PN-AAK-058

Food Security, Self-Sufficiency, and Economic Growth in the Sahelian Countries of West Africa

Prepared for

The Agency for International Development

by

J. Dirck Stryker

Food Research Institute

Stanford University

Much of this report appears in Rice in West Africa: Policy and Economics, Scott Pearson, J. Dirck Stryker, Charles P. Humphreys, eds., Stanford Univ. Press, 1981.

February 1978

Preliminary Draft — did not become a Final Report

Information from

Food Security, Self-Sufficiency, and Economic Growth in the Sahelian Countries of West Africa

by

J. Dirck Stryker

Successive droughts in the Sahelian countries of West Africa in recent years have sharpened the need for a careful examination of the possibilities for improving the security of food supplies in this region. At the same time, dependence of these countries on emergency food aid from abroad has increased their desire to become self-sufficient in essential foods. Each of these two objectives could, in turn, be in conflict with a third goal of increasing their rates of economic growth.

The purpose of this paper is to analyze these issues and to examine the relevance for them of some preliminary findings from two recent studies in West Africa financed by the Agency for International Development. One of these is a study undertaken by the Center for Research in Economic Development, University of Michigan on Marketing, Price Policy, and Storage of Food Grains in the Sahel.[1] The other, currently being conducted by the West Africa Rice Development Association and the Food Research Institute of Stanford University, concerns the Political Economy of Rice in West Africa.[2] Both of these studies have brought together a considerable quantity of data

---

[1] CILSS/Club du Sahel, Working Group on Marketing, Price Policy, and Storage, "Marketing, Price Policy and Storage of Food Grains in the Sahel: A Survey," submitted by Center for Research on Economic Development, University of Michigan, August 1977.

[2] A preliminary report from this study is West Africa Rice Development Association (WARDA), "Prospect of Intraregional Trade of Rice in West Africa," prepared jointly by the West Africa Rice Development Association and the Stanford University Food Research Institute, September 1977

related to food policy in the Sahelian countries.

In this paper we first look at what has happened recently concerning food security and self-sufficiency in the Sahel, as well as the history of food policy over the past few years. Next the basic objectives of these countries as they relate to food are defined and the major constraints to achieving those objectives are described. We then analyze a number of alternative actions which could be used in pursuit of their goals in light of some of the preliminary findings of the studies noted above. Finally, we attempt to distinguish between efficient and inefficient strategies for achieving the Sahelian countries' national objectives.

Food Security and Self-Sufficiency in the Sahel

With respect to food security, Table 1 gives annual indices of per capita food production in four of the Sahelian countries from 1965 to 1976. We observe, first, that there are substantial fluctuations in production from year to year and that these fluctuations have been particularly severe over the last decade. There are also significant differences in the relative magnitude of these fluctuations. Niger, with its relatively drier and more variable climate, for example, has experienced the greatest year-to-year changes in per capita food production. Secondly, there appears to have been a significant downward trend in food production per head in each country, though this trend may have been reversed, at least in Mali and in Senegal, by 1976. The underlying data are too weak and the period of post-drought observations too short, however, to draw any fundamental conclusions concerning the existence of such a trend.[3]

---

[3] We will not dwell here on the weak quality of food production data in the Sahelian countries. This is extensively discussed in the CILSS/Club du Sahel study.

Table 1.--Indices of Per Capita Food Production in Selected Sahelian Countries, 1965-76 (1961-65 = 100)

Year	Country			
	Mali	Niger	Senegal	Upper Volta
1965	95	93	110	101
1966	94	94	89	85
1967	94	106	107	95
1968	84	81	82	85
1969	95	103	90	84
1970	90	87	67	81
1971	79	72	93	80
1972	67	63	63	67
1973	60	50	73	62
1974	63	69	80	76
1975	84	63	100	76
1976	92	72	96	73
Mean	83	79	88	80

Source: U.S. Department of Agriculture, Economic Research Service, Statistical Bulletin: Agricultural Production in Africa and the Near East, various years.

