INTRODUCTION

Important goals of Malian rice policy have been to reduce imports, to stabilize urban prices and supplies, to increase and stabilize the incomes of rice farmers, and to achieve national food security. These goals have been achieved partly by expanding production at decreasing costs without costly trade restrictions or price supports. The success of policy has been based on the exploitation of water resources at the Office du Niger, where the irrigation system provides complete production security, and on the Niger and Bani rivers, whose geographic and hydrologic characteristics permit extensive low cost polder development. Although farmers have been given indirect subsidies, particularly part of the cost of irrigation, costs of production have been held below world prices, partly by holding producer prices of paddy below the corresponding price of imported rice.

In this paper, the resource cost methodology is used to examine the economic efficiency of the expansion of Malian rice production. The concept of private profitability is used to examine producer incentives. The paper contains five sections: a delineation of the main production, milling, and marketing techniques; a discussion of the system of economic incentives affecting the rice sector; a comparison of the private and social costs of rice production; an analysis of the sensitivities of those benefits to changes in important parameters such as labor costs, yields, and the world price of rice; and an evaluation of the effects of various policies on government objectives.

DELINEATION OF TECHNIQUES

Table 1 summarizes important characteristics of the principal field production techniques and provides alphabetic designators for each of these techniques. Table 2 shows quantities and costs per hectare of inputs in these techniques.

The oldest production technique in Mali is the flooded system (TFM) in the Delta of the Niger and Bani rivers around the city of Mopti and along the flood plains of the Niger toward Segou and of the Bani toward San. That technique is employed on holdings of about 1.5 hectares over a total area of 80,000 to 100,000 hectares.[1] Farmers have larger holdings of rice than of rainfed cereals (millet and sorghum) and combine agriculture with fishing, herding, and trade. There is no mechanization, although animal traction has been common since the 1920s and is now more important than manual cultivation.[2] The only water control is the construction of earth dikes to prevent the too rapid entry of water onto fields of immature plants. Average gross paddy yields are 500 to 700 kilograms per hectare; maximum yields are 1,000 to 1,200 kilograms without the use of inorganic fertilizers.

The crop cycle begins in late May with the first usable rains.[3] The flood starts to rise in the last two weeks of June, reaches most fields between 15 August and 15 September, reaches its peak in October, falls rapidly from mid-November to January, and subsides slowly after January. Flood timing and height are highly variable and are not very strongly correlated with regional rainfall because they are determined by rainfall throughout the basins of the Niger and Bani Rivers upstream of the Delta.

Table 1.--Key Characteristics of Rice Production Techniques

Production technique	Area 1976 (ha)[e]	Gross paddy yields (mt/ha)[f] 1976	Paddy production 1976 (mt)	Type of water control	Crops per year	Source of power: Land preparation	Source of power: Harvest	Improved seeds	Fertilizer	Pesticides
Gravity irrigation (ONC)[a]	39,922	2.25	89,425	diversion dam	1	oxen	manual	yes	yes	no
Gravity irrigation (ONI)[a]	-	3.50	-	diversion dam	1	oxen	manual	yes	yes	no
Controlled flooded (CFS)[b] Segou	34,355	1.58	54,281	partially controlled flooded	1	oxen	manual	yes	no	no
Controlled flooded (CFSI)[b] Segou	-	2.50	-	partially controlled flooded	1	oxen	manual	yes	yes	no
Traditional swamp and rainfed (TS)[c]	11,000	1.2	13,200	none	1	manual	manual	no	no	no
Improved swamp and flooded (IPS)[c]	4,000	1.8	7,200	small diversion dam	1	oxen	manual	yes	no	no
Traditional flooded (TFM)[d] Delta	110,000	0.5	55,000	unimproved flooded	1	oxen and manual	manual	no	no	no
Controlled flooded (CFM)[d] Mopti	16,074	1.15	18,485	partially controlled flooded	1	oxen	manual	yes	no	no
Controlled flooded (CFMI)[d] Mopti	-	2.5	-	partially controlled flooded	1	oxen	manual	yes	yes	no

[a]Gravity Irrigation (Office du Niger--1): Source is (6).

[b]Controlled flooded (Segou): Source is (8).

Continuation of Table 1.

[c]Traditional swamp and rainfed (Sikasso): Source is (9).
Improved swamp and rainfed (Sikasso): Source is (9).

[d]Controlled flooded (Mopti): Source is (7).

[e]Area harvested. This differs from area seeded because some seeded areas do not receive flood water in Segou and Mopti projects.

[f]Yield per seeded hectare, gross of field losses.

Table 2.--Quantities and Costs Per Hectare of Major Input

Production technique	Farm labor (mandays)	Fertilizer (kg) N	Fertilizer (kg) P_2O_5	Fertilizer (kg) K_2O	Seeds (kg)	Land development cost mf/ha	Extension service cost mf/ha
ONC[a]	90	15	0	0	100	sunk	10,000
ONI[a]	120	64	46	0	80	220,000	20,000
CFS[b]	70	0	0	0	100	400,000	6,000
CFSI[b]	95	32	23	0	80	400,000	10,000[f]
TS[c]	120	0	0	0	100	ø	ø
IPS[c]	115	0	0	0	100	300,000-1,000,000[e]	3,500
TFM[d]	60	0	0	0	120	ø	ø
CFM[d]	80	0	0	0	100	500,000	5,000
CFMI[d]	100	32	23	0	80	500,000	10,000[f]

[a]Sources are (6),(13).

[b]Source is (8).

[c]Source is (9).

[d]Sources are (7),(1),(2).

[e]The maximum of this range is the extimated cost of an irrigation scheme in southern Mali which is not yet in production.

[f]The assumption was made that the levels of administrative overhead and extension density in the Segou and Mopti projects were chosen with the goal of achieving yields of 2.5 to 3.0 metric tons/ha of paddy (i.e. the yields of the CFSI and CFMI techniques) and that some of the overhead and extension costs represent transient excess capacity. It was therefore decided to exclude some of those costs from the analysis of the CFS and CFM techniques.

The crop calendar is adapted to the supply of water. Soil preparation, whether accomplished manually or with animal traction, is possible only when there has been enough rain to break the hardpan which forms on the soil when it is dry between February and mid-May. Hand seeding of O. glabberima follows plowing and the seeds are turned over with a hand hoe to prevent desiccation. Many seed varieties have been identified in the Delta and the choice of variety depends upon the position of the farmer's field with respect to the river.[4] Farmers having lower fields must choose longer cycle, generally floating, varieties and plant earlier because their plants must germinate and grow rapidly enough to survive the earlier entry of water. Those having higher fields must avoid planting too early because of the possibility of desiccation in the interval between the first rains and the arrival of the flood. They must also use shorter cycle, generally standing, varieties because of the danger of desiccation of immature plants after the flood's recession.

Fields are weeded after seeding and before the flood's arrival which drowns any remaining weeds that have not grown above the level of the water. There is little field work between weeding and harvesting times. Harvesting from the end of November to the end of January is done with sickles. The paddy is piled in the fields to dry and threshed on the ground with flails.

Heavy field work is done almost exclusively by men while women and children do ancillary tasks.[5] The introduction of animal traction reduces work per hectare at plowing time when off-farm labor is scarce because hired workers, who often come from millet-growing regions, are planting and weeding their fields then. Hired labor is more abundant at harvest time because workers from millet regions have finished their harvests by late November

and come to the rice regions in December to work. Use of hired labor has become more important since the introduction of animal traction enabled farmers to plant larger areas. Development of the traditional system is restrained by the variability of flooding, by the severe infestation of fields with wild rice,[6] and by the low yields of the local glaberrimas.

The second important production technique, the controlled flooded polder system in Operations Riz Segou and Mopti, has been developed to solve the problems of the traditional uncontrolled flooded system. The new techniques (CFS and CFM) are designed primarily to shift traditional farmers into the improved polders, but they have also introduced rice farming into some areas, especially near Segou, that were formerly devoted largely to millet and sorghum cultivation, and to some absentee farmers, especially near Mopti, who have other primary activities such as trade.

The basis of the improved techniques is an unleveled polder consisting of an inlet gate, a common canal and drain, and an earth protection dike encircling the cultivable area. Deep plowing is done to kill wild rice. Empoldering allows the control of the rate and timing of flooding and retention of water in the fields after filling; it thus prevents too early or too rapid filling and too rapid emptying. The system has no capacity to fill polders if the flood does not arrive and no capacity to empty them if the flood has not receded when the rice has matured. Polders are planted only in rice although there are some areas in them which are left in pasture.[7]

Empoldering and improved control of flooding increase the yields of the improved sativa varieties introduced. First, they permit better separation of

varieties according to water needs and resistance to flooding. Second, they allow better control of the crop calendar by better regulating the timing of the flood. For both of those reasons, average gross paddy yields have grown to as much as 1,750 kilograms per hectare on harvested areas, although they are smaller on seeded areas because of the incomplete filling of some polders.

Field techniques now differ little between the traditional and new systems, except for the introduction of harrowing and of mechanical threshing. There is as yet no system of ox-drawn tool-bar weeding and harvesting is still done with sickles. The more general use of animal traction in the new system has allowed an increase in the average size of rice holding to 2.5 to 3.0 hectares, and farmers generally have similar holdings in millet or sorghum.

Two new practices have recently been introduced to the Mopti and Segou rice projects. The first, seeding in lines with ox-drawn seeders owned by the projects and rented to farmers, is designed to increase yields by permitting easier hoe weeding. The second, the application of small amounts of inorganic nitrogen and phosphate, is to be done after line seeding has been widely established in the projects. These practices, which now involve perhaps 10 percent of the farmers in the two projects, have been included in the definition of the intensified Mopti and Segou techniques (CFMI and CFSI).

Amortization of flood control works, extension services, and project administration costs are partly supported by a land use fee levied on farmers in the two projects. The fee is a fixed amount of paddy per hectare and must be paid in kind. The projects also offer mechanical threshing and deep plowing services to participating farmers for which payment can be in kind or in cash.

The current irrigated technique at the Office du Niger (ONC in Table 1) now supplies 35 to 40 percent of national paddy output and 60 to 70 percent of officially marketed paddy.[8] The Office is a semi-autonomous public agency which rents land to farmers for a fixed in-kind fee per hectare. After the payment of that fee, farmers are required to surrender all their production to the project at the official price except an allowance for the consumption of family members. The Office sells seeds, oxen, and equipment to farmers on credit, provides extension services, maintains the irrigation network and transports and mills paddy. Farmers do not own their lands, which can be taken from them for non-payment of debts, and have little autonomy in production decisions, such as irrigation control.

Water control in the Office is maintained by a barrage at Markala, 250 kilometers downstream from Bamako, which diverts water into a head canal of 8 kilometers. This canal then bifurcates into two primary canals, the Canal de Macina, which runs northeast, and the Canal du Sahel, which runs north. The Canal de Macina feeds only the production sector of Kolongo and the Canal du Sahel feeds the remaining three--Molodo, Kourouma, and Niono. The four rice-producing sectors are divided into a total of 23 production units, all but one of which are managed by farmers.[9]

The Office is an extensive system supporting a comparatively small population of 47,000 on 40,000 hectares of rice.[10] The average holding is 9.6 hectares, the mode is about 7 hectares, and some farms are as large as 80 hectares. Some farmers have millet and sorghum fields, about which little is known, although it is probably true that such holdings in the Office are less important than they are in the Segou or Mopti projects. Oxen draft power is universal and holdings of animals and equipment per hectare

by Office farmers are greater than those of Segou or Mopti farmers, a fact which explains the larger Office holdings. The water control in the Office makes average gross paddy yields the largest in Mali, more than 2,250 kilograms per hectare, and maximum yields sometimes approach 5,000 kilograms.[11]

The crop calendar begins in April with a shallow pre-irrigation to permit plowing before the first usable rains in late May. Plowing, broadcast seeding, and harrowing are done throughout May and June, and sometimes as late as the first third of August. A single hand weeding is done in July and August. Fertilizer is applied on roughly 30 percent of farms in doses of 50 to 100 kilograms of urea per hectare at the time of tillering. Fields are inundated in mid-August and drained after the first of November. Harvesting with sickles begins in December and continues until the end of January. The Office threshes 80 percent of the paddy mechanically with stationary threshers, using its own machines and crews of hired labor, and charges farmers a fixed amount of paddy per ton threshed. Farmers thresh about one-fifth of the harvest by hand and transport their share of the crop to the household by cart or by donkey.

Although the Office has recently been quite successful in raising yields, it is believed that measures to intensify production are necessary if yields are to continue to grow. A program of intensification has been defined which includes mechanical field levelling, line seeding, and increased use of inorganic fertilizers. The resulting field technique is the intensified Office technique (ONI) noted in Table 1. Although this technique is not now practiced, estimates have been made of its costs and returns and they are discussed below in the sections on private and social profitability (14).

The fourth production technique is the rainfed/swamp technique in southern Mali that is practiced on 15,000 to 20,000 hectares spread over a network of small river basins in an area of 4.5 million hectares. The only true rainfed technique is in the highest rainfall areas along the borders of the Ivory Coast and Guinea, where rice is sometimes grown in rotation with corn, sorghum, peanuts, and vegetables. Swamp variants of the technique use rainwater indirectly, from the overflow of small rivers or from slope runoff, and water control is provided by simple hand-built earth works. Rice is grown in swamps in rotation with other cereals and double cropped with vegetables.

Cotton is the principal cash crop of the region, millet and sorghum the principal cereals, and rice is generally grown to complement these other crops. Average rice field size varies with the use of animal traction; it is 1.0 to 1.5 hectares on those farms which have oxen draft power and less than 0.5 hectares on those farms which do not. Large farms managed by men with manual cultivation, broadcast seeding, and sickle harvesting have been used in the analysis as the traditional swamp technique (TS). Women have smaller holdings which they cultivate manually with transplanting and finger knife harvesting, but lack of data prevents the inclusion of that technique in the analysis. Average gross paddy yields are roughly 1,200 kilograms per hectare with animal traction and slightly less without.

