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**The Short Report Series**  
on  
**Locally Managed Irrigation**

*Report No. 9*

**LOCALLY MANAGED IRRIGATION  
IN THE SENEGAL RIVER VALLEY  
IN THE AFTERMATH  
OF STATE DISENGAGEMENT**

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and  
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## Purpose of the Series

The *Short Report Series on Locally Managed Irrigation* is designed to disseminate concise information on the role of local management in irrigation and irrigation management transfer or turnover experiences and policies. The *Series* is distributed worldwide to a broad range of people—policymakers, planners, researchers, donors and officials in both public and nongovernmental organizations—who are concerned with the irrigated agriculture sector. IIMI's goal is not to promote policies such as irrigation management transfer, but to enhance the knowledge base available to decision makers and advisors as they face questions of policy adoption and strategies for implementation.

Locally managed irrigation can be of many types, such as traditional farmer-constructed diversion or tank schemes, indigenous and often new lift irrigation, government-constructed but farmer-managed irrigation systems and systems where management is or has been transferred from an outside agency to a local user organization.

By "irrigation management transfer" we mean some degree of transfer of responsibility and authority for irrigation management from the government to farmer groups or other nongovernmental entities. This generally involves contraction of the role of the state and expansion of the role of the private sector and water users in irrigation management. In other words, there is a shifting upstream of the point where management responsibility and control of the water supply are transferred from the irrigation authority to local management. This may involve changes in policies, procedures, practices and the performance of irrigated agriculture. It may or may not involve "privatization" of ownership of the assets of the irrigation system. The *Short Report Series* addresses questions such as the following:

What are the necessary conditions which support viable locally managed irrigation?

What socio-technical conditions, institutional arrangements and change processes lead to sustainable locally managed irrigation?

What is the range of different models that are being applied worldwide for turnover or transfer of responsibility for local management for recently developed irrigation?

What are the effects of management transfer on the productivity, profitability, financial viability, equity, efficiency and sustainability of irrigated agriculture?

What are the perspectives of farmers, managers, policymakers, urban consumers and other stakeholders in irrigated agriculture about irrigation management transfer?

What adjustments in government may be needed as a result of turnover to provide support to locally managed irrigation systems and to improve productivity in the public sector?

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**Locally Managed Irrigation in the Senegal River Valley  
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In most cases, policies and programs to transfer management of irrigation systems from government agencies to local farmer organizations have been confined to transferring responsibility for operation and maintenance (O&M) of the irrigation systems. In these policies and programs, little emphasis is given to the role of support services that are necessary to make transfer of O&M responsibilities successful, irrespective of the fact that these services are delivered by irrigation agencies and line agencies or by the private sector.

In contrast, since the mid-1980s, disengagement of the state from irrigated agriculture in the Middle Valley of the Senegal river provides a case in which irrigation management transfer (IMT) is seen in a much broader political perspective. State disengagement in Senegal refers to the overall process of state withdrawal from irrigated agriculture, including withdrawal from the provision of irrigation O&M as well as other parastatal functions such as marketing, agricultural credit and input supply. Thus, IMT in Senegal is one of the several components of structural adjustment programs that have been implemented. The process includes both *privatization* of irrigation ownership as well as support services, and *liberalization* of prices for agricultural products and inputs.

This paper reports on the evolution of problems with, and farmers' responses to, state disengagement in two different areas in the Middle Valley of the Senegal River. In the first case disengagement took place abruptly, while in the second case the disengagement process was accompanied by institutional support to farmer organizations. From a comparison of the two cases, important lessons can be drawn concerning the process of IMT and state disengagement and the financial and economic viability of IMT in a setting of dramatic liberalization and privatization policies. The paper also explores farmers' responses to IMT and state disengagement in a context where irrigation development could only have occurred as a result of state investment in irrigation infrastructure.

The case where farmer organizations were provided institutional support and an attempt was made to minimize the impacts of disengagement on agriculture has resulted in less turmoil and disruption of agricultural production. However, the financial viability and technical sustainability of the irrigation pumps in the transferred systems remain uncertain.

The ability to provide timely information about such an important aspect of local management of irrigation is the reason the *Short Report Series* was created. The editors welcome comments and reactions to this and other reports in the Series.

# LOCALLY MANAGED IRRIGATION IN THE SENEGAL RIVER VALLEY IN THE AFTERMATH OF STATE DISENGAGEMENT

*Philippus Wester, Arjen During and Joost Oorthuizen<sup>1</sup>*

## Introduction

Until recently, irrigated agriculture in the Senegal River Valley was strongly supported by the state. Farmers received subsidies on inputs, price support for their products and a wide range of services from a parastatal, the SAED.<sup>2</sup> This support was based on a policy of agricultural modernization aimed at increasing rice production in the Valley. The outcome of this policy, however, was far from encouraging. High construction costs, frequent rehabilitations, low cropping intensities, low yields and high recurrent costs of large-scale irrigation schemes in Senegal have come under criticism (Kortenhorst et al. 1989; Horowitz and Salem-Murdock 1990; Diemer and Huibers 1991; Engelhard 1991).

Concurrent with the vocal criticism of large-scale irrigation, several authors have reported on the success of small-scale village irrigation schemes in the Senegal Valley (Diemer 1990; Diemer and Huibers 1991; Brown and Nooter 1992). Reference is made to their low construction costs (CFA Franc<sup>3</sup> 0.5–1.0 million per hectare compared to CFA Franc 5.0–8.0 million per hectare for large schemes), high yields and their rapid increase from nonexistence in 1974 to 16,340 ha in 1988 (Seck 1991). Success of small-scale irrigation schemes in the Senegal Valley is attributed to their adaptation to the local production system and the fact that they are locally managed (Diemer et al. 1991).

However, this alleged success occurred at a time when a substantial part of the costs related to irrigated agriculture was borne by the state and donors. The reshuffle of state-society relations, that has been in full swing in Senegal since the first structural adjustment program was put into action in 1980, has shifted the financial burden onto the shoulders of the farmers. The question at present is whether farmers will be able to support the "right" prices or whether the "success" of small-scale irrigation in the Senegal Valley will be short-lived.

This paper formulates a tentative answer to this question by portraying the consequences of, and farmers' responses to, state disengagement from irrigated agriculture in the Middle Valley. It is not our aim to make sweeping statements on the restructuring of state-society relations, but rather to respond to the call for empirical studies on this complex issue (Booth 1987). After a description

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3 The CFA Franc has a fixed exchange rate with the French franc ((F); before 1994, CFA Franc 50 = F1.0; since January 1994, CFA Franc 100 = F1.0; US\$1.0 = CFA Franc 449 (1985); US\$1.0 = CFA Franc 310 (1989).

of the development of irrigation in the Valley, a short outline is presented of the disengagement policy, its antecedents and its implementation. The bulk of this paper focuses on the effects of disengagement and farmers' responses in the Doué Region and on the Ile à Morphil (Figure 1).<sup>4</sup> In the Doué Region, irrigation schemes have been fully privatized since 1990. On the Ile à Morphil, a project has helped minimize effects of state disengagement. Specific attention is given to this project's program for assisting in creating viable, locally managed irrigation.

It needs to be emphasized that in this paper the term disengagement will be used to designate the overall process of state withdrawal. Disengagement consists of both *privatization*, the devolution of responsibilities and ownership from the state to the private sector; and *liberalization*, legal measures to diversify the economy, such as changes in price policies and import laws.

