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COMPARATIVE COSTS AND INCENTIVES IN SENEGALESE RICE PRODUCTION

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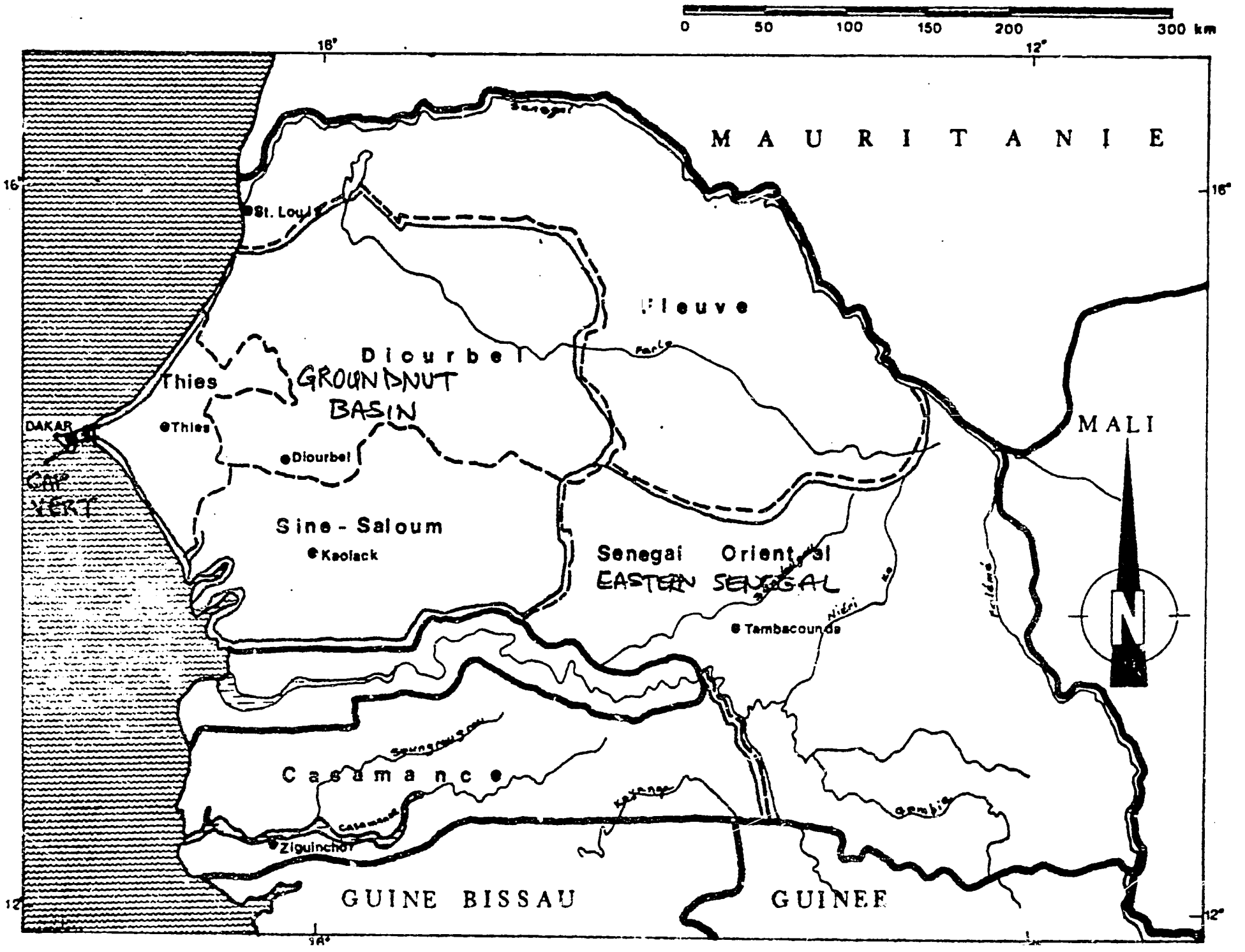
INTRODUCTION

Since Senegal achieved independence in 1960, the government has sought to diversify agricultural production away from peanuts into other export crops and import-substituting cereals. Increased rice production has been one of the principal elements of this strategy. The main objective of greater rice production is long-term self-sufficiency in cereals leading to enhanced national food security. This goal gained in importance following the 1968-73 drought and the high world rice prices in 1974. As part of the policy to develop the country's rice sector, the government, through public land development agencies (LDAs), has invested in water control and protected domestic rice in the face of cheaper imports. In addition, a highly subsidized production package has been made available to a small group of rice farmers.

The government has expanded irrigated and mechanized production in the Senegal River Basin (Fleuve Region in Map 1) where rice cultivation was unknown before 1947. More recently, the government has also devoted increased attention to the principal rice-growing region of the country, the Casamance, where the thrust of policy has been to improve traditional cultivation methods. One of the central policy questions is whether, or to what extent, to invest in capital-intensive, secure, high-yielding, yet costly irrigated polders in the Fleuve as an alternative--or a complement--to improving the already established labor-intensive, less secure, lower-yielding, but also lower-cost cultivation practices in the Casamance.

The purpose of this paper is to estimate the private and social profitabilities of several rice production techniques in different regions of the country in order to assess the impact of potential changes in factor constraints and government policies on the relative efficiency with which

SENEGAL ; MAP 1.



scarce resources are allocated. The resource cost methodology used in the study is particularly well suited to Senegal because of the importance of existing rice imports and of the country's strategy of substituting local production for these imports.

The first section of the paper describes the major rice production techniques found in Senegal. This is followed by a discussion of rice policies. The third part presents estimates of private and social returns, costs, and profitabilities for each technique. The implications of these findings for national objectives and policies are then discussed in a concluding section.

PRODUCTION TECHNIQUES

Senegal is a country of about 200,000 square kilometers situated on the most westerly point of Africa (see Map 1). Its climate is varied, ranging from the arid Sahelian zone in the north to the sub-tropical zone in the south. It is characterized by two distinct seasons--an 8-9 month dry period from about October to June, followed by a 3-4 month rainy season. Annual rainfall varies from about 350 mm in the north to over 1,500 mm in the south and southeast. However, rainfall exhibits large interannual variation. Furthermore, reliability of precipitation decreases from the south to the north and from the coast inland. Three rivers flow through Senegal, though their irregularity restricts full use of their water resources. With the exception of the clay hydromorphic soils found along the river basins, most of Senegal's soils are ferruginous, permeable, and poor in organic matter. Approximately 12-14 percent of the land area is under cultivation, and another 25 percent is potentially cultivable.

Table 1 contains characteristics of the principal rice production techniques in Senegal. Table 2 indicates the quantity and types of inputs

Table 1.--Key Characteristics of Rice Production Techniques

Production technique	Area[a] 1976 (ha)	Paddy yield (mt/ha)	Type of water control	Rice crops per year	Land preparation	Harvest	Improved seeds	Fertilizer	Pesticides
1. Pump irrigated, double-cropping manual technique, Matam village polders.	400	4.75	pump irrigation	1[b]	Manual	sickle	yes	chemical	if required
2. Pump irrigated, double-cropping mechanized technique, Nianga Senegal River Valley.	700	3.80	pump irrigation	1[c]	tractor	sickle[d]	yes	chemical	yes
3. Pump irrigated, single crop, mechanized technique, Boundoum Project, Senegal River delta.	9,000	2.5	pump	1	tractor	sickle[e]	yes	chemical	yes
4. Traditional swamp and mangrove rice, Casamance.	61,700	1.08	partially controlled flooding	1	manual	fingerknife or sickle	no	organic	no
5. Improved swamp rice, manual technique, Casamance.	4,200	2.25	limited bunding	1	manual	sickle	yes	chemical	no
6. Improved swamp rice, manual technique with partial water control, Casamance.	500	3.6	controlled flooding and drainage	1	manual	sickle	yes	chemical	no
7. Improved rainfed technique, "greysoils" with animal traction, Upper Casamance.	13,500	2.07	none	1	animal traction.	sickle	yes	chemical	yes

[a]These areas refer to the type of rice production technique and not solely to the model used in the estimation of cost data.

[b]Double-cropping with maize and vegetables.

Table 1 Footnotes (continued)

[c]Experiments with a dry season rice crop, but mostly double-cropping with maize and canning tomatoes.

[d]Experiments with combine harvesting.

[e]Most combine harvesting abandoned.

Table 2.--Quantities and Costs Per Rice Crop Per Hectare of Major Imputs

Production technique	Farm labor (mandays)	Fertilizer recommended annual dose (kg)			Seeds (kg)	Annualized land development costs (CFA francs)	Extension service cost (CFA francs)
		N	P	K			
1. Pump irrigated, double-cropping manual technique, Matam village polders	270	122	96	0	40	9,000[a]	13,000[a]
2. Pump irrigated, double-cropping mechanized technique Nianga, Senegal River Valley.	135	81.0	92	20	120	49,000[a]	6,000[a]
3. Pump irrigated, single crop, mechanized technique Boundoum Project, Senegal River delta.	92	69	72	0	120	75,500	4,800
4. Traditional swamp and mangrove rice, Casamance.	208				70	1,002	none
5. Improved swamp rice, manual technique, Casamance.	229	61	36	54	40	1,200	5,300
6. Improved swamp rice, manual technique with partial water control, Casamance.	266	87.5	45	67.5	40	14,000	11,000
7. Improved rainfed technique, "greysoils", with animal traction, Upper Casamance.	111	57	27	40.5	80	3,000	5,600

[a]Land development pump and extension costs have been prorated between the two crops according to the respective water requirements.

employed by these techniques and some major cost components of production. The seven systems summarized in these two tables are described in detail in the sections that follow.

About 80,000 ha of the total of 90,000 ha planted to rice in Senegal are located in the Casamance, where traditional techniques occupy three-fourths of the area. Despite the fact that the Casamance is the site of traditional rice production in Senegal, the thrust of governmental efforts has been to develop irrigated polders along the Senegal River. Currently, about 10,000 ha are under irrigated cultivation, including 9,000 in the Delta.

Traditional Swamp and Mangrove Rice, Casamance

Swamp rice is traditionally grown throughout the Casamance and, in general, is the responsibility of women. It is extremely labor intensive, especially in the mangrove swamps concentrated in Lower Casamance. Earthen dikes are built around the rice plots. Soil preparation involves leaching out soil salts over successive rainy seasons and building ridges onto which seedlings are transplanted. Soil fertilization is accomplished either by putting rice straw, weeds, and other vegetable wastes back into the soil during the ridge-building or by applying household wastes. In some areas, cattle are allowed to graze in the rice fields after the harvest. Throughout the Casamance, traditional swamp rice is planted in seedbed nurseries and is transplanted two weeks to a month after the rains have begun. Transplanting reduces the need for weeding, and in saline areas field soils can be leached longer while the seedlings remain in the nurseries. Harvest occurs from late November through January, depending on the rains, planting dates, and cycle duration. It is done with either a small hand knife or a sickle.

Traditional rice employs few intermediate inputs. Farmers use numerous local varieties of *Oryza glaberrima* and a number of varieties of *Oryza sativa*.

During seedbed preparation, five to ten varieties, which are adopted to different soil and growing conditions, are selected and planted (15, p. 6). Varieties that ripen at different times are used to space out the harvest.

When fields are ready for transplanting, a strict order of planting is followed--rainfed fields first, rapidly flooded areas next, and then swamps fed by tributaries. Varietal selection and sequential transplanting reduce risk in an environment of uncertain water availability. Fairly high seeding rates are used in transplanting because of the wastes due to delays and the use of many different varieties (15, pp. 6-8).

Capital inputs into traditional rice production are limited. A few hand tools are used, including a hand hoe (or specialized shovel) for land preparation, a machete for clearing brush and grass, and a small hand knife for harvesting. The only capital investments in this system are minor bunding, construction of perimeteral dikes in saline areas, and tree removal in mangrove swamps. The bunds and dikes require frequent repairs and maintenance.

Labor is a major constraint on production, and in some areas the problem is compounded by heavy outmigration (14). While some of this migration is seasonal and conflicts only with certain tasks in swamp rice cultivation, other--especially among young women--is permanent. In addition, the relatively high profitability of peanuts has led to an increased emphasis on their production, which has diverted some labor from rice. This is less true in the Upper and Middle Casamance, where there is a stricter division of labor with women cultivating rice and men growing upland crops, than in the Lower Casamance, where both men and women grow rice.

Yields from traditional swamp rice are rarely measured and vary considerably with differences in soils, climate, hydrology, and labor inputs. The

total area under this technique is also difficult to determine; approximately 61,700 ha have been estimated to be devoted to traditional swamp and upland rice (see Table 1). Problems of soil and water salinity are common in the lower Casamance mangrove swamps. When rainfall is insufficient to leach soils adequately, fields are abandoned for several years due to excessive salinity.

Improved Swamp, Manual Technique, Casamance

An improved manual swamp technique is being introduced throughout the Casamance, particularly in the middle and upper regions. The improved technique is similar to the traditional techniques, but also includes use of improved seeds, fertilizers, sprayer applied pesticides, and sickle harvesting. Better farm practices, such as timely seeding, weeding, and proper plant spacing, are important aspects of this technique. Sickle harvesting cuts harvesting times in half, and yields are double those of the traditional swamp techniques.

The major constraints are labor and credit. The financial requirements of the new inputs constitute an impediment to rapid adoption by the average farmer, especially since most of the rice farmers are women who do not have access to government credit. New credit arrangements are currently being worked out specifically for women.

Improved Swamp, Manual Technique with Partial Water Control, Casamance

This technique requires some physical alteration of the land so that rice can be grown in areas that are waterlogged during the rainy season or where the slope results in too rapid a rate of runoff. In waterlogged lands, natural drainage lines are mechanically deepened and improved, new drainage channels and sluices are added to evacuate excess water, and contour field bunds are constructed to retain the requisite amount of water for cultivation. In the upstream, sloped areas near streams, a weir and a system of distribution

channels are constructed and fields are leveled to retain and distribute irrigation water evenly.