The maximum variation shown in Table 1 is for Niger, where the 1973 level of per capita food production was only 47 percent of that produced in 1967 and 63 percent of the mean level of production over the 12-year period. This can be compared with the probability distribution for millet and sorghum yields estimated by FAO and given in Table 2. We see from this table that yields which are 70 percent of the average are likely to occur once in every 5 years and those which are 57 percent may happen once in 10 years. According to these data, then, the situation in Niger in 1973 was not terribly unusual.

For the other countries listed in Table 1 the decline in production which occurred during these drought years is expected somewhat less often. Senegal and Upper Volta can anticipate a recurrence of these conditions once every 20 years; for Mali the expected frequency of such a drought is a little less. The Sahelian countries as a group should have a 15 percent shortfall in production once every 5 years, a 20 percent deficit once in 10 years, and a 30 percent decline once every 20 years. The last is equivalent to a loss of well over 1 million tons of grain in a single year. It is clear, therefore, that the problem of food security is acute, that it can be expected to occur fairly frequently, and that its resolution will require a massive effort.

Differences in yield fluctuations between countries are primarily related to their geographic positions. Mauritania and Niger, with only marginal and highly variable rainfall, for example, have the greatest variation in yields. Geography is also important in influencing food self-sufficiency in each country, as shown by Table 3, which gives several indicators related to self-sufficiency in cereals, the most important of essential foods.

Table 2.--Probability Distribution of Millet and Sorghum Yields

	Chad	Gambia	Mali	Mauritania	Niger	Senegal	Upper Volta
Average Yield (kg/ha)	600	950	607	360	430	495	500
Lowest Yield (kg/ha) Expected with a Probability of							
20%	543	902	563	248	303	432	454
10%	515	879	539	204	244	400	431
5%	469	855	507	100	146	354	402

Source: World Bank estimates derived from FAO, "Forecasting of Millet and Sorghum Production Fluctuation in the Sahel Zone," 29 May 1975.

Table 3.--Indicators Related to Self-Sufficiency in Essential Foods

	Chad	Gambia	Mali	Mauritania	Niger	Senegal	Upper Volta
Self-Sufficiency in Cereals (%)[a]							
1961-65	99	83	99	67	105	70	98
1969-71	98	80	97	51	99	66	96
1972-74	93	85	81	27	104	59	94
1975	97	79	81	20	105	65	91
Composition of Imported Cereals 1970-72 (%)							
Rice	0	74	14	56	0	58	7
Wheat & Flour	95	25	52	28	55	31	93
Other	5	1	34	16	45	11	0
Average Cereal Yields (kg/ha)							
1961-65	760	1,127	750	375	460	573	489
1969-71	742	1,253	699	342	582	616	485
1972-74	460	1,231	556	219	405	504	432
1975	627	997	733	223	329	726	554
Labor Productivity in Cereals (kg/head of rural population)							
1961-65	266	152	210	86	235	191	175
1969-71	174	141	168	74	204	192	157

Note: [a]Production divided by production minus exports plus imports.

Sources: FAO Yearbooks, World Bank estimates.

The first of these indicators, the ratio of production to net availability[4] of cereals, varies substantially between countries. It is relatively low for the coastal states--the Gambia, Mauritania, and Senegal. These are countries which historically have chosen to specialize according to their comparative advantage, exporting some crops in exchange for importing part of their food requirements. Proximity to the sea appears to have been an important element in this choice because all the interior countries have been much less dependent on overseas sources of food supply, at least until the recent drought.[5]

The composition of food imports is also revealing. Table 3 gives a breakdown of cereals imports for 1970-72, the last years for which imports were not substantially influenced by the drought. Over one-half of the cereals imported by each coastal country during this period consisted of rice, with wheat or wheat flour in second place. These cereals are consumed primarily by the urban population and those with higher incomes.[6] The inland

---

[4]Net availability, a proxy for consumption, is defined as net production minus exports plus imports. Changes in stocks are ignored according to this definition. Net production equals total production minus 20 percent for seed and losses.

[5]An important policy issue is whether this difference between these two groups of countries is due solely to the transportation cost advantage enjoyed by the coastal countries or whether more subtle influences have historically been at work. One indication that transportation costs have not been the determining factor lies in the rapid growth recently of export crop production in some of the interior countries despite declining real producer prices. (CILSS/Club du Sahel, Vol. I, pp. 27 and 28). For an econometric analysis which concludes that lack of public investment rather than high transport costs has been the major obstacle to export growth in those countries see J. Dirck Stryker, "Colonial Investment and Agricultural Development: The French Empire," Fletcher School of Law and Diplomacy, Tufts University, October 1975.