## Development of Village Irrigation Schemes in the Middle Valley

The Senegal River Valley derives its name from the River Senegal that flows through it and forms the border between Senegal, on the south, and Mauritania on the north. The Valley is 600 km long and 20 km wide and can be divided into the Delta, the Middle Valley and the Upper Valley. The Middle Valley on the Senegalese side runs from Dagana to Dembakane and is administratively under the Departments of Podor and Matam<sup>5</sup> (Figure 1). The schemes discussed in this paper are located in the Department of Podor.

The climate in the Department of Podor is Sahelian, with a mean annual precipitation<sup>6</sup> of 176 mm between 1972 and 1990 and an evapotranspiration of approximately 2,600 mm per year (GERSAR/CACG et al. 1991). The potential for rain-fed agriculture is thus very limited. A traditionally important form of agriculture in the Valley is flood-recession agriculture in the *cuvettes*, low-lying parts of the floodplains that are partly flooded by the river during most years. The height and duration of the flood determine the amount of land that can be cultivated. For good harvests, the flooding must last longer than one month. The main crop grown on the residual water in the floodplains is sorghum in combination with beans. Soils vary from sandy in the higher parts to heavy clays in the depressions and are closely linked to the micro topography.

In the Middle Valley, approximately 400,000 people support themselves with a diversity of productive activities, such as fishing, livestock rearing, small commerce and flood-recession, rain-fed and irrigated agriculture (GERSAR/CACG et al. 1991). In this area, the population consists mainly of *Haalpulaar*, who live in a village-based society where the village represents the local political unit and has a strong internal stratification; but little cohesion exists between villages. The *Haalpulaar* divide themselves into free men, artisans and slave descendants. Most decisions at the family level are taken by the heads of extended families and at the village level by the heads of the families of free men, on the basis of consensus (Diemer et al. 1991). Access to flood-recession grounds is tightly controlled through village hierarchies and the land is mainly distributed among the free-men families. The number of families that can cultivate the *walo* grounds depends on the extent of the floods. However, even in years with a good flood, 35 percent

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4 Field research was conducted in these regions from February to August 1992. It was largely qualitative and involved informal, group and individual interviews with officials, project staff and farmers from 15 different PIVs (village irrigation schemes) and structured interviews with over 150 farmers from one selected village.

5 In Senegal, the country is administratively divided into eight Regions. These Regions are subdivided into Departments. The Senegal River Valley is called "Region du Flueve" and consists of the Departements du Dagana, Podor and Matam. Departement du Bakel lies in the Region du Senegal Oriental.

6 The rain falls in the wet season (June-October), which is followed by the cold dry season (November-January) and the hot dry season (February-May).

of the inhabitants of the Middle Valley do not have access to this land. In years with a bad flood, this percentage can be as high as 85 (Diemer and van der Laan 1987).

Advent of irrigation in the Middle Valley was a response to famines in the early seventies that were caused by the severe drought between 1968 and 1974, in combination with the high rate (2.6%) of population growth (GERSAR/CACG et al. 1991). These strongly increased the migration of males to the cities on the coast, other African countries and France. Migrants sent money home to their families left behind in the Valley, who used the remittances to complement their grain provisions and to buy other goods. The famines also induced the development of a new form of irrigation, namely, the village irrigation schemes (Périmètres Irrigués Villageois or PIVs). The first PIVs were constructed in 1974 by farmers groups with assistance from donor agencies. This form of irrigation development was taken up by other donors as a form of structural aid to help farmers overcome food shortages.

Even though many villages requested a PIV, the SAED was initially reluctant to assist them because the schemes fell outside the scope of the government's rice policy. The main objective of this policy was to reduce rice imports by developing rice cultivation on large irrigation schemes in the Delta. In 1975, after strong lobbying by individuals from the Valley, President Senghor decreed that the development of the PIVs be supported by the SAED (Carvalho 1983; Seck 1991). The area covered by PIVs grew rapidly, reaching a total of 18,180 ha in 1993 (Table 1). This development was possible due to the financial support provided by donors and the farmers' urge to find a solution to the cereal deficit in their traditional production system.

A PIV generally covers about 20 ha and is divided into plots of the same size for each family.<sup>7</sup> Plot sizes vary, from 0.1 to 0.4 ha, depending on the number of farmers and the number of PIVs in a village. Water is pumped from the river by a single pumpset.<sup>8</sup> For 20 ha, a pumping capacity of 80 l/s is customary, with an average 8 hours of daily pumping. Water distribution and system maintenance of the PIVs have always been carried out by farmers. The main principle underlying water distribution is that each farmer can take as much water as he wants when it is his turn to irrigate (Meijers and Mollinga 1991). PIVs are managed by plot owners, who, in most cases, live in the same village and are organized into farmer groups. Farmer groups are based on the same organizational model as other village associations and are an integral part of the local political system.

An important reason why the schemes are successful is that their management structure corresponds with the local political system (Diemer 1990). The main reason for their success, however, is that they provide farmers with a secure and relatively large supply of cereals, in contrast to flood-recession agriculture. Moreover, for many families, PIVs form the only means of crop production, due to limited access to the flood-recession grounds. Rice is the main crop grown on the PIVs with paddy yields ranging from 3 to 6 T per hectare. In the survival strategies of the farmer households, rice is grown almost exclusively for subsistence, because it is cheaper to grow rice than to buy it in the market.

Between 1975 and 1987—the golden age of PIVs (Niasse 1991)—PIVs underwent rapid development with strong state and donor support. Their success was the result of several factors: (1) a severe and prolonged drought; (2) technology adapted to the local production system; (3) input subsidies; (4) price support; and (5) the SAED providing a wide range of services (input delivery, marketing of rice, pump maintenance and credit facilities). The last two factors resulted

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7 Plots of the same size are a result of the genesis of the PIVs. Because they were initially designed to save people from famine, it was agreed by the farmers and the development agencies involved in the early stages of the development of the PIVs that anyone who wanted a plot should be allocated one. This agreement became established practice and thus the severely skewed access to traditional agricultural lands is not repeated in the PIVs.

8 The pumpset consists of a centrifugal pump in combination with a two- or three-cylinder diesel engine. This combination rests on a raft that floats on the river.



in a net loss for the state of CFA Franc 120 per kilogram of rice<sup>9</sup> produced domestically in 1986, on both large schemes and PIVs (Horowitz and Salem-Murdoch 1990). However, it would appear that the golden age of the PIVs is drawing to a close as a result of state disengagement, through price liberalization since 1984 and the withdrawal of the SAED since 1987.

## **Disengagement Policy for Irrigated Agriculture and Its Antecedents**

The basic policy framework for state disengagement from irrigated agriculture was drawn up in the Senegalese government's "Nouvelle Politique Agricole" (NPA), published in 1984. The line of thinking behind the NPA was that previous agricultural policies had failed to provide sufficient production incentives to farmers and instead wasted scarce resources on unproductive administration. Objectives of the NPA were to sharply reduce state expenditure in the field of agriculture, and to increase agricultural production and incomes of farmers. This was to be achieved by transferring parastatal functions (such as marketing, credit and input supply) to farmers groups and the private sector, changing the price policy ("getting the prices right") and abolishing trade restrictions on agricultural products (EIU 1988). In the NPA, the SAED was targeted as the focal point of the disengagement policy for the Senegal Valley. It stipulated that the SAED would terminate its activities over a period of five years, starting in 1984. It was the government's belief that conditions for irrigated agriculture would greatly improve as a result of state disengagement (Woodhouse and Ndiaye 1991).

