AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY

1. SUBJECT CLASSIFICATION

A. PRIMARY
Development and economics — DK00-0000-G190

B. SECONDARY
Trade and commerce--Sahel

2. TITLE AND SUBTITLE
Prospects for intraregional trade of rice in West Africa

3. AUTHOR(S)
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4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1977	133p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
Stanford

8. SUPPLEMENTARY NOTES (*Sponsoring Organization, Publishers, Availability*)
(Joint study by Stanford Univ. Food Institute and West Africa Rice Development Association)

9. ABSTRACT

10. CONTROL NUMBER
PN-AAG-778

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Rice marketing
International trade
Prices
Exports
Imports
Rice
Sahel

13. PROJECT NUMBER
698013500

14. CONTRACT NUMBER
AID/afr-C-1235

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

PN-AAG-998

Prospects for Intraregional Trade of Rice in West Africa

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September 1977

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Prospects for Intraregional Trade of Rice in West Africa

When the West Africa Rice Development Association (WARDA) was established in 1971, the thirteen member countries set the achievement of self-sufficiency in rice within the West African region as the primary goal of the new organization. At that time WARDA countries were producing about 70 percent of their total consumption of rice and importing the remaining 30 percent. WARDA was charged with assisting its members to increase their output of rice rapidly enough to exceed the growth of demand for rice and thereby to reduce and eventually to eliminate rice imports in the region.

The purpose of this study is to examine the prospects for increasing rice trade between WARDA countries. Because some members can be expected to expand their production of rice more quickly and more efficiently than others, the goal of reaching regional self-sufficiency can best be approached if deficit nations agree to import rice from WARDA countries with export capabilities. Ultimately, each WARDA member might hope to achieve national self-sufficiency in rice, but in the interim attention can be focussed on the prospects for intraregional trade within West Africa as a means of achieving regional self-sufficiency.

This paper contains four sections. The plan is to provide background information on rice supply, demand, and trade (part one), to project import gaps or export availabilities in 1980 and 1990 for each WARDA country (part two), to estimate the profitability of increasing output using the techniques of production that are expected to generate marketed supplies in potential exporting countries (part three), and to discuss the impact on intraregional trade in rice of alternative government policies (part four).

Because the scope of this study is ambitious, its results should be considered as provisional, pending the completion of ongoing research. To keep the paper within manageable limits, the text is brief; however, no detail is spared in the appendix tables which contain the data and analysis that support the textual statements. These tables are designed to allow interested readers both to trace sources of information and to follow analysis of the data.

Recent Trends in Production, Consumption, and Trade of Rice in West Africa[1]

Table One presents information on rice production, consumption, and trade during 1966 and 1975 for each of the WARDA countries and for the region as a whole. Net production, defined in milled rice equivalents net of seed and losses, increased from 821 thousand metric tons (TMT) in 1966 to 1,306 TMT in 1975 for the entire region. Major increases in rice output during this period were achieved in Nigeria, Sierra Leone, Ivory Coast, Liberia, and Ghana. At the same time rice consumption rose less than production, increasing from 1,218 TMT to 1,567 TMT.[2] Consequently, net imports of rice (imports less exports) decreased from 397 TMT in 1966 to 244 TMT in 1975.

The results of this change are portrayed in Table Two which contains self-sufficiency ratios for individual countries and for the region during the decade 1966-76.[3] In 1966 the self-sufficiency ratio for the WARDA region was .67, which

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[1]Detailed information for this section, presented on a country-by-country basis, is contained in Appendix Tables A-1 through A-13. With respect to each series of tables, the member countries are alphabetized in English so that number one refers to Benin, number two to Gambia, and so forth.

[2]In Table 1 and in Appendix Tables A-1 through A-13, consumption is estimated as net availability which is defined as production minus changes in stocks minus seed and losses plus net imports, all measured in terms of milled rice equivalents. In the instances in which changes in stocks are not known, net availability figures include these changes as well as actual consumption. In all WARDA countries changes in stocks are believed to be small before 1974.

[3]For each year the self-sufficiency ratio is defined as (production minus seed and losses) divided by net availability, where net availability equals production minus seed and losses minus changes in stocks plus net imports.

Table One.--Net Production, Net Availability, and Net Imports of Rice WARDA Member Countries and WARDA Region, 1966 and 1975[a]
(thousand of metric tons)

Country	1966			1975		
	Net production[b]	Net availability[c]	Net imports	Net production[b]	Net availability	Net imports[d]
Benin	.8	7.5	6.7	4.7	10.0	5.3
Gambia	20.6	28.2	7.6	23.9	39.0	17.1
Ghana	17.2	65.5	48.3	56.8	56.8	0.0
Ivory Coast	134.0	217.0	83.0	226.0	206.0	2.0
Liberia	112.0	158.0	46.0	143.0	174.0	31.0
Mali	83.0	83.0	0.0	102.0	99.0	20.0
Mauritania	.4	2.0	1.6	2.2	13.2	11.0
Niger	11.2	12.2	1.0	16.4	25.8	8.6
Nigeria	120.0	121.3	1.3	299.7	304.7	5.0
Senegal	68.1	227.4	159.3	65.2	245.0	123.8
Sierra Leone	224.1	258.6	34.5	344.2	359.5	10.0
Togo	12.7	16.4	3.7	6.0	7.0	1.0
Upper Volta	17.2	21.3	4.1	16.1	27.3	9.7
WARDA Region	821.3	1,218.4	397.1	1,306.2	1,557.3	244.5

Notes:

[a]Source: Tables A-1 through A-13.

[b]Net production is defined as the milled rice equivalent of paddy net of seed and losses.

[c]Net availability is defined as net production minus changes in stocks plus net imports.

[d]Net imports is defined as imports minus exports.

Table Two.--Self Sufficiency Ratios

WARDA Member Countries and WARDA Region, 1966-75[a,b]

(ratios as defined)

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Benin	.10	.09	.13	.10	.24	.27	.19	.20	.45	.47	.37
Gambia	.73	.70	.67	.47	.61	.59	.56	.43	.59	.61	.43
Ghana	.26	.28	.43	.44	.38	.45	.61	.31	.55	1.00	n.a.
Ivory Coast	.62	.86	.80	.78	.67	.64	.74	.60	.97	1.10	.79
Liberia	.71	.77	.72	.81	.71	.69	.74	.73	.79	.82	.78
Mali	1.00	1.00	1.00	.78	.85	.86	.74	.54	.50	1.03	.93
Mauritania	.20	.03	.03	.03	.08	.01	.04	.06	.06	.17	.10
Niger	.92	.92	.98	1.00	1.00	1.00	.94	.96	.63	.64	n.a.
Nigeria	.99	.98	1.00	1.00	.99	1.00	.96	1.00	.98	.98	n.a.
Senegal	.30	.31	.29	.18	.41	.21	.26	.09	.19	.27	.26
Sierra Leone	.87	.91	.94	.95	.84	.93	.98	.88	.95	.96	.94
Togo	.77	.86	.88	.77	.74	.85	.62	.63	.98	.86	n.a.
Upper Volta	.81	.70	.94	.93	.88	.94	.91	.92	.49	.59	n.a.
WARDA Region	.67	.73	.74	.74	.71	.69	.71	.64	.74	.84	.72[c]

Notes:

[a] Source: Tables A-1 through A-13.

[b] Self-sufficiency ratio for each year is defined as the ratio of production less seed and losses to net availability, where net availability is defined as production minus seed and losses minus changes in stocks plus net imports.

[c] This result is based on the eight countries for which 1976 data are available.

implies that 67 percent of total consumption was provided by local supplies and 33 percent from imports. This ratio increased to .84 in 1975 because local production increased more rapidly than consumption and hence imports declined to only 16 percent of the total.

The 1975 result must be interpreted with caution, however, because unusually high prices in the world market for rice during 1974-75 caused some countries to restrain import levels and thus consumption in this period. Therefore, the large increase in the self-sufficiency ratio during 1975 resulted from higher prices and import controls, as well as from production increases. When complete data are available for 1976, they are likely to show a lower self-sufficiency ratio than that achieved in 1975.[1]

Recorded trade in rice among WARDA member countries was irregular or negligible between 1966 and 1975. Countries experiencing special circumstances occasionally exported small amounts of rice, but no WARDA country was a consistent net exporter to other WARDA countries or to other parts of the world during this period.

Projections for 1980 and for 1990 of Production and Consumption of Rice in West Africa[2]

The purpose of making projections of the domestic demand for and supply of rice in WARDA member countries is to obtain quantitative estimates of the likely net trade position--import gap or export availability--for each country and for the

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[1]The self-sufficiency ratio in 1976 for the eight countries for which data are available is .72; in contrast, the 1975 ratio for this same group of countries is .80. The countries included in this calculation--Benin, Gambia, Ivory Coast, Liberia, Mali, Mauritania, Senegal and Sierra Leone--accounted for 70 percent of production and 73 percent of net availability in 1975.

[2]Detailed information for this section, presented on a country-by-country basis, is contained in Appendix Table E-1 through E-13 and F-2 through F-13.

West African region. Such estimates define the scope for intraregional trade in rice and identify possible exporting and importing countries.

For each country separate projections have been made for 1980 and 1990 of the demand for and domestic supply of rice. The difference between projected demand and supply is the net trade position, and the sum of all member countries' trade positions is the WARDA regional result.

Any set of projections is only as good as the information, assumptions, and techniques on which it is based. The bulk of the detailed information and assumptions, which form the basis for the projections, is presented in the appendix tables, principally those in the A, E, and F series. In general, both demand and supply projections depend on the assumptions that: (1) the world price of rice will be between US$300 and 350 (Thai rice, 5 percent brokens, f.o.b. Bangkok, constant 1976 dollars) in both 1980 and 1990; (2) climatic conditions in West Africa will be normal throughout the period; and (3) no basic changes will occur in West African government policies affecting (a) the price of rice relative to the prices of substitute crops and of foodstuffs, (b) the domestic price of rice relative to its international price, and (c) recent plans to invest in projects that will increase local supplies of rice.

The technique used to make projections of the demand for rice in each country involved consideration of the annual rate of population growth, the annual rate of growth of real per capita income, and the income elasticity of demand. Separate rural and urban estimates were used when available.[1] Table Three contains a listing

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[1] The methodology is outlined in detail in footnote a to Appendix Tables E. For all countries it is assumed that the real prices of rice and of its substitutes do not change. With this assumption plus the assumption that the elasticity of demand with respect to population growth in rural and urban areas equals one, increases in rice consumption are dependent only on the three parameters mentioned in the text. Recent trends in rice consumption form the basis for choosing the levels from which to make the projections.

Table Three.--Assumed Annual Rates of Growth of Population and of Real Per Capita Income, Assumed Income Elasticities, and Derived Annual Rates of Growth of Rice Consumption, WARDA Member Countries, 1975-80 and 1980-90[a] (measures as indicated)

Country	Annual rate of growth of population 1975-80	Annual rate of growth of population 1980-90	Annual rate of growth of real per capita income 1975-90	Income elasticity 1975-90	Annual rate of growth of rice consumption 1975-80	Annual rate of growth of rice consumption 1980-90
Benin	2.8	2.8	2.3	0.5	4.0	4.0
Gambia	2.8		2.0	0.4	3.6	3.6
Ghana	2.7	2.7	1.0	0.6	3.3	3.3
Ivory Coast	4.2	3.9	2.1	--	5.6	4.9
Urban	8.4	6.0	2.3	0.2	8.9	6.5
Rural	2.0	2.3	1.7	0.4	2.7	3.0
Liberia	2.2	2.2	2.7	--	2.5	2.6
Urban	4.2	3.9	2.7	0.3	5.0	4.7
Rural	1.6	1.6	2.7	0.1	1.9	1.9
Mali	2.5	2.5	2.0	--	4.8	5.0
Urban	5.7	5.7	2.0	0.5	6.7	6.7
Rural	2.1	1.9	2.0	0.3	2.7	2.5
Mauritania	2.6	2.6	4.0	0.4	4.2	4.2
Niger	2.8	2.8	2.2	--	6.4	6.9
Urban	7.0	7.0	2.2	0.5	8.1	8.1
Rural	2.2	2.0	2.2	0.2	2.6	2.4
Nigeria	2.6	2.6	5.0	0.6	5.6	5.6
Senegal	2.6	2.6	1.0	--	3.8	3.9
Urban	4.4	4.4	1.0	0.3	4.7	4.7
Rural	1.7	1.7	1.0	0.4	2.1	2.1
Sierra Leone	2.1	2.1	2.1	0.2	2.5	2.5
Togo	2.6	2.6	1.0	0.5	3.1	3.1
Upper Volta	2.0	2.0	1.0	--	4.4	4.8
Urban	7.0	7.0	1.0	0.5	7.5	7.5
Rural	1.6	1.4	1.0	0.2	1.8	1.6

Notes:

[a]Source: Tables E-1 through E-13.

of the assumed values by country for each of these three parameters relevant to the periods, 1975 to 1980 and 1980 to 1990, and of the resultant annual rates of growth in rice consumption. The assumed annual growth rates of population for all countries fit in the 2-3 percent range, except for the Ivory Coast where continued large inward migration is anticipated. Real per capita income growth for most countries is on the order of 1-3 percent per annum, although Nigeria and Mauritania are higher, largely because of expected petroleum and mineral incomes. The assumed income elasticities of demand vary between 0.2 and 0.6 due to different circumstances among countries. Given these assumptions, the estimated annual rates of growth of rice consumption range between 2.5 and 7.0 percent, with Liberia and Sierra Leone at the low end of the scale and Ivory Coast, Niger, and Nigeria at the high end. To a large extent the countries with very high current per capita consumption of rice (Gambia, Liberia, and Sierra Leone each consumed more than 80 kilograms per capita in 1975) are projected to increase at a slower rate than those with a low current level of consumption (Benin, Ghana, Niger, Nigeria, Togo, and Upper Volta each consumed less than seven kilograms per capita in 1975).

Rice production is projected on the basis of known capacities for expanding the principal techniques of production in each country.[1] Constraints on the

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[1]Detailed supply projections for nine countries are presented in Tables F-2 through F-13. It is assumed that local production keeps pace with demand in two other countries--Ghana and Nigeria--in both 1980 and 1990. Provisional estimates of supply for 1980 have been made on a national basis for Benin and Togo, and these two countries are also assumed to be in balance in 1990. Because none of these four countries has recently been a large importer or exporter of rice, these assumptions are not expected to affect significantly the projected WARDA regional trade position in 1980 and 1990.

expansion of each production technique include resource (land, labor, water, and capital) limitations, budgetary restrictions, availability of external financing, and management capabilities. The projections are made in light of recent performance and with knowledge of planned rice development projects. For these projects it is assumed that technical problems, such as water control, and social problems, such as those affecting resettlement schemes, can be resolved successfully. Naturally the guesses for 1980 are firmer than those for 1990. In several instances, judgments on hectarages and on yields differ from those of government agencies, usually showing less optimism and hence lower production figures. The detailed format of the series F tables in the appendix allows those who might disagree with these projections to make their own alternative assumptions and to trace the consequences on projected outputs.

The purpose of making the demand and supply projections is to indicate whether WARDA countries might be significant exporters or importers or be roughly self-sufficient in rice. The results of the projections are summarized in Table Four. For the WARDA region as a whole, demand is projected to increase from a level of 1,567 TMT in 1975 to 2,029 TMT in 1980 and then to 3,059 TMT in 1990, while regional supply is expected to expand from 1,323 TMT in 1975 to 1,711 TMT in 1980 and 2,720 TMT in 1990. The net trade position, which for the region is an import gap since demand exceeds supply, therefore increases from 244 TMT in 1975 to 340 TMT in 1980 and to 378 TMT in 1990.

Although the projected net import gap increases, the self-sufficiency ratio for the region improves from .84 in both 1975 and 1980 to .89 in 1990. This result occurs because the demand estimate for 1990 is more than half again as large as that for 1980. Consequently, while the proportion supplied by local production rises from 84 to 89 percent, the absolute import gap also grows in size to meet the large expansion of demand.

Table Four.--Demand for, Supply of, and Trade Position of Rice, WARDA Member Countries and WARDA Region, 1975 and Projections for 1980 and 1990 (thousands of metric tons)

Country	1975[a]			1980			1990		
	Demand[b]	Supply[c]	Trade position	Demand[e]	Supply[f]	Trade position[d]	Demand[e]	Supply[f]	Trade position[d]
Benin	10.0	4.7	5.3	15.6	5.6[g]	10.0[e]	23.1	23.1[h]	0.0[h]
Gambia	39.0	21.9	17.1	47.7	28.0	19.7	67.9	50.0	17.9
Ghana	56.8	56.8	0.0	84.7	84.7[h]	0.0[h]	117.2	117.2[h]	0.0[h]
Ivory Coast	206.0	204.0	2.0	378.8	293.0	85.8	413.6	394.0	19.6
Liberia	174.0	143.0	31.0	197.7	156.0	41.7	256.4	224.0	32.4
Mali	99.0	79.0	20.0	131.9	171.0	-39.1	215.2	291.0	-75.8
Mauritania	13.2	2.2	11.0	31.3	6.7	24.6	47.2	35.0	12.2
Niger	25.8	17.2	8.6	26.8	24.0	2.8	52.1	41.4	10.7
Nigeria	304.7	299.7	5.0	400.1	422.5[h]	0.0[h]	689.9	689.9[h]	0.0[h]
Senegal	245.0	121.2	123.8	277.0	99.6	180.4	404.3	205.9	198.4
Sierra Leone	359.5	339.5	10.0	392.6	388.0	4.6	502.6	541.0	-38.4
Togo	7.0	6.0	1.0	11.3	8.8[g]	2.5	15.3	15.3[h]	0.0[h]
Upper Volta	27.3	17.6	9.7	33.8	26.3	7.5	54.3	53.7	0.6
WARDA Region	1,567.3	1,322.8	244.5	2,029.3	1,711.2	340.5	3,059.1	2,720.2	377.6

Notes:

[a] Source: Tables A-1 through A-13.

[b] Net availability.

[c] Net availability less net imports.

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

[e] Source: Tables E-1 through E-13.

[f] Source: Tables F-2 through F-13.

[g] Supply projections for 1980 are national estimates based on recent performance.

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

On the basis of the results of Table Four individual countries can be grouped into three categories--exporters, major importers, and those approximately self-sufficient. Only Mali is an exporter in 1980, while both Mali and Sierra Leone have export availabilities in 1990.[1] The 114 TMT of export supplies available from these two countries in 1990, however, fills only 23 percent of the 492 TMT import gap of the other WARDA countries. Major importers in both 1980 and 1990 include Gambia, Ivory Coast, Liberia, Mauritania, and Senegal. Countries more or less self-sufficient in 1980 are Benin, Niger, Sierra Leone, Togo, and Upper Volta. All of these countries except Sierra Leone remain in this category in 1990, Benin and Togo by assumption. Also in balance by assumption in both 1980 and 1990 are Ghana and Nigeria.

In summary, the projections indicate that between 1975 and 1990, the WARDA region will become more self-sufficient in rice in terms of the percentage of demand met by local supplies but that the absolute tonnage of imports will increase. Only two WARDA countries, Mali and Sierra Leone, will be exporters of rice in 1990, and they will be able to supply only about one-fourth of imports required by the other members. More than 80 percent of the import demand will originate in two countries, Ivory Coast and Senegal. Relative to the supply, demand, and import positions of 1975, marked changes will occur in three countries according to the projections: Ivory Coast will return from temporary self-sufficiency to its earlier position of being a major importer; Mali will change from its modest import position to become a sizeable exporter; and Sierra Leone will emerge from self-sufficiency as an important exporter.

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[1]The issue of whether rice from Mali and from Sierra Leone is likely to be competitive on the world market with rice from alternative sources of supply is discussed in the following section.

With respect to Ivory Coast, however, this conclusion requires some important qualifications. As mentioned above, the projections are based on the assumption of unchanged government policies. In the face of a rapidly growing demand for rice imports, the Ivoirian government might well choose to carry out a combination of the following policy changes: (a) increasing its investment in rice projects in order to expand supplies; (b) raising the producer price of rice relative to the prices of other crops to expand local rice output and marketings; and (c) using restrictive import policies to raise the consumer price of rice relative to the consumer price of other domestic foodstuffs to reduce demand for rice. By changing policies, Ivory Coast could, at some cost, reduce its import gap substantially.

International Competiveness of Countries with Projected Export Availabilities[1]

On the basis of the results summarized above in Table Four, Mali is projected to have 39 TMT of rice available for export in 1980 and 76 TMT in 1990, and Sierra Leone 38 TMT in 1990. A critical issue is whether these potential exports can be produced and delivered to other West African markets at costs which make them competitive with other international supplies of equivalent quality rice. Insight into this issue can be gained from a social benefit-cost analysis of the rice farming, processing, and marketing techniques in Mali and Sierra Leone that are most likely to generate exportable supplies of rice.

The method used to examine whether Mali and Sierra Leone have international comparative advantages in rice production is presented in detail in Appendix B. This approach can be summarized briefly. The areas and techniques expected to produce for export have been chosen with reference to the projections of supply

[1] Detailed information for this section, presented in a technique-by-technique basis for Mali and Sierra Leone, is contained in Appendix Tables, C, D, and G.

(see Tables F-6 and F-11). Detailed cost and return data have been assembled in actual market prices prevailing in 1975 for each selected technique (see the series C tables).

Two kinds of adjustments are made to convert the market costs and returns into social costs and returns, allowing a comparison of private profitability with social profitability. First, the transfers caused by government tax and subsidy policies are removed through use of comparable world prices. For example, rice output is evaluated in terms of what the country can receive for its exports of rice instead of the actual market price which prevails domestically. Similarly, an input, such as fertilizer, that can be purchased from abroad is valued at its true import cost in place of a subsidized (or taxed) market price.

Second, labor, capital, land, and foreign exchange are evaluated with respect to their social opportunity costs, or the amount of output forgone from not using them in their best alternative employment. For example, farmers might receive government credit at, say, an interest rate of six percent when the government might otherwise have used the capital in a development project yielding a twelve percent return. In this instance the social price of capital would be twelve percent in place of the six percent actually paid by the farmer.

Having made these two kinds of adjustments, one can compare social benefits with social costs and determine whether social profitability is positive or negativ If the social benefits are calculated with reference to a competitive international price in an export market, positive social profitability implies that the country using the technique under examination has an international comparative advantage.

The Office du Niger, using mainly its existing technique of gravity irrigation and animal power and to a lesser extent an improved technique that involves intensified production with fertilizer, is expected to be the source

of most of Mali's exportable rice in 1980. Table Five contains the results of benefit-cost calculations done in both private and social prices.[1] Both sets of calculations are based on returns from export sales to Abidjan, Ivory Coast at a c.i.f. price of $350 per metric ton of milled rice, which is consistent with projected long-run world prices. Production with the Office du Niger's current techniques is highly profitable in both private and social terms. Rice production under the improved technique, however, is socially profitable but privately unprofitable, largely because intensification requires greater labor and purchased inputs on smaller landholdings that are not fully compensated by higher returns. As shown in Appendix G, important parameters in the calculation, in addition to the world price of rice, are the transportation cost of milled rice from Segou to Abidjan, the yields of paddy under both techniques, and the number of man-days of labor in farming. In addition, a key assumption in the analysis is the writing off of all past capital development costs. The decision to ignore these sunk costs is justified for the techniques in question at the Office du Niger, although future investments must, of course, be fully costed.