[6]These cereals are also consumed by farmers, especially the Wolof in Senegal, who are engaged in cash crop production. It has been argued, in fact, that colonial governments deliberately encouraged the substitution of cheap broken rice imports for local millet in this area in order to free labor time for groundnut production. Claude Arditi, Analyse Bibliographique: Les Circuits de Commercialisation des Produits du Secteur Primaire en Afrique de l'Ouest, Etudes et Documents, Paris: Ministère de la Coopération, March 1975, p. 6.

countries, on the other hand, consume less imported rice and more wheat and coarse foodgrains. In normal years they are able to satisfy their requirements for millet and sorghum, but most import wheat or wheat flour. When rainfall is inadequate, they must import all of these. Except in Mali, rice is not a major food, though its importance has been increasing in recent years.

The trends shown in Table 3 are also interesting, though somewhat distorted by the aftermath of the 1972-74 drought. Most illuminating, perhaps, is the change in self-sufficiency which took place from the early 1960s to the period 1969-71. All the countries experienced at least some increase in their dependence on the outside world for food. In part, this was probably due to some expansion in the demand for wheat and rice, which are not traditionally produced in most areas of the Sahelian countries. It may also have been partially related to a reduction in labor productivity in cereal cultivation in each country except Senegal. Why productivity declined is not clear since there is no consistent evidence of a decline in yields. One possibility is that more labor was allocated to cash crop[illegible]ch as peanuts and cotton. Another is that greater numbers of working-age people may have been away during the growing season, probably as wage laborers in the coastal countries to the south. Finally, in some areas such as the Mossi Plateau of Upper Volta there is a scarcity of good farm land which may have resulted in a decrease of labor productivity even if yields did not fall.

After 1971 the influence of the drought is unmistakable. Yields fell off dramatically in most countries and even by 1975 had not recovered to their 1960s levels in Chad, Mauritania, and Niger. Self-sufficiency also appears to have declined, but delayed imports of food still arriving in 1975 tend to make this indicator somewhat unreliable during the period

immediately following the drought. Production in Mali, for example, had substantially recovered by 1975 despite the relatively low self-sufficiency ratio. The country, in fact, began to export cereals in 1976.

In the face of substantial fluctuations in food production in all countries, low levels of food self-sufficiency in some, and a decline in self-sufficiency in others, what have been the food policies employed by the Sahelian countries over the past decade? In answering this question we distinguish between the coastal countries, for which import policy regarding food is very important, and the interior countries, which must rely much more heavily on domestic policies.

For the first group of countries, the evidence indicates that they have restricted imports of rice in most years.[7] This has led to a price of rice on the domestic market which has been slightly greater than the equivalent CIF price. The major exception occurred during 1973 and 1974 when the governments of these countries tried for a relatively short period to insulate consumers from the very high prices then prevailing in world markets. In most years there has, on the contrary, been some limited protection for domestic rice producers at the expense of consumers.[8]

---

[7] WARDA, "Prospect of Intraregional Trade of Rice in West Africa," Tables B-2, B-7, and B-10.

[8] This conclusion differs markedly from the CILSS/Club du Sahel study which maintains that consumers have generally been favored vis-à-vis producers. There are two major reasons for this difference. First, the CILSS/Club du Sahel study relies primarily on official rather than market prices. As both the WARDA and CILSS/Club du Sahel reports indicate, however, prices actually prevailing in the market are frequently higher than those established officially. The second and more fundamental reason for this difference has to do with the point of reference. The CILSS/Club du Sahel study examines the reference price issue in some detail, discussing several ways in which grain prices might be considered as too low (Vol. I, pp. 118-144), but no single concept of opportunity cost or reference price is chosen as superior to others. The WARDA study, on the other hand, generally accepts world prices as

Similar data are not yet available on the prices of imported wheat and coarse foodgrains over a number of years. One observation which we do have, however, shows that the domestic price of wheat imported into Senegal in 1972 was slightly higher than its border price.[9] This is consistent with our information on rice and indicates that the government was pursuing comparable policies for most cereals at that time.

