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CENTRE DE RECHERCHES AGRICOLES DE SAINT-LOUIS

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CTA



**Final Report**

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**AGRICULTURAL SCIENCE TECHNOLOGY & INNOVATION SYSTEM:  
CASE STUDY OF THE RICE INDUSTRY IN THE SENEGAL RIVER VALLEY**

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by

Amadou Abdoulaye FALL  
Research Scientist /Agro-economist  
at ISRA-Fleuve, Senegal

May 2005

Reviewed & Edited by  
Judith Ann Francis, CTA  
Published – April, 2012

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Commissioned by the Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA)

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*The views expressed in this report are those of the authors and do not necessarily reflect  
those of the organizations represented*

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## ACRONYMS AND ABBREVIATIONS

ANCAR	Agence Nationale de Conseil Agricole et Rural
BAME	ISRA's Bureau d'Analyses Macro-économiques
CET	Common External Tariff
CFA	Franc de la Communauté Financière Africaine (CFA franc)
CTA	Technical Centre for Agricultural and Rural Cooperation
CILSS	Inter-state committee for drought control in the Sahel / Comité Inter-États de Lutte Contre la Sécheresse au Sahel
CIRIZ	Comite Interprofessionnel sur le RIZ/Interprofessional committee on rice
CNCR	Conseil national de Concertation et de Coopération des Ruraux/National council for consultation and cooperation for rural areas
CRCR	Consiel Régional de concertation et de coopération des ruraux/ regional council for consultation and cooperation for rural areas
DAPS	Division de l'Analyse de la Prévision et des Statistiques du Ministère de l'Agriculture du Sénégal (ex- Unité de Politique Agricole)
DRDR	Direction Régionale de Développement Rural du Ministère de l'Agriculture
ECOWAS	Economic Community of West African States
FNRAA	Fond National de Research Agricoles et Agroalimentaires/ National fund for agricultural and agro-food research
FOB	Freight on Board
ISRA	Institut Sénégalais de Recherches Agricoles
NARS	National Agricultural Research System
NGO	Non-Governmental Organisation
NPA	Nouvelle politique Agricole de l'État
OMVS	Organisation pour la Mise en Valeur du fleuve Sénégal
PDGR	Directeur Général de la Rive Gauche du fleuve Sénégal Plan
SAED	Société Nationale d'Aménagement et d'Exploitation des Terres du Delta du Fleuve Sénégal et des Vallées du Fleuve Sénégal et de la Falémé.
UNACOIS	National Union of Traders and Industrialists of Senegal
UPA	Unité de Politique Agricole du Ministère de l'Agriculture du Sénégal / Agricultural Policy Unit, Senegalese Ministry of Agriculture
USAID	United States Agency for International Development
WAEMU	West African Economic and Monetary Union (UEMOA)

WARDA	West Africa Rice Development Association
WTO	World Trade Organisation

# 1. BACKGROUND

Senegal's decision-makers are alarmed by the country's declining productivity in agriculture, major variations in production levels, increased imports, the rural exodus and strong urban expansion. The combined effects of lower export earnings and rising costs for importing food and industrial goods have seriously affected the country's balance of trade and public finances. Rice, an introduced crop, has become a staple food and is the most highly prized cereal among the Senegalese. It makes up 34% in volume of the national cereal consumption, accounting for 54% of the cereals consumed in the urban areas, and 24% in the rural areas (Kelly *et al.*, 1993). Rice thus plays an overriding role in satisfying the food requirements of a population that is growing by some 3% per annum. However, national production (an estimated 200,000 tonnes per annum, maximum) is far from covering national needs as approximately 650,000 tonnes, valued at over 100 billion CFA francs, are imported each year.

This situation has convinced the government to encourage rice cultivation through intensification and growth in production to contribute to meeting more of the domestic needs. This objective can only be met if rice production remains financially profitable for the producers and economically viable for the country. With this in mind, strategies to introduce technological innovations are being advocated to increase productivity in the irrigated rice growing areas. To get a better understanding of the constraints, potential and prospects for the future, more thought needs to be given to market opportunities provided at both the local and the sub-regional level. Globally speaking, local rice is threatened by competition from imported rice although the global trade in rice remains at around 6% of the world's output. The broken rice consumed in Senegal is even more marginal on the international stage. The state cannot depend exclusively on a world market where price fluctuations are linked to the imbalance between supply and demand. At the international level, this imbalance depends largely on the degree of interventions by new exporters and importers whose presence and capacities are very variable. The challenge facing Senegal is to produce rice locally which is of good quality, commercially viable and satisfies both the rural and the urban populations.

The main objective of this study is to analyze the agricultural science technology and innovation (ASTI) system in the rice industry in the Senegal River Valley. The specific objectives are to:

- document and analyse the vision and policies underlying innovations in the rice industry;
- identify and map the different players in the industry;
- evaluate the practices, competencies and interactions of the different players; and
- identify the constraints and achievements by the various actors in generating and using knowledge and technological innovations in the rice production industry.

## **2. MATERIALS AND METHODOLOGY**

### ***2.1. OVERVIEW***

In February 2004, at the request of the Advisory Committee on Science and Technology for ACP Agricultural and Rural Development, CTA commissioned the United Nations University-Institute for New Technologies (UNU/INTECH) to conduct a training programme on national innovation systems, its relevance to development in the ACP countries and the application of the innovation systems concept to understanding innovation processes with particular reference to agriculture. Six countries were chosen for the test phase; South Africa, Cameroon, Kenya, Jamaica, Papua New Guinea and Senegal.

The workshop on the "Analysis of Agricultural, Science and Technology and Innovation Systems" took place in Maastricht from 9 to 14 February 2004. This training programme which targeted representatives from research organizations (Cameroon, Senegal, Papua New Guinea), teaching (South Africa) and policy advisory bodies (Kenya, Jamaica), was led by experts from UNU/INTECH. The objective was to enhance the knowledge, expertise and analytical skills of the ACP researchers in analyzing scientific, technological and innovation systems in ACP countries. It was also aimed at assisting ACP experts in understanding the processes of technology development and management for promoting innovation in ACP agricultural systems and providing information for influencing policy processes. The training course included methodologies and approaches for formulating policies that take into account the dynamics of innovation.

An innovation system framework approach takes as its point of departure the interactive nature of innovation, the diversity of factors that shape the interactions among actors and how these impact on the actors' individual and collective ability to learn, adapt and innovate. Using an innovation system framework to analyse a sector enables understanding of the strengths and weaknesses in the system as well as the factors which support or hinder innovation including the role of stakeholders, their habits and practices and policies and institutions which shape their behaviour. Competition has become increasingly global and its success is more and more dependent on continuous innovation. Science, technology, creativity and imagination are assets that are key to the survival of economies including the less developed economies.

The training culminated in the launch of case study projects, which were to be implemented by each country. Senegal chose the rice industry. This crop is important because it is in high demand (850,000 tonnes per year) and the import bill is about 100 billion CFA francs (153 millions euros). Local production only amounts to 200,000 tonnes per year (ISE, 2003). Under current conditions, adequate know-how on irrigation, the availability of water throughout the year for a potential irrigated land measuring 240,000 ha in the Senegal River Valley, the strong presence of research and training establishments as well as training for the producers are elements that are working in contradiction with each other. This raises the question as to how well the innovation system is functioning in this industry.

### ***2.2. ANALYTICAL FRAMEWORK***

An innovation system constitutes a network of companies and other economic agents who, together with the institutions and policies influencing their 'innovative' behaviour and performance, bring new products, new processes, dynamics, and new forms of organisation into the economy. Innovation is understood to be an interactive process in which businesses (and other key stakeholders) in interaction with each other and with the support of policies, institutions and various types of organisations, are the driving force behind the emergence of



new products, new procedures, etc. Freeman (1987) defines a national innovation system as being “a network of public and private sector institutions whose activities and interactions serve to initiate, import, modify and disseminate new technology”.

The method used to evaluate the ASTI system in the rice production industry is based upon the innovation systems approach. This involves analysing the policy and institutional environment, identifying and mapping the actors and accessing their knowledge and expertise as well as their habits and practices and the intensity of their interactions (areas of collaboration). The methodology makes it possible to appreciate the contribution of each player/actor. Assessing the performance of an innovation system makes it possible to determine the extent to which initiatives are being reinforced or actions can be taken for the purpose of achieving or sustaining socio-economic growth and development within an enabling policy and institutional framework.

In order to evaluate the innovation system in the rice industry in Senegal River Valley, two approaches were used: a desk review using secondary data to determine the policies, industry players, knowledge, achievements and constraints in the sub-sector. The second approach included a survey of key stakeholders and organizations involved in the industry. A model questionnaire, that had been designed and standardised for use throughout the six ACP countries, was pilot tested and contextualized for each country. It was subsequently divided into two sections; one section targeted organizations and the second section targeted individuals (researchers, producers, service providers, millers, traders and transporters).

Based upon the amount of time and resources required, a total sample of 270 stakeholders (mainly producers and traders) and 5 organizations (DAPS, IRED, SAED, ANCAR, CIRIZ, CNCR) were chosen. A multi-stage sampling approach was used. The first stage involved selecting the research sites and areas on the basis of the research objectives (typology and characterisation study). In the second stage, a random selection of stakeholders in the villages and markets under study was made.

The Senegal River Valley contributes 55% of local rice production, 67% of which is for commercial purposes. In this agro-ecological zone, the Delta and downstream low Valley form the hub of rice production. The Delta specialises in rice production and the Lower Valley also has land that is potentially well adapted to diversification. The study areas were chosen from two sub-zones based on criteria such as layout, amount of land under rice production, anticipated production per season, types of associations in existence, water management methods, etc. Dagana, Diawar Mboundoum, Thilene and Pont Gendarme were selected in the Delta area while in the Lower Valley, Bokhol, Gaya and Guédé were selected. A random selection of 120 producers was then made: 70 from the Delta and 50 from the lower Valley.

The market study was conducted in the five main rice markets of the Valley. These included Saint-Louis, Richard-Toll and Ross-Bethio (high-density urban centres) and the Thilla Boubacar and Fanaye weekly markets (main rural collection points in the production zones) which were chosen in accordance with their level of importance in the rice-trading network. In these markets, 10 traders were randomly selected per market.

Other stakeholders in the industry are located in these production and market zones and include service providers, processors and transporters. Systematic sampling was used on the different types of rice mills (village mill, mini-mill and large mill) while a random sampling of 20 processors was made across this sector in order to take into account the diversity of the processing system. Service providers included suppliers of inputs, labour services, harvesting

services and threshing services in the production zones. A random selection was made of 2 to 3 service providers per village out of a total of 20 stakeholders. Similarly, 20 transporters specialising in the transportation of rice from the rural markets to the urban areas were randomly selected in the sample markets.

Researchers from Institut Sénégalais de Recherches Agricoles (ISRA) in the Senegal River Valley, Dakar and Bambey in the north were interviewed. For the purpose of the study, a random sample of 20 researchers from these centres was selected.

In summary, the multi-stage random sampling technique was used. The study zones and sites as well as the category and typology of the stakeholders were selected on the basis of the knowledge and results obtained from the research. A random sampling of the units of observation, i.e. stakeholders, was then made and totalled 270.

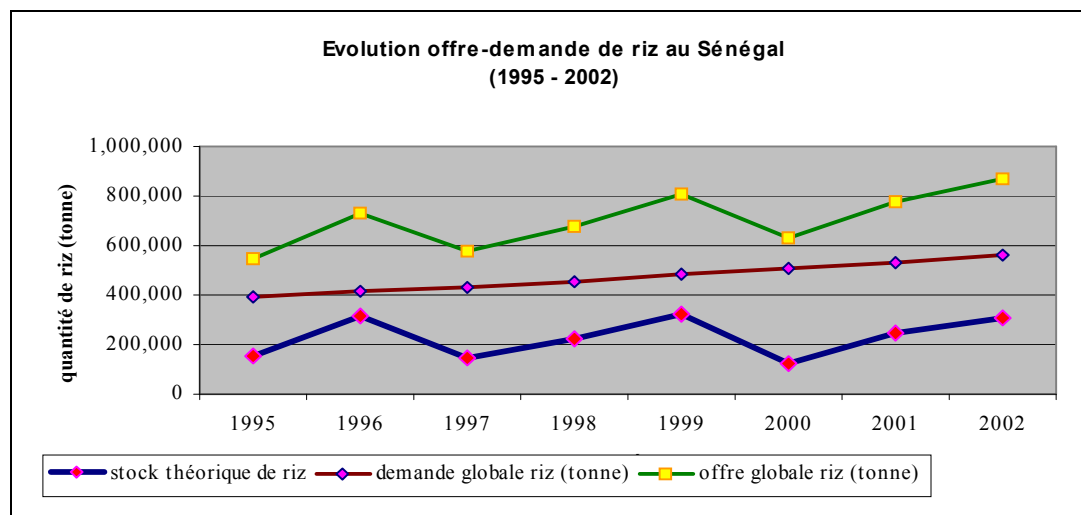
### 3. OVERVIEW OF RICE PRODUCTION IN SENEGAL

#### 3.1 THE RICE-SUB-SECTOR

The Senegalese economy is heavily dominated by the agricultural sector which employs over 70% of the rural population and accounts for 25% of the GDP (DPS, 2002). This sector generates 55% of the country's exports, while industry accounts for 17% of the GDP. The agricultural sector is highly concentrated but there is limited consolidation of the industrial sector. Despite this situation, 30% of Senegalese households are poor, and 80% of the poor live in the rural area. This drop in agricultural output is aggravating the poverty situation. Besides periodical droughts, the global offer in food products was negatively affected by a combination of economic policies that lacked incentives and agricultural and non-agricultural technologies that were not very productive. The combined result of these factors was an ever-greater gap between domestic demand for and supply of food products and the failure of research efforts to contribute to increasing productivity to achieve food self-sufficiency or even food security. This has had major effects on the balance of payments, since rice and wheat imports are very costly.