Mali's potential exports in 1990 are anticipated to originate from the Office du Niger, using the intensive technique entirely, and from Operation Riz Segou and Operation Riz Mopti, using an improved technique involving controlled flooding, animal power, and fertilizer. Again, the international competitiveness is examined with respect to the Abidjan market, and the same c.i.f. Abidjan price, $350 per metric ton, is used as in the 1980 analysis. Since both prices and costs

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[1]Underlying data and assumptions are presented in Appendix Tables C-6.

Table Five.--Private and Social Profitability
of Potential Exports of Rice from Mali and Sierra Leone
(U.S. dollars per metric ton, unless otherwise indicated)[a]

Country and technique	Area[b] (thousands of hectares)	Yield[b] (metric tons of paddy per hectare)	Production[b] (thousands of metric tons of paddy)	Private[c] Return	Private[c] Cost	Private[c] Profitability	Social[c] Return	Social[c] Cost	Social[c] Profitability
Mali[d]									
Gravity irrigation, animal power (Office du Niger, current)	38	2.5	95	93	86	7	316	219	97
Gravity irrigation, animal power and fertilizer (Office du Niger, improved)	48	3.5	168	93	106	-13	316	227	39
Controlled flooded, animal power and fertilizer (Operation Riz Segou and Operation Riz Mopti, improved)	60	2.5	150	93	90	3	316	297	19
Sierra Leone[e]									
Improved inland swamp (south)	21	4.0	84	169	87	82	326	225	101
Improved upland (south)	40	2.5	100	169	163	6	326	307	19

Table Five. (continued)

Notes:

[a]Sources: Tables C-6a through C-6e, C-11a through C-11d, D, F-6, and F-11.

[b]All figures are from Tables F-6 and F-11. Projections are for 1990 except for Mali, gravity irrigation, animal power which is for 1980

[c]Cost and return projections are for 1990, except Mali, gravity irrigation, animal power which is for 1980. The private profitability results apply only to farming. The social profitability results apply to farming, milling, and transport to the frontier. The private profitability results are converted to dollars using the 1975 official exchange rate. The social profitability numbers are converted to dollars using the social exchange rate.

[d]The official exchange rate for Mali is 428 MF/$1. The social exchange rate is 492 MF/$1.

[e]The official exchange rate for Sierra Leone is Le 0.90/$1. The social exchange rate is Le. 1.15/$1.

are given in 1975 constant dollars and their relative relationship is assumed not to change between 1980 and 1990, the results for the Office du Niger's intensive technique can be taken to apply to both years. Rice production in the two operations is slightly less socially profitable than that in the Office du Niger, but it is still competitive with international supplies at the assumed world price as long as Mali's exchange rate vis-à-vis the United States dollar does not return to its (unusual) 1975 level. Like the profitability of the two techniques of the Office du Niger, that of the controlled flooding method of production depends importantly on the world rice price, transport costs, yields, and labor costs (see Appendix Table G). Crucial to Mali's comparative advantage, as well, is the assumption that the two improved techniques will be widely adopted by 1990.

The future competitiveness of Malian rice was also tested in two additional potential export markets--central Ivory Coast (Bouaké) and Dakar, Senegal. Given the closer proximity of Bouaké than Abidjan to Mali's sources of rice production, Malian rice is considerably more competitive in central Ivory Coast than on the coast. With respect to Dakar, Malian rice has to compete with broken rice that has a much lower price than that imported by Ivory Coast. As a result, for 1990 rice from Office du Niger is only competitive in Dakar if the world price for the broken quality imported by Senegal rises to 10 percent above the level projected in this analysis.

Sierra Leone is projected to be roughly self-sufficient in 1980 and to have an export potential of some 38 TMT in 1990. Exportable supplies are expected to originate from southern Sierra Leone to supply the Monrovia, Liberia market at an assumed c.i.f. import price of $340 per metric ton. Two improved techniques, one located in inland swamps and the other in upland areas, are anticipated to be the sources of Sierra Leone's exports. As shown in Table Five, the

improved inland swamp production is very profitable, in both private and social terms, while the upland technique is privately profitable but only marginally so in social prices. The key parameter underlying Sierra Leone's social profitability is labor cost, since both techniques involve very high labor inputs. An important assumption is the use of the current (1977) exchange rate vis-a-vis the United States dollar (Le. 1.15/$1) rather than the 1975 rate (Le. 0.90/$1) to calculate social profitability. Assumptions on transportation costs for Sierra Leone are much less critical than for Mali because the distances within the Mano River Union are much less than between Mali and either the Ivory Coast or Senegal.

It is instructive to test the sensitivity of the results for all five techniques to changes in the assumed world price of rice. The lowest world rice prices (25 percent brokens, c.i.f. Abidjan for Mali and c.i.f. Monrovia for Sierra Leone) at which each technique can compete are approximately (in $U.S. per metric ton): Office du Niger, existing, 255; Office du Niger, improved, 315; Operation Riz Segou and Operation Riz Mopti, improved, 335; southern Sierra Leone, inland swamps, improved, 235; and southern Sierra Leone, upland, improved, 320. At prices lower than these levels, Malian and Sierra Leonean rice would not be competitive in Abidjan and in Monrovia, respectively.

Government Policies Affecting Intraregional Trade of Rice in West Africa[1]

While virtually all government policies influence to some degree the supply of and demand for rice in West African countries, the most important policies are those which directly affect (a) rice prices, (b) investments in rice production,

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[1]Detailed information for this section, presented on a country-by-country basis, is contained in Appendix Tables B-1 through B-13.

processing, and distribution, and (c) international trade in rice. Consequently, discussion of future government policies affecting the prospects for intraregional trade of rice in West Africa can conveniently be subdivided into separate consideration of price, investment, and trade policies.

Price policy refers to (a) use of taxes or subsidies, or (b) maintenance of price floors or ceilings by means of government purchases or sales in order to either raise or lower consumer or producer prices relative to what their market-determined levels would have been in the absence of government intervention. For example, if a government wishes to encourage an expansion of domestic production, it could guarantee purchase at a higher-than-market price to producers and then either pass the higher price on to consumers or absorb the extra cost with a government subsidy. In this example, there would be a transfer from either the consumers (if they paid higher prices) or the government (if it subsidized) to the producers. To the extent that the government allows the consumer price to rise, it must correspondingly carry out a protective trade policy to force the consumer price of imported rice to increase in step with that of domestic rice. Otherwise, consumers would simply shift to buying increased amounts of imported rice at some fixed c.i.f. import price. Because of this link between domestic and imported rice, price policy typically includes actions that affect supplies of both local and foreign rice.

Information on price policy for the past decade in all WARDA member countries is contained in Appendix Tables B-1 through B-13. Official price information is useful because it represents government intentions, but private market prices are required to be able to understand the actual effects of government policies. For most countries, good information is available on import prices and on the official prices established by government. Only a few countries, however, have collected long series of reliable price information for private prices actually prevailing in the markets. The official and private prices are equivalent only

when the government is able to maintain a floor price by being willing to purchase the supplies offered or a ceiling price by selling rice to all buyers, or in instances when it can effectively employ trade policies to tax or subsidize rice in order to offset the potential differences between official and private prices.

The c.i.f. import price represents the cost at which a country can purchase imported rice in unlimited amounts (since none of the West African countries purchases a large enough quantity of imports to influence the world price of rice). The import price can thus serve as a point of comparison for prices of local rice since the government could always choose to import more (or less) at the given import price. In the absence of government policy one would expect the producer price of local rice to be less than the import price of comparable rice, reflecting a processing and marketing margin, and the wholesale price of local rice to approximately equal the import price. In West Africa, however, all governments intervene to alter this market-oriented determination of prices.

Four instances of price policy can be distinguished. First, imposition of a tariff or quantitative restriction on imports permits the domestic price of rice to exceed its free-trade level, thereby opening a gap between wholesale and c.i.f. prices. In this circumstance consumers pay more for local rice to the benefit of the producers (or of the merchandizers if the marketing system is not competitive), and they also pay more for imported rice with the difference accruing to the government treasury as tariff revenue (or to those fortunate enough to gain access to import licences if quantitative restrictions are used and the licences are not auctioned). Second, if the domestic wholesale price is lower than the c.i.f. import price, the government price policy subsidizes consumption, directly from the treasury for imported supplies, and indirectly for local supplies because producers receive a lower price than would occur in the absence of government policy. Third, the government can protect local production to such an extent that both wholesale and producer prices are higher than the c.i.f. price. This instance is an extended version of the first with similar instruments and results. Fourth, the government can raise producer prices above

wholesale prices by providing direct subsidies to farmers (or to processors or distributors).

It is instructive to contrast the price policy for rice of WARDA countries by grouping them into the four categories just described. The results, shown in Table Six, are at best suggestive because of the absence of information on processing and marketing margins (causing reported producer prices to be biased downward) and on wholesale marketing margins (causing reported consumer prices to be biased upward). In 1972, when the world price of rice was quite low, seven WARDA countries undertook protection policies that allowed the retail price of rice to exceed the import price and at the same time set producer prices at levels beneath the world price. In that year five countries (Gambia, Ivory Coast, Mauritania, Senegal, and Upper Volta) protected local rice production to such an extent that both retail and producer prices were greater than the world price. The remaining country, Nigeria, was alone in protecting producers with a combination of somewhat higher consumer prices and direct government subsidies which caused the producer price to exceed the retail price while both were above the import price.

The world price of rice rose dramatically during late 1973 and 1974 causing many West African governments to shift price policy. Six of the nine WARDA countries for which 1974 price data are available--Benin, Gambia, Mali, Mauritania, Senegal, and Sierra Leone--chose to subsidize consumption of imported rice in that year. The other three countries--Ivory Coast, Liberia, and Togo--allowed retail prices to rise sufficiently to maintain their earlier position above import prices.

Price data for 1976 are not currently available for most WARDA member countries. In that year the world price dropped to a level that was about half of the peak

Table Six.--Retail, Import, and Producer Price Relationships, WARDA Member Countries, 1972, 1974, and 1976[a,b]

(entries as indicated)

Country	1972	1974	1976
Benin	1	2	n.a.
Gambia	3	2	n.a.
Ghana	1	n.a.	n.a.
Ivory Coast	3	1	n.a.
Liberia	1	1	3
Mali	1	2	n.a.
Mauritania	3	2	3
Niger	1	n.a.	n.a.
Nigeria	4	n.a.	n.a.
Senegal	3	2	3
Sierra Leone	1	2	n.a.
Togo	1	1	n.a.
Upper Volta	3	n.a.	n.a.

Notes:

[a]Source: Tables B-1 through B-13.

[b]Entries in the table are defined as follows:

1 = retail price greater than c.i.f. import price greater than producer price
2 = c.i.f. import price greater than retail price greater than producer price
3 = retail price greater than producer price greater than c.i.f. import price
4 = producer price greater than retail price greater than c.i.f. import price
n.a. = price data are not available

attained two years earlier. Mauritania and Senegal returned to their 1972 policies and set official producer and retail prices at levels that exceeded the import price. Liberia shifted policy and adopted this same price structure for the first time during the period under consideration. In Ivory Coast the official price for paddy (in milled rice equivalent) was higher than the official retail price, and both were in excess of the comparable import price.

In short, contrary to conventional wisdom, price policy in WARDA countries has typically protected producers and raised the costs to consumers of both local and imported rice. During 1974, however, when unusually high rice prices prevailed, many countries chose not to allow consumer prices to rise to the full extent of import prices and instead subsidized imports of rice. Apart from this atypical occurrence, WARDA countries have generally used import policy to raise consumer and producer prices and to collect government revenues on imports of rice.

The second principal set of policies affecting rice is made up of government decisions to devote portions of their capital and recurrent budgets to development projects that bring about more rice output. Some projects directly produce more rice while others create conditions that improve the profitability of rice production by decreasing the costs of farming, processing, or marketing. Especially important for intraregional trade has been investment to improve the transportation infrastructure connecting West African countries. Individual government plans to invest in rice projects are reflected in the supply projections of Tables F-2 through F-13.

A third set of policies, related to trade, has the most direct impact on prospects for intraregional trade within West Africa. One important aspect of trade policy, the decision whether and by how much to raise local prices above c.i.f. import prices, has already been discussed in the context of price policy. If a government decides to protect local production completely, by prohibiting

all imports of rice, discussion of trade policy is, of course, closed and self-sufficiency is assumed. Except for that extreme position, however, a second aspect of trade policy is also highly relevant. When some positive level of imports is desired, the government must decide whether to purchase from the cheapest foreign supplier or to undertake special trading relationships. The international trade of rice is characterized around the world by special government-to-government arrangements. A critical issue for WARDA nations to decide, therefore, is whether or not they wish to establish special regional trading arrangements for rice either in the context of the Economic Community of West African States (ECOWAS) or separately.

The prospects for intraregional trade of rice in West Africa will be brighter if governments of WARDA countries follow price, investment, and trade policies that are consistent with regional trade. This point can be demonstrated with reference to the demand and supply projections discussed in an earlier section of this paper. A continuation of recent government policies was a key assumption underlying those projections. But governments, especially of countries with projected import gaps, have at their disposal the whole range of price, investment, and trade policies with which to alter these gaps.[1]

Trade policy in this instance simply means accepting the outcome and paying for the imports of rice, assuming foreign exchange can be made available for this purpose. The point at issue then becomes the source of foreign supply, within WARDA or elsewhere.

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[1] In principle, a government could also close the import gap by reducing the rate of growth of real per capita income (an undesirable policy in virtually all instances), by slowing the rate of population growth or the rural to urban shift (an extremely difficult task, especially in a short time frame), or by lowering its consumers' income elasticity of demand for rice (an unlikely outcome in the short-run).

Investment policy attempts to work on the supply side in order to increase local production beyond that already projected. It is certainly conceivable that WARDA countries could grow more rice in 1990 than the amounts that have been projected in this paper. The issue then turns on the social profitability of such an effort. While real resource costs are rarely the sole criterion on which to base investment decisions, such costs should not be ignored. The social profitability of attempts to increase local rice production for most farming techniques in West Africa depends critically on yields, the world price of rice, and labor costs. Unless social benefits exceed social costs, external financing for additional rice projects is likely to be difficult to arrange.

Governments are left then with price policy if they desire to close import gaps. But this policy, too, has its limitations. An import gap can only be choked off by raising the domestic price of rice--relative to the prices of alternative crops to stimulate more rice output, and relative to the price of other foodstuffs to encourage consumption shifts away from rice. Because these shifts in relative prices generally have costly production and consumption effects, rice price policy should be used only when the objectives of attaining a greater degree of self-sufficiency are clearly specified and the attendant costs deemed justified. Otherwise, a more gradual, though difficult, approach of technical and economic improvements in rice production seems the wiser course for WARDA countries to pursue. Well-laid plans to increase intraregional trade in rice should be an integral part of this more prudent approach as more West African countries gradually achieve the capability to produce for export at prices that are competitive on the world market.

Table A-1.--Benin: Population and Rice Production, Trade, and Self-Sufficiency Ratios, 1965-76[a]
(thousands of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population[b] (thousands) Total	Urban	Rural	Production[c]	Changes in stocks[d]	Seed and losses[e]	Net imports[f]	Net availability[g]	Self-sufficiency ratio[h]
1965	2,370	261	2,109	.64	n.a.	.16	6.87	7.35	.06
1966	2,436	280	2,156	.96	n.a.	.18	6.73	7.51	.10
1967	2,504	298	2,296	.83	n.a.	.15	6.96	7.64	.09
1968	2,574	309	2,265	.77	n.a.	.16	3.94	4.55	.13
1969	2,646	328	2,318	1.09	n.a.	.20	7.54	8.43	.10
1970	2,720	343	2,377	1.54	n.a.	.26	4.14	5.42	.24
1971	2,796	352	2,444	3.25	n.a.	.54	7.20	9.91	.27
1972	2,874	368	2,506	3.49	n.a.	.59	12.10	15.00	.19
1973	2,954	387	2,567	3.46	n.a.	.59	11.10	13.97	.20
1974	3,037	401	2,636	5.21	n.a.	.89	5.30	9.62	.45
1975	3,122	421	2,701	5.68	n.a.	.97	5.30	10.01	.47
1976	3,209	436	2,773	8.29	n.a.	1.41	11.50	18.38	.37

Notes:

[a]Sources: WARDA Rice Statistics Yearbook for 1965-70 and WARDA "Rapport de Mission en R.P. du Benin" for 1971-76.

[b]Source: For rural and urban populations: U.N. Demographic Yearbook, 1975.

[c]Paddy production is converted to rice equivalent at a milling ratio of .64 for 1965-70 and .65 for 1971-76. Production year refers to later year of crop year: for example, 1965 production is from 1964-65 crop year.

[d]Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligible.

[e]Losses are 10 percent of paddy production. Seed use is 56 kilograms of paddy per hectare. Seed and losses are converted to rice equivalent at a milling ratio of .64 for 1965-70 and .65 for 1971-76.

[f]Net imports is defined as imports minus exports. Imports are primarily 30 percent brokens.

[g]Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[h]Self-sufficiency ratio is defined as production minus seed and losses, divided by net availabil

Table A-2.--Gambia: Population and Rice Production, Trade, and Self-Sufficiency Ratios, 1966-76
(thousands of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population[a] (thousands) Total	Urban	Rural	Production[b,c]	Changes in stocks[d]	Seed and losses[e]	Net imports[f,g]	Net availability[h]	Self-sufficiency ratio[i]
1966	401	73	328	24.0	n.a.	3.4	7.6	28.2	.73
1967	412	78	334	24.0	n.a.	3.4	8.6	29.2	.70
1968	423	83	340	24.0	n.a.	3.4	10.0	30.6	.67
1969	435	88	347	13.0	n.a.	2.0	12.5	23.5	.47
1970	447	94	353	26.0	n.a.	3.7	14.2	36.5	.61
1971	459	100	359	22.1	n.a.	3.2	13.0	31.9	.59
1972	472	107	365	22.1	n.a.	3.2	15.1	34.0	.56
1973	485	113	372	22.1	n.a.	3.2	25.4	44.3	.43
1974	498	119	379	24.7	n.a.	3.7	14.7	35.7	.59
1975	512	126	386	28.0	2.0	4.1	17.1	39.0	.61
1976	526	133	393	28.0	n.a.	4.1	31.1	55.0	.43

Notes:

[a] Source: 1973 Population Census.
Urban is defined as towns larger than 2,000 persons with predominantly non-farm population. Breakdown is provided by J. R. Dunsmore, et al., The Agricultural Development of the Gambia, Land Resource Study 22, Ministry of Overseas Development, Surrey, England, 1976.
Growth rates for total population are provided by the 1973 Population Census. Natural growth rate equals 2.0 percent; immigration equals 0.75 percent. Rural population is estimated at a growth rate of 1.8 percent per year, based on proportional changes in rural-urban populations between 1963 and 1973 censuses.

[b] Paddy production is converted to rice equivalent at a milling ratio of .65. Production year refers to later year of crop year: for example, 1965 production is from 1964-65 crop year.

[c] Sources: 1965-73 from WARDA Rice Statistics Yearbook, 1975; 1974 from National Sample Survey for Agriculture, 1973/74; 1975/76 from Preliminary Survey of Agriculture, 1974/75.

[d] Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligible.
Source: WARDA Rice Statistics Yearbook, 1975 and update.

[e] Losses are 10 percent of paddy production. Seed use is 60 kilograms of paddy per hectare. Seed and losses are converted to rice equivalent at a milling ratio of .65.

[f] Net imports is defined as imports minus exports.

Table A-2 (continued)

[g]Source: External Trade Statistics of the Gambia, 1965-72 and 1973-75, Gambia Produce Marketing Board. Years are for financial year. There may have been substantial unrecorded exports from Gambia in 1975 due to price differences between Senegal and Gambian markets. Imported rice is usually Burmese small brokens, raw rice, qualities B1 and B2.

[h]Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[i]Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table A-3.--Ghana: Population and Rice Production, Trade, and Self-Sufficiency Ratios, 1965-76[a]

(thousands of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population[b] (thousands)			Production[c]	Changes in stocks[d]	Seed and losses[e]	Net imports[f]	Net availability[g]	Self-sufficiency ratio[h]
	Total	Urban	Rural						
1965	7,587	1,990	5,597	26.5	n.a.	3.9	29.6	52.2	.43
1966	7,772	2,089	5,683	20.2	n.a.	3.0	48.3	65.5	.26
1967	7,962	2,191	5,771	18.3	n.a.	3.2	39.4	54.5	.28
1968	8,156	2,245	5,911	26.5	n.a.	4.0	30.1	52.6	.43
1969	8,355	2,353	6,002	26.5	n.a.	4.2	28.1	50.4	.44
1970	8,559	2,466	6,093	37.8	n.a.	5.9	53.1	85.0	.38
1971	8,812	2,596	6,216	34.6	n.a.	5.7	35.1	64.0	.45
1972	9,073	2,732	6,341	44.2	n.a.	6.8	24.3	61.7	.61
1973	9,342	2,873	6,469	29.4	n.a.	5.5	53.6	77.5	.31
1974	9,619	3,020	6,599	56.4	n.a.	8.5	39.1	87.0	.55
1975	9,904	3,174	6,730	68.5	n.a.	11.7	0	56.8	1.00
1976	10,197	3,333	6,864	72.5	n.a.	10.3	n.a.	n.a.	n.a.

Notes:

[a]Sources: WARDA Rice Statistics Yearbook, 1975 and update unless otherwise noted.

[b]Urban/rural figures are based on U.N. Demographic Yearbook estimates: 1960, 23 percent urban; 1971, 29 percent urban; 1974, 31.4 percent urban. Urban is defined as city of 5,000 inhabitants or more.

[c]Paddy production is converted to rice equivalent at a milling ratio of .63. Production year refers to later year of crop year: for example, 1965 production is from 1964-65 crop year.

[d]Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligible.

[e]Losses are 10 percent of paddy production. Seed use is 60 kilograms of paddy per hectare. Seed and losses are converted to rice equivalent at a milling ratio of .63.

[f]Net imports is defined as imports minus exports. Imports are primarily 35 percent brokens, ra rice.

[g]Net availability is defined as production minus seed and losses, minus changes in stocks, plu net imports.

[h]Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table A-4.--Ivory Coast: Population and Rice Production, Trade, and Self-Sufficiency Ratios, 1965-76

(Thousand of metric tons of milled rice equivalents, unless otherwise indicated)

Year	Population[a] (thousands) Total	Urban	Rural	Production[b,c]	Changes in stocks[d,e]	Seed and losses[f]	Net imports[g]	Net availability[h]	Self-sufficiency ratio[i]
1965	4,454	1,067	3,387	156	n.a.	23	78	211	.63
1966	4,641	1,141	3,504	158	n.a.	24	83	217	.62
1967	4,836	1,224	3,612	179	n.a.	27	24	176	.86
1968	5,039	1,314	3,725	217	n.a.	33	47	231	.80
1969	5,250	1,409	3,841	230	n.a.	35	55	250	.78
1970	5,471	1,521	3,959	191	n.a.	29	79	241	.67
1971	5,701	1,623	4,078	199	n.a.	30	97	266	.64
1972	5,904	1,741	4,199	243	6	36	77	278	.74
1973	6,189	1,868	4,321	202	28	30	145	289	.60
1974	6,445	2,005	4,440	211	58	32	64	185	.97
1975	6,720	2,151	4,569	266	22	40	2	206	1.10
1976	7,002	2,335	4,656	290	(-98)	43	(-31)	314	.79

Notes:

[a]Definition of urban population: from 1965 through 1974 it is the estimated population of urban centers greater than 10,000; for 1975/76 it is inhabitants of all urban centers over 10,000 and all centers between 4,000 and 10,000 having less than half their economic activity in the primary sector.