Operation Riz Pluvial et Bas Fonds (Sikasso) has begun a program to improve the traditional swamp/rainfed technique described above. The project provides water control to fields by constructing barrages across small rivers, which can be used to divert water to fields if rainfall is insufficient. Plows and other equipment are sold on credit, selected o. sativa seeds are

distributed, and fields are deep plowed when they are first placed into cultivation. There are few other technical changes. Farmers do not use inorganic fertilizers or pesticides, seeds are broadcast, and paddy is threshed by hand. Average gross paddy yields have increased to 1,800 kilograms per hectare in this technique (IPS in Table 1).[12]

Improved areas in the project have reached slightly more than 4,000 hectares in 1975/76, with plans for expansion to 11,500 hectares by 1980. Studies of the region have estimated the rice land availability to be 200,000 hectares (7), but its development is restricted by low population density (due to the presence of river blindness in many areas) and the very poor condition of roads which makes input delivery and product marketing difficult.

Transport to Mill and to Household

Table 3 shows the systems of paddy collection and mill transport associated with each field technique. It has been assumed, except for field to household transport in the traditional Delta (TFM) and traditional swamp/rainfed (TS) techniques, that public agencies control the collection and mill transport of paddy. So little is known about the activities of private traders in paddy that their activities have not been included in the analysis.

Transport of threshed paddy from fields to households in the Delta and in Sikasso is done by head load, donkey, or animal cart. Delta rice fields are planted farther from villages than are maize or millet fields. but no more than 90 minutes on foot. Sikasso rice fields are closer to villages, at most 30 minutes on foot. Net yields with these techniques are not much greater than 1,000 kilograms of paddy, so the output of one hectare could

Table 3--Farm to Mill Transport

Field Technique	Mode and Distance of Transport	Designator
Office, current (ONC) and Office, Intensified (ONI)	By 12 ton truck over 30 kilometers of poor dirt roads or by barge over 30 kilometers of canal	PCO [a]
Segou, current (CFS) and Segou, intensified (CFSI)	By 12 ton truck over 45 kilometers to small hullers in Segou, or 80 kilometers to industrial mill in Diafarabé, both on poor dirt and paved roads	PCS [b]
Mopti, current (CFM) and Mopti, intensified (CFMI)	By 12 ton truck over 35 kilometers of poor paved road to insustrial mill at Sevaré	PCM [c]
Sikasso, improved swamp (IPS)	By 20 ton truck over 50 kilometers of poor dirt and paved roads	PCR [d]
Sikasso, traditional swamp and rainfed (TS) and Mopti, traditional flooded (TFM)	By cart or by head load, costs of which are included in field labor times and in capital value of farm equipment	PCF [e]

[a] Source is (6).

[b] Source is (8). An Average distance of 60 mms was used in the resource cost analysis.

[c] Source is (7).

[d] Source is (9).

[e] Sources are (1),(2),(9).

Distances are averages from field to mill, weighted by the percent of total paddy collected from each producing area.

be carried in two cart loads or 30 to 40 head loads. Labor costs of paddy transport to households are included in field labor times in these techniques.

Transport of threshed paddy to the warehouses and mills in the Segou and Mopti projects and in the Office du Niger is in two stages. Paddy is first transported from fields to adjacent roads in tractor pulled trailers. The Office then moves paddy to its mills over an average of 30 kilometers, most of them on poor dirt roads. Paddy in the Segou project is transported over similar roads an average of 45 kilometers to small hullers in Segou or 80 kilometers to a mill in Diafarabe. Paddy in the Mopti project is moved over an average distance of 35 kilometers, mostly on a paved road to the Sevare mill. The small quantity of paddy bought by the Sikasso rice project is collected and moved to the project's huller in Sikasso, an average of 50 kilometers on very poor roads. Collection, sacking, and transport costs incurred by the projects are reimbursed at official cost schedules established by the Ministry of Finance.

Milling

Table 4 shows characteristics of the most important milling techniques. The Office des Produits Agricoles du Mali (OPAM) and the Office du Niger operate all large mills except one, at Tamani, which is not now in use. Apart from the Tamani mill, private milling in Mali is restricted to hand pounding and small electric or diesel steel cylinder hullers.

In the two traditional field production systems described (TFM and TS), women hand pound paddy. The work is done either individually or in large groups after harvest for home consumption, and some women earn money by pounding for other families. Where electric or diesel hullers have

been installed (for example, in villages near the Segou rice project) handpounding has been rapidly displaced.

Small electric or diesel powered hullers are not imported officially, but they are widely used in rice-growing areas around Segou, Mopti, and San. These machines do not have parboiling or polishing capacity and produce high percentages of broken grains. Outturns are 45 to 70 percent of rice depending on the skill of the operator and the quality of the paddy. Hourly capacities are 0.15 metric tons of paddy, implying an annual capacity of 375 metric tons if it is assumed that they are operated 2,500 hours per year. Estimates of the total number of machines vary from 100 to 150, although many of them are not used, or are used infrequently because of lack of spare parts and fuel. Byproducts are used to make plaster or, if the husks have been removed by winnowing, to feed animals.

Industrial rice milling is done principally in the Office du Niger. The Office has four mills, three with hourly capacity of 3.6 metric tons of paddy, and the fourth with hourly capacity of 2.5 metric tons. There is no parboiling done in these mills. Flour and bran are sold to Office farmers as feed; husks are used in one mill to drive a generator and are discarded in the others. The only other currently operating industrial mill in Mali is that run by OPAM at Sevare in association with Operation Riz Mopti. The Sevare mill has parboiling capacity and produces mainly white rice. Husks are used to fuel a generator, and bran and flour are sold as feed.

Marketing and Consumption

Table 5 shows the principal markets and modes of supply in Mali and in the Ivory Coast and Senegal where Malian rice might be exported. OPAM has a legal monopoly on cereals marketing, but private traders are

Table 4.--Key Characteristics of Rice Milling Techniques

Milling technique	Projected full capacity (mt paddy/year)	Quality of output	Milling ratio	Rice milled in 1976 (mt milled rice)	Unit cost (mf/mt milled rice)	Use of by-products
Industrial[g]	[a]	[b]				
Molodo (IMO)	18,000	60% brokens	0.65	12,500	16,400 mg/kg	Rice bran sold as animal feed at 12 mf/kg and flour sold at 17 mf/kg
Kourouma (IMO)	18,000	60% brokens	0.67	12,400		
Kolongo (IMO)	12,000	70% brokens	0.64	4,325		
N'Diebougou[c]	18,000	n.a.	n.a.	none		
Industrial[h]						
Sevare (IMS)	15,000	parboiled, 40% brokens	0.57	571	13,300 mf/kg	Rice bran sold as animal feed at 7 mf/kg and flour sold at 9 mf/kg
		67% brokens	0.60	8,362		
Diafarabe[d] (IMS)	12,500	n.a.	n.a.	none	n.a.	n.a.
Tamani[d]	11,000	n.a.	n.a.	n.a.	n.a.	n.a.
Kourouba[d]	6,000	n.a.	n.a.	none	n.a.	n.a.
Small steel cylinder hullers (SM)[e]	37,500	60-70% brokens	0.45-0.70	n.a.	8,000-15,000	Construction and animal feed or none
Small steel cylinder hullers (SM)[f]	56,250	60-70% brokens	0.45-0.70	15,000-20,000	8,000-15,000	Construction and animal feed or none
Hand pounding[i] (HP)	n.a.	80-100% brokens	0.70	75-80,000	30,000	Construction and animal feed or none

[a] 5,000 hours of annual operation assumed (i.e., 250 days at 20 hours/day).

Continuation of Table 4.

[b]Percentage of brokens are weighted averages (e.g., if the mill produces 10 tones of whole grains and 10 tons of 100% brokens, then the percentage of brokens shown would be 50).

[c]This mill did not begin operation until 1976/1977.

[d]The Diafarabe and Kourouba mills are owned by OPAM; they have only recently begun to operate after long periods (roughly 10 years) of inactivity. The Tamani mill is owned privately, but its owner must buy paddy and sell rice at prices fixed by OPAM. Sources are (14),(15).

[e]Assuming that capacity 0.15 mt of paddy/hour and that machines work 2,500 hours/year implies avarage capacity of 375 mt of paddy/year. This estimate is based on assumption that there are 100 such machines in Mali. Source of data is (11).

[f]Assuming 150 machines with capacity of 375 mt/year. OPAM used private hullers in 1976-1977, but quality of output was so poor that OPAM stopped hiring them in 1977.

[g]Source is (6). The Molodo and Kourouma mills have, apparently, operated at greater than their rated annual capacities.

[h]Source is (7).

[i]Source is (15) and author's surveys.

Table 5.--Principal Markets and Modes of Supply for Malian Rice

Market	Activity Designator	Source of Supply	Distance and Modes of transport[a]
Bamako[a]	BK	Segou (whether from Office du Niger or from Opération Riz Segou)	240 Kilometers by 12 ton truck over new paved road.
Bamako[a]	BK	Sikasso (whether from traditional rainfed technique or from Opération Riz Sikasso)	380 kilometers by 12 ton truck over paved road road.
Bamako[a]	BK	Mopti (whether from traditional flooded technique or from Opération Riz Mopti)	620 kilometers by 12 ton truck over 380 kilometers of poor paved road and 240 kilometers of new paved road.
Kayes[a]	KAY	Segou (whether from Office du Niger or from Opération Riz Segou	240 kilometers by 12 ton truck over new paved road and 495 kilometers by rail from Bamako to Kayes.
Abidjan[a]	ABN	Segou (whether from Office du Niger or from Opération Riz Segou)	1145 kilometers by 12 ton truck over mostly good paved road.
Dakar[a]	DKR	Segou (whether from Office du Niger or from Opération Segou)	240 kilometers by 12 ton truck over new paved road to Bamako and by rail to Dakar.
Bouaké[a]	BKE	Segou (whether from Office du Niger or from Opération Riz Segou)	773 kilometers by 12 ton truck over paved road
Abidjan[a]	ABNM	Mopti (from Opération Riz Mopti)	1305 kilometers by 12 ton truck over mixed poor and good paved road.
Dakar[a]	DKRM	Mopti (from Opération Riz Mopti)	620 kilometers to Bamako by 12 ton truck over 380 kilometers of poor paved road and 240 kilometers of new paved road. By rail from Bamako to Dakar
Bouaké[a]	BKEM	Mopti (from Opération Riz Mopti)	933 kilometers by 12 ton truck over mixed poor and good paved road.
Gao[a]	GAO	Mopti (from Opération Riz Mopti)	River transport from Mopti.

Table 5.--Principal Markets and Modes of Supply for Malian Rice

Market	Activity Designator	Source of Supply	Distance and Mode of transport[a]
Sikasso farm[b]	SIF	Sikasso (from traditional rainfed technique)	Cart or head load for on-farm consumption.
Mopti farm[c]	MPF	Mopti (from traditional flooded technique)	Cart or head load for on-farm consumption.

[a]Source is (3).

[b]Source is (9).

[c]Sources are (2),(7).

allowed to operate unofficially. Analysis of the private sector has not been done here because so little is known about it. OPAM accepts rice from the Office du Niger and Sevare mills at rates established by the Ministry of Finance and transports it to urban markets. Until 1977 OPAM did not have sufficient truck capacity to transport its purchases of all cereals and had to hire private truckers to do so. OPAM then increased its truck fleet and now seems to have sufficient capacity to avoid having to hire. Rice is transported to the 42 administrative sub-regions in Mali, from where it is distributed to consumers through a system of stores.

The majority of OPAM's deliveries are to the Bamako market, with the Gao and Kayes urban markets being of secondary importance. OPAM loses money on its deliveries to the Gao and Kayes markets because the handling and transport margins allowed it are insufficient; this is in part due to the government's policy of maintaining a fixed consumer price of rice throughout the nation. Small amounts of rice are also delivered to the Segou, Mopti, and Sikasso markets from the mills associated with the rice projects in those areas.

Export markets have also been identified in Abidjan, Bouake, and Dakar. Recently, the Office du Niger exported rice to the Ivory Coast, and it has been assumed that future exports like the recent ones would be sent by road. Rice sent to Dakar has been assumed to go from Segou to Bamako by road and from Bamako to Dakar by rail.

Incentives and Shadow Prices

The system of incentives in the Malian rice sector has several general characteristics and several which are specific to the rice projects. The general characteristics are officially fixed product and input prices.

plus a broad exemption of agriculture from tariffs and indirect taxes. Paddy and rice prices vary only by quality, never by location of market, production system, or season. They are established by ministerial decree, announced at the beginning of each crop season in June, and enforced by OPAM, which starts its crop-buying season in November. Rice imports are controlled by quotas and small tariffs.

All agricultural inputs are sold through a state agency, the Société de Credit et d'Equipement Rural (SCAER), either directly to farmers or indirectly through the development projects. Direct subsidies on capital equipment such as plows, carts, and harrows existed in the past but were removed in the 1976/77 crop season; subsidies were, however, maintained on fertilizers and fungicides, although the government plans to remove them soon. There are also some small indirect subsidies on inputs resulting from the insufficiency of margins allowed for shipment of inputs from the SCAER depot in Bamako to development projects. SCAER's costs of operation are partly supported by taxes on cotton and peanut production.

