0.845	1.147	1.296	0.311	0.422
Producers Subsidy Ratio	-0.012	-0.105	-0.233	-0.065	0.059	0.110	-0.322	-0.255
Producers Subsidy Estimate	-0.012	-0.115	-0.296	-0.068	0.054	0.097	-0.463	-0.335

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.6.6. Simultaneous changes: increased yield and reduction of imports duties on inputs

Sensitivity analyses show that a simple reduction of import duties on inputs (suppression of VAT) would provide some incentives to producers. Also, the sensitivity analysis for a farm-level productivity improvement that would permit an increase in yield from 4.3 tons/ha to 6 tons/ha, also shows a positive impact on the overall performance of the irrigated rice system, with both financial and economic profitability increasing in comparison to PAM base model results. Therefore, these scenarios combined would generate greater incentives for the overall performance of the irrigated rice production system, as presented in tables 6.26 and 6.27. An estimation of the difference between the results of this scenario to those obtained with the base model scenario indicate that, on average, the simultaneous changes scenario would allow an increase in both financial and economic profitability. Financial profitability would increase by 36,986 FCFA/tonne (77.05 US $/tonne) for both retail and wholesale markets. The financial cost-benefit ratio would be in the range of 0.385 and 0.377 for retail and wholesale markets, in comparison to a range of 0.548 and 0.536 in the base scenario model. This indicates that the system would become more competitive. The economic profitability would increase also by 29,061 FCFA/tonne (60.54 US $/tonne) for both retail and wholesale markets, with an important improvement in both DRC and social cost-benefit ratio (SCB). The DRC would change to 0.316 and 0.335 for the retail and wholesale markets respectively, in comparison to 0.426 and 0.452 for the base scenario model. The SCB would change to 0.451 and 0.473 for retail and wholesale markets respectively, in comparison to 0.551 and 0.578 in the base scenario model. The simultaneous changes would be a good incentive to improve the comparative advantage of the system. Good incentives would also be shown by the positive net policy transfer of 7,925 FCFA/tonne (16.51 US $/tonne) in favour of the system. Furthermore, the summary results (table 6.26) indicate that on average in the Niamey region, the nominal and effective protection coefficients are just equal to 1, testifying to a comparative increase in incentives.

Table 6.26: Summary: Simultaneous Increased Yield and Reduction of Imports Duties on Inputs (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	152,598	134,598	91,298	114,798	121,948	124,698
Financial Cost-Benefit Ratio	0.329	0.365	0.441	0.390	0.385	0.377
Social Profitability, FCFA	144,934	132,307	174,813	161,034	159,873	146,671
Domestic Resource Cost Ratio	0.340	0.361	0.291	0.309	0.316	0.335
Social Cost-Benefit Ratio	0.480	0.503	0.423	0.443	0.451	0.473
Transfers, FCFA	7,664	2,291	-83,515	-46,236	-37,925	-21,973
Nominal Protection Coefficient	1.043	1.023	0.741	0.859	0.892	0.941
Effective Protection Coefficient	1.032	1.005	0.662	0.804	0.847	0.904
Profitability Coefficient	1.050	1.009	0.525	0.719	0.788	0.864
Producers Subsidy Ratio	0.027	0.006	-0.275	-0.157	-0.124	-0.076
Producers Subsidy Estimate	0.024	-0.005	-0.376	-0.198	-0.176	-0.102

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.27: Results: Simultaneous Increased Yield and Reduction of Imports Duties on Inputs (per tonne of Milled Rice)

Point of Comparison	Pakistan rice				Thai parboiled			
	Niamey		Tillabery		Niamey		Tillabery	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	136,646	100,646	100,346	137,346	168,550	168,550	82,250	92,250
Financial Cost-Benefit Ratio	0.346	0.418	0.410	0.337	0.311	0.311	0.472	0.443
Social Profitability, FCFA	138,983	126,960	167,974	154,842	150,884	137,653	181,651	167,226
Domestic Resource Cost Ratio (DRC)	0.343	0.364	0.294	0.311	0.337	0.358	0.289	0.306
Socila Cost-Benefit Ratio	0.486	0.509	0.428	0.448	0.473	0.496	0.417	0.437
Transfers, FCFA	-2,337	-26,314	-67,628	-17,496	17,666	30,896	-99,401	-74,977
Nominal Protection Coefficient	1.009	0.917	0.786	0.955	1.077	1.129	0.695	0.763
Effective Protection Coefficient	0.988	0.867	0.715	0.922	1.075	1.142	0.609	0.687
Profitability Coefficient	0.983	0.793	0.597	0.887	1.117	1.224	0.453	0.552
Producers Subsidy Ratio	-0.01	-0.10	-0.23	-0.06	0.062	0.113	-0.32	-0.25
Producers Subsidy Estimate	-0.01	-0.11	-0.29	-0.07	0.057	0.100	-0.46	-0.33

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.6.7 Simultaneous changes: increased yield, reduction of imports duties on inputs and increased import duties for imported rice

From the results of the previous scenario, i.e. increased yield, reduction of import duties on inputs would generate even greater incentives for the overall performance of the irrigated rice production system, with improvements in both financial and economic profitability indicators and would also provide net transfer and some protection to the enterprise. The scenario of increased import duties for imported rice discussed in the previous section shows that the financial profitability would be greatly increased and would consequently transfer more resources in favour of the system, with better protection coefficients. In an attempt to combine all these effects into a single scenario, a simultaneous changes scenario was simulated using increased yield (6 tons/ha), a reduction of import duties on inputs (suppression of VAT) and increased import duties for imported rice (20 %). The results, presented in tables 6.28 and 6.29, are impressive. On average, in retail markets the financial profitability would be three times greater than that of the base scenario model and 2.8 times greater for the wholesale market, with very low financial cost-benefit ratios, indicating that the system would become more competitive. Economic profitability would be 1.22 to 1.25 times higher than that of the base scenario model in the retail and wholesale markets respectively. With the DRC of much lower than 1, the system would be more efficient. Both protection coefficients are greater than 1: in the range of 1.3 for the nominal protection coefficient and 1.4 for the effective protection coefficient. The profitability coefficient stands in the range of 1.6, indicating that private profit would be an average of 1.6 times the economic profit, due to the incentives provided to the system. In fact, the net transfer, which was negative in the base model scenario, becomes positive; on average its values vary between 104,017 FCFA/tonne (216.7 US $/tonne) for retail markets and 98,842 FCFA/tonne (205.92 US $/tonne) for wholesale markets. Another important result is that the subsidy ratio to producers (SRP), on average, would be 35.8 % and 35.6 % for the retail and wholesale markets respectively. The SRP is a ratio that compares the net policy transfer to the value of output in social prices, meaning that it measures the proportion of all transfers in comparison to output value in social prices. The SRP is the output tariff equivalent if the net effect of all policy transfers were carried out solely through a tariff on output (Pearson *et al*., 2003).

Table 6.28: Summary: Simultaneous Increased Yield, Reduction of Imports Duties on Inputs and Increased Import Duties for Imported Rice (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	245,275	227,648	282,505	263,376	263,890	245,512
Financial Cost-Benefit Ratio	0.233	0.246	0.202	0.214	0.217	0.230
Social Profitability, FCFA	144,934	132,307	174,813	161,034	159,873	146,671
Domestic Resource Cost Ratio (DRC)	0.340	0.361	0.291	0.309	0.316	0.335
Social Cost-Benefit Ratio	0.480	0.503	0.423	0.443	0.451	0.473
Transfers, FCFA	100,342	95,341	107,693	102,342	104,017	98,842
Nominal Protection Coefficient	1.377	1.376	1.371	1.370	1.374	1.373
Effective Protection Coefficient	1.455	1.459	1.435	1.438	1.445	1.448
Profitability Coefficient	1.692	1.720	1.616	1.635	1.654	1.677
Producers Subsidy Ratio	0.360	0.358	0.355	0.354	0.358	0.356
Producers Subsidy Estimate	0.261	0.260	0.259	0.258	0.260	0.259

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.29: Results: Simultaneous Increased Yield, Reduction of Imports Duties on Inputs and Increased Import Duties for Imported Rice (per tonne of Milled Rice)

Point of Comparison	Pakistan rice				Thai parboiled			
	Niamey		Tillabery		Niamey		Tillabery	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	233,179	216,440	269,104	250,925	257,372	238,856	295,907	275,828
Financial Cost-Benefit Ratio	0.237	0.251	0.206	0.217	0.228	0.242	0.199	0.210
Social Profitability, FCFA	138,983	126,960	167,974	154,842	150,884	137,653	181,651	167,226
Domestic Resource Cost Ratio (DRC)	0.343	0.364	0.294	0.311	0.337	0.358	0.289	0.306
Social Cost-Benefit Ratio	0.486	0.509	0.428	0.448	0.473	0.496	0.417	0.437
Transfers, FCFA	94,196	89,479	101,130	96,083	106,488	101,203	114,256	108,601
Nominal Protection Coefficient	1.37	1.36	1.36	1.36	1.39	1.39	1.38	1.38
Effective Protection Coefficient	1.44	1.45	1.42	1.43	1.47	1.47	1.45	1.45
Profitability Coefficient	1.68	1.70	1.60	1.62	1.71	1.74	1.63	1.65
Producers Subsidy Ratio	0.348	0.346	0.344	0.342	0.372	0.370	0.367	0.365
Producers Subsidy Estimate	0.255	0.254	0.253	0.252	0.268	0.267	0.266	0.265

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.6.8. Simultaneous changes: increased yield and increased import duties for imported rice

As in the previous scenario, the results obtained with this simulation show some improvement of the various indicators for the irrigated rice production system in comparison to the base scenario model results (table 6.30 and table 6.31). Most importantly, all profitability indicators are much higher than those obtained with the base model results. Financial profitability would be 3.1 and 2.8 times greater than that of the base model for the retail market and wholesale markets respectively. With such magnitude of improvement, the financial cost-benefit ratio (private cost ratio) would be reduce by 33 % to 30 % for the retail and wholesale markets respectively. These reductions in the private cost ratios would bring actual financial cost-benefit ratios to 21.7 % and 23 % for the retail and wholesale markets respectively, implying tremendous incentives for the system to become more competitive. 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. Economic profitability implies an improvement in the comparative advantage of the system, with DRC ratios that would vary between 0.309 and 0.327 for the retail and wholesale markets respectively. The profitability coefficient (PC), that is, the ratio of private profits to social profits, would vary between 1.60 and 1.62 for both markets, with average positive net transfers of 98,948 FCFA/tonne (206.14 US $/tonne) in retail markets and 93,772 FCFA/tonne (195.36 US $/tonne) in wholesale markets. In other words, the net positive transfer that would be generated with such a scenario would permit the private profits of the system to be about 1.6 times greater than the social profit (the situation without the simulated changes). This shows how important such incentives would be, as is also indicated by the protection coefficients of 1.37 to 1.41. The average subsidy ratio to producers (SRP) of 34 % also shows how important the transfers are in comparison the system's revenues evaluated in social prices. As in the case of SRP, the producer subsidy estimate (the ratio of net transfer to private profit) would be on average 25 %.