Population figures extrapolated backwards from 1975 census results.

Rural growth rate 1965 through 1974 may be overstated due to underestimation of rural populati in 1965.

Source: Projet de Plan Quinquennal de Developpement Economique, Social, et Culturel 1976-1980, Tome III (fascicule III), Ministere du Plan, Republique de Cote d'Ivoire, May 1976; Rousseau, L. Cote d'Ivoire 1965: Population for Ivory Coast, Ministere du Plan, Abidjan, 1967.

WARDA population estimates (Rice Statistics Yearbook, 1975) taken from Plan 1971-1975, Ministere du Plan, RCI, 1971, are lower than estimates here. 1975 census and Plan 1976-1980, Ministere du Plan, RCI, 1976, have revised upwards these earlier estimates.

[b]Paddy production is converted to rice equivalent at a milling ratio of .63. Production year refers to later year of crop year: for example, 1965 production is from 1964-65 crop year.

Table A-4 (continued)

[c]Production data from Statistiques Agricoles 1975, Direction des Statistiques Rurales, Ministere de l'Agriculture, Abidjan, 1976 and discussions with Director of Statistiques Rurales, Ministere de l'Agriculture.

[d]Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-71 are not available but are believed to be negligible. Stocks refer only to publicly held inventories including those held by import cartel members licensed by the Ministere du Commerce and those held by SODERIZ.

[e]Data are from Bulletins Mensuels, Chambre de Commerce d'Abidjan, Abidjan.

[f]Seed and losses are calculated at 15 percent of production by Cellule Agro-Economie, in Le Role de l'Etat dans le Developpement de la Production Rizicole, Direction des Etudes et Programmes, Direction Generale du Developpement Agricole, Ministere de l'Agriculture, Republique de Cote d'Ivoire, Abidjan, mai 1976. WARDA uses 10 percent losses plus seeding rate at 70 kilograms per hectare.
(Rice Statistics Yearbook, 1975, p. 119). Seed and losses are converted to rice equivalent at a milling ratio of .63.

[g]Net imports is defined as imports minus exports.

Unrecorded rice trade may flow from Mali to Ivory Coast, and from Ivory Coast to Ghana, Liberia, and perhaps Upper Volta, due to observed price differentials. Actual quantities unknown.

Average amounts of different qualities imported over 10 years include: 85 percent medium quality (25-30 percent brokens); 2 percent high quality, whole grains (negligible brokens); 13 percent brokens (varying from 5 to 50 percent of total yearly imports).

[h]Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[i]Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table A-5.—Liberia: Population and Rice Production, Trade, and Self-Sufficiency Ratios, 1965-76
(thousands of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population[a] (thousands) Total	Urban	Rural	Production[b,c]	Changes in stocks[d]	Seed and losses[e]	Net imports[f,g]	Net availability[h]	Self-sufficiency ratio[i]
1965	1,236	215	1,021	128	n.a.	18	33	143	.77
1966	1,263	225	1,038	130	n.a.	18	46	158	.71
1967	1,291	237	1,054	131	n.a.	18	34	147	.77
1968	1,319	248	1,071	134	n.a.	18	46	162	.72
1969	1,348	260	1,088	136	n.a.	19	28	145	.81
1970	1,378	272	1,106	138	n.a.	19	49	168	.71
1971	1,408	285	1,123	141	n.a.	20	54	175	.69
1972	1,439	298	1,141	143	n.a.	20	42	165	.74
1973	1,471	312	1,159	143	n.a.	21	46	175	.73
1974	1,503	325	1,178	153	n.a.	22	34	168	.79
1975	1,536	339	1,197	166	n.a.	23	31	174	.82
1976	1,570	354	1,216	153	n.a.	22	37	168	.78

Notes:

[a] Population census taken in 1974. Urban population is defined as cities with more than 13,000 inhabitants, estimated at 325,000. Population of cities with more than 2,000 inhabitants is 438,000.

Growth rate: total annual population growth rate is estimated at 2.2 percent. Birth rate is 50/1,000, estimated by Population Growth Survey (1971). Death rate is 28/1,000, estimated by W. Joseph (1975). No net immigration (Population Growth Survey (1971). A population census was performed in 1962, but data are not used due to suspected underestimation, particularly of urban population.

Rural annual population growth rate is 1.6 percent; Estimates from the National Rice Surveys, 1974-76.

Urban annual population growth rate is estimated as a residual and is equal to 4.6 percent.

[b] Paddy production is converted to rice equivalent at a milling ratio of .67, based on a milling survey for Liberia (1977) and a handpounding survey for Sierra Leone by D. Spencer (1975). Production year refers to later year of crop year. For example, 1965 production is from 1964-65 crop year.

Table A-5(continued)

[c] Production for years 1974-76 is taken from National Rice Surveys, 1974-76. Acreage estimations for years prior to 1974-76 are assumed to have changed in proportion to growth of farm population (1.6 percent per year). Average acreage and yields for 1974-76 are used as a basing point for the historical estimates.

Average yield - 1974-76 = 1.2 metric tons per hectare
Area under cultivation - 1974-76 = 197,000 hectares

An exception to this rule is made for years 1972-74, when a real price increase of 28 percent is assumed to have increased total acreage by 7 percent (assuming a supply elasticity of .3). Increases in marketed supply were substantially greater than this. A 1971 census found only 16 percent of farmers reporting any rice sales, while the 1976 National Rice Survey found 29 percent of farmers sold rice. These estimates are provisional.

[d] Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligible.

[e] Losses are 10 percent of paddy production. Seed use is 52 kilograms of paddy per hectare. Seeds and losses are converted to rice equivalent at a milling ratio of .67.

[f] Net imports is defined as imports minus exports. Imports are primarily raw rice, 35 percent brokens.

[g] Import statistics are taken from External Trade Statistics, Ministry of Planning and Economic Affairs.

[h] Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[i] Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table A-6.--Mali: Production and Rice Production Trade, and Self-Sufficiency Ratios, 1965-76[a]

(thousands of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population[b] (thousands) Total	Urban	Rural	Production[c]	Changes in stocks[d]	Seed and losses[e]	Net imports[f]	Net availability[g]	Self-sufficiency ratio[h]
1965	4,791	n.a.	n.a.	103	n.a.	21	(-4)	78	1.05
1966	4,912	n.a.	n.a.	105	n.a.	22	0	83	1.00
1967	5,037	n.a.	n.a.	103	n.a.	23	0	80	1.00
1968	5,164	n.a.	n.a.	110	n.a.	22	0	88	1.00
1969	5,295	n.a.	n.a.	88	n.a.	17	20	91	.78
1970	5,429	n.a.	n.a.	102	n.a.	19	15	98	.85
1971	5,567	n.a.	n.a.	110	n.a.	19	15	106	.86
1972	5,707	n.a.	n.a.	102	n.a.	16	31	117	.74
1973	5,852	n.a.	n.a.	72	n.a.	19	46	99	.54
1974	6,000	n.a.	n.a.	68	18	16	71	105	.50
1975	6,152	n.a.	n.a.	130	23	28	20	99	1.03
1976	6,308	717	5,591	168	(-10)	31	0	147	.93

Notes:

[a] Source: WARDA Rice Statistics Yearbook, 1975 and update, unless otherwise indicated.

[b] Source: Bureau Central de Recensement, Recensement General de la Population du Mali (1er au 16 Dec., 1976)--Resultats Provisoires, February 1977.

The only extant population census was conducted in 1976 and has only been partially tabulated. The figure for total population for 1976 is that obtained by this census. Of this total of 6,308,320, the population living in towns of over 10,000 inhabitants was 716,749, or 11.4 percent of the total. The best estimate of population growth is 2.5 percent per annum. This is based on a 1960 survey which recorded a birth rate of 55/1,000 and a mortality rate of 30/1,000. These are consistant with the experience of other similar countries in Africa.

[c] Paddy production is converted to rice equivalent at a milling ratio of .65. Production year refers to later year of crop year. For example, 1965 production is from 1964-65 crop year.

Table A-6 (continued)

[d] Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligible.

[e] Losses are 10 percent of paddy production. Seed use is 100 kilograms of paddy per hectare. Seeds and losses are converted to rice equivalent at a milling ratio of .65.

[f] Net imports is defined as imports minus exports. Imports are primarily 25-40 percent brokens.

[g] Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[h] Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table A-7.--Mauritania: Production and Rice Production, Trade, and Self-Sufficiency Ratios, 1965-76[a]

(thousands of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population (thousands)			Production[b]	Changes in stocks[c]	Seed and losses[d]	Net imports[e]	Net availability[f]	Self-sufficiency ratio[g]
	Total	Urban	Rural						
1965	1,030	n.a.	n.a.	.5	n.a.	.1	.4	.8	.50
1966	1,052	n.a.	n.a.	.5	n.a.	.1	1.6	2.0	.20
1967	1,076	n.a.	n.a.	.5	n.a.	.1	11.1	11.5	.03
1968	1,099	n.a.	n.a.	.5	n.a.	.1	12.1	12.5	.03
1969	1,123	n.a.	n.a.	.7	n.a.	.1	19.9	20.5	.03
1970	1,148	n.a.	n.a.	1.0	n.a.	.1	10.6	11.5	.06
1971	1,177	n.a.	n.a.	0.5	n.a.	.1	27.4	27.8	.01
1972	1,205	n.a.	n.a.	1.3	n.a.	.1	30.1	31.3	.04
1973	1,234	n.a.	n.a.	1.6	n.a.	.2	23.0	24.4	.06
1974	1,264	n.a.	n.a.	2.4	n.a.	.3	31.3	33.4	.06
1975	1,295	n.a.	n.a.	2.5	n.a.	.3	11.0	13.2	.17
1976	1,329	n.a.	n.a.	2.6	n.a.	.3	20.4	22.7	.10

Notes:

[a]Source: WARDA Rice Statistics Yearbook, 1975 and update unless otherwise indicated.

[b]Paddy production is converted to rice equivalent at a milling ratio of .65. Production year refers to later year of crop year: for example, 1965 production is from 1964-65 crop year.

[c]Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligible.

[d]Losses are 10 percent of paddy production. Seed use is 77 kilograms of paddy per hectare. Seed and losses are converted to rice equivalent at a milling ratio of .65.

[e]Net imports is defined as imports minus exports. Imports are primarily 65 percent brokens.

[f]Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[g]Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table A-8--Niger: Population and Rice Production, Trade, and Self-Sufficiency Ratios, 1965-76[a]
(thousands of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population[b] (thousands) Total	Urban	Rural	Production[c,d]	Changes in stocks[e,f]	Seed and losses[g]	Net imports[h,i]	Net availability[j]	Self-sufficiency ratio[k]
1965	4,371	326	4,045	7.5	n.a.	1.3	2.3	8.5	.73
1966	4,494	349	4,145	13.1	n.a.	1.9	1.0	12.2	.92
1967	4,620	374	4,246	20.9	n.a.	2.8	1.6	19.7	.92
1968	4,749	400	4,349	25.0	n.a.	3.5	0.4	21.9	.98
1969	4,882	428	4,454	25.0	n.a.	3.5	0.1	21.6	1.00
1970	5,019	458	4,561	23.7	n.a.	3.4	0.1	20.4	1.00
1971	5,159	490	4,669	17.5	n.a.	2.8	0.0	14.7	1.00
1972	5,304	524	4,780	20.4	n.a.	3.1	1.1	18.4	.94
1973	5,452	561	4,891	15.2	n.a.	2.1	0.6	13.7	.96
1974	5,605	600	5,005	16.4	n.a.	2.5	8.1	22.0	.63
1975	5,762	642	5,120	19.3	(-0.8)	2.9	8.6	25.8	.64
1976	5,923	687	5,236	18.8	0.2	2.5	n.a.	n.a.	n.a.

Notes:

a Source: WARDA Rice Statistics Yearbook, 1975 and update, unless otherwise noted.

b 1) Urban population is defined as cities with a population of 10,000 or more.
2) Estimates used here are based on a 1968 pilot census and an administrative census taken in t same year by the Direction du Douanes et Statistiques.
3) Estimates assume a growth rate of 2.8 percent. Urban areas are assumed to grow at 7 percent annually.

c Paddy production is converted to rice equivalent at a milling ratio of .64. Production year refers to later year of crop year. For example, 1965 production is from 1964-65 crop year.

d Source: For 1975-76: Direction de l'Agriculture-Service Statistique.

e Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligi

f Source: Direction de l'Agriculture-Service Statistique. Stocks are officially held stocks as of September 30.

Table A-8 (continued)

[g] Losses are 10 percent of paddy production. Seed use is 100 kilograms of paddy per hectare. Seeds and losses are converted to rice equivalent at a milling ratio of .64.

[h] Net imports is defined as imports minus exports.

[i] Source: Direction de l'Agriculture-Service Statistique.
1) This includes aid rice, delivered in the following amounts(in metric tons): 1974, 8,000; 1975, 7,600.
2) Whole grain rice is the dominant imported quality; 99 percent of 1975 imports came from PR

[j] Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[k] Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table A-9.--Nigeria: Population and Rice Production, Trade, and Self-Sufficiency Ratios, 1965-75[a]

(thousand of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population[b] (thousands) Total	Urban	Rural	Production[c]	Changes in stocks[d]	Seed and losses[e]	Net imports[f]	Net availability[g]	Self-sufficiency ratio[h]
1965	48,680	n.a.	n.a.	135.0	n.a.	19.5	1.4	116.9	.99
1966	49,890	n.a.	n.a.	139.2	n.a.	19.2	1.3	121.3	.99
1967	51,110	n.a.	n.a.	120.0	n.a.	20.6	1.5	100.9	.98
1968	52,420	n.a.	n.a.	231.6	n.a.	30.9	0.3	201.0	1.00
1969	53,730	n.a.	n.a.	211.8	n.a.	29.6	0.7	182.9	1.00
1970	55,070	n.a.	n.a.	195.0	n.a.	27.7	1.8	169.1	.99
1971	56,560	n.a.	n.a.	165.6	n.a.	13.9	0.3	152.0	1.00
1972	58,090	n.a.	n.a.	165.0	n.a.	16.0	5.9	154.9	.96
1973	59,660	n.a.	n.a.	265.2	n.a.	19.8	1.1	246.5	1.00
1974	61,270	n.a.	n.a.	287.4	n.a.	20.5	4.7	271.6	.98
1975	62,930	n.a.	n.a.	321.0	n.a.	21.3	5.0	304.7	.98

Notes:

[a]Source: WARDA Rice Statistics Yearbook, 1975 and update, unless otherwise indicated.

[b]Population data are from U.N. Demographic Yearbook. These are U.N. estimates. There is some controversy over the results of the Nigerian censuses. Urban/rural figures were only available for 1963 when 19 percent of the population lived in cities of 20,000 or more.

[c]Paddy production is converted to rice equivalent at a milling ratio of .60. Production year refers to later year of crop year: for example, 1965 production is from 1964-65 crop year.

[d]Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligible.

[e]Losses are 10 percent of paddy production. Seed use is 55 kilograms of paddy per hectare. Seed and losses are converted to rice equivalent at a milling ratio of .60.

[f]Net imports is defined as imports minus exports. Imports are primarily whole grain.

[g]Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[h]Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table A-10.--Senegal: Population and Rice Production, Trade, and Self-Sufficiency Ratios, 1965-76
(thousand of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population[a] (thousands) Total	Urban	Rural	Production[b,c]	Changes in stocks[d]	Seed and losses[e]	Net imports[f,g]	Net availability[h]	Self-sufficiency ratio[i]
1965	3,851	911	2,940	71.5	n.a.	10.4	179.2	240.3	.25
1966	3,949	951	2,998	79.5	n.a.	11.4	159.3	227.4	.30
1967	4,051	993	3,058	81.5	n.a.	11.7	153.4	223.2	.31
1968	4,154	1,034	3,120	89.5	n.a.	13.1	185.2	261.6	.29
1969	4,261	1,082	3,179	37.8	n.a.	6.6	145.9	177.1	.18
1970	4,370	1,130	3,240	100.3	n.a.	14.4	125.6	211.5	.41
1971	4,482	1,180	3,302	58.8	n.a.	9.7	186.8	235.9	.21
1972	4,596	1,232	3,364	70.3	n.a.	10.5	165.8	225.6	.26
1973	4,714	1,286	3,428	23.8	n.a.	4.2	192.5	212.1	.09
1974	4,835	1,342	3,493	41.8	56.0	6.8	207.2	186.2	.19
1975	4,958	1,401	3,557	76.1	(-56.0)	10.9	123.8	245.0	.27
1976	5,085	1,463	3,622	71.5	n.a.	11.9	167.1	226.7	.26

Notes:

[a] Sources: Bureau du Recensement, Resultats Provisoires du Recensement General de la Population April 1976 (for estimates of growth rates).

1. Inconsistencies occur between the most recent census and earlier censuses of 1960/61 and 1970/71. The most recent growth rate estimates of 2.56 percent per annum are used in making historical extrapolation.

2. Urban is defined here as agglomerations of 10,000 inhabitants or over. The most recent census gave an urban growth rate of 4.4 percent per annum which was used to estimate earlier urban populations. Rural figures are total population minus estimated urban population.

[b] Paddy production is converted to rice equivalent at a milling ratio of .65. Production year refers to later year of crop year: for example, 1965 production is from 1964-65 crop year.

[c] Source: ONCAD, Ministere du Plan, Actions Planifees, MDRH, Annual Reports.

[d] Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligible.

[e] Losses are 10 percent of paddy production. Seed use is 80 kilograms of paddy per hectare. Seed and losses are converted to rice equivalent at a milling ratio of .65.

Table A-10 (continued)

[f]Net imports is defined as imports minus exports. Imports are primarily brokens.

[g]Source: Direction de la Statistique, Importations Speciales and WARDA Rice Statistics Yearbook, 1975. The following years included food aid (thousand metric tons):

1970	7.0
1973	0.5
1974	3.2
1976	0.8

[h]Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[i]Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table A-11--Sierra Leone: Population and Rice Production, Trade, and Self-Sufficiency Ratios, 1965-76

(thousands of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population[a] (thousands) Total	Urban	Rural	Production[b,c]	Changes in stocks[d]	Seed and losses[e]	Net imports[f,g]	Net availability[h]	Self-sufficiency ratio[i]
1965	2,272	463	1,809	n.a.	n.a.	n.a.	18.7	n.a.	n.a.
1966	2,319	490	1,829	268.7	n.a.	44.6	34.5	258.6	.87
1967	2,367	519	1,848	281.9	n.a.	46.7	23.8	259.0	.91
1968	2,416	550	1,866	295.3	n.a.	48.8	16.9	263.4	.94
1969	2,466	582	1,884	309.4	n.a.	51.1	12.7	271.0	.95
1970	2,517	616	1,901	324.8	n.a.	53.6	49.4	320.6	.84
1971	2,569	653	1,916	416.9	n.a.	63.7	26.9	380.1	.93
1972	2,622	691	1,931	359.3	n.a.	58.9	6.6	307.0	.98
1973	2,676	732	1,944	377.9	3.0	61.8	43.7	356.8	.88
1974	2,729	775	1,954	398.2	27.3	72.0	45.0	343.9	.95
1975	2,786	821	1,965	407.7	-5.3	63.5	10.0	359.5	.96
1976	2,844	869	1,973	408.0	-17.6	64.0	3.5	365.1	.94

Notes:

[a]Source: 1963 and 1974 totals are census figures. They indicate an annual total population growth rate of 2.07.
Urban is defined as all western area and towns with more than 2,000 inhabitants and with more than 50 percent of the working population engaged in non-farm activities in 1963. Annual urban growth rate for 1963-74 was 5.9 percent.
Rural figures are calculated as a residual.

[b]Paddy production is converted to rice equivalent at a milling ratio of .67. Production year refers to later year of crop year. For example, 1965 production is from 1964-65 crop year.

[c]1965 and 1970 Agricultural Statistical Survey of Sierra Leone (Central Statistics Office); previously published figures for 1970 have been corrected for errors in yield computation. 1971 and 1974 figures are from Njala University College surveys (Spencer). 1966-73 figures are extrapolations of trend between 1965 and 1971 surveys since 1970 was known to have been an exceptionally good crop year climatically, and inland swamp production received a boost from the concentrated efforts of the Ministry of Agriculture under its inland swamp subsidy scheme. In 1974 there was a mini-drought which affected crop yields. Also upland rice acreage increased greatly because of the doubling of guaranteed producer prices of that year.

Table A-11. (continued)

[d] Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-72 are not available but are believed to be negligible.

[e] Source: Rice Corporation.

[f] Losses are 10 percent of paddy production. Seed use is 67 kilograms of paddy per hectare for upland and 150 kilograms per hectare for swamps. Seeds and losses are converted to rice equivalent at a milling ratio of .67.

[g] Net imports is defined as imports minus exports. Imports are primarily parboiled rice, 20-40 percent brokens.

[h] Source: Rice Corporation.

[i] Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[j] Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table A-12.--Togo: Population and Rice Production

Trade, and Self-Sufficiency Ratios, 1965-75[a]

(thousands of metric tons of milled rice equivalent,

unless otherwise indicated)

Year	Population[b] (thousands) Total	Urban	Rural	Production[c]	Changes in stocks[d]	Seed and losses[e]	Net imports[f]	Net availability[g]	Self-sufficiency ratio[h]
1965	1,718	172	1,546	13.2	n.a.	2.0	2.9	14.1	.79
1966	1,763	186	1,577	15.2	n.a.	2.5	3.7	16.4	.77
1967	1,809	201	1,608	18.5	n.a.	2.8	2.6	18.3	.86
1968	1,856	217	1,639	11.9	n.a.	2.0	1.3	11.2	.88
1969	1,904	235	1,669	9.9	n.a.	1.8	2.4	10.5	.77
1970	1,954	254	1,700	11.0	n.a.	2.0	3.1	12.1	.74
1971	2,005	275	1,730	8.0	n.a.	1.6	1.1	7.5	.85
1972	2,057	297	1,760	9.9	n.a.	1.5	5.2	13.6	.62
1973	2,110	321	1,789	8.6	n.a.	1.3	4.3	11.6	.63
1974	2,165	347	1,818	7.3	n.a.	1.1	0.1	6.3	.98
1975	2,221	375	1,846	7.1	n.a.	1.1	1.0	7.0	.86

Notes:

[a] Sources: WARDA Rice Statistics Yearbook 1975 and update, unless otherwise indicated.

[b] Source: For Rural/Urban figures: UN Demographic Yearbook, 1975. In 1970, 13 percent of the population was urban and in 1973, 15.2 percent was urban.

[c] Paddy production is converted to rice equivalent at a milling ratio of .66. Production year refers to later year of crop year. For example, 1965 production is from 1964-65 crop year.

[d] Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligible.

[e] Losses are 10 percent of paddy production. Seed use is 50 kilograms of paddy per hectare. Seeds and losses are converted to rice equivalent at a milling ratio of .66.