The exemption of agriculture from tariffs and indirect taxes on direct inputs (e.g., fertilizers) or indirect inputs (e.g., gasoline used in project vehicles) is nearly complete. In principle, SCAER and the rice projects (including the Office du Niger) pay only a 3 percent border tax on inputs and no sales taxes at all but, in practice, some additional duties are paid, especially those included in the prices of vehicles, petroleum products, and construction services bought from local suppliers. The rice projects and other state agencies also pay taxes on wages and salaries. There are no significant indirect taxes on traditional agriculture except a cattle head tax which is poorly enforced.

The rice projects and the Office are semi-autonomous public agencies which provide participating farmers with two classes of goods and services unavailable to others. First, in return for a fixed in-kind fee per hectare of land allocated to them, farmers receive construction and maintenance of irrigation works, extension, and administrative services. Farmers are also required to meet a marketing quota per hectare of project land; this requirement amounts to a tax because the official price of paddy has generally been below market prices.

The second class includes those goods and services for which payment is made directly--machine services, inputs and their delivery, selected seeds, and credit. Farmers pay in kind for threshing, and in cash for inputs, selected seeds, and credit at the time of harvest. The projects sell inputs and provide credit for SCAER's account and deliver paddy to mills for OPAM's account. For those services the projects are reimbursed at rates established by the Ministry of Finance. Estimates of the real costs of each class of services, farmer payments, and net subsidies are shown in Table 6.

Marketing quotas and the requirement that some service payments be made in kind are intended to enable OPAM to control sales of paddy and rice and to ensure the financial viability of the projects. Official marketings have grown rapidly as a result of the growth of project output, but the financial status of most projects is poor (with the possible exception of the Office du Niger) and they are subsidized, usually with concessional aid. Those subsidies are necessary to finance the construction and maintenance of irrigation works and the costs of extension services and administrative overhead, for there clearly would be no projects if farmers

Table 6--Farm Subsidies and Water Charges [a]

(mf/mt rice)

Technique	Class 1				Class 2								Class 1 and Class 2 total
	Water and land dev. costs	Extension and adm overhead costs	Water charges	Net subsidy	Seeds	Fert.	Pest	Land prep.	Threshing	Credit	Other[b]	Total subsidy	
ONC [c]	0	15,664	11,514	4,150	-115	790	0	0	-3,052	40	237	-2,100	2,050
ONI [c]	5,470	14,528	11,105	8,893	513	3,163	0	0	-3,844	168	287	287	9,180
CFS [d]	22,800	5,514	6,683	21,631	-446	0	0	0	- 277	0	245	478	-21,153
CFSI [d]	12,768	5,146	5,347	12,567	-200	2,285	0	0	- 199	78	378	2,342	14,909
TS [e]	0	0	0	0	- 14	0	0	0	0	0	-167	- 181	- 181
IPS [e]	16,064	2,803	0	18,867	255	0	0	0	0	12	356	623	19,490
TFM [f]	0	0	0	0	39	0	0	0	0	0	-167	- 206	- 206
CFM [f]	28,501	4,595	4,774	28,322	- 48	0	0	0	5,507	0	197	5,652	33,974
CFMI [f]	15,951	11,161	6,416	20,706	- 21	2,285	0	0	2,164	78	377	4,883	25,589

[a] Calculated with producer price of paddy equal to 1975/76 level of 40 mf/kg. Costs per ha have been converted to costs per mt/rice by dividing by the paddy yield and by the milling ratio commonly associated with the field technique.

[b] Tools, animal feed, animal traction equipment.

[c] Source is (6).

[d] Source is (8).

[e] Source is (9).

[f] Source is (7).

had to finance such investments themselves. One of the objectives of policy is to reduce subsidies on recurrent costs.

Shadow Prices

The shadow prices used in the net social profitability analysis are shown in Table 7. (Their derivation and theoretical justification are discussed in (12).) Of the adjustments specified in that paper as being necessary to derive shadow from market factor prices, only the removal of production taxes, specifically those on exports of cotton and peanuts, is likely to be of any quantitative significance. Such taxes will have important effects on shadow prices only if factors used in rice production are withdrawn from cotton or peanut production and only if they are in inelastic supply. Land is excluded because there appears to be little competition for land among rice, cotton, and peanuts (with the exception of areas in southern Mali, which are not now largely devoted to rice).

Unskilled labor is the only factor for which both of the above conditions might obtain. Evaluation of the sources of labor migration to rice producing areas suggests, however, that most laborers come from millet-producing areas (e.g., the Seno Plain and the Dogon Plateau) and not from the cotton and peanut areas. Unadjusted market prices were thus used as the basis of the shadow price estimates of unskilled labor. Surveys were made by the author in the informal labor markets at Sikasso, San, Mopti, Sofara, Segou, and Bamako, and in rice-producing areas west of Segou to gather information on wages and the origins of workers. Wages across tasks (e.g., harvesting rice) were found to be roughly equal throughout the country, except in the Office du Niger and in the town of Sikasso where they were higher. In Sikasso, this difference results from the proximity of higher wage areas in the Ivory Coast;

Table 7.--Shadow Prices of Primary Factors by Region

Primary factor	Nation	Region			
		Office du Niger	Segou	Mopti	Sikasso
Unskilled labor (mf/manday)[a]					
Men	500	700	400-500	400	600-700
Women	n.a.	n.a.	n.a.	n.a.	n.a.
Children	n.a.	n.a.	n.a.	n.a.	n.a.
Skilled labor (ratio of shadow to market wage)[a]	1	1	1	1	1
Land (mf/hectare)[a]	ø	ø	ø	ø	ø
Capital[b]					
Informal, rural	20%				
Formal, public on irrigation works	2.5%				
Formal, public on farm equipment	8%				

[a]Source is: Surveys made by author.

[b]Sources are (6),(7),(8),(9).

in the Office, it arises from the strong demand for hired labor in irrigated rice and sugarcane production.

Shadow prices of capital are based on the assumption that the capital market is segmented and that capital is available for certain purposes at concessionary rates of interest. Segmentation is maintained by credit rationing; farmers in the rice projects, for example, pay lower rates of interest than do farmers outside the projects, because access to credit is restricted by project agencies. It is assumed that foreign financing subsidizes the differences between the several market interest rates and the social opportunity cost of capital.

The shadow price of land is assumed to be zero. Land rents are rare in Mali (in money or in kind) and seem to be paid only for site value, such as in the Office du Niger. Alternatives to rice production in the Office (e.g., wheat, long-staple cotton, or sugarcane) are discussed below in the sensitivity analysis.

Activity Combinations

Activity combinations for field, collection, milling, and distribution techniques are presented in Table 8. Activities were generally joined as they are in current practice, with two exceptions. The first is that the intensified field techniques (ONI, CFSI, and CFMI) were combined with post-harvest activities based upon Malian plans for expansion of milling capacity and judgments about the importance of these techniques in supplying the various markets listed in Table 5. The second is that export markets were identified and combined with production, collection, and milling techniques based upon an earlier study (16). These combinations have been used to estimate private and social costs and returns

Table 8--Combined Production and Post-Harvest Activities

Activity combinations used in calculations of social and private profitability	
ONC/PCO/IMO/BK	TS/PCF/HP/SIF
ONC/PCO/IMO/KAY	TS/PCR/IMS/BK
ONC/PCO/IMO/ABN	
OBC/PCO/IMO/DKR	IPS/PCR/IMS/BK
ONC/PCO/IMO/BKE	
	TFM/PCF/HP/MOF
ONI/PCO/IMO/BK	TFM/PCM/IMS/BK
ONI/PCO/IMO/ABN	
ONI/PCO/IMO/DKR	CFM/PCM/IMS/BK
ONI/PCO/IMO/BKE	
	CFMI/PCM/IMS/BK
CFS/PCS/IMS/BK [a]	CFMI/PCM/IMS/GAO
CFS/PCS/SM/BK	CFMI/PCM/IMS/ABNM
	CFMI/PCM/IMS/DKRM
CFSI/PCS/IMS/BK[a]	CFMI/PCM/IMS/BKEM
CFSI/PCS/SM/BK	
CFSI/PCS/IMS/ABN[a]	
CFSI/PCS/IMS/DKR[a]	
CFSI/PCS/IMS/BKE[a]	

[a] The Segou field and collection techniques have been combined with the milling activity corresponding to the industrial mill at Diafarabé, which OPAM has recently rehabilitated.

throughout the rice sector; varying the activities contained in any one combination (e.g., changing only the marketing activity) allows isolation of critical influences on those costs and returns.

PRIVATE AND SOCIAL PROFITABILITY

Private profitability is defined only at the farm level because of the broad state control of collection, milling, and distribution of rice. OPAM and other state agencies are assumed to cover their costs including those resulting from taxes on the goods and services they purchase, through a combination of revenue and public subsidy to the three post-harvest activities. Farm private profitability is defined as gross revenue (i.e., net paddy yield times the paddy price) minus the sum of domestic factor costs and tradable input costs valued at market prices, and taxes.[13] The farm gate paddy price is assumed to be the 1975/76 official price of 40 francs per kilogram.

Net social profitability is defined with respect to the c.i.f. price of imported rice and is equal to that price minus the sum of tradable input costs minus the sum of domestic factor costs. The c.i.f. price of rice in Bamako is assumed to be 182.2 Malian francs/kilogram (kg) (i.e., $364.4/ metric ton (mt)). The prices of imported rice and of tradable inputs are converted to domestic currency units at the official exchange rate; domestic factor costs are valued at their social opportunity costs or shadow prices shown in Table 8. The net social profitability expression can be rearranged algebraically[14] to derive the resource cost indicator, which expresses the amount of domestic factor costs necessary to earn (in export activities) or to save (in import activities) a unit of foreign exchange. The difference between private and net social profitability (per unit of rice output) will be equal

to the differences between the market and the c.i.f. prices of rice in any given market, plus the sum of taxes or subsidies which affect the four activities in the rice sector, plus the sum of divergences between market and shadow factor prices.

Net social profitability measures the natural comparative advantage in rice production of a country, as defined by its resource endowments, geographic position, and technical efficiency of production, with respect to a given set of world prices. Private profitability measures the incentives provided to economic agents in rice production by government policies. Analysis of social and private profitabilities and comparisons of divergences between the two can help to assess the relative importance of government policies, resource endowments, choice of production techniques, and world prices of inputs and outputs.

Private and social profitabilities of each technique, when combined with its lowest cost collection and milling technique for marketing to Bamako, are shown in Table 9. Techniques are grouped by degree of water control.

The Office du Niger

The current field technique (ONC) is less privately unprofitable than the intensified one (ONI) at the 1975-76 producer price, although the difference is small. This suggests that farmers will be more or less indifferent to the adoption of the intensified technique when the two are compared on a per hectare basis, but that the reduction in average holding associated with the introduction of the intensified technique will reduce total farm income and thus discourage use of the intensified technique.

Table 9--Net Private and Social Profitability (mf/mt of rice)

Field technique	(1) Net social profitability	(2) Resource cost ratio	(3) Effective rate of protection	(4) Private profitability[a]	(5) (1) - (4)	(6) c.i.f. price - market price	(7) Total net taxes	(8) Net farm taxes	(9) Net off-farm
ONC	67,355	0.560	-0.275	-3,945	71,300	66,404	4,896	-2,751	7,647
ONI	58,374	0.592	-0.358	-6,137	64,511	66,404	-1,893	-9,540	7,647
CFS	39,464	0.736	-0.354	-10,546	50,010	62,975	-12,965	-21,023	8,958
CFSI	60,364	0.591	-0.386	3,858	56,506	62,975	- 6,469	15,427	8,958
TS	36,998	0.720	-0.419	-32,080	69,078	61,269	7,809	- 1,585	9,394
IPS	47,752	0.648	-0.337	- 3,681	50,933	61,269	-10,336	-19,730	9,394
TFM	1,829	0.988	-0.411	-58,864	60,693	53,319	7,374	- 3,292	10,666
CFM	16,681	0.886	-0.226	-12,504	29,185	53,319	-24,134	-34,800	10,666
CFMI	35,350	0.749	-0.282	- 2,634	39,984	53,319	-15,335	-26,001	10,666

[a] Calculated with producer price of paddy of 40 mf/kg.

The current field technique is also more socially profitable than the intensified one, and here the difference is more marked than the difference between private profitabilities. The intensified technique benefits more from greater farm level subsidies than does the current one which enable it to remain competitive privately, but less so socially. The intensified technique is less socially profitable than the current technique because the investment and variable costs (for example, field leveling and fertilizers) are not entirely offset by the higher paddy yields.

In both techniques there is a large difference between the social and private profitability. This is owing to the difference between the c.i.f. price of rice and the local market rice, as columns (5), (6), and (7) of Table 9 show. Net taxes or subsidies in the rice sector account for little of the difference between private and social profitability in both techniques.

Operations Riz Segou and Mopti

Three of the four techniques (CFS, CFM, CFMI) are privately unprofitable. The intensified techniques are more privately profitable than the current techniques. That farmers have not yet adopted the more profitable technique can be attributed largely to the riskiness and unfamiliarity of fertilizer use which is necessary in the intensified techniques. Important private cost differences exist between the two projects; the higher cost Mopti farmers benefit from greater subsidies on irrigation work and extension services (Class 1 in Table 6).

On the other hand, all four techniques are socially profitable. The intensified Segou technique is the most socially profitable, followed by the current Segou and intensified Mopti techniques, and at a substantially lower level, the current Mopti technique. The social profitabilities of the Mopti techniques are reduced, in comparison to the Segou techniques, by the extra margin of transport costs from Mopti to the Bamako market as well as by their higher irrigation and labor costs.

The differences between social and private profitabilities in these four techniques are largely due to the margin between the c.i.f. and market prices of rice. Net subsidies explain a greater part of those differences in this group of techniques than they do in the two Office du Niger techniques, but their magnitude is still not very large, except in the two Mopti techniques (CFM and CFMI) where farm level subsidies are quite important.