In relation to the other cereals, at the national level, rice is an important strategic commodity in the state's macro-economic policy options. It has become the staple for the Senegalese people. It makes up 34% in volume, of the national cereal consumption; accounting for 54% of the cereals consumed in the urban areas, and 24% in rural communities. Rice consumes 25% of the rural household budget and 18% in the urban areas. (Kelly *et al.*, 1993). For the housewife, rice is attractive because it requires less work and energy to prepare and can be used in a wide variety of dishes, which is a considerable advantage over the traditional cereals. As a general rule, rice is seen as the food of the richer social classes but the most recent empirical evidence shows that it is also eaten by the poorest people. Rice thus plays a leading role, and is still becoming more important in satisfying the food requirements of a population that is growing by some 3% per annum. The following diagram (Diagram 1) shows that the demand for rice has been increasing since 1995. Unfortunately this demand is being satisfied through imports. Domestic rice production levels hardly reach 200,000 tonnes of paddy, i.e. 132,000 tonnes of broken rice.

Although local rice is competitive, it is threatened by competition from imported rice. But the world rice market only accounts for 4% of the world's output (SAED, 1998). The world market for the quantity of broken rice consumed in Senegal is even more marginal. The state cannot depend exclusively on a world market where price fluctuations are linked to imbalances between supply and demand. At the international level, these imbalances depend largely on the level of interventions of new exporters and importers whose presence and capacities are very variable. Potentially 240,000 hectares could be prepared for cropping, but at present only 40,000-45,000 are being farmed and average yields are 5.5 t/ha. This justifies consideration of the options for irrigated rice intensification.



theoretical stock of rice      global demand for rice (in tonnes)      global rice offer (in tonnes)

Figure 1 - Rice Supply and Demand (1995 –2002) Evolution of supply and demand for rice in Senegal (1995-2002)**Source: A.A.Fall, 2003.**

### 3.2. THE STUDY ZONE

The Casamance and the Senegal River Valley are the two main rice growing areas in Senegal. Their production systems are very different. Each region has the potential to increase productivity through the introduction of new technologies. 61% of the Senegalese rice-growing lands are located in the Casamance region, but its contribution to the national output is a mere 29%. Because of the production system (traditional), water shortages (most rice is grown on the plateau) and salinity, average yields are about one tonne per ha. The main inputs are land, labour and seed; other inputs, like fertilisers, pesticides and equipment, are little used. Rainfed and swamp rice production systems are practised, and the yield is mainly for home consumption.

Unlike the Casamance, in the Senegal River Valley, intensive, irrigated rice is produced using vanguard technology: hydro-agricultural installations, high input levels especially fertilisers, mechanised tilling and harvesting, threshing and processing (rice milling and shelling). In this region, 67% of the output is sold (ISRA, 1996). A large percentage of the working population is involved in irrigated rice production, which is pivotal to the region's economy since it accounts for 89% of the region's agricultural income. But most of the Valley rice comes from the delta zone: approx. 62% of the irrigated rice production and 71% of the national paddy production. Rice farmers in this region have larger land areas and use more mechanised farming techniques.

A worsening climate and ecological changes in the valley resulting from floodwater control measures and flow regulation have gradually reduced the rainfed rice production. As a result, activities have been refocused to concentrate on irrigated cropping, especially rice. But liberalisation of the rice industry and the effects of the CFA devaluation have destabilized the rice sector and created deep mutations.

Rice is the main crop in the Valley economy and approximately 400,000 people are involved in rice farming. This raises important questions about the cost, performance, productivity, profitability and sustainability of irrigated farming systems. Government, researchers, producers

and other industry stakeholders need to explore the options for bringing innovation in the sector to provide the population with a balanced diet, increased farm incomes and, at the same time, ensure sustainable management of natural resources.

There are several R&D organizations (e.g. ISRA, WARDA, USL, SAED, ANCAR) in the region that should be able to handle most of the valley's development problems if they combine their means and skills. Synergy is being developed between them and the traditional technical services (agriculture, livestock production, waters and forests, fisheries, plant protection, seed and hydraulics, etc.) as well as with the NGOs and the producers' organisations.

## 4. THE POLICY ENVIRONMENT

### 4.1 *AGRICULTURAL TRADE POLICIES (NATIONAL, REGIONAL AND INTERNATIONAL)*

The agricultural sector has been the subject of several state interventions. Trade policies (tariffs, subsidies and quotas) have always been important policy tools, serving to condition the size and orientation of the sector. The ultimate purpose of these measures, going beyond the protectionism involved, has brought the official exchange rate closer to its real, balanced level and redistributed revenue among the various economic operators, especially in the public sector.

Liberalisation of the agricultural sector, state withdrawal from several producer support activities, and the effects of the devaluation of the CFA in 1994 caused profound changes that spurred producers in the Valley to organise themselves with unprecedented dynamism. The approach to production, processing and marketing incentives was radically altered.

The reforms of the Senegalese trade policy brought about greater transparency. Tariff structure simplification and tariff reductions led to a harmonised tariff regime in 1999 when the West African Economic and Monetary Union (WAEMU) Common External Tariff was adopted. The 2001 trade regime was singular because of its average tariffs (14%), a tariff range of between 18% and 7%, tariff peaks of 42%, elimination of import quotas and licences, elimination of export taxes and subsidies, accelerated customs formalities. Taxes from international trade brought the State 22% of its revenue; import tariffs and surcharges are the only important trade barriers.

WAEMU was created in 1994 when eight countries in West Africa<sup>1</sup> adopted a treaty on convergence, stability, growth and solidarity to align their macro-economic and sectoral policies and their tax laws. This mechanism was established to harmonise not only the agricultural policies but also to regulate the circulation of goods and services within this community, thus opening a market of 60 million consumers for agricultural produce with the same advantages for all the member states. WAEMU is a customs union but because of inappropriate practices (barriers, irregular taxes and other obstacles), is not effective in promoting intra-community trade.

The global objective of the WAEMU Agricultural Policy is to satisfy food requirements, contribute to the economic and social development of the member states, and help reduce poverty. The global objectives assigned to the UAP are:

- achieving food security by reducing food dependency and improving the functioning of the produce markets;
- improving the farmers' living conditions by developing the rural economy and reassessing their revenue and social status;
- sustainably increasing agricultural productivity and production.

The sub-region has a Common External Tariff (CET) and a mechanism for ensuring protection against unfair external competition (Structural Tax on Imports-TCI and reference values). But this mechanism is still not effective. Through agricultural tax policy harmonisation, tax mechanisms have converged and economic operators within the WAEMU

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<sup>1</sup> The countries are: Benin, Burkina Faso, Côte d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo.

area receive equal treatment. Henceforth agricultural inputs and materials are subject to an 18% VAT while unprocessed agricultural products are sold to the consumer VAT-free. But there is still one serious paradox: unlike other economic actors, farmers have no possibility to claim reimbursement of the VAT and are thus unfairly punished.

The Economic Community of West African States (ECOWAS), created in 1975, is a model of market integration for its 16 member states. The model for this union was inspired by that of the European Economic Community (EEC), and efforts have been made to harmonise the economic policies. With its free movement of goods and services, ECOWAS has created agreement on Community import tariffs. But the principle of free circulation of goods, services and persons is seriously penalised by the so-called "wildcat" taxes charged in the member states. As dependency on foreign technical and commercial sources grew, the member states started designing policy harmonisation strategies. This economic union has been trying to find its bearings since the beginning in order to develop a monetary union such as WAEMU's. As a pre-requisite to efforts to reach this goal, Community policies are being developed to clean up public finances.

Relations between the European Union and Africa-Caribbean-Pacific regions (EU-ACP) started with the overseas countries in 1957. The Lomé and Cotonou conventions (1975-2000) have economic and commercial partnership predicated on political cooperation. These relations have grown, and have led to economic partnership agreements based on the principle of free trade and reciprocity.

The conclusion of the Uruguay Round (UR) negotiations in 1994 led to the inclusion of agricultural produce in the multilateral trade system regulations. The Agreement on Agriculture (AoA) established the rules that had to be respected in the WTO member states in three domains: market access, domestic support and export subsidies, thus allowing a more open, market-oriented global trade for agricultural products. The mechanism aimed to establish a more equitable, market-oriented trade system in order to compensate, and prevent, restrictions and distortions in the global agricultural market and to take preventive action. There are other related agreements, e.g. SPS (Sanitary and Phytosanitary measures), TRIPS (Trade-Related Aspects of Intellectual Property Rights) and the TBTs (Technical Barriers to Trade) that also cover certain aspects of agricultural trade.

However, the opportunities offered to the African countries under the AoA were inhibited by the liberalisation measures adopted before the Uruguay Round, especially under the Agricultural Sector Adjustment Programme for Agriculture. These unilateral liberalisation measures sought to lower customs duties, eliminate input subsidies, abolish price controls, etc. Most of the trade distortion measures were eliminated or reduced to a minimal level before the Marrakech agreements were signed. All the Sub-Saharan Countries reported a total Global Support Measure (GSM) equal to zero. Most of the African countries reported that agricultural subsidies had been low, and fell under measures in the "Green Category". These measures apply to many agricultural support programmes (research, advisory services, training, plant protection, etc.). However, the amount that the African countries spend on this category is insignificant compared when compared with other members.

#### **4.2. Education policy**

The education policy in Senegal aims at achieving the "education for all" objective. During the last few years, emphasis has been placed on schooling for girls and keeping girls in the schools. This policy is spearheaded by the Ministry of National Education in conjunction with two sub-ministries (national languages and pedagogy). It is being implemented through the creation of primary schools, secondary schools in each *département* (district), *lycées* (at least

one in each of the eleven regions), vocational schools for agriculture (ENSA, Ecole des Cadres Ruraux, ISEP, etc.) and three universities (Cheikh Anta Diop in Dakar, Gaston Berger in St-Louis and Université des Mutang on Ile de Gorée). Regional university centres are also being created (two are nearly finished) for an estimated population of 10 million inhabitants. The rate for placing children in schools rose from 17% in 1999 to 23% in 2004 (MEN, 2005). The increase is noteworthy, but is low given the target of "education for all".

Most of the training centres teach general courses. The vocational training schools are the only ones to stress agriculture as a profession. The number of these schools does not exceed ten (ENSA, ENCR, ISEP, Horticulture School of Camberene, Forestry Schools of Djibelor, etc.). Research scientists teach or supervise the students of these vocational training programmes and collaboration is more dynamic and better structured. Students benefit from researchers field expertises and teachers have a platform to dialogue with researchers and benefit from applied research programmes. Training and advice on theses dissertations stimulate interaction between the researchers and teachers and enrich the scientific agenda and outputs.

There are very few applied research projects being carried out together with the rural communities. This type of collaboration is much desired but little practised. Through the *Fonds National de Recherches Agricoles et Agroalimentaires* (FNRAA- national fund for agricultural and agro-food research) research is carried out jointly by ISRA on the one hand, and WARDA and ITA research services, SAED and ANCAR development services and the Université Gaston Berger in St-Louis on the other. One such joint project entailed the improvements of the quality of rice produced in the Valley.

There are not many agreements between private institutions and research. SENCHIM, SPIA, manufacturers and importers of chemical products have research protocols with ISRA for testing the effectiveness and adaptability of their products, but these organizations do not fund research to develop and test local products. There are also para-public companies such as SODEFITEX, SODAGRI, etc. that are developing and funding research programmes with ISRA on commodities such as cotton and rice. SAED had a similar arrangement with ISRA in the 1990s through the European Development Fund's Irrigation IV programme.

Well-structured formal, functional coordination mechanisms do not exist to support collaboration among the various knowledge institutes. Their dependence on different ministries often makes cooperation less smooth. The development partners are also accountable to various ministries without any clear structure for coordination. Most of them are accountable to the Ministry of Education, but some report to the Ministry of Agriculture, Ministry of Vocational Training (*enseignement professionnel*) or the Ministry of Scientific Research. Conflicting leadership and roles can hinder the performance of the innovation system.