State disengagement from irrigated agriculture followed in the wake of structural adjustment programs enacted in Senegal since 1980. The Senegalese economy was thrown into a severe crisis in 1979 due to the second oil crisis and the collapse of the world peanut market (peanuts are Senegal's main export product). In that year, the Senegalese authorities turned to the International Monetary Fund (IMF) and World Bank for assistance in redressing the main imbalances in the economy (high level of recurrent expenditure, trade deficit and growing foreign debt) and Senegal received its first structural adjustment loan (Youm 1991). In 1984, the Senegalese government lost support from the IMF because of its reluctance to continue implementing austerity measures. The resulting crisis and the pressure exerted by donors were the catalysts which convinced the government that fundamental structural reform could no longer be delayed, and a new long-term adjustment program was presented by the end of 1984. This program maintained the commitment of the previous structural adjustment program to the reduction of government subsidies and tighter monetary policy, but it went further in envisioning a substantial reduction of state intervention in agriculture (outlined in the NPA) and a liberalization of Senegal's trade policies (EIU 1988).

The decision to restructure the SAED was based not only on the general disengagement policy but also on internal factors. The SAED faced a structural deficit in the beginning of the 1980s due to mismanagement, unpaid debts, the large size of the organization and unprofitable activities. By 1984, accumulated debts of farmers to the SAED had risen to CFA Franc 255 million (Woodhouse and Ndiaye 1991). An evaluation by the French Ministry of Development showed that the added value of the rice sector over 1980-81 was CFA Franc 1.9 billion, whilst the contribution of the state to this sector, excluding investments, technical assistance and amortization, was CFA Franc 1.6 billion during the same period. This situation induced the donor agencies that financed the SAED to suspend aid in 1983, only to be resumed if the SAED was

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<sup>9</sup> Of this CFA Franc 120, CFA Franc 62.50 consisted of price support and 57.50 consisted of state support for the SAED. The level of input subsidies is unknown to us, and thus not included in the figure of CFA Franc 120/kg.

reformed (Lavigne Delville 1991). Thus, the state had little choice but to restructure the SAED as part of its structural adjustment program.

The withdrawal policy of the SAED was formulated in its third "lettre de mission," published in 1987. In this document, its mission was radically redefined. From being in charge of the development and management of the rice sector in the Valley, it was to become an organization responsible for delivering extension services to farmers groups and coordinating and supervising the further development of the Valley. To achieve this, the SAED was to withdraw from a wide range of activities by 1990—construction of irrigation schemes, soil preparation, maintenance (construction material, lorries and pumps), input supply (fertilizers, pesticides, seeds, fuel and spare parts), transport and agricultural credit. All of these activities were to be taken over by private enterprises and farmers groups (SAED 1987). In a subsequent phase, from 1991 to 1994, the SAED was to privatize the operation and maintenance of the large irrigation schemes in the Delta and the transformation and marketing of paddy as well (SAED 1991).

## **Implementation of the Disengagement Policy by the SAED**

Although, officially, the withdrawal of the SAED was to start in 1984, it was not until 1987 that it really got under way. The SAED was reluctant to fire its employees and unwilling to give up control over development of irrigation in the Valley. Nonetheless, pressure placed on the SAED by donors and national politicians ensured the continued implementation of the disengagement policy (Lavigne Delville 1991). Restructuring of the SAED resulted in the retrenchment of almost three fourths of its employees (from 1,200 in 1987 to 350 in 1993). These employees did not receive any benefits, because the SAED was not able to establish a clear retrenchment policy.

### ***Input Supply***

Between 1986 and 1990, the SAED withdrew from the provision of inputs. It stopped delivering fuel in 1986, fertilizers and pesticides in 1987, and spare parts for the pumpsets in 1990 (Lavigne Delville 1991). Previously, these inputs had always been delivered to the farmers on a credit basis, with the SAED delivering the inputs at the start of the agricultural season and the farmers repaying their debts free of interest, in paddy or cash, following the harvest. Thus, the farmers needed little cash at the start of an agricultural season.

### ***Credit***

The provision of credit, as outlined above, was transferred from the SAED to the "Caisse Nationale de Crédit Agricole du Sénégal" (CNCAS), a commercial agricultural credit bank created in 1984. Provision of credit by the CNCAS commenced in 1987. One year later, the CNCAS opened branches in Podor and Matam and loaned CFA Franc 126 million to farmers in the Middle Valley. To obtain credit, farmers have to be organized in a "Groupement d'Intérêt Economique" (GIE).<sup>10</sup> The CNCAS offers two types of credit, seasonal credit and investment credit, at 15 percent interest. Its terms are that the borrower must deposit 15 percent of the value of the loan and that the GIE is collectively responsible for repayment, in cash. Application for a loan must be accompanied by a

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10 In 1984, the government enacted a law (No. 84-37) which stipulated that those wanting to participate in the economy had to group themselves in GIEs. The objective of this law was to create registered economic actors, thereby rendering the economy more transparent. A GIE must consist of, minimally, two members and no initial capital is needed to form one (République du Sénégal 1984).

technical dossier, approved by the SAED, stating the purpose of the loan. The SAED supposedly only approves credit requests by GIEs that have repaid their debts to the SAED or explicitly promised to do so (Lavigne Delville 1991; Le Gal and Dia 1991).

### ***Extension Services***

Another step in the withdrawal of the SAED was the restructuring of its extension services. The number of extension officers was reduced to one per 500 hectare of irrigated area. These workers received training to enable them to provide advice to farmer groups in the post-disengagement era, particularly concerning the preparation of credit requests for the CNCAS (Lavigne Delville 1991)

### ***Turnover of Pump Maintenance***

In 1990, the SAED withdrew from pump maintenance and all SAED mechanics were retrenched. Until then, it had carried out the maintenance of the pumpsets for free, while the spare parts had been paid for by the farmers. As a result of this change, the farmers now bear the full costs of the pumpset and are responsible for their maintenance.

### ***Rice Marketing***

The SAED is still attempting to disengage from the transformation and marketing of paddy. In 1987, it officially stopped transporting paddy to its rice mills, although it continued to do so for remoter areas of the Valley until 1993. Since 1992, the SAED has been trying to privatize its three rice mills in the Delta. The private sector, however, is not interested in buying them, largely because the mills are old and the subsidies paid by the "Caisse de Péréquation et de Stabilisation des Prix" (CPSP) will be eliminated in 1995. The CPSP is responsible for cereal imports and it sets the prices for buying and selling on the national market. The SAED sells processed rice to the CPSP for CFA Franc 170 per kilogram and the CPSP, in turn, resells it to wholesalers for CFA Franc 122 per kilogram (Havard 1992). The CPSP is able to subsidize the SAED in this manner because it earns money by importing rice. In 1990, it imported 400,000 T of rice from the world market at CFA Franc 94 per kilogram, which was resold to wholesalers at CFA Franc 122 per kilogram. Thus, the CPSP made a profit of CFA Franc 10.5 billion (NEI 1991).