Table 6.30: Summary: Simultaneous Increased Yield and Increased Import Duties for Imported Rice (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	245,275	227,648	282,505	263,376	263,890	245,512
Financial Cost-Benefit Ratio	0.233	0.246	0.202	0.214	0.217	0.230
Social Profitability, FCFA	150,003	137,377	179,882	166,104	164,943	151,740
Domestic Resource Cost Ratio (DRC)	0.332	0.352	0.285	0.302	0.309	0.327
Social Cost-Benefit Ratio	0.462	0.483	0.406	0.425	0.434	0.454
Transfers, FCFA	95,272	90,271	102,623	97,272	98,948	93,772
Nominal Protection Coefficient	1.377	1.376	1.371	1.370	1.374	1.373
Effective Protection Coefficient	1.422	1.424	1.406	1.407	1.414	1.416
Profitability Coefficient	1.635	1.656	1.570	1.585	1.602	1.621
Producers Subsidy Ratio	0.342	0.339	0.339	0.336	0.340	0.338
Producers Subsidy Estimate	0.248	0.246	0.247	0.245	0.248	0.246

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.31: Results: Simultaneous Increased Yield and Increased Import Duties for Imported Rice (per tonne of Milled Rice)

Point of Comparison	Pakistan rice				Thai parboiled			
	Niamey		Tillabery		Niamey		Tillabery	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	233,179	216,440	269,104	250,925	257,372	238,856	295,907	275,828
Financial Cost-Benefit Ratio	0.237	0.251	0.206	0.217	0.228	0.242	0.199	0.210
Social Profitability, FCFA	144,053	132,030	173,044	159,912	155,954	142,723	186,721	172,296
Domestic Resource Cost Ratio (DRC)	0.335	0.354	0.287	0.304	0.329	0.349	0.284	0.300
Social Cost-Benefit Ratio	0.467	0.489	0.411	0.430	0.456	0.478	0.401	0.420
Transfers, FCFA	89,126	84,410	96,060	91,013	101,418	96,133	109,186	103,532
Nominal Protection Coefficient	1.366	1.365	1.361	1.360	1.387	1.387	1.381	1.381
Effective Protection Coefficient	1.411	1.412	1.395	1.396	1.434	1.436	1.417	1.419
Profitability Coefficient	1.619	1.639	1.555	1.569	1.650	1.674	1.585	1.601
Producers Subsidy Ratio	0.329	0.327	0.327	0.324	0.354	0.352	0.350	0.348
Producers Subsidy Estimate	0.241	0.239	0.240	0.238	0.255	0.254	0.254	0.252

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.6.9. Simultaneous changes: reduction of import duties on inputs and increased import duties for imported rice

The scenario simulating a simultaneous reduction of import duties on inputs and increased import duties for imported rice also gives results very different from those of the base scenario (tables 6.32 and 6.33). The increases in the profitability indicators are important, although not of the same magnitude as in the previous scenario. The financial profitability for retail and wholesale markets would be 2.67 and 2.37 times more than those of the base scenario model, showing increased competitiveness. The economic profitability would be less, however, than that of the base scenario model, meaning that the efficiency would be somewhat reduced. In fact, the DRC and SCB ratios would slightly increase in comparison to the base scenario model but would still be less than 1, giving the domestic system a comparative advantage in producing irrigated rice. Overall, the reduction of import duties on inputs (suppression of VAT) and increased import duties for imported rice would have the effect of creating some transfers to the system, as shown by the positive net policy transfer of 149,017 FCFA/tonne (310.45 US $/tonne) for the retail market and 127,888 FCFA/tonne (266.43 US $/tonne) for the wholesale market. This important transfer would bring the average profitability coefficient of the system to 1.84 for the retail market and close to 1.9 in the wholesale market. In particular, in Niamey, when local milled rice is compared to Pakistani rice and Thai parboiled brands, the profitability coefficient of the irrigated rice system would reach 1.9 with an effective protection coefficient in the range of 1.4 to 1.5. The important net transfer that would be created is shown by an average SRP of 35 %. These positive SRP and PSE ratios also constitute a major difference between the simulation model and the base scenario, where these ratios were found to be negative.

Table 6.32: Summary: Simultaneous Reduction of Imports Duties on Inputs and Increased Import Duties for Imported Rice (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	208,290	190,662	245,520	226,391	226,905	208,527
Financial Cost-Benefit Ratio	0.318	0.338	0.278	0.295	0.298	0.316
Social Profitability, FCFA	108,799	96,172	138,678	124,900	123,738	110,536
Domestic Resource Cost Ratio (DRC)	0.473	0.504	0.406	0.432	0.440	0.468
Social Cost-Benefit Ratio	0.610	0.639	0.542	0.568	0.576	0.603
Transfers, FCFA	99,491	94,490	106,842	101,491	103,167	97,991
Nominal Protection Coefficient	1.377	1.376	1.371	1.370	1.374	1.373
Effective Protection Coefficient	1.480	1.486	1.456	1.460	1.468	1.473
Profitability Coefficient	1.914	1.982	1.770	1.812	1.842	1.897
Producers Subsidy Ratio	0.357	0.355	0.353	0.351	0.355	0.353
Producers Subsidy Estimate	0.259	0.258	0.257	0.256	0.258	0.257

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.33: Results: Simultaneous Reduction of Imports Duties on Inputs and Increased Import Duties for Imported Rice (per tonne of Milled Rice)

Point of Comparison	Pakistan rice				Thai parboiled			
	Niamey		Tillabery		Niamey		Tillabery	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	196,194	179,454	232,119	213,940	220,386	201,871	258,921	238,842
Financial Cost-Benefit Ratio	0.327	0.347	0.285	0.302	0.310	0.329	0.271	0.287
Social Profitability, FCFA	102,849	90,826	131,840	118,708	114,749	101,518	145,516	131,092
Domestic Resource Cost Ratio (DRC)	0.481	0.512	0.413	0.439	0.465	0.495	0.400	0.425
Social Cost-Benefit Ratio	0.620	0.649	0.551	0.577	0.599	0.629	0.533	0.559
Transfers, FCFA	93,345	88,629	100,279	95,232	105,637	100,352	113,405	107,751
Nominal Protection Coefficient	1.366	1.365	1.361	1.360	1.387	1.387	1.381	1.381
Effective Protection Coefficient	1.470	1.475	1.446	1.450	1.490	1.496	1.466	1.470
Profitability Coefficient	1.908	1.976	1.761	1.802	1.921	1.989	1.779	1.822
Producers Subsidy Ratio	0.345	0.343	0.341	0.339	0.369	0.367	0.364	0.363
Producers Subsidy Estimate	0.253	0.251	0.251	0.250	0.266	0.265	0.264	0.263

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.6.10 Simultaneous changes: technology improvement and reduction of import duties on inputs

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 a reduction of import duties on inputs (suppression of VAT) generates results that are not very different from those obtained in the base scenario model (table 6.34 and table 6.35). Financial and economic profitability would improve, providing relatively smaller incentives in comparison to the previous scenarios of simultaneous changes. In fact, the net transfer remains negative as in the case of the base scenario, with average SRP and PSE also negative. In other words, in relation to the previous simultaneous changes scenarios, the improvement in paddy milling conversion rate coupled with a reduction in import duties on inputs do not constitute sufficient incentive to boost the competitiveness and efficiency of the irrigated rice production system. However, the DRC and SCB still remain less than 1, indicating that the system would efficiently use domestic resources and remain competitive.

Table 6.34: Summary: Simultaneous Changes: Technology Improvement and Reduction of Import Duties on Inputs (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	134,186	116,186	72,886	96,386	103,536	106,286
Financial Cost-Benefit Ratio	0.393	0.438	0.535	0.471	0.464	0.455
Social Profitability, FCFA	126,654	114,027	156,533	142,755	141,593	128,391
Domestic Resource Cost Ratio (DRC)	0.406	0.431	0.349	0.370	0.377	0.401
Social Cost-Benefit Ratio	0.543	0.569	0.480	0.503	0.511	0.536
Transfers, FCFA	7,532	2,159	-83,647	-46,369	-38,057	-22,105
Nominal Protection Coefficient	1.044	1.023	0.739	0.858	0.891	0.941
Effective Protection Coefficient	1.032	1.003	0.653	0.799	0.842	0.901
Profitability Coefficient	1.056	1.006	0.469	0.684	0.762	0.845
Producers Subsidy Ratio	0.026	0.005	-0.277	-0.159	-0.125	-0.077
Producers Subsidy Estimate	0.024	-0.006	-0.379	-0.200	-0.178	-0.103

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.35: Results: Simultaneous Changes - Technology Improvement and Reduction of Import Duties on Inputs (per tonne of Milled Rice)

Point of Comparison	Pakistan rice				Thai parboiled			
	Niamey		Tillabery		Niamey		Tillabery	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	117,609	81,609	81,309	118,309	150,763	150,763	64,463	74,463
Financial Cost-Benefit Ratio	0.417	0.508	0.501	0.408	0.368	0.368	0.569	0.534
Social Profitability, FCFA	120,079	108,056	149,070	135,938	133,229	119,998	163,996	149,572
Domestic Resource Cost Ratio	0.413	0.438	0.354	0.375	0.399	0.424	0.343	0.364
Social Cost-Benefit Ratio	0.552	0.578	0.488	0.511	0.533	0.559	0.472	0.495
Transfers, FCFA	-2,469	-26,446	-67,760	-17,628	17,534	30,764	-99,533	-75,109
Nominal Protection Coefficient	1.009	0.916	0.785	0.955	1.078	1.130	0.694	0.762
Effective Protection Coefficient	0.987	0.862	0.706	0.918	1.077	1.145	0.599	0.679
Profitability Coefficient	0.979	0.755	0.545	0.870	1.132	1.256	0.393	0.498
Producers Subsidy Ratio	-0.009	-0.103	-0.233	-0.063	0.061	0.113	-0.321	-0.254
Producers Subsidy Estimate	-0.009	-0.113	-0.296	-0.066	0.057	0.100	-0.462	-0.333

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.6.11 Simultaneous changes: technology improvement and increased import duties for imported rice

The scenario of a change in technology with an improvement in the conversion rate of paddy into milled rice (75 % rather than 65 %), combined with an increase in import duties for imported rice generates results that differ from those obtained with the base scenario model (table 6.36 and table 6.37). An important improvement is seen in financial profitability, which would be greater than that of the base scenario model by 160,516 FCFA/tonne (334.41 US $/tonne) for the retail market and 139,388 FCFA/tonne (290.39 US $/tonne) for the wholesale market. However, the improvement in economic profitability is very small: only 16,912 FCFA/tonne (35.23 US $/tonne) more than the economic profitability obtained in the base scenario model. This is explained by the fact that the increase in import duty of the imported rice would affect the financial parity price. The increase in tariff would create a divergence that would generate more resources to the system as shown by the average positive net policy transfer of 97,754 FCFA/tonne (203.65 US $/tonne) for the retail market and 92,579 FCFA/tonne (192.87 US $/tonne) for the wholesale market, while in the base model, the net policy transfer was negative. On average, the profitability coefficient would vary between 1.60 and 1.70, indicating that private profits would be 60 % to 70 % greater than they would be without the simulated measures. The net transfer would explain the higher level of private profits. The system would be protected, as shown by the nominal and effective protection coefficients, which are all greater than 1. The average SRP of about 34 % shows the importance of the transfer that such a combination of measures would generate for the system.