Considerable efforts have been made to enhance coordination. A national research system was created to develop synergy and pool financial resources among the various actors. This made it possible to create the national research fund (FNRAA) and start implementing joint research projects. The partners are developing "cooperation protocol" (*protocoles de coopération*) for the training schools. Further, the Ministry of Scientific Research, and other ministries, in particular the Ministry of Agriculture, are creating regional research centres to handle requests for research, thus giving new thrust to efforts to capitalise the results of research, especially technological innovations. Collaboration is taking place in an environment that is better structured and based on a clear, forward-looking vision (ref. ISRA strategic plan for research, etc.). It is through such vision that innovation policies can be



formulated that accommodate all factors that determine and induce quality changes in support of economic and social development.

## 5. MAPPING THE ACTORS

Actors involved in the innovation system can be grouped into clusters classified as infrastructure, enterprise/business, diffusion/dissemination and research. A brief description of the major actors follows.

### 5.1. DEPARTMENT FOR ANALYSIS, FORECASTING AND STATISTICS (DAPS)

When the ministry of agriculture and livestock production was reorganised, the agricultural policy unit directorate (UPA) merged with the agricultural statistics division (DISA) to form the DAPS. DAPS is represented in each of the ten regional departments for rural development by the statistics and forecasts analysis division and at the level of the district, by the bureau for agricultural statistics.

#### Mission/Objectives

DAPS was assigned the following responsibilities: preparation of agricultural policies, analyses, forecasting, programming, planning, project/programme coordination and monitoring-evaluation. It also advises the ministry, after studies have been made and gives its opinions on various dossiers. It is charged with formulating policy recommendations and is responsible for setting up and running a fast, reliable information system with a statistics databank on agriculture.

The various types of services engaged by DAPS can be evaluated in terms of volumes of activities conducted per service type per year (notion of results) or by the annual budgetary allocation per type of service (budgetary allocation notion) or by the time allocation for the annual implementation of each type of service provided. These measurements enable us to identify the importance of one service compared to another. The analysis is summarised in Table 1.

As concerns the time allocated to these different services, DAPS spends 30% of its time on policy formulation, and information collection, processing and dissemination, 20% on policy impact monitoring, 10% on advisory services for the ministry, 5% on training and 5% on other administrative duties such as meetings and representation.

In terms of budget allocation, 25% of the budget is used for information collection, processing and dissemination, which produces 20% of the DAPS output (Table 1).

**Table 1:** Breakdown of DAPS services obtained, by type

Type	% Output	% Budget	% Time
(i) Training / Education	20	10	5
(ii) Information dissemination	20	25	30
(iii) Agricultural policy formulation	10	20	30
(iv) Policy monitoring	30	30	20
(v) Advisory services	15	15	10
(vi) Other (explain)	5	-	5
TOTAL	100%	100%	100%

Source: DAPS, 2004.

Policy formulation has been the main activity of DAPS in terms of time allocation during these last five years with a peak of 40% of time consumed in 2001. This is mainly due to the

numerous initiatives taken by the new authorities in 2000. The privatization of the peanut industry, the structure adjustments on rice, onion and tomatoes system; land tenure and the new law on agriculture, etc. are conducted by DAPS. The other DAPS activities have been stable in terms of time consumption throughout the last five years (Table 2).

**Table 2:** Evolution of importance of types of DAPS services (in%)

	1999	2000	2001	2002	2003
a. Training / Education	-	3	5	5	5
b. Information dissemination	20	20	30	30	30
c. Agricultural policy formulation	20	30	40	30	30
d. Policy monitoring	10	10	20	20	20
e. Advisory services	5	5	10	10	10
f. Other (explain)	2	3	3	4	5

Source: DAPS, 2004.

With respect to the collection and analysis of agricultural statistics, DAPS may need to rethink its role as well as the organisation and collection methods in order to simplify procedures and means used. DAPS may need to establish a decentralised system with limited staff who are trained in design information collection and surveying methods, and to organise surveys, run data retrieval networks, train/supervise research officers, and process the information to make it useable for the various technical services in the ministry. It is also expected to introduce more efficient, less expensive techniques and instruments including information and communication technologies, remote sensing, poll surveying, and adding value to data from the 1998/99 national agricultural census.

### Human Resources

In 2004, DAPS had 61 permanent Senegalese staff members, i.e.

19 senior staff,

25 intermediate staff,

17 lower level staff.

The *senior staff* include one PhD holder (*doctorat*) and 18 engineers (two are studying for their *doctorat* and *DEA*). The administration and management staff all have an education level equivalent to a bachelor's degree. There has been a slight decrease in senior technical staff between 1998 and 2003. Since the 2001 reform, the staff breakdown has been: 14 employees for administration and management, 19 technical officers/engineers, and 26 support staff. Before the 2000 reform, there were 25 senior staff.

## Financing

DAPS is financed through the national budget and counterpart project funds. Before the reform, 80% of the institution's budget came from donor agencies, via projects, *e.g.* the major reforms in the agriculture sector in general and more specifically in the rice production sub-sector in 1996, studies on competitiveness or analyses of agricultural policy matrices, etc. The state only provided 20% of the DAPS budget. The funding system was changed through the reform since the state now provides 80%, and the donor agencies have only been providing 20% since 2001.

The main part (83.5%) of the DAPS budget is used for the payroll and the rest is used for operating costs. Global budget allocations: 68% for senior staff (*cadre*) and 11% for non-technical *cadres*. The projects cover the costs of the study programmes underway.

## Collaboration and Networking

DAPS cooperates with, and coordinates certain activities for, all the divisions of the ministry. It works with all units related to the agriculture sector, mainly on policy formulation (designing and monitoring the agro-sylvo-pastoral *loi d'orientation*, etc.), research and development, information exchange, seeking funding, monitoring agreements and trade conventions with other ministries, etc. Outside the ministry, DAPS participates in information exchange, fund raising for issues of national or sub-regional importance, and training.

Collaboration is stronger with the other ministries, the funding community and the financial institutions. Relations with the other partners seem to be good. But cooperation is still essentially restricted to studies and information sharing. The main type of cooperation with the research and technical supervisory services has involved a series of studies on the competitiveness of the agricultural sector.

In terms of its achievements, DAPS has invested considerably in drafting a tariff harmonisation policy on imported rice in order to protect the local sector. DAPS was instrumental in drafting and championing the law on aggressive import taxes (*e.g.* raising the tax scale for import costs that are lower than the set protective threshold). However, importers managed to get around these regulations through submitting false declarations of the FOB value. DAPS was also behind the new agro-forestry-pastoral blueprint law adopted by the national assembly in 2004. This law assisted with enhancing professionalism in the agricultural sector through strengthening private sector involvement.

The problems encountered by DAPS concern its human and financial resources. In the past, it has always been supported by donors in its investigative and planning stages to achieve privatisation reform. Various studies to restructure the sector and support liberalisation strategies were funded. Post liberalisation of the agricultural sector, donors have withdrawn their support. DAPS has also experienced a mass departure of its human resources from other structures. Since 2004, this advisory body has been revitalised and has coordinated the rice observatory (provides information on the sector), which is a project supported by the Japanese. It is involved in evaluating and re-organising rice production in Senegal and establishing links between research (ISRA/ADRAO), development (SAED, ANCAR, DRDR), producers (CIRIZ) and the Food Security Commission (CSA), etc.

The inadequacies noted in the types of services provided arise from the manner in which statistical data are collected and organised. Data obtained through the decentralised structures of the Ministry of Agriculture, is inconsistent. The links with research and development are currently limited due to the insufficient amount of staff.

**Strengths:**

- multidisciplinary staff;
- qualified senior staff (*cadres*), with sound experience in the following fields: rural development, project/programme formulation and monitoring, agricultural statistics, and negotiating with partners-in-development;

**Weaknesses:**

- lack of material and financial means;
- lack of specialists in certain fields.

## **5. 2 NATIONAL COUNCIL FOR CONSULTATION AND COOPERATION FOR RURAL POPULATION (CNCR)**

As a farmers' association, the CNCR, provides opportunity for dialogue. It is a platform for consultation and cooperation serving the rural producers. It was created in 1993 by nine federations (producers' associations, agricultural cooperatives, horticulturists, women, fishermen, livestock producers and their cooperatives, and forestry operators). Following its Ordinary Congress, it was expanded to include ten new members, thus bringing the number of federations and associations that belong to CNCR to nineteen.

CNCR carries out its programme with the help of four governing bodies, composed exclusively of elected members, *viz.* the Congress, the Board of Directors, the Executive Council and the Secretariat General. At the regional level, CNCR and the other Producer Organizations (POs) in the region, are both part of the CRCCR *Conseil régional de concertation et de coopération des ruraux* (CRCCR regional council for consultation and cooperation for rural areas).

**Mission/Objectives**

The main task of CNCR is the organisation, support and self-promotion of rural and urban populations. The ultimate aim of its actions is sustainable socio-economic development and promotion of family farms through the development of peasant farming. At the internal level, the main objective is to facilitate dialogue, and experience sharing on the most important rural development issues in order to further unite producer organizations (POs) and federations. In its external relations, CNCR seeks to give the state and its partners a positive depiction of the farmers' identity and the producers' opinions. CNCR contributes to the promotion and sustainable development of family farms.

CIRIZ, the *Comité Interprofessionnel sur la Filière Riz* (interprofessional committee on rice) is the CNCR's contact in the rice sub-sector. It was created in 2000 after stocks of rice had accumulated and remained unsold for many years. It is an interprofessional association mainly for rice growers but also for other components of the agricultural sector. CIRIZ was created to solve the Valley rice sales problem through negotiations, setting the sales price on the basis of production costs and external market opportunities.

The CNCR's field of intervention, and thus that of CIRIZ for rice, entails assistance in organisation and negotiations (providing consultation facilities), technical support, setting up local rural radio facilities, monitoring family farms, establishing research and development trials, organising fora on agriculture, etc.

## **Human Resources**

Human resources at CNCR:

- 15 members in the *Bureau exécutif* (Executive Board), with a head office in Dakar, 46 members in the governance bodies and 29 members in the consultative body;
- 18 producer federations as member organisations and 5 affiliate members;
- a technical staff of 3 (1 coordinator, 1 agricultural policy specialist, and 1 communications specialist) and accounting and administration staff who work with the Secretary General. Two people in the coordination team have a doctorate and the third, has a master's degree. These are the people who handle the technical files and prepare the fora. The results of a survey of the CNCR members (producers) are presented in the following section.

## **Financing**

Financial resources come from the contributions made by the members (62%), subsidies and donations (25%), legacies or gifts from the State (10%), rural and urban communities (3%). From time to time CNCR receives contributions from associations "recognised as being of public service" and other national and international, public and private bodies.

CIRIZ's achievements are notable in the way it has developed its stakeholder farmers. It promotes the opinions of its stakeholders and is becoming a spokesperson for the government, in the sector (price negotiations, negotiations on the sale of unsold stock). It participates in promoting local rice and develops partnerships with external bodies. It has also facilitated joint appeals for fertilisers and herbicides through floating tenders, which have helped to reduce purchasing costs over the last two years. It negotiates with the bank for debts to be rescheduled, in order to make repayments far more efficient. It sits on the steering committee, which approves FNRAA's research projects. CIRIZ is a key partner in the preparation and implementation of agreements on rice research. It is a member of the national negotiation committee on WTO agreements. It is the linchpin of all interventions in the rice sector and collaborates with nearly all the sector's stakeholders. Its main problem is disseminating information it has received to its members. The organisation is, as yet, unstructured and this has implications for its effectiveness.

### **Strengths:**

- Availability of qualified, experienced resource persons;
- Experience in the field of negotiations and in the organisation of consultations throughout the country together with national and international partners.

### **Weaknesses:**

- Lack of human resources in institutional organisation;
- Lack of materials and financial means.

## **5.3. INDIVIDUAL PRODUCERS**

In the irrigated farming sector, rice growing is the main source of revenue for 75% of the producers. They are central to the sub-sector and their role in the innovation system is crucial. Moreover, farmers have formed associations for collective land management, buying inputs on credit and commercialization. These associations are members of CNCR and CIRIZ for the collective promotion of farmers and rice producers in particular. However, rice producers as an observation unit are the main determinants as well as beneficiaries of innovations and thus are key actors.

## Description of Producers

In the global sample, the average age of the producers was 47. The size of the family farm was, on average, 13 persons (max. 21 persons), with 7 people working. The average family farm grows rice on 0.25 to 2 ha., but there are considerable differences (coefficient of variation: 0.65). Each working person farmed an average of 0.14 ha. This land/man ratio (or total land area farmed per working person) shows serious underutilisation of the lands.

The producers are all males. Irrigated rice production is essentially a man's job. Plots that have been equipped by the public services and transferred to the producers are usually allocated to the farm heads. In the Valley, the head of household, i.e. the person to whom the equipped plots are awarded, is seldom a woman. Women are very gradually beginning to play a role in irrigated rice production, although they as well as young people play an active role throughout the rice sector. In rainfed rice management, women seem to have the upper hand.

