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A Comparative Analysis of Rice Policies  
in Five West African Countries

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A framework for policy analysis has been presented in the introductory paper and applied in the country studies. The intent of this comparative essay is to use the objectives, constraints, and policies approach to push the analysis further than can be done within the context of a single country. 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.

Background information on comparative levels of per capita income, population density, road networks, advanced schooling, and per capita rice consumption is presented in Table 1. The Ivory Coast has the highest income and best developed infrastructure in the group, and Mali lags behind in all indicators of development. Reflecting its heavy reliance on mineral and plantation exports, Liberia shows a high level of income compared to its relatively poorly developed infrastructure. The reverse holds for Sierra Leone, with its relatively low income but better network of roads and level of education. Senegal has a more balanced state of development and more consistent levels of income and infrastructure. None of the countries is densely populated, although Senegal and Sierra Leone appear to have the least room for agricultural expansion, while Mali has the greatest. Rice is the

Table 1.--Background Information\*

Indicator	Country				
	Ivory Coast	Liberia	Mali	Senegal	Sierra Leone
GNP per capita (US\$, 1975)	540	410	90	360	200
Population density <sup>a</sup> (persons per km <sup>2</sup> of agricultural land, 1976)	42	34	19	62	54
Density of all weather roads (km per thousand km <sup>2</sup> of land area)	44	23	13 <sup>c</sup>	24	39
Advanced students per 1000 persons <sup>b</sup>	19	6	9	14	17
Average rice consumption (kg per capita, 1965-76)	41	117	18	51	125

\*Sources include: Africa North and West, map No. 153 published by Pneu Michelin, Paris, 1975; Kathryn Craven and Hasan A. Tuluy, "Rice Policy in Senegal," Stanford FRI/WARDA West Africa Rice Project, 1978, preliminary; Food and Agriculture Organization, Production Yearbook 1977, 31 (Statistical series No. 15), Rome, 1978; Rolf Gusten, "Chapter on Transport in Senegal, Mali, Ivory Coast, Ghana," Letter No. 511, Regional Mission in Western Africa, International Bank for Reconstruction and Development, Abidjan, 18 November 1974; Charles P. Humphreys and Patricia L. Rader, "Background Data on the Ivorian Rice Economy," 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; Dunstan S. C. Spencer, "Government Policy and Food Production in West Africa: Rice Development Policy in Sierra Leone," WARDA, Monrovia, 1978, preliminary; United Nations, Statistical Office, 1977 Statistical Yearbook, New York, 1978; World Bank, West Africa Regional Office, Agricultural Projects Department, "Appraisal of the Mopti II Rice Project - Mali," Report N° 1561c-MLI, Washington, November 1977; The World Bank, ATLAS, Washington, 1977; and World Bank, World Tables 1976, The Johns Hopkins University Press, Baltimore, 1976.

<sup>a</sup>The following percentages of arable to total land areas are used: Ivory Coast - 50; Liberia - 47; Mali - 25; Senegal - 42; and Sierra Leone - 77. Values for Senegal and Sierra Leone are the midpoints of extreme low and high estimates.

<sup>b</sup>Dates vary but cover the period 1973-75.

<sup>c</sup>This value is calculated using one-third of the total area of Mali.

principal staple food in Liberia and Sierra Leone, a main supplementary staple in the Ivory Coast and Senegal, and a fairly minor foodstuff in Mali.

#### ISSUES.

A useful insight that emerged from the Food Research Institute's earlier study of rice policy in Asia was an understanding of the complex relationships among a country's comparative advantage in producing rice, pressures on its government in allocating scarce budgetary revenues, and the government's scope for implementing policies, especially trade policy (6, p. 282). If a country has a comparative advantage in rice production, its limited supplies of foreign exchange and scarce domestic resources (labor, land, capital, and water), when priced at their opportunity costs, can be used to produce rice profitably.<sup>1</sup> In this event, the government has a great deal of flexibility in its choice of policies affecting rice. The government can choose to do nothing, permitting its rice producers to compete efficiently with potential imports, or it can decide to tax rice producers to obtain government revenue (and to lower rice prices to consumers if it taxes exports of rice). In the first instance, the budget is unaffected, and in the second, rice contributes positively to revenues.