Table 6.36: Summary: Simultaneous Technology Improvement and Increased Import Duties for Imported Rice (per tonne of Milled Rice)

Point of Comparison	Niamey		Tillabery		Average	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	226,863	209,236	264,093	244,964	245,478	227,100
Financial Cost-Benefit Ratio	0.275	0.292	0.240	0.254	0.258	0.273
Social Profitability, FCFA	132,785	120,158	162,664	148,885	147,724	134,522
Domestic Resource Cost Ratio (DRC)	0.395	0.419	0.340	0.360	0.367	0.389
Social Cost-Benefit Ratio	0.520	0.545	0.460	0.482	0.490	0.513
Transfers, FCFA	94,079	89,078	101,430	96,079	97,754	92,579
Nominal Protection Coefficient	1.379	1.378	1.373	1.372	1.376	1.375
Effective Protection Coefficient	1.427	1.429	1.410	1.411	1.419	1.420
Profitability Coefficient	1.708	1.741	1.623	1.645	1.665	1.693
Producers Subsidy Ratio	0.340	0.337	0.337	0.334	0.338	0.336
Producers Subsidy Estimate	0.246	0.244	0.245	0.244	0.246	0.244

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.37: Results: Simultaneous Technology Improvement and Increased Import Duties for Imported Rice (per tonne of Milled Rice)

Point of Comparison	Pakistan rice				Thai parboiled			
	Niamey		Tillabery		Niamey		Tillabery	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	214,142	197,403	250,067	231,888	239,585	221,069	278,120	258,041
Financial Cost-Benefit Ratio	0.282	0.299	0.246	0.260	0.269	0.285	0.235	0.248
Social Profitability, FCFA	126,209	114,186	155,200	142,068	139,360	126,129	170,127	155,702
Domestic Resource Cost Ratio (DRC)	0.401	0.425	0.345	0.365	0.388	0.412	0.335	0.355
Social Cost-Benefit Ratio	0.529	0.554	0.467	0.489	0.512	0.536	0.452	0.474
Transfers, FCFA	87,933	83,216	94,867	89,820	100,224	94,940	107,993	102,338
Nominal Protection Coefficient	1.369	1.368	1.364	1.363	1.389	1.388	1.383	1.382
Effective Protection Coefficient	1.417	1.418	1.400	1.401	1.438	1.440	1.420	1.422
Profitability Coefficient	1.697	1.729	1.611	1.632	1.719	1.753	1.635	1.657
Producers Subsidy Ratio	0.328	0.325	0.326	0.323	0.351	0.349	0.348	0.346
Producers Subsidy Estimate	0.239	0.237	0.239	0.237	0.253	0.251	0.252	0.250

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.7 Summary of the sensitivity analysis results

An improvement in the milling rate (from 65 % to a simulated ratio of 75 %) 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. The milling improvement scenario results also show a positive impact on the system's overall performance, in the sense that it would show as transfer of resources to the system and that indicators for the nominal and effective protection coefficients would be slightly greater than 1; particularly in the case of the parboiled rice marketing system in Niamey. On average, considering the Cotonou port of import, the private profitability per tonne of local milled rice increased to 103,536 FCFA (215.7 US $/tonne) and 106,286 FCFA (221.4 US $/tonne) in the retail and wholesale markets respectively. The financial cost-benefit ratio also improved and is evaluated at 0.464 and 0.455 for retail and wholesale markets. In the base PAM model, these figures were 78,736 FCFA/tonne of milled rice (164 US $/tonne) and 84,861 FCFA/tonne of milled rice (176.73 US $/tonne), with financial cost-benefit ratios of 0.56 and 0.54 for the retail and wholesale markets respectively. The summary results indicate that on average, the economic profitability is 147,724 FCFA/tonne (307.76 US $/tonne) and 134,522 FCFA/tonne (280.25 US $ /tonne) in retail and wholesale marketing systems respectively. These figures compare well with the figures obtained with the base model, for which the economic profitability is 130,688 FCFA/tonne (272 US $/tonne) of milled rice in the retail markets, and 117,652 FCFA/tonne of milled rice (245 US $/tonne) in the wholesale markets. The DRC is 0.367 and 0.389 for the retail rice marketing and wholesale marketing systems while the social cost-benefit ratio is 0.490 and 0.513 respectively for the same marketing systems. On average, the net policy transfer per tonne of milled rice is –44,188 FCFA (–92.06 US $ /tonne) and –28,236 FCFA (–58.82 US $ /tonne) in retail and wholesale rice marketing respectively, in comparison to –51,951 FCFA/tonne (–108.23 US $/tonne) and –32,790 FCFA/tonne (–68.31 US $/tonne), which are the results obtained in the base model.

Farm-level productivity improvement from a base level of 4.3 tons/ha to an improved level of 6 tons/ha also shows a positive impact on the overall irrigated rice system's performance, with an average financial profitability of 121,948 FCFA/tonne (254.06 US $/tonne) and 124,698 FCFA/tonne (259.79 US $/tonne) for the retail and wholesale marketing systems. The financial cost-benefit ratios are evaluated at 0.385 and 0.377 respectively. This is a clear indication that, *ceteris paribus*, an increase in farm-level productivity had an impact on private profitability and the competitiveness of the irrigated system. In the different points of comparison also, the private profitability and related financial cost-benefit ratios compare well with the results generated by the base model scenario. The social profitability is positive and on average equals 164,943 FCFA/tonne of local milled rice (343.63 US $/tonne) and 151,740 FCFA/tonne (316.12 US $/tonne) in retail and wholesale markets respectively. This relative high social profitability is sustained by the low DRC of 0.284 and 0.300, supporting the fact that increased productivity would translate into greater efficiency in the system. Such an efficient system would be more cost effective, with social cost-benefit ratios of 0.434 and 0.454 in the retail and wholesale marketing systems. The net policy on average for all systems is –42,995 FCFA/tonne (–89.57 US $/tonne) and –27,042 FCFA/tonne (–56.34 US $), showing that resources are diverted from the system. This result indicates that even though increased farm-level productivity would increase the economic profitability of the system, the relatively higher productivity would not be sufficient globally to provide incentives to the various economic agents, as some channels in the system would not have enough protection.

With a simulated change in the import duty for imported rice of the common external tariff (CET), the net policy transfer becomes positive, suggesting that an increase in the tariff rate would provide greater incentives to the economic agents operating within the system. This scenario shows that a change in tariff rate would greatly increase financial profitability and consequently transfers more resources to the system. The average nominal protection coefficients would be in the range of 1.37 for both retail and wholesale rice marketing systems and for all type of final product (milled parboiled and non-parboiled rice). The effective protection coefficient would be in the range of 1.4 and this higher incentive would also translate into higher profitability coefficients, averaging 1.74 and 1.78 for the retail and wholesale marketing systems. The system producing parboiled rice would even benefit from a protection coefficient of 1.8. The SRP and PSE become positive, indicating that the system would be better protected.

A change in the exchange rate from 480 FCFA to 447 FCFA to one US $ shows that both average financial and economic profitability would increase, in comparison to the base model scenario. Overall, with such a scenario, the system would enjoy greater protection in both the retail and wholesale marketing channels of Niamey. Most importantly, on average the system producing local parboiled rice would be favoured in the region of Tillabery (the major producing area) with protection coefficients (nominal and effective) in the range of 1.12 to 1.17. The profitability coefficients would range between 1.2 and 1.35 for the retail and wholesale rice marketing channels respectively, as the system would benefit from a net policy transfer. The system producing standard, milled, non-parboiled rice would also benefit from some protection in its retail marketing channel in Niamey.

Single changes in factor provide interesting results for the system. The simultaneous changes have generated very important results in comparison to the base scenario results, ranging from improvement in private and social profitability, supported by low private cost ratios, domestic resource cost (DRC) ratios, and social benefit-cost (SCB) ratios. The simultaneous changes would also generate positive net transfer, creating high ratios of profitability coefficients. The positive net transfer allows the system to enjoy some protection, as shown by the nominal protection coefficients and effective protection coefficients, which are greater than 1 and sometimes in the range of 1.3 and 1.4. The SRP and PSE ratios also show the importance of the transfer generated to the system, and are in the range of 33 to 35 % and 24 to 26 % respectively.

Table 6.38: Summary Results for Single Factor Change Scenarios: Milling Rate and Increased Yield. Per tonne of Milled Rice.

	Milling Rate 75 %		Yield (6 T/ha)	
	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	103,536	106,286	121,948	124,698
Financial Cost-Benefit Ratio	0.464	0.455	0.385	0.377
Social Profitability, FCFA	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
Transfers, FCFA	-44,188	-28,236	-42,995	-27,042
Nominal Protection Coefficient	0.891	0.941	0.892	0.941
Effective Protection Coefficient	0.82	0.876	0.829	0.884
Profitability Coefficient	0.729	0.805	0.762	0.834
Producers Subsidy Ratio	-0.15	-0.1	-0.142	-0.094
Producers Subsidy Estimate	-0.2	-0.13	-0.196	-0.122

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.39: Average Results for Single Factor Change Scenarios: Increase of Tariff Rate for Imported Rice, Exchange Rate, and Reduction of Import Duties for Inputs. Per tonne of Milled Rice

	Tariff Rate (20 %)*		Exchange Rate**		Reducing Imports Duties on Inputs*	
Types of Markets	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	226,905	208,527	84,962	87,712	84,962	87,712
Financial Cost-Benefit Ratio	0.298	0.316	0.548	0.536	0.548	0.536
Social Profitability, FCFA	130,813	117,610	119,242	106,591	123,738	110,536
Domestic Resource Cost	0.426	0.452	0.449	0.477	0.44	0.468
Social Cost--Benefit Ratio	0.551	0.578	0.574	0.602	0.576	0.603
Transfers, FCFA	96,092	90,917	-34,280	-18,879	-38,776	-22,823
Nominal Protection Coefficient	1.374	1.373	0.929	0.98	0.892	0.941
Effective Protection Coefficient	1.422	1.424	0.852	0.912	0.834	0.894
Profitability Coefficient	1.74	1.78	0.755	0.847	0.727	0.816
Producers Subsidy Ratio	0.33	0.327	-0.12	-0.07	-0.127	-0.079
Producers Subsidy Estimate	0.24	0.238	-0.16	-0.09	-0.179	-0.105

* N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

** N.B: 447 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2008

Table 6.40: Average Results for Simultaneous Changes: Increased Yield in combination with Imports Duties Changes. Per tonne of Milled Rice.