In the *hivernage* (the hot, humid season) they all work on rice production. During the off-season period, only a small number of the producers work on rice. The main problems that were brought up were: late harvesting, marketing the output from the *hivernage* season, delays in establishing seasonal credit schemes, and the need for crop diversification. There is little double cropping for rice (39% of the growers). Most of the farmers who do not grow an off-season rice crop, grow garden crops (67%), mainly in the middle valley where crop diversification is more prevalent.

The data analysis from the survey is summarised in Table 3. The producers in the sample had an average of 35 years of experience in rice production. They are highly experienced and are thus receptive to any technological innovation that meets their specific needs. Their experience is very helpful in clarifying or justifying any process to adopt or reject technology.

Most irrigated rice producers are educated. The survey showed that 53% have received some education in French or in Arabic. The figure is higher if everyone who is literate (17%) is included. Only 30% of the people in the survey had no schooling. The majority of the educated growers had gone to primary school (33%); only 9% had been to secondary school. The highest diploma, a *maitrise* (master's) had been obtained by 1% of the sample group. This situation is unusual in a rural area. In the largest rainfed rice area, for instance, most of the people are illiterate. The producers in the Valley are educated professionals. Most of them come from agricultural services and associations that had long been supervised by SAED.

**Table 2:** Description of producers in study zone

Description	Average	CV%	min	max.	Stand. deviation
Size household	13	0.55	4	21	4.613
Level experience: - Riz growing (numb. years)	35	0.25	29	40	8.531
Importance rice growing - Hiv. (% land) - CSC (% land)	100 39	0.10 0.33	- -		
Number of years of study					
Description	Frequency %	Average	min	max.	

Level education:					
- % level. Maîtrise	1	17	17	17	
- % level. Secondary	9	11	9	13	
- % level. Primary	33	6	5	6	
- % level. Literacy	17	3	2	4	
- % level. Arab studies	10	11	8	14	
- % No schooling	30	0	0	0	

Source: ISRA, 2004.

## Financing

Irrigated rice production is input intensive (seed, fertilisers, herbicides, pesticides) and production costs are often very high (water, mechanisation, other services). Using these production factors according to a specifically timed crop protocol often involves special financing. In other words, irrigated rice production requires considerable financial resources that are often not available early enough for the producer. Many farmers are not able to self-finance their production and have to apply for credit. Most of the farmers in the survey said that they used their own resources and loans. For the 2004 season, loans from the *Caisse Nationale de Crédit Agricole* (CNCAS) was the primary source of funding (75% on average). Irrigated zones are being targeted for intensifying agricultural production due to hydro-agricultural infrastructure and the availability of water throughout the year. The formal credit system set up by the government through the CNCAS enhances the potential for resource mobilisation aimed at increasing productivity. However, the use of credit went down was reduced in the period 1998 to 2000; from satisfying 83% of the rice growers' requirements in 1998 to 73% in 2003. This drop was mainly due to credit repayment difficulties.

In general, credit needs are dispersed usually in small amounts, with little guarantee of repayment because of the vagaries of climate, drop in sales, an unstable/risky socio-economic environment, lack of sound agricultural policies and reliable producers' organisations. From the time of independence to the 1980s, the state relied on the national development banks to finance the agricultural sector. These commercial banks set up a programme to improve access to credit for rural households, but despite the subsidised interest rates, the programme did not reach its goals. The goals of the traditional commercial banks do not fit in with the credit access objectives of poor rural households that do not have the required guarantees (Fall, 2003). Furthermore, the commercial banks charge transaction costs that are too high for small rural producers applying for small loans.

The failure of formal credit arose from non-payment of outstanding amounts, which were often very high. In 1987, during the early years of CNCAS' existence, loans were issued indiscriminately and some farmers purchased vehicles and other luxury goods which had nothing to do with farming. The bank attempted to reschedule these debts, without success. The first attempt at absorbing the debt of peasant farmers (in 1980) introduced a dependency syndrome and was a departure from the objectives of issuing such credit. Consequently rice producers are abandoning or reducing the amount of land under cultivation (ref. to unsteady growth trends in areas under cultivation since 1987). Other producers are opting for diversification in the cold off-season (tomatoes, onions, sweet potatoes, etc.) in order to make profits that they then use to self-finance through rice production.

Reductions in formal credit have led to the creation of strategic options for maintaining rice production (rice being the staple food) with low performance. This gave rise to measures to introduce credit reforms. Among other things, the objectives are to refocus the credit by product and by client under guarantee (loan issued to the union and not the individual



producer), to reschedule the debts in order for previous loans to be repaid with interest on arrears and to establish local community-based debt management (producers setting up savings and credit clubs themselves, etc.) and common management of production stocks between the bank and the farmers union.

The failure of these rural funding programmes led also to further reforms in the rural credit system, garnering support from external partners who offer micro-credit and mutual funds for savings and loans. These institutional reforms related to agricultural credit facilities are one of the main pillars in the agricultural reforms introduced by the Senegalese government during the last decade in an effort to revitalise the economy. Policy reforms seek to improve access to credit for rural households and, for the irrigated rice system, to make investments in the costly hydro-agricultural installations profitable with focus on reimbursement strategies.

In the agricultural sector, difficulties in accessing loans in general have had a negative impact on technology adoption, agricultural productivity, food security, nutrition, health, and on the well-being of the rural households as a whole. If the financial market does not function smoothly, there is little chance of making any substantial and significant improvements in agricultural productivity or in the living standards of Africa's rural populations (Diagne, 1999).

### **Collaboration and Networking**

Producers form various types of partnerships. They come together in producer associations and work together on land and water management on the basis of their transfer arrangements. They also work with the research, development and technical supervision services. The most marked collaboration is at the production level (77%), followed by research and development (19%) and extension work (3%).

The level of collaboration between farmers and other stakeholders in the sector is rated from zero (0) which signifies that there are no links to five (5) which signifies that there are very strong links. The opinions of each producer by category of response, are summarised in Table 4. Most of the producers (73%) indicated that collaboration with the national services was satisfactory, and collaboration with national partners was considered very strong (42%). But 22% of the producers said that the intensity of cooperation with the national partners was relatively weak. On the other hand, they do not have direct connections with external partners.

**Table 3:** Scoring intensity of collaboration with different services (in %)

	Degree of cooperation				
	No connection	Slight	Medium	Good	Very strong
a. Research institutions	7%	8%	38 %	46%	1%
b. Producer organisations	2%	17 %	5%	21%	55%
c. Universities	86%	8%	4%	2%	-
d. External/Private Laboratories	100%	-	-	-	-
e. Extension (SAED, ANCAR, etc.)	1%	8%	55 %	36%	-
f. Agricultural equipment suppliers	62%	23 %	9%	5%	1%

g. Farmers' union	1%	10 %	13 %	8%	68%
h. Seed suppliers	22%	5%	2%	7%	64%

Looking at national partnerships, relations are very strong between the producers and their unions and between the seed suppliers and their organisations (Table 4). This is easy to understand since these organisations handle management of the facilities, the water rounds, credit schemes and marketing. It is noteworthy that the producers do not have any relationships with the universities and the private laboratories, which are keeping their distance by prioritising basic research and academic problems. Although some research programmes are carried out through partnerships led by the university, most of the producers do not have a clear picture of the programmes. Producers have shown that they understand research and extension work clearly; this can be seen from the list of fields of collaboration. They see cooperative efforts effectively being carried out in the following fields: production (77% of the answers), research and development (19%) and extension work (3%).

Under "production and adoption of technological innovations", it should be noted that 37% of the producers have changed cropping practices during the last three years. For most of the producers (63%) these changes were introduced between years 1 and 3; 27% of the producers change their cropping practices once every three years. During the last three years, 88% of the producers have adopted new varieties, something that 77% of the producers do every year. This clearly shows that producers are willing to embrace new technologies.

#### **5.1.4. TRADERS**

Traders play a key role in the rice industry by linking supply with demand. Dynamism in the innovation system depends partly on the efficiency of traders.

##### **Description of Traders**

The traders in the sample total 50 and all are men and heads of households. On average, there are 9 people in their households (5 individuals of working age and 4 children). In terms of education levels, most of the traders interviewed have not attended school (52%). Among those who are educated, 41% have attended the Arabic school and have an average of 9 years of study. The highest level of education is primary school level for 37% of those who have been to school. Those who are literate make up 22% of the sample. Regarding activities in the sector, the traders have an average of 13 years of experience with a maximum of 30 years. Rice trading is dominated by the Wolofs (62%) who constitute one of the most enterprising ethnic groups. The Toucouleurs who make up the largest ethnic group in the zone hold second position.

##### **Financing**

The traders who were interviewed have only two sources of finance: personal funds and credit. For the majority, their loans are provided by wholesale traders (81% of loans). Their personal funds are obtained mainly through trade (80%) and farming (19%) as well as other activities (1%). The trend from 1998 to 2004 for relying on personal financing is constant, while credit, decreased from 32% in 1998 to 10% in 2004. This was partly due to the fact that formal credit from the CNCAS did not yet target traders, a fact that producers in the sector have criticised. For a number of years, annual unsold stock from local rice production has varied between 5000 and 7000 tonnes. Negotiations between CIRIZ producers and UNACOIS traders are very promising. The major problem being faced concerns transaction price-setting. It should be noted that the unsold stock includes association stocks that have

been reserved to repay loans, in the hope that, on the parallel market, their income will be higher as an association than as individuals. The government has often turned to women's associations, giving them credit so that they can buy this unsold stock.

In the Valley, the cereal market in general, and the rice market in particular, are both urban and rural. The urban market is permanent and comprises a collection and delivery point for the various sectors of the wholesale or retail population. On the other hand, the rural market opens on a weekly basis and attracts the rural populations who use it to trade their produce on an informal basis. This is a retail market, which makes it possible to bring together an otherwise fragmented supply market that would make it expensive to collect supplies from each individual producer. The overall volume of trade per week is between 500 kg and 2 tonnes during the early months of harvesting, depending upon the markets and production levels per season (Fall, 1996). Rural markets are also commonly used for processing (village mills, millet mills, etc.), which accounts for the huge crowds. However, the infrastructure at these markets is limited and most transactions take place in sheds or at makeshift stalls.

Besides this standard set-up, local paddy rice is also processed and traded through rice mills (industrial as well as small-scale) by traders and producer associations or unions. These associations receive the members' share of production that is to be used for paying off loans. Local rice is also traded by retail-wholesalers in the country's large urban centres, particularly Dakar. Before the reforms arising from liberalisation, local rice collected by the CPSP was destined mainly for the production zones, and then for the Louga and Thiès regions. This is why it is difficult for locally produced rice to penetrate the other parts of Senegal, because of the difference in eating habits.

### **Collaboration and Networking**

Where partnerships were concerned, there is very limited collaboration between traders and other stakeholders in the rice sector. According to the traders who were interviewed, the only partners with whom they have a good relationship, are producer associations and their federative unions. Their relationship with rural development organisations is very weak and often limited to fora on the sector or, more recently, discussions and negotiations on the price of paddy rice and the sale of unsold stocks. SAED plays the role of intermediary between the producers' association (CIRIZ) and traders' association (UNACOIS). No commercial technical support or financing is being provided. The other key stakeholders in the sector (research organisations, universities, private laboratories, equipment suppliers) are not mentioned as partners. As far as the traders are concerned they were not direct or natural partners. However, some structures such as research and development organisations provide scientific and technical information that could help to support the traders' strategies. For instance, the research results on the flow of goods and services for a particular product in a given geographical area and at specific periods could prove useful for deciding on how to capture a market. Similarly, information on eating habits and consumption levels for a given product is vital for positioning that product.

Collaboration with the different stakeholders mainly entails information exchange and trade. Over the last five years, traders have noticed an improvement in their collaboration, which involves meetings and conferences to discuss trading conditions. In the past, the producers and traders would blame each other for any decline in local production. The former accused the latter of favouring imports, while the traders would accuse the producers of overbidding and inflating the selling price for local rice. During the 2004 season, with the establishment of SAED's training structure, the two groups of actors are beginning to work more closely. Currently, the traders are facing problems with the availability of locally produced stock.

According to the traders' perceptions of the sector's environment, agricultural policies (particularly the liberalisation of the rice sector), water and energy are the only driving forces for rice production. Most of the respondents (80% of the sample), view water and energy as crucial factors for improving the performance of the rice sector and believe that the policies are very appropriate in that regard. However, they do not feel the presence of the research, development, extension and university structures. Such a perception is understandable. Their success indicator depends on whether there is a production surplus: under current conditions, where 70-80% of local demand is met by imports, this would be impossible. Furthermore, joint-venture opportunities are rare in the local sector. The only possible scenario is for traders to finance local producers through loan schemes which can be repaid in kind.