## **Effects of Disengagement in the Doué Region and Farmers' Responses**

The Doué Region is situated in the Department of Podor, and consists of the Pété and Médina zones (Figure 1). Irrigation development in the region started in 1977 with the construction of 38 PIVs by the SAED. Between 1985 and 1990, the Ile à Morphil Project, a Dutch-funded project based on the Ile à Morphil, constructed PIVs in the Doué Region (Bastiaansen 1986). At present there are 1,070 ha of PIVs in the Doué Region which are fully privatized and not assisted by projects that could act as a buffer against the effects of disengagement.<sup>11</sup>

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11 In the field of irrigation studies, the term "turnover" is used to indicate the process by which irrigation schemes are privatized. Three levels of turnover can be distinguished, namely, (1) the turnover of operation and maintenance responsibilities, (2) the turnover of authority and control over the irrigation system and (3) the turnover of ownership and assets (Kloezen and Slabbers 1992). When all three of these stages have been completed, one may speak of privatized irrigation schemes.

### *Supply of Inputs*

The withdrawal of the SAED from the supply of inputs has had mixed effects. It has not seriously affected the availability of diesel as there are three gas stations in the area. At the start of the cropping season, the treasurer of the farmers group collects money from each member ( CFA Franc 3,000) for the purchase of diesel. The acquisition of fertilizers, pesticides and seeds, however, has become problematic. There are two input stores in the area but, according to farmers, these stores are badly stocked. Besides that, the farmers indicated that transportation from the stores to PIVs is a problem.

### *Financing and Credit*

Disengagement has had important financial consequences for farmers. First, the cost of growing rice, in constant 1980 prices, increased by 78 percent between 1980 and 1993 (Table 2). This is a result of liberalization policies pursued by the Senegalese government. In nominal prices, costs rose by a factor of three, from CFA Franc 29,700 per hectare in 1980 to CFA Franc 92,900 per hectare in 1993, while farmers' incomes increased at a slower pace during this period. The fixed price of paddy rose from CFA Franc 51.5 per kilogram in 1980 to CFA Franc 85 per kilogram in 1985, and has remained at this level since. With a hypothetical yield of 4.5 T per hectare, variable costs constituted 24 percent of annual returns in 1993 (in nominal prices). If the amortization of the pumpset is taken into account (CFA Franc 60,000 per hectare per year for one growing season), costs are 40 percent of returns. Note that these calculations are for optimal production and that the costs of household labor and scheme amortization have not been taken into account.

Actual production costs in the Doué Region in 1992, calculated on the basis of balance sheets of 33 PIVs, amounted to approximately CFA Franc 58,000 per hectare. Although this is a sharp increase in comparison with previous years, it is lower than the amount needed for optimal production of rice. The reason for this difference is that farmers use fewer inputs than that required for optimal production. Average yields are in the order of 3 T per hectare, which correlates with the lower level of inputs used. Actual variable production costs thus formed 23 percent of returns.

A second financial consequence is that the cash component of the production system has risen strongly. This is a result of the privatization of credit. As indicated above, the farmers can no longer avail of credit in kind from the SAED. Combined with the rise in input prices, this has led to a situation in which farmers must possess a large amount of cash at the start of a growing season.

Farmers have responded to these changes by using their own capital to finance crop production. Approximately 20 percent of production costs are financed with money sent home by migrants, while the remainder is financed through a variety of means, such as the sale of livestock, the sale of paddy, pensions and temporary labor. None of the farmer groups have ever utilized seasonal credit from the CNCAS for several reasons. First, most groups still have large debts with the SAED. Second, the distance to the office of the bank in Podor (70-100 km) and the troublesome procedure for requesting loans were constraints.

Farmers may need equipment credit when pump engines have to be replaced, because none of the farmers groups are saving money to buy new pump engines.<sup>12</sup> However, this will prove to be problematic because the CNCAS only provide loans to GIEs that took out loans before 1991 and have proven to be creditworthy. Hence, most GIEs in the Middle Valley have become ineligible for receiving credit because they did not take out loans before this year.

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<sup>12</sup> Before disengagement, farmer groups were supposed to save money for the replacement of the pumps. This they did to a limited extent but, since disengagement, this is no longer the case in the Doué Region.

The CNCAS enacted the policy outlined above in response to its experiences in the Delta. Repayment of loans in the Delta decreased from 97 percent in 1988/89 to 10 percent in 1991/92 (Table 3). This was caused by "farmer" malpractice" in the use of the loans.<sup>13</sup> First, until 1991, the strategy of "farmers" in the Delta was to form new GIEs in order to secure credit from the CNCAS, which they used to repay earlier loans received from this institution (Le Gal 1992). Second, farmers misused seasonal credit for the construction of private irrigation schemes. The area covered by these schemes increased from 5,853 ha in 1988 to 25,900 ha in 1993 (SAED 1993). The larger part of the bad debts of the CNCAS, amounting to CFA Franc 4 billion, was used for this purpose. Because these schemes are of dubious technical quality (no drainage system, no compacting) and yield mediocre results, very few GIES have been able to repay their debts (Le Gal 1992).

### ***Maintenance of Pumpssets***

A main consequence of withdrawal of the SAED is a deterioration in the maintenance services for the pump engines. Farmers indicated that, at present, it is very difficult to enlist a mechanic to maintain their pumpssets. There is only one private mechanic for 55 PIVs in the Doué Region. This mechanic charges CFA Franc 15,000 for maintenance and CFA Franc 100,000 for a major overhaul plus the expenses for spare parts. The fact that all SAED mechanics who were fired have moved to the cities to find employment has created a monopoly position for the remaining mechanic. This monopoly position, in combination with the lack of knowledge of the farmers to check on the mechanic's work, leads to serious problems in getting the pump engines repaired. In one (extreme) case the mechanic told a farmer group to buy spare parts worth a total of CFA Franc 300,000. The pumpset broke down again within a few weeks after the installation of these parts. The mechanic told the farmers to order exactly the same spare parts again. However, after he had installed them, the pumpset still did not function and the harvest was lost.

To obtain spare parts for a pump engine, farmers have to go to Saint-Louis (350 km) or even to Dakar (650 km). This is costly and time consuming and leads to delays in getting the pump engine repaired. Also, spare parts are much more expensive than before disengagement and the cost must be paid directly to the supplier, in contrast to the situation before disengagement when SAED supplied spare parts on a credit basis. According to many farmers, increased needs for cash lead to organizational problems within farmers groups and long delays in getting the pump engine repaired.

All farmer groups interviewed stated that their pump engines are breaking down more often (at least once per season). None of them are actually saving money to buy a new pump engine, because they hope that donors or the SAED would give them one, as was customary before disengagement. This no longer happens and farmers will have to find other means of obtaining a pump engine. According to the extension worker of the SAED for the Pété Zone, the virtual nonexistence of maintenance services and the lack of savings will lead to the abandonment of the majority of PIVs in the Doué Region by the end of 1996. However, it is likely that farmers will try to employ strategies to prevent this from happening.