	Reduction of Imports Duties on Inputs		Reduction of Imports Duties on Inputs and Increased Import Duties for Imported Rice		Increased Import Duties for Imported Rice	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	121,948	124,698	263,890	245,512	263,890	245,512
Financial Cost-Benefit Ratio	0.385	0.377	0.217	0.23	0.217	0.23
Social Profitability, FCFA	159,873	146,671	159,873	146,671	164,943	151,740
Domestic Resource Cost	0.316	0.335	0.316	0.335	0.309	0.327
Social Cost--Benefit Ratio	0.451	0.473	0.451	0.473	0.434	0.454
Transfers, FCFA	-37,925	-21,973	104,017	98,842	98,948	93,772
Nominal Protection	0.892	0.941	1.374	1.373	1.374	1.373
Effective Protection	0.847	0.904	1.445	1.448	1.414	1.416
Profitability Coefficient	0.788	0.864	1.654	1.677	1.602	1.621
Producers Subsidy Ratio	-0.124	-0.076	0.358	0.356	0.34	0.338
Producers Subsidy Estimate	-0.176	-0.102	0.26	0.259	0.248	0.246

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Table 6.41: Average Results for Simultaneous Changes of Imports Duties and Technology Improvement and Imports Duties. Per tonne of Milled Rice

	Simultaneous Changes: Reduction of Imports Duties on Inputs and Increased Import Duties for Imported Rice		Simultaneous Changes: Technology Improvement and Reduction of Import Duties on Inputs		Simultaneous Technology Improvement and Increased Import Duties for Imported Rice	
Types of Markets	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability,	226,905	208,527	103,536	106,286	245,478	227,100
Financial Cost-Benefit	0.298	0.316	0.464	0.455	0.258	0.273
Social Profitability, FCFA	123,738	110,536	141,593	128,391	147,724	134,522
Domestic Resource Cost	0.44	0.468	0.377	0.401	0.367	0.389
Social Cost--Benefit Ratio	0.576	0.603	0.511	0.536	0.49	0.513
Transfers, FCFA	103,167	97,991	-38,057	-22,105	97,754	92,579
Nominal Protection	1.374	1.373	0.891	0.941	1.376	1.375
Effective Protection	1.468	1.473	0.842	0.901	1.419	1.42
Profitability Coefficient	1.842	1.897	0.762	0.845	1.665	1.693
Producers Subsidy Ratio	0.355	0.353	-0.125	-0.077	0.338	0.336
Producers Subsidy	0.258	0.257	-0.178	-0.103	0.246	0.244

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

6.8 Chapter summary

The PAM base scenario model generated very detailed results according to different points of comparison, type of market (retail and wholesale), and port of importation of imported rice. A simple synthesis of the partial results of the analysis is presented in table 6.42. The private profitability indicators, being the results of the sum of outcomes of farm profits and post-farm activities (collection, processing and marketing), indicates that under existing policies, the irrigated rice production activities are competitive and private operators are making some positive financial gains. Moreover, the 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 maintained that despite the fact that the inputs mobilised into the activity are affected by the various common external tariff (CET) measures, the activity still performs to a level that permits the various actors to earn a positive income and allows them to sustain their businesses. However, the PAM base results show that the net policy transfer indicators are negative per unit of land and per unit of final output (milled rice) for all scenarios (types of market and comparison points). These are clear indications that private profits for the irrigated rice enterprise are less than social profits, suggesting that resources are being driven away from the system due to the policies that are in effect.

Table 6.42: Average PAM Base Scenario Results by Point of Comparison and type of market (per tonne of milled rice)

Point of Comparison	Niamey		Tillabery		Average	
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale
Financial Profitability, FCFA	115,612	97,612	54,312	77,812	84,962	87,712
Financial Cost-Benefit Ratio	0.459	0.514	0.637	0.558	0.548	0.536
Social Profitability, FCFA	115,873	103,246	145,752	131,974	130,813	117,610
Domestic Resource Cost Ratio (DRC)	0.457	0.486	0.394	0.418	0.426	0.452
Social Cost-Benefit Ratio	0.584	0.612	0.519	0.543	0.551	0.578
Transfers, FCFA	-261	-5,634	-91,440	-54,161	-45,850	-29,898
Nominal Protection Coefficient	1.043	1.023	0.741	0.859	0.892	0.941
Effective Protection Coefficient	0.995	0.965	0.620	0.764	0.808	0.864
Profitability Coefficient	0.993	0.931	0.376	0.599	0.685	0.765
Producers Subsidy Ratio	-0.002	-0.024	-0.301	-0.185	-0.151	-0.104
Producers Subsidy Estimate	-0.003	-0.035	-0.411	-0.230	-0.207	-0.133

N.B: 480 FCFA / USD (Average of the monthly exchange rates given first of every month; all year 2007).

Despite its present competitiveness and efficiency, the irrigated rice production system still performs below potential because it lacks additional incentives. In order to better investigate this issue, we have taken our analysis further to perform sensitivity analyses that consider changes in several technological and economic factors. The sensitivity analyses were performed with single factor and simultaneous changes of several factors.

An improvement in the milling rate would provide good incentives to the system, allowing it to perform more efficiently and increasing economic gains for private operators. *Ceteris paribus*, the private and economic profitability is increased in comparison to the PAM base results. In addition, the economic profitability of the retail marketing channel would improve markedly in comparison to the wholesale marketing channel, implying that an improvement of the paddy milling conversion rate would enhance the efficiency of the retail marketing system. The milling improvement scenario also shows a positive impact on the overall system's performance, in the sense that it would show as a transfer of resources to the system and that some indicators of the nominal and effective protection coefficients would be slightly greater than 1, particularly for the parboiled rice marketing system in Niamey.

Farm-level productivity improvement also shows a positive impact on the overall performance of the irrigated rice system. Both, financial and economic profitability increase in comparison to the PAM base model results. This points to the fact that increased farm-level productivity would translate into greater efficiency in the production system, particularly the retail marketing system. The parboiled local rice marketing system would be more efficient in terms of social profitability than the local milled non-parboiled rice. The main producing region of Tillabery would generate the highest social profitability. However, the average net policy for all systems is negative, showing that even though improved farm-level productivity would increase the economic profitability of the system, the relative higher productivity would not be sufficient globally to provide incentives to the various economic agents, as some channels in the system would not be well enough protected.

An important result obtained with a simulated change in the import duty for imported rice, the common external tariff (CET), is that the net policy transfer becomes positive, suggesting that an increase in the tariff rate would provide greater incentives to the economic agents operating within the system, with average nominal protection coefficients that would be in the range of 1.37 for both retail and wholesale rice marketing systems and for all types of final product (milled, parboiled and non-parboiled rice). The effective protection coefficient would be in the range of 1.4 and this higher incentive would also translate into higher profitability coefficients, averaging 1.74 and 1.78 for the retail and wholesale marketing systems. The system producing parboiled rice would benefit even from a protection coefficient of 1.8. The SRP and PSE become positive, indicating that the system would be better protected. This scenario, compared to the previous scenarios, shows that a change in tariff rate would have the effect of greatly increasing the financial profitability and would consequently transfer more resources in favour of the system.

A change in the exchange rate from 480 FCFA to 447 FCFA to the US $ show that both average financial and economic profitability would increase in comparison to the base model scenario. The most important result in this scenario is that, on average, the system producing local parboiled rice would be favoured in the region of Tillabery (the major producing area) with protection coefficients (nominal and effective) in the range of 1.12 to 1.17. Profitability coefficients would range between 1.2 and 1.35 for the retail and wholesale rice marketing channels respectively, as the system would benefit from a net policy transfer. The system producing standard, milled non-parboiled rice would also benefit from some protection in its retail marketing channel in the region of Niamey. Overall, in such a scenario, the system would enjoy greater protection in both the retail and wholesale marketing channels in Niamey.

The scenario that simulated a suppression of VAT shows relatively small impacts on the various indicators such as DRC, social cost-benefit ratio (SCB), effective protection coefficient (EPC), profitability coefficient (PC), producer subsidy ratio and producer subsidy estimate. With a reduction of import duties on inputs (suppression of VAT), the DRC ratios would change to 44 % and 46.8 % for the retail and wholesale markets respectively. The SCB would change on average from 55.1 % to 57.6 % for the retail market and from 57.8 % to 60.3 % for the wholesale market, indicating that social profitability would still be less than 1 with the suppression of VAT on import duties for inputs used in the irrigated rice production system. However, economic profitability would be reduced by an average of 7,074 FCFA per tonne of milled rice (14.737 US $/tonne). The suppression of VAT would translate into an increase of the effective protection coefficient (EPC) for retail and wholesale markets, bringing the EPC to 83.4 % as against 80.8 % for retailers and 89.4 % as against 86.4 % for wholesalers. The profitability coefficient (PC) would also increase for the retail and wholesale markets, which is an indication of relative profitability. The average PC ratios would change from 68.5 % to 72.7 % for retail markets and from 76.5 % to 81.6 % for wholesale markets. VAT suppression would indeed generate some incentives, as indicated by the EPC and PC. Producers would be less taxed because the ratios would change from –15.1 % to –12.7 % for retailers and from –10.4 % to –7.9 % for wholesalers.

A simple reduction of import duties on inputs (suppression of VAT) scenario would provide some incentives to producers. Also, the sensitivity analysis for a farm-level productivity improvement that would permit an increase in yield from 4.3 tons/ha to 6 tons/ha, also shows a positive impact on the overall performance of the irrigated rice system, with both financial and economic profitability increasing in comparison to PAM base model results. These scenarios combined would simply generate even better incentives for the overall performance of the irrigated rice production system. An estimation of the difference between the results of this scenario to those obtained with the base model scenario indicate that on average the simultaneous changes scenario would allow an increase in both financial and economic profitability. It would provide excellent incentives by improving the comparative advantage of the system. Such incentives are shown also by the positive net policy transfer of 7,925 FCFA/tonne (16.51 US $/tonne) in favour of the system.