### **5.5 RICE MILLERS**

Rice millers form the centrepiece of trade networks for paddy rice processed into white rice. Next to the 'bana-bana' traders and a few private wholesalers, industrial and small-scale rice millers cover more than 65% of the local rice market. These millers play the role of both processor and trader and are key actors in the innovation system.

#### **Description of Rice Millers**

Presently, the rice-processing sector only involves men both as owners and company managers. Most rice millers belong to the Wolof ethnic group. Their households have an average of 9 people, with a maximum of 13; made up primarily of women (55%) and children (6 out of 9 people) which means that there are more family responsibilities and, therefore, a higher level of income is required. In terms of education, 10% of the rice producers interviewed have not attended school. Among those who are educated, most have completed only primary school level (55%) having undergone an average of 6 years of studies. Only 17% of the rice producers have reached secondary school level but do not have diplomas. Despite their low levels of education, the rice millers are highly skilled and, on average, have 8 years of experience in the sector ranging from a minimum of three (3) to a maximum of sixteen (16) years. This indicates that their knowledge of rice processing is solid. Ever since SAED's withdrawal from the rice processing sector, it has provided support and training for a number of producers in the sector. These trained peasant farmers have even taken over some of SAED's rice mills. Other private stakeholders in the sector have also obtained lines of credit to purchase equipment. Since the late 1990s, when trade liberalisation policies were introduced for paddy rice, rice millers have been permitted to receive bank credit payment in kind from producers and village mills have access to various financing options.

There are three types of rice paddy processing facilities in the valley. The first involves the village mills, which, in general, have an estimated processing capacity of 100 bags of paddy rice per day. They have a milling recovery rate of between 55% and 65% depending on the quality and variety of paddy rice. In the irrigated zones, these mills are numerous and have an overall processing capacity of about 150,000 tonnes. Each year, they process between 75% and 80% of national production (SAED, 2000). The rice produced by these village mills, however, often faces tough competition from imported rice (quality and price). The quality of the paddy is damaged by severe dehydration during storage in the fields. This makes the hulling process very difficult and reduces the percentage of unspoilt grain recovered. Some of the village mills are able to satisfactorily clean the paddy rice but do not have sorting machines for separating the whole grains from the broken rice. The percentage and size of the broken rice extracted depends upon the age and condition of the machines.

The mini-mills and large mills, which are the two other types of processing facilities, number 35 units in total and are unequally distributed throughout the valley. In theory, their total processing capacity is 123,000 tonnes, and in the 1999/2000 period had a potential coverage rate of 104% in irrigated areas where they existed exclusively. However, only 51% were in operation during this period and had a processing capacity of 75,500 tonnes per year. Between 1994 and 1999, the national production of paddy rice increased by 6%, while the processing capacity of the mini-mills and large rice mills recorded a 21% increase. This signified a 9% increase in the potential processing capacity. The average output rate during processing was 67% and it was possible to use different varieties of rice, as the quality of the finished product conformed to the requirements of different markets.

The mini-mills, which could potentially produce the same quality as the larger mills, have a comparative cost advantage when running at low capacity. At full capacity, both types of mills produce the same results. The processing, primary trade and packaging costs are estimated at between 17 and 20 CFA francs per kilogram. However, it seems that for a single paddy, the recovery rate is often higher when using small-scale mills because the rice is less processed and therefore not as refined as that produced by the industrial mills, where much of the rice content is lost. Four factors play a key role in the success of these private small-scale mills. These include the high yield obtained during hulling (an average of 65%), low processing costs (6 – 7 CFA francs/kg of paddy rice), the relative affordability of the mills (cost varied between 1 and 5 million CFA francs) and their mobility (they are only used in the areas surrounding the production zones).

### **Financing**

The large rice millers use their own funds and credit to finance their operations. Since liberalisation of rice production, the millers use mainly their own funds to cover operating and maintenance costs (according to 90% of the respondents). For 75% of the sample, personal funds are primarily generated from rice milling activities. Agricultural income also forms a major source of funds for 25% of the rice millers interviewed. For 40% of the respondents, the second source of finance is credit. Only 5% of the respondents cited private aid (donations or NGO support) as a source of funds. The 1988 to 2004 cash flow trends show how much personal finance was generated over that four-year period. Limited personal finance and poor access to credit (particularly in the form of investments) make it difficult to replace production equipment and explains why the equipment is in such a bad state of repair.

An average of 16% and a maximum of 25% of income from their activities is spent on training staff. On the other hand, 13.5% of the millers' income is devoted to the factory workers. Although their activities are seasonal (harvest : October to January in the rainy season and then May to July off-season), 95% of the rice millers interviewed carry out their activities on a full-time basis. The few millers operating on a part-time basis often face problems with sourcing rice for processing.

### **Collaboration and Networking**

Rice millers play multiple roles; processing rice, trading threshed rice and as investors, which mean that they interact with various stakeholders including banks, producers and their associations, wholesale traders and consumers. In reality, the respondents tend to focus only on their collaboration with producer associations, unions and equipment suppliers. 45% of the sample perceive their links with these stakeholders as being very strong. Although they rely upon stakeholders who service their input and output markets, their relationship with

the development sector is very weak. Most of the sample (70%) has weak or non-existent relations with development partners. They also do not have any direct links with research organizations, universities, private laboratories or input suppliers. Collaboration with external stakeholders is literally non-existent (only one of the rice millers interviewed has capacity-building links with external partners). The research cluster is more interested in the providers of mechanised services in the labour offset, harvesting and threshing sectors. All the mechanised agricultural technologies introduced by research organisations at a national level, focus upon these aspects. Few activities target the rice millers (reliance upon sorters). It is not common for the millers to enter into partnership with the university, as it prefers to focus on academic aspects and to conduct basic research. However, the university is involved in different development projects in the human and social science domains (Economics, Sociology, Geography, etc.).

Rice millers tend to collaborate mainly with service providers. The second most prevalent area of collaboration for 35% of the rice millers in the sample is production, and for 20% it is training. Worth noting is that when SAED withdrew from paddy rice processing, new players in the processing sector were trained. Since then, however, training sessions are rarely held and this is having negative implications for the quality of rice. Using their experience, rice millers are doing all that they can to manage their businesses. However, a number of businesses have collapsed because of tough competition.

## **5.6. SERVICE PROVIDERS**

Irrigated rice production is considered one of the most modern agriculture sub-sectors. However, farms are still poorly equipped, with light equipment being restricted to manual sprayers. Service providers include suppliers of inputs, farm labour services as well as those providing services for mechanised harvesting and threshing. Therefore, producers are renting different equipment from service providers which is playing a key role in facilitating the highly mechanized rice production system.

### **Description of Service Providers**

These actors are primarily men and heads of households. On average there are 12 people in each household. This size varies slightly (22% for the margin of variation) with a minimum of 6 and a maximum of 16 people. Households are gender balanced but dominated by adults (an average of 7 adults and 5 children). The main ethnic group is Wolof which makes up 85% of the population.

Among the service providers interviewed, 85% are educated. However, 53% of the educated population of service providers have received primary school education averaging 6 years of study. Only 2% of those who attended school reached secondary school level. This level of education, however, has provided them with reading, writing and numeracy skills, which are useful for the kinds of activities that they carry out. They have an average of 11 years of experience in service provision with a maximum of 17 years working experience. This demonstrates good working knowledge in the field of service provision.

Irrigated rice production requires large amounts of inputs, particularly fertilisers and herbicides which are indispensable budget items for producers. In spite of this, few specialist operators are involved. Rice production input suppliers are almost always traders specialising in the sale of agricultural products and based in the large urban centres. They also visit the 'loumos' weekly markets in the production zones. Sales outlets are chosen on the basis of various parameters such as the scale of rice production, the presence of large producer organisations and their accessibility. Their average storage capacity is estimated at 76

tonnes but for one-third of the suppliers it is no more than 2 tonnes (Gaye, 1997; ISE/UNEP, 2002).

Most input suppliers resort to hiring storage facilities and, through Agricultural Savings and Credit Bank of Senegal (CNCAS), benefit credit based on sale agreements supported by delivery vouchers, with the producer organisations. Encouraging the private sector to supply the rural areas with inputs as well as the increased empowerment of rice farmer organisations in making applications and often in supplying produce have proved valuable as sustainable solutions. With the liberalisation of agriculture, the distribution of inputs by the private sector has proved more effective due to the sharp increase in volumes traded (Gaye, 1998. Randolph, 1997). Delays in releasing inputs purchased on credit provided by CNCAS has posed real problems with maintaining farming schedules in the irrigated areas. (Fall, 1998).

Approved seed suppliers are involved in the proliferation, packaging and distribution of R1 and R2 base level seeds. Most are members of the Inter-professional National Seed Producers Union (UNIS). They are required to adhere to the quality standards set by the State control services (DISEM). Most of these operators work on their own plots of land (more than 80%) and the rest on a contract basis. They are poorly equipped and only approved operators have access to storage facilities with a 3.2 to 6 tonne capacity, and an average capacity of 3.5 tonnes (Gaye, 1997). They produced an estimated 2,600 tonnes of seed in 2000/01, 3 to 4 tonnes of which were certified (Gueye, 2001). The number of seed producers increased from 22 in 1995 to more than 30 in 2004. These stakeholders service 67% of the seed market, and compete with an informal network and farmers who use seeds produced through their own farming activities. However, the approved operators are also partly responsible for supplying producers on the Rive Gauche (Mauritania).

Similarly, there is a limited number of operators in the equipment sales sector which is strongly linked, for the most part, to small-scale operators who repair and manufacture mills and small agricultural equipment. Large traders in Dakar supply heavy equipment. With the exception of spare parts, competition between local industrial organisations and small-scale industries is practically non-existent. Consequently, the seed producers' and private individuals' economic interest groups are entering the service provision sector (for labour, harvesting and threshing). As these businesses are limited in number and the equipment is in poor condition, it is difficult to access these services

## **Financing**

The main source of finance for these service providers is their own funds and credit. Private aid was only mentioned by one of the service providers. During the initial years, 75% of the finances were based on credit while the rest were personal funds. This can be explained by the heavy initial investment required and low savings among private individuals, particularly producers. Low savings among the seed producers often leads to the creation of savings clubs. Personal funds come from various sources. Cash sent from people outside the country represents 65% of the respondents' resources. This is followed by income from the provision of services, which stands at 20%. Agricultural income, salaries and income from livestock sales account for 5% of each individual's income.

The more time they spend in their field, the lower the volume of credit available. Operators therefore rely upon their own funds to continue with their activities. This raises problems with sourcing credit to replace old equipment. More than 22.6% of their net operating income is reserved to pay training personnel, while 18.6% is allocated for workers' wages.

## **Collaboration and Networking**

Since they occupy positions that are both lower down and higher up on the production chain, these operators come into direct contact with producers and their organisations. The services that they provide (seed, fertiliser and labour supplies, etc.) mean that they also interact with research and training structures. However, their level of collaboration with these structures is considered as average for most of the operators interviewed. On the other hand, their relationship with the unions, producer organisations and industrial equipment suppliers is strong. The perceived intensity of collaboration with these institutions is strong for 85 to 90% of the respondents. For most respondents, the university and private laboratories are not perceived as direct partners and the involvement of these institutions in the sector is not visible.

The areas of collaboration cited by the respondents include product and information exchange, training and development. Exchange of products are the most important areas of their collaboration. This is due to the types of activities (input supplies) and the type of payment that these stakeholders receive from the producers (for example, payment in kind of 1/10 of the yield from threshing and harvesting). The training and development aspect mainly involves seed distributors (technical support, identifying new varieties and their technical specifications, etc.) and mechanised services (introducing and testing new equipment, building technical capacity, etc.). The level of collaboration with all the partners was satisfactory. Firstly, all the stakeholders collaborated with at least one stakeholder in the sector. 50% of the service providers interviewed estimated that the level of collaboration was good to very good. Only 20% of the operators considered their level of collaboration with other service providers as weak. External collaboration, on the other hand, was restricted to trading in spare parts, which involved 25% of the sample. Of this population collaborating with external partners, 60% feel that the level of collaboration is very strong while 40% consider it average.

## **5. 7. TRANSPORTERS**

Transporters are at the input (transporting inputs) and output end of the chain (transporting harvests and processed rice). This category of actors does not only specialise in rice, as is the case for most of the other key stakeholders in the sub-sector. They are involved in all types of crops and use heavy trucks (5 to 20 tonnes). Carts are used to transport paddy rice to unions or houses.

### **Description of transporters**

They are men with between 5 and 37 dependents per household, and an average of 11 people per household mainly made up of women (6) and 5 men. The level of formal education is very low. Most of the transporters interviewed are illiterate (50%). 40% of the population has received primary school education, 30% are literate and 30% have attended Arab school. However their experience in the field is solid with an average of 15 years working experience. Moreover, 90% of these stakeholders work on a full-time basis.

### **Financing**

This group makes use of their own resources and credit to finance their activities. Their personal funds are generated primarily from the provision of services (85%) and trade (15%). Credit is obtained from banks and has gradually declined from year to year. In 1988, credit accounted for 36% of sources of finance for the transporters interviewed but in 2004 this had decreased to 11%. This is mainly due to the fact that transporters have savings and



depend less on the formal credit system to maintain their vehicles. However, quite a few investments in new cars were noted.

