BIBLIOGRAPHIC DATA SHEET	1. CONTROL NUMBER	2. SUBJECT CLASSIFICATION (695)
	PN-AAG-942	AFRC-0000-G190

3. TITLE AND SUBTITLE (240)

The political economy of rice in West Africa: a summary of principal results.

4. PERSONAL AUTHORS (100)

5. CORPORATE AUTHORS (101)

Stanford Univ. Food Res. Inst.; West Africa Rice Development Assoc.

6. DOCUMENT DATE (110)	7. NUMBER OF PAGES (120)	8. ARC NUMBER (170)
1979	103p.	AFR633.18.S785

9. REFERENCE ORGANIZATION (130)

10. SUPPLEMENTARY NOTES (500)

(Prepared by Food Research Institute and WARDA)

11. ABSTRACT (950)

BEST AVAILABLE COPY

12. DESCRIPTORS (920)

Rice
Policies
Research
Production
Marketing
Government policies
West Africa
Economic factors

13. PROJECT NUMBER (150)

698013500

14. CONTRACT NO.(140)

AID/afr-C-1235

15. CONTRACT TYPE (140)

16. TYPE OF DOCUMENT (160)

AID 590-3 (10-79)

INSTRUCTIONS

1. **Control Number** - Each document shall carry a unique alphanumeric identification number. Use uppercase letters, Arabic numerals, and hyphens **only**, as in the following example: **PN-AAA-123.**

2. **Subject Classification** - Each document shall carry a valid subject classification code used to classify the research/technical document under a general primary subject, secondary subject, and/or geographic index code. Use uppercase letters, Arabic numerals, and hyphens **only**, as in the following example: **AA23-0000-G518.**

3. **Title and Subtitle** - The title should indicate the main title of the document and subordinate subtitle (if any).

4. **Personal Authors** - Enter the author's name(s) in the following sequence, **last name, first name (or initial), middle initial.**

5. **Corporate Authors** - Enter the corporate author(s) name.

6. **Document Date** - Enter the document publication year(s) as follows: **1979** or **1978 - 1979.**

7. **Number of Pages** - Enter the total number of pages followed by '**p**' for pages and a period, i.e. **123p.**

8. **ARC Number** - Enter the AID Reference Center catalog number.

9. **Reference Organization** - The reference organization must be a valid reference organization. Enter the name, acronym, or abbreviation.

10. **Supplementary Notes** - Enter any useful information about the document that is not included elsewhere. Each note should be enclosed in parentheses.

11. **Abstract** - Include a factual summary of the most significant information contained in the document.

12. **Descriptors** - Select the proper authorized terms that identify the major concept of the research/technical document and are sufficiently specific to be used as index entries for cataloging.

13. **Project Number** - This is a unique number(s) composed of the AID project number followed by a sub-project suffix.

14. **Contract Number** - Enter the AID contract number under which the document was produced.

15. **Contract Type** - Enter the type of AID contract which funded the research/technical activity responsible for producing the document.

16. **Type of Document** - Enter a valid code representing the document type.

PN-AAG-942

SEP. 4 1979

The Political Economy of Rice in West Africa: A Summary of Principal Results

by

Food Research Institute, Stanford University

and

West Africa Rice Development Association

Property of
R. D. Library
USAID / Mauritania

July 1979

This paper was prepared as part of a project funded under contract AID/afr-C-1235 by the U.S. Agency for International Development.

THE POLITICAL ECONOMY OF RICE IN WEST AFRICA: A SUMMARY OF PRINCIPAL RESULTS

Food Research Institute, Stanford University
and
West Africa Rice Development Association

In 1973-74 rice policy in West Africa was at a crossroads. Countries in the Sahelian zone were in the last of six years of severe drought which caused, among many unfortunate consequences, a sharp increase in food imports. Concurrently, international prices of wheat and rice, the principal traded foodgrains, had temporarily soared to unexpected and previously unknown heights, four times their levels in the late 1960s. Many West African governments were faced with the unhappy prospect of needing substantial foodgrain imports at a time when prices were high. Moreover, these governments and their supplies of foreign exchange were hit doubly hard since the high bills for imported foodgrains were accompanied, coincidentally, by a quadrupling in the price of petroleum.

The importance of rice policy in West Africa grew substantially following the unanticipated confluence of events in 1973-74. Because very little wheat is grown in the region, rice is the most important foodgrain whose imports could be substituted for directly by increases in local production and marketings. Rice has traditionally been the principal staple food in a contiguous group of western coastal countries, running in an arc south and east from the Gambia through western Ivory Coast, and along the banks of the Niger River in Mali and Niger. After World War II, rice cultivation expanded throughout the region.

By 1974, all governments in West Africa began to reassess policies

affecting their nations' production, consumption, and trade of rice. Rice imports had suddenly become very expensive and their future price seemed uncertain. Governments responded by raising prices of rice to their consumers and producers, though not always by the full extent of the rise in corresponding import prices. In spite of record high prices, however, several countries continued to import large quantities of rice.

The picture in West Africa shifted again in 1975. Consumers reacted to the higher prices by partially switching from rice to other foodstuffs. Producers who received higher prices for their paddy responded with increases in output and, especially, marketings. Importing agencies, which in some countries had overbought in 1973 or 1974, were forced to carry over stocks into 1975. All of a sudden, there seemed to be too much rice for sale, rather than too little, especially in the eyes of governments which wished to mitigate the large downward fluctuation in prices that would have cleared the markets.

This concern with recent shortages and apparent gluts of rice was evidenced in 1975 at the annual meeting of the West Africa Rice Development Association (WARDA),[1] when its Governing Council called for a study of the prospects for future intraregional trade in rice and of its contribution to the objective of ultimate regional self-sufficiency. Since a number of WARDA countries had achieved or regained self-sufficiency in rice in 1975 and some even had small exportable supplies, it seemed desirable to examine prospects for trade within the region. The Food Research Institute and WARDA agreed jointly to carry out the study.

Researchers at both WARDA and the Institute initially thought that the most significant results from the project would involve intraregional trade

in rice, and the research was designed accordingly. Lessons from the Institute's earlier study of rice in Asia influenced the design. Micro-economic study of alternative techniques for rice production, milling, and marketing received major attention as did analysis of rice policy. Both of these investigations were integrated directly into the trade analysis.

Midway through the project, researchers at WARDA and the Institute prepared a study of prospects for intraregional trade of rice in West Africa (27). The results of this study confirmed that, even based on reasonably optimistic assumptions for growth of production, steadily increasing consumption of rice meant that the WARDA region was likely to require increasing amounts of rice imports during the period ending in 1990. This conclusion, coupled with large levels of rice imports into the region in 1977 and 1978, reemphasized the importance of analyzing government policies aimed at increasing the production, milling, and marketing of rice and at influencing rice consumption. Data on rice imports of WARDA member countries during 1960 through 1977 are presented in Table 1.

From the beginning, primary emphasis was placed on a group of WARDA-member countries in which rice was an important staple food and which during 1966-75 had been relatively large importers of rice--Ivory Coast, Liberia, and Senegal--or had good prospects of becoming rice exporters within the region--Mali and Sierra Leone.[2] Project researchers carried out detailed field work in the first four of these countries and updated earlier work in Sierra Leone done by Njala University College (University of Sierra Leone) and Michigan State University.

This paper provides a summary of results from the WARDA/Stanford study. The following section summarizes the study of prospects for intraregional

Table 1 .—Net Imports of Rice by Quantity, WARDA Member Countries and WARDA Region, 1960-77*[a,b]

(thousands of metric tons)

	1960-64 (average)	1965-69 (average)	1970-74 (average)	1975	1976	1977
Benin	4.6	6.5	7.4	2.4	14.3	20.0
Gambia	9.1	9.1	17.6	25.7	33.2	31.9
Ghana	42.1	35.1	41.0	0.4	0.3	43.0
Guinea Bissau	--	10.7	24.6	14.3	10.9	13.3
Ivory Coast	39.4	57.6	93.4	1.5	-30.4	159.0
Liberia	32.1	37.3	45.2	30.6	37.5	55.8
Mali	-8.5	3.3	38.7	20.1	-2.2	-10.0
Mauritania	6.3	9.0	25.6	8.0	23.2	52.0
Niger	1.4	1.1	3.1	6.8	4.0	7.4
Nigeria	1.2	1.0	2.6	6.7	45.3	427.4
Senegal	119.0	165.0	177.5	101.8	235.0	276.8
Sierra Leone	16.2	21.3	34.3	--	3.5	16.5
Togo	3.0	2.6	3.7	8.4	4.6	18.2
Upper Volta	3.2	3.5	4.4	16.2	15.4	12.0
WARDA Region	269.1	363.1	517.0	242.9	394.6	1,123.9

*Source: Development Department, WARDA.

[a]Negative figures indicate net exports.

[b]Figures include food aid.

trade of rice in West Africa, completed in September 1977. This trade analysis, which covers all WARDA member countries, receives central attention because the other studies complement and feed into it. The third section then discusses the private and social profitability of producing rice with alternative techniques in the countries in which microeconomic analysis has been carried out. Analysis is directed toward the question of whether existing techniques, or those likely soon to be adopted, can compete efficiently with imports of rice or with foreign supplies in other countries' markets within the region. The next section focuses on government policies affecting the production, consumption, and trade of rice. The effectiveness of rice policies in achieving often conflicting government objectives is analyzed. The fifth section contains a summary of the results of research placing West African rice in an international perspective. Emphasis is on determination of the world price of rice, a crucial parameter for rice policy in West Africa. The paper concludes by summarizing some principal economic policy issues and by suggesting areas of desirable action and future research that have been identified in the current study.

PROJECTIONS OF WEST AFRICAN TRADE IN RICE

The first paper completed by WARDA and Stanford researchers, "Prospect of Intraregional Trade of Rice in West Africa" (WARDA/77/STC 7/9), examines the prospects for increasing trade in rice between member countries of WARDA. The paper provides background information on rice supply, demand, and trade, projects import gaps or export availabilities in 1980 and 1990 for each WARDA country, estimates the profitability of the techniques of production that are expected to generate marketed supplies in potential exporting countries, and discusses the impact on intraregional trade in rice of alternative government policies.

In 1966 the self-sufficiency ratio for the WARDA region was .67, which implies that 67 percent of total consumption was provided by local supplies and 33 percent by imports. This ratio increased to .84 in 1975 because local production increased more rapidly than consumption and hence imports declined to only 16 percent of the total. Recorded trade in rice among WARDA member countries was irregular or negligible between 1966 and 1975.

For each country separate projections have been made for 1980 and 1990 of the demand for and domestic supply of rice. The difference between projected demand and supply is the net trade position, and the sum of all member countries' trade positions is the WARDA regional requirement for rice imported from the rest of the world. The technique used to project the demand for rice in each country incorporates the annual rate of population growth, the annual rate of growth of real per capita income, and the income elasticity of demand. Separate estimates for urban and rural areas are made if data are available. Rice production is projected on the basis of estimated capacities for expanding the principal techniques of production in each country. Constraints on the expansion of each production technique include resource limitations, budgetary restrictions, availability of external financing, and management capabilities.

According to the projections, presented in Table 2, between 1975 and 1990 the WARDA region will become more self-sufficient in rice in terms of the percentage of demand met by local supplies but the absolute tonnage of imports will increase.[3] Only two WARDA countries, Mali and Sierra Leone, appear as likely exporters of rice in 1990, and they will be able to supply only about one-fourth of imports required by the other members. More than 80 percent of the import demand will originate in two countries, the Ivory

Table 2 .--Demand for, Supply of, and Trade Position of Rice, WARDA Member Countries and WARDA Region, 1975 and Projections for 1980 and 1990[a]

(thousands of metric tons)

Country	1975			1980			1990		
	Demand[b]	Supply[c]	Trade position	Demand	Supply	Trade position[d]	Demand	Supply	Trade position[d]
Benin	10.0	4.7	5.3	15.6	5.6[e]	10.0	23.1	23.1[f]	0.0[f]
Gambia	39.0	21.9	17.1	47.7	28.0	19.7	67.9	50.0	17.9
Ghana	56.8	56.8	0.0	84.7	84.7[f]	0.0[f]	117.2	117.2[f]	0.0[f]
Ivory Coast	206.0	204.0	2.0	378.8	293.0	85.8	613.6	394.0	219.6
Liberia	174.0	143.0	31.0	197.7	156.0	41.7	256.4	224.0	32.4
Mali	99.0	79.0	20.0	131.9	171.0	-39.1	215.2	291.0	-75.8
Mauritania	13.2	2.2	11.0	31.3	6.7	24.6	47.2	35.0	12.2
Niger	25.8	17.2	8.6	26.8	24.0	2.8	52.1	41.4	10.7
Nigeria	304.7	299.7	5.0	400.1	400.1	0.0[f]	689.9	689.9[f]	0.0[f]
Senegal	245.0	121.2	123.8	277.0	102.0	175.0	404.3	211.3	193.0
Sierra Leone	330.8	332.3	-1.5	387.7	388.0	-0.3	496.3	541.0	-44.7
Togo	7.0	6.0	1.0	11.3	8.8[e]	2.5	15.3	15.3[f]	0.0[f]
Upper Volta	27.3	17.6	9.7	33.8	26.3	7.5	54.3	53.7	0.6
WARDA Region	1,538.6	1,305.6	233.0	2,024.4	1,694.2	330.2	3,052.8	2,725.6	365.9

Notes:

[a]Source: West Africa Rice Development Association and Food Research Institute, "Prospect of Intraregional Trade of Rice in West Africa," WARDA/77/STC7/9, Monrovia, September 1977, Tables A-1 through A-13.

[b]Net availability

[c]Net availability less net imports

[d]Trade position is defined as demand less supply.

[e]Supply projections for 1980 are based on recent performance.

[f]In the absence of supply projections, supply is assumed to equal demand, and the net trade position is assumed to equal 0.0.

Coast and Senegal. Relative to the supply, demand, and import positions of 1975, marked changes will occur in three countries according to the projections: the Ivory Coast is expected to return from temporary self-sufficiency to its earlier position of being a major importer: Mali is anticipated to change from its modest import position to become a sizable potential exporter; and Sierra Leone will likely emerge from self-sufficiency as an important exporter.

PRIVATE AND SOCIAL PROFITABILITY OF RICE PRODUCTION

A critical issue for rice policy in West Africa is whether domestic production can compete efficiently with imports in the main domestic consumption centers, in local supply areas, or in regional export markets. To investigate this issue, detailed empirical analyses were undertaken of the structure of benefits, costs, and incentives in a number of different rice production, assembly, milling, and marketing activities in all five countries considered in detail in this study.

The method of social benefit-cost analysis used in this study is explained in a paper by John M. Page, Jr., and J. Dirck Stryker, "Methodology for Estimating Comparative Costs and Incentives" (14). An appendix to that paper contains a detailed numerical example of the calculations employed, which will enable the reader to reproduce any of the results from the data given in the appendix tables to the individual country studies. Essentially, the method used is to estimate private and social profitability for alternative techniques of production in the rice sector. Private profitability measures the net gain for individuals or government agencies from producing, processing, and marketing rice in light of the actual costs and returns which they experience. Social profitability, on the other hand, measures the extent

to which it pays the nation as a whole to undertake this activity, given that it could otherwise import rice. Differences between the two measures of profitability arise largely because of taxes and subsidies.

An important ingredient of social profitability is the concept of shadow or social accounting prices. These prices give the social value of different resources, including rice output, intermediate inputs, and primary factors of production such as land, labor, and capital. Derivation of shadow prices used in the project is discussed in J. Dirck Stryker, John M. Page, Jr., and Charles P. Humphreys, "Shadow Price Estimation" (23). The major thrust of this derivation is to value all resources in terms of world prices as the best measure of their true social opportunity cost.

The main results of the analysis for each country are reported in a series of papers by Charles P. Humphreys (Ivory Coast) (7), Eric A. Monke (Liberia) (12), John McIntire (Mali) (9), A. Hasan Tuluy (Senegal) (26), and Dunstan S. C. Spencer (Sierra Leone) (18). These results have also been brought together in a comparative analysis by J. Dirck Stryker, "Comparative Advantage and Public Policy in West African Rice" (22), from which this summary is drawn.

This section is organized in six parts of which the first three are background and the last three contain the major results. A summary of physical and historical influences on comparative advantage in rice production is followed by discussions of principal techniques used in rice farming and in milling and distribution. The following discussion contrasts the private and social profitability of alternative ways of producing rice in the five West African countries. The results are then compared with indicators of comparative advantage for rice production in selected Asian

countries and the United States and for alternative crops in Ivory Coast, Mali, and Senegal, the only countries in the group for which comparable data are available.

Natural Endowments and Comparative Advantage

Several generalizations can be made about West African countries which influence their comparative advantage in rice production. First, because the region has a low population density, the value of land is slight relative to that of labor, and the costs of transport, marketing, and the provision of government services in rural areas are relatively high. Second, in comparison with many other areas of the world, most countries in West Africa have a poorly developed infrastructure. Irrigation is in its infancy, water flows are not regulated on any of the major rivers, and poor transport facilities impede access to many areas. Finally, there is often a shortage of government budgetary resources and of people with the training required to undertake major development projects.

In other respects, suggested in Table 3, there are substantial differences among countries and even between regions within countries. The first two indicators in this table describe key geographical features of these regions—mean annual rainfall and distance to the nearest major port. There is a fairly sharp distinction between regions with 1,300 mm or more of rainfall, which can produce rice using rainfed techniques, and those which receive 700 mm or less but have substantial water resources for irrigation or flooding. In addition, important differences in water conditions exist within these rainfall zones. The Senegal River, for example, suffers from a number of disadvantages in comparison with the Niger-Bani system: smaller water flow, greater intra-annual variation and uncertainty

Table 3.--Key Characteristics of Several Rice Producing Regions of West Africa[a]

Region	Mean annual rainfall (mm)	Average distance to major seaport[b] (km)	Rural population density[c] (persons/km^2)	Unskilled rural wage rate (US $/day)	Rural per capita income (US $/person)	Degree of urbanization[c] (%)	Density of all-weather roads (km/km^2)
Ivory Coast							
Forest	1,550	406	19	1.80	1.[illegible]	37	
Savannah	1,300	667	9	1.40	5[illegible]	21	.0435
Liberia	2,000	225	7	1.25	168	23	.0189
Mali							
Mali-Sud	1,300	853	14	1.20	50	6	.0144[d]
Mopti	520	1,317	13	1.00	40	4	
Segou/Office du Niger	700	1,145	16	1.00/1.25	50/85	9	
Senegal							
Fleuve, delta	320	338	16	1.00	56	49	.0170
Fleuve, valley	420	513	7	1.00	75	18	.0170
Casamance	1,400	395	22	1.20	100	16	.0660
Sierra Leone	2,500/3,000	175	23	0.60/0.80	70	25	.0238

[a] Data are from individual country studies: Charles P. Humphreys, "Analysis of Rice Production in the Ivory Coast," John McIntire, "Resource Costs and Economic Incentives in Malian Rice Production," Eric A. Monke, "The Economics of Rice in West Africa," Dunstan S.C. Spencer, "Private and Social Profitability in Rice Production and Marketing in Sierra Leone," and A. Hasan Tuluy, "Comparative Resource Costs and Incentives in Senegalese Rice Production," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

[b] Distance is defined from a major town or city near the geographical center of each region.