Production inputs are similar to those used in the techniques described above, although slightly greater use of fertilizers is recommended (see Table 2). Without proper credit, it is unlikely that farmers will be able to undertake the investments necessary for the implementation of the water control system. Moreover, these irrigation and drainage works require a level of organization and coordination to which independent farmers are not accustomed. Initially, at least, these types of investments have to be undertaken by various land development agencies (LDAs).

Improved Rainfed Technique, "Gray Soils" with Animal Traction, Upper Casamance

This technique is practiced outside of the swamp areas on transitional gray soils, and oxen are used for land preparation, seeding, weeding, and transport of paddy from the field. Harvesting is done with a sickle. Yields are favorable on gray soils because plants continue to be nourished by a high water table after the rains have stopped. The area is planted with varieties that have longer cycles than do those which generally survive in true upland conditions. Relatively high fertilizer rates have a beneficial effect on yields but also necessitate greater labor times devoted to weeding.

Major additional inputs are a pair of trained oxen, a plow, a cultivator, a seeder, and a cart for transport. While these inputs considerably raise costs to the farmer, they save labor--111 as compared to 229 mandays per ha in improved swamp rice cultivation--permitting more land per farmer to be brought under cultivation.

The major limitations on the expansion of this gray soils system are the need to clear the fields properly, especially of tree stumps, so that animal-drawn equipment may be efficiently used and the requirement for more

frequent and thorough weeding, a task that normally conflicts with labor demands of other crops.

Pump Irrigated, Double-Cropped Manual Technique: Matam Village Polders

Matam is an example of an irrigated village perimeter that constitutes one end of the spectrum of rice production techniques practiced by the Société d'Aménagement et d'Exploitation des Terres du Delta (SAED) along the Senegal River.[1] Before this kind of perimeter is set up, the village must ensure that there are about 20 ha of land available which are not subject to flooding but are close enough to the river for pumping, that land tenure problems are settled, and that a village-level committee for perimeter management and operation is established. SAED helps choose an appropriate site and lays out the design of the major network. Clearing, stumping, and canal construction are then done collectively by the farmers using traditional tools. Individual parcels in the polder are allocated by SAED lottery to polder members who have been chosen by the village. SAED occasionally limits the number who can join to assure that at least 0.20 ha are allotted per household. Each individual is responsible for the leveling and construction of division bunds within his own plot. The polder pump is installed by SAED and operated by the villagers, and a SAED mechanic remains responsible for major maintenance.

Land preparation is accomplished in June with a traditional hand hoe or shovel and without the benefit of pre-irrigation rains to soften the soil.[2] A collective nursery is prepared in mid-June while the river level is still low. Farmers use a short-cycle, high-yielding variety--I Kong Pao--which is purchased from SAED and renewed every three years. Seedlings are transplanted three weeks later when sufficient field water becomes available.

Fertilization rates are high.[3] Weeding is done manually or with a hoe (daba), though weeds are not generally a problem because the rice is

transplanted and individual plots are small.

Paddy is sickle-harvested by all family members from October through December and left to dry in the fields for about two days. It is then taken to a threshing floor on or near the polder and threshed over a barrel by women. Transport to on-farm storage sites varies considerably depending on the distance between the perimeter and the farmer's village. It may be done by renting, borrowing, or using one's own animal-drawn cart or by canoe or head carrying.

In addition to hand tools, fertilizers, and improved seed, farmers use pump and extension services furnished by SAED. Pump repair is done by a SAED mechanic, and villagers pay for any spare parts required. Project farmers are supposed to maintain an amortization fund out of which major repairs and pump replacement are paid.

The major constraint on expansion of this system is the availability of suitable land. In addition, if expansion increases the size of individual holdings and there is no change in the technique used, labor could become a constraint. Finally, the effectiveness of the village committees in assuring pump maintenance and replacement has yet to be tested.

Pump Irrigated, Double-Cropped, Mechanized Technique, Senegal River Valley: Nianga

The Nianga project is still at the pilot stage of 860 ha. Its final design calls for 10,000 ha. Completion will depend on greater availability of water through the regulation of the Senegal River. Until an upstream storage facility is constructed, the off-take of river water for dry season irrigation will remain seriously constrained. Because Nianga does not experience saltwater incursion, farmers can practice double-cropping if sufficient water is available. They grow rice during the rainy season and tomatoes and maize during the dry season. Total investment costs are about

1,250,000 CFA francs per ha.

Individual parcels average about one ha. Mutual guarantee groups of 15-20 farmers are put in charge of water distribution and maintenance of the feeder canals. The pumping station and primary irrigation network are maintained by SAED, which also decides on the crops to be cultivated, the varieties to be grown, and the agricultural calendar.

Land preparation, seeding, and threshing are done mechanically. Land preparation requires deep plowing every three to four years and offset and cross-harrowing in intervening years. Seeding is done with a tractor-drawn seeder. A basal dressing of potassium chloride is applied at seeding, and during the crop cycle complex fertilizers and urea are manually applied. Weeding is done by hand in conjunction with chemical herbicides. Harvesting is manual using a sickle, and mobile Borga units of 800 kg/hour capacity are used for mechanical threshing.

Part of the cost of water delivery is covered by a water charge of 25,000 CFA francs per ha of rice crop. For all service charges and input costs, farmers pay the equivalent of about 1.5 to 2.0 tons of paddy per ha.

For logistical and administrative reasons, SAED has had difficulty in expanding at the planned rate.[4] One of the key constraints on further expansion will be felt downstream. Increased pumping during the dry season draws saltwater upstream in the Delta, influencing the dry season crop in downstream projects and making it more difficult for the Delta perimeters to have suitable irrigation water available during the rainy season.

Pump Irrigated, Single-Crop, Mechanized Technique, Senegal River Delta: Boundoum

In the large Delta perimeter at Boundoum, polders are at different stages of water control. Primary polders are surrounded by an earthen perimeter dike with flood gates and depend on the river rising high and long

enough for irrigation. There is no supplementary pumping and the fields are not leveled. Secondary polders are serviced by a pumping station and improved canal networks within the polder. In the absence of leveling, however, water depth varies greatly throughout the fields and dwarf, high-yielding varieties cannot be used. With leveling in tertiary polders, this problem is overcome.[5] The cost of adding a pumping station, a more extensive canal network, and field leveling, however, is considerable. Primary and secondary improvements cost approximately 450,000 to 500,000 CFA francs/ha while tertiary development adds another 500,000 CFA francs.[6] Yields vary between 500 and 1,200 kg/ha in primary systems, depending on water availability, and between 2,000 and 3,000 kg in tertiary systems (21, pp. 2-3, 8-9, 16-40).

In bad years, no polder is secure because of saltwater incursion upstream. About 75 percent of the Senegal River's total annual flow of 25 billion cubic meters (m^3) occurs during the three months of the rainy season. Thereafter, the flow tapers off and reaches 10 cubic meters per second (m^3/s) or less in April/May. This results in the drawing of saline ocean waters 220 km upstream. Such incursions of salt water render dry season cropping in the Delta impossible. A minimum flow of about 100 m^3/s is required to repulse the saline incursion in the high flow period. Due to large interannual variations, the date at which sufficient river flow is attained to push back the ocean water and to permit pumping in the Delta varies significantly.[7] In years of bad floods, important delays occur in the planting of the rice crop in the Delta polders. In consecutive drought periods, salinization and acidification of soils become added problems.[8]

The average holding per farmer is about 2.5 ha in the Delta, considerably larger than is that of Nianga. Project control and farmer organization

are the same as in Nianga. Crop decisions are made by SAED, which also provides inputs, machinery, pumping, and extension services.

Seeding is done mechanically with line seeders. Fairly high seeding rates are required due to the low germination rates in the saline soils of the Delta. Land preparation and threshing are done with motorized equipment. As in Nianga, deep plowing is undertaken every three years, with offset and cross-harrowing done in intervening years. At harvest time, farmers pay about 1.7 tons paddy per ha for all seasonal inputs and services.[9]

The major problems confronting this system are water insecurity, the presence of salt, and the high cost of polder development. Farmers face the additional financial risk of being liable for machinery service charges and cash inputs without adequate production security.

SODAGRI, Upper Casamance

The Société de Développement Agricole et Industriel du Sénégal (SODAGRI) project being proposed for the Upper Casamance is similar in structure to Nianga. Plans have been made for two rice and other crops per year using large-scale, mechanized production with controlled irrigation provided by a retention dam. Estimated costs are close to those of Nianga, but because of the long distance from supply centers to the project site, higher costs can be anticipated. At the time of writing, the SODAGRI project had not solved some basic technical problems, and hence no cost information was available.

COLLECTION, MILLING, AND DISTRIBUTION

Almost all traditionally grown paddy is either dried in the field and threshed, or carried from the field, stored on the head, and threshed as needed (see Table 3). Traditional threshing is done with a stick, over an oil drum or in a wooden mortar with a pestle. The latter method is also

Table 3.--Key Characteristics of Rice Milling Techniques

Milling technique	Projected full capacity (mt paddy/year)[a]	Quality of output[b]	Milling ratio	Rice milled in 1976 (mt milled rice)	Unit cost (CFAF/mt milled rice)	Use of by-products
Hand pounding		raw rice, 40-60% brokens	.65-.70	54,000	5,300	domestic animal feed
Small mills	20,000	raw rice, 25-40% brokens	.66	650 -2,000	7,077	some sales of bran
Large mills	50,000	raw rice, 40-50% brokens - Sefa, 85-90% brokens - Fleuve	.65	4,840	26,000	sales of bran through ONCAD,

[a]Projected full capacity for small mills assumes 40 such units multipled by 250 days at 8 hours a day with a throughput of .2 mt paddy/hr. For large mills, full capacity is estimated on the rated per hour capacity of the three mills operating in Senegal in 1975/76; 2 mt/hr plus 2 mt/hr plus 6 mt/hr = 10 mt/hr times full operation at 5,000 hrs = 50,000 mt.

[b]No parboiling is done in Senegal. Percent brokens from large mills are in terms of percent of white product output.

used to hull nearly all traditional rice. One kilogram of paddy can be hulled in about 15 minutes, and the outturn is approximately 70 percent rice with about one-half brokens.

In a few areas paddy is hulled with small, private diesel-powered hulling machines, but this is usually only done during the rainy season when agricultural labor demands limit the time available for hand-pounding. There are 30 or 40 of these small hullers in Senegal. They are officially discouraged because the national marketing agency, Office National de la Cooperation et d'Assistance au Développement (ONCAD), has a statutory monopoly on rice marketing and milling.[10] The average rated capacity of these mills is about .2 tons/hour of rice[11] or close to 500 tons of rice per year,[12] but actual capacity utilization is probably much less than this amount. Outturn from these units, which are primarily 20 horsepower, steel-cylinder machines, appears to range between 50 and 70 percent, with 25 to 40 percent brokens. Milling charges on these small mills recently increased from 5 or 6 CFA francs/kg of rice to about 10 CFA francs due to the increased cost of fuel and lubricants. This brings the cost of the technique fairly close to that of hand-pounding. If women did not have to go so far to get to a milling unit, these small hullers would be used more widely as an alternative to hand-pounding.

Threshed paddy for official sale to LDAs is brought by the farmers to collection centers where it is weighed and purchased. At the time of weighing, the paddy equivalent of the cost of purchased inputs is deducted from the farmer's crop. In the Fleuve this often amounts to 40 percent of the harvest. The balance of the paddy is then paid for directly if purchased by the Société pour le Développement des Fibres Textiles (SODEFITEX) or settled several months afterward if purchased by SAED or Project Rural de

Sedhiou (PRS). After purchase, paddy is evacuated by ONCAD or the LDA to the nearest mill, often with some delay.[13] Some paddy is retained and treated by the LDAs for seed.

Large milling units of between 2 and 7 tons/hour rated capacity are used for officially purchased paddy. There are four such large mills currently operating in Senegal. One mill at Ross Bethio (6 tons/hour) was constructed in 1971 and another at Richard Toll (7 tons/hour) has only recently been repaired; both are run by SAED. Their combined theoretical capacity is 13 tons/hour or about 65,000 tons a year. At present, however, only 6,000 to 10,000 of paddy are processed annually by these two mills. The outturn is around 66 percent with 80 percent brokens. There is also a private mill in Saint-Louis with good equipment, but it is not allowed to operate because of the ONCAD/SAED monopoly. The other two mills are in the south. One at Sefa, near Sedhiou, is run by a private company for ONCAD, and the other is at Kedougou in eastern Senegal. Each has a rated capacity of 2 tons/hour or about 20,000 tons per year combined. The milling outturn for these two mills is between 64 and 66 percent with about 45 percent brokens.

The cost of milling in these large units is about 16 to 17 CFA francs/kg of paddy milled, largely because of low capacity utilization. At the three mills that are currently operating, only about 20 percent of capacity is used. Of the 26 CFA francs/kg cost of milling rice, ONCAD pays 8.5 CFA francs/kg, and 17.5 CFA francs are absorbed by a subsidy.

Rice from the mills along the Senegal River is evacuated to ONCAD offices at Saint-Louis and is sold, along with imported rice, to quota-holding merchants in the region. Rice from the Kedougou mill is handled there in the same manner, while rice from Sedhiou is shipped to Ziguinchor for official sales throughout the Casamance. Only small quantities of

domestically produced rice are sold in Dakar, the major import-substitution market.

GOVERNMENT POLICIES AFFECTING RICE PRODUCTION

A two-tiered system of government incentives exists in Senegal. At the general level, the central government affects all agricultural production through trade policy instruments, price setting, provision of infrastructure, and institution-building. At the sectoral level, the public land development agencies have a direct impact on rice production in particular geographic areas through their extension of a subsidized technology package, credit, and marketing services.[14]

Generally, goods destined for the agricultural sector, such as fertilizers, pesticides, equipment, and machinery, are exempt from import duties. Although an additional duty of 5 percent is levied on most imported items, reductions or exemptions are commonly granted. An excise tax of 2.1 percent is also paid on agricultural machinery and irrigation pumps. Complex fertilizers, which are produced locally, are subject to a 13.5 percent sales tax. Some inputs, insecticides for instance, are subject to all of these duties and taxes. Since most major investments in the rice sector are externally financed, they are exempt from taxes. However, several indirect taxes--fuel taxes, vehicle registration fees, annual road taxes, social security and other personnel taxes--are levied on projects in the rice sector.