### ***Marketing and Transport***

Withdrawal of the SAED from the marketing and transport of rice did not cause problems in the region. Transport is readily available, due to the proximity of villages to the highway. Few farmers market their paddy. Milling is mainly done manually within the household. Moreover, local traders

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13 Most of the GIEs in the Delta were formed by former employees of the SAED and businessmen.

and markets are present where farmers can sell small amounts of paddy to satisfy their cash needs. The price of paddy on the local market is lower than the official price (CFA Franc 85) and lies between CFA Franc 60 and 70 per kilogram (Havard 1992). Nonetheless, farmers sell paddy on the local market because they receive cash immediately. If they sell their paddy to the SAED, they have to pay transportation costs and wait several months before they are paid.

Two farmer groups have their own rice mills and several private enterprises operate another one. The introduction of rice mills in the region is making possible the local marketing of white rice. Selling white rice is financially attractive to farmers because the price for a kilo of white rice can be as high as CFA Franc 150 (the official consumer price is between CFA Franc 130 and 139 per kilogram) on local markets. Thus, returns are higher compared to returns to selling paddy. It can be concluded that the marketing of rice is shifting from SAED to the local market, and is creating alternatives for farmers to finance irrigation.

### ***Cropping Intensities and Strategies***

Although quantitative data of cropping intensity for the Doué Region before 1992 were unavailable to us, cropping intensities have decreased. In 1992, the cropping intensity in the Doué Region was 90 percent. Farmers indicated that, before disengagement, they generally grew two crops a year. Very few groups continue to grow a dry season crop, for several reasons. First, because of the deterioration of maintenance facilities for pump engines after disengagement, farmers find the risk of losing their crop due to pump failure too high. Pump failures are more frequent in the dry season because pumping hours are longer than in the wet season due to the lower level of the river and the higher rate of evapotranspiration. Second, higher production costs are felt more acutely in the dry season as a result of higher pumping costs.

These aspects are also causing organizational problems within farmer groups. Before the start of a cropping season, there are lengthy discussions between members of a group to determine if they will grow a crop or not. This was also the case before disengagement, but farmers indicated that the growing reluctance of members to shoulder higher production costs has led to an increase in the number of conflicts.

Another factor that has influenced the decline in cropping intensities is the increase in irrigable area, from 620 ha in 1985 to 1,070 ha in 1991. This has made it possible for farmers to sustain their crop production largely by growing crops only in the wet season.

### ***Scheme Maintenance***

Maintenance of PIVs has not worsened as a result of disengagement. During field trips, it became apparent that farmers maintain their schemes satisfactorily.

### ***Extension Services and Peasant Organizations***

At present, the SAED is represented by two extension workers in the region. Officially they are supposed to train the farmers in the utilization of a revolving fund and conduct literacy courses. In practice, extension workers are mainly occupied with helping farmers to solve their problems, a role similar to that of middlemen. This includes establishing links with traders and NGOs, settling conflicts within farmer groups through negotiation and serving as a source of information. An initiative of extension workers was to stimulate farmer groups to form a federation. This was still in a formative phase at the time of the field research, and little enthusiasm was being shown by farmers.

### ***Conclusions from the Doué Case***

Farmers of the Doué Region have had mixed responses to state disengagement. The first and foremost response by the majority of farmers was to wait and hope that a new project would arrive to assist them. This response is a continuation of the strategy followed by farmers before disengagement, i.e., depicting themselves as people in need of assistance. They reason that because the state encouraged them to grow rice, it is therefore the task of the state to continue to supply them with credit, new pump engines, pump maintenance and inputs. This stance is paradoxical, because the majority of their produce is not marketed but is used for home consumption. It is also doubtful whether this strategy will work in the post-disengagement era.

Another response was to accept the loss of state support and to actively engage in tackling the present problems. This was the response mainly of younger members of farmer groups. However, due to the hierarchical nature of the Haalpulaar society, they have little influence on decisions made in the farmers group.

A third response was the abandonment of some PIVs, although until now this is not widespread. For a majority of families, this is not a real option because they depend on irrigation for their cereal production. Hence, they have little choice but to cope with the increased costs of irrigation.

Although most of the schemes are still functioning in the Doué Region, their future is uncertain. Deterioration of pump engines and the lack of good mechanics pose a threat to the continuity of PIVs. Absence of credit facilities in the region could result in major problems when pump engines need to be replaced. However, it is conceivable that farmers will use the money that they now donate to the construction of social infrastructure (such as mosques, post offices, schools and pharmacies) to buy new pump engines. Also, the local marketing of rice, which is becoming a new source of income for the farmers, may well enhance the financial viability of PIVs and help counter problems outlined above.

The strategy for the implementation of withdrawal of SAED was flawed, because it was abrupt and farmers in the Doué Region were not prepared and trained for the new situation. This points to the need for informed and coherent disengagement strategies to enable farmer groups to perform functions not previously performed by them. In the following section, an example of a project that implemented such a program is presented.

### **Creating Viable, Locally Managed Irrigation: Efforts Undertaken by the Ile à Morphil Project**

PIVs have been constructed under the Project, since 1977, on the Ile à Morphil, an island in the Senegal River and its branch, the Doué (Figure 1). Implementation of state disengagement in 1988 resulted in a thorough reformulation of the objectives of the Ile à Morphil Project at the start of its fourth phase. Until then the Project focused on construction of PIVs in three zones of the island (Thioubalet, Demeth and CasCas). Although construction of new schemes continued in these zones, the main objective of the Project became the creation of viable and locally managed village irrigation schemes. To attain this objective, a project policy emphasizing institution building was formulated for the years 1989–94. Accent was placed on the creation and training of farmers organizations to assume the tasks no longer performed by SAED (SAED/DGIS 1988b). Activities undertaken by the Project to render PIVs viable after state disengagement are described below.

## ***Supply of Inputs***

To cushion the effects of the abrupt stop to input supply by SAED in 1987, the Ile à Morphil Project continued to supply inputs until the end of 1991. Since 1986, the Project has threatened to stop supplying inputs, thereby trying to induce farmers to buy the inputs themselves. However, each year, farmers refused to do so and successfully demanded that the Project continue to supply inputs. The Project gave in, because of its vested interest in ensuring high production levels of the PIVs. To overcome these problems, in 1990, the Project started to organize farmers groups into unions (one per zone). The task of these unions was to collect input orders from farmer groups and to place one combined order with private enterprises. This was expected to reduce transportation problems and costs due to economies of scale. Besides this, the Project proposed the creation of central input stores at zone level, to be managed by unions, to improve the availability of inputs on the island (SAED/DGIS 1991c).

Unions were created in 1991 with every farmer group having to pay a membership fee of CFA Franc 1,000 per month. Each union received CFA Franc 1,500,000 from the Project as starting capital and management staff of unions received training in finance and management. By the end of 1991, the Project actually stopped supplying inputs. In 1992, unions started ordering inputs for their member groups and, in 1993, central stores were opened. The fact that unions were established and started functioning is an accomplishment considering the ritual tug-of-war between the Project and farmer groups concerning supply of inputs and the fact that, traditionally, cooperation between villages is exceptional.