[c] Urban population is defined generally as those living in towns of 10,000 people or more.

[d] Total kilometers of all-weather roads divided by the one third of Mali's total land area which is in the zone where agriculture is possible.

of flooding, and salt incursion from the sea.

Rice growing regions also vary substantially in their distance to the nearest seaport. The interior regions are provided with natural protection against rice imports because of high inland transport costs. But these transport charges also substantially raise the cost of using inputs supplied from abroad and make it difficult for the interior countries to export to other West African countries, especially to the coast where the major markets are found.

The third indicator in Table 3, rural population density, is a key variable influencing the types of production techniques which are appropriate for West African conditions. As already noted, population density is generally low throughout the region. There is variation, however, and the density in Liberia is only about one-third that of the Casamance in southern Senegal or the southern Ivory Coast. In addition, there are important concentrations of population, not shown in the aggregate data, in such areas as the Senegal River Valley and the Lower Casamance.

The low ratio of labor to land influences the next two indicators, the wage rate of rural unskilled labor and rural per capita income.[4] The wage rate is often considerably greater in West Africa than in many Asian countries, where population densities are much higher. The world's most important rice exporter, Thailand, for example, had a rural wage rate equal to about $.60 at official exchange rates prevailing in the mid-1970s, or only one-third that of the forest zone of the Ivory Coast and lower than that of any West African country studied here except Sierra Leone.[5]

The last two variables of Table 3, degree of urbanization and density of all-weather roads, are indicators of the level of commercialization and

and state of infrastructure development which exists in each region. Urbanization and road development are generally much more advanced in the coastal than in the interior regions. This contrast is a reflection of the sequential nature of development, which started during the colonial era along the costs and only recently moved to an important extent into the interior.

Finally, special features, not easily summarized in tabular form, also influence comparative advantage. Capital investment made in the past can be considered as sunk, or available at no opportunity cost. The most important example is the Office du Niger; its diversion dam and principal canals were constructed during the 1930s. The countries and regions also differ with respect to the availability of data required for development. More is known about the hydrology of the Senegal River, for example, than about that of the Niger. Another special feature is past agricultural research, which opens up a range of technology otherwise unavailable. The results of this research, mostly conducted outside of West Africa, give rice an important advantage over food crops such as millet and sorghum on which research is only beginning. Standing rice has also been the subject of considerably more research than have the floating and upland varieties traditionally grown in West Africa. There is a question, however, of whether rice techniques developed for Asian conditions are appropriate for West Africa, especially in view of the difference in population densities in the two regions.

Rice Farming Techniques

The techniques used to produce rice range from traditional upland cultivation with no modern inputs and long periods of fallow to intensive mechanized cultivation under total water control. The methods vary

substantially with respect to yields, costs, dependence on outside inputs, and labor-land ratios. Several of these characteristics are shown in Table 4.

Labor times vary enormously between countries and this variation is only slightly correlated with differences in yields. Part of the variation in labor times is due to the substitution of capital for labor, especially in the form of mechanization, which has little influence on yields.[6,7]

Yields are positively correlated with degree of water control. Better water control by itself improves yields, and the fixed cost associated with land development encourages greater use of yield-increasing variable inputs such as fertilizer.[8] The yield response to fertilizer is particularly great, moreover, because of the improved seed varieties used and because existing levels of fertilizer utilization are generally very low.

Labor inputs, on the other hand, are not very closely linked with degree of water control. Traditional and improved rainfed techniques, including upland and swamp cultivation, use up to 400 mandays per hectare or more, whereas manual irrigated cultivation, such as that found in the Senegal River Valley, uses less than 300 mandays per hectare per crop. With double cropping, of course, the capacity for absorbing more labor into irrigated cultivation is increased. Nevertheless, the low correlation between degree of water control and labor input per crop, is probably caused by substitution between labor and other variable inputs, especially those associated with mechanization, as production intensifies.

Milling and Marketing Techniques

A range of techniques also exists for milling and marketing. Chief characteristics of three different milling techniques--industrial, small

Table 4. -- Characteristics of Rice Production Techniques[a]

Production technique	Paddy Yield (mt/ha/crop)	Land development cost (US $/ha)	Farm labor (mandays/ ha/crop)	Fertilizer (kg/ha/crop) N	P_2O_5	K_2O	Extension service costs (US $/ha/crop)
Traditional manual upland							
Ivory Coast	.89 -1.30	28-54	85-113	0	0	0	0
Liberia	1,05	0	214	0	0	0	0
Sierra Leone	.81 -2,17	0	205-238	0	0	0	0
Improved manual upland							
Ivory Coast	1.50 -2,20	28-72	97-117	50	27	27	31
Liberia	1.57	0	231	42	42	42	25
Sierra Leone	1.46 -1,87	0	225-258	50	50	0	8
Animal traction upland							
Ivory Coast	1.80	51	88	50	27	27	31
Senegal[b]	2.07	60	111	57	20	40	22
Mechanized upland							
Ivory Coast	2.00	520	30	50	27	27	31
Traditional manual swamp							
Liberia	1.55	50	243	0	0	0	0
Mali	1.20	0	120	0	0	0	0
Senegal	1.08	17	208	0	0	0	0
Sierra Leone	2.20 - 2.83	34-39	274-356	0-8	0-8	0-8	0
Improved manual swamp							
Ivory Coast	3.50	1,460	240-247	50	27	27	63
Liberia	3.50	750	331	42	42	42	49
Senegal	3.60	818	266	88	45	68	44
Sierra Leone	2,78 - 3.03	173	336-390	53	53	0	17

Table 4. -- Characteristics of Rice Production Techniques[a]

Production technique	Paddy Yield (mt/ha/crop)	Land development cost (US $/ha)	Farm labor (mandays/ha/crop)	Fertilizer (kg/ha/crop) N	P_2O_5	K_2O	Extension service costs (US $/ha/crop)
Improved manual mangrove							
Sierra Leone	1.74 - 2.80	0	445	0	0	0	0
Animal traction swamp							
Mali	1.80	600-2,000	100	0	0	0	7
Partially mechanized swamp							
Ivory Coast	4.00	1,680	181	50	27	27	63
Liberia	3.50	1,504	235	42	42	42	135
Improved manual uncontrolled flooding							
Sierra Leone	.96	0	112	9	9	0	0
Animal traction uncontrolled flooding							
Mali	.60	0	60	0	0	0	0
Mechanized uncontrolled flooding							
Sierra Leone	1.13 - 1.82	0	68-91	0-13	0-13	0	0
Animal traction controlled flooding							
Mali	1.40	800-1,000	70-80	0	0	0	10-12
Improved animal traction controlled flooding							
Mali	2.50	800-1,000	95-100	32	23	0	20

Table 4. -- Characteristics of Rice Production Techniques[a]

Production technique	Paddy Yield (mt/ha/crop)	Land development cost (US $/ha)	Farm labor (mandays/ha/crop)	Fertilizer (kg/ha/crop) N	P_2O_5	K_2O	Extension service costs (US $/ha/crop)
Animal traction irrigated single crop							
Mali	2.25	sunk	90	15	0	0	20
Improved animal traction irrigated single crop							
Mali	3.50	440	120	64	46	0	40
Mechanized irrigated single crop							
Senegal	2.50	4,794	92	69	72	0	10
Manual irrigated multiple crop							
Ivory Coast	4.00	6,812	247	50	27	27	63
Senegal	4.75	315	270	122	96	0	52
Mechanized irrigated multiple crop							
Ivory Coast	2.75	4,972	34	50	27	27	63
Senegal	3.80	3,116	135	81	92	20	24

[a]Data are from individual country studies: Charles P. Humphreys, "Analysis of Rice Production in the Ivory Coast," John McIntire, "Resource Costs and Economic Incentives in Malian Rice Production," Eric A. Monke, "The Economics of Rice in West Africa," Dunstan S.C. Spencer, "Private and Social Profitability in Rice Production and Marketing in Sierra Leone," and A. Hasan Tuluy, "Comparative Resource Costs and Incentives in Senegalese Rice Production," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

[b] Yields are higher than is usual for upland rice cultivation because of the peculiar "grey soils" on which the rice is grown. These permit the plants to be nourished by a high water table after the rains have stopped.

hullers, and hand pounding--are given in Table 5. The three techniques vary substantially with respect to scale. The largest industrial mills are capable of milling 30,000 tons of paddy per year whereas a single person can hand pound only about 5 or 6 tons during the same period. The former technique is also very capital intensive, employing on a single shift only 10 to 15 workers in an entire mill, whereas one woman pounding rice by hand uses only a crude mortar and pestle. Between these two extremes are the small-scale hullers, with which two persons at a time can annually mill 400 to 500 tons of paddy.

Processing costs differ substantially between techniques and countries. The cost of milling a ton of rice in the large industrial mills varies inversely with rates of capacity utilization and at current rates is considerably higher than in the small-scale hullers for all countries. Hand pounding is cheaper than large-scale milling except in the Ivory Coast and Mali, where rates of capacity utilization in the industrial mills are fairly high.[9] Paddy and milled rice must be transported to and from mills, which decreases their advantage over hand pounding for on-farm consumption. Nevertheless, the cheapest milling technique is small-scale hulling. Small-scale mills are more expensive than hand pounding only in Senegal, where rates of capacity utilization are very low because of segmented markets.

Milling ratios do not seem to differ markedly between techniques or countries in any consistent way. Hand pounding yields a higher percentage of broken rice and quality is decreased by the presence of foreign matter. Small-scale milling also increases the percentage of brokens compared with large-scale milling, except in the drier regions where breakage rates in the large mills are quite high.

Table 5. -- Characteristics of Rice Milling Techniques

Milling technique	Projected full capacity[b] (mt paddy/year/unit)	Capacity Utilization in 1976	Unit Cost (US $/mt milled rice)	Milling ratio	Quality of output
Industrial					
Ivory Coast	15,000-20,000	.64	56	.66	25-35% broken
Liberia	10,000	.06	119	.67	25-35% broken
Mali	6,000-18,000	.94	27-33	.57-.67	50-70% broken
Senegal	10,000-30,000	.15	104	.65	40-90% broken
Sierra Leone	3,750-15,000	.25	67[c]	.64	10% broken
Small huller					
Ivory Coast	500	.10	20	.63	fresh, some parboiled
Liberia	400	.38	52	.66	25-45% broken
Mali	375	.44-.69	16-30	.45-.70	60-70% broken
Senegal	500	.05-.15	28	.66	25-40% broken
Sierra Leone	433	.50	14	.67	20-40% broken
Hand pounding					
Ivory Coast	6.25	n.a.	133	.65-.69	stones, some parboiled
Liberia	6.9	n.a.	78	.60	40-50% broken
Mali	4.5	n.a.	60	.70	80-100% broken
Senegal	6	n.a.	21	.65-70	40-60% broken
Sierra Leone	5.7	n.a.	31	.67	20-40% broken

[a] Data are from individual country studies: Charles P. Humphreys, "Analysis of Rice Production in the Ivory Coast," John McIntire, "Resource Costs and Economic Incentives in Malian Rice Production," Eric A. Monke, "The Economics of Rice in West Africa," Dunstan S.C. Spencer, "Private and Social Profitability in Rice Production and Marketing in Sierra Leone," and A. Hasan Tuluy, "Comparative Resource Costs and Incentives in Senegalese Rice Production," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

[b] Assumes 5,000 hours (250 days at 20 hours/day) of operation per year for industrial mills, 2,500 hours (250 days of 10 hours/day) per year for small hullers, and 1,500 hours (250 days at 6 hours/day) for hand pounding.

[c] Adjusted from the cost estimate of Spencer (10) to reflect actual rates of capacity utilization.

Table 6 -- Private Profitability, Public Incentives, and Net Social Profitability[a]
(US $/mt milled rice)

Production technique	Private profitability	Domestic price minus border price	Net subsidy	Net social profitability
Traditional manual upland				
Ivory Coast forest	156	48	226	-117
Ivory Coast savannah	213	48	233	-70
Liberia	-96	144	-9	-231
Sierra Leone south	80	25	--	55
Sierra Leone north	26	25	--	1
Improved manual upland				
Ivory Coast forest	189	48	262	-104
Ivory Coast savannah	213	48	288	-120
Liberia	-62	144	13	-219
Sierra Leone south	128	30	36	62
Sierra Leone north	75	33	46	-4
Animal traction upland				
Ivory Coast savannah	235	48	286	-95
Senegal Casamance	106	78	36	-8
Mechanized upland				
Ivory Coast savannah	230	48	328	-143
Traditional manual swamp				
Liberia	-6	144	-9	-141
Mali	-64	-122	-16	74
Senegal Casamance	n.a.	n.a.	n.a.	n.a.
Sierra Leone south	137	30	--	107
Sierra Leone north	92	31	3	58

Table 6 -- Private Profitability, Public Incentives, and Net Social Profitability[a] (continued)
(US $/mt milled rice)

Production technique	Private profitability	Domestic price minus border price	Net subsidy	Net social profitability
Improved manual swamp				
Ivory Coast forest	136	48	291	-180
Ivory Coast savannah	176	48	305	-155
Liberia	42	144	12	-114
Senegal Casamance	79	65	22	-58
Sierra Leone south	158	44	49	63
Sierra Leone north	140	44	51	45
Improved manual mangrove				
Sierra Leone south	117	23	--	94
Sierra Leone north	64	16	--	48
Animal traction swamp				
Mali	-7	-123	21	95
Partially mechanized swamp				
Ivory Coast forest	144	48	288	-146
Liberia	108	144	138	-174
Improved manual uncontrolled flooding				
Sierra Leone Bolliland	147	33	6	108
Animal traction uncontrolled flooding				
Mali	-118	-107	-15	4
Mechanized uncontrolled flooding				
Sierra Leone Bolliland	165	24	117	24

Table 6 -- Private Profitability, Public Incentives, and Net Social Profitability[a] (continued)
(US $/mt milled rice)

Production technique	Private profitability	Domestic price minus border price	Net subsidy	Net social profitability
Animal traction controlled flooding				
Mali	-21	-126	26	79
Improved animal traction controlled flooding				
Mali	8	-126	13	121
Animal traction irrigated single crop				
Mali	6	-133	4	135
Improved animal traction irrigated single crop				
Mali	6	-133	22	117
Mechanized irrigated single crop				
Senegal Fleuve	4	131	138	-265
Manual irrigated multiple crop				
Ivory Coast savannah	202	48	360	-178
Senegal Fleuve	90	150	8	-68
Mechanized irrigated multiple crop				
Ivory Coast forest	166	48	456	-334
Senegal Fleuve	64	139	57	-132

[a]Data are from individual country studies: Charles P. Humphreys, "Analysis of Rice Production in the Ivory Coast," John McIntire, "Resource Costs and Economic Incentives in Malian Rice Production," Eric A. Monke, "The Economics of Rice in West Africa," Dunstan S.C. Spencer, "Private and Social Profitability in Rice Production and Marketing in Sierra Leone," and A. Hasan Tuluy, "Comparative Resource Costs and Incentives in Senegalese Rice Production," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979. The sum of the last three columns equals private profitability, except for the Ivory Coast where net social profitability differs from private profitability because of differences in social and private prices of land in addition to the effects of government incentives.

The collection of paddy and distribution of rice generally take place within a dual marketing system. On one hand, public marketing agencies purchase paddy from the farmer at an officially prescribed producer price, deliver it to public or privately owned industrial mills, and provide for its distribution and sale to the consumer at an official retail price. Most paddy and rice typically are traded in an informal marketing network, however, in which prices are established principally by supply and demand and processing is done either by hand or in small-scale mills.

Marketing costs are influenced by the relative adequacy of the existing road network and the density of population. They are also affected by the location of consumption in relation to production. There are numerous possibilities, including delivery from interior producing regions to coastal markets, distribution to markets within the producing regions, and on-farm consumption. In general, the farther apart are the points of production and consumption, both physically and vertically within the marketing chain, the higher is the cost of collection and distribution and the lower is the social value of rice output. The first stage in the marketing chain is often the most costly, however, because of high charges for short-distance transportation.

Private Profitability, Public Incentives, and Net Social Profitability

Appropriate production, milling, and marketing techniques have been combined to form the rice sector activities analyzed in detail in the individual country papers. Indicators of private profitability (PP), the effects of public incentives, and net social profitability (NSP) are shown in Table 6 for the major rice-producing activities, with consumption assumed to take place in the capital city.

Private profitability.—Private profitability equals the value of output minus the value of all inputs, each measured in the appropriate domestic market price faced by farmers, millers, or traders. As such, this measure is inclusive of government taxes and subsidies. The resulting PP indicator shows the incentive, for each activity, to alter the existing allocation of resources. If private profitability is positive, resources are encouraged to flow into the activity; if PP is negative, the direction of resource flow is likely to be away.

As shown in Table 6, private profitability is nearly always positive. The only exceptions are in Liberia and Mali, and these activities generally involve production for on-farm consumption rather than for delivery to the capital city, as is assumed for the estimates shown in the table. Consumption on the farm raises the value of output and causes private profitability in most cases to be positive. In addition, part of the harvest from seemingly nonprofitable rice activities in Mali is sold on the free market rather than to public buying agencies at the low official producer price used to calculate private profitability in Table 6. Therefore, no activities provide profit to farmers producing primarily for their own needs.

