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Private and Social Profitability in Rice Production and Marketing in Sierra Leone

by

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1. INTRODUCTION

Sierra Leone is the leading rice producing and consuming country in West Africa and the third most important in Africa (after Egypt and the Malagasy Republic). Rice is the staple food and most important crop grown in Sierra Leone. Per capita consumption is over 120 kgs and about 645,000 hectares of rice are cultivated each year by 85 percent of Sierra Leone farmers. Rice production generates about 15 percent of Gross National Product. Although domestic rice output has doubled during the past two decades, imports of rice have continued (17). The government of Sierra Leone believes that rice importation unnecessasily uses scarce foreign exchange and, like all other West African governments, has adopted a goal of self-sufficiency in rice.

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Consequently, rice has occupied a central place in government policy during the last forty years.

There are many rice production and post-production systems in Sierra Leone. Government policy has had a differential impact on these various systems. The major objective of this analysis is to examine the structure of costs and benefits in the major types of rice production and post-production systems in order to estimate comparative advantage in domestic rice production and to determine the effects of government policy.

The paper is divided into nine sections. Section 2 describes the different rice production techniques in Sierra Leone. Techniques are classified using the West Africa Rice Development Association (WARDA) scheme based on soil and water regimes as well as on the basis of technology. Section 3 analyzes private costs and returns in each of the production systems. Section 4 provides a description of the post-production systems which is followed by an analysis of their private costs in Section 5. In the rest of the paper the analysis concentrates on social costs and returns. Derivation of shadow prices and estimation of net input subsides are discussed in Section 6. Section 7 compares private and social profitability for each production/marketing channel. Sensitivity analyses to determine the effect of changes in input and output values on the results are discussed in Section 8. The final section contains a summary and conclusion.

2. RICE PRODUCTION SYSTEMS

Rice is grown in the uplands and lowlands of Sierra Leone. Using WARDA's classification system (16), one can demarcate four basic types of rice cultivation - strictly upland (hill rice and flatland rice), mangrove without tidal control, freshwater without water control, and freshwater with partial water control. On the basis of location, planting, weeding and harvesting practices, source of power, use of fertilizer and improved seeds etc., these four basic types can be further subdivided to give the thirteen systems of rice cultivation described and analyzed in this paper. The key characteristics of these systems are shown in Table.1.

Strictly Upland Rice Cultivation

Strictly upland rice cultivation is practiced on well drained land not subject to flooding, where rain is the only source of water. The crop does not draw water from a high ground water table. This type of rice cultivation occurs on hill sides (hill rice) and fairly flat areas (flatland rice) in Sierra Leone, but in this paper no distinction is made between the two.

Upland rice culture is the major system of rice production in Sierra Leone. As shown in Table 1, it occupies about 75 percent of the area under rice and accounts for about 55 percent of domestic rice production. It is a traditional method of rice cultivation in which soil fertility is maintained by the bush fallow method. Generally, the land is brushed, i.e., the forest vegetation is cut, allowed to dry, burnt, and the land cleared between January and April.

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Table 1

Key characteristics of Rice Production Techniques in Sierra Leone.

Production Techniques	1975 Area (000ha)	Paddy Yield (mt/ha)	1975 Paddy Production (000mt)	Type of Water Control	Source of Power		Improved Seeds	Fertilizer	Planting Method b)	Weeding Practice c)
					Land Preparation	Harvest a)				
1. Traditional Upland-South	152.8	1.30	198.6	None	Manual	Manual	None	None	B	L
2. Traditional Upland-North	179.2	0.81	145.2	None	"	"	None	None	B	M
3. Improved Upland-South	-	-	-	None	"	"	Yes	Yes	B	H
4. Improved Upland-North	-	-	-	None	"	"	"	"	B	H
5. Mangrove Swamp-South	3.1	1.74	5.4	"	"	"	None	None	T	N
6. Mangrove Swamp-North	24.3	3.15	76.5	"	"	"	Yes	None	T	N
7. Boliland (Manual)-North	12.3	.96	11.8	"	"	"	Yes	Yes	BT	L
8. Boliland (Tractor Plow)-North	5.9	1.13	6.7	"	Tractor	"	Yes	Yes	B	L
9. Riverain (Tractor Plow)-South	5.5	1.84	10.1	"	"	"	None	None	B	L
10. Traditional Inland-South	20.9	2.65	55.4	"	Manual	"	None	None	BT	L
11. Traditional Inland-North	36.0	2.20	79.2	"	"	"	Yes	Yes	T	L
12. Improved Inland-South	3.5	3.98	13.9	Partial	"	"	Yes	Yes	T	L
13. Improved Inland-North	2.0	3.30	6.6	"	"	"	Yes	Yes	T	L

a) Pannicle harvesting
b) B= Broadcast; T= Transplant; BT Combined broadcast and transplant.
c) H= Heavy, M= Meduim L= Light, N= None

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With the onset of the rains the land is slightly plowed, seeded by broadcasting, and harrowed with a short handled hoe. Traditional varieties are normally planted, and inter-cropping is common, usually with cassava, maize, benniseed or broad beans. Hand weeding is necessary, time consuming and has a great effect on yields. Hand harvesting with a small knife usually takes place between August and October. Because of better soil and rainfall, yields are slightly higher in the center, east and south of Sierra Leone than in the north. Consequently, upland rice cultivation in the north is differentiated from that in the south.[1]

Starting in the 1976/77 crop season an improved upland rice cultivation system was introduced into Sierra Leone by the Integrated Agricultural Development Projects (I.A.D.P.) in the north and south of the country. In this system cultural practices are the same as in the traditional upland rice system except that improved seeds and fertilizer are used. Less than 1000 hectares were under this system of cultivation by the end of 1978. Therefore the strictly upland rice cultivation system is subdivided into four systems in this paper- Traditional Upland-South (system 1), Traditional Upland-North (system 2), Improved Upland-South (system 3), and Improved Upland-North (system 4).

Mangrove Rice Cultivation Without Tidal Control

Mangrove swamps are located along the coast where tidal action causes inundation at high tides and drainage at low tides (Figure 1). The mangrove soils are acid sulphate or cat clays.