### **Collaboration and Networking**

The transporters are in direct contact with the producer organisations, unions, and input and equipment suppliers. Their level of collaboration with these stakeholders is rated as very good by between 45 and 65% of the respondents. There is no close collaboration with the other stakeholders (research, extension services, the university and private laboratories). In actual fact, these institutions are not natural partners for this sector.

They collaborate among themselves on transport services primarily on information exchange. There is little or no collaboration with other actors. More than 65% of the respondents perceive the policy environment for the sector as positive. This also applies to the availability of energy and water (63 to 85% respectively). Joint ventures are not common in the sector, according to 87% of the respondents.

### **5.8. DISSEMINATION / DIFFUSION ACTORS**

In the Senegal River Valley there are essentially two organisations that disseminate scientific and technical information to the producers: SAED and ANCAR.

#### **5.8.1. SAED**

SAED was created in 1965 to promote irrigated agriculture in the Senegal River Valley. As of 1981, when it became a national company, SAED has been bound to the State through "*lettres de mission*" that are redefined every three years.

#### **Mission and Objectives**

Its mission involves two public service functions: *maîtrise d'ouvrage* (contract management) for the state's hydro-agricultural investments, and provision of advice and assistance for various categories of actors involved in irrigated agriculture, namely, farmers, livestock producers, agricultural works entrepreneurs, manufacturers.

The main areas of focus for SAED are:

maintenance of hydro-agricultural installations (structures and collective facilities);  
intensification of irrigated rice production;  
production diversification;  
land tenure security.

The seventh *lettre de mission* (2003–2005) subdivided the two global functions into seven fields of activity:

- public investments (studies and implementation);
- preservation of the hydro-agricultural installations and the environment;
- water management;
- assistance to local communities in the management of rural areas;
- assistance in achieving optimal value (agricultural and rural counselling, research-development, monitoring-evaluation);
- assistance with actor professionalisation, especially for farmers;
- promotion of private, agricultural entrepreneurship;
- establishing an observatory on the technico-economic evolution of agriculture in the Valley using a Geographic Information System.

As concerns the time allocated to these different services, SAED spends 35% of its time on contract management (Table 5). Technology transfer (extension) uses 30% of its times allocated to services. However, training/education activities accounts only for 2% of its times.

In terms of budget allocation, 55% is used for *maîtrise d'ouvrage* (building contract management) which produces 53% of the results obtained by SAED (Table 5). This activity is at the heart of the SAED mission. As for extension work, it consumes 10% of the budget and produces 20% of SAED's overall results. Similarly, advisory and support services accounts for 15% of its annual results and consumes fairly as much as of the budget (17%).

**Table 4:** Breakdown of types of services obtained by SAED

Type	% Results	% Budget	% Time
(i) <i>Maîtrise d'ouvrage</i>	53	55	35
(ii) Technology extension	20	10	30
(iii) Advisory/support	15	17	25
(iv) Collection, exploitation, dissemination	10	13	8
(v) Training/education	2	5	2
<b>TOTAL</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Source: SAED, 2004.

By looking at the trend evolution of the different activities, it is noted that contract management increases from 28% in 1999 to 35% in 2003 (Table 6). This explains the high importance of this activity within SAED's mission and it is due to the increase interest of the government to restore and build new irrigated schemes during the period, 1999 - 2003. However, collection of agricultural statistical data, which are used in all the agricultural services, is taking less time. Research and agricultural services, etc. should contribute in order to ensure proper monitoring. To make data collection sustainable, thought should be given to setting up an observatory with joint financing and staffing. SAED, with its far-reaching capacity, has comparative advantages for coordination work, albeit at the regional level (its area of operation is the Valley region).

**Table 5:** Evolution of importance of types of services by SAED (in%)

	1999	2000	2001	2002	2003
a. <i>Maîtrise d'ouvrage</i>	28	30	32	33	35
b. Technology extension	25	26	26	28	28
c. Advisory/support	17	20	20	22	25
d. Collection, exploitation, dissemination	10	9	7	6	7
e. Training/education	20	15	10	11	5

Source: SAED, 2004.

As concerns contract management, SAED has enough qualified staff to discharge this function which is gradually occupying most of the time of the assigned staff. SAED's mandate was to develop an average of 5 000 ha of irrigated land per year until 2000, 3,500 ha of which was in the Senegal River Valley. Out of one potentially irrigable surface area of 240,000 ha, the land developed by SAED totalled 40,000 ha. In 1983/84, 12,223 ha of land was developed, and then 14,225 ha in 1994. The increase in land developments on the

government's initiative was far below the objectives that were set by the New Agricultural Policy in 1984. During the 1984 to 1993 period, SAED developed slightly more than 11,350 ha, averaging a development rate of 1,250 ha per year (SAED/DPDR, 1994). Although the objective was not fully achieved, considerable efforts were made to rehabilitate and maintain the first set of facilities that had been developed. Until 1987/8 at the start of the reforms, only SAED was involved in providing technical development support. The private sector became involved in 1988/89 when they began to develop 10,000 ha of land and the initiative grew to an estimated 28,000 ha.

The growth rate was poor and irregular due to the limited availability of finance, high cost of the facilities, diverse methods of designing and managing the facilities and the deadlines set for implementation (research sites, financial set-up, resource mobilisation, etc.). The other problems concern the maintenance of the water networks. The producer unions are managing the facilities that SAED handed over to them but SAED remains responsible for managing the maintenance of the networks and rehabilitation of the hydro-agricultural infrastructure which it is failing to do correctly.

In terms of support and training, SAED was the only structure involved in rice production until 2001, when ANCAR was set up. For a long time, SAED monitored and trained producers throughout the sector. Capacity-building support involves creating agricultural experts in all the domains where training is needed. SAED participates in introducing appropriate equipment (tractors, threshers, etc.) and was responsible for creating joint trade organisations for each type of crop (rice, tomatoes, potatoes and onions). The role of these organisations is to set up frameworks for dialogue among stakeholders in the same sector. These frameworks have been successful for tomato and onion growers. There is some progress among rice producers but the local sector is encountering problems with trading and a lack of understanding among key stakeholders, particularly the traders and producers. However, time spent on training and support for producers' union is decreasing (Table 6).

### ***HUMAN RESOURCES***

SAED has a decentralised advisory system that includes four delegations (Dagana, Podor, Matam and Bakel) supported by central services, more specifically the planning department, the construction (*aménagements*) department and the maintenance department. It has a total staff of 320 agents in 2004. Staff figures rose from 294 in 2002 to 320 in 2004, in other words, an increase of 26.

The staff is composed of technical staff (30%), senior staff for administration and management (27%) and support staff (43%). There has been a slight increase in technical staff between 2000 and 2003 which had stood at 27% before the latest *lettre de mission* (2003-2005). Ten percent of the senior staff have a PhD; the rest of the staff in this category have a DEA or an engineering degree. Ten employees are studying for their PhD or a DEA. All the staff working in administration and management have reached a Bachelor's level.

The following table shows that the payroll accounts for 90% of the budget, training for 2% and the rest is for operating expenses.

**Table 6:** Structural costs (in millions of CFA francs)

	2003	2004	2005	TOTAL
Payroll	1,305	1,329	1,335	<b>3,969</b>
Operating costs	120	120	120	<b>360</b>
Sub-Total	1,425	1,449	1,455	<b>4,329</b>
Training	30	30	30	<b>90</b>
<b>Total</b>	<b>1,455</b>	<b>1,479</b>	<b>1,485</b>	<b>4,419</b>

Source: SAED *7<sup>e</sup> lettre de mission*

### Financing

Funding is provided by donors (60%), state counterpart financing for public services (30%), and SAED's own revenue. Before the reform, 70% of the institution's costs were borne by the donors through hydro-agricultural projects and maintenance. SAED was the adviser and the financial agent for the organisations before the 1996 liberalisation movement. The State only contributed 30% of the budget. The reform changed the financial trends. The largest part of the global budget (90%) is consumed by the payroll: 48% for senior staff (*cadres techniques*), 22% for non-technical *cadres*. Current study programmes connected to capacity building are paid for through the projects.

### Collaboration and Networking

SAED's natural partners include producers, the research sector, other development organizations (ANCAR, DRDR), DAPS and, to a lesser extent, the university. SAED works in particularly close collaboration with farmers, their joint trade organisations and the research sector. The organisation has entered into several research and development agreements with research institutions on local rice and its development, sweet potatoes, tomatoes, agro-fruit systems and windbreaks, and on the management of space through occupation plans, in collaboration with decentralised local authorities. All these agreements are financed by FNRAA. Collaboration with other partners remains weak.

### Strengths:

SAED strengths are supported by 38 years of experience in the Valley, systematic field operations throughout the agro-ecological zones, a database that was computerised in 1990, and a GIS as of 1993. SAED operations now use a sectoral approach, (establishment assistance, monitoring, advisory services) and a systemic view of family farms.

### Weaknesses:

Short duration of *lettres de mission*, staff restricted to 320 agents.

## 5.8.2. NATIONAL RURAL AND AGRICULTURAL EXTENSION SERVICE (ANCAR)

The rural extension agency is one of the main instruments the State uses to achieve its goals for agricultural growth, food security and natural resources management. It is part of the PSAOP (*Agricultural Services and Farmers Union Programmes supported by the World Bank*). ANCAR's ultimate goal is to contribute to improving the agricultural growth rate at the macro-economic level and to sustainably increase productivity in the farm holdings. ANCAR has regional departments to carry out its programme.

## **Mission and Objectives**

ANCAR's basic mission is to help create an agricultural-rural council that takes a global account of the needs of the rural communities and to set up an institutional framework for harmonising and coordinating strategies and programmes put forth by the various entities working on agricultural and rural advisory services. With this in mind, ANCAR aims at providing the farmers with a larger range of technical innovations generated by research, improving the level of adoption and dissemination of endogenous solutions stemming from the farmers' experiences, solutions whose practical value is recognised, and strengthening the institutional capabilities of the producers' organisations. ANCAR works in the following fields: assistance-advice needed for the enhancement of rural activities, technical support for rural crafts, agricultural produce transformation and marketing, popularising technologies, intermediation (rural infrastructure, credit schemes, healthcare, training, etc.) and monitoring family farms.

## **Human Resources**

ANCAR has the following resources:

- a director general, a technical director;
- 11 regional directors who manage the technical and administrative personnel in their region;
- staff for administration and management;
- Assistants and persons specialised in agriculture, livestock production, fisheries, hydraulics and environmental issues.

Funding comes from contributions from the State, the State/bank convention, conventions with internal and external development partners.

## **Collaboration and Networking**

ANCAR was recently created to stimulate a new agricultural advisory dynamic. With the support and at the initiative of the World Bank, this structure serves as a link between research institutions and the rural areas. It has set up regional offices throughout the country and, ever since its creation, has improved the discussion among rural stakeholders. Subsequent to conducting a participatory diagnostic study on problems faced in each location, it packages the information gathered in the form of a proposal. By means of contracts with producers and in keeping with the conditions of the proposal, ANCAR then approaches research institutions to acquire available solutions or to research them together. The first piece of research that is underway in that area is on sweet potatoes. ANCAR's relationship with SAED (its counterpart in agricultural advisory services) is still unclear (at least, it was in the initial stages). It is now crucial to harmonise the advisory approaches of these two structures and ensure that their roles complement each other.

ANCAR has worked in closest collaboration with all its training partners, the producers, their joint associations and the local authorities since it was set up. It has a weak relationship with the research sector. Aside from various desires that have been expressed to set up partnerships, no concrete action involving joint activities has been implemented. However, the frequency with which they meet during discussion fora and their programmes of activities provide opportunities for more sustained collaboration.

## **Strengths:**

- Availability of experienced, qualified persons throughout the 11 regions of Senegal;

- Experience in the field of assistance/advisory services and extension work;
- Availability of work facilities.

**Weaknesses:**

- Shortage of human resources to cover all disciplines.

## **5.9. RESEARCH ACTORS**

### **5.9.1. SENEGALESE AGRICULTURAL RESEARCH INSTITUTE (ISRA)**

ISRA is one of the leading national agricultural research organisations in Senegal. It was created in 1974, as an *Etablissement Public à Caractère Industriel et Commercial*. To effectively respond to its mandate, ISRA has established national centres (CRODT, CNRF, LNERV, LNRPV), regional centres (ISRA/Fleuve, Centre du Bassin Arachidier/Bambey, Moyenne et Basse Casamance/Kolda, Haute Casamance/Ziguinchor) and research units (UNIVAL, BAME...). The services that work directly on irrigated rice production are l'ISRA/Fleuve, the Centre de Kolda and also BAME, (for analysing and monitoring agricultural policies). Mission and objectives

ISRA's mission is to propose technologies that are adapted to the environment and can improve agricultural productivity. ISRA's activities include agricultural production system intensification, crop diversification, natural resources and environmental management, agricultural policy evaluation, and the formulation of decision-support tools. In the rice sub-sector, ISRA's research plays a role in the production process, harvesting, processing and commercialisation.