Guaranteed producer prices for paddy were introduced in 1963-64. Prices are established by an interministerial advisory committee to the Prime Minister, the Comité des Grands Produits Agricoles (CGOT), and are announced each November, several months after planting (3, vol. II, pp. 81-85 and 95-96). The paddy price is uniform across regions and varies only according to the red rice content for which there is a discount. In November 1974, paddy

producer prices were set on a par with peanuts at 41.5 CFA francs/kg, slightly below the price of cotton.

Paddy producer prices are set above the prices for paddy equivalent of comparable quality imported rice, and the consumer retail price is also generally set higher than the price of imports. In addition to this protection for local producers, subsidies are paid to the LDAs on local rice delivered at the millgate and to the marketing agency to cover the difference between its cost price and the regulated retail price.[15]

ONCAD holds the monopoly on paddy purchases, thus legally eliminating private traders. ONCAD, or the LDAs on its account, purchases paddy at harvest. Payments are usually deferred until after the farmers' input and service debts have been deducted. Official purchases of paddy have not exceeded 8 to 10 percent of the estimated annual paddy production because of insufficient price incentives and the lateness and unwillingness of the marketing agency to enter the market.[16] Official producer prices thus apply only to those limited purchases.

The Senegalese government has emphasized policies that seek to increase the aggregate supply of rice through technical improvements. The most effective of these has been the formation of LDAs. These agencies develop the land, supply water, and exercise a substantial degree of control over the choice of crops to be grown. Furthermore, LDAs have direct access to technical expertise and to foreign funding at favorable terms for their capital investments. The Senegalese government is frequently required to provide funds only for certain recurrent expenditures, typically about 20 percent of total project costs. The cost of developing a full water control, tertiary SAED polder in the Fleuve is about 60,000 CFA francs per ha per year when annualized over a 25-year life at a 2.5 percent real interest rate.[17]

The annual cost of providing partial water control in the Casamance swamps is 12,000 CFA francs/ha. These land development costs are fully absorbed by the LDA projects. In theory, maintenance as well as operating costs of the irrigation network are charged to project farmers through a flat per crop-hectare water charge. This charge, however, usually covers only the operating cost of providing water and falls short of assuring proper network maintenance. Along with infrastructure, LDAs also provide free management and extension services to project farmers.

As Table 4 indicates, inputs to rice farmers are subsidized. The formation of LDAs has facilitated the dissemination of technology packages using improved inputs and to encourage farmer acceptance, subsidies are placed on most key inputs, including improved seeds, fertilizer, some herbicides and pesticides, machinery services, extension, and management. In addition, a general program of agricultural subsidies, the Program Agricole, was begun in 1964 with major foreign financing.[18] At present, the subsidy bill for both LDAs and the Program Agricole is largely met from national sources through current receipts of special accounts. The most important of these is the Caisse de Péréquation et de Stabilisation des Prix (CPSP), a stabilization fund which centralizes the net earnings from peanut and cotton sales and tax receipts on imported rice.[19] While the CPSP surplus has primarily been used to finance general budgetary deficits or part of the investment budget, a share of the earnings is earmarked for producer--and sometimes consumer--subsidies. With short-term supplier's credit extended by the Banque Nationale du Développement Senegalaise (BNDS), ONCAD purchases agricultural equipment and inputs at cost and delivers them to LDAs and cooperatives at subsidized prices. The price difference is then paid to ONCAD by the Stabilization Fund.[20] As with product prices, official input

Table 4.--Farm Subsidies and Charges[a]

(CFA francs/mt milled rice)

Production technique	Subsidies										Fixed charges
	Intermediate inputs			Mechanical land prep.	Land dev.	Water	Extension	Med.-term credit	Other	Total	
	Seeds	Fert.	Pest. and weed killer								
1. Matam Village polders.	62	7,603	188	0	0	0[b]	3,091	36[c]	5,430[d]	16,411	0
2. Nianga, Senegal River Valley.	617	6,989	0	- 829[e]	19,547[f]	0	2,342	0	8,720[g]	37,386	9,968[h]
3. Boundoum Project, Senegal River delta.	921	8,494	1,430	-1,261[e]	58,798[f]	0	2,920	124[c]	13,204[g]	84,630	15,152[h]
4. Traditional swamp and mangrove rice, Casamance.	0	0	0	0	0	0	0	0	0	0	0
5. Improved swamp rice Casamance.	- 92	11,265	278	0	120[i]	0	3,798	22	0	15,391	0
6. Improved partial water control, swamp rice, Casamance.	- 58	9,477	174	0	5,558[j]	0	4,749	48	4,288[d]	24,236	0
7. Improved rainfed animal traction, Upper Casamance.	-201	10,358	303	0	0	0	4,129	634[k]	0	15,223	0

[a]Per hectare subsidies were divided by the net yields and then divided by the milling ratio to obtain net subsidies per mt of milled rice. For the Fleuve techniques, the milling ratio of the SAED mill (.66) was used. In the Casamance the milling ratio used was that of Sefa (.65). Negative entries denote taxes on the farm.

[b]The cost of pump replacement was charged to the farmer even though the system of farmer amortization of the pump has not yet been put to effect. The original pump subsidy was 1,745 FCFA/mt of milled rice.

Table 4 Footnotes (continued)

[c]On the purchase of an ox cart.

[d]Operation and maintenance of polder vehicles, mechanics, drivers and other technical personnel.

[e]Deep ploughing and cross-harrowing.

[f]Pumping station and power generator costs were included in land development and not in water delivery costs.

[g]Operation, maintenance, irrigation network and equipment depreciation, personnel other than extension services adjusted for farm taxes on certain machinery services.

[h]25,000 FCFA water charge per hectare of paddy.

[i]Rock phosphate was included as a land development cost.

[j]Costs of drainage and retention canals.

[k]Subsidies on the purchase of animal traction equipment.

prices are uniform throughout the country.

The main input subsidy is on locally manufactured compound fertilizer (NPK) and imported urea. At its peak in 1974, the farm subsidy on compound fertilizer was 75 percent of its ex-factory price. In 1976 it was reduced to about 60 percent when ONCAD purchased NPK at 66.7 CFA francs per kg ex-factory but delivered it at 20 CFA francs. Imported urea, valued at 83.0 CFA francs c.i.f. was supplied in 1976 to farmers as seasonal credit-in-kind for 25 CFA francs.[21] The large government subsidy and nitrogen responsiveness of improved rice varieties have led to an impressive growth in the demand for fertilizers (12, p. 29). From about 1,600 tons in 1961-62, fertilizer consumption for rice climbed to 13,000 tons in 1967-68, and, after a sharp decline during the drought, reached about 20,000 tons in 1974-75.

Subsidies are also paid on selected high-yielding seeds. Research costs of developing suitable strains are not passed on to farmers, who only pay the marginal cost of seed multiplication. Moreover, cost estimates from the Nianga seed farm suggest that there is an added direct subsidy of about 15-20 percent on the 70 CFA francs per kilo the farmer pays for selected seeds.

Other subsidized services available on seasonal credit are the machinery services and water provided by large projects. Machinery services are made widely available to project farmers in the delta and lower valley of the Senegal River where heavy clay soils are not suited for manual land preparation and the growing season is constrained by a short flood cycle.[22] Most service charges are set approximately to meet costs. Certain tasks, such as deep plowing, are subsidized about 10 percent, while others, for example, drill seeding, are priced so that the farmer is actually taxed. As mentioned previously, the flat water charge--25,000 CFA francs per ha of rice in 1976--covers only the operating cost and not the maintenance and depreciation

expenditures of the irrigation network.

Threshers, seeders, carts, and other equipment are made available to producer cooperatives with a state subsidy and on credit. The subsidy mechanism is similar to that for seasonal inputs. Agricultural equipment is purchased by ONCAD from the Société Industrielle Sénégalaise de Construction Mécaniques et Materiels Agricoles (SISCOMA), the local manufacturer, at cost and is sold to the producers at subsidized prices. Repayment takes place in three to five annual installments at an estimated implicit interest rate of 8 percent.[23] ONCAD's losses are reimbursed by the Stabilization Fund. The agricultural equipment program has had only a small impact on rice producers, whose purchases have been limited to carts, draft animals, and, less frequently, plows and seeders.

The government's rural credit program is essentially restricted to these schemes for purchasing seasonal inputs and agricultural equipment. Official credit is therefore rationed by channeling it exclusively through LDAs and producer cooperatives.[24] Cooperative members are collectively responsible for the repayment of the credit. While this practice has virtually eliminated defaults, it has also skewed the provision of credit toward farmers with sound creditworthiness.

SHADOW PRICES

The factor markets in Senegal function well, causing market prices to reflect the scarcity values of factors.[25] The agricultural daily wage in the Fleuve (250 CFA francs) is less than that in the Casamance (300 CFA francs). Because this differential persists in the face of vigorous migration, the gap probably reflects actual relocation costs. Minimum wage legislation, especially for skilled labor, has had little impact, even in the urban industrial sector. There is no reason to suspect that the labor

market has major imperfections, and the market wage is an adequate measure of the opportunity cost of labor.

The effective wage rate for traditional production techniques in the Casamance might, however, be less than 300 CFA francs. Ties between the traditional and commercial sectors in this area of underdeveloped infrastructure are weak, and the supply of family labor to the market could be quite inelastic. Hence, valuation of predominantly female traditional on-farm labor at the marginal wage rate of the commercial agricultural sector overstates the reservation price of family labor in traditional techniques. Instead, it is assumed that female labor should be valued at 250 CFA francs per day.

In view of the wide availability of land and the extensive nature of Senegalese rice cultivation, the shadow price for land is assumed to be zero. The Fleuve experiences occasional shortages of water rather than land, and hence the social opportunity cost of water might be positive there.[26] This constraint will not be binding for some time, except in years of drought, however, and by then there is likely to be some seasonal regulation of the river (25, p. 10). In the Casamance, long fallow cycles and low labor intensity of cultivation suggest that land pressures will not develop soon (2, p. 23).

Capital markets in Senegal are segmented. For priority sectors and projects, capital is made available on preferential terms. LDAs borrow from the national development bank (BNDS) at 7.5 and 8.0 percent, or 2.5 to 3.0 percent real rates of interest, and capital from foreign donors may be made available at lower rates.[27] A small number of project farmers have access to concessionary government credit channelled through producer cooperatives.[28] Otherwise, rural interest rates are well above the government rates and typically

vary according to the borrower's asset position. Because of higher transactions costs and default risks, these funds are generally available at between 20 and 35 percent nominal interest rates per annum. Capital market segmentation is perpetuated through strict rationing, absorptive capacity limitations, and project specificity of funding.

PRIVATE AND SOCIAL PROFITABILITY

Combinations of the different production, collection, milling, and distribution systems are described in Table 5 as activities. The seven main production techniques are variously combined with informal and official collection methods, hand-pounding, custom hulling, or public milling, and distribution of rice through private and official channels. The most widely practiced combinations and those presenting greatest potential for expansion have been selected for analysis.

Private and social profitability estimates for the production of Matam village polders and the Nianga project in the middle valley were calculated for hand-pounded on-farm consumption and for delivery to the Saint-Louis and Dakar markets, where rice is distributed by public agencies. Production from the Delta perimeter goes mainly to the Saint Louis and Dakar markets, entirely through official channels. Estimates for traditional swamp production of the Casamance were calculated only for home consumption, since rice is produced primarily for domestic household needs. The improved swamp and gray soils, animal traction production techniques were each evaluated for household consumption and for sales in Ziguinchor and Dakar through national agencies. In addition, cost estimates were made for rice collected from improved, manually cultivated swamps and custom milled for sale on the illicit parallel market in Ziguinchor.

Table 5.--Combined Production and Post-Harvest Activities

Activity designator	Production technique	Collection	Milling Technique	Distribution center
1.1	Matam village polders	None	Hand pounding	Home consumption
1.2	Matam village polders	Public agency	Large public mill	Official channels, Saint-Louis
1.3	Matam village polders	Public agency	Large public mill	Official channels, Dakar
2.1	Nianga project	None	Hand pounding	Home consumption
2.2	Niange project	Public agency	Large public mill	Official channels, Saint-Louis
2.3	Niange project	Public agency	Large public mill	Official channels, Dakar
3.1	Delta/Boundoum project	Public agency	Large public mill	Official channels, Saint-Louis
3.2	Delta/Boundoum project	Public agency	Large public mill	Official channels, Dakar
4.1	Traditional swamps	None	Hand pounding	Home consumption
5.1	Improved swamp rice	None	Hand pounding	Home consumption
5.2	Improved swamp rice	Informal channel	Small hullers	Informal channels, Ziguinchor
5.3	Improved swamp rice	Public agency	Large public mill	Official channels, Ziguinchor
5.4	Improved swamp rice	Public agency	Large public mill	Official channels, Dakar
6.1	Water control swamps	None	Hand pounding	Home consumption
6.2	Water control swamps	Public agency	Large public mill	Official channels, Ziguinchor
6.3	Water control swamps	Public agency	Large public mill	Official channels, Dakar
7.1	Rainfed animal-traction	None	Hand pounding	Home consumption
7.2	Rainfed animal-traction	Public agency	Large public mill	Official channels, Ziguinchor
7.3	Rainfed animal-traction	Public agency	Large public mill	Official channels, Dakar

Private Profitability

Various indicators of private and social profitability are shown in Table 6. The most widely practiced technique in the country, traditional swamp rice in the Casamance, exhibits slightly positive private profitability when female unskilled labor is valued at 250 CFA francs per day and paddy is valued at an on-farm import substitution price of 57 CFA francs/kg. The switching intc more remunerative crops and outmigration from traditional rice cultivation areas attest to this low level of private profitability (14).