Assistance from the Project notwithstanding, their overall performance to date is still somewhat poor, because farmer groups hesitate to place a large order for inputs at the start of the agricultural season and they do not pay the unions in advance. Also, farmers often wait to see if the floods are favorable for cultivation and decide whether to grow a crop during the wet season at the last moment. Consequently, transportation has to take place at a time when the rain has already started and dirt roads on the island have become practically impassable. As a result, the unions order only a small amount of inputs, financed from their own working capital. Anticipated advantages of combined large orders for inputs have thus far not yet fully materialized. However, the experience of the union of Thioubalel is promising. For the 1993 wet season, it placed a large order for inputs thereby making a handsome profit for itself and its members. This was partly made possible by the commitment and organizational skills of the president of this union (Musch 1994).

## ***Financing and Credit***

The first response of the Project to the withdrawal of the SAED was the introduction of revolving funds, starting in 1987. The Project's course of action was based on the reasoning that the CNCAS was not a viable credit option for farmer groups because repayment of debts was based on the marketing of rice. Since the level of marketing on the island was low, the Project opted for revolving funds as the solution for the credit needs of farmers to cover their production costs (de Klerk 1987). Funds are to be used by farmer groups to buy inputs at the beginning of the agricultural season. Its members are expected to repay their share of the revolving fund after the harvest or, at the latest, before the start of the next season. Introduction of revolving funds was accompanied by training programs and literacy courses to render farmer groups capable of handling their own financial affairs and bookkeeping. The outcome of this program to date is mixed and problems with repayment of funds have led to the bankruptcy of several farmer groups. In other cases, funds have been used to pay for repairs of pumpsets (Musch 1994).

Another effect of disengagement, which was foreseen by the Project, was the unavailability of credit for replacement of pump engines. The Project tried to overcome this problem by inducing the farmers groups to amortize their pump engines. To this end, a training program was developed



providing them with the means (a bank account was opened for each farmers group) and knowledge to carry out an amortization program. The Project recommended a cycle of savings of CFA Franc 36,000 per hectare per year (for one cropping season a year) for the amortization of the pump engine (Scheer and Meerburg 1991). In practice, however, farmer groups were saving an average of CFA Franc 10,500 per hectare in 1992 (ibid.). At present, the major constraint to the pump amortization program is the belief of farmers that there will always be a donor or organization that will supply them with a new pumpset for free. Due to disengagement, this is highly unlikely and it will prove to be difficult for farmers to raise the money needed to buy a new pumpset. It is possible, however, that the money currently used for the construction of social infrastructure such as mosques and schools will be reallocated by the farmers to buy new pumps.

The Project introduced the cultivation of tomatoes and onions as cash crops to end the dependency of PIVs on money sent by emigrants and funds provided by the Project. Income generation is important as there is a lack of cash within the production system in the island. Rice production generates little of the cash needed to repay credit from the revolving fund and to cover fixed costs. Although production costs of tomatoes and onions are considerably higher than those of rice, net returns are also higher.<sup>14</sup> Thus, a successful introduction of these crops could resolve the problems surrounding the financial viability of PIVs. The area under cash crops has increased since 1990 (Table 4). The main impediment to this program is the lack of adequate transportation facilities to bring products to markets in the Delta (see below).

### ***Maintenance of Pumpsets***

To counter problems that were foreseen as a consequence of the firing of SAED mechanics in 1991, a private enterprise was set up on the island. This enterprise, the GIE Yeeritaare, was established by two mechanics formerly employed by the SAED. Its creation was heavily sponsored by the Project (building, equipment, cars, working capital). In its first two years of operation, the GIE faced financial and organizational problems. These were partly resolved by splitting the GIE into two separate entities in 1993. Nonetheless, it remains uncertain whether this solution will prove to be viable and if the continued maintenance of pumpsets is guaranteed.

Most farmer groups have a one-year contract with the GIE at CFA Franc 8,000 a month. The contract covers regular visits and small repairs while additional costs for spare parts and overhauls have to be paid separately. However, the majority of farmer groups only paid their monthly dues during the four months of the cropping season and, consequently, the GIE could not recover its costs and had to be subsidized by the Project. Farmers, moreover, were not very content with the functioning of the GIE because poor communications frequently led to lengthy delays in the repair of pumpsets. This increased the tendency of farmers not to pay their dues and, in turn, gave rise to even longer delays.

### ***Marketing and Transport***

Marketing of rice on the island is different to that in the Doué Region. Until 1993, the SAED continued to buy rice from farmers and transport it to rice mills in the Delta. At present, the marketing of rice, onions and tomatoes is the responsibility of farmers. The Project did not implement a program to guide the privatization of these activities. As outlined in the section on the Doué Region, local milling of paddy has become economically viable. The Project, however,

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<sup>14</sup> The production costs of tomatoes, onions and rice are CFA Franc 310,000, 262,000 and 80,200 per hectare, respectively. The net returns, excluding pump amortization, are CFA Franc 679,000, 1,692,000 and 382,000 per hectare, respectively (Scheer and Meerburg, 1991).

was unable to stimulate this development through the introduction of rice mills in the villages due to project financial reasons (no loans from the CNCAS, and no project budget for such activities).

In order to meet transportation requirements, the Project intended to assist unions in acquiring a truck. This was deemed necessary because transportation companies rarely come to the island due to the difficulties involved in crossing the river in the ferry (the maximum weight it can carry is 10 T) and the bad condition of roads on the island (SAED/DGIS 1991c). However, in 1991, a project evaluation mission concluded that the organizational capacity of unions was still too weak to manage a truck (NEI 1991). The Project then decided that unions could avail of a truck only if the central stores for input supply are managed properly.

To date, unions have not been able to fulfill this condition. Good transport facilities are critical, especially for tomatoes. In 1992, the tomato harvest of a farmers group was partly lost because a private transporter did not show up. It can be concluded that the transportation of the produce is a problem and it severely hampers the introduction of cash crops.

### *Cropping Intensities and Strategies*

The construction of new maize PIVs by the Project has partly mitigated the negative effects of state disengagement on farmer production. As a result of the substantial increase in input prices since 1984, rice production has become much more expensive for farmers. Consequently, as in the Doué Region, farmers largely refrained from rice cultivation in the dry season. The sharp price increase of 110 percent for fertilizers in 1984 alone correlates with the sharp drop in the cropped area from 863 ha in 1984 to 606 ha in 1985 (Table 4). Since then, the area cropped with rice has remained fairly constant (on average, 584 ha, excluding 1989), although it has been declining since 1990. The steady increase of irrigable area on the island from 355 ha in 1980 to 1,423 ha in 1993, however, has opened up possibilities for farmers to adopt cropping strategies in line with the new price levels.

Farmers have opted to increase the area cropped with maize and sorghum, mainly on the new maize PIVs and to some extent on rice PIVs. These crops are cultivated extensively (no inputs) by most farmers, partly due to cash problems. They are used for home consumption and fodder. Also, it would appear that farmers are starting to substitute sorghum for rice because of the higher risks of rice cultivation due to ageing pump engines and higher production costs. In recent years, farmers have also started growing onions and tomatoes, on a limited scale, for both home consumption and to increase their cash income (Table 4).

On the whole, the average cropping intensity since 1990 (93%) is higher than that between 1985 and 1988 (86%). At the same time, between 1985 and 1993, the irrigable area nearly doubled, implying that the total cropped area has highly increased. This implies that farmers' concern over the higher production costs are not actually refraining them from practicing irrigated agriculture. The steady rise in cropped area, despite the setbacks in 1985 (sudden increase in input prices) and 1989 (armed conflict with Mauritania), indicates that farmers are managing to counteract the effects of disengagement.