BAME and the economists in the regional centres have a twofold socio-economic research mission. They have an external mission whose main objective is, first, to help the public decision makers formulate agricultural policies correctly and ensure proper monitoring and evaluation, and second, to help the economic operators refine their strategies. BAME also has an internal mission to participate effectively and directly, together with the regional programmes, in the various steps of the technology generation, validation and transfer processes that may relieve the producers' concerns.

There are many axes of research: varietal breeding and adaptation, definition of cropping practices and crop protocols, crop protection and management, water and land management, sub-sectoral studies, production economics, rural financial systems, professionalisation of Producer Organisations, poverty and food security, assistance with methodology and evaluation of the social impacts of research. These activities have been grouped into six major fields of action, e.g. research, education, scientific management (coordination and administration), consultation.

Research is clearly the most important mission since it accounted for 62% of the work time and 63% of the institution's results, and consumed 63% of the institution's total budget in 2003. Management and coordination only accounted for 16% of the work time and took second place in the ISRA results (12%), while consultations accounted for 7% of the volume of work. Since the introduction of regulations on consultation services in 2001, ISRA's expertise has often been solicited at the national, sub-regional and international levels. Despite its low budget (2%), consultations generate 5% of the ISRA results.

**Table 7 : Breakdown of type of services at ISRA in 2003(in%)**

Type	% Results	% Budget	% Time
(i) Research	65	63	62
(ii) Education	5	3	8
(iii) Training	3	19	9
(iv) Consultation	9	2	7
(v) Scientific Management	12	9	16
(vi) Administration	6	4	8
TOTAL	100%	100%	100%

In terms of volume of work, ISRA's scientific activities have dropped from 68% in 1998 to 55% in 2003. This shows that the diversity of research services has improved considerably. Many of the preoccupations of the rural communities are handled by the institute's various services. We see that scientific management, (which includes project design), scientific leadership, the development of scientific partnerships with other organisations, etc. are subjects that are gaining ground since they used to occupy 9% of the scientists' time, and now occupy 15%. Since the demand for research is becoming increasingly more complex and multi-facet, it now requires synergy and partnership in the research community. Capacity building through education also means more funding for technological innovations (Table 9).

**Table 8: Changes in types of services between 1998 and 2003 (in%)**

	1999	2000	2001	2002	2003
a. Research	68	70	62	59	55
b. Education	3	3	6	6	7
c. Training	10	6	7	8	8
d. Consultation	3	4	5	6	7
e. Scientific management	9	11	13	14	15
f. Administration	7	6	7	7	8

## Human Resources

ISRA has a total staff working across the country of 446 employees: 193 (43%) for scientific research, 43 (10%) for administration and management, 210 (47%) for support services, i.e. research assistants, observers, secretaries, drivers, reprographics staff, etc.

In scientific research, 33% of the staff hold PhDs, and 27%, Masters' or DEA level. The rest of the scientific staff is composed of engineers (40%). All incoming scientists have to be at the doctorate level, and if they do not have their degree they are enrolled in ISRA training programmes so that they can reach a level that matches that required by the institute. This training programme is mainly supported by the World Bank and is applied to all fields in order to close the existing gap. In 2003 there were 54 employees (28 from scientific research and 26 from administration and accounts) who were being trained through the ISRA training programme (20 of the 28 research scientists are studying abroad). Training for administrative staff is provided through modules at the local level (95%). This is an *à la carte* capacity-building scheme that uses modules. For higher level administrative staff (*cadres*), less than 5% are following diploma course, (including one studying for a PhD

abroad). In these training programmes there are three technical assistance officers (*assistants techniques*) who are working towards an engineering degree or a DEA.

According to the authorities in the institute, both types of training (local and external) are appreciated since they fulfil ISRA's expressed needs. But certain subjects are not yet taught at the local level, e.g. agricultural machinery, animal husbandry, genetics, etc. For economic reasons, ISRA prefers the local level for its capacity-building schemes.

Staff trends (Table 10) show a drop of 15% in ISRA's research potential between 1998 and 2003. During that same period the number of support staff rose. Administrative staff remained more or less stable. The brain drain among the scientific staff grew worse during the last three years; it started when ANCAR (a new supervisory structure) was created and hired many ISRA scientists. The reduction in the scientific potential has not decreased the volume of research however. Mobility strategies for the scientific staff, and the partnership that the institute developed, quickly closed the gap and made it possible to cope with the demand for research.

**Table 9: Staff evolution at ISRA**

Number	1998	1999	2000	2001	2002	2003
Administration and management	45	44	40	45	45	43
Scientists	226	225	220	193	193	191
Support staff	177	172	149	201	201	200

Source: RH/ISRA

The ISRA/Fleuve rice team has 42 members. About ten of them are national research scientists who work with the regional WARDA/Sahel station. This is a technical team that includes a breeder, two agronomists, one soil scientist, an agricultural machinery specialist, a weed scientist, an animal husbandry specialist, a veterinarian, an agricultural economist, a hydraulics engineer and two vegetable agronomists based in Dakar.

For socio-economic research, ISRA has:

- 5 economists and 1 sociologist directly attached to the BAME "hard core";
- 7 economists assigned to the research centres: one in Bambey, one in Saint-Louis, one in the Livestock Laboratory, one in DRPF, one in CRODT and two in Kolda.

## FINANCING

Funding is obtained from the national budget, special conventions and internal resources. As shown in the table below, the state's contribution has fallen sharply, from 71% in 1999 to 36% in 2003. This contribution is mainly used for salaries and operating expenses. Research is financed by the donor agencies and consumes more than 40% of the budget. Internally generated resources have hardly exceeded 20% since 1998.

**Table 10: Financial trends% per source (in%)**

Source	1998	1999	2000	2001	2002	2003
(a) Government	38	71	47	40	27	36
(b) Donors	51	18	35	41	59	48
(c) Internally generated resources	11	11	18	19	14	16



Allocation of the state's contribution to the budget is as follows: 54% for salaries of senior staff (*cadres techniques*), 27% for salaries of the administration and management officers, 19% for salaries of the support staff and for operating costs. Contributions from donors do not provide for the salaries of the research scientists. It is only the temporary labourers (observers, surveyors) who can be paid out of donors' subventions to contribute to the satisfactory conduct of research activities. The other operating costs are paid for out of internal resources.

### **Cooperation and Networking**

ISRA has established both internal and external contacts in all its fields of interest: policy formulation, research and development, information exchange, financial sources, monitoring agreements and conventions, etc.

Its collaboration is strongest with the research institutions, the donor community, the beneficiaries of the results of research (POs), financial institutions, rural supervisory services, etc. It maintains contacts with the national universities (Cheikh Anta and Gaston Berger) and other ministries, but, as yet, these contacts are not very active. Joint research programmes have been growing since 1999 when the national organisation was set up to coordinate research activities.

Collaboration between ISRA, the Producers' Organisations and the extension services has considerably improved after noting the ineffective uptake of the results of research during the last few years. Collaboration with the university in working on special conventions has also improved. Relations with the other ministries have remained very limited during the last three years.

There are various fields of cooperation. Progress can be seen through the increase in the number of joint publications and the increase in information/experience exchanges with non-research partners. On the other hand, the funding for these activities has gone down during the last three years.

### **Strengths:**

- Availability of qualified scientific and administrative staff;
- Experience in agricultural research, training, and collaboration with national and international partners;
- Expertise and major achievements reputed at the national and international levels;
- Multidisciplinary research scientists dispatched to regional centres to work on specific themes with national services at both the national and a cross-cutting level;
- Importance given to socio-economists in the ISRA revival arrangements.

### **Weaknesses:**

- Too few research scientists in all disciplines at ISRA considering the research needs;
- Lack of material and financial means;
- Shortage of senior research scientists (1/3rd of the staff is of PhD level).

### **Needs**

- Build up capacity and resources.

Besides ISRA, the national research system includes entities devoted to basic research (universities) and specific fields (*ITA-Institut Technique Alimentaire* which works on foods, and the *Institut des Sciences de l'Environnement*, etc.). ISRA has been involved in a

restructuring exercise since 1995. Discussions on the strategic aspects of research and the business project forming part of donor requirements (in particular the World Bank) have led to the identification of three areas of focus: to set up an effective and sustainable national agricultural and food processing research system, to conduct high quality, demand-driven research and to enhance the skills, productivity and motivation of the human resources. The aim is to break the ISRA and ITA monopoly in agricultural research by creating synergies between institutions skilled in this domain (public/private, associations, etc.) on the basis of their comparative advantages, through development projects, planning–evaluation mechanisms and resource allocation mechanisms. The aim is also to implement an active regional, international and North-South policy in order to bring together skills, economies of scale and skills transfer.

ISRA works with these entities, although its main thrust is applied research. ISRA serves as the partner to national, regional and international bodies to implement special conventions designed to respond to various requests for research. ISRA also receives expatriate research scientists from CIRAD and IRD. In the rice sub-sector, ISRA works closely with WARDA/Sahel which is a CGIAR center for the west and central Africa; the two organisations share rural experimentation and research centres.

## 5.9.2. INDIVIDUAL RESEARCHERS

### Description

The researchers who were interviewed average 44 years of age, with a low degree of variability (15% coefficient of variation). The youngest researcher among the 20 surveyed was 30 years old while the oldest was 60 years old. This makes up the overall profile of all the institute's researchers who average 46 years of age (ISRA, 1996). Their total working experience averages about 15 years ranging between two and 30 years experience. Within this group, 50% hold PhDs, 35% hold Masters or DEA<sup>1</sup> qualifications and 15% are qualified engineers. On average, according to the respondents, PhD or Doctoral studies take between 4 and 6 years to complete after the Masters or DEA while the DEA or Masters takes between 2 and 3 years to complete. Engineering studies can take between 4 and 6 years to complete.

In terms of gender and field of work, this group is highly diversified. Women represent 20% of the sample, which corresponds to their percentage representation (16%) in the institute. The different fields of work represented in this sample cover nearly all of ISRA's areas of intervention (except fisheries). Of all the respondents, three are breeders, one of whom is involved in rice production, five in agricultural management (phytocoltures, soil sciences and agronomy), one in crop protection (pest and weed science) and six in social sciences (economics, statistics, sociology and agricultural mechanisation). The group also includes two zoo technicians, two veterinarians, one of whom specialises in animal nutrition, and one forester.

Table 12 provides a summary of the time allocation of the researchers surveyed with respect to research management (project planning, administrative project or programme coordination work, meetings, etc.), research, teaching, consultations, research and development activities, laboratory work and undergoing training. Results show that research activity dominates, based on a 44% time allocation. This is followed by research and development activities which form one of the pillars of ISRA's technology transfer roles. The

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<sup>1</sup> DEA is the Diplôme d'Etudes Approfondies, a post-graduate qualification attained just before acquiring one's doctorate.

time allotted to administrative activities is higher than that allotted to teaching. However the time allocated to training (8%) does not correspond with the average number of doctoral students among the respondents (50%).

The limited amount of time lent to teaching may also pose a problem in terms of the need to strengthen the link between research and teaching to enhance the practical training component in agricultural colleges. The three ISRA centres participating in the study have had opportunities to teach at the following institutes: ISRA/Bambey at ENCR and ENSA, ISRA Dakar at the veterinary school, Cheikh Anta Diop University and ENSA and ISRA/ Fleuve at Gaston Berger University, ENSA and Ecole Elevage. The institute is making an overall and long-term contribution towards training pupils and students through courses and by providing dissertation support. However their involvement in university and institute training courses is still limited. Due to the importance of training for developing knowledge and skills and of teaching to expanding outreach of research, more time could be allocated to these activities.

The budget and financial results are only reported for research, as this is the main role of the researchers. Consultancies that were officially accepted in 2002, used to take place under private arrangement (vacations were taken for the purposes of long consultancies or consultancies held outside the country). These activities are now being regulated and institutes are being paid for them. Such activities are also being recorded and noted for career appraisal purposes. However, the results of these consultancies are not yet being recorded in the institute's financial statements, as they are often confidential and remain the exclusive preserve of the applicant.

**Table 11:** Researchers' Time Allocations

Activity	% Time
(i) Research management	14
(ii) Research	44
(iii) Teaching	5
(iv) Consultations	s
(v) Research – development	15
(vi) Laboratory	6
(vii) Training	8
<b>TOTAL</b>	<b>100%</b>

Source: ISRA surveys, 2004.