A simultaneous combination of increased yield (6 tons/ha), a reduction of import duties on inputs (suppression of VAT) and increased import duties for imported rice (20 %) generates results that are quite outstanding. On average, in retail markets the financial profitability would be three times higher than that of the base scenario model and 2.8 times greater for the wholesale market, with very low financial cost-benefit ratios, indicating that the system would become much more competitive. Economic profitability would be 1.22 to 1.25 times more than that of the base scenario model in the retail and wholesale markets respectively. With a DRC much lower than 1, the system would be far more efficient. Both protection coefficients are greater than 1: in the range of 1.3 for the nominal protection coefficient and 1.4 for the effective protection coefficient. The profitability coefficient stands in the range of 1.6, indicating that average private profits would be 1.6 times the economic profits, due to the incentives provided to the system. The net transfer, which was negative in the base model scenario, becomes positive. On average, its values vary between 104,017 FCFA/tonne (216.7 US $/tonne) for the retail market and 98,842 FCFA/tonne (205.92 US $/tonne) for the wholesale market. Furthermore, the subsidy ratio to producers (SRP), on average, would be 35.8 % and 35.6 % for the retail and wholesale markets respectively.

The results obtained with a combination of an increase in yield (6 tons/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. Most importantly, all profitability indicators are much higher than those obtained for the base model. The financial profitability would be 3.1 to 2.8 times greater than those of the base model for retail market and wholesale markets respectively. With such 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 DRC ratios would vary between 0.309 and 0.327. The profitability coefficient (PC) would vary from 1.60 to 1.62 for both markets with average positive net transfers of 98,948 FCFA/tonne (206.14 US $/tonne) in the retail market and 93,772 FCFA/tonne (195.36 US $/tonne) in the wholesale market. In other words, the net positive transfer that would be generated with such a scenario would permit private profits of the system to be about 1.6 times greater than the social profits (the situation without the simulated changes). The average subsidy ratio to producers (SRP) of 34 % also shows how important such transfers are in comparison to the system's revenues evaluated in social prices. As for the case of SRP, the producer subsidy estimate (the ratio of net transfer to private profit) would be 25 % on average.

The scenario simulating a simultaneous reduction of import duties on inputs (suppression of VAT) and increased import duties for imported rice (20 %) gives also results that are very different from those of the base scenario. The increases in the profitability indicators are important, though not of the same magnitude as in the previous scenario. Overall, the reduction of import duties on inputs (suppression of VAT) and increased import duties for imported rice would have the effect of creating some transfers to the system, as shown by the positive net policy transfer of 149,017 FCFA/tonne (310.45 US $/tonne) for the retail market and 127,888 FCFA/tonne (266.43 US $/tonne) in the wholesale market. This important transfer would bring the average profitability coefficient of the system to 1.84 for the retail market and close to 1.9 in the wholesale market. In particular, in Niamey, when the local milled rice is compared to the Pakistani and Thai parboiled brands, the profitability coefficient of the irrigated rice system would reach 1.9, with an effective protection coefficient in the range of 1.4 and 1.5. The important net transfer that would be created is shown by an average SRP of 35 %. These positive SRP and PSE ratios also constitute a major difference between the simulation model and the base scenario, where these ratios were found to be negative.

The scenario of a change in technology with an improvement in the conversion rate of paddy into milled rice (75 % rather than 65 %), combined with a reduction in import duties on inputs (suppression of VAT) generates results that are not very different from those obtained with the base scenario model. Financial and economic profitability would improve, providing relatively smaller incentives in comparison to the previous scenarios of simultaneous changes. In fact, the net transfer remains negative as in the case of the base scenario, with average SRP and PSE negative also. In other words, in relation to the previous simultaneous changes scenarios, the improvement in paddy milling conversion rate coupled with a reduction of import duties on inputs do not constitute sufficient incentives to boost the competitiveness and efficiency of the irrigated rice production system. However, the DRC and SCB still remain less than 1, indicating that the system would efficiently use domestic resources and remain competitive.

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, has generated some results which differ from those obtained with the base scenario model. 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 improvement is 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. The increase in tariff would create divergences that would generate more resources to the system as shown by the average positive net policy transfer of 97,754 FCFA/tonne (203.65 US $/tonne) for the retail market and 92,579 FCFA/tonne (192.87 US $/tonne) for the wholesale market, while in the base model, the net policy transfer was negative. On average, the profitability coefficient would vary between 1.60 and 1.70, indicating that private profits would be 60 % to 70 % greater than they would be without the simulated measures. The important positive net transfer would explain the higher level of private profits. The system would be protected, as shown by the nominal and effective protection coefficients, which are all greater than 1. An average SRP of about 34 % shows the importance of the transfer that such a combination would generate for the system.

CHAPTER 7: MAJOR FINDINGS, RECOMMENDATIONS AND POLICY IMPLICATIONS OF THE RESEARCH

7.1 Introduction

One major objective of our research was to contribute to the debate relating to the effects of common external tariff (CET) measures and the competitiveness of the irrigated rice production system in Niger. To fulfill its objectives, the study first made a review of research work on rice policy development and irrigated rice production in West Africa. Secondly, in order to better understand the economic background of rice policy development as it takes place within a national economy, the study also made a review of the effects of different trade policy measures on both competitiveness and general economic welfare, with some reference to irrigated rice production systems. Next, the study continued with a review of general literature and theoretical frameworks for assessing the comparative advantage and competitiveness of farming systems and agribusiness by stressing the relevance of the policy analysis matrix (PAM) as an adequate tool to serve the purposes of the research. The development of the PAM models for irrigated rice systems was explained with the various sub-channels involved. The previous chapter discussed our research findings relating to base scenario results and sensitivity analyses. This final chapter aims at discussing the major findings, the recommendations, and the policy implications of the research.

7.2 Major findings

One fundamental question of interest to the research was how competitive is the irrigated rice sub-sector, given the implementation of the common external tariff? Other specific research questions to which the study tried to provide some answers included:

- With the application of common external tariff, how does the irrigated rice sub-sector perform in terms of private and economic incentives?
- Under the CET regime, has the comparative advantage of irrigated rice production improved?
- What is the response of rice producers with regard to these macro-economic changes?

- What are the policy implications for rice research and development?

Answers to these questions are important for many reasons, among which is the issue relating to the policy implications for national rice research and development and the regional rice trade. With the pursuit of food security goals, and using rice as a component of this strategy, it is imperative to shed light on how the dominant rice production system in Niger responds to policy changes. It should be borne in mind that the commodity system evolves in a highly competitive global environment and it interacts with the rest of the national economy through various economic activities (production, processing, marketing, and consumption).

Our investigation was made possible by the policy analysis matrix (PAM) approach used to evaluate the effects of common external tariffs on the performance of irrigated rice production systems. The various analyses were performed using farm-level data in combination with post-harvest and rice marketing data. In addition, both the financial and economic parity prices of different brands of imported rice were estimated at various comparison points (Niamey urban markets and Tillabery region) at which the imported rice and the locally produced rice competes. The approach made possible the analysis of both private and economic profitabilities of irrigated rice enterprise, the estimates of the indicators of policy effects and the analysis of the system's efficiency (comparative advantage).

7.2.1 Competitiveness and comparative advantage of the irrigated rice production system in Niger

The results from the PAM base scenario model showed that under the evaluated CET policy irrigated rice production activities were competitive and private operators were earning positive financial gains, meaning that private profitability was positive. On average, when the locally produced rice was compared to a brand of imported rice which entered into the country through the Cotonou port, with a whole price of 231,000 FCFA (481.25 US $) per tonne, the activity generated for all operators a financial gain of 84,861 FCFA/ tonne of milled rice (176.73 US $/tonne). This financial gain amounted to 237,188 FCFA/hectare (494 US $/ha). The financial cost-benefit ratio was evaluated at 0.54, implying a high profitability level for the activity. With a retail price of 239,000 FCFA/tonne of milled rice, the financial profitability gains amounted to 78,736 FCFA/tonne of milled rice (164 US $/tonne) and 220,068 FCFA/hectare (458.475 US $/ha). In this scenario, the financial cost-benefit ratio was 0.56. These results compared well with those obtained by individual points of comparison (Niamey or Tillabery), with a financial cost-benefit ratio varying between 0.50 and 0.62. Similarly, when the locally produced rice was compared to an imported rice brand entering into the country through the Tema port, the results were quite enlightening. With a wholesale price for locally produced rice of 240,625 FCFA/tonne of milled rice, the financial gains were 84,861 FCFA/tonne (176.80 US $/tonne) and 237,188 FCFA /hectare (494 US $/ha), with a cost-benefit ratio of 0.54, implying also good profitability of the activity for all operators involved.

This result confirms earlier findings relating to the competitiveness of the irrigated rice system in Niger (Faivre-Dupaigre *et al*., 2006; Abernathy *et al*., 2000) and in some other UEMOA member countries (UEMOA, 2005; Faivre-Dupaigre *et al*., 2005; Diarra, 2004). A study conducted by IFPRI (2006) on Regional Strategic Alternatives for Agriculture-led Growth and Poverty Reduction in West Africa also found that rice showed the highest potential for growth among other commodities. The evaluation of private profitability took into account not only the various types of rice brands or quality of processed rice that could be produced with local milled rice but also the rice marketing channels (retail and wholesale markets). In addition, the spatial differences that induced some differences in commodity prices were also considered by selecting the region of Niamey, which is in reality the major consumption area with high demand for the commodity, and the region of Tillabery, the major rice producing area and a rural city. However, differences were observed in relation to these factors (distribution points, marketing systems, and quality of rice). Thus, the system was competitive at output and input market prices in both the region of Tillabery, which constitutes the main rice producing area, and in Niamey, which is the capital city and the first main market point for imported rice.

Moreover, the irrigated rice production enterprise revealed positive economic profitability for both retailers and wholesalers. In retail markets on average, economic profitability was

130,688 FCFA per tonne (272 US $ per tonne) of milled rice when comparing local milled rice to imported rice brands originating from port of Cotonou. In wholesale markets, it was 117,652 FCFA/tonne of milled rice (245 US $ per tonne). The comparison of local milled rice to the imported rice brands originating from Tema's port showed an economic profitability of 141,176 FCFA per tonne (294.11 US $ per tonne) in retail markets versus 127,640 FCFA/tonne (265.92 US $/tonne) in wholesale markets. The economic profitability indicator was relatively higher in the Tillabery region than in the Niamey capital urban.