### *Scheme Maintenance*

Farmer groups have always taken care of regular scheme maintenance satisfactorily. However, the higher cost of irrigation water induced the Project to develop an extension program concerning scheme maintenance, aimed at increasing irrigation efficiency. This program improved farmers' insight into the consequences of bad canal maintenance and plot leveling for irrigation efficiency. Problems still exist, however, for incidental large-scale maintenance. Until 1992, this was performed by the Project, but at present the farmers have to organize it themselves. This is difficult

because of the lack of privately owned earth-moving machinery in the vicinity of the scheme. Apart from that, it is also unclear if farmers are able and willing to pay for large-scale maintenance.

### ***Extension Services and Farmers Organizations***

The contribution of the SAED to the extension services on the Ile à Morphil consists of one qualified extension worker per zone. However, to execute its multiple extension programs, the Project established a literacy section and hired extra extension workers. The literacy section conducts literacy courses to farmers groups as well as gives training in book keeping and management. Also, one extension worker trains pump operators to perform daily pump maintenance and carry out small repairs. Another extension worker is occupied with the scheme maintenance training program.

The bulk of the Project's privatization program consisted of institution building by means of extension programs and financial and organizational support. With the help of the Project, all farmer groups in the three zones have become GIEs and have regrouped themselves into three unions. In the Project's view, these unions are to become crucial actors in ensuring the viability of irrigation on the island. Recently, farmers and project staff created a farmer federation whose members are the unions. This organization has been established to reinforce the negotiating power of farmers vis-a-vis the state and other organizations and to obtain tax exemptions. At present, it is too early to assess the role this federation will play. The fact that traditionally little cohesion exists between villages is a major obstacle that needs to be overcome if the federation is to be a success.

### ***Conclusions from the Ile à Morphil Case***

As in the Doué Region, the main consequence of disengagement on the Ile à Morphil is that most tasks and costs of irrigated agriculture have been placed on the shoulders of farmers. The impact of disengagement was less abrupt though, because the Project played a buffering role by executing most of the functions formerly fulfilled by SAED and by gradually handing them over to farmers. During this process, institution building played an important role in preparing farmers for tasks they were to take up. Specifically, the Project actively engaged in introducing revolving funds and privatizing pump maintenance and input supply. We believe that the approach chosen by the Project is superior to the overall disengagement program. It implemented measures that need to be taken if state disengagement is to provide incentives to farmers for financing recurrent irrigation costs themselves.

Several factors impeded the Project in attaining its objective of creating viable locally managed PIVs. In its attempt at institution building, the Project had to overcome the attitude of farmers that the Project should continue to support them and their reluctance to believe that the Project would no longer do so. In this light, the organizational strength of unions and the federation is an accomplishment and points to an increased awareness among farmers that they have to take their future into their own hands. Also, cash problems of farmers due to disengagement increased due to difficulties surrounding revolving funds and problems unions have with ordering inputs. These problems are not only financial but also organizational in nature. Other concerns are the maintenance and amortization of pump engines, problems surrounding credit, transportation problems and the rise in production costs.

## Concluding Remarks

The specific character of the Senegal case of state disengagement from irrigated agriculture is twofold: on the one hand we see the existence of simultaneous processes of market liberalization and parastatal privatization; on the other, these processes were drastic in nature and were implemented abruptly. Several of the lessons to be learned from this case are as follows:

1. *State disengagement and the concomitant parastatal privatization should be a carefully guided process.* Withdrawal of SAED has endangered the viability of the PIVs. It was abrupt and based on the notion that the invisible hand of the market would automatically lead development in the right direction. Highly imperfect markets for pump maintenance, credit and input supply in the Doué Region indicate that this notion was overly optimistic and that more attention should have been paid to institution building during the withdrawal process. Privatization accompanied by supporting programs, as implemented by the Ile à Morphil Project, and, especially, the attention given to strengthening the management capacity of farmers are prerequisites for creating financially viable, locally managed irrigation schemes.
2. *Liberalization and privatization does not necessarily lead to improved system performance.* Instead of dramatically improving production levels and conditions for irrigated agriculture, which was its stated purpose, disengagement has increased the underutilization of PIVs. Reduction of subsidies on inputs resulted in a 78 percent increase in real production costs over the period 1980-93. Production costs, including amortization of the pump engine, reached 40 percent of returns in 1993. As a result, on the Ile à Morphil, rice production in the dry season was greatly reduced while the overall irrigated rice acreage did not increase throughout the period. This occurred despite the fact that the irrigable area expanded during this period. And, there was no substantial growth in market production, except perhaps for the rather limited production of tomatoes and onions.
3. *Farmers adjust their production processes in the face of the new environment created by the processes of disengagement.* Loss of state support and price subsidies did not make farmers, especially on the Ile à Morphil, reduce their production or abandon PIVs and migrate to the cities. Instead, farmers adjusted their cropping strategies in line with the new environment and actively explored and exploited new opportunities including local milling of paddy, extensive cultivation of new irrigated crops (maize and sorghum), and production of cash crops (tomatoes and onions).
4. *Project interventions in a context of disengagement and a long history of donor involvement are paradoxical.* We have seen that the Ile à Morphil Project faced great difficulties in organizing farmers to take up activities formerly performed by the state. This difficulty arose because farmers internalized the idea that both the state and donors are responsible for and should take care of large parts of their production requirements. Hence, supporting farmers to prepare themselves for a situation of greatly reduced state support is a message difficult to get across and requires well-elaborated intervention strategies.

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Figure 1. The Senegal River Valley.