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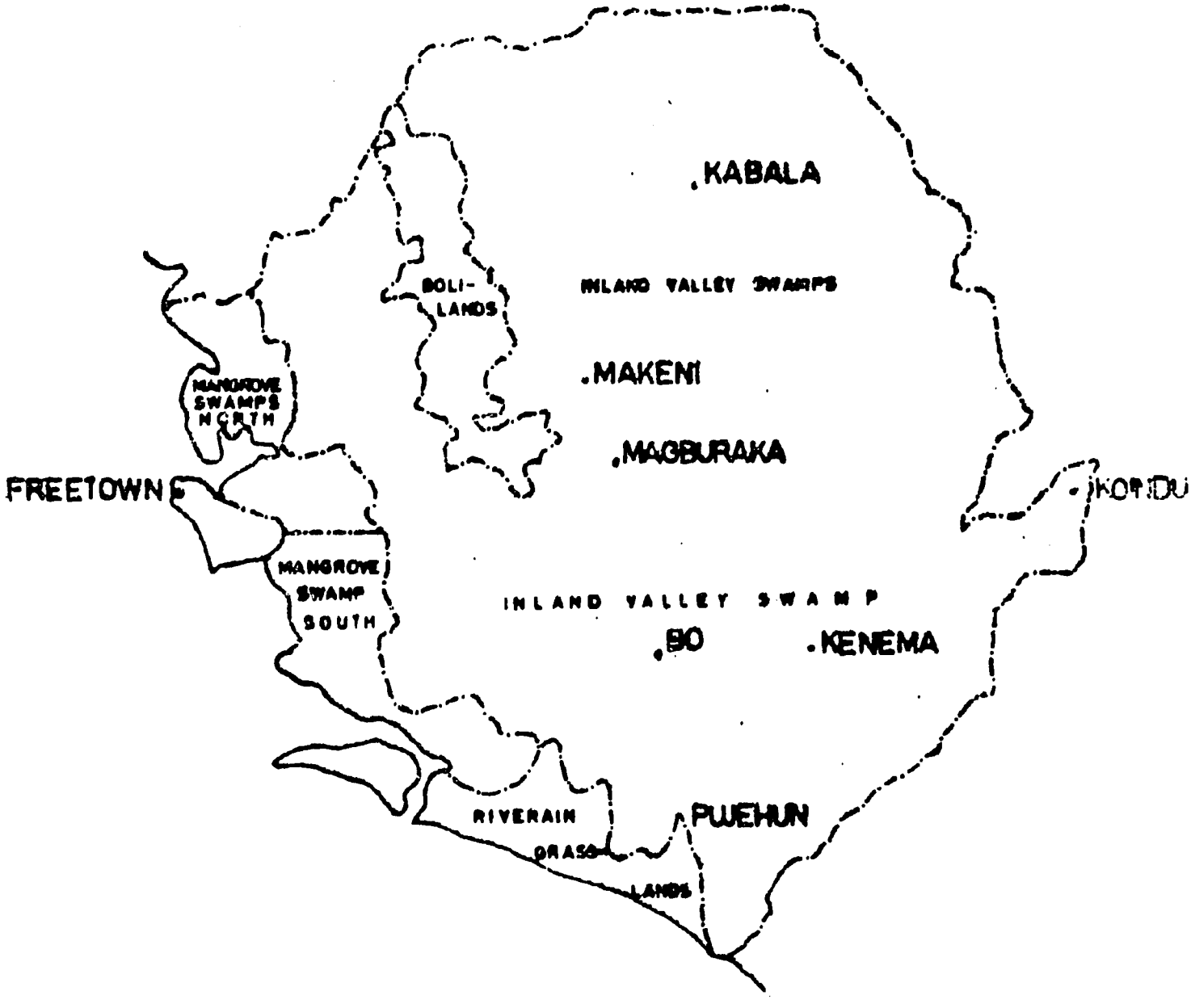

FIG.1. AREAS WHERE DIFFERENT TYPES OF SWAMPLAND ARE CONCENTRATED IN SIERRA LEONE.

Cultivation of swamp rice in Sierra Leone probably started about 1800 in the mangrove swamp areas around the Great and Little Scarcies Rivers in northern Sierra Leone. Mangrove swamps gave such good results that by 1900 practically all the better swamps in the Scarcies were under cultivation following clearing of the native mangrove forests, a very difficult and expensive task. Clearing and cultivation of mangrove swamps in the southern coastal belt, especially along the banks of the Ribbi River, developed later and more slowly. Most of the currently unutilized mangrove swamps (50,000 hectares) are in this southern coastal belt. Tidal mangrove swamps are continuously cultivated from year to year. Transplanting takes place in July and August after the rains have pushed the salt tongue out to sea and leached the salt from the soil. Empoldering to protect crop land from the intrusion of saline water is not practiced in Sierra Leone. Weeding is uncommon, and hand harvesting takes place in December and January. Because of differences in land preparation and transplanting practices, yields are different in the Northern and Southern mangrove swamps. Consequently, two systems of mangrove swamp cultivation without tidal control - Mangrove Swamp-South (System 5), and Mangrove Swamp-North (system 6), are distinguished in this paper.

Fresh Water Cultivation Without Water Control

There are three types of fresh water rice cultivation systems without water control in Sierra Leone - bolilands, riverain grasslands, and inland valley swamps.

(a) Bolilands

Bolilands are low, saucer-shaped swamp grasslands associated with the Rokel River and its tributaries in central and northern Sierra Leone (Figure 1). It is estimated that 30,000 hectares of bolilands are suitable for rice cultivation. As shown in Table 1, about 60 percent of this area is presently cultivated. Boliland swamps (bolis) are dry throughout the dry seasons, but are flooded up to 1.5 meters for periods varying from three to six months as a result of rain water accumulation and river flooding. The soils are acidic and very low in phosphorus. Without the use of phosphatic fertilizers, yields are very low. Consequently, even under semi-traditional conditions (system 7) super-phosphate is used in this area. In fact, almost all of the fertilizer consumed in Sierra Leone was used in the bolis until recently.

Because of the flat topography, partial mechanization (plowing) using a government provided and heavily subsidized tractor hire scheme has been introduced into the area (system 8). In 1975/76 about 6,000 hectares in the bolis were mechanically plowed. When mechanical plowing is utilized, seed is broadcast. Under hand cultivation, broadcasting takes place in May or transplanting in June and July. Yields are higher with transplanting. Weeds are a problem in the bolis and hand weeding is necessary. Hand harvesting takes place in December and January.

(b) Riverain Grassland

Small patches of riverain grasslands are scattered throughout the country. Extensive areas are only located in the south where two rivers, the Waanje and the Sewa, are prevented from flowing directly into the sea by a raised sand bar (Figure 1). The silt deposited by the rivers has formed extensive grassy plains which flood up to four meters in the rainy season, necessitating the use of floating rice varieties. Hand cultivation of these areas is extremely labor intensive because of the heavy infestation of weeds. Because of very low population density in the area, there has been little hand cultivation of these soils.

Mechanical cultivation under a government scheme started in 1949 and has been quite popular (system 9). A substantial number of the users are absentee farmers. Area cultivated fluctuates with the size of the government tractor fleet, declining to virtually zero in some years (for example, 1978) and rising up to 6,000 hectares in others (for example, 1974).

It is estimated that over 50,000 hectares are suitable for rice cultivation in the riverain grasslands. As shown in Table 1, only about 10 percent of this area is presently cultivated. Seed is usually broadcast in April and May so that initial growth has started before deep flooding takes place. Weeding is essential if the crop is not to be choked by weeds. Hand harvesting among the tangled mat of lodged straw takes place in December and January after the floods have receeded. Production in the riverain grasslands is unpredictable because of the uncontrolled nature of flooding, the weed problem, and labor shortage in the area.

(c) Inland Valley Swamp

Inland valley swamps are found throughout the country wherever depressions occur in the rolling upland. It is estimated that there are about 300,000 hectares of inland swamps in Sierra Leone of which only about 65,000 hectares are currently being cultivated. Under traditional culture, inland swamps are cultivated for a number of years before being fallowed. The swamps are not completely stumped and there is no water control. Transplanting is usual, but broadcasting is not uncommon. Only one crop is planted a year in pure stands. As shown in Table 1, yields are nearly double those on uplands and yields in the South are higher than in the North, the result again of better soil conditions. Consequently, two types of inland swamps without water control -- Traditional Inland-South (system 10), and Traditional Inland-North, (system 11) -- are distinguished for purposes of analysis here.