With respect to rice, wheat, and wheat flour, a similar policy seems to have been pursued in the interior countries. That is, the market price of these products has in most years been higher than the comparable CIF price, indicating that imports were either taxed or restricted in some way.[10] The relationship between the CIF and local market prices of millet and sorghum, on the other hand, appears to have been variable. One estimate shows CIF prices in 1975 in Mali and Upper Volta to have been greater than

---

best reflecting the opportunity cost of tradable goods and services. For the past decade or more, rice prices in world markets have been relatively low. This has enabled countries like Senegal to gain substantially from exporting cash crops and importing food. There was one important exception to this, however, and that was the period of very high world prices from 1973 to 1975 when the governments of all the coastal Sahelian countries subsidized consumers and penalized producers in relation to the high prices paid for imported rice. The CILSS/Club du Sahel report appears to place a great deal of emphasis on this relatively short period (Vol. I, pp. 105-11); the WARDA study does not.

[9] Brendan Horton, "Incentives and Resource Costs in Senegalese Industry," Center for Research on Economic Development, University of Michigan, October 15, 1976. The CILSS/Club du Sahel report indicates, on the other hand, that the Senegalese government subsidized wheat flour prices in 1975 and 1976 after the steep rise in world prices which took place in 1973 and 1974. This was more in the nature of stabilization than subsidization, however, since the subsidy was removed at the end of 1976 (CILSS/Club du Sahel, Vol. I, p. 109).

[10] For rice we have the evidence contained in WARDA, Tables B-6, B-8, and B-13; for wheat our only observation shows that the local price of imported flour in Mali was twice its CIF price in 1974 (FAO, Trade Yearbook, 1975; Chambre de Commerce et d'Industrie du Mali, Precis Fiscal, Commercial, des Changes, et des Echanges, 1975-76, Bamako (1976?)).

comparable prices on the local market.[11] To some extent this may have been because these countries were trying to isolate their domestic markets from the high level of world prices at the time. But other evidence suggests that millet and sorghum have been sold below world price levels even when these have been fairly low.[12]

There are two important observations to be made. First, the official prices at which coarse foodgrains were sold were, in each case for which we have data, far below actual market prices which were often approximated by prices prevailing on the world market.[13] Thus the quantity of cereals imported and distributed at subsidized prices was insufficient to match demand, resulting in a two-tiered price structure and the need for some form of rationing to allocate the subsidized grain sales. Although consumers who were able to purchase cereals at subsidized prices benefitted, others were forced to buy in the open market at relatively high prices and were less well off than if no subsidy existed.

Second, government sales of imported millet and sorghum at prices below those prevailing on the world market occurred most frequently where the imported cereals were obtained as food aid.[14] Because of the financial losses involved, government marketing agencies are much less inclined to sell cereals at these low prices when they are purchased. Budgetary

---

[11] Roger Montgomery, "The Economics of Fertilizer Use on Sahelian Cereals: The Experiences in Mali and Upper Volta," (1976?).

[12] See CILSS/Club du Sahel, Vol. II, for examples of subsidized sales of millet and sorghum during the early 1970s.

[13] See, for example, CILSS/Club du Sahel, Vol. I, p. 106.

[14] CILSS/Club du Sahel, Vol. I, pp. 120-21.

pressures, therefore, seem to have been more important in determining price policy than the influence of consumers.

In addition to a modest amount of protection resulting from trade policy, governments have also tried to aid producers by narrowing the difference between producer and consumer prices. Lacking the resources for continuing subsidies out of general revenue, they have instead squeezed allowable commercial margins to the point that these have been insufficient to pay for the cost of transport, processing, and marketing. The result has been deficits and severe financial problems for state marketing agencies and considerable disruption of the private distribution network.[15]

The most critical failure of government policy with respect to producer prices, however, has been the inability of state marketing agencies to purchase sufficient quantities of cereals in times of abundant harvest to keep the price from falling below officially established levels. Only with commodities which are externally traded on a relatively large scale, such as rice, has the government been able to maintain fixed producer prices through its use of policies affecting that trade. Millet and sorghum, on the other hand, are traded across the border in only marginal quantities, and no feasible way has been found of maintaining support prices for these cereals despite the official announcement of such prices in most of these countries.[16]

---

[15] CILSS/Club du Sahel, Vol. I, pp. 110-12.