The incentive to produce for market, however, varies enormously among techniques and countries. At one extreme, private profitability is so low that efforts to improve manual cultivation of rice in the uplands of Liberia are unlikely to succeed as long as this rice is distributed to Monrovia. In the Ivory Coast, on the other hand, price incentives and input subsidies enable farmers to earn profits of over $200/mt for several different production techniques.

Most of this variation is due to differences in profitability between

countries rather than between techniques in the same country. An unweighted average of private profitability for each activity shown in Table 6 is $197/mt in the Ivory Coast, $111/mt in Sierra Leone, $46/mt in Senegal, $.3/mt in Liberia, and $-26/mt in Mali. For the Ivory Coast, Liberia, and Sierra Leone taken together, on the other hand, private profitability averages $76/mt in traditional upland, $109/mt in improved manual upland, and $130/mt in improved manual swamp cultivation.

Public incentives.--Private profitability of rice production in West Africa is influenced to an important extent by public incentives, consisting of trade and price policies, taxes, and subsidies. In Table 6 these incentives are aggregated into two groups. The first is the net effect of trade and price policies causing the domestic price of rice to differ from its border price--either c.i.f. or f.o.b. depending upon whether rice is imported or exported. The second consists of net taxes and subsidies on intermediate and capital inputs. The sum of these two groups of incentives is equal to the difference between private and net social profitability, where NSP is measured in world prices or their equivalents.

There are substantial differences between countries in the magnitude and type of public incentives offered to encourage rice production. In Mali, the low official price of paddy purchased by the government, which controls about half of the total tonnage marketed, tends to discourage substitution of domestic production for rice imports. Mali is practically self-sufficient in rice, however, and in good years it exports the grain. Therefore, the f.o.b., rather than the c.i.f., price is more relevant as a yardstick with which to compare the domestic price. The disincentive resulting from Mali's price and trade policies is then greatly reduced and

is offset for most improved production through net subsidies paid by the government on inputs.

The Ivory Coast, Senegal, and Sierra Leone all protect domestic production to a moderate degree through their trade policies and pricing systems. They differ substantially, however, in the extent to which they subsidize inputs. The Ivory Coast provides input subsidies averaging over $300/mt, mostly as a subsidy to the government-owned mills which enables them to offer a high purchase price for paddy. Input subsidies in Senegal and Sierra Leone, on the other hand, average only $62/mt and $27/mt, respectively. In all of these countries, net input subsidies increase with mechanization and higher degrees of water control. In addition, subsidies are greater in the drier northern regions of each country than they are in southern areas which receive more adequate rainfall.

Liberia differs from the other countries because it relies primarily on import restrictions as a means of promoting local rice production. The domestic price in Monrovia in 1975-76 was $144/mt greater than the comparable c.i.f. price, and agricultural inputs received only very slight subsidies except in partially mechanized cultivation for which the net subsidy was $138/mt.

Social profitability.--The magnitude of incentives offered to rice production is such that private profitability is an unreliable guide to the efficient allocation of resources. Net social profitability, in fact, diverges widely from the private measure of net benefits. Furthermore, there are significant variations in NSP among countries and between techniques.

As results in Table 6 suggest, only two countries--Mali and Sierra Leone--are able to substitute profitably local production of rice for imports consumed in the capital city. In the other countries, NSP is negative for

each activity. Liberia appears to be especially disadvantaged since no technique can be used to produce rice without a loss of at least $114/mt. An unweighted average of NSP for each activity in Liberia is $-176/mt, compared with $-148/mt in the Ivory Coast and $-106/mt in Senegal.

Sierra Leone's net social profitability is positive in every activity but one--improved manual upland cultivation in the north--and even that activity is nearly efficient. The principal explanation for this result seems to be that wage rates in Sierra Leone are very low in comparison with other West African countries.[11] In addition, as was noted earlier, techniques of production in Sierra Leone are very labor-intensive.[12] Since the shadow prices of inputs other than labor are roughly equal in each of the countries studied, low wage rates in Sierra Leone are an important explanation of comparative advantage in that country.

Mali has the highest rates of net social profitability of any of the five countries, ranging from $4/mt for ox-drawn cultivation under uncontrolled flooding conditions to $135/mt for single crop, irrigated cultivation using animal traction at the Office du Niger. High rates of NSP in Mali reflect natural advantages, such as the relatively predictable flooding of the Niger River and the sunk capital invested in the Office du Niger. In addition, wages in Mali are fairly low compared to other countries, especially the Ivory Coast.[13] Finally, the c.i.f. price of rice in Mali, which is used here to value the benefits from production, is higher than that of other countries because of the cost of transport from the coast to Bamako.

Some generalizations can also be made concerning net social profitability of different techniques within countries. In both the Ivory Coast and Sierra Leone, for example, social profitability is increased by improving manual

rainfed cultivation in the south, but it is decreased when this change is made in the north. NSP is also increased by introducing improved techniques throughout Liberia, where the amount of rainfall is uniformly high. This pattern is a reflection of a lower yield response to the introduction of improved varieties and fertilizer in zones of lesser rainfall compared with those where rainfall is abundant.[14] It suggests that increased water control is necessary if the full potential of improved cultivation is to be realized in drier areas. The evidence concerning the effects on NSP of introducing improved practices into swamp cultivation is mixed, however, indicating that water there appears to be less critical. In Liberia, social profitability is increased, whereas in both northern and southern areas of Sierra Leone and the Ivory Coast NSP is reduced with improved methods of swamp cultivation. On the other hand, control of flooding in Mali raises NSP considerably and, in addition, makes possible further increases in social profitability through greater intensification of cultivation.[15]

For improved upland cultivation in the Ivory Coast and traditional swamp production in Mali, use of animal traction is more profitable than manual cultivation. The advantage of partially mechanized swamp cultivation, involving use of power tillers, is less well established, however, since it is more profitable than manual cultivation in the southern Ivory Coast but less profitable in Liberia. Full mechanization using tractors has a lower NSP than less mechanized techniques in every instance for which comparisons can be made--upland cultivation in the Ivory Coast savannah, uncontrolled flooding in Sierra Leone's Bolilands, and irrigated multiple crop production in Senegal. The intermediate stages of mechanization, therefore, appear to have the greatest chance for success.

Finally, the data show clearly the problems associated with trying to produce rice in irrigation systems where only one crop per year can be grown. In the delta region of the Senegal River Basin, salt incursion from the sea during the dry season prevents pumping from the river for a second crop. Further upstream, two crops can be grown, which spreads some of the high overhead and capital costs associated with this kind of irrigation.

Exports.--The profitability estimates shown in Table 6 all assume that consumption of locally grown rice takes place in the largest urban center, for each country the capital city, where most imports of rice are consumed. Positive net social profitability in Mali and Sierra Leone, however, suggest that these countries might have a comparative advantage in exporting to other countries in West Africa. Revised NSP estimates for rice exported from Mali and Sierra Leone to several likely West African markets are given in Table 7 for a few selected techniques which can be expanded to generate exportable supplies. These results are lower than those presented in Table 6 because the f.o.b. value of rice is less than its c.i.f. value due to the influence of transport costs.

It appears from this table that there are opportunities for profitable exports of rice from both countries. The decline in net social profitability resulting from using an f.o.b. rather than a c.i.f. price to value rice output, however, is considerably greater for Mali than for Sierra Leone because of the much longer distances involved. This is evident from the gain in NSP which results from shipping rice to Bouaké, in the center of the Ivory Coast, rather than to Abidjan on the coast. It also can be seen by comparing the NSP of rice exported from Ségou with that produced near Mopti, closer to the center of the interior delta of the Niger River, the major

Table 7.-- Net Social Profitability of Rice Exports
(US $/mt milled rice)

Production Technique	Consumption Point	
	Monrovia	Freetown
Traditional manual upland Sierra Leone south	40	55
Improved manual upland Sierra Leone south	47	62
Traditional manual swamp Sierra Leone south	92	107
Improved manual swamp Sierra Leone south	50	65

	Abidjan	Bouaké	Dakar	Bamako
Improved animal traction controlled flooding				
Mali (Ségou)	11	47	-32	121
Mali (Mopti)	-25	12	-83	71
Animal traction irrigated single crop				
Mali (Office du Niger)	25	61	-18	135
Improved animal traction irrigated single crop				
Mali (Office du Niger)	7	43	-36	117

[a] Data are from individual country studies: Eric A. Monke, "The Economics of Rice in Liberia," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979 and Dunstan S.C. Spencer, "Private and Social Profitability in Rice Production and Marketing in Sierra Leone," Stanford/WARDA Study of the Political Economy of Rice in West Africa, West Africa Rice Development Association, Monrovia, July 1979.

area for potential growth of rice cultivation. Aside from long distances, Mali suffers an additional disadvantage in trying to supply the Dakar market because of competition from inexpensive broken rice imported from Asia.

The ranking of NSP by technique is the same as when rice is produced for domestic consumption. The techniques vary, however, in the degree to which they can contribute to exports. In general, the improved techniques, with their higher yields, offer more marketings for export. The profitability of producing irrigated rice for export at the Office du Niger, however, is likely to decline in the future as an increasing proportion of that rice comes from using improved techniques of cultivation. On the other hand, rapid development of rural areas in the Ivory Coast is enlarging the size of the interior Ivorian market for rice which Mali can supply with relatively low transport costs.

Local consumption.--In the Ivory Coast, Liberia, and Senegal, production of rice for consumption in the capital city is socially unprofitable for each activity. This result does not imply, however, that rice which is consumed closer to the areas of cultivation is also unprofitable. Just as costs of transport and handling make it easier to meet competition from imports than to export profitably, so the cost of imported rice, and thus the shadow price of domestically produced rice, rises as the consumption point is shifted closer to the areas of production. In addition, of course, the cost of marketing local rice also declines.

The effect of shifting the consumption point closer to the farm is seen in Table 8. Net social profitability rises as consumption is transferred from the capital city to regional and local markets and finally to the farm. Transport costs are reduced, and various stages in the marketing chain

Table 8-- Net Social Profitability of Rice for Local Consumption
(US $/mt milled rice)

Production Technique	Consumption Point: On-farm[b]	Local market[c]	Regional market[c]	Capital city[d]
Traditional manual upland				
Ivory Coast forest	-8	-44	-87	-117
Ivory Coast savannah	34	18	-38	-70
Liberia	-128	n.a.	n.a.	-231
Improved manual upland				
Ivory Coast forest	n.a.	-31	-75	-104
Ivory Coast savannah	n.a.	-34	-87	-120
Animal traction upland				
Ivory Coast savannah	n.a.	-8	-62	-95
Senegal Casamance	87	n.a.	29	-8
Traditional manual swamp				
Senegal Casamance	-39	n.a.	n.a.	n.a.
Improved manual swamp				
Ivory Coast forest	n.a.	-110	-150	-180
Ivory Coast savannah	n.a.	-72	-122	-155
Liberia	-4	n.a.	n.a.	-114
Senegal Casamance	37	n.a.	-21	-58
Mechanized irrigated single crop				
Senegal, Fleuve	n.a.	n.a.	-249	-265
Manual irrigated multiple crop				
Ivory Coast savannah	n.a.	-95	-146	-178
Senegal Fleuve	100	n.a.	-51	-68
Mechanized irrigated multiple crop				
Ivory Coast forest	n.a.	-272	-305	-334
Senegal Fleuve	-25	n.a.	-116	-132

[a]Data are from individual country studies: Charles P. Humphreys, "Analysis of Rice Production in the Ivory Coast." Eric A. Monke, "The Economics of Rice in Liberia," and A. Hasan Tuluy, "Comparative Resource Costs and Incentives in Senegalese Rice Production." Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

[b]Assumes rice is hand pounded.

[c]Assumes rice is processed in small-scale hullers.

[d]Assumes rice is processed in large-scale hullers.

n.a. not available.

are eliminated. In addition, the use of small-scale hullers to process rice for the local market results in further savings over large-scale milling. Furthermore, when consumption takes place on the farm, the elimination of collection and distribution costs more than offsets the higher cost of hand pounding relative to the use of small-scale hullers.

As a result, a number of techniques, which are not profitable when rice is delivered to the capital city, become socially profitable when consumption takes place closer to the farm. The improvement in NSP is especially strong for Senegal because of the long distances between the producing regions and the Dakar market. Somewhat less improvement occurs for traditional upland cultivation in the Ivory Coast savannah, traditional upland cultivation in the Ivory Coast forest, upland cultivation involving animal traction in the Ivory Coast savannah, and improved manual swamp production in Liberia. On the other hand, mechanized cultivation is not profitable for consumption anywhere, and except for the techniques mentioned, the Ivory Coast and Liberia do not have a comparative advantage in rice production even for on-farm consumption.

Comparison with Asia and the United States

A previous study of comparative advantage of rice production in Asia and the United States using a methodology similar to that employed here provides estimates of net social profitability for four countries, including the world's two most important rice exporters--Thailand and the United States (13). These estimates are shown in Table 9, together with some obtained for the West African countries. Thailand, the world's most important rice exporter, has by far the highest net social profitability. Production in the United States, which is the second largest exporter, is only marginally

Table 9 -- Net Social Profitability of Rice in Asia, the United States and West Africa[a]
(US $/mt milled rice)

Production technique	Philippines	Taiwan	Thailand	United States	Ivory Coast	Alberta	Mali	Senegal	Sierra Leone
Improved upland	--	--	84/122	--	-143/-95	-219	--	-8	-4/62
Improved swamp, mangrove, and flooding	--	--	165/196	--	-180/-155	-114	79/121	-58	26/108
Partially mechanized irrigated	-99	-161/-68	--	--	-146	-174	--	--	--
Mechanized irrigated single crop	--	--	--	-30/20	--	--	--	-265	--
Mechanized irrigated multiple crop	-105/-123	--	--	--	-334	--	--	-132	--

[a]Data are from Eric A. Monke, Scott R. Pearson, and Narongchai Akrasanee, "Comparative Advantage, Government Policies, and International Trade in Rice," Food Research Institute Studies, Vol. XV, No. 2, 1976, Table 4. The latter estimates have been revised to reflect world prices of rice in 1975-76 rather than 1974, the year for which they were originally calculated. All estimates have been corrected for any differences which may exist between official shadow rates of foreign exchange. Where estimates exist for several activities within each category of production technique, low and high values are given. Prices used to value output are f.o.b. for Thailand and the United States and c.i.f. for the other countries.

profitable. The other two Asian countries, the Philippines and Taiwan, as well as the Ivory Coast, Liberia, and Senegal, have NSPs which are negative as long as they are substituting for imports of rice going to their major markets.[16] Of the African countries, only Mali and Sierra Leone have positive NSPs, which would be reduced if these two countries were to export within the region. If they should try to export outside of West Africa, moreover, the f.o.b. price of rice would drop to the point where exports would not be profitable. This problem should not arise, however, since the size of the West African market considerably exceeds the capacity of these two countries to supply it.

Comparison with Other West African Agricultural Activities

If resources in the agricultural sector of some of the West African countries were to be reallocated away from rice production, the question arises whether there are other agricultural activities which are more socially profitable than rice. Estimates of net social profitability are available for a number of crops in addition to rice in the Ivory Coast, Mali, and Senegal (20). These results cannot be compared with NSP in rice production, however, because the units are not comparable. Instead, it is necessary to make use of an indicator which is independent of units, such as the resource cost ratio (RCR). This ratio compares the social value of domestic resources used to produce a given quantity of output with the value added in world prices created in producing that output. If this ratio exceeds unity, the opportunity cost of the domestic resources, expressed in world prices, is greater than value added in world prices, and net social profitability is negative. If the RCR is less than one, on the other hand, NSP is positive. Since both numerator and denominator of the RCR are expressed

in the same units, the ratio itself is independent of these units, and comparisons can be made between activities producing different products. The lower is the RCR of a given activity in relation to all other activities, the greater the comparative advantage which the country has in that activity.[17]

An indicator of incentives comparable to the resource cost ratio is the effective protection coefficient (EPC). This measure compares value added in domestic market prices with value added in world prices. Since both are measured in the same currency, EPC, too, is a ratio which is independent of units. If the EPC is greater than unity, there is an incentive for value added to be created locally; if the EPC is less than one, there is no such incentive. Unlike private profitability, which includes all taxes and subsidies, however, the EPC takes into account only those assessed on tradable outputs and inputs. It is only a partial indicator, therefore, of total net incentives affecting the allocation of domestic resources.[18]

Estimates of the RCR and of EPC are given in Table 10 for each rice production technique (contained above in Table 6), plus a number of other agricultural activities. Output in all rice activities is valued in c.i.f. prices at the major consumption center; for the other activities valuation is c.i.f. or f.o.b. depending upon whether the product is customarily imported or exported.