Fresh Water Rice Cultivation With Partial Water Control

Fresh water rice cultivation with partial water control as practiced in Sierra Leone involves stumping, partial land levelling, and the construction of dikes and contour bunds in inland valley swamps. The dikes and bunds allow some control over the submersion and drainage of plots. This system was introduced on a pilot basis in 1966/67. Presently it is being promoted by the various development projects in Sierra Leone. These projects encourage farmers not only to adopt the water control system but also to use improved seeds and fertilizers. In 1976/77 about 8,500 hectares were under these improved inland swamp systems in Sierra Leone comprising Improved Inland-South (system 12) and Improved Inland-North (system 13). Yields are generally 30 to 50 percent above those in the traditional systems.

3. PRIVATE COST OF RICE PRODUCTION

Table 2 shows the private cost per hectare of the 13 rice production systems. Physical input-output data were collected in a detailed farm management survey conducted in 1974/75 (11). Prices have been adjusted to 1976 prices. Land development (or investment) costs apply only to inland swamp rice systems where land is cultivated for a number of years after forest vegetation has been cleared.[2] In the traditional system tree stumps are not completely removed. Hence, costs are lower than in the improved systems where stumping is more complete, and bunds and water canals are constructed. Land development costs are mainly labor costs, sluice gates being made out of palm logs.

Labor inputs per hectare into inland swamp land development are about 47 and 60 man days, respectively, for traditional swamps in the South and North, the difference being due to better stumping in the North. For improved systems land development takes about 185 man days per hectare. Costs are prorated over 10 years.[3] For traditional systems an estimated real market rate of interest of 40 percent is used.[4]

Farmers adopting the improved system receive a five year loan of Le 172.90 per hectare at eight percent. This loan covers the land development costs (185 mandays at Le 0.73 in the South and Le 0.65 in the North) and costs of farm tools. To calculate the private cost of the land development, the annuity on the five year loan is discounted at the market rate of interest (40%) to get the discounted present value of the loan. This is then prorated over the actual estimated life of the investment (10 years), using the market interest rate, to give the annual farmer cost of land development.

Annual fees for land use are paid by some farmers in Sierra Leone to persons who control use of the land.[5] Such fees are paid by less than a quarter of all farmers (11). They are used in Table 2 to reflect the rental value of land in calculating private cost. Fees paid are higher for the more productive swamp lands.

Table 2

Quantities and Private Costs of Major Inputs into Rice Production Systems in Sierra Leone, 1[illegible]. (Leones [a]) per hectare unless otherwise indicated).

Production Techniques	Land Cost		Farm Labor			Fertilizer		Seeds					Total Private Costs	
	Development	Annual Fee	Man-days	Daily Wage Rate	Total Cost	kgs N-P-K	Cost	kgs	Cost	Annual Tool Cost	Interest on Working Capital	Plowing Fee	Cost Per ha	Per ton Paddy
1. Traditional Upland-South	-	3.51	205	0.70	142.89	-	-	54	10.53	2.23	4.62	-	163.77	140.0
2. Traditional Upland-North	-	3.51	25[illegible]	0.52	123.76	-	-	52	10.71	1.76	4.16	-	143.90	177.6
3. Improved Upland-South	-	3.51	225	0.70	157.50	50-50-0	21.34	56	16.40	2.23	6.63	-	207.61	110.9
4. Improved Upland-North	-	3.51	25[illegible]	0.65	167.70	50-50-0	21.34	56	16.40	1.73	6.83	-	217.59	149.2
5. Mangrove Swamp-South	-	6.84	220	0.75	165.00	-	-	92	17.94	3.11	5.91	-	198.80	114.5
6. Mangrove Swamp-North	-	20.40	445	0.80	356.00	-	-	150	29.25	5.86	11.83	-	423.34	151.0
7. Boliland (Manual) - North	-	1.73	112	0.60	67.20	9-9-0	1.98	70	14.42	7.07	3.51	-	95.91	99.6
8. Boliland (Tractor Plow)-North	-	5.19	68	0.60	40.80	13-13-0	2.96	60	12.36	2.10	5.30	24.70	93.41	82.5
9. Riverain (Tractor Plow)-South	-	4.20	91	0.80	72.80	-	-	48	9.36	3.67	5.23	24.70	119.96	65.9
0. Traditional Inland-South	14.21	12.96	274	0.73	200.02	-	-	56	10.92	7.13	6.09	-	251.33	107.7
1. Traditional Inland-North	16.15	14.72	356	0.65	231.40	8-8-0	1.90	105	21.63	7.21	8.13	-	301.14	140.6
2. Improved Inland-South	28.52	12.96	336	0.73	245.28	53-53-0	22.70	67	19.63	9.62	9.15	-	347.86	114.6
3. Improved Inland-North	25.40	14.72	390	0.65	253.50	53-53-0	22.70	67	19.63	9.62	9.36	-	354.93	127.4

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Le 1.00 = ¥1.00

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Farm labor

Labor use in Sierra Leone rice production systems ranges from 68 to 443 mandays per hectare. Low labor use figures are found in systems in which seed is broadcast on grassland farms, especially where tractor plowing takes place. High labor utilization occurs in manually cultivated swampland farms where there is transplanting. Improved systems of production use more labor for harvesting the increased yield as well as for changes in cultural practices including shifts from broadcasting to transplanting, better weeding, and application of fertilizers and chemicals.

Rural wage rates in Sierra Leone vary by region, sex, season, and task reflecting the active nature of the rural labor market (11, 15). The daily wage rates shown in Table 2 are weighted average annual wages per man day. They are based on data collected in a detailed farm management survey in 1974/75, adjusted upward in proportion to increases in the official minimum wage rate since 1975.[6] The wages include cash payments as well as the value of payments in kind. Generally, agricultural wages are higher in the South where there are alternative employment opportunities in more profitable tree crop production (coffee, cocoa, and oil palm). They are also higher in swamp than in upland rice farming systems because of the arduous nature of work in swamps. The quantities of labor used in Sierra Leone rice production systems are similar to those used in neighbouring Liberia (7) but are higher than those used in the Ivory Coast (3) and some Sahelian states (6, 15).

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This is due to the fact that cultivation in heavy rain forest areas is more labor demanding than in more open savannah regions and thinner rain forests such as in the Ivory Coast. On the other hand, rural wage rates are lower in Sierra Leone than in neighbouring Liberia reflecting the relative lack of alternative rural employment opportunities, such as in the timber and mining concessions, that exist in Liberia. This lower wage rate is also reflected in the lower per capita GNP in Sierra Leone compared to Liberia. Labor is the single most important cost item, accounting for 44-61 percent of total private cost in partially mechanized systems and for over 70 percent in manual systems.