### Cooperation and Networking

When undertaking their activities, the researchers work with various partners. The researchers' main local partners include producers and their organisations, development and teaching structures and local donors. The level of collaboration with these partners is considered highly satisfactory by 55% of the respondents. The relative degree of collaboration is indicated in Table 13. Results shows that the researchers accord high value to the relationship with their research colleagues (58% of respondents). According to 40% of the sample, the level of collaboration with producer associations is good and another 40% consider it average. Their relationship with the extension services is rated as fair to good (85% of the respondents). On the other hand, the relationship with private laboratories, equipment suppliers and seed distributors is rated as relatively poor. However, a working relationship exists between the researchers and private laboratories such as SENCIM, SPIA (for chemical tests and analyses). Similarly, seed producers are being trained by extension

workers and research monitors. Some privately owned agricultural equipment is also checked and undergoes adaptability tests by the researchers.

**Table 12:** Assessment of Levels of Collaboration with different entities

	Extent of Collaboration				
	No link	Poor	Fair	Good	Very good
a. Research Institutions	-	-	15%	55%	3%
b. Producer Associations	-	20%	40%	40%	-
c. Universities	-%	30%	35%	25%	10%
d. External/Private Laboratories	45%	15%	30%	10%	-
e. Extension services (SAED, ANCAR, etc.)	-	15%	50%	35%	-
f. Agricultural Equipment Suppliers	65%	15%	15%	5%	-
g. Agricultural producer unions	-	45%	40%	15%	-
h. Seed suppliers	80%	5%	15%	-	-

The areas in which these partners collaborate concerns mainly research and development (45% of cumulative opinions expressed), project planning/mobilising funds (19%) and research activities (17%).

Research is no longer done on a whim, but is, rather, targeted at resolving concrete problems faced by producers. This means that it is now demand-driven. ISRA's strategic plan forecast analysis (1996) highlighted that the low level of adoption of research technologies was partly due to the fact that research was done in isolation. The beneficiaries needed to take ownership of the technology through research and development (R & D) activities, which involved joint problem-identification and problem-solving. This mechanism is reinforced by the National Agricultural and Agro-food Research Fund (FNRAA), which was set up in 2000 with the World Bank's support, aimed at creating synergies between research, development and producers. Although some problems exist, particularly in the mobilisation and management of funds, FNRAA, by virtue of the collaborative nature of the project, has succeeded in bringing together several partners who work according to the needs of the producers who are the decision- makers on how the funds are managed.

Although ISRA has shown a strong will to be part of the national research system, the same does not apply for the other actors. Research projects are mainly initiated by ISRA and then submitted to potential partners. A great deal of mistrust often arises when the projects are underway (delays, discrepancies in the finances, low subsidies for some partners, slow resource allocation procedures, etc.). There are still insufficient resources being channelled towards training in relation to demand, and the same would apply for the high-quality rehabilitation of the research infrastructure. Motivation among the researchers is low. An evaluation of the first phase (out of four) is currently underway for the purposes of making any necessary adjustments.

The scarcity of resources has forced the government and several donors to decrease their contribution to research funds. Consequently, ISRA has opted to encourage its researchers to compete for funding at a national, sub-regional, regional and international level (FNRAA and other donors). To a large extent, this explains the importance that the respondents place on sourcing funds. Other areas of interaction between the researchers and their partners include information exchange, training and publishing. Over the last three years there has been a noticeable increase in information exchange, meetings and joint research and development.

Researchers tend to collaborate most when sourcing external funds (37% of responses). This is followed by joint research partnership (31%), research in networks (12%) and joint publications (12%). Research has survived mainly due to external funding arising out of bilateral and multilateral agreements, funds from regional research networks such as CORAF and partnerships for the purpose of releasing publications. The networks (e.g. ROCARIZ, the rice producers network, INSAH which conducts research impact studies and its journal « Etudes et Recherches Sahéliennes », ICRISAT for millet producers, CRISPE for cowpeas and CORAF's PSI, etc.) constitute the frameworks for regional dialogue and participation in increasing collaborative research, training (exchanging experiences and sharing methodologies) and joint publications.

## 6. INFRASTRUCTURE

The poor state of the infrastructure (markets, transport, roads, communications) in the rice sub-sector is indicative of the difficulties farmers face. These are factors that play a major role, e.g. in how the market functions, especially with regard to information availability and market access. They impact on competitiveness including issues related to quality and price. Information and knowledge flow is linked to the structure of the sector, and even more so to the actors and their relationships. Various studies devoted to relations between the actors and information management in the rice sub-sector, reveal the dysfunctional nature of information management with regard to prices, market stocks, volumes of rice sold (flows). Other aspects that concern the sale of local output for consumption relate to marketing and quality.

Discussions with the actors indicated that the farmers did not sell all their paddy at 100 CFA francs per kilo. That price is only applied to the part of the output that is sold to repay loans from CNCAS. The rest is sold at a much lower price (between 60 and 70 CFA francs per kilo) in order to meet the farmers' need for cash, especially early in the harvesting period. Unsold stocks amounted, on average, to 5-6,000 tonnes per annum. This is very paradoxical since national production covers less than one-third of the apparent need, and points to the problem of marketing local rice.

For local rice, the *aggregate trade margin* is the difference between the paddy production price and the retail price for white rice. The price, thus, has to cover the cost of harvesting, processing and distribution. There is constant pressure to improve efficiency and profits. Estimates suggest that all the post-harvest operations only account for 10.2% of the retail sales price, processing for 4.8% and collection and distribution for a modest 5.4%.

Several studies have been carried out on the rice sub-sector in order to evaluate the performance of rice production and they highlight issues related to production constraints. The main results in the irrigated rice zone give parallel importance to using improved seeds, fertilisers and for widespread mechanisation. After the liberalisation of the agricultural sector, the private sector took over the distribution of the inputs; it was more efficient and larger amounts were sold (Gaye, 1997; Randolph, 1997). The delay in delivering inputs bought with CNCAS loans has made it very difficult to respect the cropping calendar in the irrigated rice production zone (Fall, 1999). Offers from other financial institutions, such as the savings and loans funds, the FPE credit lines, etc. may provide slightly more opportunities to obtain loans. But the problem of credit annualisation for improvements along other aspects of the chain (marketing, light equipment, etc.) have not yet been considered.

## 7. CONCLUSIONS AND RECOMMENDATIONS

As defined a system of innovation consists of a network of economic agents together with institutions and policies that influence their innovative behaviour and performance. Thus, productivity improvements and the uptake of innovations in the rice sector require a combination of several closely interlinked factors ranging from political vision to enabling policies and institutions, access to information and knowledge, actors' with the necessary competencies, behaviour and habits especially as they relate to learning and innovation. Although technology is not the only factor of progress, it is obvious that without investments in science and technology, economic growth will be weak or even non-existent.

Technological development as well as access to new and improved technologies is vital to the growth and competitiveness' of the local rice in Senegal. Several factors have been identified which hinder growth and competitiveness in the rice industry in Senegal River Valley. These include limited access to finance at critical times in the production chain to little collaboration between research and other industry actors. From an innovation system perspective, it is argued that the ineffectiveness of the system might be the institutional context in which it is embedded which often acts as inertia force (Horton and Elliott, 1993).

To improve the performance of the system and effectively respond to demand, research requires adequate financial resources and very close collaboration with the productive sector. On the technological side, varietal improvements, development of high-yielding, stress-resistant varieties, (especially resistant to diseases and weeds), soil and water management, and environmental preservation are important. Similarly, thought must be given to tracking the evolution of the sub-sector, the impact of agricultural policies on the producers and processors, the development of decision-support models, information on the sub-sectors, etc.

The farmers, traders and processors also generate knowledge and are learning through their ongoing collaboration among themselves and interaction with external agents such as input suppliers and service providers, technical partners, etc. Farmers are interested in acquiring new knowledge in order to develop new procedures, new products and to improve efficiency and increase market share and earnings. They have demonstrated their willingness to introduce and adopt new technologies.

Innovation can be spurred by factors such as improved interactions among actors, better coordination and research that responds to the needs of producers, processors and other actors but this requires an enabling policy and institutional context. The state's support measures have proven to be important. Liberalization led to significant developments; however public funding for research and technology upgrade was reduced and reliance placed on donor funding which became a greater challenge when it no longer became available. The producers want the state to cancel certain taxes and duties and to have policies enacted which benefit the producers' organisations. Other measures being sought include the establishment of a disaster fund and a bonus fund, and lower seed prices from lower inspection costs. Improving financing mechanisms and instruments will also benefit the industry.

There is room for progress in the industry to meet growing local demand and stem the loss of foreign exchange and this can be achieved, in particular, by equipping more farmland, increasing water availability (crop intensification), with the potential for higher yields, and

improvements in crop protocols, shelling rates and the quality of the rice. The following recommendations are made:

1. The establishment of a sustainable funding mechanism for research and development (e.g. tax on agricultural imports);
2. Evaluation of low-cost technologies and agricultural equipment that are well adapted, thus enabling Senegal to undertake a genuine agricultural modernisation programme (rice production);
3. Consideration of annualising agricultural credit schemes to ensure adequate financing for producers and other related agricultural activities;
4. Provision of short- and medium-term credit lines and mechanisms to finance hydro-agricultural equipment and facilities;
5. Eliminate or reduce taxes on agricultural machines and equipment, and their spare parts;
6. Promotion facilitation of synergy and collaboration among the various organizations especially research, development, training and extension in order to better meet demands for innovations.

Economic liberalisation in Senegal led to progress in the development of the rice industry. It has, *inter alia*, triggered increased trade flows and a substantial flow of private investment and capital. Producer organizations were strengthened and private capital was used to expand the number of mills, but these are now operating at 50% capacity. Producers over have shown willingness to adopt new cropping practices, varieties and other arrangements to improve production but are unable to undertake further modernization. Limited access to credit is reducing the amount of land under cultivation. Satisfying the local market and accessing sub-regional markets is difficult because of funding constraints and limited collaboration among key actors especially research in the sector. There is need for continuous innovation in the Senegal rice industry and increasing the collaboration among actors and facilitating information and knowledge flows as well as creating the enabling environment require policymakers, research, extension, training, financial agencies, producers and other entrepreneurs to work together if rice will continue to be a major staple for food and nutrition security.



## BIBLIOGRAPHY

Fall, A.A. (1998), Étude comparative des coûts et rentabilité des systèmes de production rizicole dans le delta et la moyenne vallée du fleuve Sénégal, Rapport de recherche ISRA/ADRAO, March.

Fall, A.A. (1999), Systèmes d'Exploitation Agricole dans le Delta et la Moyenne Vallée du Fleuve Sénégal : Allocation Optimale des Ressources à l'aide d'un Modèle de Programmation Linéaire, le GAMS, ISRA/INSAH Research Report, November.

Fall, A.A. (2002), Situation du Riz et Sécurité Alimentaire au Sénégal, ISRA/FAO Research Report, February.

Fall, A.A. (2002), Impact économique de la recherche sur le riz dans deux pays de l'Afrique de l'Ouest : Sénégal et Mauritanie, Agriculture and Development Strand of the Conference for the African Evaluation Association and IPGRI, Nairobi, Kenya 10-14 June 2002.

Gaye, M., La Filière Riz au Sénégal face aux réformes structurelles, ISRA/IFPRI Research Report, June 1997.

Institut Sénégalais de Recherches Agricoles (ISRA), (1996), Plan Stratégique de la zone agro-écologique du Fleuve, March.

International Food Policy Research Institute (IFPRI), Accelerating Food Production in Sub-Saharan Africa, edited by John W. Mellor, Christopher L. Delgado, and Malcolm J. Blackie, The Johns Hopkins University Press, 1987.

KELLY, V., DIAGANA, B.N., FALL, A.A., La Consommation des Céréales et des Légumineuses en Milieu Rural Sénégalais, Doc. no VII of ISRA/IFPRI Project, July, 1991.

KELLY, V., REARDON, T., FALL, A.A., et DIAGANA, B.N., L'Impact des Politiques de Prix et de Revenus sur la Consommation et l'Offre des Produits Agricoles, Vol. 1 and 2, Part 1 and II, Final Report of ISRA/IFPRI Project, June 1993.

Kite, Rod, "Senegal: Implications for the Rice Policy Dialogue", USAID/Dakar, Revised September 1993.

Ministère de l'Agriculture, Division des Statistiques Agricoles (DISA), Prévision de récolte de la Campagne 1993/94, November, 1994.

Sidibe, Mamadou. "Effets des Politiques Macro-économiques sur le Niveau de Protection de la Filière du Riz Local Irrigué", ISRA/BAME, First document, October 1993.

Société Nationale d'Aménagement et D'Exploitation des Terres du Delta (SAED), 1995.  
"Estimation des Productions en Riz-Mais-Sorgho : Hivernage 1993/94", Saint-Louis, April.  
Société Nationale d'Aménagement et D'Exploitation des Terres du Delta (SAED), 1997.  
"Estimation de la Production de Paddy dans la Délégation de Dagana", Saint-Louis, 1997.

Société Nationale d'Aménagement et D'Exploitation des Terres du Delta (SAED), 1998.  
"Politiques et stratégies de développement rural dans la vallée et le delta du fleuve Sénégal, Annexe 1: Evolution des superficies aménagées", Contribution de la DPDR, February 1998.