The results for the rice activities parallel those discussed previously from Table 6. In addition, Table 10 permits comparison of rice with alternative rainfed crops. The results are very striking. In the Ivory Coast, rice competes very poorly with coffee, cocoa, palm products, copra, and maize. Each of these other crops can be produced with at least one technique for which the resource cost ratio is less than unity. Hence, each is socially

Table 10.— Resource Cost Ratios and Effective Protection Coefficients for Various Agricultural Activities[a]

Production technique - crop	Resource Cost Ratio	Effective Protection Coefficient
Traditional manual upland		
Ivory Coast forest - rice	1.43	1.16
Ivory Coast forest - coffee	0.58	0.60
Ivory Coast forest - cocoa	0.46	0.84
Ivory Coast Savannah - rice	1.26	1.17
Ivory Coast Savannah - maize	0.88	1.00
Liberia - rice	1.78	1.46
Senegal Casamance - peanuts	0.80	0.76
Senegal Casamance - millet	1.30	1.01
Sierra Leone south - rice	0.87	1.02
Sierra Leone north - rice	1.09	1.02
Improved manual upland		
Ivory Coast forest - rice	1.43	1.24
Ivory Coast forest - coffee	0.44	0.60
Ivory Coast forest - cocoa	0.42	0.84
Ivory Coast forest - palm products	0.43	0.91
Ivory Coast forest - copra	0.38	0.92
Ivory Coast Savannah - rice	1.53	1.29
Ivory Coast Savannah - cotton	1.03	0.49
Ivory Coast Savannah - maize	0.84	0.98
Liberia - rice	1.99	1.62
Sierra Leone south - rice	0.82	1.12
Sierra Leone north - rice	1.13	1.15
Animal traction upland		
Ivory Coast Savannah - rice	1.41	1.26
Ivory Coast Savannah - cotton	0.84	0.52
Ivory Coast Savannah - maize	0.81	0.99
Senegal Casamance - rice	1.04	0.90
Senegal Casamance - peanuts	0.48	0.78
Senegal Casamance - millet	1.27	1.25
Senegal Casamance - cotton	0.80	0.76
Senegal Casamance - maize	0.80	1.25

Table 10.-- Resource Cost Ratios and Effective Protection Coefficients for Various Agricultural Activities[a] - Continued

Production technique - crop	Resource Cost Ratio	Effective Protection Coefficient
Mechanized upland		
Ivory Coast Savannah - rice	1.67	1.26
Traditional manual swamp		
Liberia - rice	1.48	1.46
Mali - rice	0.72	0.58
Sierra Leone south - rice	0.69	1.02
Sierra Leone north - rice	0.90	1.03
Improved manual swamp		
Ivory Coast forest - rice	1.75	1.22
Ivory Coast Savannah - rice	1.65	1.23
Liberia - rice	1.44	1.52
Senegal Casamance - rice	1.26	0.93
Sierra Leone south - rice	0.82	1.08
Sierra Leone north - rice	0.94	1.09
Improved manual mangrove		
Sierra Leone south - rice	0.74	1.02
Sierra Leone north - rice	0.98	1.02
Animal traction swamp - rice		
Mali - rice	0.65	0.66
Partially mechanized swamp		
Ivory Coast forest - rice	1.61	1.22
Liberia - rice	1.69	1.70
Improved manual uncontrolled flooding		
Sierra Leone Boliland - rice	0.72	1.04
Animal traction uncontrolled flooding		
Mali - rice	0.99	0.59
Mechanized uncontrolled flooding		
Sierra Leone Bolilands - rice	1.01	1.06

Table 10.-- Resource Cost Ratios and Effective Protection Coefficients for Various Agricultural Activities[a] - Continued

Production	Resource Cost Ratio	Effective Protection Coefficient
Animal traction controlled flooding		
Mali - rice	0.74	0.65
Improved animal traction controlled flooding		
Mali - rice	0.59	0.61
Animal traction irrigated single crop		
Mali - rice	0.56	0.72
Improved animal traction irrigated single crop		
Mali - rice	0.59	0.64
Mechanized irrigated single crop		
Senegal Fleuve - rice	232.22	114.34
Manual irrigated multiple crop		
Ivory Coast Savannah - rice	1.74	1.22
Senegal Fleuve - rice	1.41	0.97
Mechanized irrigated multiple crop		
Ivory Coast forest - rice	2.99	1.28
Senegal Fleuve - rice	2.35	1.55

[a]Data are from individual country studies: Charles P. Humphreys, "Analysis of Rice Production in the Ivory Coast," John McIntire, "Resource Costs and Economic Incentives in Malian Rice Production. " Eric A. Monke, "The Economics of Rice in West Africa," Dunstan S.C. Spencer, "Private and Social Profitability in Rice Production and Marketing in Sierra Leone," and A. Hasan Tuluy, "Comparative Resource Costs and Incentives in Senegalese Rice Production," Stanford/WARDA Study of the Politica- Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979, and J. Dirck Stryker, "Western Africa Regional Project: Ivory Coast, Chapter II, Economic Incentives and Costs in Agriculture," Fletcher School of Law and Diplomacy, Tufts University, Medford, April 1977.

profitable, and in some cases very much so, whereas none of the RCRs for rice is less than one. Moreover, the effective protection coefficients are greater than unity for all of the rice activities but less than or equal to one for each of the other crops in the Ivory Coast--an indication of the protection which is required if rice is to be produced locally using inefficient techniques.

In Senegal, on the other hand, the competition between rice and other crops is closer. Peanuts have a strong advantage and maize and cotton a slight edge, but rice production with some techniques is more profitable than cultivation of millet, particularly in the Casamance region of the south. In the Fleuve, rice is more expensive to produce than is either rice or millet in the Casamance. The EPCs in Senegal tend to correspond fairly closely to the RCRs, except for rice, which receives high subsidies on nontradables such as irrigation.

Rice grown in Mali does not have to compete with other crops for land, since it is not an upland crop, but it does compete for capital and labor. The RCRs from Table 10 suggest, however, that all these crops can be grown profitably using a number of different techniques. The low level of producer prices maintained in Mali is indicated by the low EPC for each activity.

RICE POLICY

One central focus of the WARDA/Stanford project's research has been on the effectiveness of various rice policies in furthering government objectives. The results of this work are reported in detail in Scott R. Pearson, J. Dirck Stryker, and Charles P. Humphreys, "An Approach for Analyzing Rice Policy in West Africa" (16); Scott R. Pearson, Charles P. Humphreys, and Eric A. Monke, "A Comparative Analysis of Rice Policies in Five West African

Countries" (15); and a series of country studies by Charles P. Humphreys and Patricia L. Rader (Ivory Coast) (8), Eric A. Monke (Liberia) (11), John McIntire (Mali) (10), Kathryn Craven and A. Hasan Tuluy (Senegal) (2), and Dunstan S. C. Spencer (Sierra Leone) (18). Some of the important features of individual country policy as well as the interesting comparative conclusions are summarized here, drawn largely from the comparative analyses in the paper by Pearson, Humphreys, and Monke (15).

The principal advantage of planning and carrying out similar policy studies in a number of countries is the scope presented for obtaining comparative insights. A search for patterns within a group of countries also aids understanding of each government's choice of policy. This search begins with a summary of the main elements of policy in the Ivory Coast, Liberia, Mali, Senegal, and Sierra Leone to provide convenient points of reference for the comparative evaluation of policies that follows.

Comparison of Objectives, Constraints, and Policies

The methodological framework for policy analysis used in this study emphasizes interactions among a country's objectives, constraints, and policies.[19] Governments are viewed as having several objectives that they try to achieve within a framework of constrained optimization. Constraints are limits on the availability or deployment of resources and on the flexibility of consumer preferences that prevent the full attainment of all objectives. Policies are the instruments used by governments to achieve objectives by influencing the allocation of resources and patterns of consumption. Constraints on resources thus limit the extent to which policies succeed and hence the degree to which objectives are attained. The method of implementing policies can also affect their success or failure.

Policy analysis consists of identifying the relevant government objectives, specifying the nature of resource or consumer constraints, delineating the policy options, and tracing the interactions.

Objectives.--All WARDA member countries have the attainment of self-sufficiency in rice as a central objective of policy, and self-sufficiency in rice can be viewed as part of the broader objective of self-sufficiency in staple foods.[20] It is useful, therefore, to explore whether increases in rice self-sufficiency through expansion of local production contribute positively or negatively to the three fundamental economic objectives--efficient generation of income, more equal distribution of income, and security of food supplies.[21] In particular, it is helpful to assess the relative effectiveness of various ways of increasing rice production in contributing to these objectives. In contrast to political economy analyses which put political motivations at the fore, this approach initially looks for economic rationales for policy. If policies contribute negatively to all economic objectives, purely political motivations can sometimes explain a government's decisions.

Some insights into the weights that governments attach to objectives emerge from a comparison of the recent historical performance with respect to objectives of the five countries, as shown by the indicators in Table 11. Security of rice production is a tertiary goal in the three forest-zone countries--Ivory Coast, Liberia, and Sierra Leone--because climatic variation

Table 11. --Objectives*

Indicator	Country				
	Ivory Coast	Liberia	Mali	Senegal	Sierra Leone
Growth of GNP per capita, 1960-75 (percent per year)	3.5	1.8	0.9	-0.7	1.5
Ratios of different income groups	0.37[a]	0.19[b]	n.a.	0.18[c]	0.61[d]
Food security:					
Variation in per capita food production[e]	5	3	19	21	6
Export instability (1968-74)[f]	9.3	3.5	5.0	12.5	9.5
Net cereal imports as a percent of earnings from merchandise exports (1960-61 to 1974-77)	3.7[g]	5.4[h]	29.6[i]	17.9[j]	7.7[k]
Rice self-sufficiency 1965-76)[l]	0.75	0.75	0.82	0.26	0.92

*Sources include: Kathryn Craven and Hasan A. Tuluy, "Rice Policy in Senegal," Stanford FRI/WARDA West Africa Rice Project, 1978, preliminary; Charles P. Humphreys and Patricia L. Rader, "Background Data on the Ivorian Rice Economy," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; Robert P. King and Derek Byerlee, "Income Distribution, Consuption Patterns and Consumption Linkages in Rural Sierra Leone," African Rural Economy Paper No. 16, Department of Agricultural Economics, Michigan State University, East Lansing, and Department of Agricultural Economics, Njala University College, Njala, Sierra Leone, 1977; John McIntire, "Rice Policy in Mali," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; Eric A. Monke, "Rice Policy in Liberia," Stanford FRI/WARDA West Africa Rice Project, 1978, preliminary; Dunstan S. C. Spencer, "Government Policy and Food Production in West Africa: Rice Development Policy in Sierra Leone," WARDA, Monrovia, 1978, preliminary; The World Bank, ATLAS, Washington, 1977; World Bank, World Table 1976, The Johns Hopkins University Press, Baltimore, 1976; World Bank, Regional Projects Department, Western African Regional Office, "Appraisal of a Second Sedhiou Project - Senegal," Report No. 1094-SE, Washington, 4 June 1976; West Africa Rice Development Association, Rice Statistics Yearbook, Monrovia, 1975 (and subsequent updates); and United Nations, Department of International Economic and Social Affairs, Statistical Office, Yearbook of International Trade Statistics 1977, Volume 1, "Trade by Country," New York, 1976.

[a]This figure is the ratio of rural incomes in the savannah and forest zones, respectively, in 1974.

[b]This figure is the ratio of rural and urban incomes in 1976.

[c]This figure is the ratio of rural and urban incomes in 1975.

[d]This figure is the ratio of rural and urban incomes in 1974-75.

Table 11 footnotes (continue).

[e]These figures are the coefficients of variation for estimated per capita food production, converted to grain equivalents. Years and crops for each country are:

Ivory Coast--1960-74; rice, maize, yams, plantains, and cassava;
Liberia--1965-76; rice;
Mali--1961-76; rice, maize, millet, and sorghum;
Senegal--1961-76; rice, millet, and sorghum;
Sierra Leone--1970-76; rice.

Except for Mali, no account is taken of seeds and losses. Because of revisions in statistical series, 1975-76 are not included for the Ivory Coast and 1960-69 are excluded for Sierra Leone.

[f]Export instability is based on five-year moving averages centered on the years covered. See explanation in the World Tables 1976, p. 19.

[g]Data cover the years 1960-77.

[h]Data cover the years 1960-75, excluding 1964.

[i]Data cover the years 1961-76, excluding 1973.

[j]Data cover the years 1960-75.

[k]Data cover the years 1960-74.

[l]Self-sufficiency is defined as the ratio of net domestic production to total disappearance.

does not cause wide swings in annual levels of rice production. Food availability is not a critical problem. Furthermore, food imports do not place a large demand on foreign exchange in these countries, giving them a wide margin in which instability of world rice prices can be tolerated. Finally, these countries have diverse and fairly stable opportunities to earn foreign exchange to pay for the additional cost of cereal imports that might be occasioned by unexpected shortfalls in domestic food output.

Conversely, Mali and Senegal seem to place primary emphasis on security because shortfalls in food crops are more frequent and severe in these Sahelian countries. High variation in food production--three times that found in forest-zone countries--occurs in both countries. In addition, these countries have less flexibility in adjusting to unexpected reductions in local food production. For Senegal, this problem is exacerbated by fairly high instability in foreign exchange earnings and relatively large cereal imports. Consequently, increased rice production with secure methods of water control is viewed by both countries as an important way to ameliorate the security of their food supplies.

Among the three southern countries, increasing incomes through an efficient allocation of resources is viewed as a much more important objective than enhancing food security, and the expansion of rice production is seen as a potential way of contributing to this goal. For the Ivory Coast, income growth is undoubtedly the main objective of economic policy in general and probably also of rice policy. In Liberia, recent agricultural development policy, including rice policy, has aimed at finding a long term, gradual complement for growth based on exports of iron ore and rubber. Income

generation through an expansion of agricultural and silvicultural activities lies at the center of this approach. In Sierra Leone, which has the highest per capita production and consumption of rice in the WARDA region, policy makers desire to achieve additional income out of more rice production primarily through the introduction of new techniques. As Table II shows, these three countries have achieved growth rates exceeding those in the Sahelian countries, with the Ivory Coast by far the most successful. What the table does not show, and what is doubtful, is the contribution of expanded rice production to this growth.

In view of the wide disparity in income levels within countries, summarized in Table II, each of the five countries has clearly stated goals to spread economic development more evenly by means of rice policy. In Liberia and Sierra Leone, the distributional concern is to generate higher rural incomes in general. The Ivory Coast has focused rice investment in its northern savannah since that part of the country has not benefitted from agricultural and silvicultural exports to the same extent as the forest zone. In Senegal, rice investment has been mainly concentrated in the Senegal River valley and, more recently, in the Casamance, the area of traditional rice production. Both areas are more remote and less developed than many other regions of the country. Finally, only Mali has emphasized low rice prices to consumers.

If this analysis is correct, the fundamental objectives of rice policy in each country can be ranked from primary (1) to tertiary (3) importance:

	Ivory Coast	Liberia	Mali	Senegal	Sierra Leone
Generation of income	1	1	3	3	1
Distribution of income	2	2	2	2	2
Security of food supplies	3	3	1	1	3

While these rankings show differences between Sahelian and forest countries, the importance of such differences should not be exaggerated.

In summary, self-sufficiency is the major stated objective of rice policy in all five countries, and this goal can be viewed as essentially a means of enhancing economic growth, redistributing income, or improving security. Both the possibility of achieving self-sufficiency and its effects on the three fundamental objectives vary importantly among the five countries. In particular, the two Sahelian countries diverge widely from one another. While both emphasize food security, Mali is an efficient rice producer and is nearly self-sufficient in rice in normal years. In contrast, Senegal lacks efficient production techniques and produces only one-quarter of its rice consumption, which, on a per capita basis, is nearly triple that of Mali. For the forest-zone countries, the scope for import-substitution is substantial, though not so large as in Senegal. Liberia and the Ivory Coast each produce about three-fourths of their rice needs, and Sierra Leone is more than 90 percent self-sufficient.

Constraints.—Constraints to increasing rice production in West Africa are seldom absolute. It is usually possible to obtain the additional resources required to raise production, but the costs of attracting them can be substantial. Public policies can try to alleviate these cost constraints through the promotion of improved production techniques and the development of economic infrastructure.[22] The best way to assess the constraints facing countries in their efforts to increase domestic rice production is to estimate both the costs required to overcome shortages of necessary resources and the capacity of the public sector to intervene.

While constraints vary widely among the five countries, in all of them expansion of rice production is limited by the range of feasible production techniques, the costs of domestic factors of production, and the capacity to design and carry out effective public interventions. Table 12 contains information that can be used to assess the importance of different constraints on increased rice production. For a number of reasons, mostly associated with its level and rate of development, the Ivory Coast has the greatest degree of technical flexibility among the countries considered here in choosing methods of production. While Mali has a comparative advantage in rice, its production is nevertheless constrained, as discussed below. For differing reasons, the other countries fall between the extremes of the Ivory Coast and Mali.

Rainfall is the most important constraint in traditional production. With the exception of areas around Sikasso, Mali cannot grow rainfed rice and requires irrigation to produce rice in other regions. Floodwaters in the interior Delta of the Niger River and in lowland basins along the Ivorian border have traditionally provided the necessary water to produce rice but with high uncertainty and no water control. In the other four countries, rainfed rice provides nearly all of traditional production, reflecting their relatively better endowment of rainfall.

Water constraints in West Africa, coupled with the high water demands of the rice plant, make the objective of providing enhanced food security through increased production expensive to obtain. The cost of overcoming the water constraint varies enormously among countries and techniques. Complete control generally requires an investment of $4,000 or more per ha, while partial control costs as much as $1,000 per ha. The two notable

Table 12.--Information on Constraints*

Indicator	Country				
	Ivory Coast	Liberia	Mali	Senegal	Sierra Leone
Rainfall in rice producing areas (mm per year)	1,300-1,500	2,000	620[a]	750-1,800[b]	2,500-3,000
Daily agricultural wages (US$/manday, 1975-76)	1.40-1.80[c]	1.25	1.00	1.00-1.20	0.60-0.80
Direct farm labor cost per kg paddy (US$, 1975-76)[d]	0.118	0.247	0.065	0.147	0.118
Investment costs of water control[e]					
Complete (US$/ha, 1975)	3,983-5,978[f]	--	444[g]	400-4,311[h]	--
Partial (US$/ha, 1975)	1,390[i]	750[j]	600-900[j]	712[i]	249[i]
Annual costs of water control[e,k]					
Complete (US$/ha/crop, 1975)	373-348[f,l]	--	43[m]	103-340[h,n]	--
Partial (US$/ha/crop, 1975)	173[i,o]	124[i,p]	42[m,q]	80[i,r]	112[i,s]
Government consumption as percent of GDP (average, 1960-73)[t]	15.2	11.8	16.2	18.1	7.6
Government investment as percent of GDP (average, 1960-73)[u]	2.4	1.4	-3.15[v]	4.0	2.7
Debt service as percent of export earnings	8.3[w]	7.1[x]	22.0[y]	6.9[z]	16.1[aa]
Shipment to capital city (US$/mt)	93	71	76	70[bb]	34

*Sources include: Kathryn Craven and Hasan A. Tuluy, "Rice Policy in Senegal," Stanford FRI/WARDA West Africa Rice Project, 1978, preliminary; International Monetary Fund, Balance of Payments Yearbook, 29, December 1978; Charles P. Humphreys, "Analysis of Rice Production in the Ivory Coast," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; Charles P. Humphreys and Patricia L. Rader, "Background Data on the Ivorian Rice Economy," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; Charles P. Humphreys, "Data on Costs of Ivorian Rice Production," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1979, preliminary; Charles P. Humphreys and Patricia L. Rader, "Rice Policy in the Ivory Coast," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; Liberia, Government of, Ministry of Planning and Economic Affairs, Quarterly Statistical Bulletin of Liberia, (summary for 1976), Monrovia, June 1977; John McIntire, "Resource Costs and Economic Incentives in Malian Rice Production," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; John McIntire, "Rice Policy in Mali," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; Eric A. Monke, "Rice Policy in Liberia," Stanford FRI/WARDA West Africa Rice Project, 1978, preliminary; Eric A. Monke, "The Economics of Rice in Liberia," Stanford FRI/WARDA

Table 12 footnotes (continued).