Table A-13.—Upper Volta: Population and Rice Production, Trade, and Self-Sufficiency Ratios, 1965-76[a]

(thousands of metric tons of milled rice equivalent, unless otherwise indicated)

Year	Population[b] (thousands) Total	Urban	Rural	Production[c,d]	Changes in stocks[e]	Seed and losses[f]	Net imports[g]	Net availability[h]	Self-sufficiency ratio[i]
1965	4,585	179	4,406	21.1	n.a.	3.9	3.2	20.4	.84
1966	4,677	192	4,485	21.1	n.a.	3.9	4.1	21.3	.81
1967	4,772	206	4,566	21.1	n.a.	3.9	7.5	24.7	.70
1968	4,868	221	4,647	24.8	n.a.	4.8	1.3	21.3	.94
1969	4,967	237	4,730	24.8	n.a.	4.5	1.5	21.8	.93
1970	5,067	254	4,813	21.1	n.a.	4.2	2.3	19.2	.88
1971	5,169	272	4,897	21.3	n.a.	4.1	1.1	18.3	.94
1972	5,274	292	4,982	19.8	n.a.	3.6	1.6	17.8	.91
1973	5,380	313	5,067	15.9	n.a.	3.5	1.0	13.4	.92
1974	5,489	336	5,153	19.2	2.7	3.8	18.7	31.4	.49
1975	5,600	360	5,240	20.0	(-1.5)	3.9	9.7	27.3	.59
1976	5,712	367	5,345	24.7	(-1.2)	4.5	n.a.	n.a.	n.a.

Notes:

[a] Source: WARDA Rice Statistics Yearbook, 1975 and update, unless otherwise indicated.

[b] Source: 1975 Census, Institut National de la Statistique et de la Demographie. Annual growth rate = 2 percent per annum; urban growth rate = 7 percent per annum.

[c] Paddy production is converted to rice equivalent at a milling ratio of .62. Production year refers to later year of crop year. For example, 1965 production is from 1964-65 crop year.

[d] Source: For 1971-1976: Ministère de l'Agriculture et de l'Elevage.

[e] Changes in stocks represents stocks at the end of the indicated year minus stocks at the beginning of the same year. Figures for 1965-73 are not available but are believed to be negligible.

Table A-13 (continued)

[f] Losses are 10 percent of paddy production. Seed use is 80 kilograms of paddy per hectare. Seeds and losses are converted to rice equivalent at a milling ratio of .62.

[g] Net imports is defined as imports minus exports. In 1974, 17,500 metric tons of imports were food aid. Qualities imported: both brokens and whole grains are imported. For 1975, 70 percent of imports were whole grains, 30 percent of imports were brokens.

[h] Net availability is defined as production minus seed and losses, minus changes in stocks, plus net imports.

[i] Self-sufficiency ratio is defined as production minus seed and losses, divided by net availability.

Table B-1.--Benin: Selected Price Series, 1970-76[a]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f.[b]	Retail official	Wholesale official	Producer, official[c]	
				Paddy	Milled rice equivalent[d]
1970	.16	.18	.18	.06	.09
1971	.15	.18	.16	.06	.09
1972	.15	.26	.17	.06	.09
1973	.10	.29	n.a.	.09	.14
1974	.59	.29	n.a.	.10	.15
1975	n.a.	.44	.40	.19	.29
1976	n.a.	.43	n.a.	n.a.	n.a.

Notes:

[a]Source: WARDA Rice Statistics Yearbook, 1975 and update.

[b]c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily 30 percent brokens.

[c]Applicable to crop year ending in year indicated.

[d]Milled rice equivalent prices are obtained by dividing producer paddy prices by a milling ratio of .65.

Table B-2.--Gambia: Selected Price Series, 1966-76

(annual average US$ per kilogram of milled rice, unless otherwise indicated)[a,b]

Year	c.i.f. Banjul[c,d]	Retail Banjul official		Retail market price		Producer, official[e]	
		Local	Imported	Local	Imports	Paddy	Milled rice equivalent[f]
1966	.11	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1967	.11	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1968	.12	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1969	.15	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1970	.12	n.a.	n.a.	.17	.17	n.a.	n.a.
1971	.10	n.a.	n.a.	.18	.17	.04	.06
1972	.10	.18	.18	.19	.18	.08	.12
1973	.24	.21	.21	.23	.21	.09	.14
1974	.36	.28	.28	.26	.25	.13	.20
1975	.35	.26	.26	n.a.	n.a.	.14	.22
1976	.17	n.a.	n.a.	n.a.	n.a.	.14	.22

[a]Prices are converted at the average exchange rate for the year indicated. Exchange rates for 1965-69 are obtained from the WARDA Rice Statistics Yearbook, 1975 and for 1969-76 from the IMF International Financial Statistics.

[b]Source: WARDA Rice Statistics Yearbook, 1975 and update, unless otherwise indicated.

[c]c.i.f. prices are average unit values, obtained by dividing the total value of inputs by the total quantity. All prices refer to financial year, rather than calendar year. Imports are primarily Burmese brokens, B1 and B2.

[d]Source: Gambia Produce Marketing Board, 1973-76.

[e]Applicable to crop year ending in year indicated.

[f]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .65.

Table B-3.--Ghana, Selected Price Series, 1965-76[a,b]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f.[c]	Retail official	Wholesale, official		Producer, official[d]	
			Local	Imported	Paddy	Milled rice equivalent[e]
1965	.14	n.a.	.19	.26	n.a.	n.a.
1966	.16	n.a.	.20	.25	n.a.	n.a.
1967	.18	n.a.	.18	.26	n.a.	n.a.
1968	.22	n.a.	.18	.27	n.a.	n.a.
1969	.21	n.a.	.22	.31	.10	.15
1970	.19	n.a.	.22	.30	.10	.15
1971	.17	.29	.23	.29	.12	.19
1972	.19	.36	.24	.32	.09	.15
1973	.23	.45	.37	.51	.13	.20
1974	.51	n.a.	.37	n.a.	.16	.25
1975	n.a.	.61	n.a.	n.a.	.15	.24
1976	n.a.	n.a.	n.a.	n.a.	.15	.24

Notes:

[a]Source: WARDA Rice Statistics Yearbook, 1975 and update.

[b]Prices are converted at the average exchange rate for the year indicated. Exchange rates for 1965-69 are obtained from the WARDA Rice Statistics Yearbook, 1975 and for 1969-76 from the IMF International Financial Statistics.

[c]c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily 35 percent broken .

[d]Applicable to crop year ending in year indicated.

[e]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .63.

Table B-4.—Ivory Coast: Selected Price Series, 1965-76[a]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f. Abidjan[b]	Retail		Wholesale (buying)	Producer, official[d,f]	
		Abidjan market[c]	official[d]	Abidjan official[d,e]	Paddy	Milled rice equivalent[g]
1965	.12	.20	n.a.	n.a.	.07	.11
1966	.16	.22	n.a.	n.a.	.07	.11
1967	.15	.24	.22	.20	.07	.11
1968	.16	.23	.22	.20	.08	.13
1969	.13	.23	.21	.19	.08	.13
1970	.09	.27	.18	.16	.08	.13
1971	.07	n.a.	.18	.16	.08	.13
1972	.11	n.a.	.20	.18	.10	.16
1973	.26	n.a.	.28	.26	.13	.20
1974	.46	n.a.	.48	.44	.27	.43
1975	n.a.[h]	n.a.	.50	.45	.30	.48
1976	n.a.[h]	n.a.	.42	.37	.27	.43

Notes:

[a]Prices are converted at the average exchange rate for the year indicated. Exchange rates for 1965-69 are obtained from the WARDA Rice Statistics Yearbook, 1975 and for 1969-76 from the IMF International Financial Statistics.

[b]c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily 25-30 percent brokens.

[c]Retail prices 1965-70 from Bulletins Mensuels de Statistique, Direction de la Statistique, Ministere de l'Economie et des Finances, Abidjan.

[d]Official prices (nation-wide) from Journal Officiel de Cote d'Ivoire, Abidjan, 1973-76.

[e]Wholesale prices 1967-72 calculated by subtracting 5 percent marketing margin from known official retail prices, Etude sur la Commercialisation et la Consummation du Riz en Cote d'Ivoire, SEDES, Paris, 1968.

[f]Applicable to crop year ending in year indicated.

[g]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .63.

[h]Average unit values for these years are not listed because imports were in small amounts and were primarily of luxury rice.

Table B-5.—Liberia: Selected Price Series, 1965-76[a]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f.[b]	Retail, Monrovia		Producer, official[c]	
		Local	Imported	Paddy	Milled rice equivalent[d]
1965	.19	n.a.	n.a.	n.a.	n.a.
1966	.16	n.a.	n.a.	n.a.	n.a.
1967	.19	.29	.29	n.a.	n.a.
1968	.19	.29	.30	n.a.	n.a.
1969	.19	.32[e]	.32[e]	.07	.10
1970	.20	.31[e]	.31[e]	.07	.10
1971	.18	.30[e]	.30[e]	.07	.10
1972	.18	.31	.28	.11	.16
1973	.27	.44	.48	.15	.22
1974	.46	.55	.55	.22	.33
1975	.64	.51	.54	.26	.39
1976	.34	.49	.51	.26	.39

Notes:

[a]Sources: Price Statistics Division, Ministry of Planning and Economic Affairs; External Trade Statistics, Ministry of Planning and Economic Affairs.

[b]c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily raw rice, 35 percent brokens.

[c]Applicable to crop year ending in year indicated.

[d]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .67.

[e]Only averages of local and imported retail prices are available for 1969-71.

Table B-6.--Mali: Selected Price Series, 1965-77[a]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f.[b,c]	Retail				Wholesale, official[f]	Producer, officia	
		Official[d]		Market[e]				
		White parboiled	40 percent brokens	White parboiled	40 percent brokens	40 percent brokens	Paddy	Milled eq equivalen
1965	n.a.	.09	n.a.	.18	n.a.	.15	.02	.04
1966	n.a.	.09	n.a.	.21	n.a.	.16	.02	.04
1967	n.a.	.11	n.a.	.21	.23	.19	.03	.05
1968	n.a.	.11	n.a.	.20	.23	.12	.04	.06
1969	.16	n.a.	n.a.	.17	.16	.11	.04	.06
1970	.14	n.a.	n.a.	.16	.17	.13	.05	.07
1971	.13	n.a.	n.a.	.21	.20	.13	.05	.07
1972	.14	.16	.16	.24	.24	.15	.05	.08
1973	.26	.18	.18	.39	.34	.17	.06	.09
1974	.49	.17	.19	.33	.33	.17	.05	.08
1975	.48	.26	.26	.31	.35	.24	.10	.15
1976	n.a.	.23	.23	.28	.30	n.a.	.09	.14
1977	n.a.	n.a.	.22[i]	n.a.	n.a.	n.a.	.08[i]	.13

[a] Prices are converted at the average exchange rate for the year indicated. Exchange rates for 1965-69 are obtained from the WARDA Rice Statistics Yearbook, 1975 and for 1969-77 from the IMF International Financial Statistics.

[b] c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily 25-40 percent brokens.

[c] Source: WARDA Rice Statistics Yearbook. Unit c.i.f. values Abidjan have been converted to c.i.f. values Mali frontier by adding estimated handling and transport costs.

[d] Source: Office des Produits Agricoles du Mali.

[e] Source: Direction National du Plan et de la Statistique.

[f] Source: "MALI--Etude prospective de l'intensification de la riziculture à l'Office du Niger," WARDA, 1977.

Table B-6 (continued)

[g]Applicable to crop year ending in year indicated.

[h]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .65.

[i]Average exchange rates for January and February 1977 were used for conversion.

Table B-7.--Mauritania: Selected Price Series, 1970-76[a,b]

(annual average US$ per kilogram of milled rice, unless otherwise specified)

Year	c.i.f.[c]	Retail market		Wholesale official		Producer, official[d]	
		Wholegrain	Brokens	Wholegrain	Brokens	Paddy	Milled rice equivalent[e]
1970	.11	.43	n.a.	.36	.23	.09	.14
1971	.09	.43	n.a.	.40	.14	.09	.14
1972	.10	.57	n.a.	.40	.16	.08	.12
1973	.15	.56	n.a.	.49	.18	.07	.11
1974	.37	.58	[illegible]	.60	.32	.18	.28
1975	.32	.65	.42	.69	.58	.25	.38
1976	.21	.73	.33	.40	.29	.20	.31

[a]Source: MPOURIE Direction, SONIMEX and WARDA Rice Statistics Yearbook, 1975.

[b]Prices are converted at the average exchange rate for the year indicated. Exchange rates for 1965-69 are obtained from the WARDA Rice Statistics Yearbook, 1975 and for 1969-76 from the IMF International Financial Statistics.

[c]c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily 65 percent brokens.

[d]Applicable to crop year ending in year indicated.

[e]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .65.

Table B-8.--Niger: Selected Price Series, 1965-76[a,b]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f.[c]	Retail	Producer, official[d]	
		Local rice	Paddy	Milled rice equivalent[e]
1965	.04	.24	n.a.	n.a.
1966	.13	.25	n.a.	n.a.
1967	.13	.26	.07	.11
1968	.17	.22	.08	.12
1969	.39	.25	.07	.11
1970	.31	.23	.08	.12
1971	.42	.24	.08	.12
1972	.19	.29	.09	.14
1973	.20	.43	.13	.20
1974	n.a.	.37	.14	.22
1975	.35	.42	.16	.25
1976	n.a.	.43	.17	.26

Notes:

[a]Source: Direction de l'Agriculture-Service Statistique and Direction des Douanes et Statistiques.

[b]Prices are converted at the average exchange rate for the year indicated. Exchange rates for 1965-69 are obtained from the WARDA Rice Statistics Yearbook, 1975 and for 1969-76 from the IMF International Financial Statistics.

[c]c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily whole grain rice.

[d]Applicable to crop year ending in year indicated.

[e]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .64.

Table B-9.—Nigeria: Selected Price Series, 1965-74[a]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f.[b] Lagos c.i.f.	Retail Lagos official	Producer, official[c] Paddy	Producer, official[c] Milled rice equivalent[d]
1965	.25	.27	.21	.35
1966	.28	.31	.24	.40
1967	.27	.30	.24	.40
1968	.23	.28	.22	.37
1969	.11	.32	.28	.47
1970	.11	.37	.28	.47
1971	.28	.51	.35	.58
1972	.21	.49	.40	.67
1973	.31	.47	n.a.	n.a.
1974	.38	.62	n.a.	n.a.

[a]Source: WARDA Rice Statistics Yearbook, 1975 and update.

[b]c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily whole grain.

[c]Applicable to crop year ending in year indicated.

[d]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .60.

Table B-10.--Senegal: Selected Price Series, 1965-76[a]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f.[b,c]	Retail			Wholesale[f]	Producer, official[g]	
		Dakar private wholegrain[d]	Private[e] brokens	Official brokens	Dakar official	Paddy	Milled rice equivalent[h]
1965	.10	.38	n.a.	.12	n.a.	.07	.12
1966	.11	.44	n.a.	.14	n.a.	.07	.12
1967	.14	.42	.19	.14	.16	.08	.13
1968	.15	.41	.20	.14	.17	.08	.13
1969	.11	.42	.19	.17	n.a.	.08	.13
1970	.11	.41	.19	.16	n.a.	.07	.12
1971	.09	.39	.20	.14	.14	.07	.12
1972	.10	.50	.21	.16	n.a.	.08	.13
1973	.22	.66	.29	.27	n.a.	.09	.15
1974	.36	1.38	.29	.25/.42[i]	.40	.10/.18[i]	.16/.27[i]
1975	.34	1.71	.57	.47	.44	.20	.30
1976	.18	1.17	.37	.42/.33[j]	.40	.18	.27

Notes:

[a] Prices are converted at the average exchange rate for the year indicated. Exchange rates for 1965-69 are obtained from the WARDA Rice Statistics Yearbook, 1975 and for 1969-76 from the IMF International Financial Statistics.

[b] c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily brokens.

[c] Source: Trade data from Direction de la Statistique and WARDA Rice Statistics Yearbook.

[d] Source: Direction de la Statistique.

[e] Source: Caisse de Perequation et de Stabilisation des Prix.

[f] Sources: SATEC, Developpement de la Riziculture au Senegal, Rapport General, 1968, p. 55 and Journal Official de la Republique du Senegal, various issues.

Table B-10 (continued)

[g]Applicable to crop year ending in year indicated. From Journal Official de la Republique du Senegal and Ministère du Developpement Rural et de l'Hydraulique (MDRH).

[h]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .65.

[i]Price change effective October 1974.

[j]Price change effective May 1976.

Table B-11.—Sierra Leone: Selected Price Series, 1960-77[a]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f.[b] Freetown	Retail[c] Market	Wholesale[d] Official	Producer, official[e] Paddy[d]	Producer, official[e] Milled rice Equivalent[f]
1960	.06	n.a.	.09	.05	.07
1961	.07	n.a.	.09	.05	.07
1962	.07	.12	.09	.04	.06
1963	.06	.15	.09	.04	.06
1964	.12	.12	n.a.	.04	.06
1965	.07	.14	n.a.	.04	.06
1966	.07	.14	.09	.04	.06
1967	.07	.14	.09	.05	.07
1968	.13	.17	.11	.06	.09
1969	.10	.18	.13	.06	.09
1970	.09	.21	.17	.06	.09
1971	.08	.17	.17	.07	.10
1972	.10	.19	.16	.06	.09
1973	.11	.20	.16	.07	.10
1974	.33	.32	.27[e]	.10	.15
1975	n.a.	.41	.37	.16	.24
1976	n.a.	.51	.45	.19	.28
1977	n.a.	n.a.	.48[g]	.21[g]	.31

[a] Prices are converted at the average exchange rate for the year indicated. Exchange rates for 1965-69 are obtained from the WARDA Rice Statistics Yearbook, 1975 and for 1969-77 from the IMF International Financial Statistics.

[b] c.i.f. prices are average unit values, obtained by dividing the total value of imports by t total quantity. Imports are primarily 20-40 percent brokens.

[c] Source: Ministry of Labor and Central Statistics Office.

[d] Source: Rice Corporation

[e] Applicable to crop year ending in year indicated.

Table B-11 (continued)

[f]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .67.

[g]Average of January and February 1977 exchange rates used for conversion.

Table B-12.—Togo: Selected Price Series, 1970-75[a]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f.[b]	Retail official	Wholesale official	Producer, official[c]	
				Paddy	Milled rice equivalent[d]
1970	.14	.30	n.a.	.06	.09
1971	.14	.30	n.a.	.07	.11
1972	.14	.31	n.a.	.09	.14
1973	.21	.39	.21	.11	.17
1974	.31	.56	n.a.	.11	.17
1975	.29	n.a.	n.a.	n.a.	n.a.

[a]Source: WARDA Rice Statistics Yearbook, 1975 and update.

[b]c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily white rice, whole grain.

[c]Applicable to crop year ending in year indicated.

[d]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .66.

Table 8-13.--Upper Volta: Selected Price Series, 1965-76[a,b]

(annual average US$ per kilogram of milled rice, unless otherwise indicated)

Year	c.i.f.[c]	Retail, market		Producer, official[d]	
		White	Red	Paddy[d]	Milled rice equivalent[e]
1965	.14	.36	.23	.11	.18
1966	.16	.39	.25	.10	.16
1967	.17	.32	.23	.10	.16
1968	.12	.26	.22	.07	.11
1969	.12	.31	.26	.08	.13
1970	.12	.27	.22	.07	.11
1971	.12	.23	.19	.11	.18
1972	.14	.26	.24	.12	.19
1973	.20	.35	.31	.13	.21
1974	n.a.	.38	.35	.15	.24
1975	.38	.56	.54	.16	.26
1976	n.a.	.61	.63	.15	.24

Notes:

[a]Sources: Institut National de la Statistique and Ministere du Developpement Rural.

[b]Prices are converted at the average exchange rate for the year indicated. Exchange rates for 1965-69 are obtained from the WARDA Rice Statistics Yearbook, 1975 and for 1969-76 from the IMF International Financial Statistics.

[c]c.i.f. prices are average unit values, obtained by dividing the total value of imports by the total quantity. Imports are primarily whole grains.

[d]Applicable to crop year ending in year indicated.

[e]Milled rice equivalent prices are obtained by dividing producer paddy prices by the milling ratio of .62.

Table C-11a.--Sierra Leone:
Production Budget for Farming
Improved Inland Swamp, South
(Leones per hectare)

Inputs	Tradable inputs: c.i.f. cost	Tradable inputs: Indirect taxes/ subsidies	Taxes/subsidies on labor and capital	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Return to domestic capital	Total market value
1. Direct labor inputs[a]				298	238.40			238.40
A. Land preparation				18				
B. Seeding and planting				118				
C. Weeding				15				
D. Chemical application				2				
E. Control of birds, etc.				15				
F. Harvest				90				
G. Threshing, winnowing				35				
H. Transport				5				
2. Hand tools[b]	12.22						1.21[c]	13.43
3. Seeds[d]	3.13	-0.77	-2.02		13.55	1.82	3.92	19.63
4. Fertilizer[e]	50.77	-28.70	-1.83			2.46		22.70
5. Insecticides, etc.								
6. Land development[f]	12.34	-4.50	-28.30	230	7.09	20.10	69.50[g]	76.23
7. Animals								
8. Equipment								
9. Machinery								
10. Irrigation operation and maintenance								
11. Extension services[h]	6.28	-6.28	-10.82			10.52	.30	0
12. Water charge								
13. Other costs								
Total costs	84.74	-40.25	-42.97		259.04	34.90	74.93	370.39

Yield 3,600[i]; market price of paddy .152; ratios of shadow price to market price for: unskilled labor 1.0, skilled labor 1.0, capital .56, and foreign exchange 1.15/.90; total social cost per hectare 444.18; total social cost per metric ton rice equivalent Le. 184[j], $160[k].

Table C-11a (continued)

Notes:

[a]Man-day inputs are based on 1971/72 and 1974/75 production surveys (Spencer and Byerlee, 1976; Spencer, 1975). The rural wage rate is estimated at Le. .80 per man day, 2/3 of government minimum wage.

[b]Traditional tools are evaluated at a 20 percent opportunity cost (Le. 1.33) and 40 percent operator cost (Le. .176). An additional investment of Le. 16.05, made under project auspices, is depreciated over three years at 20 percent opportunity cost and 8 percent operator cost.

[c]In contrast with this figure, the social value of capital is Le. 0.84.

[d]Seeding rates of 67 kilograms per hectare are based on survey results. The project sells seed for Le. 8.00 per bushel of 60 pounds (Le. .293/kilogram). Costs are distributed in proportion to other costs of production.

[e]These compound fertilizer costs are based on an Eastern Area Project survey result which found farmers using 267 kilograms per hectare. The project recommends 295 kilograms/hectare

[f]Land development-1974/75 survey (Spencer and Byerlee, 1976) showed a 95 percent increase in total labor over traditional practices. It assumed that 10 percent additional labor is needed for recurrent operations, i.e., bund repair and better seed preparation. The rest is development labor valued at a wage rate of Le. 0.80 and prorated over 10 years at 20 percent shadow interest and 40 percent operator interest.

Tradable inputs and skilled labor costs are project development costs based on costs of Eastern Area and Northern Area projects (World Bank/IDA financed). The projects are 2-4 year investment activities after which the project ends and normal extension activities continue.