The introduction of improved seeds, chemical fertilizers, and better agricultural practices into swamp rice cultivation areas has led to significantly higher yields compared to traditional methods. While labor requirements and intermediate cash expenses have also risen, average yields have doubled to 2,250 kg/ha. Nevertheless, despite the fact that the costs of extension services are not included in the calculation of net private profitability (NPP), partially improved swamp cultivation remains only marginally profitable as a cash crop. Relative tc other cash crops, such as peanuts and cotton, paddy prices do not offer large incentives. Profitability calculations per manday in the Middle Casamance, where these improved swamp techniques are being introduced, indicate that peanuts are more remunerative than rice (3, vol. 1, pp. 129-131), Tables XV-XVII). Given the present price structure, therefore, paddy is often not the first choice as a cash crop in areas where switching between crops is possible (3, vol. I, p. 115).

The construction of bunds, retention structures, and drainage canals on improved swamps results in greater water control and permits fuller exploitation of the fertilizer-responsive rice technology. Fertilizer application is further increased in partially improved swamps, farm labor inputs rise by 15-20 percent, and yields are increased 60 percent above those attained in

Table 6.--Indicators of Private and Social Profitability

(CFA francs/mt of milled rice)

Activity combination[a]	Net private profitability[b] (NPP) (1)	Net social profitability (NSP) (2)	Resource cost ratio (RCR) (3)	Effective protection coefficient (EPC) (4)	NSP-NPP (5)	c.i.f.-market price (6)	Total taxes (+) or subsidies (-) (7)
1.1	21.25[c]	24.29	.658	.886	3.04	13.93	-10.89
1.2	22.47	-13.35	1.304	.985	-35.82	-33.60	- 2.22
1.3	22.47	-17.49	1.430	.971	-39.96	-38.01	- 1.95
2.1	16.55[c]	6.36	.881	1.121	-10.19	12.83	-23.02
2.2	17.83	-28.71	2.037	1.503	-46.54	-32.05	-14.49
2.3	17.83	-32.85	2.340	1.547	-50.68	-36.47	-14.21
3.1	4.16	-62.02	18.939	10.566	-66.18	-31.34	-34.84
3.2	4.16	-66.15	231.439	114.340	-70.31	-35.74	-34.57
5.1	16.46[c]	13.40	.824	.905	- 3.06	10.38	-13.44
5.2	18.02	13.42	.804	.939	- 4.60	3.20	- 7.80
5.3	18.02	- 3.59	1.055	.897	-21.61	-14.00	- 7.61
5.4	18.02	-12.84	1.224	.858	-30.86	-23.67	- 7.19
6.1	33.02[c]	16.67	.772	.952	-16.35	4.55	-20.90
6.2	34.57	2.03	.969	.917	-32.54	-17.49	-15.05
6.3	34.57	- 7.21	1.127	.934	-41.78	-23.70	-18.08
7.1	32.65[c]	26.55	.641	.930	- 6.10	9.03	-15.13
7.2	34.21	11.92	.818	.893	-22.29	-16.44	- 5.85
7.3	34.21	2.67	.954	.905	-31.54	-22.66	- 8.88

[a]For a more detailed description of Activity designators see Table 5. p. 20a.

[b]Where post-harvest activities are in fact controlled by public agencies and all post-harvest costs are assumed to be met through state subsidies or transfers, PP shows only residual on-farm profitability.

[c]By contrast to (b), in the case where the farmer processes and markets--or consumes on-farm--his production, the PP measure reflects the profitability of the entire activity from production through marketing.

the unimproved swamps. Costs of the dense extension network and the water control investments are fully subsidized and therefore are not charged to project farmers. As a result of these subsidies and the high yields, NPP is favorable in improved swamps with partial water control.

The key to the high NPP rates of the rainfed, gray soils technique is the reduction in the labor requirements realized by the introduction of animal traction. Draft animals and small farm equipment, like most intermediate inputs, receive important subsidies. Consequently, the farmer's cash expenses remain at the level of improved swamp techniques with water control. The activity is highly profitable because the drop in yields is more than compensated by a reduction in labor input.

As a result of impressive yields--4.5 to 5 tons/ha achieved through the use of transplanting, the application of chemical fertilizers, careful and intensive labor, and pump irrigation--private profitability in Matam village polders is high. Inputs consist mainly of unskilled family labor and subsidized seasonal inputs for which the farmer is required to make an outlay of about 15,000 CFA francs, either in cash or in credit repayable at harvest. While the capital costs of polder development, about 25,000 CFA francs, and pump replacement are charged to the farmers, the high extension costs are not.[29] Even with the inclusion of these costs, however, the technique remains privately profitable. This high NPP has clearly contributed to the rapid acceptance of this labor-intensive technique and to the strong demand for new polders in an area where rice cultivation was unknown before 1973-74.

Downstream at Nianga, labor times are reduced with higher degrees of mechanization. Yields are 3,800 kg/ha, 80 percent of those at Matam. Although farmer charges for mechanical services, water use, and intermediate

inputs are steep (about 70,000 to 80,000 CFA francs/ha), the activity is privately profitable because of the high yields, reduced labor inputs, and the opportunities for double-cropping which permit the spreading of certain fixed costs between two crops. Production in the middle valley is secure, water is readily available at current levels of development, and to date salinity has not presented problems.

By comparison, NPP in the Delta is borderline.[30] At the yields obtained in the Delta, a single rice crop is only marginally profitable. Despite having the lowest number of mandays among all production techniques, rice farming in the Delta combines high farmer charges with average yields of only about 2,500 kgs/ha to give a low NPP. Therefore, farmers in the Delta rely on a variety of secondary economic activities, including where possible a remunerative second crop, livestock, seasonal migration, or remittances from migrant family members. Rice, however, remains the principal food crop.[31] Assured availability of usable, salt-free water during the cropping season is also a critical problem in the Delta. Greater water security and more constant seasonal availability through river regulation should increase NPP by raising yields and permitting cultivation of a dry-season crop.

Social Profitability

As the results presented in Table 7 indicate, all techniques of rice production in Senegal, with the exception of gray soils, animal traction cultivation and production for on-farm and sometimes regional consumption, are socially unprofitable. The substantial divergence between private and social profitability (see columns 1, 2, and 5 of Table 6) is the result of a high degree of trade protection and of input taxes and subsidies.

Unlike the Casamance, where rainfall is sufficient to permit rainfed cultivation, field water availability in the Fleuve can only be assured

Table 7.--NSP and RCR Results of Major Rice Production Activities at Various Conssumption Centers

(CFA francs/kg milled rice)

Technique	Home		Saint-Louis[a]		Ziguinchor[a]		Dakar[a]	
	RCR	NSP	RCR	NSP	RCR	NSP	RCR	NSP
1. Pump irrigated, double-cropping manual technique, Matam village polders.	.658	24.29	1.304	-13.35	n.a.	n.a.	1.430	-17.49
2. Pump irrigated, double-cropping mechanized technique, Nianga, Senegal river valley.	.881	6.36	2.037	-28.71	n.a.	n.a.	2.340	-32.85
3. Pump irrigated, single crop, mechanized technique, Boundoum Project, Senegal river delta.	2.377	-33.01	18.939	-62.02	n.a.	n.a.	231.439	-66.15
4. Traditional swamp and mangrove rice, Casamance.	1.055	- 4.93	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
5. Improved swamp rice, manual technique, Casamance.	.824	13.40	n.a.	n.a.	1.055	- 3.59	1.224	-12.84
6. Improved swamp rice, manual technique with partial water control, Casamance.	.772	16.67	n.a.	n.a.	.969	2.03	1.127	- 7.21
7. Improved rainfed technique, "greysoils", with animal traction, Upper Casamance.	.641	26.55	n.a.	n.a.	.818	11.92	.954	2.67

[a]Marketing and distribution by public agencies. n.a. = not applicable.

through costly investments in land development and water control. In spite of these investments, however, river water salinity in the dry season prevents the cultivation of a second crop in the Delta. In addition, heavy clay soils and the timing of fresh water availability result in a need for mechanized field operations. To ensure adequate private profitability, none of the capital costs on land, irrigation, or equipment are passed on to the farmers, and production in the Delta turns out to be highly unprofitable in social terms. The middle valley is not subject to annual saltwater incursion and can thus benefit from double cropping. At Nianga, where double cropping with a highly remunerative industrial tomato crop is feasible, resource cost ratios (RCRs) are around 2.0. Further upstream around Matam, soils are lighter and population densities higher so that two labor-intensive crops can be grown. In Matam, few capital costs are subsidized, all operations are manual, and RCRs are 1.3 to 1.4 on the major urban markets.

In addition to these capital investments and their maintenance, subsidies are provided on most intermediate inputs and services. Total subsidies are 30-35 CFA francs per kg of milled rice in the Delta and 14-23 CFA francs in Nianga. Net subsidies are much lower in Matam, where farmers are collectively responsible for all land development and maintenance of the irrigation system, and production is less socially inefficient.

In the Casamance, subsidies per unit of output, mainly on seasonal inputs and extension services, are less than in the Fleuve. An exception is improved swamps, where LDAs provide large subsidies on water control investments. For traditional swamp cultivation with little access to improved inputs and extension services, subsidies are effectively zero. Thus the Casamance, with its greater natural availability of water, is a region in which rice can be produced more efficiently than in the Fleuve.

The investment, operation, and maintenance subsidies which are required to ensure farmer acceptance of improved rice techniques have important budgetary consequences. In the past, LDA budgetary deficits have frequently been met through large transfers from an already strained national budget. Elimination of any major subsidy, however, especially from mechanized government projects, would render the activity privately unprofitable.

NPP estimates are based on the protected paddy price, while net social profitability (NSP) is based on the lower c.i.f. price of comparable quality imports, which have been available in most years at only about $250-300 per metric ton c.i.f. The NPP-NSP divergence is further influenced by the relatively long distances between the rice producing regions and Dakar, the major port of importation. Because of high transport costs, the price of imported rice delivered to on-farm consumption centers often exceeds local production costs. NSP is thus positive in this case and the differences from NPP are equal essentially to production subsidies. At urban consumption points such as Saint-Louis, Ziguinchor, and especially Dakar, on the other hand, transport costs work in the other direction, increasing the cost of domestically produced rice delivered to the cities and lowering the price of imports with which that rice might compete. Since the cost of transporting domestically produced rice to these cities is fully subsidized, this increases the divergence between NSP and NPP.

A summary of NSP and RCR indicators for the major production techniques at various consumption points is contained in Table 7. Rice from the Fleuve is highly unprofitable at off-farm consumption centers because of costly, mechanized production techniques and the high percentage of brokens (80 percent). Casamance rice is of better quality and effectively competes with

more expensive imports; its RCRs are closely distributed around one.[32] Rice produced in the Casamance could substitute for imports in Dakar at $325-$385 (1975 U.S.$) per metric ton. In contrast, to be competitive on major urban markets, Nianga would require a delivered c.i.f. price of about $440 for 80 percent brokens, while Delta rice could compete only at a world price of $570. This indicates that the Casamance has a distinct efficiency advantage over the Fleuve in supplying the Dakar market.[33]

SENSITIVITY ANALYSIS

The sensitivity of the NSP results to changes in factor costs, yields, and milling ratios is shown in Table 8. The social profitability of all techniques is most sensitive to changes in yields and in milling ratios. These results are not surprising, "the effect of changing the whole being greater than that of changing one of its parts" (16, p. 149). For the traditional and improved swamp techniques of the Casamance and the Matam village polders, the next most significant influence on social profitability rates is the variation in the cost of unskilled labor. This effect is most pronounced for on-farm consumption activities where unskilled labor is by far the largest component of costs.[34] The impact of changes in these costs diminishes as paddy is delivered to off-farm consumption points because of increases in transport, processing, and distribution costs, all of which use a higher proportion of skilled labor and capital. With techniques using greater degrees of mechanization, the impact of skilled labor, including drivers, operators, extension agents, and other technicians increases and exceeds the influence of changes in the cost of unskilled farm labor.

An unanticipated result is the relative insensitivity of all activities to changes in the price of capital. This outcome was expected for the traditional and labor-intensive techniques. However, the low capital

Table 8.--Elasticities of Net Social Profitability with Respect to Yields, Milling Ratios, and the Social Costs of Primary Inputs

Activity designator[a]	Elasticities				
			Social costs		
	Yields	Milling Ratio	Unskilled labor	Skilled labor	Capital
	(1)	(2)	(3)	(4)	(5)
1.1	2.137	2.137	- 1.470	- .348	- .102
1.2	3.830	4.157	- 2.068	-1.691	- .527
1.3	2.924	3.448	- 1.579	-1.334	- .414
2.1	10.947	10.946	- 4.106	-2.577	- .688
2.2	2.389	2.630	- .634	-1.029	- .302
2.3	2.088	2.299	- .554	- .992	- .270
3.1	1.666	1.749	- .301	- .587	- .168
3.2	1.562	1.640	- .282	- .562	- .160
4.1	16.399	16.399	-17.578	- .087	-1.466
5.1	4.687	4.687	- 3.755	- .493	- .439
5.2	4.671	4.970	- 2.867	- .758	- .487
5.3	17.457	19.471	-12.106	-4.403	-2.634
5.4	4.884	5.448	- 3.387	-1.320	- .761
6.1	3.427	3.427	- 2.367	- .465	- .559
6.2	28.111	31.672	-16.060	-8.352	-6.347
6.3	7.921	8.925	- 4.525	-2.511	-1.832
7.1	1.783	1.783	- 1.233	- .338	- .219
7.2	3.973	4.581	- 2.175	-1.526	- .787
7.3	17.732	20.442	- 9.705	-7.236	-3.629

[a]For a more detailed description of Activity Designators see Table 5, p. 20a.

elasticity coefficients of both mechanized techniques in the Fleuve are at first surprising. These low elasticities occur because of the relatively high cost of intermediate inputs and assumptions concerning the long lifetime of certain capital items and low rates of discount, which result in low annualized capital values.

Table 9 shows changes in NSP in relation to changes in the world market price of rice over a range from $250 to $600 per metric ton. No techniques are socially profitable at the low figure and all are at the high one.

These results underscore the importance of yield data and of labor times and wage information. Few consistent time-series studies of yields are available in Senegal. Much of the available information is either for agronomic field yields or estimates of production over harvested area which exclude investments made on seeded but abandoned land. Both measures tend to overstate economic yields. SAED has recently begun annual crop-cuttings, although it is too early to obtain time-series which permit an assessment of yield stability. For the majority of the paddy produced in the country from individual traditional farms, yield information is available only from highly inadequate estimates made by the regional agricultural services. Because of these difficulties, this analysis has employed rather conservative yield estimates.