West Africa Rice Project, Stanford, 1979, preliminary; Dunstan S. C. Spencer, "The Economics of Rice Production in Sierra Leone - 1: Upland Rice," Department of Agricultural Economics and Extension, Njala University College, University of Sierra Leone, Bulletin No. 1, Njala, March 1975; Dunstan S. C. Spencer, "Private and Social Profitability in Rice Production and Marketing in Sierra Leone," WARDA, Monrovia, 1979, preliminary; Hasan Ahmet Tuluy, "Comparative Resource Costs and Incentives in Senegalese Rice Production," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; and World Bank, World Tables 1976, The Johns Hopkins University Press, Baltimore, 1976.

[a]This figure is an average for Mopti and Ségou.

[b]The first figure refers to the Senegal river valley and the second to the Casamance region.

[c]The first figure refers to the savannah zone and the second to the forest zone.

[d]These figures are the averages of labor costs in all techniques of paddy production in 1975, weighted by each technique's share in total output.

[e]These costs are net of most, if not all taxes. As such, they represent social, not private costs.

[f]The first figure refers to mechanized schemes in the forest zone relying on pump irrigation, the second to gravity irrigation using dams in the savannah zone.

[g]This figure is the cost for improvements in the Office du Niger, consisting mainly of levelling and rehabilitation of canals. The cost of the basic infrastructure is considered sunk.

[h]The first figure is for small-scale pumping in Matam, the second for large-scale, mechanized pump irrigation in the Delta.

[i]Partial water control here refers to the improvement of lowlands, usually in forest areas, by bunding and diversion weirs.

[j]The first figure is for improvement of lowlands in the Sikasso area, the second for controlled flooding improvement near Ségou and Mopti, excluding initial deep plowing.

[k]Unless otherwise noted, recurrent costs include both the annuity on the investment and operation and maintenance of the irrigation system.

[l]Annuities for dam irrigation are based on an average of 27 years for the system as a whole and an average annual interest rate of 5.8 percent. For pump irrigation, the expected average life is 15.4 years, with an average annual interest rate of 5 percent. These annuities for pump and dam irrigation both assume 1.85 crops per year and utilisation of 80 percent of total area.

[m]This figure covers only the annuity, based on a 25 year service life and a 2.5 percent annual interest rate. Operation and maintenance costs are not included.

Table 13 footnotes (continued).

[n]Annuities for Matam are based on an average service life of about 9 years and an average annual interest rate of 1 percent. For the Delta, the average life is 24 years and the average annual interest rate is 2.75 percent. For Matam, 65 percent of the annuity is allocated to the rice crop.

[o]The annuity is based on a 15 year service life and an average annual interest rate of 7.7 percent. This figure assumes 1.3 crops per year and utilization of 90 percent of improved land.

[p]This cost covers the annuity, and is based on a 20 year service life and an annual interest rate of 15 percent. Repairs are based on 5 mandays, or $6. Such costs are also included in direct labor charges.

[q]This cost represents only the annuity and is the average for controlled-flooding polders near Ségou and Mopti and lowlands around Sikasso.

[r]The annuity is based on a service life of 20 years and an average annual interest rate of 3 percent.

[s]The annuity and is based on a 10 year service life and an average annual interest rate of 24 percent. Maintenance costs of 45 US$/ha are also included in farm labor costs.

[t]Government consumption is defined as recurrent expenditures on goods and services and includes all defense expenditures.

[u]Government investment excludes defense expenditures.

[v]Data for Mali cover only 1965-73.

[w]Data cover the years 1969-76, and debt service includes repayment and interest on government debt, loan repayments by government enterprises, and retirement of government securities.

[x]Data cover the years 1970-75, and debt service includes repayment and interest on government debt, IMF repurchases and reconstitution of assets. This ratio increases substantially (to 10.2 for 1967-73) when debt service is compared to total current account earnings.

[y]Data cover the years 1970-77, and debt service includes repayment and interest on long-term government debt, interest on overdrafts with the French Treasury, charges paid to the IMF, and repurchases of IMF credit.

[z]Data cover the years 1968-75, and debt service includes repayment and interest on government debt, and repayment of trade credits issued to the government.

[aa]Data cover the years 1969-76, and debt service covers repayments of loans to the government, of issues by the central government, and of prefinancing by foreign contractors.

[bb]This figure is for shipment from either Matam or the Casamance. Shipment from the Delta costs about 51 US$/mt.

exceptions, where complete control is not so expensive, are unlikely to be replicated on a large scale. The Office du Niger in Mali and the Matam polders in the Fleuve region of Senegal provide full water control at costs beneath those required for full control elsewhere. But in the former, enormous infrastructure costs, which were made in the 1930s, are now considered sunk. For the latter, the area in which low cost projects can be carried out is restricted to land directly bordering the river.

Although estimates vary according to the type and lifetime of investment and the interest rate used, information in Table 12 gives some orders of magnitude of the high costs generally involved. For rice produced under full water control, the annual capital costs and charges for maintaining the irrigation system can be as high as $150 per mt of milled rice. The annual capital and maintenance costs vary more widely for rice produced under partial water control, but are estimated to be about $65 per mt.[23] However, with partial control, the security of production is often only marginally better than under traditional production since the delivery of water remains largely dependent on natural rainfall and flooding. The one significant exception, which still has considerable potential for expansion, is the controlled flooded technique in Mali. The security of flooding is estimated to be 90 percent of that with complete control, while annual capital and maintenance costs are probably only about one-half those for the partially controlled, improved lowlands in the forest zone countries.

As suggested by the low population densities in these countries, wage rates are relatively high throughout West Africa and pose an important near-term economic constraint on the efficient expansion of rice production.

Daily wage rates are clearly highest in the Ivory Coast, ranging from $1.40 to $1.80 per day for men, reflecting the success of the country in promoting agricultural exports and attaining a rapid rate of development. At the other extreme, wage rates in Sierra Leone are less than half those in the Ivory Coast. Such low rates stem from a lack of natural resources and agricultural capacity in that country. The wage rates for Mali, Senegal, and Liberia are in the range bounded by those in the other two countries.

The pattern of unit labor costs among countries requires consideration of worker productivity as well as wage rates. (By definition, unit labor costs are the product of the wage rate and the inverse of labor productivity.) Marginal unit labor costs can be approximated by the value of direct farm labor in each additional kg of rice produced domestically. Labor costs per kg of rice are clearly lowest in Mali, where inexpensive water control schemes, the extensive use of animal traction, and high rates of insolation all help raise the productivity of labor. For Mali, wage rates are relatively low and labor productivity is relatively high.

On the other hand, the unit cost of labor in Sierra Leone is the same as in the Ivory Coast, where wage rates are twice as high. Senegal also seems to lose the benefits of its relatively low wage rates, and labor costs per kg of rice are the second highest in the five countries. In Sierra Leone, low wage rates appear to be more than offset by high labor input, while in Senegal they seem to be counteracted by low yields in the Casamance. In the Ivory Coast, relatively high wages seem to be offset to a considerable

extent by higher productivity--reflecting perhaps the favorable climatic conditions and greater use of other inputs. Liberia has the highest unit labor cost in rice production because of high wage rates coupled with very inefficient traditional production techniques. In short, differences in natural environments, including quality of land and supply of water, permit labor productivity in rice production to vary widely among the five countries. This differing productivity strongly influences the pattern of labor costs since these costs depend on both productivity and wage rates.

The variations in worker productivity are not in themselves unusual. Research by Timmer and Falcon on nine Asian countries demonstrates the importance of complementary inputs in production--environmental conditions, irrigation investments, and high-yielding seed varieties (25). These factors accounted for a three-fold difference in yields among the nine Asian countries studied. The key point is that increases in complementary inputs reduce the relative importance of labor costs in total costs. But in the West African context, high wage rates, coupled with low worker productivity, cause very high unit labor costs.

Capital becomes constraining at the national level primarily when large-scale investment must be made in land clearing and water resource development. The necessary capital must come from either domestic savings or foreign borrowing and aid. Because the size of most of these investments demands that they be undertaken by a government agency, the capacity of the government to allocate tax revenues for investments and its ability to obtain foreign funds can importantly constrain the expansion of rice production.

Capital is also an important constraint at the farm level, as reflected by high real rates of interest that prevail in the informal rural capital markets.

With the exception of cooperative projects, which only affect a small number of farmers, farm capital comes primarily from savings and short term borrowing. Improvements in rural lending facilities are thus an important constraint on the dissemination of new techniques with high levels of recurrent expenditures for improved seeds and fertilizer.

Of the five countries, Liberia would appear to have the greatest scope to increase both government investment and foreign borrowing. Neither the ratio of government investment to GDP nor the debt-service ratio is particularly high compared to the other countries. Moreover, favorable rainfall might reduce the need for large-scale investments relative to that in other countries, although the institutional constraint due to the scarcity of rural lending facilities is somewhat greater. At the other extreme is Mali, which has actually suffered negative government investment owing to the difficulties of the Sahel drought. It also has a debt-service ratio that is three times as large as that for most of the other countries. Unlike Liberia, however, Mali has concessional aid available to it, and such capital is relatively inexpensive. Senegal also has access to considerable foreign aid, especially for projects in the Senegal River Basin where water development is most expensive. Hence, Liberia, Mali, and Senegal probably have the least restrictive constraints on capital, although none has the flexibility to divert large sums into rice projects solely of its own choosing.

Existing high levels of government investment and a growing debt-service ratio in the Ivory Coast mean that additional investments come only at increasing higher capital costs. In a country where natural conditions make water development especially expensive, the presence of such a constraint

could hamper efforts to expand irrigated rice production on a large scale. Sierra Leone is the most severely constrained in terms of capital, with a very high debt-service ratio and a relatively high share of GDP already devoted to investment. Some concessional foreign aid is available but less than for the drier countries to the north.

In West Africa, land is widely available and hence has a very low opportunity cost. This situation can be expected to change in the future as population densities increase. But during the next 25 years or so, the period in which the longest investments in rice might be amortized, land is likely to remain inexpensive. Investments in land development to increase water control are considered under the constraint on capital. With respect to rice production, the surplus of land provides little in the way of economic advantage. Irrigated rice is relatively ill-suited to land-extensive production. Moreover, the potential for efficient utilization of inexpensive land (i.e., the substitution of capital and land for labor) in upland rice production, prominent in the forest-zone countries, remains largely unknown.

Other constraints include the availability of revenue for recurrent financing of government programs, managerial talent, rural infrastructure, and the location of rice production relative to major consuming centers. Perhaps the most immediate concern of government leaders is the capacity of the budget to sustain the sizeable recurrent expenses that accompany intervention in the rice sector. Such recurrent costs are particularly important when subsidies are paid on the output, and they can also be significant when high levels of modern inputs are heavily subsidized.

Total current government expenditures are about one-sixth of GDP in the three francophone countries, while the share in the other two countries is much smaller. Due to the severity of the budget constraints, alternative demands on funds could preclude additional expenditures on rice, unless foreign assistance is forthcoming.

With respect to domestic managerial talent, the Ivory Coast currently has the highest level of advanced education, and it also hires large numbers of foreign technical experts. In contrast, Mali and Liberia have education levels for advanced students roughly one-half of those in the other countries. Moreover, Mali does not depend significantly on foreign talent. In between are Senegal and Sierra Leone. Of course, many other factors affect the capacity to intervene in the rice sector, among them the willingness to divert scarce talent into these areas. Mali and the Ivory Coast have probably had the best past experience and Liberia the least satisfactory. But in all countries managerial skill is scarce and policies demanding significant public intervention may be severely constrained.

The Ivory Coast is the least constrained and Mali is the most affected by the availability of all-weather roads. However, since most of expanded production in Mali is likely to occur along the Niger River between Bamako and Mopti where a reasonably adequate road system already exists, this constraint might be considered relatively unimportant for rice production. In Senegal, especially in the Casamance, the lack of good roads presents an important constraint that increases the costs of production and marketing. The cost

of transporting local rice to the major consumption centers is greatest for Senegal, as a result of the long distance of major production from Dakar. It is least in Liberia and Sierra Leone, reflecting the small size of these two countries.

The predominance of producer-oriented rather than consumer-oriented constraints on West African rice policy contrasts significantly with the conduct of rice policy in much of Asia where consumers play a much more prominent role in the creation of objectives and constraints on policy formation (4, 5). Consumer-related issues of rice availability and price, particularly in urban areas, have been of critical concern to Asian policy makers. In part, differences between Asia and West Africa reflect an unavoidable bias in the method of policy analysis. Consumer-related constraints are often hidden, awaiting new policy actions or events to call them into existence. But more importantly, the differences are due to the more severe income problems of some countries in Asia, particularly in cities, and the more central role of rice in Asian diets. Only in Liberia and Sierra Leone does rice play anywhere near as important a role in consumption patterns as in Asia, and in these two countries consumers seem to demonstrate a high degree of substitution between rice and wheat, plantains, cassava, yams, and other staples. This substitutability is important in understanding the relatively passive reaction of West African consumers to price policy.

Several generalizations can be offered regarding constraints on rice policies. First, because of the levels and variability of rainfall, the Sahelian countries have a greater need to control water supplies than do

the forest countries. Second, all countries are constrained by labor costs in rice production, and most yet face land shortages. Third, all countries face difficult tradeoffs in allocating government revenues. Foreign aid can play an important role in easing the capital budget constraint of the Sahelian countries, while Sierra Leone is in the most difficult position with respect to capital. Finally, with respect to administrative talent, rural infrastructure and the location of production, the constraints facing countries vary. On balance, the Ivory Coast is probably the least constrained and Liberia is the most limited by these factors.

Policies.—Whereas the number of constraints can be large, the range of options available to governments in West Africa for the purpose of implementing policy is quite narrow. In this study, policies are classified into three areas—trade and price policies, domestic tax or subsidy policies, and investment policies (16). These policies have an impact on the rice economy through their effects on output prices and on input and capital costs. The effectiveness of each policy is heavily influenced by the opportunity costs of domestic resources and by choices of production and milling techniques which together influence social profitability of rice production. Information that can help measure the application and impact of government policies is contained in Table 13.

Trade policy is similar in all countries, except Mali. Contrary to the belief that West African governments subsidize rice consumers, domestic wholesale prices of rice between 1965 and 1976 have been about one-fourth to one-third higher than comparable c.i.f. import prices in the four protecting countries. Mali is the exception, where official domestic

Table 13.--Information on Policies*

Indicator	Country				
	Ivory Coast	Liberia	Mali	Senegal	Sierra Leone
Ratio of domestic official wholesale to c.i.f. price[a]	1.38[a]	1.29[b]	0.61[c]	1.25[d]	1.36[e]
Rate of subsidy or tax (-) in official domestic producer price (1975-76)[f]	0.56	0.11	0.05	0.25	-0.29
Government purchases of paddy (000 mt of paddy)	124[g]	3[h]	88[i]	10[i]	11[i]
(Percent of total production)	(28)	(1)	(41)	(4)	(7)
Rate of subsidy on fertilizers[k] (197_)	0.45[l]	0.00	0.27[m]	0.74	0.62[n]
Additional output due to fertilizer (000 mt paddy, 1975)[o]	21	1	8	33	19
(Percent of total production)	(5)	(0)	(3)	(25)	(3)
Rate of subsidy on irrigated land development (1975)[k]	0.76[p]	0.00	1.00[q]	1.00[r]	0.41[s]
Area under irrigation (000 ha, 1975-76)	23	1	90	15	5.5
(Percent of total area in rice)	(6)	(1)	(40)	(16)	(1)
Rate of subsidy on motorized services (1975-76)[k]	0.04[t]	0.00	0.50[u]	-0.16[v]	0.77[w]
Area plowed or threshed by motorized services (000 ha, 1975-76)	8	1[x]	90	10	17[y]
(Percent of total area in rice)	(2)	(0)	(57)[z]	(11)	(4)
Area planted in improved rice seeds (000 ha, 1975-76)	27	2	94[aa]	29	84
(Percent of total area in rice)	(7)	(1)	(29)	(32)	(19)

Table 13 footnotes.

*Sources include:
Kathryn Craven and Hasan A. Tuluy, "Rice Policy in Senegal," Stanford FRI/WARDA West Africa Rice Project, 1978, preliminary; Charles P. Humphreys, "Analysis of Rice Production in the Ivory Coast," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; Charles P. Humphreys and Patricia L. Rader, "Background Data on the Ivorian Rice Economy," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; Charles P. Humphreys, "Data on Costs of Ivorian Rice Production," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1979, preliminary; Charles P. Humphreys and Patricia L. Rader, "Rice Policy in the Ivory Coast," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; John McIntire, "Resource Costs and Economic Incentives in Malian Rice Production," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; John McIntire, "Rice Policy in Mali," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary; Eric A. Monke, "Rice Policy in Liberia," Stanford FRI/WARDA West Africa Rice Project, 1978, preliminary; Eric A. Monke, "The Economics of Rice in Liberia," Stanford FRI/WARDA West Africa Rice Project, 1979, preliminary; Sunstan S. C. Spencer, "Government Policy and Food Production in West Africa: Rice Development Policy in Sierra Leone," WARDA, Monrovia, 1978, preliminary; Dunstan S. C. Spencer, "Private and Social Profitability in Rice Production and Marketing in Sierra Leone," WARDA, Monrovia, 1979, preliminary; and Hasan Ahmet Tuluy, "Comparative Resource Costs and Incentives in Senegalese Rice Production," Stanford FRI/WARDA West Africa Rice Project, Stanford, 1978, preliminary.

[a]Data cover the period 1960-77 and are for imports of 25-35 percent broken rice only. For 1960-72, the official wholesale price is estimated by subtracting 3 CFA francs from the official retail price.

[b]Data cover 1967-76 and are for all rice imports.

[c]Data cover 1969-74 and are for all rice imports. These are the only years in which Mali imported rice.

[d]Data cover 1965-76 and are for 100 percent broken rice imports only.

[e]Data cover the period 1960-76, excluding 1964-65 and 1975. Imports include all types of rice.

[f]The rate of subsidy (or tax, for negative values) is defined as:

$$S = \frac{(P+M) - C}{C}, \text{ where}$$

S is the rate of subsidy,
P is the official producer price, in rice equivalent,
M is the sum of the private costs for collection of paddy, milling, and distribution of rice, using the most common techniques in the country, and
C is the official wholesale price of rice.