[g]In contrast with this figure, the social value of capital is Le. 37.16.

[h]Data are from the Eastern Area Project. This entry is the projected level of extension activity needed to maintain project achievements in the post-project period.

[i]Yields are assumed to increase to 50 percent above those achieved by traditional southern swamp technique. This represents levels achieved by the top 1/3 farmers in the Eastern Area Project in 1974/75. This yield is assumed to represent average farmer performance at the time of project stabilization (1977). The yield is adjusted for 10 percent on-farm losses.

[j]Social costs are converted at a milling ratio of .67.

[k]This figure is calculated at a 1975 shadow price of foreign exchange (Le. 1.15/$1). The official exchange rate in 1975 was Le. .90/$1.

Table C-11b.--Sierra Leone:

Production Budget for Farming
Improved Upland, South
(Leones per hectare)

Inputs	Tradable inputs: c.i.f. cost	Tradable inputs: Indirect taxes/ subsidies	Taxes/subsidies on labor and capital	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Return to domestic capital	Total market value
1. Direct labor inputs[a]				308	246.40			246.40
A. Land preparation				43				
B. Seeding and planting				51				
C. Weeding				44				
D. Chemical application				2				
E. Control of birds, etc.				40				
F. Harvest				103				
G. Threshing, winnowing				20				
H. Transport				5				
2. Hand tools[b]	1.57						.66[c]	2.23
3. Seeds[d]	2.62	-0.87	-0.69		10.90	.76	.05	12.77
4. Fertilizer[e]	47.73	-27.64	-1.06		.38	1.93		21.34
5. Insecticides, etc.								
6. Land development[f]	6.17	-6.17	-10.23			10.05	.18	0
7. Animals								
8. Equipment								
9. Machinery								
10. Irrigation operation and maintenance								
11. Extension services[g]	3.14	-3.14	-5.40			5.25	.15	0
12. Water charge								
13. Other costs								
Total costs	61.23	-37.82	-17.38		257.68	17.99	1.04	282.74

Yield 1,900[h]; market price of paddy .152; ratios of shadow price to market price for: unskilled labor 1.0, skilled labor 1.0, capital .44, and foreign exchange 1.15/.90; total social cost per hectare 354.37; total social cost per metric ton rice equivalent Le. 278[i], $242[j].

Table C-11b(continued)

Notes:

[a]The labor inputs are based on a 1971/72 survey of traditional upland (Spencer, 1975). The labor times are increased by 40 percent for harvest and post-harvest tasks, due to increased yield with improved package.

[b]All traditional tools except winnowing trays and planting sticks (6 percent of investment value) are tradable. The social return to capital is 20 percent, and the private return to capital is 40 percent.

[c]The social cost of capital in hand tools is Le. 0.11.

[d]Seeding rates are 56 kilograms/hectare. Costs of improved seed are assumed to be 50 percen above the market price, Le. .228 kilograms. Costs are distributed in proportion to costs of production less seed costs.

[e]This entry comprises 251 kilograms/hectare compound fertilizer.

[f]Land development costs represent project development costs and are assumed to be 50 percent of the project development costs contianed in the inland swamp calculations. No unskilled labor investment is required in upland land development. All unskilled labor inputs are applied annually.

[g]Extension costs are assumed to be one-half of costs for inland swamp extension.

[h]The yield figure is based on an assumption of a 60 percent increase in yields above traditional upland. The yields are adjusted for 10 percent on-farm losses.

[i]Social costs are converted at a milling ratio of 0.67.

[j]This figure is calculated at a 1975 shadow price of foreign exchange of Le. 1.15/$1. The official exchange rate in 1975 was Le. .90/$1.

Table C-11c.--Sierra Leone:

Marketing Costs[a]

(Leones per metric ton of milled rice)

	Tradable inputs		Taxes/subsidies on labor and capital	Unskilled labor		Skilled labor	Return to capital	Total market value
	c.i.f. cost	Indirect taxes/ subsidies		Man-days	Market value		Market value	
1. Bags	7.85							7.85
2. Transport to mill[b]				13	10.40			10.40
3. Processing[c]	9.96	1.72	.53		.05	2.26		14.52
4. Assembly[d]	.57	.16	.12	2	1.60	.65		3.10
5. Transport to frontier[e]	4.83	1.40	1.05			5.47		12.75
Total costs	23.21	3.28	1.70		12.05	8.38		48.62

Ratios of shadow price to market price for : unskilled labor 1.0 ; skilled labor 1.0 ; and capital 1.0 .

Percentage brokens 35 ; milling ratio .67 .

Notes:

[a]Input-output data from Spencer, Moy-Parker, and Rose, 1977.

[b]Three mile average transport distance to small-scale mills. Assuming 40 kilograms paddy/headload, and three trips per day results in 13 man-days per metric ton milled rice.

[c]Processing costs are for Satake SB 10 rubber roller mill processing 466 tons of paddy per year. All capital is assumed tradable and evaluated at a social return to capital of 20 percent.

[d]10 miles transport @ Le. 15/metric ton-mile (small lorries); 2 man-days unskilled labor for loading and unloading.

[e]125 miles @ Le. .102 per metric ton-mile.

Table C-11d.--Sierra Leone: Cost Summary
(costs per metric ton of milled rice)

	Social costs	
	Improved upland	Improved inland swamp
Farm gate cost, milled metric tons equivalent	Le. 278	Le. 184
Marketing cost to frontier	Le. 49	Le. 49
f.o.b., frontier	Le. 327	Le. 233
f.o.b., frontier, 1975 US$[a]	$ 284	$ 203
Foreign rice, c.i.f., frontier[b]	$ 326	$ 326

Notes:

[a]Social costs converted at social price of foreign exchange of Le. 1.15/US$1 (equivalent to 1977 rate).

[b]The expected long-run world price is US$340 for 35 percent brokens, c.i.f. Monrovia. Transportation from Monrovia to the Sierra Leone border is calculated at $14, 125 miles @ $0.112 per metric ton-mile.

Table C-6 a.--Mali

Production Budget for Farming
Gravity Irrigation, Ox-drawn
(Malian francs/hectare)

Inputs	Tradable inputs: c.i.f. cost	Tradable inputs: Indirect taxes/ subsidies	Taxes/subsidies on labor and capital	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Return to domestic capital	Total market value
1. Direct labor inputs				90	45,000			45,000
A. Land preparation[a]				24				
B. Seeding and planting[b]				1				
C. Weeding[c]				13				
D. Chemical application				1				
E. Control of birds, etc.				15				
F. Harvest[d]								
G. Threshing, winnowing[e]				8				
H. Transport[f]				3				
2. Hand tools	165	45	15			54	21	300
3. Seeds[g]	1,280	80	80		1,960	520	80	4,000
4. Fertilizer[h]	3,557	-1,063	-35			270	31	2,760
5. Insecticides, etc.								
6. Land development[i]								
7. Animals[j]	3,028	8	8		196	52	8	3,300
8. Equipment[k]	2,829	-400	-2			69	118	2,614
9. Machinery services[l]	9,151	-626	522			2,473		11,520
10. Irrigation operation and maintenance[m]	11,126	-11,126	-10,642			9,433	1,209	0
11. Extension services								
12. Water charge[n]			16,000					16,000
13. Other costs								
Total costs	31,136	-13,082	5,946		47,156	12,871	1,467	85,494

Yield 2,250 kg; market price of paddy 40 MF/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, and foreign exchange 1.15; total social cost per hectare 97,300MF; total social cost per metric ton milled equivalent 66,530 MF/t, $135.17/t.

Table C-6[a] (continued)

[a]Plowing and harrowing with oxen plus 10 man-days devoted to irrigation.

[b]Broadcast seeding.

[c]Hand weeding.

[d]Harvesting with a sickle.

[e]Mechanical threshing except for 450 kilograms which is manually threshed and winnowed.

[f]Transport of paddy by ox cart.

[g]100 kilograms of farmer's seed.

[h]30 kilograms of urea costing 145.6 Malian francs/kilogram and sold to farmers at 92 Malian francs/kilogram. This is the current rate of utilization of fertilizer in the Office du Niger but is not sustainable at a gross yield of 2,500 kilograms per hectare. If fertilizer dosage is not increased, yields will decline in the future.

[i]All land development costs are considered as sunk and are thus omitted from the cost calculation.

[j]Interest at 12 percent on a pair of oxen costing 140,000 Malian francs. No depreciation is charged since it is assumed that the animals can be resold for their purchase price. One pair of oxen is required for each plow. Cost of feed and veterinary products is 500 Malian francs.

[k]The following assumptions are made involving equipment charges:

	hectares used	actual cost (Malian francs)	price to farmer (Malian francs)
plow	6	46,500	46,500
harrow	10	38,000	23,500
cart	20	94,995	84,700

All equipment is depreciated over 10 years and interest is charged at 12 percent. Ox carts are assumed to be used one-half time for agricultural activities. Maintenance involves renewal of plowshares every two years and of moldboards every five years.

[l]Mechanical threshing of 1,800 kilograms of paddy (net yield minus 450 kilograms which is manually threshed). The farmer is charged 160 kilograms of paddy for each ton threshed.

[m]Both irrigation operation and maintenance and extension services are included here as part of the general overhead cost of the Office du Niger which is allocated to rice.

[n]400 kilograms of paddy.

Table C-6b.--Mali
Production Budget for Farming
Gravity Irrigation, Ox-drawn, Fertilizer
(Malian francs per hectare)

Inputs	Tradable inputs: c.i.f. cost	Tradable inputs: Indirect taxes/ subsidies	Taxes/subsidies on labor and capital	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Return to domestic capital	Total market value
1. Direct labor inputs				120	60,000			60,000
A. Land preparation[a]				29				
B. Seeding and planting[b]				2				
C. Weeding[c]				25				
D. Chemical application				2				
E. Control[d] of birds, etc.				15				
F. Harvest				35				
G. Threshing,[e] winnowing[f]				8				
H. Transport				4				
2. Hand tools	165	45	15			54	21	300
3. Seeds[g]	2,100	-228	-492		1,920	1,260	240	4,800
4. Fertilizer[h]	23,506	-6,676	-161			1,741	290	18,700
5. Insecticides, etc.								
6. Land development[i]	22,533	-22,603	-5,117			231	4,956	0
7. Animals[j]	5,002	57	58		1,411	374	58	6,960
8. Equipment[k]	6,024	-744	-5			126	277	5,678
9. Machinery services[l]	13,726	-939	783			3,710	0	17,280
10. Irrigation operation and maintenance[m]	16,047	-16,047	-15,349			13,605	1,744	0
11. Extension services								
12. Water charge[n]			24,000					24,000
13. Other costs								
Total costs	89,103	-47,135	3,732		63,331	21,101	7,586	137,718

Yield 3,150 kg; market price of paddy 40 MF/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, and foreign exchange 1.15; total social cost per hectare 194,486; total social cost per metric ton milled equivalent 94,987 MF/t, $192.98/t.

Table C-6b (continued)

Notes:

[a]Plowing and harrowing with oxen plus 15 man-days devoted to leveling, bunding, and irrigation.

[b]Using ox-drawn seeder-weeder.

[c]Hand weeding plus use of ox-drawn seeder-weeder.

[d]Harvesting with a sickle.

[e]Mechanical threshing except for 450 kilograms which is manually threshed and winnowed.

[f]Transport of paddy and straw by cart.

[g]80 kilograms of improved seed costing 60 Malian francs/kilogram.

[h]100 kilograms of urea costing 145.6 Malian francs/kilogram and sold to farmer at 92 Malian francs/kilogram; 100 kilograms of DAP costing 144.6 Malian francs/kilogram and sold to farmer at 95 Malian francs/kilogram.

[i]200,000 Malian francs development cost involving leveling and improvements of the irrigation system. This does not include the cost of construction of the basic irrigation network, which is treated as sunk. Depreciation is over 25 years and interest is charged at 12 percent.

[j]Interest at 12 percent on a pair of oxen costing 140,000 Malian francs. No depreciation is charged since it is assumed that the animals can be resold for their purchase price. One pair of oxen is required for each plow. Cost of feed and veterinary products is 3,600 Malian francs.

[k]The following assumptions are made involving equipment charges:

	hectares used	actual cost (Malian francs)	price to farmer (Malian francs)
plow	5	46,500	46,500
harrow	7	38,000	23,500
cart	7	94,995	84,700
seeder-weeder	7	80,000	80,000

All equipment is depreciated over 10 years and interest is charged at 12 percent. Ox carts are assumed to be used one-half time for agricultural activities. Maintenance involves renewal of plowshares every two years and moldboards every five years.

[l]Mechanical threshing of 2,700 kilograms of paddy (net yield minus 450 kilograms which is manually threshed). The farmer is charged 160 kilograms of paddy for each ton threshed.

[m]Both irrigation operation and maintenance and extension services are included here as part of the general overhead cost of the Office du Niger which is allocated to rice. This cost is assumed to increase from current levels as intensification proceeds.

[n]The current Office du Niger water charge of 400 kilograms of paddy is assumed to be increased to 600 kilograms for this more intensified technique.

Table C-6 c.--Mali

Production Budget for Farming
Controlled Flooding, Ox-drawn, Fertilizer
(Malian francs/hectare)

Inputs	Tradable inputs: c.i.f. cost	Tradable inputs: Indirect taxes/ subsidies	Taxes/subsidies on labor and capital	Unskilled labor: Man-days	Unskilled labor: Market value	Skilled labor	Return to domestic capital	Total market value
1. Direct labor inputs				95	47,500			47,500
A. Land preparation[a]				14				
B. Seeding and planting[b]				1				
C. Weeding[c]				28				
D. Chemical application				1				
E. Control of birds, etc.				15				
F. Harvest[d]				25				
G. Threshing, winnowing[e]				8				
H. Transport[f]				3				
2. Hand tools	165	45	15			54	21	300
3. Seeds[g]	1,330	152	152		1,216	798	152	3,800
4. Fertilizer[h]	11,753	-3,338	-81			871	145	9,350
5. Insecticides, etc.								
6. Land development[i]	38,910	-38,910	-11,490			420	11,070	0
7. Animals[j]	5,112	32	32		784	208	32	6,200
8. Equipment[k]	4,726	-643	-16			82	241	4,390
9. Machinery services[l]	6,568	-173	471			1,774		8,640
10. Irrigation operation and maintenance	682	-682	-622			622		0
11. Extension services[m]	1,600	-1,600	-6,100			5,900	200	0
12. Water charge[n]			8,000					8,000
13. Other costs								
Total costs	70,846	-45,117	-9,639		49,500	10,729	11,861	88,180

Yield 2,250 kg; market price of paddy 40 MF/kg; ratios of shadow price to market price for: unskilled labor 1, skilled labor 1, capital 1, and foreign exchange 1.15; total social cost per hectare 153,563MF total social cost per metric ton milled equivalent 105,000 MF/t, $213.33/t.

Table C-6c (continued)

Notes:

[a]Plowing and harrowing with oxen.

[b]Using ox-drawn seeder.

[c]Hand weeding.

[d]Harvesting with a sickle.

[e]Mechanical threshing except for 450 kilograms which is manually threshed and winnowed.

[f]Transport of paddy and straw by ox cart.

[g]80 kilograms of seed renewed every three years. Average cost is 47.5 Malian francs/kilogram.

[h]50 kilograms urea costing 145.6 Malian francs/kilogram and sold to farmer at 92 Malian francs/kilogram; 50 kilograms DAP costing 144.6 Malian francs/kilogram and sold to farmer at 95 Malian francs/kilogram.

[i]400,000 Malian francs land development cost depreciated over 25 years with interest charged at 12 percent.

[j]Interest at 12 percent on a pair of oxen costing 140,000 Malian francs. No depreciation is charged since it is assumed that the animals can be resold for their purchase price. One pair of oxen is required for each plow. Cost of feed and veterinary products is 2,000 Malian francs.

[k]The following assumptions are made involving equipment charges:

	hectares used	actual cost (Malian francs)	price to farmer (Malian francs)
plow	4	46,500	46,500
harrow	7	38,000	23,500
ox cart	15	94,995	89,700
seeder	40	340,000	340,000

All equipment is depreciated over 10 years and interest is charged at 12 percent. Ox carts are assumed to be used one-half time for agricultural activities. Maintenance involves renewal of plowshares every two years and of moldboards every 5 years.

[l]Mechanical threshing of 1,800 kilograms of paddy (net yield minus 450 kilograms which is manually threshed). The farmer is charged 120 kilograms of paddy for each ton threshed.

[m]Assumes that the cost of extension services increases from the current level of about 7,000 Malian francs to 10,000 Malian francs as intensification proceeds.

[n]Assumes that the present charge of 140 kilograms of paddy is increased to 200 kilograms.

Table C-6d.--Mali
Marketing Costs
(Malian francs per metric ton of milled rice)

	Tradable inputs		Taxes/subsidies on labor and capital	Unskilled labor	Skilled labor	Return to capital	Total market value
	c.i.f. cost	Indirect taxes/ subsidies					
1. Bags[a]	5,489	1,497	499	---	1,796	699	9,980
2. Transport to mill[b]	5,400	3,957	6,530	---	5,130	945	21,962
3. Processing[c]	2,958	957	435	---	3,828	522	8,700
4. Assembly[d]	2,036	388	259	---	420	129	3,232
5. Transport to frontier							
Ivory Coast[e]	6,603	1,258	838	200	1,363	419	10,681
Senegal[f]	6,603	2,589	1,282	400	963	419	12,256
6. Total Costs							
Ivory Coast	22,486	8,057	8,561	200	12,537	2,714	54,555
Senegal	22,486	9,388	9,005	400	12,137	2,714	56,130

Ratios of shadow price to market price for: unskilled labor 1.0, skilled labor 1.0, capital 1.0, and foreign exchange 1.15 percentage brokens 60 ; milling ratio .65 ; social cost per metric ton of milled rice equivalent 41,310 MF/t, $83,93/t for Ivory Coast and 41,110 MF/t , $83.52/t Senegal.

Notes:

[a]Includes both bags used for the collection of paddy and those in which milled rice is exported.

[b]Cost of collection and transport plus interest at 12 percent applied to the value of paddy collected over an average period of six months.

[c]Average milling cost at the Office du Niger.

[d]Average cost of transport by boat to Segou.

[e]Includes the cost of loading and transport by truck from Segou to the frontier at the official road transport tariff of 26.4 Malian francs/ton/kilometer applicable in 1975-76. Although exports were supposed to be shipped at one half this tarif in practice the full tariff was usually applied.

[f]Includes the cost of loading, truck transport from Segou to Bamako, handling in Bamako, and shipment by rail to the frontie Private cost of rail shipment is valued at the tariff in effect in 1975-76; social cost is valued in terms of the estimated marginal cost of shipment.

Table C-6e.--Mali: Cost Summary[a]
(Malian francs per metric ton of milled rice)

	Controlled Flooding with fertilizer		Gravity Irrigation		Gravity Irrigation with fertilizer	
	Private Cost	Social Cost	Private Cost	Social Cost	Private Cost	Social Cos
Farm gate cost	60,300	105,000	58,500	66,500	67,300	95,000
Cost f.o.b. frontier						
Ivory Coast	114,900	146,300	113,100	107,600	121,900	136,300
Senegal	116,400	146,100	114,600	107,600	123,400	136,100
Cost consumption center						
Ivory Coast[b]						
Abidjan	134,600	166,000	132,800	127,500	141,600	156,000
Bouaké	124,800	156,200	123,000	117,700	131,800	146,200
Senegal[c]						
Dakar	124,400	154,100	122,600	115,600	131,400	144,100

Notes:

[a] Sources: Tables C-6a through C-6d. Quality of milled rice is about 60% broken.

[b] Based on the official trucking tariff of 26.4 MF/ton/kilometer applicable in 1975-76. Although exports were supposed to be shipped at one-half this tariff, in practice the full tariff was usually applied.

[c] Based on actual rail tariffs in effect in 1975-76.

Table D.--Private and Social Profitability

(dollars per metric ton unless otherwise indicated)

	Mali			Sierra Leone	
	Gravity irrigation, animal power	Gravity irrigation, animal power and fertilizer	Controlled, flooded, animal power, and fertilizer	Improved inland swamp	Improved upland
Market value of output and the border[a]	271	271	271	489	489
Market value of tradable inputs[a]	100	119	112	61	61
Value added in market prices[a]	171	152	159	428	428
Value of land and labor in market prices[a]	126	126	126	172	278
Sum of taxes and subsidies on traded and nontraded inputs[a]	27	-11	126	-32	-42
Private profitability[a]	14	-7	10	254	179
f.o.b. value of output at the border[a]	316	316	316	326	326
c.i.f. value of tradable inputs[a]	102	154	166	90	76
Value added in world prices[a]	214	162	150	236	250
Social value of land and labor inputs[b]	110	110	110	135	217
Social value of capital inputs[b]	8	13	22	15	0
Ratio of the social exchange to the official exchange rate	1.15	1.15	1.15	1.28	1.28
Social profitability[b]	97	39	19	101	19
Nominal protection coefficient on output	0.9	0.9	0.9	1.5	1.5
Nominal protection coefficient on inputs	1.0	0.8	0.7	0.8	0.7
Effective protection coefficient	0.8	0.9	1.1	1.8	1.7
Domestic resource cost ratio[b]	0.63	0.87	1.01	0.76	1.20
Ratio of the domestic resource cost ratio to the ratio of the shadow to the official exchange rate	0.55	0.76	0.88	0.60	0.92

Notes:

[a]Converted to dollars using the official exchange rates of 428 Malian francs/$1 in Mali and .90 Leones/$1 in Sierra Leone.

[b]Converted to dollars using the social exchange rates of 492 Malian francs/$1 in Mali and 1.15 Leones/$1 in Sierra Leone.

Table E-1.--Benin: Rice Consumption, 1975 and Projections for 1980 and 1990[a]

(measures as indicated)

	Total		
	1975	1980	1990
Population			
Annual rate of growth (percent)	2.8	2.8	2.8
Population (thousands)	3,122	3,584	4,724
Income			
Annual real per capita income growth (percent)	--	2.3	2.3
Income elasticity of demand for rice	--	0.5	0.5
Consumption			
Annual rate of growth (percent)	8.7[b]	4.0	4.0
Thousand metric tons	12.8[c]	15.6	23.1
Kilograms per capita	4.1	4.4	4.9

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]1965-76.

[c]Average of 1971-76 net availability.

Table E-2.--Gambia: Rice Consumption, 1975 and Projections for 1980 and 1990[a] (measures as indicated)

	Total		
	1975	1980	1990
Population			
Annual rate of growth (percent)	2.8	2.8	2.8
Population (thousands)	512	588	775
Income			
Annual real per capita income growth (percent)	--	2.0	2.0
Income elasticity of demand for rice	--	0.4	0.4
Consumption			
Annual rate of growth (percent)	6.9[b]	3.6	3.6
Thousand metric tons	40.0[c]	47.7	67.9
Kilograms per capita	78.1	81.1	87.6

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]1966-76.

[c]Average of 1971-76 net availability.

Table E-3.--Ghana: Rice Consumption, 1975 and Projections for 1980 and 1990[a] (measures as indicated)

	Total		
	1975	1980	1990
Population			
Annual rate of growth (percent)	2.7	2.7	2.7
Population (thousands)	9,904	11,315	14,769
Income			
Annual real per capita income growth (percent)	—	1.0	1.0
Income elasticity of demand for rice	—	0.6	0.6
Consumption			
Annual rate of growth (percent)	0.9[b]	3.3	3.3
Thousand metric tons	72.0[c]	84.7	117.2
Kilograms per capita	73.0	7.5	7.9

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]1965-75.