In the absence of survey data on labor-intensive techniques, unskilled labor data are more reliable from mechanized, pump-irrigated projects. On the latter, labor tasks are delimited by pumping periods and mechanized operations, and they are directed by the extension staff. For labor-intensive techniques, on the other hand, labor times exhibit larger apparent spatial and interannual variation. Confidence, of course, is greater where survey

Table 9.--Net Social Profitability in Relation to the World Market Price of Rice

(CFA francs/mt milled rice)

Activity designator[a]	% broken	Net social profitability for a world price of $250/mt	$300/mt	$350/mt	$400/mt	$450/mt	$500/mt	$550/mt	$600/mt
1.1	.40	- 2,363	10,262	22,887	35,512	48,137	60,762	73,387	86,012
1.2	.80	-28.899	-16,274	- 3,649	8,976	21,601	34,226	46,851	59,476
1.3	.80	-30,938	-18,313	- 5,688	6,937	19,562	32,187	44,812	57,437
2.1	.40	-20,464	- 7,839	4,786	17,411	30,036	42,661	55,286	67,911
2.2	.80	-44,422	-31,797	-19,172	- 6,547	6,078	18,703	31,328	43,953
2.3	.80	-46,462	-33,837	-21,212	- 8,587	4,038	16,663	29,288	41,914
3.1	.80	-77,969	-65,344	-52,719	-40,094	-27,469	-14,844	- 2,219	10,406
3.2	.80	-80,008	-67,383	-54,758	-42,133	-29,508	-16,883	- 4,258	8,367
4.1	.40	-31,397	-18,772	- 6,147	6,478	19,103	31,728	44,353	56,978
5.1	.40	-13,203	- 578	12,047	24,672	37,297	49,922	62,547	75,172
5.2	.40	-11,351	1,274	13,899	26,524	39,149	51,774	64,399	77,024
5.3	.45	-30,291	-17,666	- 5,041	7,584	20,209	32,834	45,459	58,084
5.4	.45	-33,332	-20,707	- 8,082	4,543	17,168	29,793	42,418	55,043
6.1	.40	- 7,585	5,040	17,665	30,290	42,915	55,540	68,165	80,790
6.2	.45	-24,673	-12,048	577	13,202	25,827	38,452	51,077	63,702
6.3	.45	-27,714	-15,089	- 2,464	10,161	22,786	3,541	48,036	60,661
7.1	.40	2,306	14,931	27,556	40,181	52,806	65,431	78,056	90,681
7.2	.45	-14,782	- 2,157	10,468	23,093	35,718	48,343	60,968	73,593
7.3	.45	-17,822	- 5,197	7,428	20,052	32,678	45,303	57,928	70,553

[a]For a more complete description of Activity Designators see Table 5, p. 20a.

data are available, as in Matam, and less reliable for the traditional swamp techniques. Input data for skilled labor were collected from personnel records and other studies and are more accurate and reliable than figures on unskilled labor.

Milling ratios, another parameter to which NSPs are highly sensitive, have been well studied in large public mills, and the evidence suggests that there is little room for much improvement.[35] For small hullers, on the other hand, milling information is sketchy. Cost estimates indicate that small hulling is the most efficient milling technique because of reductions in paddy transport costs and fuller capacity utilization, leading to lower average fixed costs.

CONCLUDING REMARKS

Since the period of unusually high rice prices in 1973-75, Senegal has been concerned with fluctuations in the price of rice on the international market. The experience of this era has increased the government's commitment to self-sufficiency in rice, defined as a reduction in imports brought about through increases in local production. On average, three-fourths of Senegal's total annual rice consumption of 245,000 tons is met by imports. In years of unusually bad domestic harvests (1973-74) imports have reached 200,000 tons, while in good years (1975) they have declined to around 100,000 tons. Between 1961-75 imports averaged 155,000 tons, requiring the expenditure of about 10 percent of annual export earnings (3, pp. 8-9).

Imported rice is destined almost exclusively for Dakar (Cap Vert) and the Groundnut Basin.[36] But these consumption centers lie at considerable distance from the main producing regions in the Casamance and the Fleuve. Hence, domestic transportation costs act as a barrier to the competitive

delivery of local rice, especially in view of the high cost of many of the techniques used in producing that rice.

Efforts to expand rice production and therefore to increase self-sufficiency can be analyzed in terms of their contributions to three fundamental economic objectives--increased national income, more even income distribution, and greater food security. If the efficient allocation of resources and hence generation of national income is the principal criterion, techniques which minimize net social costs should be promoted. With current prices and production conditions, labor-intensive techniques in the Casamance and in Matam and animal-traction methods in the middle and upper Casamance are the most efficient techniques for local import substitution. They permit large private profits to the farmer without sacrificing social profitability. However, only the animal-traction technique of the Casamance is competitive with imports in Dakar. All other rice-producing techniques show negative social profitability on the Dakar market, as shown by the figures in the following tabulation:

Technique	Location	Water source	Level of security	NSP in Dakar
Matam	Upper Fleuve	Pumping	High	-17.5
Nianga	Middle Fleuve	Pumping	High	-32.9
Delta	Fleuve Delta	Pumping[a]	Low-medium	-66.2
Improved swamp with water control	Middle Casamance	Bunding	Medium	- 7.2
Rainfed animal traction	Middle and Upper Casamance	Grey soils	Medium-low	+ 2.7
Improved swamp manual	Casamance	Rainfed	Low	-12.8

[a]Delta pumping, even on tertiary developments, is not very secure as saline water incursion can lead to total abandonment of the fields or to delays in planting which result in important reductions in yields and increases in costs.

Senegal's primary objective related to rice policy, however, is to enhance the security of food availability by reducing fluctuations in domestic supplies. In the Fleuve and the Casamance, food security can be increased through investments in small-scale irrigation. By increasing water security, higher and less variable yields can be attained and more intensive technologies introduced. But the least costly, small-scale techniques often do not have high sales per farmer and thus do not make locally produced rice available to other consumers in years of drought when millet production falls short. Marketings can most easily be increased only at a substantial efficiency cost by expanding production from double-cropped, large-scale irrigated projects, like Nianga, in the Senegal River Basin.

Increasing rice production also has implications for regional income distribution. The drought severely affected the incomes of the poorer, peripheral regions of Senegal, and the government has since devoted attention to increasing regional incomes and to regional development. Investments in the Fleuve would raise net farmer incomes and increase production security. While both Matam and N anga exhibit large private profitability indicating that farmers stand to gain from rice production, social profitability in Matam is much higher than at Nianga, suggesting that the distributional gains there have a lower cost in terms of national income. Furthermore, production at Matam requires less LDA intervention and assistance and, due to its scale and labor-intensity, results in a wider distribution of benefits.

Animal traction and improved swamp production techniques in the Casamance have the highest private and social profitabilities in that region. However, in the Casamance, other crops (corn, peanuts, fruits) are both privately and socially more profitable than rice. To the extent that other crops

have higher social profitabilities, rice policy would be an inefficient means of effecting regional development.

With currently known technologies and factor prices, Senegal can best advance its objectives of rice policy by promoting low-cost irrigated projects, following the Matam model, which increase and stabilize farmer incomes without incurring high social costs. This approach can be complemented by expanding output in the Casamance with efficient techniques using animal traction. But before any dams regulating flows of the Senegal River are built, Senegal needs to develop a low-cost technique using larger irrigated polders which is well adapted to its needs and resources.

FOOTNOTES

[1]SAED is a public, semi-autonomous land development agency responsible for agricultural development throughout the Senegal River Basin.

[2]At present the peakiness of the flood does not permit irrigation of major fields early in June. Preirrigation will be possible if the river is seasonally regulated by an upstream dam.

[3]One reason for the high fertilization rates is that each farmer holding 0.2 to 0.25 ha is sold one 50 kg sack of urea and one of compound fertilizer to facilitate input distribution.

[4]SAED developed the basin at an average rate of 2,178 ha/year between 1973 and 1977, although cultivated areas do not always correspond to the number of ha developed (18, p. 46).

[5]At present, only one-half of SAED-managed areas are under full water control. Because of the extended drought of 1968-73, however, all existing polders are being transformed to full water control, and all new projects are begun as tertiary developments (21, p. 1).

[6]These are minimum estimates. Current tertiary construction costs have in some instances risen to 1.25 to 1.50 million CFA francs/ha (23, p. 28; 6; 19, p. 9; 16, pp. 39-43, 66-67).

[7]Retreat of the saline incursion can vary from July 24 to August 8 for flood probabilities of 50 to 95 percent flow frequency. Furthermore, large-scale developments upstream may result in drawing the saline waters further upstream in the dry season, further delaying the date at which the saline incursion is repulsed in the rainy season (28, p. 28). For a discussion of the effects of planting delays on yields in the Delta, see (28, p. 42). Beye (1) also discusses the effects of salinity on yield in Boundoum.

[8]Earlier the Delta was thought to be an ideal area for rice cultivation due to the lack of relief, the "complementarity of rainfall and flooding," the heavy clay soils, the lack of populations and associated tenure problems, and market access (see 28, p. 24). The same report also pointed out potentially serious soil toxicity and acidity problems of certain Delta soils (28, p. 46 and 46 bis). Sene et al. observe that 25,300 of the 34,220 ha of the Delta are saline (20, p. 437).

[9]In 1975 farmers paid for seed, fertilizer, weed-killer, machinery services, thresher services, and a flat per hectare water charge of 25,000 CFA francs, totaling about 70,000 francs/ha of rice crop.

[10]There are an estimated 13 huller units in the Fleuve, 15 in the Casamance, and another 5 or 10 in the Sine-Saloum region of the country.

[11]These observations are based on the work by Spencer (29).

[12]Theoretical capacity was calculated assuming 8 hours of operation per day for 250 working days per year.

[13]These delays in the Fleuve result in important humidity losses because of the large diurnal temperature variation. Paddy frequently arrives at the Ross-Bethio mill with no more than 7-8 percent relative humidity and large cleavages. In the absence of parboiling, this results in the high percentage (about 80-90 percent) of broken rice obtained from the SAED mills (35, pp. 54-70).

[14]SAED, the LDA responsible for the development of the Senegal River Valley, was founded in 1965 and has incorporated all previous development agencies of the region. SODEFITEX, primarily a cotton agency with operations in the eastern part of the country, has also diversified into upland rice cultivation. A regional LDA did not exist in the Casamance until 1977-78 when the Societe pour la Mise en Valeur de la Casamance (SOMIVAC) was founded to supervise the region's projects.

[15]At present the price of locally produced rice from the SAED mill is above the official retail price, which is above the c.i.f. import price (4).

[16]ONCAD's marketing difficulties, its cash-flow problems, and the restrictive price structure are discussed in (3, pp. 96-116).

[17]The Matam village polders, while technically tertiary developments, are less expensive since their development and operation is manual. Total costs are estimated at 300,000 to 350,000 CFA francs/ha.

[18]For a description, see (5, pp. 185-274 and 4).

[19]For a description of the Special Accounts prior to the establishment of the CPSP, see International Monetary Fund (13, pp. 554-95).

[20]See (3, vol. II, pp. 33-36). Craven and Tuluy (4) describe the difficulties encountered by ONCAD and the BNDS in paying for agricultural subsidies during the 1973-76 period.

[21]The farmer price of fertilizers was further increased in 1977 to 25 CFA francs/kg for compound and 35 CFA francs/kg for urea, reducing the subsidy element to about 45 percent.

[22]The brevity of the flood peak does not permit preirrigation of the soils which would allow for manual or animal-traction land preparation. Thus there is a premium on time-saving techniques of early land-preparation and shorter-cycle varieties.

[23]Since guarantee payments, made by the cooperatives to ONCAD, on which no interest is earned constitute equity in the BNDS, the actual interest rate is probably higher. In 1976 these funds were about 46 percent of total disbursed credit, so that the true nominal rate was closer to 17 percent. See de Jonge, van der Klei, Meilink, and Storm (14).

[24]Only 3 percent of agricultural credit has been allocated directly to individual farmers, mainly for vegetable and poultry production. No official credit has been given to rice producers not participating in government projects.

[25]For a more thorough discussion, see Stryker, Page, and Humphreys (33).

[26]For a brief discussion of the shadow price of water, see Stryker, Page, and Humphreys (33, pp. 30-31).

[27]The difference between the nominal and real interest rates indicates the creditors' expectations concerning rates of inflation (33).

[28]While nominal rates are generally around 8.0 percent, for reasons discussed in footnote 23, the rate at which cooperative farmers actually receive credit may be closer to 17 percent.

[29]The extension density appears to be higher in Matam than elsewhere in the country because of the dispersed nature of the village polders and the small average size of holdings per cooperative member and hence the large number of farmers to whom each extension agent is responsible.

[30]For a comprehensive socioeconomic discussion of NPP in the Delta, see Waldstein (34).

[31]Rice continues to be cultivated despite the negative NPP because of the different paddy price which applies to on-farm consumption. The reference price then is not the official price, but the paddy equivalent of the price of milled rice at the nearest consumption center plus transportation and handling costs to the farm.

[32]For all techniques, rice processed on the informal market by small hullers has the highest rates of private and social profitability. This observation is consistent with findings in other West African countries (31).

[33]The import-substitution prices in the Dakar market at which the various production techniques are profitable also indicate that labor-intensive techniques are the most efficient competitors:

Technique	U.S.$/mt (1975)
Rainfed, gray soils	324
Improved swamps with water control	363
Matam	376
Improved swamp	386
Nianga	437
Senegal River Delta	570

[34]The classification of family farm labor as unskilled labor is somewhat arbitrary. Clearly, certain tasks such as transplanting and weeding involve workskills.

[35]Increased efficiency in public mills is likely to be associated with increased throughput. However, gains in efficiency will be modest because fixed costs are only a minor component of total milling costs.