A value of zero implies that the structure of official prices neither taxes nor subsidizes. A positive value implies that official purchases of paddy and sales of rice produce a budgetary deficit, which is transferred to producers, while a negative value implies the generation of a budgetary surplus, which is taxed from producers.

Table 13 footnotes (continued).

[g]This value is the average for the two crop years 1974-75 and 1975-76. It may represent as much as 70 percent of all marketed rice.

[h]This value is for the crop year 1976-77 and may be equal to 8 percent of all marketed rice.

[i]This value is the average for the two crop years 1974-75 and 1975-76.

[j]This value is for the crop year 1974-75.

[k]All subsidies are based on social costs, net of all taxes.

[l]This rate is the unweighted average for rainfed and irrigated rice in the forest and savannah zones. The subsidy on fertilizer is estimated from the total subsidy on current inputs as the share of fertilizer costs in total costs. This estimate may overestimate the rate subsidy if other inputs are, in fact, more heavily subsidized.

[m]This is the rate of subsidy on fertilizer used in the Office du Niger.

[n]This is the average rate of subsidy on fertilizer used on Bolilands (0.66) and on improved uplands and improved inland swamps (0.58).

[o]Additional paddy output due to fertilizer application has been estimated by assuming that 1 kg of N gives 14 kg of paddy on rainfed, upland rice and 25 kg of paddy on irrigated rice.

[p]This value represents the average rate of subsidy on investments in swamps, pump irrigation, and dams, weighted by the share in total costs of each type of land development between 1960 and 1976. Subsidy rates for swamps, pumps, and dams are 0.63, 1.00, and 0.89, respectively.

[q]This rate of subsidy applies to investments in the Niger river basin. For swamps, the rate is 0.87.

[r]This rate of subsidy applies to investments in the Delta and at Nienga. Rates for investments at Matam and in swamps in the Casamance are 0.35 and 0.92, respectively.

[s]This rate applies to improved inland swamps only.

[t]This is the average rate of subsidy on large and small scale motorized services in rainfed and irrigated production, weighted by the share in total area under each type of mechanization. Rates are zero, except for large-scale motorized services on irrigated production where it is 0.15. Purchases of oxen and equipment are slightly subsidized at a rate of 0.12.

Table 13 footnotes (continued).

[u]This rate is the average for motorized threshing at Mopti and the Office du Niger. Deep plowing is subsidized at the rate of 1.00, but it is not done annually. Purchases of oxen equipment are subsidized at the rate of 0.09.

[v]The purchase of oxen equipment for rainfed production in the Casamance is subsidized at a rate of 0.28.

[w]This is the subsidy rate for land preparation of Bolilands and riverain grasslands.

[x]This value is less than one, resulting in the zero percentage.

[y]This is the average of 1975 and 1976, which were 11,000 ha and 22,000 ha, respectively.

[z]This percentage is the share of paddy production threshed, not the percentage of land on which the paddy is produced (that percentage equals 0.42).

[aa]These seeds are renewed, in theory, every 3 years; hence the annual plantings in new improved seeds equal one-third the value shown.

prices have been lower than c.i.f. import prices. Typically, the governments of Ivory Coast, Liberia, Senegal, and Sierra Leone restrict imports of rice with variable levies or quotas, thereby forcing consumers to pay higher than international prices, permitting producers to receive higher prices, and generating government revenues from the rice imports. In Mali, the reverse holds, and consumers of officially marketed rice tend to be subsidized relative to c.i.f. import prices. When world rice prices increased rapidly in 1974, this pattern was temporarily interrupted because Senegal, Sierra Leone, and Mali subsidized imports to maintain more stable prices to consumers, while Ivory Coast and Liberia raised domestic prices in line with the hike in world prices, allowing their producers to benefit. Generally though, the thrust of trade policy has been to transfer resources from consumers to producers or to the government treasury.

All countries set official producer prices for paddy and consumer prices for rice. The structure of official prices alters the pattern of prices created by trade policies only to the extent that the countries are successful in enforcing official prices, which requires a large involvement in the marketing and milling sectors. In this regard, the Ivory Coast and Mali have been most successful in purchasing paddy, handling from one-fourth to two-fifths of production in peak years. The remaining countries have never purchased more than a minor share of output and marketing is dominated by private traders.

Since independence (1960), the Ivory Coast has used a restrictive trade policy to raise consumer prices and thereby to buttress a floor price to producers. Producer prices--especially during the mid-1970s--have

been further supported by farm subsidies channeled through collection and milling activities without equivalent increases in the consumer price. In 1975, roughly one-half of the official producer price consisted of government subsidy. Starting in 1978, however, government paddy purchases were severely curtailed. On balance, consumers still face domestic prices that are higher than comparable import prices for rice but not so high as the official producer price would require if there were no government subsidy.

Price policy in Mali is more complicated. The government's established producer price applies to about one-half of rice marketings because a high proportion of commercial sales arises from large, geographically-confined development projects whose farmers are required to pay fees in kind and to meet quotas for marketed paddy. The government through its state marketing agency then rations this rice by selling it at a price below the market-clearing level to selected consumers who belong to cooperatives. In effect, Malian price policy forces producers in government projects to subsidize consumers who have access to rationed rice in cooperative markets. The official price structure in Mali thus tends to tax farmers relative to the c.i.f. import price because the official consumer price is below that price. This policy raises the free market price of rice for both consumers and producers who are not part of government programs.

The other three countries also establish official prices for rice. But the impact of such policies has been small since only a slight percentage of national production is marketed through government channels, especially in Liberia. The pattern varies, however, among the three countries. Both Senegal and Liberia tend to subsidize producers who use the improved techniques,

although by amounts less than in the Ivory Coast. But traditional techniques which dominate total production are not effectively subsidized, because of either limitations in the funds to purchase paddy or the absence of purchased inputs in traditional farm production. In these countries price policy depends critically on the capacity and will of the government to pay for subsidies on paddy that is purchased and milled by government agencies. Moreover, the incidence of taxation on consumers increased significantly after 1974 in these three countries because domestic prices were not allowed to fall in line with world prices during the 1974-78 period. Hence, producers have received increasing transfers from consumers.

Sierra Leone is the only country where the official producer price implies a tax on farmers relative to the official consumer price. Unlike Mali, however, the country lacks the large, geographically-concentrated projects which make enforcement of unfavorable producer prices possible. As a result, the government is largely unable to compete in the private market for paddy, and the tax has very little effect on actual production.

The extent of subsidies on intermediate inputs into rice production differs greatly among the five countries. At one end of the spectrum, Liberia has no effective input subsidies save that on its extension service. As data in Table 13 show, virtually no Liberian production benefits from motorized services, fertilizers, or improved seeds. These results reflect the very low level of government intervention in the past, and rice projects being planned will surely contain higher rates of subsidy.

In the other countries, extension services are universally subsidized, and government policies also affect fertilizer, motorized services, and improved seeds. The Ivory Coast has concentrated on fertilizers, subsidizing

roughly half their price, and to a lesser extent on improved seeds.[24] However, these subsidies have had relatively little impact, and only a small percentage of domestic rice production benefits from modern inputs.

Mali has provided little encouragement to fertilizer use through subsidization. On the other hand, mechanical services, especially motorized threshing, are subsidized by about 50 percent, and over half of domestic production is handled in this way. Improved seeds, introduced once every three years, have also been strongly promoted. Mali has, therefore, concentrated on inputs that best complement other elements in the production systems. Inexpensive water control does not require fertilizers in order to be profitable, and extensive tillage practices using privately owned oxen and equipment benefit from mechanized threshing. In addition, mechanized threshing allows the government to buy a large share of paddy marketings at the relatively low official price.

Senegal has relied most heavily on fertilizers and improved seeds, providing the largest subsidies (up to 75 percent on fertilizer) and increasing production by as much as one-fourth as a result. On the other hand, mechanical services are slightly taxed. Consequently, such services are used only in the Delta, where soils are heavy and farmers participating in projects have little choice concerning their use.

Although Sierra Leone has the second highest rate of subsidy on fertilizers and the highest on mechanized services, the impact on national production has been quite small—due in part to constraints on the government budget and the already high level of traditional production. As in most of the other countries, the use of improved seeds is the most widespread of all modern inputs.

All countries except Liberia have maintained important government investment policies in order to develop irrigated rice production, and Liberia is beginning developments in this area. Subsidies have been highest in Mali and Senegal, probably because of the large scale of the projects required to control water along the Niger and Senegal rivers. With small scale irrigation schemes, farmers participate in the investment, and subsidy rates on land development costs are generally lower. They range from about two-fifths to two-thirds in Sierra Leone and the Ivory Coast, respectively, compared with 100 percent in Mali and Senegal. For Senegal, the major exception to this pattern is Matam, where low costs, small scale, and relatively high population densities make it possible to obtain participation with subsidies amounting to only about one-third of total costs.

A common theme underlies rice investment policy in all five countries--the overwhelming importance of foreign aid donors in designing, financing, and implementing rice development projects. The Ivory Coast, the only country in the group which has the resources to fund major rice production projects without concessional foreign assistance, has not done so to an important extent--preferring instead to use its own available funds for other, more profitable investments. All the governments, however, take some equity participation in donor-assisted projects. Liberia is at the high end of the range with about 50 percent and Mali and Senegal are at the low end with 15 to 20 percent.

The amount of direct government participation in rice production, processing, and distribution is greatest in Mali, decreasing through Senegal, Ivory Coast, and Sierra Leone, and least in Liberia. In all countries state

farms for rice are almost nonexistent, and direct government participation in paddy production is restricted to land and water development, production of improved seeds, research and extension, provision of credit, and input delivery. The degree of government involvement increases through the rice production chain. In all countries, small private hullers coexist with large government-owned mills, but the former are much more important in the anglophone and the latter in the francophone countries. This same pattern is also true for rice marketing. All five countries have state marketing agencies, but they often move a large proportion of paddy or rice in Mali and the Ivory Coast whereas the private trade is predominant in Liberia, Senegal, and Sierra Leone. This participation provides a potentially important source of pressure on policies by creating influential interest groups—such as state development agencies and marketing boards—who usually have easy access to decision makers.

Evaluation of Policies

Policies should be evaluated in terms of their effectiveness in achieving one or more government objectives in the face of resource constraints which limit both the choice and implementation of those policies. Effective policies successfully advance objectives at minimum cost.[25] The effectiveness of a policy depends, first, on its ability to make a positive contribution toward advancing an objective, such as increasing national income, distributing income more evenly, or improving the security of food supplies. This aspect of effectiveness can be readily measured by changes in appropriate indicators used to define the objective. As will be clear from the discussion that follows, some policies do not advance certain objectives, irrespective of the level of economic costs. Second, the effectiveness of a policy depends on the costs associated with it in obtaining

a given improvement in an objective. The methodology used in this study to assess the social profitability of rice production techniques can be applied to measure the loss (or gain) in economic efficiency and potential national income engendered by policies which cause a divergence between social and private profitability. Additional costs can be associated with the political effects caused by the transfers required to enact policies and with the administration of the policy interventions. The evaluation of policies, therefore, consists of two steps--determining whether desired objectives are furthered and measuring the associated cost (or gain) of resource reallocation.

The fundamental objectives of efficient income generation, income redistribution, and food security can be furthered by either increases in the level, or changes in the structure, of rice production. But self-sufficiency through import substitution demands increased national output if consumption levels are to be maintained. To achieve these ends, rice policies provide either universal or specific incentives. Universal incentives are available to all farmers and include tariffs, fertilizer subsidies, and paddy price supports. If productive inputs are high mobile, universal incentives are relatively easy to administer and cause the least distortion in efficiency. However, these policies can bring about large transfers among economic groups, such as all rice consumers and all rice producers, that are both unintended and unwanted. On the other hand, if resources are, or can be, tied specifically to the production of rice--such as systemic insecticides, mechanical threshing, and, to a lesser extent, irrigated land--specific incentives might offer the most efficient and most easily administered type of policy with fewer unintended transfers.[26]

Nevertheless, all government policies are likely to bring about at least some unintended transfers among various groups in the country. In general, rice producers stand to gain from policies aimed at increasing production. Since consumers are the only losers from import restrictions, a strong consumer bias in a country (creating, for example, pressure to hold down urban prices) would be required to dissuade governments from using this policy instrument to increase production. The government budget—as well as the taxpayers outside the rice sector—are likely to be the strongest forces in favor of trade policy and against output and input subsidies. Between these last two policies, producers can be expected to favor an output subsidy, because each producer will then be free to allocate inputs in production optimally.

The government treasury's position is, however, indeterminate. It depends on the relative costs of administering input and output subsidy programs and on the impact of the alternative policies on rice production. Input subsidies can be ineffective relative to output subsidies if the inputs (e.g., fertilizer) are used in the production of alternative crops. But if input subsidies can be tied solely to the marginal costs associated with additional production, such as through the development of irrigated perimeters, input subsidy programs are usually preferred to universal output subsidies.

The two countries with a comparative advantage in rice, Mali and Sierra Leone, are not required to subsidize inefficient local production. For Mali, security of food production appears to be the primary goal, and income generation and its regional distribution are of somewhat lesser importance.

The country has been able to expand socially profitable rice techniques that improve the security of rice production, notably in the Office du Niger and to a lesser degree in projects at Segou and Mopti. This expansion of competitive rice production to improve food security clearly generates additional national income. In addition, much of this extra income accrues to farmers and other rural residents, although urban consumers gain from Malian price policy.[27] In the future, Mali is likely to face a difficult decision in its rice investment policy between further intensification of existing projects with improved packages based mainly on fertilizer and better water control, which would raise recurrent costs, and extensification through the construction of additional polders in the Niger-Bani basin. Although the second approach involves a somewhat lower degree of security, it is likely to be the most profitable given the availability of concessional foreign aid for polder construction and the existence of additional land that could be developed.

The principal objective of rice policy in Sierra Leone, the other country in this group which has a comparative advantage in rice production, appears to be increasing incomes and staple food supplies in its rural areas. In order to achieve this objective, the country is investing--using capital supplied by foreign aid donors--in several rice projects to introduce and spread improved techniques of production in both upland and swamp regions. Land development is subsidized for improved swamps, and modern inputs, such as fertilizer, seeds, and mechanical services, are also subsidized. In addition, farmers receive significant protection from the world price of rice. If these improved techniques are socially profitable, as they appear to be, they can contribute to efficient income growth. This income growth could involve rice only indirectly if new technologies are substituted for their traditional counterparts, thus freeing domestic resources for other cash-crop opportunities.

If the new techniques increase production, rather than simply substituting for traditional cultivation, they contribute to self-sufficiency in rice without requiring a tradeoff with the growth and distribution objectives.

It is curious that Sierra Leone uses strong incentives to promote expansion of a commodity in which the country enjoys a comparative advantage. The issue becomes especially important because the government budget has been constrained historically and has been unable to provide all the subsidized inputs demanded. The explanation may be twofold. Since redistribution of income is also an objective that is strongly held, trade protection and subsidized production projects may serve as a means of transferring income to poorer regions. For example, in two of the poorer regions of the country, the North Plains and the Bolilands, improved rice production techniques have raised the net return per unit of labor input by three to five times that earned in traditional rice production.[28]

Second, rice in Sierra Leone may not be competitive with other crops that can be produced, even though it is competitive with imports of rice. In that event, the government would have to adopt policies that discriminate in favor of rice in order to expand domestic production. Only improved, highly subsidized rice is competitive in regions that produce three of the more important cash crops—oil palm, coffee, and cocoa.[29] Sierra Leone could therefore be undertaking rice projects and policies that, while competitive internationally with rice, are not the most efficient use of resources when compared to other domestic production opportunities. Because export taxes on oil palm, coffee, and cocoa generally depress domestic prices of these crops while import restrictions raise the domestic price of rice, the existing gap in private returns between traditional rice production and cultivation of export crops is smaller than would exist in the absence of these trade policies.

The choice of policy is much more difficult in the other three countries which do not have a comparative advantage in exporting rice or in competing with imports in the urban consumption centers. If they desire to promote local rice production to replace imports in the cities, governments in these countries must protect or subsidize producers, which entails losses in national income. Consequently, their freedom of policy choice is circumscribed because they face difficult tradeoffs.

The two objectives of rice policy in the Ivory Coast are to increase incomes generally and to ensure that the northern part of the country in particular benefits from this growth. Unfortunately, neither of these goals has been furthered by recent policy. In light of the unprofitability of rice production in Ivory Coast, any policy to expand output is bound to be costly. Recent Ivorian trade and price policy has resulted in welfare losses to consumers, government subsidies to producers, and a decrease in GNP that has been estimated at 2 billion francs CFA annually (8).

Moreover, distribution objectives have not been sufficiently well served by rice policies to offset these highly negative income effects. Rice investment policies have, by design, clearly favored the north, which is consistent with the objective of income redistribution. But the irrigated techniques in the north are less efficient than improved rainfed production in the forest zone, because of the greater cost of water control in more arid areas, and no improved technique is as efficient as traditional production in the northern savannah zone. Therefore, investment subsidies have primarily served to offset higher costs rather than to redistribute income toward northern farmers. Moreover, despite high investment subsidies, costly trade and output price policies have also been required to make improved,

irrigated rice production in the north privately profitable. The greatest proportion of transfers resulting from these policies, however, has gone to farmers in the forest zone where most rice is grown. Hence, Ivorian rice policy does not advance either the income generation or the regional redistribution objectives effectively.

Excellent opportunities to produce other crops efficiently exacerbate the problem of making rice policy effective. Greater social profitability of other crops, such as coffee, cocoa, cotton, copra, and palm products, results in high opportunity costs for national resources devoted to rice production. Moreover, strong incentives are necessary to bring forth increased rice production, and incentives of such size increase the magnitude of unintended transfers and the costs of administration. In the Ivory Coast, large budgetary deficits coupled with the unwillingness of consumers to pay high prices for rice have thwarted the implementation of government rice policies aimed at increasing the share of output from modern techniques and at transferring production resources and income to the north.