[c]Average of 1970-75 net availability.

Table E-4.--Ivory Coast: Rice Consumption, 1975 and Projections for 1980 and 1990[a,b]

(measures as indicated)

	Total			Urban			Rural		
	1975	1980	1990	1975	1980	1990	1975	1980	1990
Population									
Annual rate of growth (percent)	4.2	4.2	3.9	8.4	8.4	6.0	2.7	2.0	2.
Population (thousands)	6,720	8,255	12,102	2,151	3,219	5,765	4,569	5,036	6,337
Income									
Annual real per capita income growth (percent)	2.1	2.1	2.1	2.3	2.3	2.3	1.7	1.7	1.
Income elasticity of demand for rice	—	—	—	0.2	0.2	0.2	0.4	0.4	0
Consumption									
Annual rate of growth (percent)	6.0	5.6	4.9	8.9	8.9	6.5	2.6	2.7	3
Thousand metric tons	288.0[c]	378.8	613.6	128.0	196.0	367.9	160.0	182.8	245
Kilograms per capita	42.9	45.9	50.7	59.5	60.9	63.8	35.0	36.3	38

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand the the annual rate of growth of real per capita income. The projections for 1980 and 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratio of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]Urban and rural estimates of consumption are aggregated to obtain total consumption. Total consumption is divided by total population to obtain per capita consumption for the country as a whole. Because consumption is obtained by aggregating rural and urban estimates, there are no aggregated estimates for income elasticities.

[c]This figure is derived by assuming that average net availability for 1971-76 is applicable to 1973 and projecting this modified 1973 consumption to 1975 using a growth rate of net availability of six percent.

Table E-5.--Liberia: Rice Consumption, 1975 and Projections for 1980 and 1990[a,b] (measures as indicated)

	Total			Urban			Rural		
	1975	1980	1990	1975	1980	1990	1975	1980	1990
Population									
Annual rate of growth (percent)	2.2	2.2	2.2	4.6	4.2	3.9	1.6	1.6	1.6
Population (thousands)	1,536	1,713	2,129	339	417	611	1,197	1,296	1,519
Income									
Annual real per capita income growth (percent)[c]		2.7	2.7		2.7	2.7		2.7	2.7
Income elasticity of demand for rice	--	--	--	0.3	0.3	0.3	0.1	0.1	0.1
Consumption									
Annual rate of growth (percent)	1.5	2.5	2.6	--	5.0	4.7	--	1.9	1.9
Thousand metric tons	174.0	197.7	256.4	37.0	47.2	74.7	137.0	150.5	181.7
Kilograms per capita	113.2	115.4	120.4	109.1	113.2	122.3	114.5	116.1	119.6

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official governmen documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]Urban and rural estimates of consumption are aggregated to obtain total consumption. Total consumption is divided by total population to obtain per capita consumption for the country as a whole. Because consumption is obtained by aggregating rural and urban estimates, there are no aggregated estimates for income elasticities.

Table E-5 (continued)

[c]Income growth taken from historical average of real per capita income growth for years 1970-75. Assume future income growth is evenly distributed between rural and urban populations.

Table E-6.--Mali: Rice Consumption, 1975 and Projections for 1980 and 1990[a,b] (measures as indicated)

	Total			Urban			Rural[c]		
	1975	1980	1990	1975	1980	1990	1975	1980	1990
Population									
Annual rate of growth (percent)	2.5	2.5	2.5	--	5.7	5.7	--	2.1	1.9
Population (thousands)	6,152	6,960	8,909	678	896	1,560	5,474	6,064	7,349
Income									
Annual real per capita income growth (percent)	--	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Income elasticity of demand for rice	--	--	--	0.5	0.5	0.5	0.3	0.3	0.3
Consumption									
Annual rate of growth (percent)	1.2	4.8	5.0	n.a.	6.7	6.7	n.a.	2.7	2.5
Thousand metric tons	104.3[e]	131.9	215.2	53.0	73.3	140.2	51.3	58.6	75.0
Kilograms per capita	16.9	19.0	24.2	78.1[d]	81.8	89.9	9.4	9.7	10.2

Notes:

[a]The following technique is used to make demand projections. Population growth (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]Urban and rural estimates of consumption are aggregated to obtain total consumption. Total consumption is divided by total population to obtain per capita consumption for the country as a whole. Because consumption is obtained by aggregating rural and urban estimates, there are no aggregated estimates for income elasticities.

[c]Rural population is estimated as a residual.

[d]Urban consumption for 1975 from SEDES, L'Approvisionnement des Villes dans Les Pays Francophones d'Afrique, Vol. V, Bamako, Paris, 1972.

[e]Average of 1972-1976 net availability.

Table E-7.--Mauritania: Rice Consumption, 1975

and Projections for 1980 and 1990[a]

(measures as indicated)

	Total		
	1975	1980	1990
Population			
Annual rate of growth (percent)	2.4[b]	2.6[c]	2.6
Population (thousands)	1,295	1,472	1,903
Income			
Annual real per capita income growth (percent)	--	4.0	4.0
Income elasticity of demand for rice	--	0.4	0.4
Consumption			
Annual rate of growth (percent)	--	4.2	4.2
Thousand metric tons	25.5[d]	31.3	47.2
Kilograms per capita	19.7	21.3	24.8

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]1971-75.

[c]WARDA Rice Statistics Yearbook, 1975.

[d]This is the average of 1971-76 net availability.

Table E-8.--Niger: Rice Consumption, 1975 and Projections for 1980 and 1990[a,b] (measures as indicated)

	Total			Urban			Rural		
	1975	1980	1990	1975	1980	1990	1975	1980	1990
Population									
Annual rate of growth (percent)	2.8	2.8	2.8	7.0	7.0	7.0	2.4	2.2	2.
Population (thousands)	5,762	6,615	8,719	642	900	1,770	5,120	5,715	6,949
Income									
Annual real per capita income growth (percent)	--	--	--	--	2.2	2.2	--	2.2	2.
Income elasticity of demand for rice	--	--	--	--	0.5	0.5	--	0.2	0.
Consumption									
Annual rate of growth (percent)	--	6.4	6.9	--	8.1	8.1	--	2.6	2.
Thousand metric tons	19.6	26.8	52.1	13.5	19.9	43.4	6.1	6.9	8.
Kilograms per capita	3.4[c]	4.1	6.0	21.0[d]	22.1	24.5	1.2	1.2	1.

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table are assumed to continue until 1990. Assumed rates of growth of annual real per capita income ar based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]Urban and rural estimates of consumption are aggregated to obtain total consumption. Total consumption is divided by total population to obtain per capita consumption for the country as a whole. Because consumption is obtained by aggregating rural and urban estimates, there are no aggregated estimates for income elasticities.

[c]Average per capita in the years 1971-75 was 3.4 kilograms. This figure is used as the base point for projections. 1975 figures are high due to food aid.

[d]Urban per capita consumption estimate based on SEDES data. Rural consumption is estimated as a residual.

Table E-[illegible] -Nigeria: Rice Consumption, 1975

and Projections for 1980 and 1990

(measures as indicated)

	Total		
	1975	1980	1990
Population			
Annual rate of growth (percent)	2.6	2.6	2.6
Population (thousands)	62,930	71,548	92,485
Income			
Annual real per capita income growth (percent)	--	5.0	5.0
Income elasticity of demand for rice	--	0.6	0.6
Consumption			
Annual rate of growth (percent)	10.4	5.6	5.6
Thousand metric tons	304.7	400.1	689.9
Kilograms per capita	4.8	5.6	7.5

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

Table E-10.—Senegal: Rice Consumption, 1975 and Projections for 1980 and 1990[a,b]

(measures as indicated)

	Total			Urban			Rural[c]		
	1975	1980	1990	1975	1980	1990	1975	1980	1990
Population									
Annual rate of growth (percent)	2.6	2.6	2.6	4.4	4.4	4.4	--	1.7	1.7
Population (thousands)	4,958	5,637	7,287	1,401	1,738	2,673	3,557	3,899	4,614
Income									
Annual real per capita income growth (percent)	--	1.0	1.0	--	1.0	1.0	--	1.0	1.0
Income elasticity of demand for rice	--	--	--	--	0.3	0.3	--	0.4	0.4
Consumption									
Annual rate of growth (percent)	0.2[d]	3.8	3.9	--	4.7	4.7	--	2.1	2.1
Thousand metric tons	230.5	277.0	404.3	142.9	179.8	284.6	87.6	97.2	119.7
Kilograms per capita	46.5[e]	49.1	55.5	102.0[f]	103.5	106.5	24.6	24.9	25.9

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]Urban and rural estimates of consumption are aggregated to obtain total consumption. Total consumption is divided by total population to obtain per capita consumption for the country as a whole. Because consumption is obtained by aggregating rural and urban estimates, there are no aggregated estimates for income elasticities.

[c]Rural population is estimated as a residual.

[d]1965-75.

[e]Average of 1971-76 per capita availability.

[f]Rural/urban consumption differences based on 1975 study, "Essai d'Evaluation de la Production de l'Agriculture—Produits Vivrieres," Direction de la Statistique.

Table E-11.--Sierra Leone: Rice Consumption, 1975 and Projections for 1980 and 1990[a] (measures as indicated)

	Total		
	1975	1980	1990
Population			
Annual rate of growth (percent)	2.1[c]	2.1	2.1
Population (thousands)	2,786	3,091	3,805
Income			
Annual real per capita income growth (percent)[b]	--	2.1	2.1
Income elasticity of demand for rice	--	0.2	0.2
Consumption			
Annual rate of growth (percent)	3.1	2.5	2.5
Thousand metric tons	347.0[d]	392.6	502.6
Kilograms per capita	124.6	127.0	132.1

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]2.1 percent was the rate of growth of real per capita GDP during 1963-70.

[c]1965-75.

[d]Average of 1970-76 net availability.

Table E-12.--Togo: Rice Consumption, 1975

and Projections for 1980 and 1990[a]

(measures as indicated)

	Total		
	1975	1980	1990
Population			
Annual rate of growth (percent)	2.6[b]	2.6	2.6
Population (thousands)	2,221	2,525	3,264
Income			
Annual real per capita income growth (percent)	—	1.0	1.0
Income elasticity of demand for rice		0.5	0.5
Consumption			
Annual rate of growth (percent)	—	3.1	3.1
Thousand metric tons	9.7[c]	11.3	15.3
Kilograms per capita	4.4	4.5	4.7

Notes:

[a]The following technique is used to make demand projections: Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]1965-75.

[c]Average of 1970-75 net availability.

Table E-13.--Upper Volta: Rice Consumption, 1975 and Projections for 1980 and 1990[a]

(measures as indicated)

	Total			Urban			Rural		
	1975	1980	1990	1975	1980	1990	1975	1980	1990
Population									
Annual rate of growth (percent)	2.0	2.0	2.0	7.0	7.0	7.0	--	1.6	1.4
Population (thousands)	5,600	6,183	7,537	360	505	993	5,240	5,678	6,544
Income									
Annual real per capita income growth (percent)[b]	--	1.0	1.0	--	1.0	1.0	--	1.0	1.0
Income elasticity of demand for rice	--	--	--	--	0.5	0.5	--	0.2	0.2
Consumption[c]									
Annual rate of growth (percent)	--	4.4	4.8	--	7.5	7.5	--	1.8	1.6
Thousand metric tons	27.3	33.8	54.3	11.5	16.5	34.0	15.8	17.3	20.3
Kilograms per capita	4.9	5.5	7.2	31.9	32.7	34.2	3.0	3.0	3.1

Notes:

[a]The following technique is used to make demand projections. Population growth rates (from Table A) are assumed to continue until 1990. Assumed rates of growth of annual real per capita income are based on recent performance (from WARDA statistics or official government documents) and on expert opinion. Estimates of income elasticities of demand are based on studies in West Africa and elsewhere. The annual rate of growth of consumption is defined as the sum of the annual population growth rate and the product of the income elasticity of demand and the annual rate of growth of real per capita income. The projections for 1980 and for 1990 are made from the level of consumption in 1975 (from Table A) or from average consumption for several recent years in instances in which 1975 consumption is believed to be off trend. Consumption projections are obtained by applying the calculated rates of growth of consumption to actual or adjusted consumption in 1975. Projections of per capita consumption are the ratios of projected total consumption to projected total population for 1980 and 1990, respectively.

[b]Sources: 1970, Direction du Plan et des Etudes de Developpement; 1972-74, Institut National de la Statistique et de la Demographie.

[c]Urban and rural estimates of consumption are aggregated to obtain total consumption. Total consumption is divided by total population to obtain per capita consumption for the country as a whole. Because consumption is obtained by aggregating rural and urban estimates, there are no aggregate estimates for income elasticities. Source: For rural/urban consumption patterns: Republique Francaise, Secretariat d'Etat aux Affaires Etrangeres, "L'Approvisionnement des Villes dans les Pays Francophones d'Afrique--Enquetes et Perspectives," Vol. IV, Ouagadougou, 1972 (Paris: SEDES). Rural per capita consumption is derived as a residual.

Table E-13 (continued)

[c](continued) 1972 (Paris: SEDES). Rural per capita consumption is derived as a residual. National average per capita consumption for 1971-75 was 3.4 kilograms. 1975 consumption estimates are high due to exceptionally high imports, 90 percent of which arrived in Upper Volta in January and February of 1975. This is believed to represent a drought-related phenomenon rather than a permanent change in consumption habits.

Table F-2.--Gambia: Rice Production, 1976

and Projections for 1980 and 1990

(measures as indicated)

Production technique	1976			1980[a]			1990[b]		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Upland	15	.9	14	14	.9	13			
Improved upland							7	1.3	9
Inland swamp	5	1.6	8	6	1.5	9	7	1.5	10
Tidal swamp, controlled flooding	4	1.8	7	4	1.7	7	5	1.7	8
Mangrove swamp	9	1.0	9	10	1.0	10			
Improved Mangrove							18	1.4	25
Irrigated (double crop)	2	3.0	6	4	3.1	12	12	3.1	37
Total	35	1.3	44	38	1.3	51	49	1.8	89
Milled rice (thousand metric tons)[c]			24			28			50

Notes:
(1) = hectares (thousands); (2) = yield (metric tons of paddy per hectare); (3) = metric tons of paddy (thousands). (1) times (2) may not equal (3) due to rounding errors.

[a] Irrigated: increases by 500 hectares per year, maintaining cropping intensity of 1.25. Project ongoing from 1977.

Swamps: increase at rate of rural population growth (1.8 percent per annum).

Upland: declines by increase in irrigated area. Historically this technique is in long-term decline.

[b] Irrigated: increases by 500 hectares per year. These figures represent a cropping intensity of 1.25 for 1975 and 1980. Intensity assumed to increase to 1.50 by 1990.

Swamps: World Bank Improved Mangrove Swamp Project to be completed in 1983 comprises 10,000 hectares.

Other swamp techniques expand at population growth rate.

Assume added mangrove project by 1990; this exhausts potential swamp land area (30,000 hectares).

Upland: World Bank Improved Upland Project to be completed in 1983 comprises 3,800 hectares.

Labor supply limits total hectarage to 44.8 (based on increase in rural population between 1975 and 1990). Assume 2,900 hectares additional improved upland to reach this total.

[c] Paddy produced minus losses (10 percent), and seed (60 kilograms per hectare), converted at a milling ratio of 65 percent to rice equivalent.

Table F-4.--Ivory Coast: Rice Production, 1976 and Projections for 1980 and 1990 (measures as indicated)

Production technique	1976[a] (1)	1976[a] (2)	1976[a] (3)	1980[a] (1)	1980[a] (2)	1980[a] (3)	1990[a] (1)	1990[a] (2)	1990[a] (3)
Traditional upland, forest[b]	224	1.3	288	230	1.3	299	210	1.3	273
Improved upland, forest[c]	5	2.5	12	10	2.0	20	40	2.0	80
Improved irrigated lowland, forest[d]	3	4 0	13	7	4.3	30	18	4.5	81
Unimproved irrigated lowland, forest	4	2.0	9	3	2.0	6	0	---	---
Improved irrigated lowland, power-tiller, forest[d]	0[j]	4.3	1	2	4.4	9	4	4.5	18
Improved pump/dam irrigation, tractor, forest[e]	1	2.8	3	2	3.5	7	6	4.0	26
Unimproved upland, savannah[b]	100	0.8	82	98	0.8	78	93	0.8	74
Improved upland, savannah	6	1.8	11	10	1.8	18	16	2.0	32
Improved upland, ox-drawn, savannah[f]	2	1.8	3	6	1.8	11	11	2.0	22
Improved upland, tractor, savannah[f]	3	2.0	6	6	2.0	12	10	2.0	20
Improved dam irrigation, tractor, savannah[g]	0	---	---	3	3.5	10	8	4.0	32
Improved and unimproved irrigated lowland, savannah[g]	8	2.8	23	10	3.1	31	15	3.7	56
Improved and unimproved dam irrigation, savannah[h]	4	3.0	11	5	3.3	16	6	4.0	24
TOTALS	360	1.3	462	392	1.4	547	437	1.7	736
Rice supply[i] (thousand metric tons)			247			293			394

Table F-4 (continued)

Notes:
(1) = hectares (thousands); (2) = yield (metric tons of paddy per hectare); (3) = metric tons of paddy (thousands). (1) times (2) may not equal (3) due to rounding errors.

[a] Relative and real paddy prices are assumed constant.

[b] Growth assumed to be correlated with population, minus growth of other manual and power tiller and oxen production. In the past, area planted has not kept pace with population growth, so production should be considered as a maximum. Production in the savannah includes some flooded tractor cultivation in the northwest, which is not expected to expand because of low returns and climatic uncertainty.

[c] Rainfed rice under contract with SODERIZ.

[d] Improved bottomlands most of which have been developed with government subsidies. Present SODERIZ rate of expansion is 300-400 hectares per year. Financing is a major constraint, especially after 1980. It is assumed that 500 hectares are developed each year, giving 750 hectares for production with some double cropping. Yields should also rise as farmers become more skilled. The proportion of the land farmed with power tillers after 1975 is presently rather uncertain.

[e] Completely dependent on government investment for expansion. 1980 levels are already financed, although savannah area in 1980 is relatively uncertain.

[f] Expansion of ox-drawn and tractor techniques of upland production in the savannah are linked because both rely on government subsidized clearing. The use of oxen is more likely to expand without government financing because of cheaper winch clearing and lower investment. 1980 estimates for this technique are consistent with the Companie Ivoirienne pour le Développement des Textiles (CIDT) estimate for 1980, given current usage patterns. 1975-80 growth is not expected to continue during 1980-90, but yields may rise closer to planning norms.

[g] Bottomlands in the north and center. Most have only one cycle per year. Total includes unimproved and improved (contract) production, with yields of 2.5 and 3.2 respectively in 1975. Expansion is likely to be slow because of shortage of people in the north and climatic irregularities in the center.

[h] Dams with manual cultivation and about 1.8 cycles per year. Total includes both improved (contract) and unimproved production.

[i] Rice supply is calculated as paddy production minus losses and seed (15 percent) and converted to rice equivalent at milling return of .63.

[j] Less than 500 hectares

Table F-5.—Liberia: Rice Production, 1976 and Projections for 1980 and 1990

(measures as indicated)

Production technique	1976[a] (1)	1976[a] (2)	1976[a] (3)	1980[b] (1)	1980[b] (2)	1980[b] (3)	1990[c] (1)	1990[c] (2)	1990[c] (3)
Traditional upland	181	1.2	209	188	1.2	226	102	1.2	122
Improved upland	---	---	---	8	1.6	13	118	1.6	189
Traditional swamp	8	1.7	14	8	1.7	14	10	1.7	17
Improved swamp	---	---	---	1	2.4	2	8	2.4	19
Irrigated single crop	2	2.8	6	2	2.8	6	3	2.8	8
Irrigated double crop	---	---	---	1	10.0	10	3	10.0	30
Total	191	1.2	229	208	1.3	271	244	1.6	385
Milled rice (thousand metric tons)[d]			131			156			224

Notes:
(1) = hectares (thousands); (2) = yield (metric tons of paddy per hectare); (3) = metric tons of paddy (thousands). (1) x (2) may not equal (3) due to rounding error.

[a] Data from National Rice Survey ATS.

[b] Double crop irrigation, CESTOS project will begin development in 1979. Assume 1,000 hectares in projection by this time.

Improved upland and improved swamp areas are result of World Bank projects in Lofa and Bong counties. Projects are only partially completed by 1980.

Other techniques expand with population growth.

[c] Double crop irrigation, completion of CESTOS project.

Completion of World Bank projects in Lofa and Bong counties, which involves 3,700 hectares of improved swamp and 9,700 hectares of improved upland.

Assume two additional World Bank projects--11,000 hectares of improved upland, 3,800 hectares of improved swamp.

Small farmer development program. Government of Liberia project assumed to reach 35 percent of holdings by 1990 with an improved upland package. Affects 96,000 hectares by 1990.

Remaining techniques expand (traditional upland contracts) so that total hectarage expands in proportion to farm population growth (1.6 percent per annum).

[d] Paddy produced minus losses (10 percent), seed (52 kilograms per hectare) and converted to a milling ratio of 67 percent to rice equivalent.

Table F-6.--Mali: Rice Production, 1976 and Projections for 1980 and 1990[a]

(measures as indicated)

Production technique	1976			1980			1990		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Controlled flooded, ox-drawn[a]	54	1.4	77	60	1.4	84	30	1.4	42
Controlled flooded, ox-drawn with fertilizer[a]	--	--	--	12	2.5	30	60	2.5	150
Gravity irrigation, ox-drawn[b]	43	2.4	105	38	2.5	95	--	--	--
Improved gravity irrigation, ox-drawn with fertilizer[b]	--	--	--	5	3.5	18	48	3.5	168
Pump irrigation[c]	1	1.5	2	3	3.5	10	16	3.5	56
Traditional swamp[d]	11	1.2	13	7	1.2	8	5	1.2	6
Improved swamp, manual[d]	2	1.8	4	3	2.2	7	4	2.2	9
Improved swamp, ox-drawn[d]	2	1.8	4	6	2.5	15	15	2.5	38
Traditional flooded and other[e]	107	0.5	54	103	0.5	52	126	0.5	63
Total	220	1.2	259	237	1.3	319	304	1.8	532
Rice supply[f] (thousand metric tons)			137			171			291

Notes:

(1) = hectares (thousands); (2) = yield (metric tons of paddy per hectare); (3) = metric tons of paddy (thousands). (1) times (2) may not equal (3) due to rounding error.

[a]Operation Riz Segou and Operation Riz Mopti. Projections for 1990 include 4,000 hectares in the Upper Valley of the Niger River.

[b]Office du Niger.

[c]Includes pump irrigation projects at San, Gao, Tombouctou, and Kayes.

[d]All in the Action Riz Sikasso region. Traditional swamp is assumed to expand in proportion to rural population less the area placed under improved swamp techniques.

[e]Calculated as a residual after subtracting other areas and production from the totals for 1975-76. Area is assumed to expand in proportion to rural population less the area placed under controlled flooding techniques.

[f]Rice supply is calculated as paddy production minus losses (10 percent) and seed (100 kilograms per hectare) times .65 to convert to milled rice equivalent.