Improved Rainfed/Swamp (Sikasso)

The improved rainfed/swamp technique (IPS) is slightly less privately profitable than the most profitable technique (CFSI). This is due in part to the fairly large farm subsidies which it enjoys (there is, for example, no water charge in this project), and to the good yields achieved without the use of fertilizers. This technique is also quite socially profitable, although less so than several of the others. The difference between the large positive social profitability of this technique and its private profitability is mainly due to the margin between the c.i.f. and market prices of rice, although the element of subsidies is important also, especially at the farm level.

Traditional Techniques

The two traditional techniques are both privately unprofitable. The rainfed/swamp techniques (TS) is less unprofitable, although it is much less favorable than the improved technique (IPS) which is replacing it. The traditional Delta technique (TFM) is the least privately profitable of all nine, and is greatly inferior in this respect to the four improved Delta techniques (CFS, CFSI, CFM, and CFMI) which are replacing it. These results explain the quite rapid adoption of the improved rainfed and Delta techniques in the last eight years.

The two traditional techniques are, in contrast, socially profitable. The Sikasso technique is more so than the traditional Delta technique, which is only marginally socially profitable. The large differences between social and private profitability in these two techniques are, again, due to the difference between the c.i.f. and market prices of rice; taxes and subsidies have little role in those differences, especially at the farm level where producers are almost entirely unaffected by the fiscal system.

These comparisons show that all field techniques have strong comparative advantages for production of rice for the Bamako market, but that the current difference between the c.i.f. and official prices of rice makes farm private profitability often negative for rice delivered to Bamako. It is useful then to consider the incentive effects of increasing the farm price of paddy. This is done in Table 10 which presents comparisons of social and private profitability for a producer price of 50 francs. This change makes private profitability more generally positive. The two traditional techniques (TS and TFM) remain privately unprofitable and the current Segou and Motpi techniques (CFS and CFM) become only marginally so. Both Office techniques and the pair of intensified Segou and Mopti techniques become positively profitable. Such a change would, therefore, encourage adoption of techniques which are more socially profitable in all four groups of techniques with the exception of the Office du Niger, where the current technique is less privately but more socially profitable than the intensified one at the higher producer price.

Raising the producer price of paddy would also allow the government to reduce some subsidies now given to farmers. This would work by increasing the value of the water charges paid by project farmers and would reduce the majority

Table 10.--Net Private and Social Profitability (mf/mt rice)

Field Technique	(1) Net social profitability	(2) Private profitability[a]	(3) (1) - (2)	(4) c.i.f. price - market price	(5) Total net taxes	(6) Net farm taxes	(7) Net off-farm taxes
ONC	68,055	13,488	54,567	51,720	10,040	2,393	7,647
ONI	59,074	14,416	44,658	51,720	- 1,545	- 6,102	7,647
CFS	40,162	769	39,393	47,800	- 8,407	-17,365	8,958
CFSI	61,154	16,448	44,706	47,800	- 3,186	-12,144	8,958
TS	36,998	-17,976	54,794	45,396	9,578	184	9,394
IPS	47,252	12,065	35,187	45,396	-10,209	-19,603	9,394
TFM	1,829	-46,500	48,329	37,446	10,883	217	10,666
CFM	16,681	1,341	15,340	37,446	-22,106	-32,772	10,666
CFMI	35,350	11,265	24,085	37,446	-13,361	-24,027	10,666

[a] Private profitability calculated with producer price of paddy equal to 50 mf/kg.

of current subsidies on irrigation works and extension services. Such a raise would essentially transfer the costs of those subsidies out of the government budget to consumers. Changing the paddy price from 40 to 50 francs per kilogram would increase wholesale rice prices about 13 percent.

The continued existence of the traditional techniques is attributable to several factors. One is that the relevant farm gate price of output is not the official paddy price, but rather some average market price, which in Mali is generally higher than the official price and tends to increase returns to traditional production. A second is that the relevant farm gate price in subsistence production should include the imputed value of collection, processing, and marketing services included in the price of rice which the farmer would have to buy were he not a prod[illegible]. This would also tend to increase returns to traditional techniq[illegible]. A third is that the improved techniques are not freely available; that is, the Delta polders and the improved lands in southern Mali cannot now accomodate all producers who desire improved lands. These problems have not been analyzed in detail here because there is so little reliable information on market prices of paddy and of rice, and because the improved techniques have been shown to be dramatically more profitable to farmers and to society at one set of prices. A uniform change in prices would not change the ranking of techniques.

One important source of the social profitability in Malian rice production is the low cost of water control and the increased yields resulting from the introduction of water control into traditional production systems. This is shown most clearly in the comparisons among the traditional Delta technique (TFM) and its replacements in the Segou and Mopti projects

(CFS, CFSI, CFM, and CMFI). On the other hand, the social profitability of the traditional swamp technique in Sikasso (TS) is comparable to those of all but one of the improved Delta techniques, implying that that region has a natural advantage in rice production because of its superior rainfall.

A second source of the social profitability of these techniques has been the introduction of improved seed varieties. This is most noticeable in the Sikasso rice project, where the improved technique (IPS) shows significantly greater social profitability than the traditional technique after the introduction of limited water control and of improved seeds, and in the improved Delta techniques, where the replacement of local glaberrimas with improved sativas explains perhaps half of the improvement in yields over the traditional technique.

The use of inorganic fertilizers explains little of the difference in social profitabilities among the current field technique (ONC, CFS, CFM, and IPS).[15] Fertilizers are used only in small doses in the current Office du Niger technique, the most socially profitable one, where water control seems to be the most important factor in raising yields. Fertilizers do, however, increase yields in the improved techniques (ONI, CFSI, and CFMI). In spite of the fact that greater extension and overhead costs have been allocated to each hectare using the more intensive techniques, social costs fall per metric ton of rice, except in the Office du Niger. The small current use of fertilizers appears to be due more to risk and to farmers' unfamiliarity with them than it does to relative prices; the fertilizer-using techniques are generally more privately profitable than the current ones.[16]

MALIAN RICE EXPORTS

Table 11 presents the net social profitabilities for several field techniques (ONC, ONI, CFSI, and CFMI) able to generate a large marketable surplus. Exports to Dakar are generally unprofitable because Senegalese consumers prefer cheaper broken grains, which sell at a discount of roughly 17 percent. Exports to Abidjan are profitable from all producing areas but Mopti and exports to Bouake are profitable from all areas. The differences between the net social profitabilities of these techniques for delivery to the Bamako market and to these foreign markets again demonstrates the importance of transport costs in the Malian comparative advantage. Exporting rice reverses the transport margin between the port c.i.f. price of rice and the c.i.f. price at Bamako, subtracting it from the Bamako price and adding it to the sum of domestic factor and tradable input costs, thus reducing net social profitability.

SENSITIVITY ANALYSIS

The sensitivity of the results to changes in factor costs, paddy yields, milling outturns, and the world price of rice was analyzed to test the weak points in the data and to identify changes in the rice sector which might occur as a result of external changes in the Malian or world economy. Results of the sensitivity analysis in Table 12 show that elasticities are functions of the size of net social profitability and of the share of the factor in total initial costs.

Factor Costs

Net social profitabilities are shown to be most elastic with respect to changes in the costs of unskilled labor. Unskilled labor enters the production process almost exclusively as direct field labor, and it is not, therefore, surprising to see that its effect is greatest in the traditional field techniques (TS and TFM) where farm costs are the largest component of total domestic factor costs. Unskilled labor elasticities

Table 11.--Net Social Profitability of Malian Rice Exports
(mf/mt rice)

Technique[d]	Market Abidjan[a]	Dakar[b]	Bouaké[c]
ONC	12,310	- 9,060	30,502
ONI	3,329	-18,041	21,521
CFSI	5,319	-16,051	23,511
CFMI	-12,294	-41,268	5,898

[a]C.i.f. price is 150,000 mf/mt ($300/mt), 25 to 35 percent broken rice.

[b]C.i.f. price is 125,000 mf/mt ($250/mt), 80 percent broken rice.

[c]C.i.f. price is equal to 159,800 mf/mt ($319 6/mt), 25 to 35 percent broken rice.

[d]The improved rainfed-swamp technique (IPS), although socially profitable for delivery to the Bamako market, has been excluded from the analysis of export potential because so little rice (less than 1,000 metric tons on average) is marketed through official channels from the Sikasso Rice Project. There is probably some rice sent to the northern Ivory Coast and to Upper Volta from the Sikasso region, but data on quantities, cost, and prices are unavailable for analysis of private marketing.

Table 12.--Elasticities of Net Social Profitability with Respect to Yields and the Social Cost of Primary Inputs

Activity	Yields	Milling outturns	Social Costs		
			Unskilled labor	Skilled labor	Capital
ONC/PCO/IMO/BK	1.011	1.281	- 0.623	-0.321	- 0.338
ONC/PCO/IMO/KAY	1.797	2.275	- 1.118	-0.595	- 0.637
ONC/PCO/IMO/ABN	5.639	7.141	- 3.484	-2.351	- 2.312
ONC/PCO/IMO/DKR	7.262	9.196	- 4.571	-2.599	- 2.743
ONC/PCO/IMO/BKE	2.245	4.083	- 1.385	-0.844	- 0.854
ONI/PCO/IMO/BK	1.314	1.624	- 0.632	-0.375	- 0.476
ONI/PCO/IMO/ABN	23.828	29.448	-11.493	-8.906	-10.231
ONI/PCO/IMO/DKR	4.217	5.212	- 2.077	-1.356	- 1.690
ONI/PCO/IMO/BKE	3.577	4.421	- 1.723	-1.207	- 1.443
CFS/PCS/IMS/BK	3.527	4.140	- 1.591	-0.659	- 1.688
CFSI/PCS/IMS/BK	1.337	1.653	- 0.630	-0.390	- 0.462
CFSI/PCS/IMS/ABN	19.769	24.937	- 9.354	-7.457	- 8.110
CFSI/PCS/IMS/DKR	4.542	5.615	- 2.194	-1.483	- 1.737
CFSI/PCS/IMS/BKE	3.558	4.398	- 1.681	-1.217	- 1.370
TS/PCR/IMS/BK	2.600	3.163	- 2.580	-0.370	- 0.392
TS/PCF/HP/SIF	14.281	14,281	- 1.775	-0.003	- 0.072
IPS/PCR/IMS/BK	1.515	1.907	- 0.963	-0.338	- 0.589
TFM/PCM/IMS/BK	24.984	29.499	-20.807	-3.329	- 6.253
TFM/PCF/HP/MOF	21.831	21.831	- 2.909	-0.010	- 0.432
CFM/PCM/IMS/BK	7.470	8.941	- 3.589	-1.588	- 3.625
CFMI/PCM/IMS/BK	2.558	3.175	- 1.078	-0.741	- 1.128
CFMI/PCM/IMS/ABN	14.890	18.479	- 6.277	-4.696	- 6.842
CFMI/PCM/IMS/DKR	2.217	7.751	- 0.957	-0.714	- 1.049
CFMI/PMC/IMS/BKE	7.537	9.354	- 3.177	-2.609	- 3.621
CFMI/PCM/IMS/3AO	1.578	1.959	- 0.666	-0.394	- 0.664

are greater where production is for export or where it takes place at greater distances from the border (in Mopti, for example) because of the smaller net social profitabilities of those activities.

Net social profitabilities are less elastic with respect to changes in the cost of capital. The smallest elasticity is in those activity combinations involving the current Office du Niger field technique (ONC), where the special assumption has been made that the costs of irrigation works are sunk. Elasticities of capital costs are slightly higher in the other combinations, but there are no systematic differences among them except for the groups involving the current Segou and Mopti field technique (CFS and CFM); this is due to the comparatively large share of irrigation in total costs and low yields in those projects.

Elasticities of skilled labor costs are smaller than those for unskilled labor costs because the share of that factor in the total costs of all techniques is smaller. Skilled labor enters the production process almost entirely off-farm (e.g., in wages paid to mill workers or to drivers) and its importance increases, therefore, with growing farm yields of paddy because of the inverse effect of increased yields on farm costs. Elasticities are slightly greater when production is for export, reflecting the added weight of skilled labor in transport costs.

The economic costs of land have been assumed throughout to be zero. Although land rents exist in some areas (e.g., Operation Riz Segou), they are paid for specific types of empoldered rice land, i.e., as payments for capital embodied in land which can be used only in rice production. The only producing area where land may be said, perhaps, to have alternative value is in the Office du Niger where the capital costs have been

considered as sunk and where alternatives include cotton, sugarcane, and wheat. The rents generated in any of those activities would, as Table 13 shows, have to be equal to more than 90,000 francs/hectare for net social profitability in the current Office technique to be negative. Although the intensified Office technique is less socially profitable than the current one, land rents must be greater than 125,000 francs/hectare if that technique is to become socially unprofitable because of the higher paddy yields produced in the proposed intensified technique.

Yields

The elasticity of net social profitability with respect to paddy yields is large, reflecting the fact that the average cost of the most expensive of the four activities, farm production, varies inversely with yields. This implies that social profitability can be greatly improved by increasing yields; that improvement would be diminished, however, if raising yields involves raising variable costs of production. There is no general pattern of sensitivity to yields across the group of activities except that the net social profitabilities calculated for export markets are more sensitive to changes in yields than are those calculated for domestic markets, because their central values are smaller to begin with.