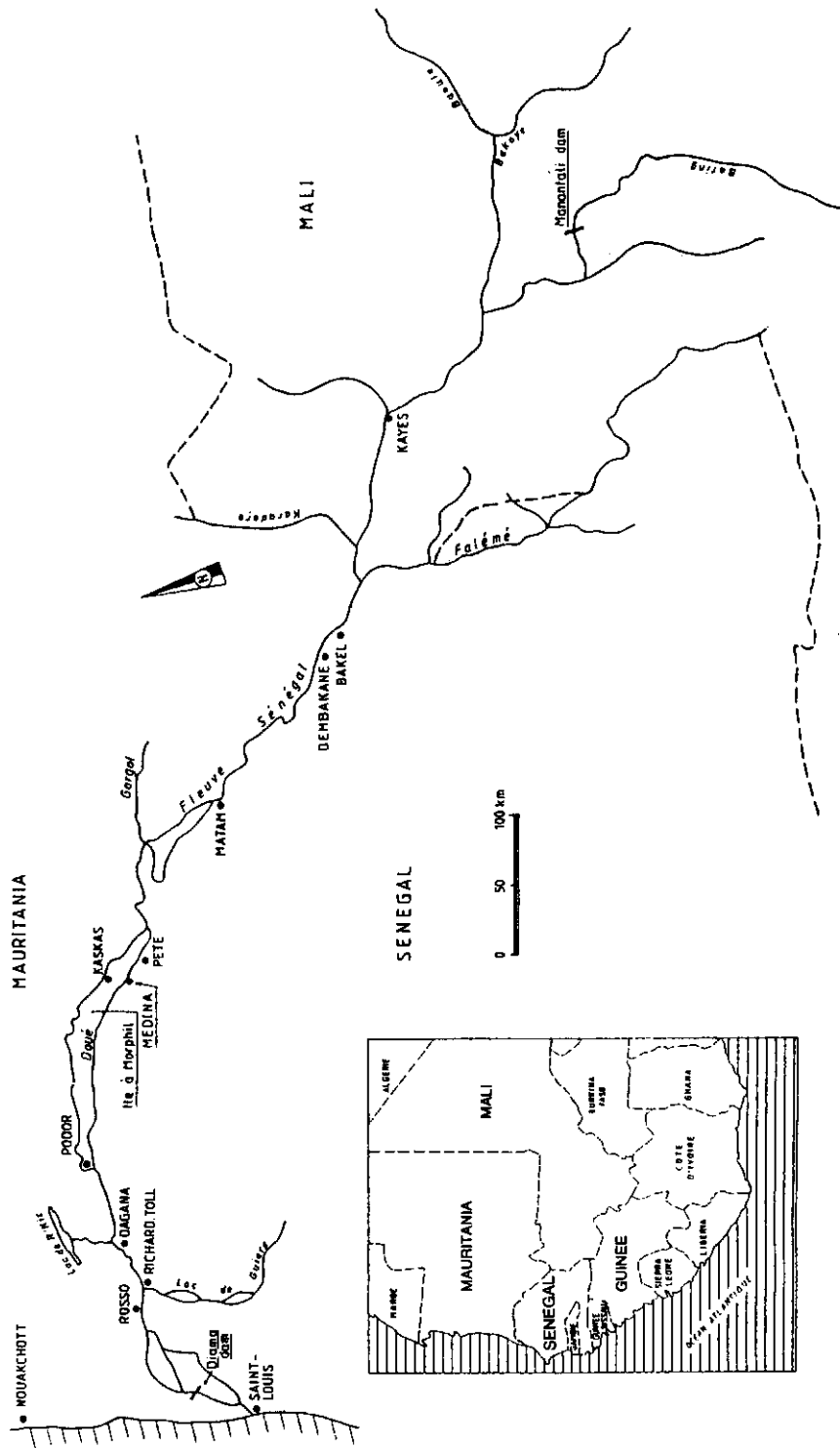




Table 1. Evolution of the irrigable area on the left bank of the Senegal River Valley (ha).

	1976	1980	1984	1988	1990	1992	1993
Large schemes	7,080 <sup>a</sup>	9,525 <sup>a</sup>	12,800 <sup>a</sup>	13,140 <sup>d</sup>	16,260 <sup>b</sup>	16,260 <sup>c</sup>	16,260 <sup>c</sup>
PIVs	1,040 <sup>a</sup>	4,670 <sup>a</sup>	9,085 <sup>a</sup>	16,340 <sup>d</sup>	17,875 <sup>b+d</sup>	18,180 <sup>c</sup>	18,180 <sup>c</sup>
PIPs*	0 <sup>a</sup>	40 <sup>a</sup>	200 <sup>a</sup>	2,240 <sup>d</sup>	15,000 <sup>c</sup>	22,210 <sup>c</sup>	25,900 <sup>c</sup>
Agro-business	3,000 <sup>d</sup>	3,000 <sup>d</sup>	7,660 <sup>d</sup>	7,660 <sup>d</sup>	7,660	7,660	7,660
Total	11,120	17,235	29,745	39,380	56,795	64,310	68,000

\* PIPs (Périmètres Irrigués Privé) are privately owned and managed irrigation schemes that have been constructed without assistance from the state or donors. Most of them are situated in the Delta, although their number in the Middle Valley is increasing.

Sources: <sup>a</sup>OMVS (1988); <sup>b</sup>SAED (1991); <sup>c</sup>SAED (1993); <sup>d</sup>Seck (1991).

Table 2. Variable production costs for rice on PIVs under optimal production conditions (in constant 1980 CFA Franc/ha\*).

Item	Quantity (per ha)	1980	1984	1988	1990	1993
Diesel	150 l <sup>b</sup>	11,450 <sup>b</sup>	12,250 <sup>b</sup>	17,970 <sup>b</sup>	17,850 <sup>a</sup>	21,340 <sup>d</sup>
Urea	150 kg <sup>b</sup>	3,750 <sup>c</sup>	8,850 <sup>c</sup>	6,375 <sup>c</sup>	9,915 <sup>a</sup>	8,540 <sup>d</sup>
NPK (18-46-0)	100 kg <sup>b</sup>	2,500 <sup>c</sup>	9,620 <sup>c</sup>	6,275 <sup>c</sup>	6,230 <sup>a</sup>	5,690 <sup>d</sup>
Seeds	40 kg <sup>b</sup>	2,500 <sup>c</sup>	2,040 <sup>c</sup>	2,690 <sup>c</sup>	3,630 <sup>a</sup>	5,690 <sup>d</sup>
Salary (pump operator)	—	6,000 <sup>b</sup>	3,870 <sup>b</sup>	3,420 <sup>b</sup>	3,400	3,415
Spare parts (pump)	—	3,500 <sup>b</sup>	2,840 <sup>b</sup>	3,080 <sup>b</sup>	4,820 <sup>a</sup>	5,465 <sup>d</sup>
Costs (mechanic)	—	0	0	0	0	2,730
Total	—	29,700	39,470	39,810	45,845	52,870

\* Constant prices calculated on the basis of the price index given by IMF (1994) and EIU (1988).

Sources: <sup>a</sup>Scheer and Meerburg (1991); <sup>b</sup>Bastiaansen (1988); <sup>c</sup>SAED/DGIS (1988a); <sup>d</sup>Klein (personal communication, 1994).

Table 3. Loans taken by the CNCAS and the repayment level (in million CFA Franc).

Year	1987/88	1988/89	1989/90	1990/91	1991/92
Seasonal credit	148	789	2,007	5,801	2,842*
Investment credit	46	293	730	291	n.a.
Total	194	1,082	2,737	6,092	n.a.
Level of repayment	99%	97%	96%	61%	10%

\* This is only for the winter season 91/92 and the CSF for Saint-Louis.

Source: SAED 1992.

Note: n.a. = not available

Table 4. Cropped areas and cropping intensities for PIVs on the Ile à Morphil (zones CasCas, Demeth and Thioubale) from 1980 to 1993 (%).

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	
Rice (ha)	468	462	573	531	614	432	528	568	627	396	633	617	593	522	
Maize (ha)	0	0	85	35	249	174	286	304	201	122	369	479	417	616	
Onions (ha)	0	0	0	0	0	0	0	0	0	0	0	3	23	19	
Tomatoes (ha)	0	0	0	0	0	0	0	0	0	0	0	4	92	53	
Sorghum (ha)	0	0	0	0	0	0	0	0	0	0	0	1	22	116	
Total cropped area (ha)	468	462	658	566	863	606	814	872	828	518	1,002	1,104	1,147	1,426	
Total irrigable area (ha)	355	355	443	468	622	788	886	946	987	935	1,045	1,255	1,300	1,423	
Cropping intensity (%)	132	130	149	121	138	77	92	92	84	55	96	88	88	100	
Average cropping intensity (%)	134										86		93		

Sources: SAED/DGIS (1989, 1990a, 1990b, 1991a, 1991b, 1992a, 1992b, 1993a, 1993b, 1994); NEI (1991); Berg, van den and Ngalane (1994).