Table F-7.--Mauritania: Rice Projection, 1976

and Projections for 1980 and 1990[a]

(measures as indicated)

Production technique	1976			1980			1990		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Mpourie	0.8	4.2	3.4	1.5	4.2	6.3	4.0	6.3	25.2
Irrigated, double crop[b]	0.2	2.5	0.6	1.4	3.9	5.5	6.0	6.0	36.0
Total	1.0	4.0	4.0	2.9	4.1	11.8	10.0	6.1	61.2
Rice supply (thousand metric tons)[c]			2.3			6.7			35.0

Notes:

(1) = hectares (thousands); (2) = yield (metric tons of paddy per hectare); (3) = metric tons of paddy (thousands). (1) times (2) may not equal (3) due to rounding error.

[a] Sources: OMVS, Amenagements Hydroagricoles dans le Basin du Senegal and Rythmes de Developpement et Modulation des Crues, avril 1977; Joseph Nguekeng, "L'Economie du Riz en Afrique de l'Ouest" and "Situation en Republique Islamique de Mauritanie," December 1975; and Liste et Etat d'Annoncement des Projets Hydroagricoles Confiés à la SONADER.

[b] It is assumed that the dry season crop will not be all paddy, but will include tomatoes, wheat, sorghum, and vegetables. A reasonable dry season rice cropping intensity is 50 percent (on the Hollalde soils only).

[c] Rice supply is calculated as paddy minus waste (10 percent) minus seed (77 kilograms per hectare per crop) times .65 to convert to milled rice equivalent.

Table F-8.--Niger: Rice Production, 1976 and Projections for 1980 and 1990 (measures as indicated)

Projection technique	1976 (1)	1976 (2)	1976 (3)	1980[b] (1)	1980[b] (2)	1980[b] (3)	1990[c] (1)	1990[c] (2)	1990[c] (3)
Controlled flooded	1.2	1.8	2.1	0.7	1.6	1.	0.4	1.5	0.6
Irrigated, single crop	0.1	3.5	.5	0.5	3.5	1.8	0.4	3.5	1.4
Irrigated, double crop	1.5	6.1	9.2	3.4	7.0	23.8	8.4	7.0	58.8
Traditional flooded	13.5[a]	1.3	17.5	12.4	1.3	16.1	9.6	1.3	12.5
Total	16.1	1.8	29.3	17.0	2.5	42.	18.8	3.9	73.3
Rice supply (thousand metric tons)[d]			16.3			24.0			41.4

Notes:
(1) = hectares (thousands); (2) = yield (metric tons of rice per hectare); (3) = metric tons of rice (thousands). (1) times (2) may not equal (3) due to rounding error.

[a] Traditional rice includes approximately 500 hectares of bas-fonds; the remainder is deep flooded rice.

[b] 1) Kilo and Koutoukale (510 hectares) move from controlled flooded to double cropping irrigated. Remaining area is lower yielding.

2) Koumadougou (400 hectares)--new single cropping irrigated.

3) 2,000 hectares additional double cropping.

4) Traditional rice declines by 2,000 hectares and increases by rate of population growth (1.3 percent).

5) Assume 75 percent of irrigated expansion comes into cultivation.

6) Assume yield increase in double-crop irrigated.

[c] 1) Double cropping has a maximum potential of 10,000 hectares, leaving only Koumadougou (400 hectares flooded ri. , water level not controlled, 400 hectares single crop irrigated) as non-double cropped area.

2) Traditional rice area declines by amount of expanded acreage in other techniques, and increases at rate of population growth.

3) Assume 75 percent of irrigated expansion comes into cultivation.

[d] Paddy produced minus losses (10 percent), seed (52 kilograms per hectare per crop), and converted at milling ratio of 64 percent to rice equivalent.

Table P-10.—Senegal: Rice Production, 1976 and Projections for 1980 and 1990 (measures as indicated)

Production technique	1976[a]			1980			1990		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Irrigated, mechanized, single crop, Senegal River delta	9.0	1.5[b]	13.2	11.5	3.0	34.5	16.4	3.0	49.2
Irrigated, mechanized, double crop, Senegal River valley	0.7	2.1[b]	1.5	3.1	4.0	12.4	10.3	4.0	41.2
Irrigated, manual, double crop, Senegal River valley	0.4	3.0[b]	1.2	1.4	4.5	6.3	3.7	4.5	16.7
Irrigated, dry season crop[c]	--	--	--	1.0	4.0	4.0	12.1	3.5	42.3
Traditional mangrove[d]	10.2	0.8	8.2	11.0	0.8	8.8	13.1	0.8	10.5
Traditional swamp[e]	51.5	0.9	45.3	34.5	0.9	31.0	31.1	0.9	28.0
Improved swamp, manual[f]	4.2	3.0	12.6	4.4	2.5	11.0	--	--	--
Improved swamp, partial water control, manual	0.5	4.0	2.0	3.9	4.0	15.6	10.0	4.0	40.0
Improved rainfed[f]	13.5	1.9	26.0	25.0	2.0	50.0	50.0	2.3	115.0
Irrigated, mechanized, double crop, Upper Casamance[g]	--	--	--	--	--	--	5.0	4.5	22.5
Total	90.0	1.2	110.2	95.8	1.8	173.6	151.7	2.4	365.4
Rice supply[h] (thousand metric tons)			59.6			96.6			205.9

Notes:

(1) = hectares (thousands); (2) = yield (metric tons of paddy per hectare); (3) = metric tons of paddy (thousands). (1) times (2) may not equal (3) due to rounding error.

[a]The basic source, MDRH, Compagne Agricole 1975-76, does not give data by type of technique. A number of assumptions based on field observations are given as notes to the table.

[b]Yields in the Senegal River delta were abnormally low due to heavy rat infestation following the 1972-74 drought.

[c]Applies to all irrigated cultivation in the Senegal River delta and valley.

[d]Area for 1975-76 is estimated on the basis of an ILACO cereal survey in 1971 extrapolated in proportion to change in estimated total area devoted to rice production in the Lower Casamance. This area is assumed to expand in proportion to the rural population. There are also efforts under way to develop an improved mangrove technique, which could come to fruition by 1990.

Table F-10.—Senegal (continued)

[e]Area and production for 1975-76 are estimated as residuals and assumed to grow in proportion to rural population with deduction for the expansion of improved swamp and one-half the area devoted to improved rainfed. The rest of improved rainfed is assumed to represent new land brought into rice production as a result of labor being shifted from other crops or being released due to the spread of animal traction.

[f]Assumes that one-half the area improved by FIDAC and the Chinese missions is devoted to rainfed and the rest to swamp rice.

[g]The SODAGRI irrigation project for the Upper Casamance has not been fully developed yet, so projections are very tentative.

[h]Rice supply is calculated as paddy production minus losses (10 percent) and seed (80 kilograms per hectare) times .65 to convert to milled rice equivalent.

Table F-11.—Sierra Leone: Rice Production, 1976 and Projections for 1980 and 1990 (measures as indicated)

Production technique	1976			1980			1990		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Traditional upland, north[a]	179	0.8	145	195	0.8	156	171	0.9	154
Traditional upland, south[b]	153	1.3	199	166	1.3	216	140	1.3	182
Traditional inland swamp, north[c]	36	2.2	79	31	2.2	68	26	2.2	57
Traditional inland swamp, south[c]	21	2.6	55	19	2.6	49	13	2.6	34
Mangrove swamps, north	24	3.2	76	24	3.2	77	24	3.8[d]	91
Mangrove swamps, south	3	1.7	5	3	1.7	5	6	3.5	21[e]
Boli lands	12	1.0	12	12	1.0	12	15	1.5	23[f]
Boli lands, mechanized	6	1.1	7	6	1.2[g]	7	6	2.0[h]	12
River, mechanized	6	1.8	10	6	1.8	11	6	3.6[i]	16
Improved inland swamp, north[c]	2	3.3	7	10[j]	3.3	33[k]	26	3.3	86
Improved inland swamp, south[c]	4	4.0	14	8[l]	4.0	32[k]	21	4.0	84
Improved upland, north[a]	0	0.0	0	10	1.5	15	40	2.0	80
Improved upland, south[b]	0	0.0	0	2	2.0	4	40	2.5	100
Total	446	1.4	609	492	1.4	685	534	1.8	940
Rice supply (thousand metric tons)[m]			344			388			541

Notes:

(1) = hectares (thousands); (2) = yield (metric tons of rice per hectare); (3) = metric tons of rice (thousands). (1) times (2) may not equal (3) due to rounding error.

[a] Total upland acreage in north assumed to expand with population growth (2.1 percent per year). Cultivable capacity of 211,000 hectares reached by 1990.

[b] Same as for north, with capacity of 180,000 hectares reached by 1990.

[c] Total inland swamp area expands with population growth (2.1 percent per year). Traditional swamp area calculated as a residual.

[d] 20 percent yield increase over the decade, effect of current WARDA/Rokupr research program.

Table F-11 (continued)

[e] Moyamba project to double area and average yields.

[f] Area expansion of 2.1 percent per annu, same as population growth. Yield increase due to improved variety and fertilizer use. i.e., half that under Rolako mechanization project.

[g] Effect of Rolako project which will raise yields on 800 hectares to 2 metric tons per hectare.

[h] Rolako project to be expanded to cover all 1980 area.

[i] Effect of Ikrma Bum project which should come on stream by 1979/80 and raise yields on 2,550 hectares to 3.46 metric tons per hectare.

[j] Effect of Northern Area Project (2,430 hectares), WFP (3,440 hectares), Kabala project (1,000 hectares), others (1,100 hectares).

[k] 10 percent annual increase in cropped area.

[l] Effect of Eastern Area Project (2,430 hectares), Moyamba project (1,000 hectares), others (1,000 hectares).

[m] Paddy produced less waste (10 percent), seed (130 kilograms per hectare for traditional swamp and 67 kilograms per hectare for all others), converted at milling ratio of 67 percent.

Table F-13.--Upper Volta: Rice Production, 1976

and Projections for 1980 and 1990

(measures as indicated)

Production technique	1976			1980			1990		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Improved upland	--	--	--	--	--	--	5.8	2.0	11.6
Traditional swamp[b]	37.4	0.7	27.8	38.8	.7	27.2	35.5	.7	24.8
Improved swamp[c]	1.7	1.5	2.6	4.8	1.5	7.2	14.8	1.5	22.2
Irrigated single crop[d]	0.6	3.5	2.2	1.3	3.5	4.5	5.6	3.5	19.6
Irrigated double crop[e]	1.6	4.6	7.4	2.2	5.7	12.5	4.6	5.2	23.9
Total	41.3	1.0	39.9	47.1	1.1	51.4	66.3	1.5	102.1
Milled rice (thousand metric tons)[f]			28.2			26.3			53.7

Notes:
(1) = hectares (thousands); (2) = yield (metric tons of paddy per hectare); (3) = metric tons of paddy (thousands). (1) times (2) may not equal (3) due to rounding error.

[a] No projects feasible by 1980. Projects feasible by 1990: Niena Dionkele, 1,845 hectares; Kamadena, 2,000 hectares; Loumana, 1,000 hectares; and miscellaneous, 1,000 hectares.

[b] Traditional swamp hectarage is assumed to expand in proportion to population growth. Assume hectarage cultivated decreases by 1/2 the incremental hectarage of improved swamps for 1980 and 1990. Thus the assumption implies that 50 percent of the hectarage under improved swamp development involves either farmers who formerly cultivated traditional swamps or improvements of traditional swamps themselves.

[c] Average development rate of 500 hectares per annum since 1975. Addition of 3,100 hectares improved swamp by 1980 (2,700 new swamps, 400 redeveloped). Addition of 10,000 hectares by 1990 (development rate of 1,000 hectares per annum, leaving 10,000 hectares expendable capacity).

[d] Yield of 3.5 tons per hectare for single crop. Recent historical expansion has been less than 25 hectares per year. By 1980, assume 650 hectares (financed) brought into production. By 1990, the 5,600 hectares cultivated exhausts the physical potential of this technique.

[e] 1976. Irrigated areas with only single crop of rice:

300 hectares in Vallee du Kou, yield 3.0 metric tons/hectare
200 hectares in Banfora, yield 3.0 metric tons/hectare
200 hectares in Kaya and Dedougou, yield 3.0 metric tons/hectare

Irrigated areas with double cropping of rice:

900 hectares in Vallee du Kou, yield 6.0 metric tons/hectare

Table G.--Sensitivity of Social Profitability to Changes in Selected Parameters[a]

Country and technique	Cost of Unskilled Labor	Cost of Skilled Labor	Cost of Capital	Yields	Milling Ratio	Ratio of the Social to the Official Rate of Exchange
Mali						
Gravity irrigation, animal power (Office du Niger, current)	-0.7	-0.4	-0.1	1.4	1.8	2.2
Gravity irrigation, animal power and fertilizer (Office du Niger, improved)	-1.6	-1.2	-0.3	4.9	6.0	4.1
Controlled flooded, animal power and fertilizer (Operation Riz Segou and Operation Riz Mopti, improved)	-3.7	-2.2	-1.2	11.3	13.6	8.1
Sierra Leone						
Improved inland swamp (south)	-1.0	-0.2	-0.1	1.4	1.7	2.3
Improved upland (south)	-6.1	-0.6	b	7.3	8.5	7.7

Notes:

[a]The entries in this table indicate the effect on social profitability of a one percent increase in the column heading. For example, if the cost of unskilled labor increases by one percent, the social profitability of gravity irrigation, animal power (Office du Niger, current) in Mali decreases by 0.7 percent.

[b]Less than .1 percent.

Appendix B

Methodological Annex[1]

Comparative Advantage, Net Social Profitability, and the Domestic Resource Costs of Foreign Exchange Earned or Saved

A country has a comparative advantage in rice production if the social opportunity costs of producing an incremental unit of rice are less than the border price of rice.[2] This definition of comparative advantage is based on the concept of social opportunity costs and hence on the distinction between social and private profitability. An individual or firm generally makes its private investment decisions on the basis of past, present, and expected future market prices for its inputs and outputs. From the viewpoint of society, the value of a productive activity -- the social profitability of the activity -- can exceed or be less than the private profitability, dictated by market prices. Hence, net social profitability (NSP), can be positive, negative, or zero, depending on the balance of a variety of effects.

The kinds of effects that contribute to (or detract from) NSP can be indicated with a more precise definition of this concept.[3] Net social

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[1]The first two sections of this annex consist of a slightly edited version of Pearson, Akrasanee, and Nelson [1976]. The third section is drawn from Southworth, Monke, and Pearson [1976, pp. 28-34].

[2]This definition is developed by Chenery [1961, pp. 19-25]. The social opportunity costs of rice production are defined as the value of all factors of production used to produce rice in their best alternative employment plus the value of all tradable inputs defined in terms of their border prices, i.e., the c.i.f. prices of comparable imports. The border price of rice refers to the f.o.b. export price if the country is an exporter of rice or to the c.i.f. import price if the country is an importer of rice.

[3]It is assumed throughout the discussion that streams of benefits and costs are discounted at an appropriate social discount rate to allow comparability at one point in time. For expositional convenience, time and the discount rate are not introduced explicitly into the analysis.

profitability (NSP_j) can be defined as the net gain (or loss) associated with the j^{th} economic activity when all commodity outputs produced and material inputs and factors of production employed are evaluated at their social opportunity costs (through the use of shadow prices) and when all external effects on the domestic economy are given a social valuation and included directly in the measure:

$$NSP_j = \sum_{i=1}^{n} a_{ij} p_i - \sum_{s=1}^{m} f_{sj} v_s + E_j \qquad (1)$$

where a_{ij} is the quantity of the i^{th} commodity output produced by the j^{th} activity (or the quantity of the i^{th} material input used by the j^{th} activity, in which case the term is negative), p_i is the shadow price of the i^{th} commodity output (or of the i^{th} material input) (in domestic currency), f_{sj} is the quantity of the s^{th} factor of production used by the j^{th} activity, v_s is the shadow price of the s^{th} factor of production (in domestic currency), and E_j is a measure of the net external benefits or costs imparted by the j^{th} activity to the rest of the domestic economy.[1]

If (a) all production units are profit maximizers, (b) no factor or product market distortions exist, (c) no economic rents are generated, (d) government tax/expenditure policies do not distort relative prices, (e) income redistribution measures are continuously enacted (or are of no concern), and (f) externalities are zero (or fortuitously offsetting), market prices and shadow prices of inputs and outputs will be equal. In this hypothetical situation, social benefits of an economic activity would equal social costs of production, and hence the net social profitability of the activity would be zero.

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[1] For a discussion of external effects, see Pearson [1970, especially pp. 45-50].

Typically, few, if any, of the conditions listed above are satisfied in developing economies, including those in West Africa. A long list of policies and institutional considerations, such as legislated minimum wage levels, maximum interest ceilings, and overvalued exchange rates, often introduce distortions resulting in a divergence between private market prices and social opportunity costs. As a result, considerable interest attaches to an examination of net social profitability of economic activities in developing countries, under existing and changed constellations of government policies. For each assumed set of government policies, there will be a corresponding set of shadow prices for inputs and outputs. Input coefficients for activities may also vary, although for analytical convenience these coefficients are usually assumed to remain unchanged.

The relationship between NSP and comparative advantage is straightforward: a country (or region) has a comparative advantage in producing a commodity if the net social profitability of the activity is positive. Two adjustments to (1) and some algebraic manipulation will permit a demonstration of this result. First, all outputs are assumed to be tradable -- either exports that earn foreign exchange, or import substitutes that save foreign exchange. Second, all input costs are divided into costs of tradable inputs and costs of primary domestic factors.

While the notation used below is similar to that applied by Bruno [1972, pp. 18-22], this approach differs significantly from his. Bruno treats all locally produced inputs as nontradable, thereby defining them with respect to actual government policy. In the approach used here, the social opportunity cost of all inputs, like primary domestic factors, are estimated with reference to optimal government policy. Consequently, a locally produced

input is classified as (a) tradable if it is fully traded i.e., if the country also imports some of the good, or (b) nontradable if it is nonfully traded, i.e., if the country does not import any of the good.[1] Inputs classified as nontradable are then decomposed into tradable components and primary domestic factors by moving backward through the input-output chain.

With these two modifications, a second definition of NSP, equivalent to the first when all outputs are tradable is:

$$NSP_j = (u_j - \bar{m}_j - r_j)\, v_1 - \sum_{s=2}^{m} \bar{f}_{sj}\, v_s + E_j \qquad (2)$$

where u_j is the total value at world prices (in foreign currency) of the output of the j^{th} activity, $\bar{m}_j$ is the total (direct plus indirect) value (in foreign currency) of tradable materials used by the j^{th} activity, r_j is the total (direct plus indirect) value (in foreign currency) of repatriated earnings of foreign-owned factors of production employed by the j^{th} industry (including repatriated portions of the direct foreign factor costs, $f_{1j}\, v_1$, and of the indirect foreign factor costs), v_1 is the shadow price of foreign exchange, expressed as a ratio of local currency to foreign currency, and $\bar{f}_{sj}$ is the total (direct plus indirect) quantity of the s^{th} primary domestic factor employed by the j^{th} industry.

As stated above, comparative advantage is implied if the social opportunity cost of producing additional amounts of a commodity is less than its border price. This definition of comparative advantage can be stated in terms of total, rather than per unit, costs and revenues to accord with the definitions of variables in (2):

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[1] See Joshi [1972] for a discussion of the concepts of fully and nonfully traded inputs.

$$\text{comparative advantage} \iff (\bar{m}_j + r_j)\, v_1 + \sum_{s=2}^{m} \bar{f}_{sj}\, v_s - E_j < u_j\, v_1 \qquad (3)$$

A country has a comparative advantage in producing a commodity if total social costs of an incremental project -- including direct and indirect tradable costs ($(\bar{m}_j + r_j)\, v_1$) and direct and direct and indirect costs of primary domestic factors ($\sum_{s=2}^{m} \bar{f}_{sj}\, v_s$) less net external benefits (E_j) -- are less than total social returns ($u_j\, v_1$). By rearranging the terms of (3), the relationship between a positive NSP and the existence of comparative advantage is established:

$$\text{comparative advantage} \iff (u_j - \bar{m}_j - r_j)v_1 - \sum_{s=2}^{m} \bar{f}_{sj}\, v_s + E_j > 0\,, \quad \text{or NSP} > 0\,. \qquad (4)$$

Under some circumstances, it is convenient to employ an alternative technique in order to measure net social profitability and thus to indicate the existence or lack of comparative advantage. In evaluating activities in developing countries, an appropriate measure of the social value of foreign exchange is often a critical variable. But the shadow price of foreign exchange may be the most difficult of all to estimate. In that event, it is useful to formulate a ratio from the definition of NSP which excludes the shadow price of foreign exchange and is therefore free of errors introduced by using an improper estimate of this parameter.

The ratio obtained by setting NSP in (2) to zero and solving for v_1 (the shadow price of foreign exchange) has been termed the domestic resource costs of foreign exchange earned or saved (DRC).[1] With respect to the j^{th}

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[1] This relationship was noted by Chenery [1961, p. 43] and later demonstrated by Bruno [1967, p. 106], [1972, p. 20].

activity, DRC_j is a measure of the social opportunity cost (in terms of the domestic factors of production employed directly and indirectly by the j^{th} activity) of earning a net marginal unit of foreign exchange:

$$DRC_j = \frac{\sum_{s=2}^{m} \bar{f}_{sj} v_s - E_j}{u_j - \bar{m}_j - r_j} = \frac{DC_j}{NVA_j} \qquad (5)$$

where DC_j is the opportunity cost of domestic resources employed by the j^{th} activity (in domestic currency), and NVA_j is net foreign exchange earned or saved (in foreign currency), or equivalently, value added at world prices.[1] Again, while the algebraic definition of the DRC measure presented here is virtually identical to that formulated by Bruno, the two concepts are not the same because of the differing treatments of locally produced inputs.

A direct relationship between DRC and NSP can be obtained by substituting (5) into (2):

$$NSP_j = (v_1 - DRC_j)(u_j - \bar{m} - r_j) . \qquad (6)$$

The DRC measure can be subtracted from the shadow price of foreign exchange and the difference multiplied by net foreign exchange earned or saved to find net social profitability. Note that if net foreign exchange earned or saved is negative, NSP must also be negative.[2]

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[1] This concept, which was originally developed in Israel during the 1950s, has been introduced to a much wider audience of professional economists by Bruno [1963], [1967], [1970], [1972], and by Krueger [1966], [1972].

[2] If net foreign exchange earned or saved is negative, DRC must be negative, causing $(v_1 - DRC_j)$ to be positive and the product of this term and $(u_j - m_j - r_j)$ to be negative.

When NSP is zero, the DRC measure is equal to the shadow price of foreign exchange. Similarly, when NSP is positive, DRC is less than v_1, and when NSP is negative, DRC is greater than v_1. In short, $NSP_j \gtreqless 0$ as $DRC_j \lesseqgtr v_1$. Hence, an activity is socially profitable if its DRC ratio, which measures its efficiency in transforming domestic resources into foreign exchange, is less than the shadow price of foreign exchange, which can be thought of as a weighted average of the efficiency of all tradable activities in the economy in transforming domestic resources into foreign exchange.[1] In other words, DRC_j is equivalent to an exchange rate for the j^{th} activity, indicating how many domestic resources are required to earn a unit of foreign exchange in that activity, whereas v_1 is the exchange rate for the entire economy, measuring how many domestic resources the country is willing to give up to obtain a unit of foreign exchange. Therefore, if DRC_j is less than v_1, fewer domestic resources are required to earn a unit of foreign exchange than the country on average is willing to pay for it. The result is a gain in welfare.