Milling Outturns

The elasticity of net social profitability with respect to changes in milling outturns is also large, reflecting the influence of those outturns on average costs of field production, paddy collection, and milling. Outturn elasticities are greatest in the highest cost activities, and least in the lowest cost ones. One peculiarity of this elasticity calculation, which is shared by that with respect to yields, is that increases in social

Table 13.--Changes in Social Profitability of Office du Niger Techniques in Function of Land Rents

(mf/mt rice)

Net social profit when land rent[a] is equal to	ONC	ONI
Ø	67,355	58,374
10,000	60,159	53,747
50,000	31,376	35,239
93,493	Ø	15,245
126,026	-23,250	Ø

[a]In mf/ha, converted to mf/mt rice by dividing by appropriate net paddy yields and milling outturns.

profitability from efficiency improvements (e.g., increases in outturns due to more careful milling) are greatest in those export activities in which net social profitabilities are smaller than in domestic markets.

The World Price of Rice

Changes in net social profitability with respect to the world price of rice, shown in Table 14, must be interpreted cautiously. The natural protection provided rice production for domestic markets allows quite large changes in world rice prices without endangering the social profitability of import substitution; for example, the world price of rice would have to fall to rougly $230/metric ton (about three-fourths of its average value in this study) before the social profitability of the current Office du Niger technique became negative. On the other hand, rice production for export is very sensitive to changes in world prices and its social profitability becomes negative even in the best market at Bouake if the world price falls only 10 percent.

Among the factor prices only changes in the costs of unskilled labor are likely to make very much difference in total social costs and net benefits of rice production. This implies that errors in measurement in field labor times would have important consequences for estimations of net social profitability, as would errors in estimation of the shadow price of unskilled labor. That such errors would affect the relative social profitability of rice compared to that of its important Malian alternatives (millet, cotton, and groundnuts) is less likely, however, because changes in the shadow price of labor would affect the entire agricultural sector, thus

Table 14.--Net Social Profitability in Relation to the World Market Price of Rice

($/mt)

Activity	Net social profitability for a world price (Thai 25-35% brokens) of								
	$200/mt	$250/mt	$300/mt	$350/mt	$400/mt	$450/mt	$500/mt	$550/mt	$600/mt
ONC/PCO/IMO/BK	- 27	27	78	123	173	224	274	325	375
ONC/PCO/IMO/KAY	- 44	6	56	106	156	206	256	306	356
ONC/PCO/IMO/ABN	- 72	- 22	24.66	78	128	178	228	278	328
ONC/PCO/IMO/BKR	- 65	- 18.12	31.88	85	135	185	235	285	335
ONC/PCO/IMO/BKE	- 55	- 5	61.00	95	145	195	245	295	345
ONI/PCO/IMO/BK	- 44	6	56	106	156	206	256	306	356
ONI/PCO/IMO/ABN	- 90	- 40	7	60	110	160	210	260	310
ONI/PCO/IMO/DKR	- 82	- 32	13.92	68	118	168	218	268	318
ONI/PCO/IMO/BKE	- 73	- 23	43.04	77	127	177	227	277	327
CFS/PCS/IMS/BK	- 99	- 49	1	51	101	151	201	251	301
CFSI/PCS/IMS/BK	- 42	8	58	108	158	208	258	308	358
CFSI/PCS/IMS/ABN	- 88	- 38	12	62	112	162	212	262	312
CFSI/PCS/IMS/DKR	- 81	- 31	19	69	119	169	219	269	319
CFSI/PCS/IMS/BKE	- 72	- 32	28	78	128	178	228	278	328
TS/PCR/IMS/BK	- 86	- 36	14	64	114	164	214	264	314
TS/PCF/HP/SIF	- 30	20	70	120	170	220	270	320	370
IPS/PCR/IMS/BK	- 54	- 4	46	96	146	196	246	296	346
TFM/PCM/IMS/BK	-150	-100	-50	0	50	100	150	200	250
TFM/PCM/HP/MOF	- 76	- 26	24	74	124	174	224	274	324
CFM/PCM/IMS/BK	-130	- 80	-30	20	70	120	170	220	270
CFMI/PCM/IMS/BK	- 89	- 39	11	61	111	161	211	261	311
CFMI/PCM/IMS/GAO	- 74	- 24	26	76	126	176	226	276	326
CFMI/PCM/IMS/ABN	-103	- 53	- 3	47	97	147	197	247	297
CFMI/PCM/IMS/DKR	-128	- 78	-25	22	72	122	172	222	272
CFMI/PCM/IMS/BKE	-120	- 70	-20	30	80	130	180	230	280

changing net social profitability more or less evenly across it. There is also no reason to believe that labor times in rice production are systematically understated.

Only the special case of the social profitability of rice production in the Office du Niger was analyzed with respect to the costs of land as shown in Table 13. This analysis demonstrated that if land has no alternative economic value more extensive techniques (i.e., the current technique), though lower yielding, are more socially profitable.

The elasticities of net social profitability with respect to paddy and to outturns yields are large, implying that errors in estimation of these parameters would have important effects on net social profitability estimates. A conservative approach was taken to estimation of yields in this analysis, however, so, if anything, net social profitability was systematically underestimated. The problem of yield estimates is probably most important in the rainfed and flooded field techniques where production varies because of rainfall and flood variability. Discount factors were applied to average yields in average rainfall and flood years to try to include some of the cost effects of yield variations in the analysis; to the extent, therefore, that production is less variable than it has been in those techniques, net social profitability will be improved. Milling outturns can be increased by more careful milling and thus improve net social profitability markedly. Comparison of Malian outturns to outturns in similar milling techniques in other areas of the world suggests, however, that they are competitive and that little further improvement can be expected.

CONCLUSIONS

The Malian rice sector enjoys a strong comparative advantage owing to low irrigation costs, high paddy yields, and efficient milling. Although private profitability in the sector is much less than social profitability, efficient techniques have been adopted rapidly by farmers because they are more privately profitable than traditional rice production techniques or than competing crops. This supply response has enabled the Malian government to achieve most of the objectives of its rice policy.

There remain two policy problems to which this analysis is perhaps relevant. One is the preference of the government to subsidize OPAM's losses rather than to pass OPAM's costs on to consumers in the form of higher cereals prices. This has led to the accumulation of large OPAM debts and to the inability of the government to control private market prices, which have been higher than official retail prices. The demonstration above that private profitability is less than social argues for an increase in official producer and consumer prices, but only so much as to cover OPAM's marketing losses and to improve farm profitability. Any increase beyond those levels, say to the point at which the domestic price would equal the c.i.f. price, would destroy export competitiveness and necessitate consumption or export subsidies in years of surplus production.

The second is the problem of food security. The approach of Malian policy makers has been to try to achieve food security by using the current Office du Niger technique, the flooded projects at Segou and Mopti, and to a lesser extent the improved rainfed areas of southern Mali. In an average rainfall and flood year, this policy is successful, allowing satisfaction of that year's

demand as well as the accumulation of stocks for the following year. In a drought or sub-normal rainfall and flood year, this policy is unsuccessful because of harvest failures in the flooded projects and in southern Mali, not only in rice but in strictly rainfed cereals such as millet and sorghum as well.

There are several approaches to achieving greater food security. One is to invest not in more rice production but in export crops (e.g., cotton and groundnuts) which may have greater social profitabilities (11, 10) and to hold the foreign exchange thereby earned or saved as reserves with which to import cereals in drought years. This would be the reliance upon the international cereals market which has already been rejected by the Malian government as involving unacceptable social, economic, and political costs (5, 10).

A second is to constitute reserves out of domestic production (and, perhaps, aid) in good or even average years and to hold stocks as physical reserves against production failures in drought years. The size of necessary reserves and associated management problems might make such a policy very costly at the national level, and it is doubtful that constitution of such stocks can do much except relieve emergencies until international aid arrives if deficits are very large (10). Mali, for example, received more than 430,000 metric tons in cereal aid in 1973 and 1974, in addition to more than 100,000 metric tons of commercial rice imports. So while the first two policies (constitution of foreign exchange or grain reserves) could obviously improve security, they will imply some reliance upon food aid and commercial markets.

A third is to invest more in irrigated agriculture, whether in the Office du Niger or in pumping projects along the major rivers, such as the one at San on the Bani. This policy would guarantee production as

opposed to holding inter-annual stocks. The analysis of net social profitability here shows that while the most important irrigated techniques (ONC and ONI) are also the most socially profitable, their comparative advantage depends partly upon the assumption that the capital costs of irrigation are sunk. To expand large-scale irrigated agriculture in other areas would require new infrastructure and would probably be prohibitively costly.

A fourth approach is to expand the small-scale rainfed and irrigated agriculture in southern Mali, not only of rice but of other cereals. The social profitability of the principal improved rice production technique there (IPS) is high, and the physical area suited to that technique is large if the problems of human and animal disease can be solved. This approach would rely on rainfed agriculture to some degree and would therefore be less secure than large-scale irrigation, but it would allow the exploitation of areas in which rainfall variation is less and the natural security of production is greater.

A fifth approach, now being adopted by the Malian government, is to expand the empoldered areas in the Mopti and Segou projects, while promoting intensification there and in the Office du Niger. Expansion of the polders is now limited by the technical requirement that they achieve a high probability of filling (in 95 of 100 years), in order to provide a greater amount of security. Empoldering smaller areas will also promote the intensification in the flooded systems by reducing risk associated with flood failure. Promotion of the intensified technique in the Office du Niger, while slightly less socially profitable than promotion of the current technique, would increase total output, whether for constitution of stocks for domestic use or export and is thus consistent with increased security and only slightly diminished economic efficiency.

There are several important consequences of this approach. One is that it helps to ensure official control of urban supplies by concentrating rice production in limited areas to which entry of producers is restricted and in which economic incentives encourage entry. A second is that it neglects the broad exploitation of mixed rainfed and irrigated agriculture in southern Mali, which might provide greater economic benefits and more production security[17] (at least if compared to the flooded projects at Segou and Mopti), but which is not likely to expand as rapidly or to produce as much marketed rice as are the techniques in the Delta or in the Office du Niger.

Another consequence of this approach to achieving greater security is that it restricts benefits of investments in rice production to relatively small sectors of the rural population. This is likely to be true to the degree that intensification in the flooded projects and the Office du Niger, without reduction of holdings, is promoted, and construction of new polders is neglected. The maldistributive effect among producers will be heightened to the extent that producer prices are raised in order to increase the private profitability of the intensified techniques.

Finally, this approach to production security establishes the basis for Malian rice exports within West Africa, an advantage which none of the other approaches provides, and thereby helps to advance other objectives of Malian agricultural policy, including increasing incomes and supplying urban markets.

FOOTNOTES

[1]See (2, 4) which show that rice parcels in eight areas of the Delta surveyed in 1973 and 1974 vary, on average, between 0.8 and 4.4 hectares. Accurate estimations of the total area devoted to traditional rice cultivation in the Delta are not available because of the lack of aerial photographs of the region before harvest time in December. The average holding of millet was about 1.3 hectares per family but the typical family did not have 1.5 hectares of rice and 1.3 hectares of millet; the mode seemed to be that families or zones would tend to be more specialized in one crop.

[2]See (1, vol. 1, pp. 199-228) for a description of the Delta's rice cultivators in the 1950s and early 1960s.

[3]See (1, vol. 1, p. 221), where usable rain is defined as three millimeters in one day. Gallais observes that the first useful rain generally fell between 15 May and 15 July (1).

[4]See (1, vol. 1, p. 99), where Gallais writes that Pierre Viguier, an agronomist who worked in the French Sudan in the 1930s, identified 41 varieties of O. glaberrima.

[5]Women's work is usually limited to threshing, winnowing, and head loading paddy home. Children help with plowing and crop protection.

[6]See (1) for a discussion of the problem of wild rices. This seems to be more serious in Operation Riz Mopti than elsewhere in and around the Delta. To combat wild rice, farmers sometimes plow after harvest and mechanical deep plowing is sometimes done. Chemical methods of control have been rejected as too expensive. At Mopti there has also been a program of weeding in deep water (faucardage), which necessitates taking land out of production for one season.

[7]In Operation Riz Mopti in 1975/76, 16,074 hectares were planted and only 12,703 were harvested. Polders at that project were redesigned and reduced from a planned 31,000 to 26,000 hectares (7). Reduction of areas within the protection dike causes an increase in the average fixed costs of irrigation works, but such increases are partly offset by the value of the pasture planted in areas taken out of rice.

[8]The Office du Niger was established by the French Empire to grow cotton as an export crop and rice as a subsistence crop for settler farmers, many of whom were brought to Mali from what is now Upper Volta. The Office is in an arid area of low population density and efforts to intensify production there have, until recently, failed, in part because of insufficient density of settlement. See (13) for a history of the Office.

[9]The remaining unit is used as a seed farm by the Office's administration. There are also some rice lands (hors casier) outside the officially developed area which may produce 2,000-3,000 mt of paddy.

[10]Note, in comparison, that Operation Riz Segou supports 115,000 to 125,000 people on a rice area of 35,000 hectares (8).

[11]Yield estimates in the Office are made from crop cuttings and perhaps overstate true yields.

[12]The project has raised average farm size to about 3 hectares, thus contributing to the installation of rice as a staple crop in a region where it had been secondary.

[13]Seed costs and in-kind service fees are converted to money at the official paddy price of 40 francs/kg.

[14]That is, if $NSP = \sum_{i=1}^{N} a_{ij} s_j - V(P_w - \Sigma a_{it} p_t)$ and if NSP = 0,

$$RCR = V = \frac{\sum_{i=1}^{N} a_{ij} s_j}{P_w - \Sigma a_{it} p_t}$$

where a_{ij} is the j^{th} domestic input into the i^{th} activity, s_j is the shadow price of the j^{th} input, V is the shadow price of foreign exchange, P_w is the world price of rice output, a_{it} is the t^{th} tradable input into the i^{th} activity, and p_t is the border price of the t^{th} tradable input.