Fertilizer

Fertilizer is used by farmers in improved systems of inland swamp and upland rice cultivation and in partially mechanized bolilands. It is also used by otherwise traditional farmers manually cultivating bolilands and inland swamps in the Northern Province. These farmers have apparently learnt about fertilizers from neighbours participating in the government tractor hire scheme in the bolilands. As shown in Table 2 average fertilization levels are quite low on such farms.

Seed

Farmers provide their own seed in all systems except in the improved upland and inland swamp where they are supplied with improved seed from seed multiplication farms run by the development projects. [8] Seed rates are higher in swamp rice systems where transplanting takes place, particularly in northern mangrove swamps where long transportation distances and damage by crabs result in much seedling loss (9).

Farmer provided seed cost 12-18 percent above the average paddy producer price reflecting the expected price increase between harvest and planting dates. Seed supplied by the development projects cost about 29 cents per kilogram.

Tools

The annual user cost (depreciation plus interest) of hand tools is a small proportion of total costs. When the investment is financed out of the farmers' own resources, the actual acquisition cost is depreciated. When financed by a loan, the discounted present value of the medium term loan is depreciated. [9]

Working Capital

The cost of working capital is calculated using the market interest rate of 40%. Working capital is tied up in the labor input for an average of three months since work in the rice fields spans the six months average rice growing season. For seed, fertilizer, and plowing fees it is tied up for an average of six months since these items are invested in at the start of the growing season.

Plowing Fees

A fixed plowing fee of Le 24.70 per hectare is paid by farmers using the government tractor hire service in the bolilands and riverain grasslands.

Total Costs

Total private costs per hectare vary from Le 93.41 in tractor plowed bolilands to Le 423.34 in manually cultivated mangrove swamps in northern Sierra Leone. As is to be expected, the adoption of improved technology within a production system generally leads to increased private costs per hectare, except where, as in the case of tractor plowed bolilands, the level of subsidy is so high that costs per hectare are reduced. By constrast, with one exception costs per ton of paddy produced are reduced by adoption of the improved technologies since resulting yield increases more than make up for increased costs per hectare. For the same reason comparisons across systems show that there is a much smaller range in private costs per ton of paddy (Le 111.70) than in private costs per hectare (Le 329.93). Private costs of production per ton of paddy are lowest in the heavily subsidized partially mechanized systems and highest in the more traditional (manual) rice production systems.

4. RICE MARKETING SYSTEMS

It is estimated that about 105,000 metric tons or 35 percent of annual domestic rice production is marketed in Sierra Leone (13). Assembly, processing and distribution of this rice is performed by private intermediaries as well as by the government-owned Rice Corporation.[10]

Assembly

Resident village and itinerant merchants (who might also be farmers) purchase directly from the farmers. These private merchants handle virtually all the rice sold by farmers. Only a small proportion of rice marketings is sold through cooperative societies or directly to consumers in the small towns and villages. Farmers headload their produce to the merchant's place of business in the village. Village or itinerant merchants transport their produce using boats in the Scarcies and Riverain grasslands and trucks elsewhere. They typically sell less than 10 percent of the produce to the Rice Corporation and the bulk to private wholesalers.

Processing

Rice processing involves parboiling and milling. Parboiling consists of saturating paddy with water and raising the temperature to that required to gelatinize the starchy endosperm. In the most common village method of parboiling rice, a mixture of paddy and water is boiled in large iron pots or in 44 gallon drums, or part of a drum, until the grains are slightly swollen and soft and some of them burst. The paddy is then removed and spread out in the sun. Paddy is parboiled in this way by farmers themselves or by itinerant, village, or wholesale merchants who either use their own family labor or hired workers. Commercial parboiling involves passing wet steam under atmospheric pressure through grain that has been soaked for a few hours, followed by mechanical or sun drying. It is used only in the large rice mills. About 40 percent of rice consumed in rural areas is parboiled (60 percent in the Northern Province and 20 percent in the South). In urban areas the proportion is as high as 80 percent (10).

There are three basic types of rice milling techniques in Sierra Leone - hand pounding with small wooden mortars and pestles, small rubber roller or steel cylinder mills processing about 0.2 tons of paddy per hour, and large mills processing 0.75-3.0 tons of paddy per hour. Hand pounding is used by farmers to prepare their rice for subsistence consumption and for sale in small village markets. In addition, there are over 350 privately owned small mills concentrated mainly in small towns in the major rice producing areas.

The mills operate at about 50 percent of capacity. Finally, there are four large rice mills in the country. The Rice Corporation owned three of these mills with a total nominal capacity of 6 tons per hour. They have been run at an average of less than 25 percent of capacity during the last 10 years. Throughput increased to 44% of capacity in 1975/76. The privately owned large mill has a capacity of 0.75 tons per hour but has rarely operated since it was set up in 1975.

Milling out turn is about 67 percent for hand processing and small mills which produce rice with 20-40 percent brokens. The large mills produce rice with less than 10 percent brokens and have recovery rates averaging around 64 percent.[11]

Between 60 and 70 percent of the 160,000 tons of paddy that is milled annually in Sierra Leone is processed in the small rice mills. Virtually all the rest is hand pounded and goes to supply small towns and large villages. Large mills process less than 5 percent each year.

Distribution

Up to April 1979 imported rice was handled exclusively by the government owned Rice Corporation. The Corporation sold its imported rice primarily to licensed wholesale merchants who took delivery usually in Freetown. The rice was sold to retailers in Freetown or trucked by the wholesale merchants to other towns. Secondary channels for imported rice were direct sales to retailers and consumers by the Rice Corporation from its depots in Freetown and the major towns. The Corporation also distributed the small proportion of domestic rice which it handled in the same way.[12]

The privately marketed domestic rice is trucked to urban areas either by itinerant merchants or by large wholesalers who have taken title in the small provincial towns and villages. In the urban areas the rice is sold to retailers who sell in the public markets using volume measures such as the cigarette or milk tin.

5. PRIVATE COST OF RICE MARKETING

Table 3 shows the costs of marketing rice using the three alternative means of rice processing. Assembly costs consist of the annual user cost of sacks as well as transportation and handling charges. Sacks last two years. Transportation costs involve headloading of paddy for the first five kilometers followed by trucking.

Milling costs are highest in hand pounding because of the high labor input, while small mills have the lowest milling cost in Sierra Leone. The relatively high cost of milling using the large disc sheller mills of the Rice Corporation was due to the poor physical condition of these mills, the low paddy supply resulting in an achievement of only 44 percent of nominal capacity in 1975/76, and the low average milling ratio of 64 percent. But distribution costs to Freetown, the capital city, are lowest for the large mills since they are in general located closer to Freetown than the average distance for hand processing and small mills.

Total assembly, milling and distribution costs are lowest for the small mills channel. As stated earlier, this channel handles 60-70 percent of domestic rice marketing and over 90 percent of the domestic rice that moves to Freetown. In the analysis that follows the small mills channel is used exclusively.

6. SOCIAL COSTS AND GOVERNMENT SUBSIDIES

Because of government taxes and subsidies on inputs as well as trade and price policies, private costs do not reflect the true social costs of domestic resources used in rice production. In order to calculate social costs and profitability, it is necessary to use shadow prices and to estimate the amount of subsidies and taxes on domestic resources and output.