The ability of government to tax staple food production effectively has received substantial emphasis in development theory and in the historical experience of a number of Asian countries, of which Japan is the most successful example. Tax revenues provide potential investment capital for industrialization, but perhaps more important in the growth and industrialization process is the impact of food production taxes on wage rates. When a staple food is an effective wage good, comparative advantage in food production allows a country to maintain lower food prices and, ceteris paribus, lower wage

rates than countries that find the cost of calories higher. Such an advantage is most pronounced at the initial stages of industrialization, when unskilled labor is the dominant resource used in manufacturing. Comparative advantage in food production thus presents governments with a policy choice-- to exploit the existing advantage to a maximum and export food, or to maintain relatively low prices to consumers through taxation of food exports, thus influencing the growth and industrialization process and satisfying consumer distributional objectives.

In the opposite situation, the country does not have a comparative advantage in rice production because its costs of production exceed the costs of comparable imports. If the government wants to promote local production, it has little choice but to subsidize it. There is still a range of options available to transfer resources to producers. But all of them involve either higher prices, forcing consumers of rice to pay the costs of inefficient local production, or direct subsidies from the government treasury. Subsidies can be paid on inputs (e.g., fertilizer), on investment in production projects (e.g., land clearing and water control systems), or on output (with payments made to farmers, millers, or merchants).

Herein lies the bind for policy. Unless consumers can be forced to carry the entire burden, subsidization of local rice production means continued calls on the budget. To an important extent, foreign aid donors might be willing to provide assistance for investment in rice, but the government is then left with the possibility of drains on its recurrent budget. Such drains will be continuing if the government subsidizes intermediate inputs or renewal of capital equipment. Hence, even though the government might desire to expand production, use of trade policy is often constrained by consumer pressures and

the use of subsidies is limited by budgetary shortages. Such shortages, in turn, can be caused by pressures from other taxpayers or by strongly competing demands on government resources from outside the rice sector. The country might then opt to continue to import rice.

As discussed in detail in Stryker's companion paper (9), the costs, profitability, and comparative advantage of the various techniques of producing rice in the five countries considered in this volume vary widely. In general, rice production is most profitable for home consumption in remote regions, because costs of transportation make delivery of imported rice relatively expensive. But in three of the five countries studied—Mali and Sierra Leone are the two exceptions—imports of rice at normal levels of world prices are cheaper than most locally produced rice delivered to the main consumption center (9).<sup>2</sup> Since these countries cannot efficiently substitute for most imports, they would be able to generate greater national income by using their resources in other, more productive activities and continuing to purchase rice from abroad. Yet their governments desire to reduce imports and become more self-sufficient in rice by increasing production.

Explaining this drive for self-sufficiency is crucial for understanding rice policy in West Africa. Four possible reasons are relevant. First, the governments might lack adequate information and not appreciate that import substitution for rice has been and is likely to continue to be costly. This information gap might be a reflection of an historical inertia through which attitudes, policies, and perceived circumstances have not changed much. Conversely, governments might have overreacted to transitory phenomena that briefly increased the comparative advantage of rice production, such as the surge in world rice prices in 1973-75. Information is costly, but empirical results of this study point to a high return to expenditures on rice analysis.

Second, policy makers might understand the current situation fully but hold different expectations about the future levels of key parameters--especially the world price of rice, the yields of improved techniques, and the relative costs of domestic resources. The expansion of local production to substitute for imports could be profitable--and the analysis of this study proved incorrect--if the world price of rice were to be considerably higher than that projected, if yields were much larger than anticipated, or if the alternative opportunities for domestic resources were not so lucrative as expected, causing factor prices to be lower than those used in the analysis. Sensitivity analysis has been carried out using more optimistic assumptions, however, and for the most part the level of optimism must be very high before any techniques in the Ivory Coast, Liberia, and Senegal become socially profitable ways of substituting for rice imports in the main cities (9).