[15] Current fertilizer use in the Office du Niger, for example, is roughly 30 kilograms of urea (46-0-0) per hectare. Assuming the response of yields to nitrogen is 15 kilograms of paddy to 1 kilogram of nitrogen, the average yield increase in the current Office technique would be about 210 kilograms (i.e., 30 x 0.46 x 15 = 207) or only 25 percent of the difference between yields there and yields in the flooded rice project (i.e., 2250 - 1400 = 850; 210 $\tilde{=}$ 850 x 0.25) (6).

[16]Experience with the San project is too short to serve as a guide to its long-run costs and returns. It is clear, nonetheless, that the project is more costly than its relevant alternatives in the flooded projects. According to (8), capital costs of irrigation in the San project are 2 million to 2.5 million Malian francs/ha; capital costs in other polders of Operation Riz Segou cite less than 500,000 Malian francs/ha.

[17]Correlation analysis was done for time series data on production of rice (using all techniques), millet and sorghum, cotton, and peanuts from 1960 to 1976. (The data are in Appendix Table 3 of (5).) Outputs of rice, millet and sorghum, and peanuts were found to be positively correlated at roughly 0.6, with significance greater than 95 percent. (Cotton was correlated with the other crops at about 0.3, at significance levels less than 70 percent; this is probably due to the rapid growth of cotton output in Mali during the 1960s and 1970s.) The coefficients of variation of rice and millet and sorghum output were, respectively, 20 percent and 14 percent, which suggests that rainfed cereals may, in fact, be less subject to variation than rice production. The significance of this result is open to some doubt because the trend of rice output since independence has been affected importantly by government policies (especially increases in producer prices and investments in improved polders) in a way that the trend of millet and sorghum output has not. It is obvious, however, that output in the Office du Niger (which produced more than one-third of Malian paddy output in 1976) is secure, and it is probable that production in most of the improved polders is more secure than exclusively rainfed cereals in all but the wettest areas of Mali.

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Table A.--Total Cost Summary of Production and Post-Harvest Techniques

Technique	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market cost	Total social cost	Total social cost milled equivalent: ((mf)/mt)	Total social cost milled equivalent: ($US/mt)
Farm production (mf/ha)											
ONC	47,646	12,992	13,957		15,216	- 6,739	10,065	98,137	94,811	68,224	136.45
ONI	63,331	20,953	40,844		41,742	-25,889	12,700	153,681	166,870	77,210	154.42
CFS	37,490	6,566	25,471		10,880	-12,350	- 2,200	65,857	80,407	95,963	191.93
CFSI	49,649	9,982	28,942		23,602	-16,391	- 1,778	94,006	112,175	74,971	149.94
TS	65,646	126	3,648		348	102	30	69,900	69,768	97,143	174.86
IPS	57,527	5,342	23,456		7,863	-16,234	- 4,889	73,065	94,188	86,900	173.80
TFM	34,853	332	5,706		4,229	54	24	45,198	45,120	125,648	226.17
CFM	41,471	6,642	35,152		9,573	-22,480	- 4,984	65,374	92,838	110,798	221.60
CFMI	51,334	15,882	44,183		26,447	-35,007	- 5,540	101,899	137,846	92,128	184.26
Collection (mf/ton paddy)											
PCO	1,260	2,455	2,493		5,651	1,563	828	14,250	11,859	18,246	36.49
PCS	1,260	3,155	2,993		6,551	1,813	978	16,750	13,959	22,157	44.31
PCR	1,260	2,917	2,823		6,245	1,728	927	15,900	13,245	21,024	42.50
PCM	1,260	3,155	2,993		6,551	1,813	978	16,750	13,959	22,157	44.31
Milling (mf/mt rice)											
IMO	4,221	4,516	2,161		3,888	1,176	483	16,445	14,786	14,786	29.44
IMS	729	4,666	1,441		4,206	1,327	885	13,254	11,042	11,042	22.08
SM	1,177	4,194	2,174		2,689	482	450	11,166	10,234	10,234	20.47
HP	30,000							30,000	30,000	30,000	60.00
Distribution (mf/mt rice)											
BKO	1,326	3,169	2,767		5,614	1,534	842	15,252	12,876	12,876	25.75
ABN	1,467	10,628	7,896		16,429	4,526	2,482	43,428	36,420	36,420	72.84
DKR	2,248	6,127	5,706		18,214	4,534	2,647	39,476	32,295	32,295	64.59
BKE	1,417	7,850	5,902		12,856	3,535	1,887	33,447	28,025	28,025	56.05

Table A-1.--Production Budget for Farming - ONC (mf/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	90	45,000							45,000
A. Land preparation	14								
B. Seeding	1								
C. Chemical application	1								
D. Weeding	13								
E. Pest control	15								
F. Irrigation	10								
G. Harvesting	25								
H. Threshing	8								
I. Transport	3								
2. Seed[a]		2,450	650	400		1,300	100	100	5,000
3. Fertilizer[b]			270	318		3,270	- 1,063	- 35	2,760
4. Interest and depreciation									
A. Small tools[c]			54	27		159	45	15	300
B. Animals[d]				1,867					1,867
C. Animal implements[e]			60	2,555			- 386	- 21	2,208
D. Mechanical equipment									
E. Land improvement									
5. Operation and maintenance									
A. Animals[f]		196	52	32		204	8	8	500
B. Animal implements									
C. Mechanical equipment									
D. Land improvements									
6. Extension services			9,433	2,176		10,159	-11,126	-10,642	0
7. Fixed charges[g]								20,000	20,000
8. Land cost[h]									
9. Other costs									
A. Mechanical threshing[i]			2,473	9,027		124	- 5,683	- 693	18,000
B. Interest on working capital[j]				2,555				- 55	2,500
Total costs		47,646	12,992	18,957		15,216	- 6,739	10,065	98,137

*Yield 2,138; market price farm gate 50 mf/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1, and foreign exchange 1; total social cost per hectare 94,811; total

Continuation of Table A-1.

* mf/ha **Source of data is (6)

[a]100 kgs of farmers' seed at 50 mf/kg.

[b]30 kgs of urea at 92 mf/kg to farmer; cost price is 145.6 mf/kg.

[c]Hand tools estimated at 300 mf/ha/year.

[d]Purchase price of 2 oxen is 140,000 mf and it is assumed they are resold at purchase price. Interest cost is 140,000 mf x 8 percent and 2 animals are used over 6 hectares.

[e]

Equipment	Hectares used	Farmer price	Cost
Cart	20 ÷ 50% use	77,585	94,995
Plow	6	42,594	46,500
Harrow	10	21,526	38,000

All equipment is depreciated over 10 years at 8 percent interest. Annual costs of spare parts (moldboards and plowshares) are estimated at 540 mf.

[f]Costs of animal feed.

[g]400 kgs/ha at 50 mf/kg.

[h]Land costs assumed to be sunk.

[i]160 kgs/mt at 50 mf/kg is price to farmer of threshed paddy. It is assumed farmer threshes 450 kgs by hand.

[j]20 percent over three months on value of labor and seed, plus 2.5 percent over 6 months on value of fertilizers.

Table A-2.--Production Budget for Farming - ONI (mf/ha) *

Inputs	Unskilled labor		Skilled labor	Domestic capital	Land	Tradable inputs	Taxes and subsidies		Total market value
	Man-days	Market value					Tradables	Nontradables	
1. Direct Labor	120	60,000							60,000
A. Land preparation	14								
B. Seeding	2								
C. Chemical application	2								
D. Weeding	25								
E. Pest control	15								
F. Irrigation	15								
G. Harvesting	35								
H. Threshing	8								
I. Transport	4								
2. Seed[a]		1,920	1,260	600		1,740	- 436	- 817	4,267
3. Fertilizer[b]			1,741	2,321		21,475	- 6,676	- 161	18,700
4. Interest and depreciation									
A. Small tools			54	27		159	45	15	300
B. Animals[c]				2,240					2,240
C. Animals implements[d]			90	3,882		1,584	- 746	- 49	4,761
D. Mechanical equipment									
E. Land improvement[e]			119	11,224		478	- 9,669	- 2,152	0
5. Operation and maintenace									
A. Animals[f]		1,411	374	231		1,469	57	58	3,600
B. Animal implements									
C. Mechanical equipment									
D. Land improvements									
6. Extension services			13,605	3,139		14,652	-16,045	-15,351	0
7. Fixed charges[g]								30,000	30,000
8. Land cost									
9. Other costs									
A. Mechanical threshing[h]			3,710	13,541		185	7,581	1,583	26,600
B. Interest on working capital[i]				3,639				- 426	3,213
Total costs		63,331	20,953	40,844		41,742	-25,889	12,700	153,681

Yield 3,325 mt/ha; market price farm gate 50 mf/kg ratios of shadow price to market price for: unskilled labor 1, skilled 1, labor 1, capital 1, land 1, and foreign exchange 1; total social cost per hectare 166,870; total social cost per metric ton milled product equivalent 77,210.

Continuation of Table A-2.

* Source of data is (6).

[a] 80 kgs of farmers seed at 50 mf/kg 2 out of every 3 years and 80 kgs of improved seed at 60 mf/kg every third year. Estimated real cost of improved seed is 105 mf/kg.

[b]

	farmer price	cost
100 kgs urea	92 mf/kg	145.6 mf/kg
100 kgs diammonium phosphate	95 mf/kg	144.6 mf/kg

[c] Purchase price of 2 oxen is 140,000 mf and it is assumed they are resold at prchase price. Interest cost is 140,000 x 8 percent and 2 animals are used over 5 hectares.

[d]

Equipment	Hectares used	Farmer price (mf)	Cost (mf)
Cart	7 ÷ 50% use	77,585	94,995
Plow	5	42,594	46,500
Harrow	7	21,526	38,000
Seeder	7	73,280	80,000

All equipment is depreciated over 10 years at 8 percent interest. Annual costs of spare parts (moldboards and plowshares) are estimated at 648 mf/ha.

[e] Capital value of 220,000 mf/ha annualized over 25 years at 2.5 percent.

[f] Costs of animal feed and care.

[g] 600 kgs of paddy/ha x 50 mf/kg.

[h] 160 kgs of paddy/mt x 50 mf/kg threshed is charge to farmer. It is assumed that farmer threshes 450 kgs of paddy by hand.

[i] 20 percent are 3 months on value of labor and seed, plus 2.5 percent over 6 months on valve of fertilizers.

Table A-3.--Production Budget for Farming - CFS (mf/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	70	35000							35000
A. Land preparation	14								
B. Seeding	3								
C. Chemical application									
D. Weeding	15								
E. Pest control	15								
F. Irrigation									
G. Harvesting	18								
H. Threshing	2								
I. Transport	3								
2. Seed [a]		1706	1117	534		1548	214	214	5333
3. Fertilizer									
4. Interest and depreciation									
A. Small tools [b]			54	27		159	45	15	300
B. Animals [c]				2800					2800
C. Animal implements [d]			93	1567		1636	- 309	20	3007
D. Mechanical equipment									
E. Land improvement [e]			174	18149		782	-12505	-6600	ø
5. Operation and maintenance									
A. Animals [f]		784	208	128		816	32	32	2000
B. Animal implements									
C. Mechanical equipment									
D. Land improvements									
6. Extension services			3540	180		900	- 960	3660	ø
7. Fixed charges [g]								7000	7000
8. Land cost									
9. Other costs			1380	69		5039	1133	779	8400
A. Mechanical threshing [h]									
B. Interest on working capital [i]				2017					2017
Total costs		37490	6566	25471		10880	-12350	-2200	65857

Yield* 1.330 ; market price farm gate 50 mf/kg ratios of shadow price to market price for: unskilled labor 1 , skilled labor 1 , capital 1 , land 1 , and foreign exchange 1 ; total social cost per hectare 80,407 ; total social cost per metric ton milled product equivalent 95.963 .

Continuation of Table A-3

*mt/ha **Source of data is (8)

[a] 100 kgs of farmers seed at 50 mf/kg two out of every three years and 100 kgs of improved seed at 60 mf/kg every third year.

[b] Hand tools valued at 300mf/ha per year

[c] Purchase price of 2 oxen is 140,000 mf and it is assumed they are resold at purchase price. Interest cost is 140,000 mf x 8 percent and 2 animals are used over 4 hectares

[d]

Equipment	Hectares Used	Farmer price	Cost
Cart	20 + 50 % use	77,585	94,995
Plow	4	42,594	46,500
Harrow	10	21,526	38,000

All equipment is depreciated over 10 years at 8 percent. Annual costs of spare parts (moldboards and plowshares) are estimated at 810 mf/ha.

[e] Investment costs equal to 400,000 mf/ha, annualized over 25 years at 2.5 percent.

[f] Animal feed.

[g] 140 kgs of paddy/ha valued at 50 mf/kg.

[h] Rice project charges farmer 12 percent of amount of paddy threshed (i e. 1400 kgs/ha x 12 percent x 50 mf/kg).

[i] 20 percent over 3 months on value of labor and seed.

Table A-4.--Production Budget for Farming - CFSI (mf/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	95	47500							47500
A. Land preparation	14								
B. Seeding	1								
C. Chemical application	1								
D. Weeding	28								
E. Pest control	15								
F. Irrigation									
G. Harvesting	25								
H. Threshing	8								
I. Transport	3								
2. Seed a		1365	894	427		1238	171	171	4266
3. Fertilizer b			871	1161		10737	- 3338	- 81	9350
4. Interest and depreciation									
A. Small tools			54	27		159	45	15	300
B. Animals c				2800					2800
C. Animal implements d			107	3092		1891	- 676	- 12	4402
D. Mechanical equipment									
E. Land improvement e			174	18149		782	-12505	- 6600	ø
5. Operation and maintenance									
A. Animals f		784	208	128		816	32	32	2000
B. Animal implements									
C. Mechanical equipment									
D. Land improvements									
6. Extension services			5900	300		1500	- 1600	- 6100	ø
7. Fixed charges g								-10000	10000
8. Land cost									
9. Other costs									
A. Mechanical threshing h			1774	89		6479	1480	978	10800
B. Interest on working capital i				2769				181	2588
Total costs		49649	9982	28942		23602	-16391	- 1778	94006

Yield* 2.375 ; market price farm gate 50mf/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1, and foreign exchange 1; total social cost per hectare 112,175; total

Continuation of Table A-4.