A more effective rice policy for the Ivory Coast would involve reduction of protection and elimination of the milling subsidy paid to government mills to support domestic producer prices. Beginning in 1977, the government has followed this strategy. Meanwhile, the government can continue the search for a new technology, probably based on divisible labor-saving techniques for rainfed rice production, that can relax the most immediate resource constraint of expensive labor. Both income growth and more equitable distribution of incomes, however, are better promoted by producing other crops that can be grown efficiently, especially in the poorer north. Because the security of food supplies has historically been a relatively unimportant issue in the Ivory Coast, there is little pressure to achieve self-sufficiency in rice production at high costs for this purpose.

Liberia has objectives for rice policy similar to those of the Ivory Coast--a primary emphasis on income generation, a secondary desire to have the increases in income occur in rural areas, and little concern with food security. Despite the place of rice as the principal staple food in Liberia, until very recently government intervention has been limited to trade policy. Investment policies in rice have only lately begun, no important subsidies on inputs exist, and government expenditures on rural infrastructure have not been large. Trade policy has consisted of taxing rice imports to collect government revenue and to protect local production. Because Liberian rice cannot be delivered efficiently to Monrovia, which is the main market for rice imports, government efforts to increase rice output run counter to the objective of generating income. Government policy does transfer resources from urban consumers to rural producers, but only at a significant loss in national income. Furthermore, the limited volume of marketings suggests that actual urban-rural income transfers are of a small magnitude. This situation will only be rectified by cost-reducing improvements in techniques of production and distribution. Such improvements might best be promoted by investment subsidies and research. As in the Ivory Coast, maximization of rural incomes requires attention to other crops such as coffee and cocoa, that utilize available resources more efficiently.

Evaluation of rice policy in Senegal is more complicated. This Sahelian country is mainly concerned with improving food security, although the government also wants to change the regional distribution of income and to increase national income. Senegal does not have a comparative advantage in rice generally, and the most secure techniques are often

the least efficient. The objective of increasing national income is thus contravened by policies that expand secure rice production. Moreover, the evidence is not convincing that increased production of irrigated rice will necessarily reduce the long-run instability of food supplies until numerous technical problems, such as management, maintenance, and salinity, are resolved.

Because areas where rice is produced coincide with those designated to benefit from improved income distribution, expansion of rice production by building irrigated polders can be an effective means of achieving this goal as well as of improving the security of local food supplies relative to traditional production. But as in Ivory Coast, Liberia, and Sierra Leone, rice production policies do not usually maximize the income growth potential of these areas.

A second aspect of the food security issue involves the willingness to rely on imports to offset shortfalls in domestic production (21). Food security must consider the reliability and costs of improved production relative not only to traditional production but also to the variability of prices and availabilities of rice on the world market. Food security is thus not fully realized until domestic production is increased to a level where imports are usually not necessary. This dynamic problem depends on the variability of domestic production, the variability of world prices, and the subsidies needed to sustain irrigated domestic production. Unfortunately, analytical techniques to relate these tradeoffs within a framework of maximum economic efficiency are not available. Some general remarks based on the results of this study are possible, however.

If variability in c.i.f. prices is the concern of policy, the government has three broad categories of policy response open to it. First, it can substitute other staples for rice during periods of high rice prices.

Second, the government can establish a financial buffer fund to cover the expected change in c.i.f. prices. Only the difference between the actual c.i.f. price and the expected long run average c.i.f. price needs to be covered by this fund. Third, the government can subsidize irrigated production. Subsidization is necessary because, on average, irrigated techniques are socially unprofitable in delivering rice to Dakar, the main center of import substitution.

The social profitability results for Senegal indicate subsidies of $70-265/mt are needed to support production given a long run c.i.f. Dakar price of $250/mt. This level of subsidy thus amounts to an average percentage subsidy of 28-106 percent of c.i.f. prices. If the government desires protection against fluctuations in c.i.f. prices equal to 100 percent of the average price (the maximum historical variation), a buffer fund is clearly more efficient than the subsidization of domestic production as a means of providing food security because real rates of interest on government loans to the Senegalese government are only 2.5 to 8 percent. Furthermore, these calculations assume that domestic production is 100 percent reliable and that no substitution in consumption occurs. Only if the government has strong inclinations that rice will be unavailable at any price on the world market does the alternative of domestic production appear economically rational. In summary, given the high cost of rice production imposed by severe resource constraints in Senegal, a trade-off arises between losses of income that must be incurred in order to obtain increases in food security relative to traditional production and positive regional distributional effects.

A number of general observations emerge from these evaluations of individual country policies. First, for countries with a comparative advantage in rice, Mali and Sierra Leone, rice policy can be used to further all of their objectives simultaneously. Second, countries such as the Ivory Coast and Liberia, that desire to redistribute income to certain rural areas but produce rice inefficiently if it is used to replace imports in urban consumption centers, are likely to reach their objectives more effectively by focusing on more profitable crops. Finally, in Senegal, where improved food security is the primary objective, the effectiveness of policy depends on the choice among alternative techniques and regions with different costs and degrees of security. Expansion of rice production under existing techniques can only increase food security at a high cost in terms of foregone national income and recurring subsidies and hence it is a less desirable policy than establishment of a buffer fund.

The role of foreign aid donors is very important in influencing the costs of rice development that are borne by West African governments. Sometimes donors provide concessional assistance to countries that can produce rice efficiently. Donors might also share a recipient country's goal of improving food security or aiding the rural poor and for this reason justify giving aid for a project that cannot compete without protection or subsidy. In the five countries discussed here, aid has been a predominant force behind rice investment. Given budgetary constraints, it appears unlikely that any of them would choose to make large investments in rice projects in the absence of foreign aid. If this observation holds true, donors will continue to help shape rice policy in West Africa through their roles as contributors to rice investment projects and as spokesmen for various trade, price, and subsidy policies.

The results of the social profitability analysis confirm that some kinds of production techniques can efficiently compete in all countries with imported rice for consumption on-farm or in markets in the producing area. Transportation costs of delivering rice imports to distant rural areas provide natural protection to much local production. Accordingly, a potentially fruitful approach for countries that are unable to substitute efficiently for imports in main urban consumption centers and that desire to increase food security or to improve income distribution is to concentrate on production which can be carried out efficiently for local and regional markets. Such projects would have to be carefully designed, probably combining features of better water security with relatively small scale and a modest degree of capital intensity. In the longer term, reductions in marketing costs through improvements in the transportation system would reduce both the natural protection of rice produced by these projects and the cost of delivering rice to main consumption centers.

WEST AFRICAN RICE IN AN INTERNATIONAL PERSPECTIVE

The Stanford project has focused primarily on the determinants of supply and demand within West Africa. But several countries outside the region have an important influence on the economics of rice policy in West Africa. Thailand, Burma, China, Pakistan, and the United States have been dominant suppliers to WARDA nations. In addition, the level and variability of international rice prices, crucial economic variables to all WARDA countries, are determined primarily by other countries (see Tables 14 and 15). Ten of the 12 largest importers are Asian countries as are 6 of the 10 largest exporters. On the other hand, the 12-country import concentration ratio declined

Table 14--Import Statistics for International Rice Trade*

	1961-77		1961		1966		1971		1976		1977	
	Quantity (million tons)	Share (percent)	Quantity (million tons)	Share (percent)	Quantity (million tons)	Share (percent)	Quantity (million tons)	Share (percent)	Quantity (million tons)	Share (percent)	Quantity (million tons)	Share (percent)
Trade, Imports	8.26	-	6.41	-	7.88	-	9.25	-	9.22	-	10.23	-
World trade as percent of world production[a]	-	4.5	-	4.4	-	5.0	-	4.9	-	4.2	-	4.5
Importers												
Bangladesh	.33	4.0	.49	7.7	.33	4.2	.35	3.8	.40	4.3	.20	1.9
Cuba	.22	2.7	.19	2.9	.15	1.8	.28	3.0	.18	1.9	.25	2.4
Hong Kong	.35	4.2	.34	6.1	.34	4.6	.35	4.0	.36	3.9	.34	3.3
India	.55	6.6	.61	9.5	.97	12.3	.52	5.8	.38	4.5	.09	1.1
Indonesia	.92	11.1	1.06	16.6	.31	3.9	.51	5.5	1.30	14.1	1.96	19.2
Japan	.44[b]	5.3[b]	.14	2.1	.81	10.3	-	-	-	-	-	-
Malaysia	.32	3.9	.40	6.6	.30	4.3	.25	2.7	.21	2.5	.29	2.9
Singapore	.20	2.4	.19	5.2	.16	3.3	.26	3.3	.22	2.4	.21	2.2
Sri Lanka	.44	5.3	.47	7.3	.69	8.8	.34	3.7	.38	4.1	.54	5.3
South Korea	.24	2.9	0	0	.01	1.5	.007	0	.16	1.9	.06	0.6
USSR	.26	3.1	.02	0.3	.27	3.5	.32	3.6	.31	3.5	.45	4.5
Vietnam	.76	9.1	-.17	-	.44	5.7	1.38	15.0	.64	7.0	.28	2.7
Total	5.03	61	3.74	58	4.78	61	4.56	49	4.56	49	4.67	46

*Source: Food and Agriculture Organization of the United Nations, Trade Yearbook, various years.

[a]World production statistics are converted from paddy to milled rice at an assumed milling ratio of 0.62

[b]1961-68 only.

Table 15--Export Statistics for International Rice Trade*

Exporters	1961-77		1961		1966		1971		1976		1977	
	Quantity (million tons)	Share[b] (percent)	Quantity (million tons)	Share (percent)	Quantity (million tons)	Share (percent)	Quantity (million tons)	Share (percent)	Quantity (million tons)	Share (percent)	Quantity (million tons)	Share (percent)
Australia	.12	1.4	.06	1.0	.06	1.0	.10	1.1	.22	2.4	.26	2.4
Burma	.84	10.1	1.59	24.0	1.13	14.4	.81	8.7	.63	7.0	.67	6.2
China	1.57	18.9	.39	7.7	1.34	17.8	2.15	23.2	1.36	16.0	1.12	10.4
Egypt	.37	4.5	.25	3.8	.35	4.4	.51	5.5	.21	2.3	.22	2.1
Italy	.23	2.8	.22	3.3	.08	1.0	.44	4.7	.39	4.3	.30	2.8
Japan	.32[a]	3.8	-	-	-	-	.91	9.8	-	-	-	-
Nepal	.20	2.4	.16	2.4	.27	3.4	.23	2.5	.18	2.0	.11	1.0
Pakistan	.41	4.9	.17	2.6	.43	5.5	.18	2.0	.78	8.7	.94	8.7
Thailand	1.51	18.2	1.57	23.8	1.51	10.2	1.59	17.1	1.92	21.4	2.94	27.2
United States	1.64	20.0	.83	12.6	1.34	17.2	1.41	15.9	2.10	23.4	2.29	21.1
Total	7.21	87	5.25	81	6.53	84	8.33	90	7.79	88	8.85	82

*Food and Agriculture Organization of the United Nations, Trade Yearbook, various years.

[a]1969-77 only.

[b]Share measured as percent of world exports. Export statistics differ slightly from import data because of stock changes and transshipments.

from 61 percent in 1961 to 46 percent in 1977. Part of this decline was due to increased African participation, and in 1977 WARDA nations collectively accounted for about 10 percent of total imports.

The essay by Walter P. Falcon and Eric A. Monke, "The Political Economy of International Trade in Rice," brings together quantitative and qualitative information about the world rice market. The paper outlines the structure and operation of the world rice market and examines the effectiveness of the price mechanism for rice. In the international market the main actors are governments of the principal rice exporting and importing countries. The international market is a residual market onto which failures in, or conflicts among, domestic rice policies are shifted. The price of rice continues to play a key role as an equilibrating mechanism, but price movements relate only to changes in demand and supply on the international market. Because of the prominence of quantitative controls on imports and exports in most countries, movements in world prices do not result in corresponding movements in domestic prices.

A major portion of the paper is devoted to an historical analysis of world rice prices, which are shown in Figure 1. In spite of the small size of this market--only about 9 million tons annually for rice compared with about 70 million tons for wheat--international rice prices are well integrated across time, space, and qualities. Given this synchronization, any extensively traded form of rice, such as Thai 5 percent brokens, is an appropriate quality on which to base future price projections.

Two dominant conclusions emerge from the analysis. First, there is little prospect ahead for eliminating variability in rice prices on the international market. Ten Asian countries plus the United States are likely to continue to be the high-variance participants in rice trade. However, only two

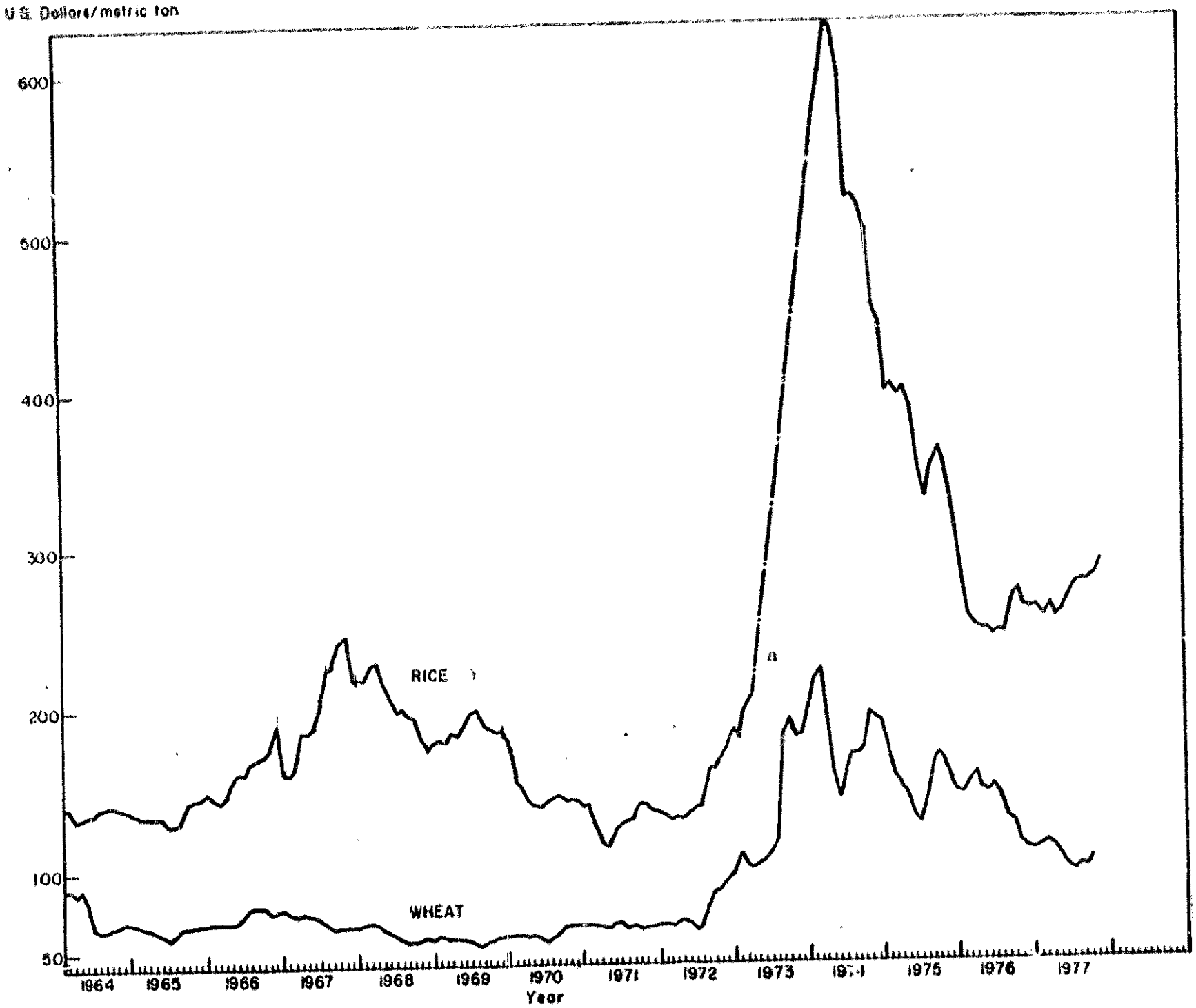

Figure 1.—The export price of rice (Thai, 5% broken, FOB Bangkok) and the export price of wheat (American hard winter)
[a] No price quotations for rice from April — December 1973.

countries, China and the United States, generally increase export supplies as world prices rise (or decrease them as prices fall). These countries thus act to stabilize world prices. In the other nine countries, the variation of trade participation is due primarily to the vagaries of weather or of government policy. These changes tend to cause, rather than result from, movements in world prices.

Given the importance of rice in their economies, most Asian countries stabilize internal availability of rice within a narrow price band. Since weather affects many of these countries simultaneously, Asian importers typically demand more rice in the same years that exporters have less to sell. Changes in policies, due to political disruptions and the appearance of short-run budgetary or foreign exchange constraints, have also had some impact on international market availabilities and demands.

WARDA nations should thus plan on some year-to-year price variability in the foreseeable future. On the other hand, there is only a very small probability that the events of 1973-74 will reoccur in the 1980s. In particular, the linkage between the rice and wheat markets now seems much more secure, and new institutional arrangements for wheat are likely to prevent extreme price gyrations for either commodity.

With respect to price levels, Falcon and Monke provide a 1990 price forecast of $350 per metric ton for Thai 5 percent brokens (f.o.b. Bangkok in 1975 prices). This level is nearly 20 percent higher than the real price of $300 per ton that has prevailed (on average) over the past 20 years, but is similar to that projected by the World Bank. This modest rise is

rice prices is expected to be linked closely to higher prices for all grains and caused by growing populations, increasing incomes, rising costs of energy and irrigation inputs, and declining excess agricultural capacity, particularly in North America. While increases in demand and marginal production costs will create upward pressure on world prices, there are also factors that will tend to mitigate this increase. Much depends on the resolution of political difficulties in a number of potential exporters in Southeast Asia. The conduct of producer price policy will also be critical in a number of major exporting and importing countries who currently tax producers relative to world price levels. Burma, Indonesia, Pakistan, and Thailand are perhaps the most prominent countries in this category. Finally, technological change presents some major uncertainties. While much of the Green Revolution potential has been realized in irrigated areas, the development of new technologies, particularly for rainfed cultivation, could have an important impact on levels of output and the associated costs of expanded rice production.

SUMMARY AND CONCLUSION

All WARDA member countries desire to achieve self-sufficiency in rice production. The economic significance of increasing local production of rice to substitute for rice imports can be examined with reference to the national objectives of income generation, redistribution of income, and food security.