[36]Data by region on consumption, production, and deficit or surplus are shown in (4, p. 10a; 26 , p. 100):

Region	Consumption	Production	Deficit (-) or surplus (+)
Cap Vert	96,429	0	-96,429
Groundnut Basin	55,850	4,435	-51,415
Fleuve	20,573	11,193	-9,380
Eastern Senegal	5,342	4,272	-1,070
Casamance	49,333	56,134	+6,801
	227,527	75,034	-151,492

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Table A-1.--Production Budget for Farming, Matam, Fleuve*

(CFA francs/ha)

	Unskilled labor						Taxes and subsidies		Total
	Man-days	Market value	Skilled labor	Domestic capital	Land	Tradable inputs	Tradables	Nontradables	market value
1. Direct labor[a]	295	69,460							69,460
A. Land preparation	49								
B. Seeding[b]	82								
C. Chemical application	5								
D. Weeding[c]	45								
E. Pest control									
F. Irrigation	14								
G. Harvesting[d]	46								
H. Threshing[e]	46								
I. Transport	8								
2. Seed[f]			1,233	148		795	117	-27	2,266
3. Fertilizer[g]			4,546	2,261		21,936	-16,513	-5,029	7,200
4. Insecticides, etc.[h]			521	372		5,208	683	66	6,850
5. Interest and depreciation									
A. Small tools			1,150	510		624	85	6	2,376
B. Animals[i]				304					304
C. Animal implements[j]			23	16		232	-134	-22	116
D. Mechanical equipment			1,223	639		10,238	-4,112	-690	7,299
E. Land improvement[k]	66	1,598							1,598
6. Operation and maintenance									
A. Animals									
B. Animal implements									
C. Mechanical equipment[l]			4,030	2,093		15,971	1,660	-1,004	22,750
D. Land improvements									
7. Extension services[m]			9,692	640		1,838	-1,838	-10,331	0
8. Fixed charges									
9. Land cost									
10. Other costs, working capital[n]			3,720	106		756		-70	4,513
Total costs		71,058	26,139	7,088		57,598	-20,051	-17,101	124,732

Yield 4,750 mt/ha; market price farm gate 41.5; ratios of shadow price to market price for: unskilled labor 1; skilled labor 1; labor 1; capital 1; land 1; and foreign exchange ____; total social cost per hectare 161,883; total social cost per metric ton milled product equivalent ____.

Footnotes for Table A-1.

*Source of data is Hasan A. Tuluy, "Survey of Three Villages in the Matam Region: Preliminary Results (1977-78)", Food Research Institute, Stanford University, 1979.

[a]238 days of male labor valued at 250 CFA francs/day and 57 days of female labor valued at 175 CFA francs/day.

[b]Includes 19 days of female labor.

[c]Includes 8.5 days of female labor.

[d]Includes 1.5 days of female labor.

[e]Includes 28 days of female labor.

[f]40 kilograms of I Kong Pao seed per hectare, renewed every three years at a unit cost to the farmer of 70 CFA francs/kg. The delivered cost price is 84 CFA francs/kg. Retained seed for the other two years was valued at 50 CFA francs/kg.

[g]200 kgs of NPK (16-48-0) at 16 CFA francs/kg and 200 kgs of Urea (46-0-0) at 20 CFA francs/kg farmer price. Delivered cost price of NPK is 69 CFA francs/kg and 86 CFA francs/kg for Urea.

[h]10 kgs of Basudin at 685 CFA francs/kg and 5 kgs of HCH at 118 CFA francs.

[i]Locally purchased horse and ONCAD purchased cart, each with 10 year service life and used half time on 10 hectares. The cart is valued at 32,340 CFA to the farmer, and 76,690 CFA to ONCAD. Payment by the farmer is in 5 equal annuities at real interest rate of 2.5 percent.

[j]Lister HR2 engine, Caprari pump, piping and spare parts, furnished tax-free. Service life is estimated at 10 years. Total value 1,760,000 CFA francs. An additional 190,000 CFA francs worth of parts are subject to taxes, and have a service life of 5 years. 140,000 CFA francs of locally purchased equipment and services (masons) are also subject to all taxes. All of the above costs are for a 20 hectare polder and 65 percent of the total annual costs are allocated to the rice crop. The allocation is on the basis of the water requirements of the two crops; rice and maize. Project vehicles, extension agents' mopeds, and boats are also included in this line item. Boats are fully allocated to the rice crop while other vehicles are allocated to rice at 65 percent of their cost.

[k]Construction is estimated at 66 mandays/hectare. The polder is assumed to require rebuilding every 10 years.

[l]Operating costs of the pumps: 245 litres of fuel per hectare of rice crop at 72 CFA francs/litre plus delivery of 1,715 CFA, 9.7 litres of lubricants at 300 CFA/litre plus a delivery cost of 485 CFA francs. Pump maintenance costs were estimated to be 10 percent of the capital value for 20 hectares, and were allocated to the rice crop at 65 percent of the total cost. Operation and maintenance costs of the vehicles and boats per hectare of rice crop were estimated at 5,834 CFA francs.

Footnotes for Table A-1 (continued).

[m]Extension costs assumed one extension agent/30 hectares, one mechanic and various office personnel directly involved in rice production.

[n]Working capital was estimated on three months of labor inputs at 20 percent and on farmer intermediate inputs which are repaid at the time of harvest, for three months at 2.5 percent interest.

Table A-2.--Production Budget for Farming, Nianga, Fleuve*

(CFA francs/ha)

Inputs	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Domestic capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Direct labor[a]	135	33,225							33,225
A. Land preparation									
B. Seeding									
C. Chemical application	3								
D. Weeding[b]	35								
E. Pest control	48								
F. Irrigation	6								
G. Harvesting	40								
H. Threshing	3								
I. Transport									
2. Seed[c]			2,387	597		4,675	533	208	8,400
3. Fertilizer[d]			4,091	1,892		15,234	-11,282	-4,342	5,594
4. Insecticides, etc.[e]			874	624		8,741	1,998	250	12,486
5. Interest and depreciation									
A. Small tools			2,365	1,040		1,182	142	--	4,729
B. Animals[f]				787					787
C. Animal implements									
D. Mechanical equipment[g]			828	473		10,005	-10,005	-1,301	
E. Land improvement[h]			8,329	1,587		22,608	-22,608	-9,916	
6. Operation and maintenance									
A. Animals									
B. Animal implements									
C. Mechanical equipment[i]			6,067	1,946		13,527	-13,527	-8,013	
D. Land improvements			3,465			3,805	-3,805	-3,465	
7. Extension services[j]			4,949	308		619	619	-5,257	
8. Fixed charges, water[k]								25,000	25,000
9. Machinery services[l]			5,832	1,053		8,991	7,511	2,123	25,500
10. Other costs, working capital[m]			1,324	42		308	-308	-183	1,183
Total costs		33,225	40,511	10,349		89,685	-51,969	-4,897	116,904

Yield 3,800 mt/ha; market price farm gate 41.5; ratios of shadow price to market price for: unskilled labor 1 ; skilled labor 1 ; labor 1 ; capital 1 ; land 1 ; and foreign exchange; total social cost per hectare 171,770; total social cost per metric ton milled product equivalent.

Footnotes for Table A-2.

*Data are from Chef de Perimetre, SAED/Nianga, furnished in response to questionnaires submitted by Stanford/WARDA in 1977. (See other sources in notes.)

[a]128 days of male labor valued at 250 CFA francs and 7 days of female labor valued at 175 CFA francs.

[b]Includes 7 days of female labor.

[c]120 kgs of 1 Kong Pao seed from the Nianga seed farm valued at 70 CFA francs farmer price and 83 CFA francs cost price.

[d]34 kgs KCl (0-0-60) and 195 kgs NPK (16-48-0) both valued at 16 CFA francs/kg, and 96.5 kgs of Urea (46-0-0) at 20 CFA francs/kg farmer price. Cost price of the fertilizers were 39.5, 67, and 83 CFA francs/kg respectively. Total delivery costs from Saint-Louis (225 kms) was estimated at 442 CFA francs.

[e]0.5 kgs of Basudin at 685 CFA francs/kg and 9.7 litres of Stam F 34 at 1,252 CFA francs/litre.

[f]Locally purchased donkey at 10,000 CFA francs with a 10 year service life, depreciated at 20 percent. Annual maintenance costs were included 1,550 CFA francs, as well. Half of the costs were allocated to the rice crop.

[g]Tractors, trailers, plows, offset, harrows, seeders, and threshers, project vehicles, and extension agents' mopeds. Data are from SAED/Division Financiere, "Materiel d'exploitation du Perimetre de Nianga", 1976.

[h]Includes the cost of land development, construction of pumping station, and the capital cost of pumps. Data are from Hydroplan Ingenieur Gesellschaft, "Amenagement Hydroagricole du perimetre de Nianga/Senegal; Premiere tranche de l'Amenagement Interieur -- Rapport Final sur l'execution des travaux", 1975. Irrigation infrastructure was assumed to have a 25 year service life and was depreciated at 2.5 percent real interest. Buildings were assumed to have a 20 year life, while equipment was assumed a service life of 10 years. Costs were charged to the rice crop on the basis of the water requirements at 65 percent of the total charges.

[i]Includes the operation and maintenance of the pumping units, vehiches, and agricultural machinery. Pump operation cost data are from SAED, "Cout de Pompage a Nianga", 1975.

[j]An extension density of 1 agent/75 hectares was assumed.

[k]A flat fee of 25,000 CFA francs was charged to the farmers per hectare of rice crop.

Footnotes for Table A-2 (continued).

[l]The mechanical services were: Deep plowing by a 805 Fiat every fourth year at a fee of 8,000 CFA francs, annual offset and cross-harrowing by 805 Fiat crawlers at a fee of 5,000 CFA each, seeding with 480 Fiat and Nodet-Gougis seeder at 3,500 CFA, and threshing with a BORGA thresher (800 kgs paddy/hr) at 10,000 CFA francs. Transportation to collection centers is done with the 480 Fiat and a trailer at no charge to the farmers. Total farmer costs are 25,500 CFA francs/ha, while the real costs were estimated at 21,523 CFA francs. Data were updated from SAED, "Couts des facons culturales a Nianga", 1975.

[m]Working capital was charged on labor inputs for 2 months at 20 percent, and on intermediate inputs which are repaid at harvest time, for 3 months at a real interest rate of 2.5 percent.

Table A-3.--Production Budget for Farming, Delta, Fleuve*

(CFA francs/ha)

Inputs	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Domestic capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Direct labor[a]	92	22,625							22,625
A. Land preparation									
B. Seeding									
C. Chemical application	4	1,000							
D. Weeding[b]	25	6,250							
E. Pest control	28	7,000							
F. Irrigation	4	1,000							
G. Harvesting	28	7,000							
H. Threshing	3	750							
I. Transport									
2. Seed[c]			2,300	576		4,497	424	183	8,050
3. Fertilizer[d]			2,929	1,425		12,634	-9,422	-3,166	4,400
4. Insecticides, etc.[e]			870	623		8,704	-40	-82	10,075
5. Interest and depreciation									
A. Small tools[f]			1,794	790		897	108	1	3,590
B. Animals				787					787
C. Animal implements			23	16		232	-21	-134	116
D. Mechanical equipment			1,178	673		14,240	-14,240	-1,851	
E. Land improvement[g]			12,814	2,441		34,781	-34,781	-15,255	
6. Operation and maintenance									
A. Animals									
B. Animal implements									
C. Mechanical equipment			2,231	1,437		9,936	-9,936	-3,668	
D. Land improvements			5,330			5,850	-5,850	-5,330	
7. Extension services[h]			3,642	238		647	-647	-3,880	
8. Fixed charges, water[i]								25,000	25,000
9. Machinery services[j]			5,056	936		7,865	9,144	3,166	26,167
10. Other costs, working capital[k]			936	33		242	-242	-144	825
Total costs		22,623	39,103	9,975		100,525	-65,434	-5,159	101,635

Yield 2,500 mt/ha; market price farm gate 41.5; ratios of shadow price to market price for: unskilled labor 1; skilled labor 1; labor 1; capital 1; land 1; and foreign exchange 1; total social cost per hectare 172,228; total social cost per metric ton milled product equivalent.

Footnotes for Table A-3.

*Data are from Mr. Diallo, Chef de Perimetre, SAED/Delta, furnished in response to questionnaires submitted by Stanford/ WARDA, 1977. The Tertiary Development Boundoum Project was used here as the example.

[a]87 days of male labor valued at 250 CFA francs/day and 5 days of female labor valued at 175 CFA francs/day.

[b]Includes 5 days of female labor.

[c]115 kgs/hectare of I Kong Pao seed delivered from the Savoigne Seed Multiplication farm at a farmer cost of 70 CFA francs/ kg. The delivered cost price is 83 CFA francs/kg.

[d]150 kgs NPK (16-48-0) at 16 CFA francs/kg and 100 kgs of Urea (46-0-0) at 20 CFA francs/kg farmer price. The delivered cost prices were 67 CFA and 84 CFA francs/kg respectively.

[e]1 kg of Basddin at 685 kg CFA francs/kg, 20 kgs of HCH at 118 CFA francs, and 7.5 litres of Stam F 34 at 1,252 CFA francs/ litre.

[f]4 daba, 2 shovels, and 6 sickles per hectare were assumed. In addition each hectare used 1/10th of the capacity of a back-sprayer.

[g]Land development costs of an incremental tertiary irrigated hectare were assumed rather than the costs of upgrading more rudimantary secondary polders. The figures used here are from Nianga. (See Table A-2, Note (h)).

[h]An extension density of one agent/100 hectares was assumed. Ross Bethio Delta Perimeter Overhead administration personnel services were pro-rated to the Boundoum project proportionally by the surface of the project.

[i]A flat fee of 25,000 CFA francs/hectare of rice crop is levied on the farmer.

[j]Deep plowing with crawler tractors is done every third year at a fee of 8,000 CFA francs/hectare, offset and cross-harrowing each year at a fee of 5,000 CFA each, seeding at 3,500 CFA, and threshing at 10,000 CFA francs/hectare. Total farmer cost is 26,167 CFA francs/hectare of rice crop.