Following a similar analytical procedure using a per hectare comparison basis, locally produced milled rice was compared to imported rice brands originating from Cotonou port. The results showed that the social profitability was 365,273 FCFA per hectare (761 US $/ha), assuming that the milled locally produced rice was sold in retail markets. This figure was evaluated in the range of 328,836 FCFA/hectare (685 US $/ha) when the locally produced milled rice was sold in wholesale markets. When the locally produced rice was compared to imported rice brands originating from Tema's port, its economic profitability per hectare was 394,587 FCFA (822.06 US $/ha) and 356,755 FCFA/ha (743.24 US $/ha), assuming rice was sold in retail and wholesale markets respectively. Therefore, as an economic activity, it generated net positive income for the national economy per unit of land devoted to this activity. It can be maintained that despite the fact that the inputs mobilised into the activity were affected by the various common external tariff (CET) measures, the activity still performed to a level that allowed the various actors to earn a positive income and to sustain their businesses into the future.

Despite its competitiveness and efficiency, the irrigated rice production system still performed below potential because it lacks certain additional incentives. In retail markets and on a per hectare basis, output transfers were –118,110 FCFA (–246.04 US $/ha) and –85,543 FCFA/ha (–178.21 US $ /ha) for wholesale markets. The output transfer evaluated per tonne of milled rice gave –42,254 FCFA in retail markets (–88.03 US $/tonne) and –30,606 FCFA (–63.76 US $/tonne) in wholesale markets.

Overall, on average for both points of comparison, the net transfer values were negative and in retail markets scenario, these values were –145,204 FCFA/hectare (–302.51 US $/ha) and –51,951 FCFA/tonne (–108.23 US $/tonne). For the wholesale markets scenario, the net transfer became –91,649 FCFA/hectare (–190.94 US $/ha) and –32,790 FCFA/tonne (–68.31 US $/tonne). The scenarios developed to compare the locally produced rice to imported rice brands originating from Tema port also indicated negative values for the net policy transfer. Furthermore, in the majority of cases, the nominal protection coefficients for outputs were less than 1, indicating that in output markets, the irrigated rice production system received little protection and, on average, the retail rice marketing channels tended to be even less well protected. The absence of incentives was also shown by the effective protection coefficients (EPC) which differed depending on the point of comparison of locally milled rice to imported rice brands, the port of import and also the type of rice market. When local milled rice was compared to imported rice brands originating from the port of Cotonou, on average, the EPC varied between 0.78 and 0.85 for the retail and wholesale markets respectively. These coefficients did not, however, differ very much from the ones obtained when the local milled rice was compared to imported rice brands originating from Tema port, where the EPC varied between 0.76 and 0.81 for the retail and wholesale markets respectively. The EPC figures were slightly lower than the nominal protection coefficient (NPC) due to the fact that the slight input transfer was taken into account. As in the case of NPCO, the EPC was less than one, indicating that the value added at market prices for the irrigated rice production system was less than what the value added would have been at reference prices. In other words, when all the effects of policies on irrigated rice output and input markets were considered, it can be seen that the value added, evaluated at market prices, was less than what it would have been in the absence of these policy effects. Furthermore, on average, the policy effects tended to be more pronounced when considering their impact on retail markets. It also implied that the retail marketing channel of the irrigated rice production system tended to be more negatively affected by these policy effects.

Different sensitivity analyses were performed with single factor and simultaneous changes of several factors. All the sensitivity analyses were performed using two imported rice brands namely the Pakistani rice (25%) and Thai parboiled (100 %). The simulations considered were independent of the port of importation and consequently we used only one port (Cotonou) to perform our sensitivity analyses.

An improvement in the milling rate (from 65 % to a simulated ratio of 75 %) provided 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 enhanced the efficiency of the retail marketing system. The milling improvement scenario results also showed a positive impact on the system's overall performance, in the sense that it resulted as a transfer of resources to the system and that indicators for the nominal and effective protection coefficients were slightly greater than 1; particularly in the case of the parboiled rice marketing system in Niamey. On average, considering the Cotonou port of import, the private profitability per tonne of local milled rice increased to 103,536 FCFA (215.7 US $/tonne) and 106,286 FCFA (221.4 US $/tonne) in the retail and wholesale markets respectively with financial cost-benefit ratio evaluated at 0.464 and 0.455 for retail and wholesale markets. The economic profitability, on average, was 147,724 FCFA/tonne (307.76 US $/tonne) and 134,522 FCFA/tonne (280.25 US $ /tonne) in retail and wholesale marketing systems respectively. These figures compared well with the figures obtained with the base model, for which the economic profitability was 130,688 FCFA/tonne (272 US $/tonne) of milled rice in the retail markets, and 117,652 FCFA/tonne of milled rice (245 US $/tonne) in the wholesale markets. The DRC was 0.367 and 0.389 for the retail rice marketing and wholesale marketing systems while the social cost-benefit ratio was 0.490 and 0.513 respectively for the same marketing systems.

Farm-level productivity improvement from a base level of 4.3 tons/ha to an improved level of 6 tons/ha showed a positive impact on the overall irrigated rice system's performance, with an average financial profitability of 121,948 FCFA/tonne (254.06 US $/tonne) and 124,698 FCFA/tonne (259.79 US $/tonne) for the retail and wholesale marketing systems. The financial cost-benefit ratios were evaluated at 0.385 and 0.377 respectively. This was a clear indication that, ceteris paribus, an increase in farm-level productivity had an impact on private profitability and the competitiveness of the irrigated system. The social profitability was positive and on average equaled 164,943 FCFA/tonne of local milled rice (343.63 US $/tonne) and 151,740 FCFA/tonne (316.12 US $/tonne) in retail and wholesale markets respectively. This relative high social profitability was sustained by the low DRC of 0.284 and 0.300, supporting the fact that increased productivity was translated into greater efficiency in the system. The net policy on average for all systems was –42,995 FCFA/tonne (–89.57 US $/tonne) and –27,042 FCFA/tonne (–56.34 US $), showing that resources were diverted from the system. This result indicated that even though increased farm-level productivity increased the economic profitability of the system, the relatively higher productivity was not sufficient globally to provide incentives to the various economic agents, as some channels in the system did not have enough protection.

An important result obtained with a simulated change in the import duty for imported rice, the common external tariff (CET), was that the net policy transfer became positive, suggesting that an increase in the tariff rate provided greater incentives to the economic agents operating within the system, with average nominal protection coefficients that were in the range of 1.37 for both retail and wholesale rice marketing systems and for all types of final product (milled, parboiled and non-parboiled rice). The effective protection coefficient was in the range of 1.4 and this higher incentive translated into higher profitability coefficients, averaging 1.74 and 1.78 for the retail and wholesale marketing systems. The system producing parboiled rice benefited even from a protection coefficient of 1.8.

A simple reduction of import duties on inputs (suppression of VAT) scenario provided some incentives to producers. Also, the sensitivity analysis for a farm-level productivity improvement that permitted an increase in yield from 4.3 tons/ha to 6 tons/ha, also showed a positive impact on the overall performance of the irrigated rice system, with both financial and economic profitability increasing in comparison to PAM base model results. These scenarios combined simply generated even better incentives for the overall performance of the irrigated rice production system. On average the simultaneous changes scenario allowed an increase in both financial and economic profitability. It provided excellent incentives by improving the comparative advantage of the system. Such incentives were shown also by the positive net policy transfer of 7,925 FCFA/tonne (16.51 US $/tonne) in favour of the system.

A simultaneous combination of increased yield (6 tons/ha), a reduction of import duties on inputs (suppression of VAT) and increased import duties for imported rice (20 %) generated results that were quite outstanding. On average, in retail markets the financial profitability were three times higher than that of the base scenario model and 2.8 times greater for the wholesale market, with very low financial cost-benefit ratios, indicating that the system became much more competitive. Economic profitability was 1.22 to 1.25 times more than that of the base scenario model in the retail and wholesale markets respectively. With a DRC much lower than 1, the system was far more efficient. Both protection coefficients were greater than 1: in the range of 1.3 for the nominal protection coefficient and 1.4 for the effective protection coefficient. The profitability coefficient was in the range of 1.6, indicating that average private profits were 1.6 times the economic profits, due to the incentives provided to the system. The net transfer, which was negative in the base model scenario, became positive. On average, its values varied between 104,017 FCFA/tonne (216.7 US $/tonne) for the retail market and 98,842 FCFA/tonne (205.92 US $/tonne) for the wholesale market. Furthermore, the subsidy ratio to producers (SRP), on average, was 35.8 % and 35.6 % for the retail and wholesale markets respectively.

The results obtained with a combination of an increase in yield (6 tons/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. Most importantly, all profitability indicators were much higher than those obtained for the base model. The financial profitability was 3.1 to 2.8 times greater than those of the base model for retail market and wholesale markets respectively. With such magnitude of improvement, the financial cost-benefit ratio (private cost ratio) was 21.7 % and 23 % for retail and wholesale markets respectively, implying tremendous incentives for the system to become more competitive. The economic profitability also increased in the range of 1.26 and 1.29 times those of the base model for the retail and wholesale markets respectively and their DRC ratios varied between 0.309 and 0.327. The profitability coefficient (PC) varied from 1.60 to 1.62 for both markets with average positive net transfers of 98,948

FCFA/tonne (206.14 US $/tonne) in the retail market and 93,772 FCFA/tonne (195.36 US $/tonne) in the wholesale market. Thus, the net positive transfer generated with such a scenario permitted private profits of the system to be about 1.6 times greater than the social profits (the situation without the simulated changes). The average subsidy ratio to producers (SRP) of 34 % also showed how important such transfers were in comparison to the system's revenues evaluated in social prices. As for the case of SRP, the producer subsidy estimate (the ratio of net transfer to private profit) was 25 % on average.

The scenario simulating a simultaneous reduction of import duties on inputs (suppression of VAT) and increased import duties for imported rice (20 %) gave also results that were very different from those of the base scenario. Overall, the reduction of import duties on inputs (suppression of VAT) and increased import duties for imported rice had the effect of creating some transfers to the system, as shown by the positive net policy transfer of 149,017 FCFA/tonne (310.45 US $/tonne) for the retail market and 127,888 FCFA/tonne (266.43 US $/tonne) in the wholesale market. This important transfer brought the average profitability coefficient of the system to 1.84 for the retail market and close to 1.9 in the wholesale market. The important net transfer created was shown by an average SRP of 35 %. These positive SRP and PSE ratios also constituted a major difference between the simulation model and the base scenario, where these ratios were found to be negative.