Detailed economic analysis has been undertaken in five countries. Two, Mali and Sierra Leone, have a comparative advantage in producing rice to substitute for imports and, with some techniques, for export to neighboring countries. Central issues for these two countries involve the choice of

technique for continued expansion of production and the selection of policies that will provide necessary incentives to farmers as well as maximize the contribution to other objectives.

In Mali, policy makers face a choice between intensification of production, based on the use of fertilizer, improved water control, and mechanical weeding practices in existing projects, and extensification, principally by creating more polders with controlled flooding in the Niger-Bani basin. A main feature of this choice is weighing the enhanced security of production, rising costs, and high recurrent public expenditure requirements, associated with intensification, against less secure, more socially profitable production in new polder schemes.

The decision in Sierra Leone is between promoting rice or encouraging other crops in which it enjoys an even stronger comparative advantage. If it chooses to continue its efforts to accelerate rice production, the government needs to select policies that encourage farmers to undertake more rice cultivation. In the face of more lucrative alternatives elsewhere in the economy, such policies require large transfers to producers. Fortunately for Sierra Leone, this result is consistent with its objective of improved income distribution, although rice subsidies have a severe impact on a budget that is already tightly constrained. Since food security is not a strongly held objective, the choice between full and less complete water control is wholly an efficiency issue.

Ivory Coast, Liberia, and Senegal are unable to produce rice efficiently with existing techniques for delivery to either export markets or main domestic consumption centers. Some techniques of production in these countries can compete with imports of rice in rural areas of production

and thus do not require protection from import competition. But substantial portions of local rice production cannot survive in the absence of restrictive trade policy, which results in income losses from the inefficient use of resources and in welfare losses from the higher price of rice.

Several factors might help to explain why the Ivorian, Liberian, and Senegalese governments desire to promote unprofitable rice production. The first is an information gap, a lack of understanding that rice does not have a comparative advantage. This explanation is not particularly convincing, given the existence of rice imports and the observable high costs of much rice production. It is true, however, that policy makers often base decisions on distorted private, rather than social, prices.

An additional explanation is based on governmental expectations that rice will become competitive in the future because of dynamic learning effects that accompany intensification, rising world prices for rice, or worsening prospects for other domestic activities, usually exports, that would cause the costs of local land, labor, or capital to decrease. Sensitivity analysis based on reasonable changes in these parameters does not indicate that future competitiveness is in sight for these countries.

One central issue for this group of governments, therefore, is to examine the sources of their inefficiency in rice production and the likelihood that greater efficiency might be achieved in the foreseeable future. Generally, advanced techniques have not improved productive efficiency in these countries because they simply substitute more expensive intermediate inputs for small reductions in relatively expensive domestic resources. Either the technology does not exist that can overcome existing constraints competitively or the choice of technique in the past has been inconsistent with prevailing and expected factor prices.

A third possible reason why these countries are devoting scarce resources to rice when they could generate more income in alternative uses is that they believe expanded rice production contributes to other objectives. Governments may not be fully aware of the tradeoffs inherent in making choices among policies to advance conflicting objectives.

The government of Senegal, for example, can be viewed as holding food security as a primary objective. If greater security of food supplies can be obtained by increasing rice production, despite Senegal's comparative disadvantage in rice, the government should weigh its security and income objectives and decide how much to forego of one in order to enhance the other. But it is quite possible that self-sufficiency in rice or food may not be the most effective way to secure food supplies, which would mean that Senegal's rice policies have caused a loss in income with little or no offsetting gain in security.

The Ivorian government has attempted to transfer income to the northern savannah area by promoting rice production in that region. Even though the northern zone has benefited from a larger share of heavily-subsidized investments than the richer south, these investments must still be coupled with trade protection and price subsidies to make the improved rice techniques attractive to farmers. Because trade control and price subsidies apply to all domestic rice production, the south has, on balance, benefited more than the north from rice policy simply because most Ivorian rice is produced in the southern forest zone. The key issue for the Ivory Coast is to review whether emphasis on rice is desirable in view of more profitable alternatives available in Ivorian agriculture to achieve the same objectives.

The government of Liberia has tried to increase incomes in rural areas by encouraging rice development. This goal, which does not have a particular regional focus, might be met better, with a gain instead of a reduction in potential national income, if the government promoted expansion of agricultural commodities, such as coffee and cocoa, which can be grown efficiently.

The study has several implications for WARDA's goal of reaching regional self-sufficiency of rice in West Africa. First, most rice produced with existing techniques is socially profitable if the output substitutes for imports on-farm or in markets near the site of production. It is thus desirable to expand production for many regional markets with current and improved techniques. The replacement of traditional methods with more efficient improved techniques can also release domestic resources for use in other productive activities, including cash cropping in many areas.

Second, outside of Mali and Sierra Leone, rice production to replace imports in urban consumption centers is socially unprofitable with existing techniques. Furthermore, the advanced techniques, especially those using full water control, are usually less efficient than traditional rainfed production. Hence, research into and development of more appropriate technologies is required before future rice production will become socially profitable. Critical areas for research include development of chemical and mechanical techniques to substitute for labor, more efficient use of irrigation water, additional investment in infrastructure, and cost-reducing changes in processing and distribution. This technical research should be complemented by continuously updated analysis of policy changes needed to accompany the introduction of new techniques and of the effectiveness of policies in furthering objectives as constraints gradually change.

The development and dissemination of new technologies is no small order. But if the historical experience of Asian rice policy is any guide, the agenda outlined above is of critical importance. In most Asian countries, both price policy and research were critical preconditions for the success of production programs. Malaysia, the Philippines, Taiwan, and Indonesia, for example, achieved rapid production gains as a result of the dissemination of seed-fertilizer packages, once appropriate price incentives were established (4, 5).

Yet to note that prices matter overlooks some fundamental differences between the economic environments of West Africa and Asia. The Green Revolution that took place in Asia during the 1960s represented a technological package very well suited to Asian factor endowments and institutional settings. Labor was relatively low cost or seasonally unemployed, thus allowing profitable increases in double cropping and land-use intensity. Irrigation infrastructure had been in place for decades, if not centuries, reflecting substantial farmer experience with water control. As this study has shown, these conditions differ greatly from those in contemporary West Africa.

Nor do such revolutions occur overnight. The experiences of Taiwan and Malaysia, where 20 to 30 years were required for the development of effective varieties and irrigation facilities, are relevant to the current West African situation (2). Creation of the International Rice Research Institute and other research institutions has reduced but not eliminated this time lag. Finally, the results of this study indicate that most Asian technologies are not transferable without substantial sacrifices in economic efficiency, and hence the successful development of rice production in West Africa will likely prove to be a highly indigenous process.

FOOTNOTES

[1]WARDA is an intergovernmental organization of which all 15 countries in the West African region are members. When WARDA was established in 1971, a primary goal of the new organization was to provide rice research and development services to member countries and thereby to assist the region in achieving self-sufficiency in rice.

[2]WARDA is carrying out similar studies for Benin, Ghana, Guinea, Guinea-Bissau, Nigeria, and Togo. Results of these studies were not available for inclusion in this paper.

[3]In the absence of detailed information on which to make supply projections for Ghana and Nigeria, it was assumed that supplies of rice in these two countries would match domestic consumption and that imports would therefore be zero. These assumptions were subsequently invalidated in 1977 by the return of Ghana to a substantial deficit condition and the emergence of Nigeria as a major importer in the region (Table 1).

[4]See Stryker, Page, and Humphreys (23) for a discussion of the West African labor market.

[5]The problems associated with making comparisons of this type at official exchange rates have been discussed elsewhere (6).

[6]It also appears that different methods used for estimating labor times have produced results which are not entirely comparable. Labor inputs in the Ivory Coast, Mali, and Senegal, for example, have been calculated from a

number of sources, including information provided by farmers and extension workers, which suggest how much time should be required for each agricultural task. Estimates for Liberia and Sierra Leone, on the other hand, are based primarily on multiple-interview surveys of farmers, which indicate the number of days actually devoted to each task but have relatively little to say about the amount of effort expended in performing that task on a given day. It is likely that the former approach tends to underestimate and the latter to overestimate actual labor inputs.

[7]Another source of variation in labor times is the treatment of family labor used for land development. If land which is cleared is cultivated for several consecutive years, for example, the time involved in clearing the land is treated as a capital cost. In several instances, however, time spent developing the land is included with other labor inputs as a current operating cost either because the land is only farmed for one year or because, as for Sierra Leone, the data do not allow a distinction to be made between these two types of labor input. Whether land development costs are treated as a capital or current input probably does not affect very much the overall calculation of private and social profitability, though it does influence the estimates given in Table 4.

[8]The simple correlation coefficient between nitrogen fertilizer and land development cost is .32; that between fertilizer and yields is .78. One instance in which land development has not led to relatively high rates of fertilizer use is the Office du Niger ("Animal traction irrigated single crop" in Table 4), which, with its capital costs already sunk, is able to operate using a very land-extensive technique resulting in yields of only 2250 kg of paddy per hectare.

[9]Hand pounding in the Ivory Coast is also relatively expensive because of the high wage rates prevailing in that country.

[10]The sole exception is the Ivory Coast, for which PP and NSP also differ because of relatively small differences between private and social prices of primary factor inputs. Other possible reasons for private profitability varying from social profitability, such as the existence of externalities or monopoly power, could not be measured for any of the countries.

[11]Wages of unskilled labor in Sierra Leone in 1975-76 were estimated to be the equivalent of about 130-200 CFA francs per day, compared with a range of 200-450 CFA francs in the other countries.

[12]This may be because wages are low, inducing the use of labor relative to that of other inputs. It may also be due, as Spencer (18) observes, 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."

[13]Wages of unskilled labor in Mali varied from 200 to 350 CFA francs in 1975-76.

[14]In Sierra Leone, the profitability of improved cultivation in the north is also decreased because of relatively high wages in the vicinity of Makeni, where this technique is being introduced.

[15]Although intensification of cultivation increases profitability in the controlled flooding perimeters of Mali, it does not do so in the fully controlled irrigation system of the Office du Niger. This is primarily because all investment costs are considered to be sunk for the current

Office technique, but if further intensification is to raise yields from 2.25 to 3.5 t/ha, greater investment to improve water control is required. In the controlled flooding perimeters, on the other hand, no increase in water control is necessary to raise yields from their current level of about 1.4 t/ha to close to 2.5 t/ha.

[16]Local production for on-farm consumption might be socially profitable, but calculations employing this alternative assumption have not been made.

[17]A detailed discussion of the RCR methodology is contained in (14).

[18]The EPC methodology is summarized in (14).

[19]This framework was introduced in (24) and is summarized in (16).

[20]Progress toward self-sufficiency is readily measured by observing increases or decreases in import shares of total rice consumption.

[21]Substitution in consumption between rice and various other foodstuffs can be an important issue of food policy. However, the focus of this study is on expanding production of rice because West African governments (with the possible exception of Senegal) desire to substitute for rice imports by increasing output, not by reducing consumption.

[22]The relaxation of expected future constraints usually requires long leadtimes, often as much as 20 to 30 years. Irrigation investment is an inherently long-term process, in terms both of constructing the infrastructure and of farmers' learning to manage water resources. These long-term effects could make rice production that is uncompetitive today much more efficient in the future. Corden (1), among others, has argued, however, that future gains from learning seldom repay current losses from the inefficiencies caused by protection and subsidy policies. Whether future gains from improving management in irrigation projects will be sufficient to offset short-term costs is an important empirical question.

[23] These figures are based on the following assumptions:

	Partial water control	Full water control
Annual capital and maintenance costs (US$/ha)	125	350
Yield (mt paddy/ha)	3.0	3.5
Milling outturn (percent)	65	65
Cost per mt milled rice	65	150

There is no clear trend in the future direction of irrigation costs. Upward cost pressure will result from using up the best locations for irrigation projects. But cost reductions can be expected as construction activit, expands. In addition, increased regulation of water flow in the major rivers will likely lower costs, e.g., due to the reduced size of perimeter dikes required following better flood control.

[24] In the Ivory Coast, a package of inputs is provided through a fixed contract, the total value of which is subsidized. Hence, allocation of subsidies to specific inputs is arbitrary. The method used in this study is to prorate the total subsidy to the different inputs which make up the package according to their respective shares in the total value of the contract.

[25] Imperfections in factor or product markets, caused by segmentation of markets, externalities, and natural monopolies, among others, create divergences between private and social evaluations of resources and products (1). Government intervention can generate additional income efficiently by offsetting these

divergences, wholly or in part. In the absence of such imperfections, however, policies affecting production will result in reductions of income through an inefficient use of resources and those affecting consumption will involve losses in consumer welfare. For example, a government might choose to promote an inefficient method of producing or milling rice in order to advance distributive or security objectives or for non-economic reasons. But unless significant market imperfections are simultaneously offset, the policy will engender costs because of productive inefficiency or consumer losses. This is the nature of the trade-offs among multiple objectives, discussed earlier.

[26] Specific incentives thus require that segmented factor markets exist, which government policies can exploit to achieve objectives effectively. In less developed countries, such segmentation is common and arises from diverse causes. These causes include the immobility of assets and productive resources, the time required to learn about new techniques, and the large scale of many investments in land development. Segmentation permits the government to ration its incentives among selected groups, with minimal leakage to other groups.

[27] Malian price policy, which keeps retail prices below c.i.f. import prices, has the effect of transfering income from producers to consumers, thereby redistributing income largely from rural to urban residents. This policy option is made possible by the absence (in normal production years) of the need to protect local production with higher consumer prices or to provide government subsidies.

[28] A study of Sierra Leone farm systems reports the following private returns per unit of labor input for 1974-75, in Le per manhour, net of capital charges and operating expenses (19, p. 60):

Region	Traditional rice	Improved rice
Northern Plains	0.085	0.25
Bolilands	0.053	0.28
Riverain Grasslands	0.105	0.17

In the Riverain grasslands, which is a relatively rich area, the increase in income resulting from improved rice production is less than in the two other, poorer areas.

[29] Private returns (in Le per hour for 1974-75) net of capital charges and operating expenses were (19, p. 60):

Region	Traditional rice	Improved rice	Oil Palm	Coffee and cocoa
Northern Plains	0.08	0.25	0.17	--
Riverain Grasslands	0.10	0.17	0.36	--
Moa Basin	0.10[a]	--	--	0.14

[a] This figure includes returns on minor other crops.

CITATIONS

1 W.M. Corden, Trade Policy and Economic Welfare, Clarendon Press-Oxford University Press, London, 1974.

2 Kathryn Craven and A. Hasan Tuluy, "Rice Policy in Senegal," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

3 Walter P. Falcon and Eric A. Monke, "The Political Economy of International Trade in Rice," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

4 Food Research Institute Studies, Vol. XIV, No. 3, 1975.

5 Food Research Institute Studies, Vol. XIV, No. 4, 1975.

6 M. Gilbert and I. Kravis, An International Comparison of National Products and the Purchasing Power of Currencies, OEEC, Paris, 1954.

7 Charles P. Humphreys, "Analysis of Rice Production in the Ivory Coast," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

8 Charles P. Humphreys and Patricia L. Rader, "Rice Policy in the Ivory Coast," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute Studies, Stanford University, Stanford, July 1979.

9 John McIntire, "Resource Costs and Economic Incentives in Malian Rice Production," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

10 _____, "Rice Policy in Mali," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

11 Eric A. Monke, "Rice Policy in Liberia," Stanford/WARDA Study of the Political Economy of Rice in West Africa," Food Research Institute, Stanford University, Stanford, July 1979.

12 _____, "The Economics of Rice in Liberia," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

13 Eric A. Monke, Scott R. Pearson, and Narongchai Akrasanee, "Comparative Advantage, Government Policies, and International Trade in Rice." Food Research Institute Studies, Vol. XV, No. 2, 1976.

14 John M. Page, Jr., and J. Dirck Stryker, "Methodology for Estimating Comparative Costs and Incentives," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

15 Scott R. Pearson, Charles P. Humphreys, and Eric A. Monke, "Comparative Analysis of Rice Policies in Five West African Countries," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

16 Scott R. Pearson, J. Dirck Stryker, and Charles P. Humphreys, "An Approach for Analyzing Rice Policy in West Africa," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

17 Dunstan S.C. Spencer, "Rice Policy in Sierra Leone," Stanford/WARDA Study of the Political Economy of Rice in West Africa, West Africa Rice Development Association, Monrovia, July 1979.

18 _____, "Private and Social Profitability in Rice Production and Marketing in Sierra Leone," Stanford/WARDA Study of the Political Economy of Rice in West Africa, West Africa Development Association, Monrovia, July 1979.

19 Dunstan S.C. Spencer and Derek Byerlee, "Small Farms in West Africa: A Descriptive Analysis of Employment, Incomes, and Productivity in Sierra Leone," Working Paper No. 19, African Rural Economy Program, Department of Agricultural Economics, Michigan State University, East Lansing, and Department of Agricultural

Economics, Njala University College, Njala, Sierra Leone, February 1977.

20 J. Dirck Stryker, "Western Africa Regional Project: Ivory Coast, Chapter II, Economic Incentives and Costs in Agriculture," Fletcher School of Law and Diplomacy, Tufts University, Medford, April 1977.

21 _____, "Food Security, Self-Sufficiency, and Economic Growth in the Sahelian Countries of West Africa," U.S. Agency for International Development, Washington, D.C., February 1978.

22 _____, "Comparative Advantage and Public Policy in West African Rice," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

23 J. Dirck Stryker, John M. Page, Jr., and Charles P. Humphreys, "Shadow Price Estimation," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

24 C. Peter Timmer, "The Political Economy of Rice in Asia: A Methodological Introduction," Food Research Institute Studies, Vol. XIV, No. 3, 1975.

25 C. Peter Timmer and Walter P. Falcon, "The Impact of Price on Rice Trade in Asia," in G.S. Tolley, ed., Trade, Agriculture and Development, Ballinger Press, Cambridge, 1975.

26 A Hasan Tuluy, "Comparative Resource Costs and Incentives in Senegalese Rice Production," Stanford/WARDA Study of the Political Economy of Rice in West Africa, Food Research Institute, Stanford University, Stanford, July 1979.

27 West Africa Rice Development Association and Food Research Institute, "Prospect of Intraregional Trade of Rice in West Africa," WARDA/77/STC7/9, Monrovia, September 1977.

Property of
R. D. Library
USAID / Mauritania