*mt/ha. ** Source of data is (8)

[a]80 kilograms of farmers seed 2 out of 3 years at 50 mf/kg plus 8 kilograms of improved seed every third year purchased at 60 mf/kg.

[b]

	Farmer price	Cost
50 kgs of urea	92 mf/kg	145.6 mf/kg
50 kgs of diammonium phosphate	95 mf/kg	144.6 mf/kg

[c]Purchase price of 2 oxen is 140,000 mf and it is assumed they are resold at purchase price. Interest cost is 140,000 mf x 8 percent and 2 animals are used over 4 ha.

[d]

Equipment	Hectares used	Farmer price	Cost
Cart	15 ÷ 50% use	77,585	94,995
Plow	4	42,594	46,500
Harrow	7	21,526	38,000
Seeder	40	311,440	340,000

All equipment is depreciated over 10 years at 8 percent. Annual costs of spare parts (moldboards and plowshares) are estimated at 810 mf.

[e]Investment costs equal to 400,000 mf/ha, annualized over 25 years at 2.5 percent.

[f]Costs of animal feed.

[g]200 kgs of paddy/ha at 50 mf/kg.

[h]12 percent of amount of paddy threshed (i.e. 1800 kgs/ha x 0.12 x 50 mt/ha).

[i]20 percent over 3 months on value of farmer's labor and seed plus 2.5 percent on value of fertilizers over 6 months.

Inputs	Unskilled labor		Skilled labor	Domestic capital	Land	Tradable inputs	Taxes and subsidies		Total market value
	Man-days	Market value					Tradables	Nontradables	
1. Direct labor	120	60000							60000
A. Land preparation	40								
B. Seeding	3								
C. Chemical application									
D. Weeding	20								
E. Pest control	20								
F. Irrigation									
G. Harvesting	12								
H. Threshing	18								
I. Transport	7								
2. Seed [a]		5646	18	294		30	12		6000
3. Fertilizer									
4. Interest and depreciation									
A. Small tools			108	54		318	90	30	600
B. Animals									
C. Animal implements									
D. Mechanical equipment									
E. Land improvement									
5. Operation and maintenance									
A. Animals									
B. Animal implements									
C. Mechanical equipment									
D. Land improvements									
6. Extension services									
7. Fixed charges									
8. Land cost									
9. Other costs									
A. Mechanical threshing									
B. Interest on working capital [b]				3300					3300
Total costs		65646	126	3648		348	102	30	69900

Yield* 1,140; market price farm gate 50mf/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1, and foreign exchange 1; total social cost per hectare 69,768; total social cost per metric ton milled product equivalent 97,143.

Continuation of Table A-5.

*mt/ha. ** Source of data is (9).

[a]120 kgs of unimproved seed/ha at 50 mf/kg.

[b]20 percent over 3 months on value of seed and labor.

Table A-6.--Production Budget for Farming - IPS (mf/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	115	57500							57500
A. Land preparation	17								
B. Seeding	3								
C. Chemical application									
D. Weeding	24								
E. Pest control	20								
F. Irrigation									
G. Harvesting	18								
H. Threshing	30								
I. Transport	3								
2. Seed a			1760	439		3447	- 593	280	5333
3. Fertilizer									
4. Interest and depreciation									
A. Small tools			175	175		350			700
B. Animals b				1867					1867
C. Animal implements c		27	41	2049		475	- 377	- 7	2208
D. Mechanical equipment									
E. Land improvement d			1262	15601		3133	-14148	-3158	2690
5. Operation and maintenance									
A. Animals									
B. Animal implements									
C. Mechanical equipment									
D. Land improvements									
6. Extension services			2104	458		458	- 1116	-1904	Ø
7. Fixed charges									
8. Land cost									
9. Other costs									
A. Mechanical threshing									
B. Interest on working capital e				2867				- 100	2767
Total costs		57527	5342	23456		7863	-16234	-4889	73065

Yield* 1.71 ; market price farm gate 50mf/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1, and foreign exchange 1; total social cost per hectare 94,188; total social cost per metric ton milled product equivalent 87,430.

Continuation of Table A-6.

*mt/ha. ** Source of data is (9).

[a]100 kgs/ha of farmers' seed at 50 mf/kg two out of three years and 100 kgs/ha of improved seed at 60 mf/kg every third year.

[b]Purchase price of 2 oxen is 140,000 francs and it is assumed they are resold at purchase price. Interest cost is 140,000 francs x 8 percent and they are used over 6 hectares.

[c]Equipment	Hectares	Purchase price	Cost
Cart	20 ÷ 50% use	77,585	94,995
Plow	6	42,594	46,500
Harrow	10	21,526	38,000

All equipment is depreciated over 10 years at 8 percent. Annual costs of spare parts (moldboards and plowshares) are estimated at 540 mf/ha.

[d]Investment costs of 300,000 mf/ha, annualized over 25 years at 2.5 percent, plus deep plowing costs of 17,500 mf/ha, annualized over 5 years at 2.5 percent, 1 percent added to investment costs to cover maintenance charges on irrigation workers.

[e]20 percent over 3 months on value of labor and seed.

Table A-7.--Production Budget for Farming - TFM (mf/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	60	30000							30000
A. Land preparation	14								
B. Seeding	3								
C. Chemical application	Ø								
D. Weeding	10								
E. Pest control	15								
F. Irrigation	Ø								
G. Harvesting	6								
H. Threshing	10								
I. Transport	2								
2. Seed a		4853	20	821		288	9	9	6000
3. Fertilizer									
4. Interest and depreciation									
A. Small tools			54	27		159	45	15	300
B. Animals b				2800					2800
C. Animal implements c			258	258		3782			4298
D. Mechanical equipment									
E. Land improvement									
5. Operation and maintenance									
A. Animals									
B. Animal implements									
C. Mechanical equipment									
D. Land improvements									
6. Extension services									
7. Fixed charges									
8. Land cost									
9. Other costs									
A. Mechanical threshing									
B. Interest on working capital d				1800					1800
Total costs		34853	332	5706		4229	54	24	45198

Yield .57mt/ha; market price farm gate 50mf/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1, and foreign exchange 1; total social cost per hectare 45,120; total social cost per metric ton milled product equivalent 125,648.

Continuation of Table A-7.

* Sources of data are (1,2,7).

[a]120 kgs of farmers seed valued at 50 mf/kg.

[b]Purchase price of 2 oxen is 140,000 mf and it is assumed that they are resold at that price. Interest cost is 140,000 mf x percent and oxen are used over 4 hectares.

[c]Equipment	Hectares	Purchase price	Cost
Plow	4	46,500	46,500

Plow is depreciated over 10 years at 20 percent. Annual costs of spare parts (moldboard and plowshare) are estimated at 810 mf/ha.

[d]20 percent over 3 months on value of seed and labor.

Table A-8.--Production Budget for Farming - CFM (mf/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	80	40000							40000
A. Land preparation	19								
B. Seeding	3								
C. Chemical application									
D. Weeding	15								
E. Pest control	15								
F. Irrigation									
G. Harvesting	23								
H. Threshing	2								
I. Transport	3								
2. Seed a		687	961	412		3227	- 66	+ 112	5333
3. Fertilizer									
4. Interest and depreciation									
A. Small tools			54	27		159	45	15	300
B. Animals b				1867					1867
C. Animal implements c			93	1567		1636	- 309	+ 20	3007
D. Mechanical equipment									
E. Land improvement d			217	22687		977	-17802	-6079	∅
5. Operation and maintenance									
A. Animals e		784	208	128		816	32	32	2000
B. Animal implements									
C. Mechanical equipment									
D. Land improvements									
6. Extension services			2950	150		750	- 800	-3050	∅
7. Fixed charges f								5000	5000
8. Land cost									
9. Other costs									
A. Mechanical threshing g			2159	6047		2008	- 3580	-1034	5600
B. Interest on working capital h				2267					2267
Total costs		41471	6642	35152		9573	-22480	-4984	65374

Yield* 1.33 ; market price farm gate 50 mf/kg ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1, and foreign exchange 1; total social cost per hectare 92,838; total social cost per metric ton milled product equivalent 110,798.

Continuation of Table A-8.

*mt/ha. ** Source of data is (7).

[a]100 kgs/ha of farmers' seed valued at 50 mf/kg two out of three years and 100 kgs/ha of improved seed purchased at 60 mf/kg. every third year

[b]Purchase price of two oxen is 140,000 and it is assumed they are resold at purchase price. Interest cost is 140,000 x 8 percent and oxen are used over 4 hectares.

[c]Equipment	Hectares used	Farmer price	Cost
Cart	20 ÷ 50% use	77,585	94,995
Plow	4	42,594	46,500
Harrow	10	21,526	38,000

All equipment is depreciated over 10 years at 8 percent. Annual costs of spare parts (plowshares and moldboards) are estimated at 810 mf/ha.

[d]Investment costs are 500,000 mf/ha, annualized over 25 years at 2.5 percent.

[e]Animal feed.

[f]100 kgs/ha of paddy at 50 mf/kg.

[g]1400 kgs/ha threshed at 6 mf/kg.

[h]20 percent over 3 months on value of seed and labor.

Table A-9.--Production Budget for Farming - CFMI (mf/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	100	50000							50000
A. Land preparation	19								
B. Seeding	1								
C. Chemical application	1								
D. Weeding	28								
E. Pest control	15								
F. Irrigation									
G. Harvesting	30								
H. Threshing	3								
I. Transport	3								
2. Seed a		550	769	330		2582	- 52	88	4267
3. Fertilizer b			871	1161		10737	- 3338	- 81	9350
4. Interest and depreciation									
A. Small tools			54	27		159	45	15	300
B. Animals c				1867					1867
C. Animal implements d			107	3092		1891	- 676	- 12	4402
D. Mechanical equipment									
E. Land improvement			217	22687		977	-17802	- 6079	∅
5. Operation and maintenance									
A. Animals e		784	208	128		816	32	32	2000
B. Animal implements									
C. Mechanical equipment									
D. Land improvements									
6. Extension services			5900	300		1500	- 1600	- 6100	∅
7. Fixed charges f								12000	12000
8. Land cost									
9. Other costs A. Project Overhead g			3900	900		4200	- 4600	-4400	∅
B. Mechanical threshing h			3856	10797		3585	- 2416	-822	15000
C. Interest on working capital i				2894				-181	2713
Total costs		51334	15882	44183		26447	-30407	-5540	101899

Yield* 2,375 ; market price farm gate 50mf/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1, and foreign exchange 1; total social cost per hectare 137,846; total social cost per metric ton milled product equivalent 92,128.

Continuation of Table A-9.

*mt/ha. ** Source of data is (7).

[a]80 kgs/ha of farmers' seed valued at 50 mf/kg two out of three years and 80 kgs/ha of improved seed purchased at 60 mf/kg every third year.

[b]

	Farmer price	Cost
50 kgs of urea	92 mf/kg	145.6 mf/kg
50 kgs of diammonium phosphate	95 mf/kg	144.6 mf/kg

[c]Purchase price of 2 oxen is 140,000 mf and it is assumed they are resold at purchase price. Interest cost is 140,000 x 8 percent, and they are used over 6 hectares.

[d]

Equipment	Hectares used	Farmer price	Cost
Cart	15 ÷ 50 percent use	77,585	94,995
Plow	4	42,594	46,500
Harrow	7	21,526	38,000
Seeder	40	311,440	340,000

All equipment is depreciated over 10 years at 8 percent. Annual costs of spare parts (moldboards and plowshares) are estimated at 810 mf.

[e]Animal feed.

[f]240 kgs/ha of paddy x 50 mf/kg.

[g]Administrative costs, such as maintenance of marketing records and provision of technical assistance not included in costs of extension services.

[h]Farmers charged 6 mf/kg of paddy threshed.

[i]20 percent over 3 months on value labor and seed, plus 2 1/2 percent over 6 months on cost of fertilizers to project.

Table B.--Budget for Collection

PCO

(mf/mt paddy)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Sacks[a]	-	495	193	-	1,511	413	138	2,750
2. Handling[b]	490	490	700	-		350	210	3,500
3. Transport[c]	-	700	500	-	900	250	150	2,500
4. Commissions[d]	770	770	1,100	-	1,980	550	330	5,500
5. Capital charges[e]	-	-	-	-	-	-	-	-
6. Storage	-	-	-	-	-	-	-	-
7. Other	-	-	-	-	-	-	-	-
Total	1,260	2,455	2,493	-	5,651	1,563	828	14,250

Price received at mill 64,250; ratios of shadow price to market price for: unskilled labor 1; skilled labor 1, capital 1, land 1; total social cost per kilogram paddy 11.86, social cost per metric ton milled product equivalent 18, 246.

[a]Sacks calculated at 575 mf/sack, 3 uses/sack and 14.3 sacks/ton of paddy.

[b]Field collection.

[c]83 mf/ton-kilometer and 30 kilometers average transport in Office du Niger

[d]Fee paid to OPAM for marketing and storage services.

[e]Included in milling costs associated with this technique.