The third and fourth explanations are related and thus can be conveniently discussed together. It is possible that governments understand that import substitution for rice is inefficient and believe it will continue to be so, but have other objectives which might be furthered by increased production and self-sufficiency. As argued in the introductory essay, the economic aspects of the goal of self-sufficiency in rice can be analyzed in terms of three fundamental objectives--increased generation of income, changes in the distribution of income, and enhanced food security. There is certainly no reason why improved efficiency should receive total or even primary weight in a government's decision process. In the discussion below, an attempt is made to evaluate the extent to which alternative objectives are furthered by use of policies that enhance self-sufficiency.

Finally, government objectives in rice development are often complemented by those of foreign aid donors. Donors might provide concessional assistance to rice projects, including land development, provision of infrastructure, and investment in water control facilities. If this aid is in the form of grants or concessional loans, the costs in efficiency terms to the recipient country of expanding rice production could be very low unless other efficient projects are foregone when rice activities are aided. Usually, however, rice production projects impose costs on the local economy, including recurrent subsidies on inputs, misallocation of domestic resources, and welfare losses of consumers. These costs might be viewed as bearable, however, if distribution and security objectives--of both recipient and donor--are furthered.

The issues to be discussed in this essay are now clear. First, which countries, if any, have a comparative advantage in rice production? Second, given that West African governments cannot influence the world price of rice, what techniques of production, if any, should governments promote?<sup>3</sup> Third, in view of the fact that governments have multiple objectives, how have various kinds of rice policies advanced each objective? Finally, in what ways has the availability of foreign aid for rice projects complemented government objectives and influenced the direction of rice policy? Comparative answers to these questions await summaries of the evolution of policy.

#### 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.<sup>4</sup> This framework is summarized in the introduction to this book

(7, pp. 4-5):

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.<sup>5</sup> 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.<sup>6</sup> 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 2. Security of rice production is a tertiary goal in the three forest-zone countries--Ivory Coast, Liberia, and Sierra Leone-- because climatic variation

Table 2.--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 <sup>a</sup>	0.19 <sup>b</sup>	n.a.	0.13 <sup>c</sup>	0.41 <sup>d</sup>
Food security:					
Variation in per capita food production <sup>e</sup>	5	3	19	21	6
Export instability (1968-74) <sup>f</sup>	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 <sup>g</sup>	5.4 <sup>h</sup>	29.6 <sup>i</sup>	17.9 <sup>j</sup>	7.7 <sup>k</sup>
Rice self-sufficiency 1965-76) <sup>l</sup>	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, Consumption 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, 1978.

<sup>a</sup>This figure is the ratio of rural incomes in the savannah and forest zones, respectively, in 1974.

<sup>b</sup>This figure is the ratio of rural and urban incomes in 1976.

<sup>c</sup>This figure is the ratio of rural and urban incomes in 1975.

<sup>d</sup>This figure is the ratio of rural and urban incomes in 1974-75.

Table 2 footnotes (continue).

<sup>e</sup> 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.

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

<sup>g</sup> Data cover the years 1960-77.

<sup>h</sup> Data cover the years 1960-75, excluding 1964.

<sup>i</sup> Data cover the years 1961-76, excluding 1973.

<sup>j</sup> Data cover the years 1960-75.

<sup>k</sup> Data cover the years 1960-74.

<sup>l</sup> 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.<sup>7</sup> As Table 2 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 2, 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:

	<u>Ivory Coast</u>	<u>Liberia</u>	<u>Mali</u>	<u>Senegal</u>	<u>Sierra Leone</u>
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.<sup>8</sup> 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 3 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 3.--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 <sup>a</sup>	750-1,800 <sup>b</sup>	2,500-3,000
Daily agricultural wages (US\$/manday, 1975-76)	1.40-1.80 <sup>c</sup>	1.25	1.00	1.00-1.20	0.60-0.80
Direct farm labor cost per kg paddy (US\$, 1975-76) <sup>d</sup>	0.118	0.247	0.065	0.147	0.118
Investment costs of water control <sup>e</sup>					
Complete (US\$/ha, 1975)	3,983-5,978 <sup>f</sup>	--	444 <sup>g</sup>	400-4,311 <sup>h</sup>	--
Partial (US\$/ha, 1975)	1,390 <sup>i</sup>	750 <sup>i</sup>	600-900 <sup>j</sup>	712 <sup>i</sup>	249 <sup>i</sup>
Annual costs of water control <sup>e,k</sup>					
Complete (US\$/ha/crop, 1975)	373-348 <sup>f,l</sup>	--	43 <sup>m</sup>	103-340 <sup>h,n</sup>	--
Partial (US\$/ha/crop, 1975)	173 <sup>i,o</sup>	124 <sup>i,p</sup>	42 <sup>m,q</sup>	80 <sup>i,r</sup>	112 <sup>i,s</sup>
Government consumption as percent of GDP (average, 1960-73) <sup>t</sup>	15.2	11.8	16.2	18.1	7.6
Government investment as percent of GDP (average, 1960-73) <sup>u</sup>	2.4	1.4	-2.15 <sup>v</sup>	4.0	2.7
Debt service as percent of export earnings	8.3 <sup>w</sup>	7.1 <sup>x</sup>	22.0 <sup>y</sup>	6.9 <sup>z</sup>	16.1 <sup>aa</sup>
Shipment to capital city (US\$/mt)	93	71	76	70 <sup>bb</sup>	34

\*Sources include: Kathryn Craven and Harold 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, Stanford, 1978, preliminary; Eric A. Monke, "The Economics of Rice in Liberia," Stanford FRI/WARDA

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<sup>a</sup>This figure is an average for Mopti and Ségou.

<sup>b</sup>The first figure refers to the Senegal river valley and the second to the Casamance region.

<sup>c</sup>The first figure refers to the savannah zone and the second to the forest zone.

<sup>d</sup>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.

<sup>e</sup>These costs are net of most, if not all taxes. As such, they represent social, not private costs.

<sup>f</sup>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.

<sup>g</sup>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.

<sup>h</sup>The first figure is for small-scale pumping in Matam, the second for large-scale, mechanized pump irrigation in the Delta.

<sup>i</sup>Partial water control here refers to the improvement of lowlands, usually in forest areas, by bunding and diversion weirs.

<sup>j</sup>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.

<sup>k</sup>Unless otherwise noted, recurrent costs include both the annuity on the investment and operation and maintenance of the irrigation system.

<sup>l</sup>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.

<sup>m</sup>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 3 footnotes (continued).

- <sup>n</sup> 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.
- <sup>o</sup> 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.
- <sup>p</sup> 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.
- <sup>q</sup> This cost represents only the annuity and is the average for controlled-flooding polders near Ségou and Mopti and lowlands around Sikasso.
- <sup>r</sup> The annuity is based on a service life of 20 years and an average annual interest rate of 3 percent.
- <sup>s</sup> 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.
- <sup>t</sup> Government consumption is defined as recurrent expenditures on goods and services and includes all defense expenditures.
- <sup>u</sup> Government investment excludes defense expenditures.
- <sup>v</sup> Data for Mali cover only 1965-73.
- <sup>w</sup> 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.
- <sup>x</sup> 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.
- <sup>y</sup> 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.
- <sup>z</sup> 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.
- <sup>aa</sup> 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.
- <sup>bb</sup> 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 3 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.<sup>9</sup> 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 (13). 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 Sahelian 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 increasingly 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, Table 1 (p. 1a) provides some insights based on the importance of advanced education. 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.

With respect to rural infrastructure, as measured in Table 1 by the density of all-weather roads, the Ivory Coast is the least constrained and Mali is the most affected. 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 (3, 4). 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 none 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, regarding 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 (7). 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 4.

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 4.--Information on Policies\*

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

Table 4 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; Eric A. Monke, "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.

<sup>a</sup>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.

<sup>b</sup>Data cover 1967-76 and are for all rice imports.

<sup>c</sup>Data cover 1969-74 and are for all rice imports. These are the only years in which Mali imported rice.

<sup>d</sup>Data cover 1965-76 and are for 100 percent broken rice imports only.