[k]Working capital was charged on two months of labor inputs at 20 percent interest and on intermediate inputs for which repayment occurs at harvest for a three month term at 2.5 percent real interest.

Table A-4.--Production Budget for Farming, Traditional Swamp, Casamance*

(CFA francs/ha)

Inputs	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Domestic capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Direct labor[a]	208	48,650							48,650
A. Land preparation	56								
B. Seeding[b]	55								
C. Chemical application[c]	3								
D. Weeding[d]	25								
E. Pest control[e]	20								
F. Irrigation									
G. Harvesting[f]	41								
H. Threshing									
I. Transport[g]	8								
2. Seed[h]		3,935		265					4,200
3. Fertilizer									
4. Insecticides, etc.									
5. Interest and depreciation									
A. Small tools, hand tools			300	132		150	18		600
B. Animals									
C. Animal implements									
D. Mechanical equipment									
E. Land improvement[i]				1,002					1,002
6. Operation and maintenance									
A. Animals									
B. Animal implements									
C. Mechanical equipment									
D. Land improvements									
7. Extension services									
8. Fixed charges									
9. Land cost									
10. Other costs, working capital[j]				3,540					3,540
Total costs		52,585	300	4,939		150	18		57,992

Yield 1,080 mt/ha; market price farm gate 50-57; ratios of shadow price to market price for: unskilled labor 1; skilled labor 1; labor 1; capital 1; land 1; and foreign exchange 1; total social cost per hectare 57,974; total social cost per metric ton milled product equivalent.

Footnotes for Table A-4.

*Data were provided by Kathryn Craven, Stanford/WARDA, 1977.

[a]70.5 days of male labor valued at 300 CFA francs/day and 137.5 female work days valued at 200 CFA francs.

[b]Includes 55 days of female labor.

[c]Includes 3 days of female labor; manuring.

[d]Task performed exclusively by women; 25 days.

[e]Task performed exclusively by women; 20 days.

[f]Task performed excusively by women; 41 days.

[g]Task performed exclusively by women; head carrying 8 days.

[h]70 kgs of retained traditional seed valued at 60 CFA francs/kg.

[i]Land improvement consists of bund construction for 14 days of labor valued at 300 CFA francs/day. Service life of improvements is 10 years, and the investment is depreciated at 20 percent interest.

[j]Working capital is charged on the value of seeds over 6 months and on labor inputs over three months at 20 percent interest.

Table A-5.--Production Budget for Farming, Improved Swamp, Manual, Casamance*
(CFA francs/ha)

Inputs	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Domestic capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Direct labor[a]	229	55,025							55,025
A. Land preparation	56								
B. Seeding[b]	55								
C. Chemical application[c]	3								
D. Weeding[d]	35								
E. Pest control[e]	20								
F. Irrigation									
G. Harvesting[f]	29								
H. Threshing[g]	22								
I. Transport	9								
2. Seed[h]			615	154		1,205	469	257	2,700
3. Fertilizer[i]			3,704	1,751		14,335	-10,656	-3,934	5,200
4. Insecticides, etc.			29	21		286	-286	-49	0
5. Interest and depreciation									
A. Small tools				582			18		600
B. Animals[j]				149					149
C. Animal implements									
D. Mechanical equipment				94				-94	0
E. Land improvement[k]			0	1,159		0	0	-157	1,002
6. Operation and maintenance									
A. Animals[l]				194					194
B. Animal implements									
C. Mechanical equipment			2	2		24	-24	-3	0
D. Land improvements									
7. Extension services[m]			4,445	278		556	-556	-4,722	0
8. Working capital[n]				3,855				-285	3,570
9. Land cost									
10. Other costs (ox cart rental)[o]			855	90		3,195	315	45	4,500
Total costs		55,025	9,649	8,328		19,600	-10,719	-8,943	72,940

Yield 2,250 mt/ha; market price farm gate 41.5; ratios of shadow price to market price for: unskilled labor 1; skilled labor 1; labor 1; capital 1; land 1; and foreign exchange; total social cost per hectare 92,602; total social cost per metric ton milled product equivalent.

Footnotes for Table A-5.

*Data were furnished by Kathryn Craven, Stanford/WARDA, 1977.

[a]137 days of female labor valued at 200 CFA francs/day and 92 days of male labor valued at 300 CFA francs.

[b]Includes 41 days of female labor.

[c]Includes 2.5 days of female labor.

[d]Task performed by female labor only.

[e]Task performed by female labor only.

[f]Includes 22 days of female labor.

[g]Includes 16.5 days of female labor.

[h]40 kgs of I Kong Pao seed per hectare valued at 67.5 CFA francs/kg farmer price, and 64 CFA francs/kg cost price.

[i]200 kgs of NPK (8-18-27) valued at 16 CFA francs/kg and 100 kgs of Urea valued at 20 CFA francs/kg farmer price, with a cost price of 67 and 83 CFA francs respectively.

[j]One donkey used half-time on 8 hectares, valued at 10,000 CFA francs and depreciated over its service life of 10 years at 20 percent interest.

[k]Land development consists of the construction of bunds using 14 mandays at 300 CFA francs/day, and applying rock phosphate. The investments are depreciated over 10 years at 20 percent interest rate.

[l]Maintenance costs of the donkey.

[m]An extension density of one agent for 100 hectares was assumed.

[n]Working capital was charged on 3 months of labor inputs at an interest rate of 20 percent and on 6 months on intermediate inputs which are repaid at harvest time, at a rate of 2.5 percent.

[o]Ox cart were rented at a rate of 2,000 CFA francs/mt.

Table A-6.--Production Budget for Farming, Improved Swamp Cultivation with Water Control, Casamance*

(CFA francs/ha)

Inputs	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Domestic capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Direct labor[a]	266	62,675							62,675
A. Land preparation	56								
B. Seeding[b]	55								
C. Chemical application[c]	3								
D. Weeding[d]	35								
E. Pest control[d]	20								
F. Irrigation									
G. Harvesting[e]	46								
H. Threshing[f]	36								
I. Transport[g]	15								
2. Seed[h]			615	154		1,205	469	256	2,700
3. Fertilizer[i]			4,754	2,293		19,668	-14,629	-5,086	7,000
4. Insecticides, etc.			29	21		286	-286	-49	0
5. Interest and depreciation									
A. Small tools				854			26		880
B. Animals[j]				239					239
C. Animal implements									
D. Mechanical equipment				94				-94	0
E. Land improvement[k]				11,807				-10,805	1,002
6. Operation and maintenance									
A. Animals				310					310
B. Animal implements									
C. Mechanical equipment			2	2		24	-24	-3	
D. Land improvements[l]			2,500	400		5,400	-5,400	-2,900	
7. Extension services[m]			8,890	556		1,111	-1,111	-9,445	
8. Working capital[n]				4,504				-379	4,125
9. Land cost									
10. Other costs (ox cart rental)[o]			1,368	144		5,112	504	72	7,200
Total costs		62,675	18,157	21,376		32,805	-20,450	-28,433	86,130

Yield 3,600 mt/ha; market price farm gate 41.5; ratios of shadow price to market price for: unskilled labor 1; skilled labor 1; labor 1; capital 1; land 1; and foreign exchange 1; total social cost per hectare 35,013; total social cost per metric ton milled product equivalent ____.

Footnotes for Table A-6.

*Data are from Projet Rural de Sedhiou (PRS) furnished in response to questionnaires submitted by Kathryn Craven Stanford/ WARDA, 1977.

[a]171 days of female labor valued at 200 CFA francs/day and 95 days of male labor valued at 300 CFA francs.

[b]Includes 41 days of female labor.

[c]Includes 2.5 days of female labor.

[d]Task performed entirely by female labor.

[e]Includes 34.5 days of female labor.

[f]Includes 27 days of female labor.

[g]Includes 11 days of female labor.

[h]40 kgs of I Kong Pao seed per hectare valued at 67.5 CFA francs/kg farmer price and 64 CFA cost price.

[i]250 kgs of NPK (8-18-27) at a farmer price of 16 CFA francs/kg and 150 kgs of Urea (46-0-0) at 20 CFA francs/kg farmer price; valued at 67 and 83 CFA francs/kg cost-price, respectively.

[j]One donkey for 5 hectares used half-time on the rice crop, and is valued at 10,000 CFA francs and depreciated over a 10 year service life at 20 percent interest.

[k]Manually constructed bunding; 14 mandays at 300 CFA francs/day and depreciated over 10 years at 20 percent, and mechanically constructed retention and drainage canals valued at 200,000 CFA francs and depreciated over 20 years at 2.5 percent interest. The retention and drainage network is fully subsidized to the farmers.

[l]Maintenance of the drainage canals assumed to be at an annual rate of 5 percent of the capital value of the investment.

[m]An extension density of one agent/50 hectares was assumed.

[n]Working capital was charged on labor inputs for 3 months at 20 percent and on intermediate inputs which are repayed at harvest time for 4 months at a 2.5 percent interest rate.

[o]Ox-cart services are rented at a cost of 2,000 CFA francs/mt.

Table A-7.--Production Budget for Farming, Rainfed, Animal-Traction, Casamance*

(CFA francs/ha)

Inputs	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Domestic capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Direct labor[a]	111	26,985							26,985
A. Land preparation	12								
B. Seeding	2								
C. Chemical application	2								
D. Weeding[b]	25								
E. Pest control[c]	20								
F. Irrigation									
G. Harvesting[d]	27								
H. Threshing[e]	21								
I. Transport	2								
2. Seed[f]			1,231	308		2,410	938	514	5,401
3. Fertilizer[g]			2,903	1,418		12,500	-9,301	-3,119	4,401
4. Insecticides, etc.			29	20		286	-286	-49	0
5. Interest and depreciation									
A. Small tools				854			26		880
B. Animals[h]			156	884					1,040
C. Animal implements[i]			93	93		1,379	-324	-119	1,122
D. Mechanical equipment				94				-94	0
E. Land improvement[j]			3,000					-3,000	0
6. Operation and maintenance									
A. Animals[k]				1,300					1,300
B. Animal implements[k]			210	116		573	16	-30	885
C. Mechanical equipment[k]			2	2		24	4	1	32
D. Land improvements									
7. Extension services[l]			4,445	278		556	-556	-4,723	0
8. Working capital[m]				2,188				-253	1,935
9. Land cost									
10. Other costs									
Total costs		26,985	12,069	7,555		17,727	-9,483	-10,872	43,981

Yield 2,070 mt/ha; market price farm gate 41.5; ratios of shadow price to market price for: unskilled labor 1; skilled labor 1; labor 1; capital 1; land 1; and foreign exchange 1; total social cost per hectare 64,336; total social cost per metric ton milled product equivalent.

Footnotes for Table A-7.

*Data are from SODEFITEX, furnished in response to questionnaires submitted by Kathryn Craven, Stanford/WARDA, 1977.

[a]63 days of female labor valued at 200 CFA francs/day and 48 days of male labor valued at 300 CFA francs.

[b]Includes 19 days of female labor.

[c]Includes 10 days of female labor.

[d]Includes 18 days of female labor.

[e]Includes 16 days of female labor.

[f]80 kgs of I Kong Pao seed valued at 67.5 CFA francs/kg farmer price, and 64 CFA francs/kg cost price.

[g]150 kgs of NPK (8-18-27) at 16 CFA francs/kg and 100 kgs/Urea (46-0-0) at 20 CFA francs/kg farmer price, and at a cost price of 67 and 83 CFA francs/kg respectively.

[h]A pair of trained oxen valued at 65,000 CFA used on 5 hectares, and depreciated over service life at 8 percent interest.

[i]A UCF plow, Sine Hoe, Super Eco seeder, and ox-cart were assumed to have been used for 5 hectares with a service life of 10 years and depreciated at 8 percent interest rate.

UCF plow	15,342	CFA francs farmer cost	20,515	CFA francs cost price
Sine hoe	14,192	CFA francs farmer cost	18,978	CFA francs cost price
Super eco	19,021	CFA francs farmer cost	25,000	CFA francs cost price
Ox cart	41,680	CFA francs farmer cost	65,528	CFA francs cost price

[j]50 mandays of land improvement at 300 CFA francs/day with infinite service life (given proper maintenance) depreciated at 20 percent interest rate.

[k]Maintenance and operating costs were assumed at 10 percent of the annual per hectare capital value.

[l]An extension density of one agent/100 hectares was assumed, and salary figures from the Projet Rural de Sedhiou were used.

[m]On labor inputs for three months at 20 percent interest, and on intermediate inputs repayable at harvest for four months at a 2.5 percent interest rate.

Table B.--Budget for Collection

Informal Paddy Collection for Small Hullers, Casamance

Units: CFA francs/kg paddy

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies		Total market value
					Tradables	Nontradables	
1. Sacks[a]		.13	.10	.92	.23	.04	1.42
2. Handling[b]	.30						.30
3. Transport[c]		.42	.09	.68	.43	.43	2.05
Total	.30	.55	.19	1.60	.66	.47	3.77

Price received at 45.3; ratios of shadow price to market price for: Unskilled labor 1, skilled labor 1, capital 1, land 1; total social cost per kilogram paddy 3.77, per metric ton milled product equivalent 5,800.

[a]85 CFA francs/60 kg sack.

[b]Loading and unloading at 150 CFA francs/mt each.

[c]Transportation over 50 kilometers of unpaved road to mill site, at 100 CFA/75 kg sack.

Table B.--Budget for Collection

Official Paddy Collection, Casamance

Units: CFA francs/kg paddy

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies		Total market value
					Tradables	Nontradables	
1. Sacks[a]		.12	.09	.94	.22	.04	1.41
2. Handling[b]	.40						.40
3. Transport		.65	.18	.90	.20	.04	1.97
4. Administration		.43	.10	.46	.07	.04	1.10
5. Capital charges[c]		.10	.02	.06	.01	.01	.20
6. Storage[d]		.07	.15	.08	.09	-	.39
Total	.40	1.37	.54	2.44	.59	.13	5.47

Price received at mill 47.0 ; ratios of shadow price to market price for: unskilled labor 1 , skilled labor 1 , capital 1 , land 1 ; total social cost per kilogram paddy 5.46 , per metric ton milled product equivalent 8,400 .