Table B.--Budget for Collection

PCS
(mf/mt paddy)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Sacks[a]	-	495	193	-	1,511	413	138	2,750
2. Handling[b]	490	490	700	-	1,260	350	210	3,500
3. Transport[c]	-	1,400	1,000		1,800	500	300	5,000
4. Commissions[d]	770	770	1,100	-	1,980	550	330	5,500
5. Capital charges[e]	-	-	-	-	-	-	-	-
6. Storage	-	-	-	-	-	-	-	-
7. Other	-	-	-	-	-	-	-	-
Total	1,260	3,155	2,993		6,551	1,813	978	16,750

Price received at mill 66,750; ratios of shadow price to market price for: unskilled labor 1; skilled labor 1, capital 1, land 1; total social cost per kilogram paddy 16.75; social cost per metric ton milled product equivalent 13, 959.

[a] Sacks calculated at 575 mf/sack, 3 uses/sack and 14.3 sacks/ton of paddy.

[b] Field collection.

[c] 83 mf/ton-kilometer and 60 kilometers average transport in Opération Riz Segou.

[d] Fee paid to OPAM for marketing and storage services.

[e] Included in milling costs associated with this technique.

Table B.--Budget for Collection

PCR

(mf/mt paddy)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies		Total market value
						Tradables	Nontradables	
1. Sacks[a]	-	495	193	-	1,511	413	138	2,750
2. Handling[b]	490	490	700	-	1,260	350	210	3,500
3. Transport[c]	-	1,162	830	-	1,494	415	249	4,150
4. Commissions[d]	770	770	1,100	-	1,980	550	330	5,500
5. Capital charges[e]	-	-	-	-	-	-	-	-
6. Storage	-	-	-	-	-	-	-	-
7. Other	-	-	-	-	-	-	-	-
Total	1,260	2,917	2,823	-	6,245	1,728	927	15,900

Price received at mill 66,900; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; total social cost per kilogram paddy 13,25, social cost per metric ton milled product equivalent 21, .032.

[a]Sacks calculated at 575 mf/sack, 3 uses/sack and 14.3 sacks/ton of paddy.

[b]Field collection.

[c]50 kilometers at 83 mf/ton-kilometer in Sikasso region.

[d]Fee paid to OPAM for marketing and storage services.

[e]Included in milling costs associated with this technique.

Table B.--Budget for Collection

PCM

(mf/mt paddy)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies		Total market value
						Tradables	Nontradables	
1. Sacks [a]	-	495	193	-	1,511	413	138	2,750
2. Handling [b]	490	490	700	-	1,260	350	210	3,500
3. Transport [c]	-	1,400	1,000	-	1,800	500	300	5,000
4. Commissions [d]	770	770	1,100	-	1,980	560	330	5,500
5. Capital charges [e]	-	-		-	-	-	-	-
6. Storage	-	-	-	-	-	-	-	-
7. Other	-	-	-	-	-	-	-	-
Total	1,260	3,155	2,993	-	6,551	1,813	978	16,750

Price received at mill 66,750; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; total social cost per kilogram paddy 13.96, social cost per metric ton milled product equivalent 22, 159.

[a] Sacks calculated at 575 mf/sack, 3 uses/sack and 14.3 sacks/ton of paddy.

[b] Field collection.

[c] 60 kilometers at 83 mf/ton-kilometer in Mopti region.

[d] Fee paid to OPAM for marketing and storage services.

[e] Included in milling costs associated with this collection technique.

Table C.--Budget for Milling [a]

IMO

(mf/mt milled rice)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Direct labor	-	3,787	-	-	-	-	-	3,787
2. Fuel								
3. Oil	27	-	30	-	838	257	10	1,162
4. Electricity	-	290	437	-	728	-	-	1,455
5. Rent	-	-	-	-	-	-	-	-
6. Interest and depreciation								
A. Building B. Equipment	1,402	-	509	-	765	351	166	3,193
7. Maintenance and repair								
A. Building B. Equipment	1,734	-	630	-	946	433	197	3,940
8. Capital charges [a]	449	160	231	-	244	48	34	1,166
9. Insurance	-	-	-	-	-	-	-	-
10. Other								
A. Transport of personnel	26	70	24	-	50	25	32	227
B. Losses	583	209	300	-	317	62	44	1,515
Total	4,221	4,516	2,161	-	3,888	1,176	483	16,445

Yield 65% ; rice percentage brokens 50 ; price received ex-mill n.a. ; ratios of shadow price to market price for: unskilled labor 1 , skilled labor 1 , capital 1 , land 1 ; social cost per metric ton milled rice 14, 786

Source is (6).

[a] 2.5 percent over 6 months on in-mill value of paddy.

Table C.--Budget for Milling

IMS

(mf/mt milled rice)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies		Total market value
						Tradables	Nontradables	
1. Direct labor	-	2,006	-	-	-	-	501	2,507
2. Fuel	51	-	79	-	2,200	674	47	3,051
3. Oil								
4. Electricity	-	-	-	-	-	-	-	-
5. Rent	-	431	157	-	235	108	48	979
6. Interest and depreciation								
A. Building	-	992	361	-	541	248	111	2,253
B. Equipment								
7. Maintenance and repair								
A. Building	-	438	159	-	239	110	49	995
B. Equipment								
8. Capital charges[a]	125	412	267	-	291	61	56	1,212
9. Insurance	-	43	16	-	24	10	5	98
10. Other								
A. Overhead	6	163	48	-	290	36	7	550
B. Losses	597	181	354	-	386	80	61	1,609
Total	729	4,666	1,441	-	4,206	1,327	885	13,254

Yield 63% ; Rice percentage brokens 50 ; price received ex-mill n.a.; ratios of shadow price to market price for: unskilled labor 1 , skilled labor 1 , capital 1 , land 1 ; total social cost per metric ton milled rice 11 , 042 .

Source is (7).

[a] 2.5 percent over 6 months on in-mill value of paddy.

Table C.--Budget for Milling

SM

(mf/mt milled rice)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Tradables	Nontradables	Total market value
1. Direct labor	-	3,333	-	-	-	-	-	3,333
2. Fuel	-	-	-	-	-	-	-	-
3. Oil and grease	-	7	7	-	192	33	3	242
4. Electricity	-	333	1,333	-	1,333	167	167	3,333
5. Rent	42	-	38	-	28	10	15	133
6. Interest and depreciation A. Building B. Equipment	-	197	117	-	357	90	130	891
7. Maintenance and repair A. Building B. Equipment	155	-	45	-	88	38	26	352
8. Capital charges	433	143	280	-	305	64	48	1,273
9. Insurance	-	-	-	-	-	-	-	-
10. Other[a]	547	181	354	-	386	80	61	1,609
Total	1,177	4,194	2,174	-	2,689	482	450	11,166

Yield 60 ; rice percentage brokens 70 ; price received ex-mill n.a. ; ratios of shadow price to market price for: unskilled labor 1 , skilled labor 1 , capital 1 , land 1 ; total social cost per metric ton milled rice 10 , 234 .

Sources are (14) and surveys made by author in Mali.

[a]Losses.

Table C.--Budget for Milling

HP

(mf/mt milled rice)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Tradables	Nontradables	Total market value
1. Direct labor[a]	30,000	-	-	-	-	-	-	30,000
2. Fuel	-	-	-	-	-	-	-	-
3. Oil	-	-	-	-	-	-	-	-
4. Electricity	-	-	-	-	-	-	-	-
5. Rent	-	-	-	-	-	-	-	-
6. Interest and depreciation[b]								
A. Building	-	-	-	-	-	-	-	-
B. Equipment	-	-	-	-	-	-	-	-
7. Maintenance and repair								
A. Building	-	-	-	-	-	-	-	-
B. Equipment	-	-	-	-	-	-	-	-
8. Capital charges	-	-	-	-	-	-	-	-
9. Insurance	-	-	-	-	-	-	-	-
10. Other	-	-	-	-	-	-	-	-
Total	30,000	-	-	-	-	-	-	30,000

Yield 70%; rice percentage brokens 80; price received ex-mill n.a.; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 10; social cost per metric ton milled rice 30, 000.

[a]18 kilograms or paddy hand pounded per day, yielding 12.6 kilograms of rice; women hand pounding rice are assumed to be paid at 75 percent of male wage, i.e. at 375 mf per day.

[b]Interest and depreciation costs of mortar, pestle, and winnowing bowls are insignificant.

Table D.--Budget for Distribution to Bamako

(mf/mt milled rice)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies		Total market value
						Tradables	Nontradables	
1. Sacks[a]	-	345	134	-	1,053	288	96	1,916
2. Handling[b]	-	-	-	-	-	-	-	-
3. Transport[c]	-	1,774	1,267	-	2,281	634	380	6,336
4. Commissions[d]	700	700	1,000	-	1,800	500	300	5,000
5. Capital Charges[e]	-	-	-	-	-	-	-	-
6. Storage[f]	-	-	-	-	-	-	-	-
7. Other[g]	626	350	366	-	480	112	66	2,000
Total	1,326	3,169	2,767	-	5,614	1,534	842	15,25°

Price received from wholesalers in consumption center n.a.; import price of comparable rice 182,200 mt/mf; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; social cost per metric ton milled rice 12, 876 mf[h].

[a] 575 mf/sack, 3 uses/sack, 10 sacks/ton of rice.

[b] Included in commissions which represent handling and storage costs of OPAM.

[c] 240 kms Segou to Bamako at 26.4 mf/ton-km.

[d] Fee paid to OPAM for handling and storage costs.

[e] Included in commissions.

[f] Included in commissions.

[g] Losses estimated at 1.63% of value of rice inclusive of all costs.

[h] For shipment from Office du Niger or Operation Riz Segou.

Table D.--Budget for Distribution to Abidjan

(mf/mt milled rice)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies		Total market value
						Tradables	Nontradables	
1. Sacks[a]	-	1,035	402	-	3,159	866	288	5,750
2. Handling[b]	-	-	-	-	-	-	-	-
3. Transport[c]	-	8,464	6,046	-	10,882	3,023	1,813	30,228
4. Commissions[d]	700	700	1,000	-	1,800	500	300	5,000
5. Capital charges[e]	-	-	-	-	-	-	-	-
6. Storage[f]	-	-	-	-	-	-	-	-
7. Other[g]	767	429	448	-	588	137	81	2,450
Total	1,467	10,628	7,896	-	16,429	4,526	2,482	43,428

Price received from wholesalers in consumption center n.a.; border price of comparable rice 150,000; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; social cost per metric ton milled rice 36, 420.[h]

[a] 575 mf/sack, 3 uses/sack, 10 sacks/ton of rice.

[b] Included in commissions which represents handling and storage costs of OPAM.

[c] 240 kms Segou to Bamako at 26.4 mf/ton-km.

[d] Fee paid to OPAM for handling and storage costs.

[e] Included in commissions.

[f] Included in commissions.

[g] Losses estimated at 1.63% of value of rice inclusive of all costs.

[h] For shipment from Office du Niger or from Opération Riz Segou.

Table D.--Budget for Distribution to Dakar

(mf/mt milled rice)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies: Tradables	Taxes and subsidies: Nontradables	Total market value
1. Sacks[a]	-	1,035	402	-	3,159	866	288	5,750
2. Handling[b]	-	-	-	-	-	-	-	-
3. Transport[c]	-	1,774	1,267	-	2,281	634	380	6,336
4. Commissions[d]	700	700	1,000	-	1,800	500	300	5,000
5. Capital charges	-	-	-	-	-	-	-	-
6. Storage[e]	-	-	-	-	-	-	-	-
7. Other[f]	748	418	437	-	574	134	79	2,390
[g]	800	2,200	2,600	-	10,400	2,400	1,600	20,000
Total	2,248	6,127	5,706	-	18,214	4,534	2,647	39,476

Price received from wholesalers in consumption center n.a.; border price of comparable rice 125,000; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; social cost per metric ton milled rice 32, 295.[h]

[a] 575 mf/sack/use, 10 sacks/ton-rice.

[b] Included in commissions which represent handling and storage costs of OPAM.

[c] 240 kms Segou to Bamako at 26.4 mf/ton.

[d] Fee paid to OPAM for handling and storage costs.

[e] Included in commissions.

[f] Losses at 1.63% of value of rice inclusive of all costs except rail transport.

[g] Estimated cost of rail transport to Dakar.

[h] Shipment from Office du Niger or Opération Riz Segou.

Table D.--Budget for Distribution to Bouaké

(mf/mt milled rice)

Inputs	Unskilled labor	Skilled labor	Capital	Land	Tradable inputs	Taxes and subsidies		Total market value
						Tradables	Nontradables	
1. Sacks[a]	-	1,035	402	-	3,159	866	288	5,750
2. Handling[b]	-	-	-	-	-	-	-	-
3. Transport[c]	-	5,714	4,081	-	7,347	2,041	1,224	20,407
4. Commissions[d]	700	700	1,000	-	1,800	500	300	5,000
5. Capital charges[e]	-	-	-	-	-	-	-	-
6. Storage[f]	-	-	-	-	-	-	-	-
7. Other[g]	717	401	419	-	550	128	75	2,290
Total	1,417	7,850	5,902	-	12,856	3,535	1,887	33,447

Price received from wholesalers in consumption center n.a. ; import price of comparable rice 159,800; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, land 1; per metric ton milled rice 28, 025. [h]

[a]575 mf/sack, 3 uses/sack, 10 sacks/ton of rice.

[b]Included in commissions which represent handling and storage costs of OPAM.

[c]240 kms Segou to Bamako at 26.4 mf/ton-km.

[d]Fee paid to OPAM for handling and storage costs.

[e]Included in commissions.

[f]Included in commissions.

[g]Losses estimated at 1.63% of value of rice inclusive of all costs.

[h]For shipment from Office du Niger or Opération Riz Segou.