The scenario of a change in technology with an improvement in the conversion rate of paddy into milled rice (75 % rather than 65 %), combined with a reduction in import duties on inputs (suppression of VAT) generated results that were not very different from those obtained with the base scenario model. Financial and economic profitability improved, providing relatively smaller incentives in comparison to the previous scenarios of simultaneous changes. In fact, the net transfer remained negative as in the case of the base scenario, with average SRP and PSE negative also. In other words, in relation to the previous simultaneous changes scenarios, the improvement in paddy milling conversion rate coupled with a reduction of import duties on inputs did not constitute sufficient incentives to boost the competitiveness and efficiency of the irrigated rice production system. However, the DRC and SCB still remained less than 1, indicating that the system used efficiently domestic resources and remained competitive.

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 which differed from those obtained with the base scenario model. An important improvement was shown in financial profitability, which was greater than that of the base scenario model, although the increase in the economic profitability improvement was relatively very small. This was explained by the fact that the increase in import duty of the imported rice affected the financial parity price. The increase in tariff created divergences that generated more resources to the system as shown by the average positive net policy transfer of 97,754 FCFA/tonne (203.65 US $/tonne) for the retail market and 92,579 FCFA/tonne (192.87 US $/tonne) for the wholesale market, while in the base model, the net policy transfer was negative. On average, the profitability coefficient varied between 1.60 and 1.70, indicating that private profits were 60 % to 70 % greater than they would be without the simulated measures. The important positive net transfer explained the higher level of private profits. The system was protected, as shown by the nominal and effective protection coefficients, which were all greater than 1. An average SRP of about 34 % showed the importance of the transfer that such a combination generated for the system.

A graphical illustration of the effects of possible policy changes on financial and social profitability was also made using only the average results of Niamey and Tillabery for the Pakistani brand of imported rice. This was done for the sake of easy comparison of the results, but these illustrations are just sample illustrations, and although the magnitudes differ, the main trends are similar for the other imported rice varieties, and in both markets.

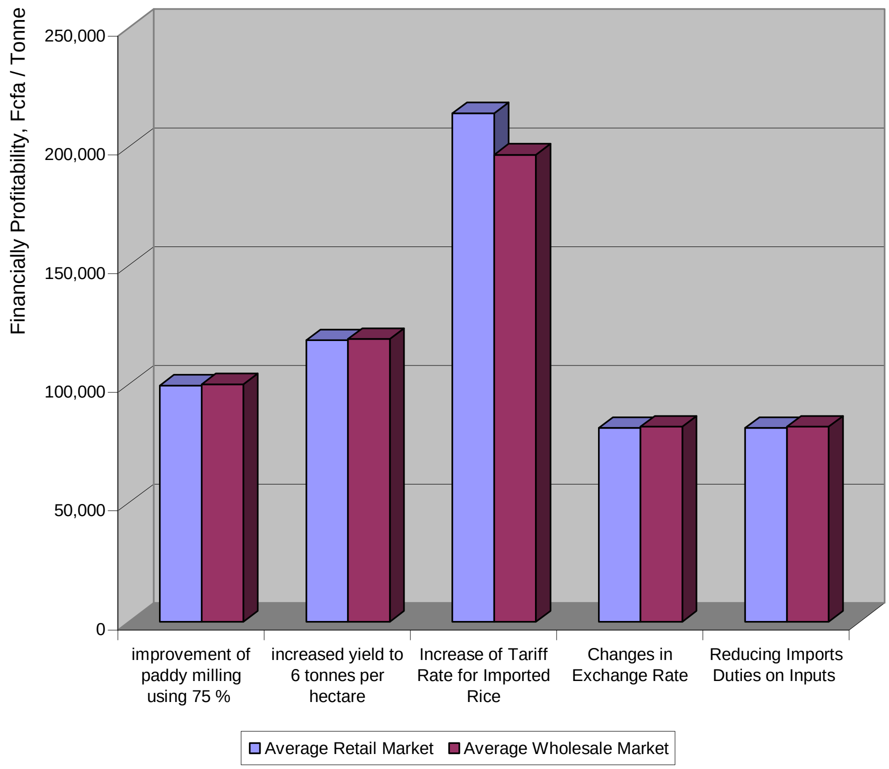

Figure 7.1: Effects of Possible Policy Changes on Financial Profitability (single factor sensitivity analysis)

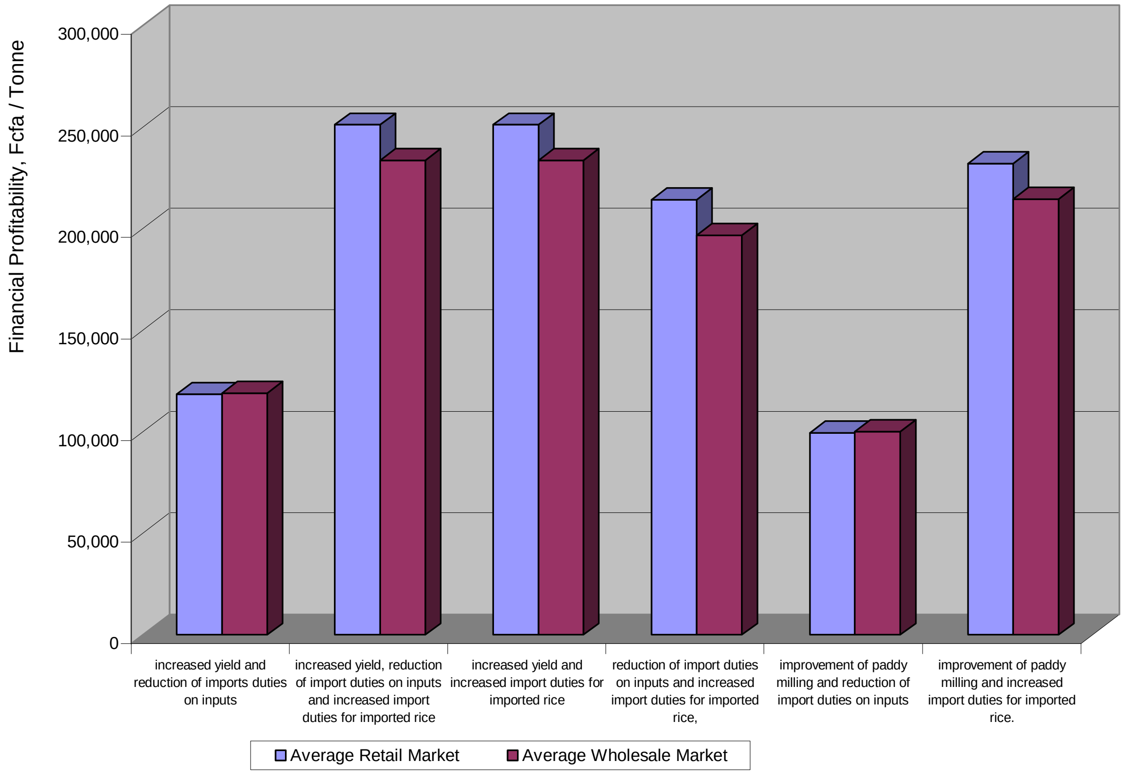

Figure 7.2: Effects of Possible Policy Changes on Financial Profitability (simultaneous changes sensitivity analysis)

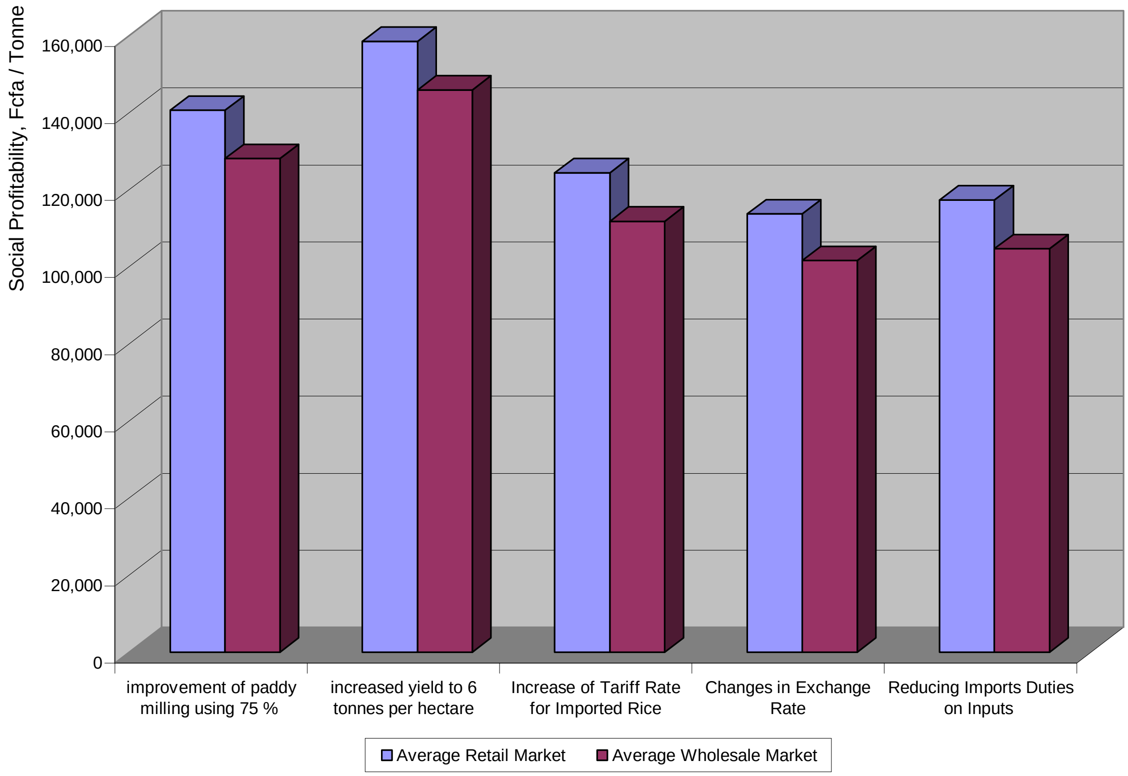

Figure 7.3: Effects of Possible Policy Changes on Economic Profitability (single factor sensitivity analysis)