Shadow Prices

Stryker, Page and Humphreys (14) provide details of the procedures used in estimating shadow prices in this study. In summary, these shadow, or social accounting, prices reflect the value placed by society on the benefits acquired and the opportunities foregone by using scarce resources in the different rice production and marketing systems. They were estimated assuming that existing policies would remain in effect in the short run.

Table 3

Annual Private Costs of Rice Marketing Systems in Sierra Leone with mill operating at 67% of maximum capacity[a] (Leones per ton clean rice)

	Hand Processing	Small Mills	Large Mills
1. Assembly			
1.1. Cost of Sacks	7.85	7.85	7.85
1.2. Headloading[b]	0.00	7.48	7.48
1.3. Trucking	0.00	0.00	1.37[c]
1.4. Handling	0.00	1.32	1.77
1.5. Total Assembly Cost	7.85	16.65	18.47
2. Milling			
2.1. Unskilled labor	30.60	0.02	2.37
2.2. Skilled labor	0.00	0.97	3.16
2.3. Rent	0.00	0.31	1.15
2.4. Equipment cost[d]	0.30	5.33	11.92
2.5. Electricity, Fuel and Oil	0.00	3.25	3.91
2.6. Repairs and Maintenance	0.00	4.62	2.16
2.7. Others	0.00	0.00	0.40
2.8. Total Milling cost	30.90	14.50	25.07
3. Distribution to Freetown			
3.1. Headload	7.48	0.00	0.00
3.2. Trucking[e]	14.48	14.48	13.26
3.3. Handling	4.40	2.90	2.65
3.4. Total Distribution cost	26.36	17.38	15.91
4. Total Marketing Cost	65.11	48.53	59.45

Source: Spencer, May-Parker and Rose (10).

[a] Operating 20 hours per day, 200 days a year. This rate is used for consistency among mills. It is higher than the rates achieved up to 1975 but is closer to the expected rates of utilization in subsequent years. For large mills maximum capacity is only 65% of manufacturers stated capacity because of the poor physical condition of the mills.

[b] Le 0.40 per 66kg. bag of paddy for 5 kms.

[c] 15 kms.

[d] Depreciation and interest. Market interest rate of 20% for longer term capital investment.

[e] Average cost of Le 0.061 per ton per km.

The shadow price of Sierra Leone rice output is the price of imported rice, 10-25 percent brokens (wholesale buying) at Freetown and is estimated at Le 309.00 per metric ton. This is based on an expected CIF price of Le 300.00 per ton. Landing costs, i.e. costs of moving the rice from ship to wholesale warehouses, of Le 9.00 per ton are added. The CIF price of Thai five percent brokens is expected to be about $400.00 per metric ton (2).

Shadow wage rates for unskilled labor are taken to be the same as the market wages. There is ample evidence of the existence of a fairly active rural labor market with minimum distortion of wages (12).

For the cost of capital, market interest rates of 40 percent are used when traditional sources of credit finance investment in tools and working capital. A rate of 20 percent is used for 3-5 year investments in rice mills usually financed by traders in larger towns. [13] During the last five years, Sierra Leone has been successful in obtaining concessional credit for financing its agricultural development projects. This foreign aid is expected to continue during the next ten years. Consequently, a shadow interest rate of 3.5 percent is used for government investment capital in the Integrated Agricultural Development Projects (for improved inland swamp and upland development), since these are financed from concessional sources. For government investment in mechanical cultivation a higher interest rate of 8 percent is used reflecting the fact that the government employs foreign commercial credit for this activity. All interest rates have been adjusted for the effects of inflation which was assumed to average about 12 percent in 1975.

Since land is not in short supply (and site value plays no role in this analysis), the shadow price of land is assumed to be zero. This assumption is supported by the earlier observation that private land costs are low and account for only a small proportion of total private cost.

Foreign exchange is not shadow priced in this analysis because it is very difficult to estimate a true shadow price for the Leone and there is evidence that overvaluation of the Leone was minimal during the period covered in the analysis.

Government Subsidies

In order to encourage farmers to adopt improved methods of rice cultivation the government has subsidized some inputs and has supported domestic rice prices through restrictive trade policies.[14] Subsidies are provided on land development, fertilizers, plowing, and extension service costs. The net subsidy on each input is shown in Table 4. These are total annual resource costs to the government excluding repayments by farmers and all indirect taxes.

There is a subsidy on land development for improved inland swamp systems because of the development loan farmers receive at the subsidized interest rate of 8 percent. The subsidy is the difference between the annual cost of total investment at the market rate of interest and the actual private cost at the subsidized interest rate. Thus forty-nine percent of the annual user cost of land development is subsidized.

Table 4

Net Input Subsidies and Charges (Leones per hectare, unless otherwise indicated)

Production Technique	Land Development	Extension Service		Plowing Service	Fertilizer	Farm Tools	Working Capital	Net Input Subsidy	
		Development	Maintenance					Per Hectare	Per Ton Rice[a]
1. Traditional Upland -South	-	-	-	-	-	-	-	-	-
2. Traditional Upland -North	-	-	-	-	-	-	-	-	-
3. Improved Upland - South	-	7.10	8.34	-	28.71	-	1.08	45.23	36.06
4. Improved Upland - North	-	7.10	8.34	-	28.71	-	1.08	45.23	46.30
5. Mangrove Swamp - South	-	-	-	-	-	-	-	-	-
6. Mangrove Swamp - North	-	-	-	-	-	-	-	-	-
7. Boliland (Manual) - North	-	-	-	-	3.94	-	-	3.94	6.10
8. Boliland (Tractor Plow)-North	-	-	-	82.92	5.83	-	-	88.75	117.00
9. Riverain (Tractor Plow)-South	-	-	-	82.92	-	-	-	82.92	68.00
10. Traditional Inland - South	-	-	-	-	-	-	-	-	-
11. Traditional Inland - North	-	-	-	-	3.80	-	-	3.80	2.64
12. Improved Inland - South	27.43	13.96	16.67	-	30.53	9.26	1.21	99.06	43.75
13. Improved Inland - North	24.42	13.96	16.67	-	30.53	9.26	1.21	96.05	51.48

[a] Paddy converted to rice using 67 percent recovery rate.

92

Extension advice, defined as the teaching of new skills to farmers, is traditionally provided free to farmers. Its cost can be regarded as a subsidy to farmers. Since the degree of extension input varies according to the system of production, the rate of subsidy also varies. In Sierra Leone only rice farmers using improved systems of upland and inland swamp rice cultivation receive any extension input.[15] Extension input subsidies are concentrated in the Integrated Agricultural Development Projects.