The relationship between DRC and comparative advantage is established by rearranging the terms of (3):

$$\text{comparative advantage} \Leftrightarrow \frac{\sum_{s=2}^{m} \bar{f}_{sj}\, v_s}{u_j - \bar{m}_j - r_j} < v_1, \text{ or } DRC_j < v_1 . \qquad (7)$$

Hence, DRC, like NSP, is also a statement of comparative advantage. An

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[1] Bacha and Taylor [1971, especially pp. 214-17] provide a comparative analysis of alternative measures of the shadow price of foreign exchange and suggest a formula for an equilibrium exchange rate which would be appropriate when trade restrictions are removed. This formula is equivalent to one derived independently by Balassa [1971, pp. 326-31]. An alternative formulation of the shadow price of foreign exchange is contained in Dasgupta, Marglin, and Sen [1972] and in Roemer and Stern [1975].

export is socially profitable -- or has a comparative advantage in international trade -- if the opportunity cost of domestic resources used in its incremental production per unit of net foreign exchange earned is less than the shadow price of foreign exchange. If the DRC ratio of the activity is less than this shadow price, the country has a comparative advantage in producing the incremental output of the activity.

Within a single country, the DRC concept can, of course, be used to evaluate a single project or several alternative projects.[1] Two or more projects can be ranked according to their DRC ratios so long as they can be assumed not to alter relative prices in the economy.[2] However, measurement of comparative advantage or of net social profitability requires that a project be compared with the shadow price of foreign exchange. The smaller the DRC of a project in relation to the shadow price of foreign exchange, the greater is that project's relative degree of comparative advantage within an economy. If the correct shadow price of foreign exchange is not known, it is still possible to indicate the relative degree of comparative advantage among projects within a single country by comparing their DRC ratios (again subject to the qualification made above about relative prices). This kind of comparison is especially useful in determining the efficient location of competing projects in alternative regions within a country.

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[1] In the ensuing discussion, the term, project, is used to underscore the incremental nature of the DRC concept. This choice of terminology is not meant to imply necessarily any investment by a government.

[2] Any ranking of projects by DRC, NSP, or any other criterion can be justified only on empirical, rather than theoretical, grounds. To rank projects it must be assumed that the activities are small in relation to the economy so that their introduction would not alter relative prices. For a summary discussion of this point, see Bruno [1972, pp. 31-32].

It is often of interest to contrast the degree of relative comparative advantage of producing additional amounts of a commodity in one country with that of other countries. For example, if one is undertaking a comparative analysis of rice projects in several countries, it would be useful, first, to measure how each country's rice project compares with alternative domestic projects, and, second, to contrast these results across countries. For this purpose, the DRC of the rice project in each country (which is, of course, assumed to be the best incremental investment in rice in that country) is compared with that country's shadow price of foreign exchange. The more closely the ratio of a project's DRC to this shadow price approaches one, the smaller is the project's degree of comparative advantage within the country. If this ratio exceeds one, the project is socially unprofitable and the country has a comparative disadvantage in producing the incremental output in question.

When each side of (7) is divided by v_1, the criterion for comparative advantage becomes:

$$\frac{DRC_j}{v_1} < 1 . \qquad (8)$$

If the ratio of DRC_j (where j refers to a rice project in this illustration) to v_1 in one country is less than a similar ratio in a second country, it can be argued that the first country has a relative comparative advantage over the second in producing additional rice. In other words, given that the ratio of DRC_j to v_1 for the first country is smaller than that for the second country, both countries have international comparative advantages in producing and exporting rice, but the first has a greater comparative advantage than the second. In this sense the first country is economically

more efficient than the second in growing and marketing incremental amounts of rice. Provided that the rice project of the second country does not generate more net foreign exchange than that of the first country, global welfare, defined in terms of income generation, would increase more if the first country produces more rice than if the second country expands its rice output.[1] Using superscripts to denote countries, one can rank the relative comparative advantage of rice projects in two or more countries with the ratio, DRC_j^h / v_1^h, where h is the country index.

In empirical analysis, it is sometimes convenient to use a modified form of the DRC measure in which both the numerator and denominator are expressed in terms of domestic currency. This modified measure, which can be defined as DRC_j^*, differs from the conventional measure in equation (5) because the denominator, net foreign exchange earned or saved, is expressed in domestic currency through multiplication by the official exchange rate, v_1^*:

$$DRC_j^* = \frac{\sum_{s=2}^{m} \bar{f}_{sj} v_s - E_j}{(u_j - \bar{m}_j - r_j)v_1^*} = DRC_j \cdot \frac{1}{v_1^*} . \qquad (9)$$

With the modified measure, the criterion for comparative advantage is:

$$\frac{DRC_j^*}{v_1/v_1^*} < 1 . \qquad (10)$$

Correspondingly, the ratio for cross-country comparisons is

$$DRC_j^{*h} \Big/ \frac{v_1^h}{v_1^{*h}} .$$

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[1] The proof of this proposition will be supplied upon request. Intuitive the qualification arises because of the possibility of projects being of unequal economic size resulting from (say) unequal availabilities of suitable land.

Principal Assumptions Underlying the Measurement of Comparative Advantage

As defined in this essay, NSP and DRC are based on a common set of basic assumptions.[1] Among the most crucial of these assumptions are: (a) the world price of the output (rice) is given exogenously or is estimable; (b) incremental costs of production, determined by a given technology (with no substitution) and an assumed set of relative factor prices, are constant, subject to sensitivity analysis to reflect changed assumptions; (c) shadow prices of inputs and outputs, which are representative of the true opportunity costs of factors and of the true scarcity values of commodities, are calculable; and (d) the true foreign exchange costs of production can be calculated.

The empirical application of any technique will, of course, yield results that are useful only to the extent that the assumptions underlying the analysis are realistic. It is difficult to generalize about how restrictive the above list of required assumptions might be. The assumption of an exogenously determined world price for rice would presumably make sense for all West African countries. Constancy of the input coefficients and unchanging relative factor prices are probably quite realistic assumptions at the margin, although the credibility of both may be strained if consumer welfare enters directly into rice production decisions.

Sometimes the most crucial assumptions in an analysis of social profitability or of comparative advantage concern the shadow prices, especially those for the major factors — labor, capital, land, and foreign exchange.

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[1] For a thorough discussion of assumptions underlying use of these concepts, see, among others, Chenery [1961], Prest and Turvey [1966], Bruno [1967], and Gittinger [1972].

No attempt will be made here to review the most important techniques available for estimating shadow prices.[1] Briefly, shadow prices of factors of production in this study are defined in terms of the social opportunity costs of income foregone by not using the factor in its best alternative employment, while the shadow prices of material outputs and inputs are border prices (f.o.b. export prices or c.i.f. prices of comparable imports).

Another central element of the DRC technique is the division of nontradable input costs into tradable input costs and primary domestic factor costs. Problems may arise with respect to the classification of tradable and nontradable materials and services. Moreover, whether or not an input-output table is available, the breakdown of inputs classified as nontradable into (direct plus indirect) tradable input and primary domestic factor costs can be troublesome.

The DRC measure contains an inherent bias because of the impossibility of correctly classifying locally produced inputs as tradable or nontradable. Tradable (or nontradable) inputs are defined as goods that would (or would not) be traded if the country were implementing optimal economic policies, thereby causing market prices to equal social prices. Since actual government policy departs from optimal policy in virtually all countries, it is not possible to be sure whether an input, which is produced locally under existing policy, would continue to be produced domestically under optimal policy. A strong presumption exists that, given optimal policy, fully traded

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[1] Useful sources on this topic include Bacha and Taylor [1971], Balassa [1975], [1976], Dasgupta, Marglin, and Sen [1972], Little and Mirrlees [1974], and Roemer and Stern [1975].

local inputs would be tradable, but it is not clear whether nonfully traded inputs would be tradable or nontradable. In the absence of information, nonfully traded inputs are treated as if they were nontradable. To the extent that they are not, a bias is introduced because some tradable input costs are incorrectly counted as primary domestic factor costs.

If tradable input costs are erroneously counted as primary domestic factor costs, or vice versa, the measured DRC ratio suffers from a systematic bias. As Bruno [1967, p. 114] has shown, the degree of bias can be demonstrated with the following formula:

$$DRC'_j = \frac{DRC_j + \alpha v_1}{1 + \alpha}$$

where DRC'_j is the measured value, DRC_j is the true value and α is the ratio of the amount of tradable costs, erroneously counted as domestic factor costs, to net foreign exchange earned or saved. If α is small, $DRC'_j \cong DRC_j + \alpha(v_1 - DRC_j)$. For $\alpha > 0$ and $DRC < v_1$, $DRC'_j > DRC_j$, i.e., when tradable costs are counted as domestic factor costs and the j^{th} activity is efficient, the measured DRC ratio will exceed the true value. Conversely, for $\alpha > 0$ and $DRC_j > v_1$, $DRC'_j < DRC_j$, and the observed value will have a downward bias. Hence, either bias results in an observed value which is closer to v_1 than the true value would have been. In both instances, the bias will increase with an increase in the size of α.

A major difficulty in attempting to measure comparative advantage -- or for that matter in carrying out any type of social profitability analysis -- stems from the overriding importance of dynamic elements. Chenery [1961] has described the adjustments which have to be made in order to incorporate

elements of growth theory with those of trade theory. Bruno [1967], [1970] has carried out several innovative empirical analyses of the Israeli economy, incorporating growth aspects in a dynamic linear programming model in order to determine dynamic comparative advantage for sectors in that one country.

In the absence of data required for a programming approach, sensitivity analyses can be undertaken on major variables in an effort to approximate the effects of dynamic changes. Variables which might usefully be subjected to sensitivity analyses include: the world price of rice; the input-output coefficients, reflecting different assumptions on changes in technology (for example, the use of new varieties or techniques) and/or in factor productivity; the shadow prices of domestic factors, allowing for changing opportunity costs as factor supplies or policies are altered; the external effects; and the shadow price of foreign exchange, as a result of changing comparative advantage of other domestic activities or of alterations in policies. By changing assumptions in this manner, it is possible to ascertain the sensitivity of the empirical results to particular assumptions.

Accounting Framework for the Estimation of the Efficiency and Policy Indicators

The accounting framework presented in Table 1 clarifies the concepts and data requirements underlying the efficiency and policy indicators. The eighteen items in the table are either cost and return data or one of the indicators. These items appear as rows in the accounting framework. The column headings, entitled Countries/Areas/Techniques, refer to the rice-producing activity being evaluated. As an example, a column might involve rice production at the national or regional level, or production with a specific technology. Each item will be discussed in turn below.

Item one: Gross output, at actual prices or at government support prices.

The important thing to recognize about this entry is that it is not necessarily the domestic market price of rice. If, for example, a government purchasing agency subsidizes domestic production by buying milled rice from processors at one price and reselling the rice to consumers at a lower price, then the market price of rice is not the relevant price. The market price does not adequately describe the production incentives for farmers or the cost of the rice to the domestic economy. The relevant price is the subsidized price or, equivalently, the per unit market price plus the per unit subsidy on rice. Taxes on output should be treated as negative subsidies.

$$\frac{\text{Price of Gross Output}}{\text{kg. milled rice}} = \frac{\text{Market Price}}{\text{kg. milled}} + \frac{\text{Subsidy}}{\text{kg. milled}}$$

It is important to be careful about the units involved in assessing subsidies. If a subsidy is implemented on paddy—i.e., the government buys paddy (unmilled) rice from farmers and then resells the rice to millers,

Table 1.--Accounting Framework for the Estimation of the Efficiency and Policy Indicators

Cost and Return Date and Indicators / Countries/ Areas/ Techniques
(1) Gross Output, at actual market prices or at government support prices (inclusive of government subsidies to domestic rice production)
(2) Tradable Inputs, at actual market prices
(3) Value Added, in actual market prices ((1)-(2))
(4) Factor Costs, other than capital, at actual market prices
(5) Indirect Taxes/Subsidies
(6) Private Profitability ((3)-(4)-(5))
(7) Gross Output, at world market prices
(8) Tradable Inputs, at world market prices
(9) Value Added, in world market prices ((7)-(8))
(10) Domestic Recource Costs, other than capital, at opportunity costs
(11) Domestic Capital Costs, at opportunity costs
(12) Ratio of Shadow Price of Foreign Exchange (SPFX) to Official Exchange Rate (OER)
(13) Net Social Profitability, at shadow price of foreign exchange ((9)x(12)-((10)+(11)))
(14) Nominal Protective Coefficient on Output (NPCO) ((1)÷(7))
(15) Nominal Protective Coefficient on Tradable Inputs (NPCI) ((2)÷(8))
(16) Effective Protective Coefficient on Value Added (EPC) ((3)÷(9))
(17) Domestic Resource Cost Coefficient (DRC) ([(10)+(11)]÷(9))
(18) Ratio of DRC to SPFX/OER ((17)÷(12))

adding up per unit market prices plus per unit subsidies will not yield an appropriate output price because the subsidies will be paid per unit of paddy while the market price is in terms of milled rice. This problem can be dealt with by using milling ratios--the efficiency with which paddy is converted to milled rice. The milling ratio will vary from country to country depending on processing technologies and the type of rice being produced. A subsidy on rice at the farm-gate level would thus be handled as follows:

$$\frac{\text{Price of Gross Output}}{\text{kg. milled rice}} = \frac{\text{Market Price}}{\text{kg. milled}} + \left[\frac{\text{Subsidy}}{\text{kg. paddy}} \times \frac{\text{a(kgs. paddy)}}{\text{b(kgs. milled)}}\right]$$

where a/b = milling ratio.

Clearly, there is no single market price for rice in a country. Rice prices will vary according to market location and according to the grade of rice. Since a comparison will be made between domestic prices and world prices, the relevant domestic market price is the price that prevails at the major point of importation/exportation. With respect to multiple grades of rice, there are a number of possible alternatives for handling this problem--choosing a single grade, or choosing a weighted average of all grades. All data (world prices, domestic production costs, and processing costs) are framed in terms of the same grade of rice.

Finally, it may be impossible to collect market prices at all. In this case it is necessary to use cost of production data in pricing the output: cost of production or price at the farm gate plus the cost of processing and transporting the rice to the point of importation/exportation.

Data for item 1: Milling ratio, market prices of a particular grade (at the point of importation/exportation), subsidized prices.

Item 2: Inputs treated as tradable goods at actual market prices. The relevant cost to use for each tradable input is the farm gate cost of the input (or the portion of the input treated as tradable) plus(minus) taxes (subsidies) which will be netted out later. In view of the fact that these prices will be utilized in calculations of private profitability, they are inclusive of government subsidies on inputs and tariffs.

A prototype calculation is presented below for fertilizer. Assume that fertilizer has a c.i.f. price of $500/ton; the government maintains a subsidy on fertilizer consumption of $100/ton; there is a transportation cost of $50/ton for transportation of the fertilizer from the port; there is a tariff of $30/ton; and there is a domestic sales tax of $10/ton.

Cost of input = c.i.f. + tariff + taxes - subsidy treated as tradable, or

440 = 500 + 30 + 10 - 100.

Note that this price differs from the cost to the farmer by an amount equal to the transportation costs which are treated as nontradable costs since they are nonfully traded. The cost to the farmer is equal to

490 = 500 + 30 + 10 - 100 + 50.

Data for Item 2: Farm gate prices, tariff rates, domestic tax rates, government subsidies, nonfully traded component of input, c.i.f. prices.

Item 3: Value added in market prices. This item is derived by subtracting item 2 from item 1 and will be used in calculating the effective protection coefficient.

Item 4: Factor costs, other than capital, at actual market prices. This category refers to the market prices for labor and land. For land the prevailing rental rate should be used, if available. The market wage

for hired labor should be imputed to all labor used in farm production. This category includes all direct and indirect labor and land costs.

Data for Item 4: Prices of inputs, shares of labor and land in inputs and input components treated as nontradables.

Item 5: Taxes and subsidies. This category includes all domestic taxes and subsidies.

Data for Item 5: Indirect tax rates and subsidies on inputs.

Item 6: Private profitability. This entry is derived from the above items. Private profitability = value in actual market prices (3) less direct factor costs other than capital, at actual market prices (4) less taxes (5). Private profitability within this framework is defined as the return to capital.

Item 7: Gross output at world market prices. This item is the border price of rice, the f.o.b. export price or the c.i.f. import price depending on whether expanded domestic rice production would be exported or serve as an import substitute, exclusive of tariffs and domestic taxes. As a per unit price, it should be consistent with item (1), the domestic price of rice.

Data for item 7: c.i.f. or f.o.b. price of rice, tariff and domestic tax rates on rice.

Item 8: Inputs treated as tradable goods, at world market prices. The desired items in this category are c.i.f. prices of inputs treated as tradable goods net of tariffs. If c.i.f. prices are not directly available, they must be calculated by indirect procedures, working back from farm gate prices to net out the c.i.f. price.

Data for Item 8: Same as for Item 2.

Item 9: Value added in world market prices. Value added in world market prices = gross output, at world market price (7) less inputs treated as tradables, at world market prices (8).

Item 10: Domestic resource costs, other than capital, at opportunity costs. This item includes the social opportunity cost of land and labor. As such, the calculations for this item involve applying shadow prices for land and labor.

Data for Item 10: Shadow price of labor and shadow price for land. These shadow prices are derived from the cost structure of the best alternatives for rice, yields, and price of output of best alternatives, amount and types of labor inputs and allocation of labor time over the course of a year.

Item 11: Domestic capital costs at opportunity costs. This item includes the capital costs of input components that are nonfully traded as well as capital services used directly. These capital costs are derived with reference to the shadow price of capital.

Data for Item 11: Capital components of all items treated as nontradable, shadow price of capital.

Item 12: Ratio of shadow price of foreign exchange to official exchange rate. This ratio adjusts for the divergence between the shadow price of foreign exchange and the official exchange rate. It makes it possible to compare the efficiency and policy indicators on an international basis.

Item 13: Net social profitability, at the shadow price of foreign exchange ((9)x(12)-((10)+(11)). Utilizing the ratio discussed in Item 12, the net social profitability calculation is adjusted for any divergence between the shadow exchange rate and the official exchange rate.

The remaining five items are self-explanatory and are derived from the items already discussed.

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This study examines the prospects for increasing trade in rice between selected countries of the West Africa Rice Development Association (WARDA). It first provides background information on rice supply, demand, and trade, and calculates import gaps or export availabilities in 1980 and 1990 for each WARDA country. Estimates the profitability of increasing output using the technologies of production that are expected to generate marketed supplies in potential exporting countries, and discusses the impact on intraregional trade in rice of alternative government policies.

In 1960 the self-sufficiency ratio for the WARDA region was .67, which implies that 67 percent of total consumption was provided by local supplies and 33 percent from imports. This ratio increased to .84 in 1975 because total production increased more rapidly than consumption and hence imports declined to only 16 percent of the total. Recorded trade in rice among WARDA member countries was irregular or negligible between 1960 and 1975.

For each country separate projections have been made for 1980 and 1990 of the demand for and domestic supply of rice. The difference between projected demand and supply is the net trade position, and the sum of all member countries' trade positions is the WARDA regional result. The technique used to make projections of the demand for rice in each country involved the application of the annual rate of population growth, the annual rate of increase in real per capita income, and the income elasticity of demand. Rice production is projected on the basis of known capabilities for expanding the principal techniques of production in each country. Constraints on the expansion of each production technique include resource (land, labor, water, and capital) limitations, budgetary restrictions, availability of external financing, and management capabilities.

The projections indicate that between 1975 and 1990, the WARDA region will become more self-sufficient in rice in terms of the percentage of demand met by local supplies but that the absolute tonnage of imports will increase. Only two WARDA countries, Mali and Sierra Leone, will be exporters of rice in 1990, and they will be able to supply only about one-fourth of imports required by the other members. More than 80 percent of the import demand will originate in two countries, Ivory Coast and Senegal. Relative to the supply, demand, and import positions of 1975, marked changes will occur in three countries according to the projections: Ivory Coast will return from temporary self-sufficiency to its earlier position of being a major importer; Mali will change from its modest import position to become a sizeable exporter; and Sierra Leone will emerge from self-sufficiency as an important exporter.

Mali is projected to have 34 thousand metric tons (TMT) of rice available for export in 1980 and 76 TMT in 1990, and Sierra Leone 38 TMT in 1990. A critical issue is whether these potential exports can be produced and delivered to other West African markets at costs which make them competitive with other international supplies of equivalent quality rice. Insight into this issue is gained from a social benefit-cost analysis of the rice farming, processing, and marketing techniques in Mali and Sierra Leone that are most likely to generate exportable supplies of rice.

The Office du Niger, using mainly its existing technique of gravity irrigation and animal power and to a lesser extent an improved technique that involves intensified production with fertilizer, is expected to be the source of most of Mali's exportable rice in 1980. Benefit-cost calculations in both private and social prices are based on returns from export sales to Abidjan, Ivory Coast, at a c.i.f. price of $350 per metric ton of milled

rice, which is consistent with projected long-run world prices. Production with the Office du Niger's current techniques is highly profitable in both private and social terms. Mali's potential exports in 1990 are anticipated to originate from the Office du Niger, using an intensive technique entirely, and from Operation Pêche Segou and Operation Riz Mopti, using an improved technique involving controlled flooding, animal power, and fertilizer. Again, the international competitiveness is examined with respect to the Abidjan market, and the same c.i.f. Abidjan price, $350 per metric ton, is used as in the 1980 analysis. Rice production in the two operations is significantly less socially profitable than that in the Office du Niger, but it is still competitive with international supplies at the assumed world price.

Sierra Leone is projected to be roughly self-sufficient in 1980 and to have an export potential of some 15,000 MT in 1990. Exportable supplies are expected to originate from southern Sierra Leone to supply the Monrovia, Liberia market at an assumed c.i.f. import price of $340 per metric ton. Two improved technologies, one located in inland swamps and the other in upland areas, are anticipated to be the sources of Sierra Leone's exports. The improved inland swamp production is very profitable, in both private and social terms, while the upland technique is privately profitable but only marginally so in social prices.

While virtually all government policies influence to some degree the supply of and demand for rice in West African countries, the most important policies are those which directly affect (a) rice prices, (b) investments in rice production, processing, and distribution, and (c) international trade in rice. Price policy in WARDA countries has typically protected producers and raised the costs to consumers of both local and imported rice during

1974, however, when unusually high rice prices prevailed, many countries chose not to allow consumer prices to rise to the full extent of import prices and instead subsidized imports of rice. Apart from this atypical occurrence, WARDA countries have generally used import policy to raise consumer and producer prices and to collect government revenues on imports of rice.

The second principal set of policies affecting rice is made up of government decisions to devote portions of their capital and recurrent budgets to development projects that bring about more rice output. Individual government plans to invest in rice projects are reflected in the supply projections. A third set of policies, related to trade, has the most direct impact on prospects for intraregional trade within West Africa. A critical issue for WARDA nations to decide is whether or not they wish to establish special regional trading arrangements for rice either in the context of the Economic Community of West African States (ECOWAS) or separately.