<sup>e</sup>Data cover the period 1960-76, excluding 1964-65 and 1975. Imports include all types of rice.

<sup>f</sup>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 4 footnotes (continued).

<sup>g</sup>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.

<sup>h</sup>This value is for the crop year 1976-77 and may be equal to 8 percent of all marketed rice.

<sup>i</sup>This value is the average for the two crop years 1974-75 and 1975-76.

<sup>j</sup>This value is for the crop year 1974-75.

<sup>k</sup>All subsidies are based on social costs, net of all taxes.

<sup>l</sup>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.

<sup>m</sup>This is the rate of subsidy on fertilizer used in the Office du Niger.

<sup>n</sup>This is the average rate of subsidy on fertilizer used on Boillands (0.66) and on improved uplands and improved inland swamps (0.58).

<sup>o</sup>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.

<sup>p</sup>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.

<sup>q</sup>This rate of subsidy applies to investments in the Niger river basin. For swamps, the rate is 0.87.

<sup>r</sup>This rate of subsidy applies to investments in the Delta and at Nianga. Rates for investments at Matam and in swamps in the Casamance are 0.35 and 0.92, respectively.

<sup>s</sup>This rate applies to improved inland swamps only.

<sup>t</sup>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 4 footnotes (continued).

<sup>u</sup>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.

<sup>v</sup>The purchase of oxen equipment for rainfed production in the Casamance is subsidized at a rate of 0.28.

<sup>w</sup>This is the subsidy rate for land preparation of floodlands and riverain grasslands.

<sup>x</sup>This value is less than one, resulting in the zero percentage.

<sup>y</sup>This is the average of 1975 and 1976, which were 11,000 ha and 22,000 ha, respectively.

<sup>z</sup>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).

<sup>aa</sup>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 all three 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 4 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.<sup>10</sup> 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 choice and implementation of those policies. Effective policies successfully advance objectives at minimum cost. 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.<sup>12</sup>

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.<sup>13</sup> 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.<sup>14</sup>

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.<sup>15</sup> 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 (5).

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 (10). 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 compete efficiently 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.

#### 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 weight 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 (3, 4).

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

<sup>1</sup>The measurement of comparative advantage in rice is discussed in detail in (9).

<sup>2</sup>\$350 per metric ton (in 1975 prices) for 5 percent broken quality rice, f.o.b. Bangkok is taken as a reasonable long-run base for the world price of rice.

<sup>3</sup>The first two issues are examined in detailed in Stryker (9).

<sup>4</sup>This approach is introduced in Timmer (12).

<sup>5</sup>Progress toward self-sufficiency is readily measured by observing increases or decreases in import shares of total rice consumption.

<sup>6</sup>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.

<sup>7</sup>In the terms of comparative statics, the interest of the three forest-zone countries centers on the search for the optimum point on the production possibilities frontier. The success of policies in achieving this goal will be reflected over time in the observed rate of growth.

<sup>8</sup>The relaxation of expected future constraints usually requires long lead-times, 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 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.

<sup>9</sup>These figures are based on the following assumptions:

	<u>Partial water control</u>	<u>Full water control</u>
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 activity 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.

<sup>10</sup>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.

<sup>11</sup>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 distribution 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.

<sup>12</sup>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.

<sup>13</sup>Malian price policy, which keeps retail prices below c.i.f. import prices, has the effect of transferring 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.

<sup>14</sup>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 (8, p. 60):

<u>Region</u>	<u>Traditional rice</u>	<u>Improved rice</u>
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.

<sup>15</sup>Private returns (in Le per hour for 1974-75) net of capital charges and operating expenses were (8, p. 60):

<u>Region</u>	<u>Traditional rice</u>	<u>Improved rice</u>	<u>Oil Palm</u>	<u>Coffee and cocoa</u>
Northern Plains	0.08	0.25	0.17	--
Riverain Grasslands	0.10	0.17	0.36	--
Moa Basin	0.10 <sup>a</sup>	--	--	0.14

<sup>a</sup>This figure includes returns on minor other crops.

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