Extension has two phases. The first occurs during the initial years of project development lasting 3-6 years when farmers are being taught new skills and the extension input is heavy (the development phase) while the second takes place in subsequent years when extension effort is to maintain project achievements and introduce small changes (the maintenance phase). During the development phase, costs are treated as capital investment prorated over 20 years at the shadow government interest rate of 3.5 percent. During the maintenance phase, costs are projected annual costs. The subsidies shown in Table 4 are based on the costs of Integrated Agricultural Development Projects (Phase II Eastern Area, and Phase 1 Northern Area).[16]

The government started to provide tractor plowing services to Sierra Leone farmers in 1949. The government fleet plows, harrows, and sometimes seed harrows for farmers who pay a highly subsidized fee, presently Le 24.70 per hectare. This service costs the government about Le 108 per hectare [17] so that the subsidy rate is about 77 percent. Because of the heavy subsidy, it has been difficult for the government to make the necessary budgetary provision for importation of spares and new equipment as well as for purchase of fuel that would provide the service consistently to farmers. The area mechanically plowed has therefore fluctuated widely, reaching 11,250 hectares in 1971, dropping to 5,000 in 1973 and increasing to 21,000 in 1974, then dropping again to less than 10,000 hectares in 1977. [18]

Fertilizers are imported and distributed to farmers by the Ministry of Agriculture. Only about three percent of Sierra Leone farmers use the five to eight thousand tons of fertilizers imported each year. Until the end of the 1974/75 crop season farmers paid about three cents a kilogram for compound rice fertilizer (20-20-0) which cost the government about 20 cents a kilogram in 1974. In 1975/76 the price was raised to 8.5 cents to farmers in the Integrated Agricultural Development Projects and 5.5 cents to others. Subsidy rates were therefore between 57 and 66 percent.

Subsidies on farm tools and working capital are due to the subsidized interest rate on the loans given to farmers in the development projects. They are calculated in the same way as the land development subsidy.

Total input subsidies per hectare shown in Table 4 are highest in improved inland swamp systems. But because of high yields obtained with these systems, the subsidy per ton of paddy is much lower than that provided to farmers using the tractor plowing service.

7. PRIVATE AND SOCIAL PROFITABILITY

Details of the methodology used in this analysis are given by Page and Stryker (8). Net private profitability (NPP) is the difference between the market value of output and the market costs of all inputs. It measures the incentive to private producers of the commodity. Net social profitability (NSP) is the profit calculated when all inputs and outputs are valued at their social opportunity costs. Net social profitability therefore measures the economic efficiency and comparative advantage of producing rice domestically to substitute for imported rice. The difference between private and social profit is a measure of the impact of government programs on domestic rice production.

The other measure of economic efficiency utilized in this paper is the Resource Cost Ratio (RCR) which is the ratio obtained by dividing the sum of all domestic factor costs valued at social opportunity cost by the value added at world prices. Unlike NSP this ratio is independent of the unit of measurement and is therefore useful as a relative measure of economic efficiency for making inter-technique and international comparisons. The RCR represents the rate of transformation between domestic resources and value added at world prices.

When the ratio is less than unity the activity is socially profitable and the country has a comparative advantage in its production. The lower the ratio the more socially profitable the activity.

The Effective Protection Coefficient (EPC) is the ratio of the value added at domestic prices to the value added at world prices. It measures the net increase in domestic value added permitted by trade protection policies over the value added in the absence of such policies. The higher the EPC the higher the degree of protection. Trade protection policies include restrictions on imports (duties or quantitative controls), subsidies on exports, as well as domestic price support policies.

Table 5 shows private and social profitability as well as the resource cost ratio and effective protection coefficient for each rice production activity in Sierra Leone using the small mills marketing channel for delivery to Freetown. All of the systems have positive NPP, indicating that farmers have a positive incentive to produce rice for commercial trade. Private incentives are highest for the systems using the government tractor hire scheme. They are also quite high in the improved inland swamp farming schemes as well as the improved upland system in the South, systems fostered by the Integrated Agricultural Development Projects. NPP is not very high in the improved upland system in the North because of relatively high labor costs in areas around Makeni where the system has been introduced.

Net social profitability is lower than NPP for all the systems examined showing that in general domestic rice production was subsidized by government policies. Producers were earning higher profits than they would have in the absence of such policies, i.e. there was a net transfer from consumers to producers. The social value of such transfer (social cost of protection) can be measured by the differences between NPP and NSP. These are also given in Table 5. They range from Le 16-23 per t n for mangrove swamps to Le 96-141 for tractor plowed bolilands and riverain grassland. This transfer from consumers to producers was effected by the government through input subsidies as well as through higher domestic market prices. Deducting the net input subsides to producers in Table 4 from the social cost of protection in Table 5, leaves the net effect of trade policies which keep the domestic price of rice high. [19] These range from Le 16-44 per ton of rice delivered to Freetown. The differences between systems were due to differences in yields as well as differences in the location of systems relative to Freetown resulting in different transportation costs. The greatest beneficiaries of government policies are the improved systems. This is further confirmed by the fact that EPC's are highest for improved uplands and swamps and for boliland systems where farmers benefit from the full range of government input subsidies and protection policies. Traditional farmers only benefit from the protection provided by trade policies.

NSP is positive for all techniques except the improved upland system in the North indicating that Sierra Leone has a comparative advantage in using twelve of its thirteen rice production systems to replace imports into its major urban center.[20] This is also shown by the RCR's which are less than unity for the twelve systems. NSP is highest in the more traditional manually cultivated swamps (bolilands and mangrove swamps in the North as well as inland swamps in the South).

Since production for the Freetown market is socially profitable, it follows that production for closer urban markets and home consumption would also be socially profitable. Such production is accorded the further protection of transport costs from the port inland. In addition all Sierra Leone rice production systems except three in the Northern Province - traditional and improved upland techniques and tractor plowed bolilands, have a comparative advantage in exporting to Monrovia, the major urban center in neighbouring Liberia. (Table 6). The production systems in the north are further away from Monrovia than those in the South. Thus, their social profit for supply to Monrovia is lower. Generally social profit for supply to Monrovia is slightly lower than for supply to Freetown, reflecting the greater transportation distances.

Table 5

Expected Yield [a] and Private and Social Profitability Per Metric ton of Rice delivered to Freetown, Sierra Leone [b]

Production Technique	Expected Yield kgs/ha	Net Private Profit		Net Social Profit		Resource cost ratio	Effective Protection Coefficient	Social cost benefit (Leones)
		Leones	Rank	Leones	Rank			
1. Traditional Upland-South	1,170	80.00	10	55.00	8	0.811	1,022	25.00
2. Traditional Upland-North	810	26.00	13	1.00	12	0.996	1.022	25.00
3. Improved Upland-South	1,872	129.00	7	62.00	6	0.756	1,115	66.00
4. Improved Upland-North	1,458	75.00	11	-4.00	13	1.018	1.147	79.00
5. Mangrove Swamp-South	1,736	117.00	8	94.00	4	0.679	1,022	23.00
6. Mangrove Swamp-North	2,803	64.00	12	48.00	9	0.837	1.022	16.00
7. Boliland (Manual) - North	963	147.00	4	108.00	1	0.622	1.044	39.00
8. Boliland (Tractor Plow)-North	1,132	165.00	2	24.00	11	0.904	1.056	141.00
9. Riverain (Tractor Plow)-South	1,820	192.00	1	96.00	3	0.651	1,024	96.00
10. Traditional Inland - South	2,334	137.00	6	107.00	2	0.634	1.022	36.00
11. Traditional Inland - North	2,142	92.00	9	58.00	7	0.802	1.031	34.00
12. Improved Inland - South	3,034	158.00	3	65.00	5	0.757	1.080	93.00
13. Improved Inland - North	2,785	140.00	5	45.00	10	0.831	1.086	95.00

[a] Normal expected yields. These are generally lower than 1975 yields shown in Table 1, since 1975 was generally a good year for most rice production techniques.