[a]85 CFA francs/60 kg sack.

[b]200 CFA francs/mt for loading and unloading each.

[c]Paddy purchase price plus sack, handling, and transportation costs over a two month period at 2.5 percent interest.

[d]200 CFA francs/mt/month over an average duration of two months.

Table B.--Budget for Collection

Boundoum project to Ross Bethio, Official Channels

Units: CFA francs/kg paddy

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies		Total market value
					Tradables	Nontradables	
1. Sacks[a]		.12	.09	.94	.22	.04	1.41
2. Handling	.69						.69
3. Transport[b]		.04	.01	.06	.01	.01	.13
4. Administration		.43	.10	.46	.07	.04	1.10
5. Capital charges[c]		.10	.02	.06	.01	.01	.20
6. Storage[d]		.07	.15	.08	.09	-	.39
Total	.69	.76	.37	1.60	.40	.10	3.92

Price received at mill 45.4 CFA francs/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; total social cost per kilogram paddy 3.92 CFA francs, per metric ton milled product equivalent 5,939 CFA francs.

[a]85 CFA francs/50 kg sack.

[b]Transported to Ross Bethio, 15 kilometers on a 10-ton Berliet truck.

[c]Paddy price plus sack, handling and transportation costs over a two month period at 2.5 percent interest.

[d]200 CFA francs/mt/month over an average of two months holding time.

Table B.--Budget for Collection

Nianga to Ross Bethio, Official Channels

Units: CFA francs/kg paddy

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies		Total market value
					Tradables	Nontradables	
1. Sacks[a]		.12	.09	.94	.22	.04	1.41
2. Handling	.69						.69
3. Transport[b]		.48	.13	.68	.14	.04	1.47
4. Administration		.43	.10	.46	.07	.04	1.10
5. Capital charges[c]		.10	.02	.06	.01	.01	.20
6. Storage[d]		.07	.15	.08	.09	-	.39
Total	.69	1.20	.49	2.22	.53	.13	5.26

Price received at mill 46.8: ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; total social cost per kilogram paddy 5.26 CFA francs, per metric ton milled product equivalent 7,970 CFA francs.

[a]85 CFA francs/60 kg sack.

[b]Transported to Ross Bethio 175 kilometers on a 10-ton Berliet truck.

[c]Paddy purchase price plus sack, handling and transportation costs over a two month period at 2.5 percent interest.

[d]200 CFA francs/mt/month over an average of two months holding time.

Table B.--Budget for Collection

Matam to Ross Bethio, Official Channels

Units: CFA francs/kg paddy

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies		Total market value
					Tradables	Nontradables	
1. Sacks[a]		.12	.09	.94	.22	.04	1.41
2. Handling	.69						.69
3. Transport[b]		1.05	.29	1.47	.32	.06	3.19
4. Administration		.43	.10	.46	.07	.04	1.10
5. Capital charges[c]		.10	.02	.06	.01	.01	.20
6. Storage[d]		.07	.15	.08	.09	-	.39
Total	.69	1.77	.65	3.01	.71	.15	6.98

Price received at mill 48.5 CFA/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; total social cost per kilogram paddy 6.98 CFA francs, per metric ton milled product 10,576 CFA/kg.

[a]85 CFA francs/60kg sack.

[b]Transported by a 10-ton Berliet Truck 380 kilometers.

[c]Paddy purchase price plus sack, handling and transport costs held for two months at 2.5 percent interest.

[d]200 CFA francs/mt/month over an average two months holding time.

Table C.--Budget for Milling

Handpounding

Units: CFA francs/kg milled rice

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies		Total market value
					Tradables	Nontradables	
1. Direct labor[a]	12.68						12.68
2. Interest and depreciation on equipment[b]			.16				.16
3. Maintenance and repair of equipment[c]			.03				.03
Total	12.68		.19				12.87

Yield 69%; percentage brokens 40; price received ex-mill _____; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; total social cost per kilogram milled rice _____, per metric ton milled rice _____.

[a]40 kilograms of paddy can be pounded per hour up to 5 hours per day. The wage rate is 175 CFA francs/day.

[b]The equipment used here consists of a 600 CFA mortar and a 300 CFA pestle (pilon) which have a 3 year service life, and are depreciated at 20 percent interest.

[c]Maintenance and repairs were assumed to be 10 percent of the total capital costs of the equipment.

Table C.--Budget for Milling

Small Hullers[a]

Units: CFA francs/kg milled rice

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Direct labor[b]		.91					.91
2. Fuel[c]		.05	.03	.36	.23	.01	.68
3. Oil[d]		.02	.02	.17	.11	.01	.33
4. Interest and depreciation							
A. Building[e]		.04	.03	.03	.01	.03	.14
B. Equipment[f]		.03	.02	.43	.05	.01	.54
5. Maintenance and repair of equipments[g]		.07	.04	.19	.07	.02	.39
6. Other							
A. Bags for bran		.01	.01	.05	.01	-	.08
B. Bran sales				-.23	-	-	-.23
Total		1.13	.15	1.00	.48	.08	2.84

Yield 65%; percentage brokens 40; price received ex-mill _____; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; total social cost per kilogram milled rice _____, per metric ton milled rice _____.

[a]750 hours of operation are assumed annually (150 days at 5 hours/day), for an output of 187.5 mt of rice per year.

[b]Labor component assumes one person for 150 days at 535 CFA francs/day.

[c]Fuel consumption is assumed to be 2 litres/hour at 75 CFA francs/litre.

[d]Inclusive of other material besides oil for 931 CFA francs/mt.

[e]A shelter valued at 150,000 CFA francs with a service life of 5 years, depreciated at 20 percent interest.

Footnotes for Table C (continued).

[f] 1,200,000 CFA francs Huller with an average service life of 5 years depreciated at 20 percent interest.

[g] 25 CFA/mt; every 5 months 400 CFA francs/blades, and every 2 months 2,000 CFA francs for screens which require replacement.

Table C.--Budget for Milling

Large-Scale Mill/Casamance*

Units: CFA francs/kg milled rice

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies		Total market value
					Tradables	Nontradables	
1. Direct labor (personnel)		4.830					4.830
2. Fuel, oil, and electricity[a]		.140	.090	.910	.580	.030	1.750
3. Interest and depreciation[b]							
A. Building	1.77		1.08	1.22	.470	1.290	5.830
B. Equipment	1.10		.40	.60	.280	.120	2.500
4. Maintenance and repair							
A. Building	.260		.184	.541	.138	.102	1.225
B. Equipment	.089		.053	.252	.100	.031	.525
5. Capital charges (interest)		.300	.150	.190	.080	.150	.870
6. Insurance		.130	.040	.050	.010	.060	.290
7. Losses	1.620		.300	.890	.120	.120	3.050
8. Storage		.096	.059	.066	.025	.070	.316
9. Administration		.143	.044	.047	.013	.069	.316
Total	4.839	5.639	2.400	4.766	1.816	2.042	21,500

Yield 65%; percentage brokens 45; price received ex-mill _____; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; total social cost per kilogram milled rice _____, per metric ton milled rice _____.

*Based on information provided by the personnel of the Séfa mill, Casamance, in response to questionnaires submitted by K. Craven, Stanford/WARDA, 1977.

Footnotes for Table C.

[a]Capital charges represent government loans. The figure reported by the mill was taken as nominal (7 1/2 percent) and discounted to a real interest rate of 2 1/2 percent.

[b]Storage charges are 200 CFA francs/mt.

Table C.--Budget for Milling

Large-Scale Mill/Ross-Bethio*

Units: CFA francs/kg milled rice

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Direct labor		4.951					4.951
2. Fuel, oil, and electricity		.254	.15[illegible]	1.654	1.050	.064	3.181
3. Bags		2.031	.281	.219	.500	.094	3.125
4. Interest and depreciation							
A. Building		1.256	.769	.868	.331	.909	4.133
B. Equipment		1.295	.470	.706	.323	.147	2.941
5. Maintenance and repair							
A. Building	.683		.483	1.424	.364	.267	3.221
B. Equipment	1.140		.671	3.220	1.274	.403	6.708
6. Administration		.600	.183	.199	.053	.290	1.325
7. Insurance		.089	.027	.030	.008	.043	.197
8. Other							
A. Losses 5%	1.685		.318	.922	.127	.127	3.179
B. Seed treatment		.039	.011	.404	.088	.012	.554
Total	3.508	10.515	3.372	9.646	4.118	2.356	33.515

Yield 66%; percentage brokens 80; price received ex-mill _____; ratios of shadow price to market price for: unskilled labor _____, skilled labor _____, capital _____, land _____; total social cost per kilogram milled rice _____, per metric ton milled rice _____.

*Data are from Mr. Maitre, SAED/Division Industrielle (DIN)-Rizerie, furnished in response to questionnaires submitted by Stanford/WARDA, 1977, SAED/DIN-Rizerie, "Rapport d'Activites du Mois", various 1975-76, SAED/DIN, "Budget de Fonctionnement", 1976, SAED/DIN, "Couts du Riz Usiné par la SAED", 1975, and SONED, "Elements d'Integrations Industrielle", Vol. II, Dakar 1977, pp. 18-27.

Table D.--Budget for Distribution

Small Hullers to Ziguinchor*

Units: CFA francs/kg milled rice

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies		Total market value
					Tradables	Nontradables	
1. Handling[a]	.400						.400
2. Transport[b]		.950	.198	1.540	.972	1.000	4.660
3. Commissions[c]		.330	.090	.460	.100	.020	1.000
4. Capital charges		.202	.043	.126	.027	.022	.420
5. Storage[d]		.122	.075	.084	.032	.088	.401
Total	.400	1.604	.406	2.210	1.131	1.130	6.881

Price received from wholesalers in consumption center _____; border price of comparable rice _____; ratios of shadow price to market price for: unskilled labor __1__, skilled labor __1__, capital __1__, land __1__; total social cost per kilogram milled rice _____, per metric ton milled rice _____.

*Data were provided by Kathryn Craven, Stanford/WARDA, 1977.

[a]200 CFA francs/mt for loading and unloading each.

[b]4,660 CFA francs/mt trucking costs.

[c]Weighing charges and commissions.

[d]200 CFA francs/mt/month over a two month holding period.

Table D.--Budget for Distribution

Large Mill (Casamance) to Ziguinchor*

Units: CFA francs/kg milled rice

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies		Total market value
					Tradables	Nontradables	
1. Sacks[a]		.123	.094	.936	.222	.043	1.418
2. Handling[b]	.400						.400
3. Transport		.578	.158	.806	.175	.035	1.752
4. Commissions[c]		.330	.090	.460	.100	.020	1.000
5. Capital charges		.196	.041	.122	.026	.021	.406
6. Storage[d]		.243	.149	.168	.064	.176	.800
Total	.400	1.470	.531	2.492	.587	.295	5.776

Price received from wholesalers in consumption center _____; border price of comparable rice _____; ratios of shadow price to market price for: unskilled labor __1__, skilled labor __1__, capital __1__, land __1__; total social cost per kilogram milled rice _____, per metric ton milled rice _____.

*Data were provided by Kathryn Craven, Stanford/WARDA, 1977.

[a]85 CFA francs/60 kilogram sack.

[b]200 CFA francs/mt for loading and unloading.

[c]ONCAD marketing commission of 1,000 CFA francs/mt of milled rice.

[d]400 CFA francs/mt of milled rice/month for a two month period.

Table D.--Budget for Distribution

Large Mill (Casamance) to Dakar*

Units: CFA francs/kg milled rice

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies		Total market value
					Tradables	Nontradables	
1. Sacks[a]		.123	.094	.936	.222	.043	1.418
2. Handling[b]	.400						.400
3. Transport		1.708	.466	2.382	.520	.100	5.176
4. Commissions[c]		.330	.090	.460	.100	.020	1.000
5. Capital charges[d]		.202	.043	.126	.027	.022	.420
6. Storage[e]		.243	.149	.168	.064	.176	.800
Total	.400	2.606	.842	4.072	.933	.361	9.214

Price received from wholesalers in consumption center _____; border price of comparable rice _____; ratios of shadow price to market price for: unskilled labor __1__, skilled labor __1__, capital __1__, land __1__; total social cost per kilogram milled rice _____, per metric ton milled rice _____.

*Data were furnished by ONCAD and Sefa mill personnel in response to questionnaires submitted by Stanford/WARDA, 1977.

[a]85 CFA francs/60 kg sack.

[b]200 CFA francs/mt for loading and unloading each.

[c]ONCAD marketing charges; 1,000 CFA francs/mt.

[d]Paddy price delivered to the mill plus milling costs, handling, and transportation costs over an average of two months at 2 1/2 percent interest.

[e]400 CFA francs/mt/month over two months.

Table D.--Budget for Distribution

Large Mill (Ross-Bethio) to Dakar*

Units: CFA francs/kg milled rice

Inputs	Unskilled labor	Skilled labor	Capital	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Sacks[a]		.123	.094	.936	.222	.043	1.418
2. Handling[b]	.400						.400
3. Transport[c]		.899	.245	1.253	.272	.054	2.723
4. Commissions[d]		.330	.090	.460	.100	.020	1.000
5. Capital charges		.202	.043	.126	.027	.022	.420
6. Storage[e]		.243	.149	.168	.064	.176	.800
Total	.400	1.797	.621	2.943	.685	.315	6.761

Price received from wholesalers in consumption center _____; border price of comparable rice _____; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; total social cost per kilogram milled rice _____, per metric ton milled _____.

*Data were provided by ONCAD and SAED in response to questionnaires submitted by Stanford/WARDA, 1977.

[a]85 CFA francs/60 kg sack.

[b]200 CFA/mt for loading and unloading, each.

[c]Delivery to Dakar (325 kms) by 10-ton truck.

[d]ONCAD commission of 1,000 CFA francs/mt.

[e]400 CFA francs/mt/month for an average duration of two months.

[f]Deliveries of milled rice to Saint-Louis from the Ross-Bethio mill differ only in the transportation line item, as the transport distance is reduced to 55 kms. The total transport cost reduces to .419 CFA francs/kilogram of milled rice.