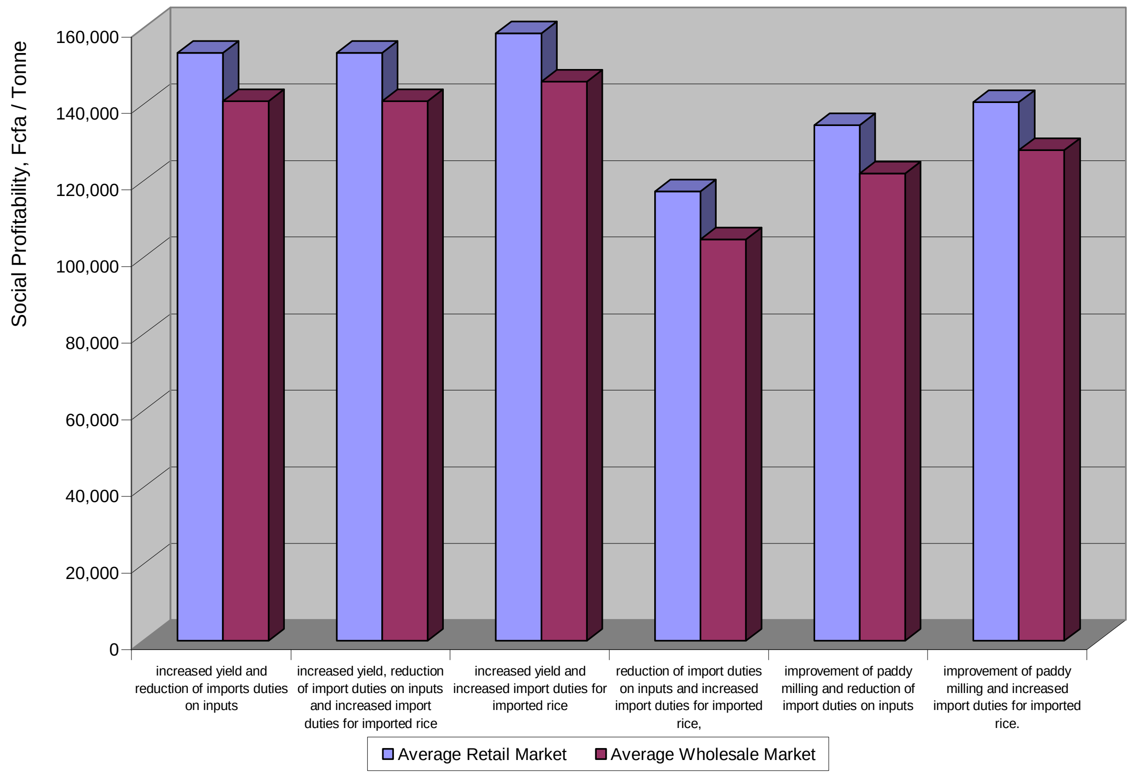

Figure 7.4: Effects of Possible Policy Changes on Economic Profitability (simultaneous changes sensitivity analysis)

7.2.2. Incentives and protection

The PAM base results showed that the net policy transfer indicators were negative per unit of land and per unit of final output produced (milled rice) for all scenarios (type of markets and comparison points). These constituted clear indications that the private profits for the irrigated rice enterprise were less than the social profits, suggesting that resources were driven away from the system due to the policies in place. The single changes in factor proved to be interesting for the system. The simultaneous changes generated very important results in comparison to the base scenario. These range from improvements in private and social profitability supported by low private cost ratios, domestic resource cost (DRC) ratios, and social cost-benefit (SCB) ratios. The simultaneous changes also generated positive net transfer, creating high ratios of profitability coefficients. The positive net transfer allowed the system to enjoy some protection, as shown by the nominal protection coefficients and effective protection coefficients, which was greater than 1 and sometimes in the range of 1.3 and 1.4. The SRP and PSE ratios showed the importance of the transfer generated to the system, being in the range of 33 to 35 % and 24 to 26 % respectively.

7.3 Recommendations

As more attention was given to the sector, and with greater accountability on the part of producers and their organisations, 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. Moreover, adoption of better post-harvest techniques that can lead to better rice quality along with improvement in the milling rate can substantially contribute to the efficiency of the system. Better post-harvest activities improved 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 could be noticed in each channel. But, 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 commercialisation.

7.4 Policy Implications of the Research

The sensitivity analyses showed that private profits, *ceteris paribus*, were sensitive to improvements in technological factors such as farm-level productivity and post-harvest techniques that enhanced the milling conversion rate of paddy into milled rice. Private profits were shown to be sensitive also to changes in economic factors relating to reduction of import duties on input, increase of import duties on imported rice, and changes in the exchange rate. Although single factor changes indeed showed improvement in private profits, the net policy effects were still negative, with the exception of the scenario relating to increased import duties on imported rice. The negative net policy effect indicated that, overall, some resources were diverted away from the system or that the system was taxed so that not many incentives were given to the producers. 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. 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. Further research needs to be conducted on this aspect. As stated by Pearson *et al*. (1981), 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. Therefore, we suggested 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. In particular, future research endeavors should focus on better understanding the economic and institutional factors that explain the differences of the custom union tariffs effects on retail and wholesale marketing system. Thus, another important area that requires further investigation is the efficiency of the irrigated rice marketing system, which marketing system must the government favors in order for the irrigated rice production to become more competitive?

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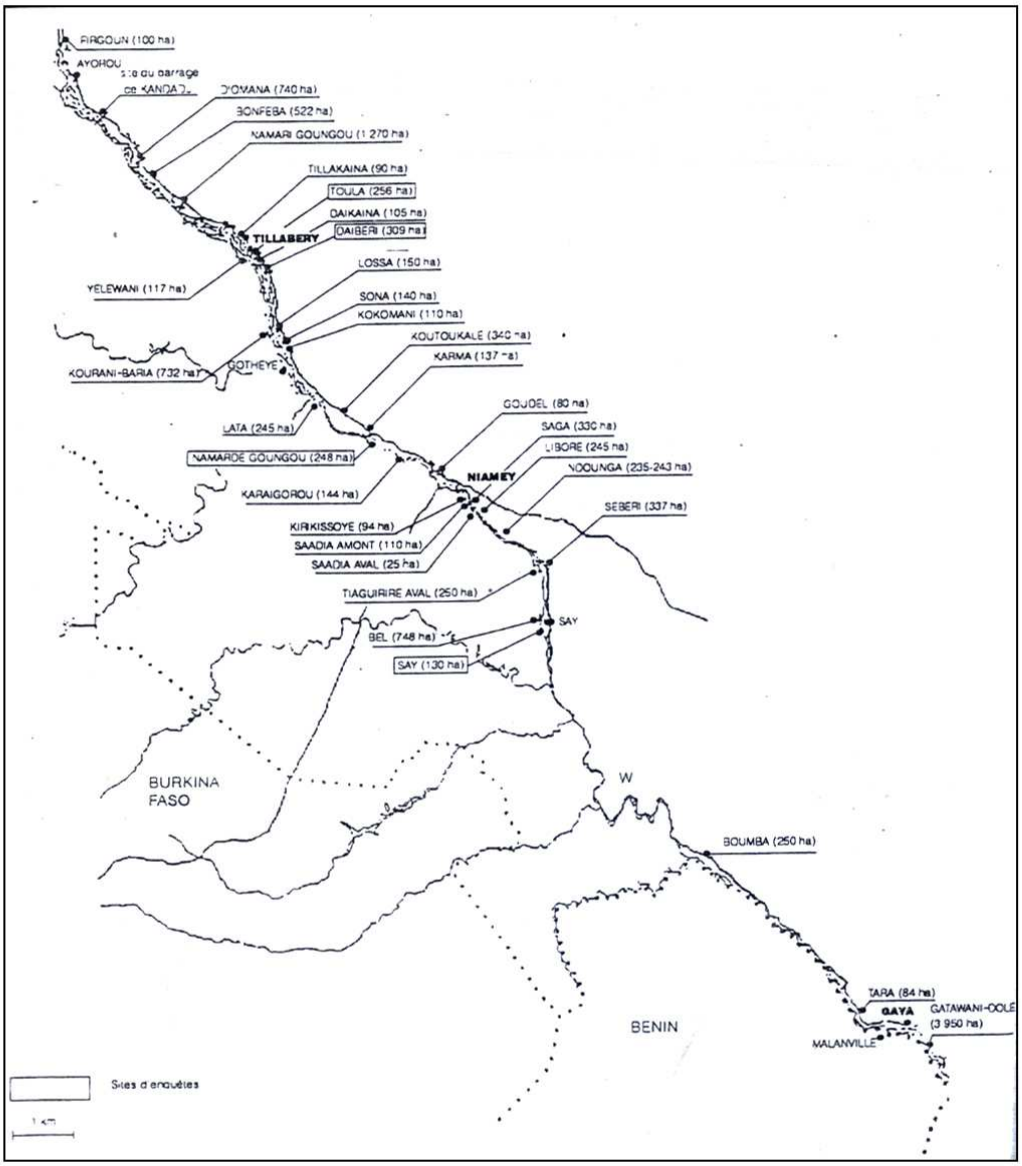
APPENDICES

Appendix 1: Map of Irrigated Perimeters along the Niger River Valley

Carte n° 1. Aménagements hydro-agricoles à vocation rizicole dans la vallée du fleuve Niger



2

Appendix 2: List of Irrigated Perimeters in the Niger River Valley

Région	Périmètre	Surface (hectares)	Vocation	Région	Périmètre	Surface (hectares)	Vocation
NIAMEY	Koutoukalé	340	Rizicole	TILLABERY	Firgoun Nord	120	Rizicole
	Karma	133			Firgoun Sud	105	
	Namardé Goung.	245			Namari Goung.	690	
	Karaïgourou	144			Diamballa	621	
	Goudel	49			Tillakeïna 1	71	Maraîchage
	Lata	246			Tillakeïna 2	15	
	Kirkissoye	100			Yéléwani	120	Rizicole
	Saadia Amont	111			Toula	350	
	Saadia Aval	35			Daïkena	120	
	Saga	431			Daïbery	350	
	Liboré	272			Kourani Baria 1	425	
	N'Dounga 1	288			Kourani Baria 2	265	
	N'Dounga 2	285			Kokomani	54	
	Séberi	397			Sona cuvette	153	
	Tiaguiriré	180			Sona Terrasse	39	Polyculture
	Say 1	296			Lossa	160	Rizicole
	Say 2	195			Bonféba	324	
GAYA	Tara	120	Rizicole		Diomana	424	
	Boumba	22		KONNI	Ibohamane	750	Polyculture
	Gaya amont	170			Tounfafi	27	
	Gatawani Dolé	83,7			Kawara	52	
DIFFA	CDA Diffa	160	Rizicole		Moulela	65	
	Lada	48			Galmi	250	
	Tam	20			Konni 1 & 2	2.447	
	Chétimari	55			Djiratawa	512	

Récapitulatif des surfaces aménagées et répartition par vocation

Région	Nombre de périmètres aménagés	Surface aménagée (hectares)	Surface rizicole (hectares)	Surface en polyculture ou maraîchage (hectares)
Niamey	17	3.747	3.747	
Tillabery	18	4.406	4.281	125
Gaya	4	395,7	395,7	
Konni	7	4.103	0	4.103
Diffa	4	283	283	
TOTAL	50	12.934,7	8.706,7	4.228

Source ONAHA