[b] Small mills channel.

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Table 6

Private and Social Profitability Per Metric Ton of Rice Delivered to Monrovia, Liberia.

Production Technique	Net Private Profit (Leones)	Net Social Profit (Leones)	Resource Cost Ratio
1. Traditional Upland - South	58.00	40.00	0.867
2. Traditional Upland - North	-8.00	-26.00	1.088
3. Improved Upland - South	106.00	47.00	0.822
4. Improved Upland - North	41.00	-32.00	1.129
5. Mangrove Swamp - South	94.00	79.00	0.738
6. Mangrove Swamp - North	16.00	5.00	0.983
7. Boliland (Manual) - North	114.00	80.00	0.724
8. Boliland (Tractor Plow) - North	131.00	-3.00	1.012
9. Riverain (Tractor Plow) - South	169.00	81.00	0.715
10. Traditional Inland - South	115.00	92.00	0.694
11. Traditional Inland - North	58.00	30.00	0.898
12. Improved Inland - South	136.00	50.00	0.819
13. Improved Inland - North	106.00	17.00	0.936

The net effect of government incentives in rice production is illustrated by the relative ranking of the systems in terms of private and social profitability (Table 5). The changes in rankings are statistically significant with a 90 percent confidence interval (based on Spearman's rank-order correlation coefficient, one tailed test . $R_3 = 0.51$, $_{..} = 1.77$). However, the effect on three-fourths of the production systems is negligible (a change of one to three places). Some of the smallest changes occur in the more traditional and least privately profitable systems (1, 2 and 11). The most dramatic effect occurs in the bolilland swamp farms which use the government tractor hire scheme. Because of the heavy input subsidies, one of the least socially profitable systems, ranking 11th in NSP, is transformed into one of the most privately profitable systems with a rank of second in NPP. Improved uplands in the North as well as improved inland swamps (North and South) and mechanized riverain grasslands are the other systems whose ranking's are improved in NPP relative to NSP. The net effect of government policies on production incentives is thus to transform some of the least socially profitable production systems into the most privately profitable systems. The experience of the development projects, which have had no difficulty getting farmers to adopt the improved systems of production, bears testimony to the fact that farmers are aware of the advantages provided by the government incentive structure. For example, the government tractor hire scheme has never been able to completely satisfy farmer demands.

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Since all except one of the systems in Sierra Leone are socially profitable, the effect of government policy on national income is not as adverse as in other West African countries where systems with negative social profitability are made privately profitable by government intervention.[21]

A question which arises from this analysis relates to why the Sierra Leone government chooses to protect rice production when almost all techniques are socially profitable. First of all it should be pointed out that the world rice price used in this analysis represents almost a 50 percent increase compared to the prices prevailing before 1974. As is shown later in the section on sensitivity analysis, a 35 percent lower world rice price would make most systems socially unprofitable. The events in the world rice market that affected domestic rice policy in Sierra Leone favourably affected social profitability. Government protectionist policies that started in an era when most domestic rice production was socially unprofitable continued when increases in the world market price changed the situation. Furthermore, as is shown elsewhere, the Sierra Leone government desired to receive revenue from inports of rice. The Rice Corporation made a profit on its trade in imported rice in most years (13).

6. SENSITIVITY ANALYSIS

The empirical results discussed above are based on best estimates of the average values of several parameters. It is necessary to examine the effect of variations in these values on the empirical results. Such variations could reflect errors in data, heterogeneity among farmers, climatic effect on yields or alternative social costs of inputs.

Elasticities of changes in NSP resulting from changes in parameter values are given in Table 7. Since these are point elasticities they are only valid for small changes. Furthermore, the values are dependent on the absolute value of NSP, becoming very large as NSP approaches zero, so that comparisons can only be made between input and output values within techniques. Such comparisons show that NSP is most sensitive to variations in yields and the milling ratio. Variations in unskilled labor costs also have an important effect on NSP, but variations in capital and skilled labor costs, both minor cost items, have minimal effect on NSP.

Table 8 shows the percentage change in yields, world rice price, and social costs of labor and capital that are necessary to reduce NSP to zero. These are the percent changes that would cause Sierra Leone rice production techniques to lose their comparative advantage.

Table 7

Elasticities of Net Social Profitability Resulting from changes in yields, Milling Ratio, and Social cost of Labor and Capital. [a]

Production Technique	Yields	Milling Ratio	Unskilled Labor	Skilled Labor	Capital
1. Traditional Upland - South	3.65	3.95	-3.66	-0.15	-0.48
2. Traditional Upland - North	231.34	246.28	-229.64	-7.62	-26.84
3. Improved Upland - South	3.16	3.49	-2.33	-0.23	-0.54
4. Improved Upland - North	59.45	65.21	-44.00	-3.64	-8.48
5. Mangrove Swamp - South	1.74	1.91	-1.74	-0.09	-0.20
6. Mangrove Swamp - North	4.38	4.72	-4.43	-0.18	-0.52
7. Boliland - Manual	1.40	1.55	-1.20	-0.08	-0.37
8. Boliland - Tractor Plow	9.58	10.26	-3.96	-0.35	-5.09
9. Riverain - Tracot Plow	1.70	1.87	-0.93	-0.09	-0.85
10. Traditional Inland - South	1.41	1.56	-1.33	-0.08	-0.35
11. Traditional Inland - North	3.48	3.77	-3.17	-0.15	-0.72
12. Improved Inland - South	2.98	3.24	-2.11	-0.23	-0.78
13. Improved Inland - North	4.77	5.14	-3.41	-0.34	-1.16

[a] These are point elasticities measuring the effect of a 1% increase in parameter value. They are therefore sensitive to the absolute value of NSP. As the value of NSP approaches zero the elasticity becomes very large.

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Table 8

Approximate Percent change in Social cost of Labor and Capital, World Price of Rice and Yields needed to change Net Social Profitability of Rice Production in Sierra Leone to zero

Production Technique	Unskilled Labor Cost	Skilled Labor	Capital Cost	World Price of Rice	Yields
1. Traditional Upland - South	27	307	208	-20	-27
2. Traditional Upland - North	0.4	17	4	-1	-0.4
3. Improved Upland - South	43	455	155	-21	-32
4. Improved Upland - North	-2	-27	12	+2	+2
5. Mangrove Swamp - South	58	757	357	-33	-57
6. Mangrove Swamp - North	23	556	192	-18	-35
7. Boliland - Manual	83	1250	270	-37	-71
8. Boliland - Tractor Plow	25	286	20	-10	-10
9. Riverain - Tractor Plow	108	1111	118	-33	-59
10. Traditional Inland - South	75	1250	303	-37	-71
11. Traditional Inland - North	31	607	139	-20	-29
12. Improved Inland - North	47	455	128	-23	-34
13. Improved Inland - North	29	294	86	-15	-21

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Except for uplands in the North (traditional and improved) and tractor plowed bolilands, it would take more than a 100 percent increase in the social opportunity cost of capital, ceteris paribus, for production techniques to lose their comparative advantage. The increases in skilled labor cost needed are very large but those for unskilled labor are smaller but usually over 30 percent. On the other hand, yields and world market prices need to drop less than 30 percent, for all but four of the systems to lose their comparative advantage.

Generally, one can conclude that the estimates of net social profitability are moderately sensitive to yield, the milling ratio, the cost of unskilled labor and the world market price of rice. Nonetheless, it would be reasonable to assume that most production techniques in Sierra Leone would maintain their comparative advantage in replacing imports in the medium term since over a 25 percent increase in the real costs of most inputs or a similar fall in yields or world price of rice would be needed, ceteris paribus, for them to lose their comparative advantage.

9. SUMMARY AND CONCLUSION

This paper has analysed the structure of private costs and returns in rice production and marketing in Sierra Leone. Rice is the staple food crop and has occupied a central place in agricultural policy making over the last four decades. The country has set a goal of increasing domestic production so as to replace rice imports which have amounted to an average of five percent of annual consumption since 1950.

Thirteen systems of rice production have been identified and analyzed in this paper. They range from traditional upland rainfed rice cultivation in the Northern Province with yields averaging about 800 kilograms of paddy per hectare to improved systems of inland swamps cultivation using partial water control, improved seeds, and fertilizers with yields averaging 3000 kilograms of paddy per hectare. Private costs per hectare range from Le 93 to Le 423 with labor usually accounting for over 60 percent of the total costs of production.

Three post harvest channels for rice moving to Freetown were described and analyzed. The estimated costs of rice delivered to Freetown are about Le 49 when processing in small mills, Le 59 when using large mills, and Le 65 when using hand pounding. In the analyses of private and social profitability of replacing imported rice by domestic production, the analysis concentrated on the channel using small mills which is estimated to handle over 90 percent of domestic rice movement to Freetown.

The Sierra Leone government provides subsidies on several rice production inputs. Net input subsidies on land development, extension service, planting service, fertilizer, farm tools and working capital range from zero in the traditional production systems to almost Le 100 per hectare in improved inland swamp rice farms participating in the Integrated Agricultural Development Projects. Because of these input subsidies and the government's trade policies which keep domestic rice prices high, net private profitability exceeds net social profitability for all systems analyzed. This indicates that producers are on the average protected by the government, a continuation of past policies. But net social profitability is now positive for all except one system of production, the improved upland system in the North. This indicates that using prevailing trends in world rice prices Sierra Leone has a comparative advantage in producing rice to replace imports. In fact ten of the twelve systems which have a comparative advantage for replacing imports into Freetown are also competitive in exporting to neighboring Liberia.

The net effect of government input subsidy and trade policy is to transform some of the least socially profitable systems of rice production into some of the most privately profitable. Tractor plowing in the bolilands in particular is given a big boost. The effect of such distortional policies on the national economy is not as great as in some neighboring countries since most systems are socially profitable. Nonetheless, the socially desirable pattern of production is distorted at a cost to society. Expected benefits need to be carefully weighed against projected costs.

From this analysis we could conclude that government policy should give priority to production in swamps over uplands. Furthermore, manual traditional cultivation in such swamps should be given priority over mechanized or improved production. But the above analysis considers only efficiency factors and not other factors that affect government policy i.e. equity factors. These and other considerations are the subject of another paper (13).

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FOOT NOTES

1. South is defined here to include the Southern and Eastern provinces of Sierra Leone. The north comprises the Northern Province. Annual rainfall in the north averages about 2700 mm and about 3450 mm in the South.

2. Forest vegetation is cleared in upland rice farming systems also, but, since the land is only cropped for one year, such costs are not regarded as land development (or investment) costs.

3. In calculating the annual user cost of all capital investment items the following formula is used.

$$k = \frac{rv}{1 - (1+r)^{-n}}$$

where k = annual user cost

v = original (acquisition) cost of the asset

r = interest (discount) rate

n = expected life of the asset

4. This figure is based on Linsenmeyer's (4) estimate that fishing households paid about 43 percent interest on short to medium term loans after defaults were taken into amount. In the absence of alternative empirical evidence this rate is used for farming households also.

5. In the communal system of land tenure practiced in Sierra Leone the direct controller of land is usually the head of the extended family, but in some chiefdoms the chief exercises this control (5).

6. There was evidence that wages in general in Sierra Leone started increasing rapidly in early 1974. In the absence of direct empirical measurements and rural cost of living indices the rate of increase was assumed the same as that for the official minimum wage. It must not be implied from this that the official minimum wage affects actual rural wages. As the author shows elsewhere (12), the reverse is in fact the case.

7. Average annual rainfall in the rice producing areas of Sierra Leone is about 3200 mm while it is 2000 mm in Liberia, 1400 mm in Ivory Coast 1200 mm in Senegal and about 620 mm in Mali.

8. With the recent establishment of the specialized seed multiplication project this situation is changing. Farmers in and out of development projects are now to be supplied with certified seed from central seed multiplication farms and certified seed growers.

9. As stated earlier, farmers adopting the improved inland swamp system receive a five year loan of Le 30,00 at 8% for tools. In calculating the discounted present value of the loan the annuity at the loan rate (8%) is discounted at the market rate (40%) and summed over the life of the loan (5 years).

10. The Rice Corporation was dissolved in April 1979, leaving the domestic rice trade completely in private hands, although the government apparently intends to continue to control prices.

11. Most of the rice that is commercially milled in Sierra Leone is parboiled. For further details of rice processing in Sierra Leone see Spencer, May-Parker and Rose (10).

12. The Corporation handled less than 5 percent of the domestic rice crop that was marketed annually between 1965 and 1975.

13. This rate is actually applicable only to small mills but is also used for large mills in this analysis.

14. For a detailed analysis of Sierra Leone government rice policies see Spencer (13).

15. Farmers in the bolilands and riverain grasslands are in contact with government extension agents, but the input of the agents is not true extension education. Instead extension agents provide tractor plowing services or deliver fertilizers. In both instances the costs are treated as subsidies on the inputs handled.

16. Costs of road improvements, well construction, and technical assistance for feasibility studies are not directly chargeable to project farmers and therefore are excluded. The average cost is Le 10.93 per hectare. Since the teaching of the techniques of the improved inland swamp system is more difficult than that of the improved upland system, inland swamp extension costs during the development phase are assumed to be 30 percent above the average or Le 14.20 per hectare. Annual extension costs for upland rice systems are assumed to be half of those for inland swamp systems.

17. Based on 1971 estimates by Due and Whittaker (1) updated in 1975 by Ministry of Agriculture. The reported estimates have been recomputed using an 8 percent rate of interest.

18. At the peak of the mechanical cultivation scheme in 1974 government spent about Le 1.74 million to subsidize tractor plowing. This was equivalent to about 55 percent of the annual recurrent expenditure of the Agriculture Division of the Ministry of Agriculture and National Resources.

19. These trade policies included import restrictions, a tax on imported rice price in the form of trading surpluses by the monopoly government Rice Corporation, as well as government purchase and storage of domestic rice. For analysis of these policies see Spencer (13).

20. Virtually all imported rice is consumed in Freetown (13).

21. See, for example, analyses of Ivory Coast, Liberia and Senegal (3, 7, 15).

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