[16] The CILSS/Club du Sahel (Vol. I, pp. 186-208) report has an excellent analysis of the problems involved in supporting and stabilizing prices for these cereals. One might disagree, as we shall see later, with their conclusion that the interio countries cannot influence domestic prices, particularly of rice, with trade policies by exporting to other countries in West Africa. It should be noted, too, that the inability to maintain officially established producer prices can also benefit producers. Evidence collected for the CILSS/Club du Sahel report (Vol. I, p. 58) indicates that prices for millet and sorghum in small rural markets located in producing areas of Niger and Upper Volta were in 1971-75

Price policy has, however, been important in one way. All the governments in these countries tax export crops as an important source of public revenue.[17] The effect is to depress their domestic prices below comparable FOB world price levels. This discourages the cultivation of cash crops and implicitly encourages the production of food crops which are not generally taxed. It is difficult to say how important this effect is because we know little about the price elasticity of substitution in supply between various crops and because farmers would undoubtedly grow a large part of their own food under most circumstances. In addition, lower income from cash crops which are taxed may discourage the cultivation of food crops because of the farmer's inability to finance the purchase of inputs. In any case, the marketed surplus of food crops in undoubtedly affected in one way or another by this tax policy. It is important to note, therefore, that one of the principal findings of the CILSS/Club du Sahel report is that the real value of producer prices for cash crops in most of the Sahelian countries fell substantially from 1960 to 1974, and after an upward adjustment in 1974 may be decreasing once more.[18]

---

as much as two or three times the official producer price. This, of course, was a period of substantial shortages.

[17] There are various methods for doing this, including the collection of export taxes, profits of marketing boards and stabilization funds, and taxes on cash crops used as inputs into a local processing industry.

[18] CILSS/Club du Sahel, Vol. I, p. 28. Note that the distortion in official prices is not as great as in the prices which farmers actually face, since officially announced producer prices for foodgrains have been kept fairly low, too, at least in relation to prices prevailing in the market. On balance, however, even official prices have tended to move in favor of foodgrains (Vol. I, p. 123). This does not imply, of course, that cereals can be produced more profitably than cash crops, but only that government price distortions have increasingly favored food crops. On the other hand, cash crops have historically benefitted from a much greater research and development effort.

The most important way in which governments have tried to influence food production has been through various kinds of direct investment and input subsidy schemes linked to specific projects. One of the big advantages of these from the governments' point of view is that the costs are largely borne by foreign donors and are not a severe drain on local budgetary resources. This, in turn, has given project managers substantial financial and administrative autonomy. The absence of important budgetary constraints has also led, in many instances, to production techniques which are quite costly. Most obvious among these are large-scale, mechanized irrigation schemes.

Another instrument of food policy in some of the countries has been an attempt to influence patterns of consumption. The construction of irrigation systems or the promotion of lowland development schemes, for example, has not only increased cereal production and made it more secure, but in many cases it has also caused people to consume more of the foods, especially rice, promoted by those projects. And in Senegal the government has been trying to encourage the substitution of other foodgrains for imported rice by developing new food processing technology.

Aside from policies which influence prices, investment choices, and consumption patterns, governments in the Sahelian countries have also been active in the marketing and storage of food.[19] Each of the francophone countries has a public agency charged with this, and in Mali, Niger, Senegal, and Upper Volta this agency has a legal monopoly on the cereals trade. Yet in none of the Sahelian countries is more than one-half of

---

[19] These subjects are dealt with extensively in the CILSS/Club du Sahel report. Here we only summarize a few main points.

marketed grain sold through these agencies. In most cases the percentage is much less. Furthermore, most of the available evidence indicates that cereals are marketed by the private sector in a reasonably efficient manner. Nevertheless, infrastructure used for marketing, storage, and transport is inadequate and the private trading system is quite underdeveloped. There is very little specialization in trading grain, the credit system is rudimentary, and significant storage by traders is uncommon. Yet ". . . government policies have done little to encourage and much to frustrate the development of private trading skills."[20] Instead, the governments appear determined to increase control of grain distribution by state marketing agencies in order:

1) to ensure that producers receive a remunerative minimum price for their cereals;
2) to ensure that grain is distributed to deficit areas, including the cities;
3) to reduce or to eliminate seasonal price fluctuations.[21]

These goals have not been reached for a number of reasons. First, private traders are usually able to undersell the state trading agencies, partly because they are not obliged to maintain uniform prices throughout each country. Second, the state agencies have neither the finances nor the storage capacity to buy up all the grain available at official producer prices in years of abundant rainfall. Third, the state agencies have had difficulty organizing themselves in such a way as to assure timely purchases of grain shortly after harvest. Fourth, storage losses have been common

---

[20] CILSS/Club du Sahel, Vol. I, p. 74.

[21] CILSS/Club du Sahel, Vol. I, p. 98.

because of inadequate facilities and poor management. Fifth, the agencies have been plagued by continuing financial difficulties, partly because of the tendency to squeeze commercial margins in order to narrow the gap between producer and consumer prices. Finally, and perhaps most basically, ". . . the operation of grain marketing agencies in Sahelian conditions is extremely demanding; it requires substantial inputs of trained manpower, information, coordination capacities, organizational and administrative flexibility. These management-related inputs are extremely scarce throughout the Sahel."[22]

Objectives and Constraints

The major long-term development objectives of the Sahelian countries have been stated in various development plans and were summarized in March 1974 at a donor conference sponsored by the Comité Inter-Etats pour la Lutte contre la Secheresse dans le Sahel (CILSS) in Bamako:[23]

1) The mitigation of consequences of future emergencies.
2) The attainment of self-sufficiency in food staples.
3) The acceleration of economic and social development with particular emphasis on the least developed countries.

These objectives, which seem also to have been accepted by the international donor community, correspond reasonably well to the concepts of food security, self-sufficiency, and economic growth. There is a need, however, for further definition and refinement of each of these goals.

---

[22] CILSS/Club du Sahel, Vol. I, p. 103.

[23] United Nations Sahelian Office, An Approach to Recovery and Rehabilitation of the Sudano-Sahelian Region, New York, November 1974, p. 35.

By food security, for example, we may suppose that the Sahelian countries want to ensure, even in the worst years, that their populations have adequate food and water and that, at the same time, the national environment is preserved so that it may be used to sustain their needs over an indefinite period of time. Even if we accept the validity of this broad definition, however, we must clarify certain of its elements. First, there is the question of what is meant by "adequate food and water." This might alternatively imply a) the physiological minimum required for survival, b) the physiological minimum which permits worker productivity to be maintained, c) the minimum subsistence which is socially acceptable within any given "historical and cross-cultural context,"[24] or d) the standard of subsistence achieved in normal years. There is also the question of for whom must food and water supplies be adequate. Even in normal years there are some people who are not adequately nourished according to one or more of the above definitions. In time of drought this number will increase. At what point is this increase no longer acceptable?

A second dimension to the concept of food security is related to the uncertainty of whether or not the supply of food and water will be adequate. Each potential source of supply has attendant risks. Production may decline because of lack of rainfall or an inadequate flood. Stored cereals may be lost through spoilage. If a country is dependent upon imported foods in

---

[24] Clifton K. Wharton, Jr., "Risk, Uncertainty and the Subsistence Farmer: Technological Innovation and Resistance to Change in the Context of Survival," paper presented at the Joint Session American Economic Association and Association for Comparative Economics, Chicago, December 28, 1968, p. 27.

time of emergency, what is the reliability of foreign sources of supply?[25] Even if the required physical quantities can be obtained there is still uncertainty as to what the price will be and whether foreign exchange reserves will be adequate to cover the cost of purchases. Finally, if the country is unable to finance emergency imports of food, what assurance does it have that food aid will be forthcoming and on what political, if not economic, terms? Thus to "ensure" that an adequate supply of food and water is available means to accept some relatively low level of risk implied by a particular strategy.

The objective of self-sufficiency in food staples can also be very ambiguous. First there is the question of to which foods the term should apply. All the Sahelian countries import wheat or wheat flour, for example, and though this cereal can be grown in some areas, ecological conditions in most of the region are not suitable for its cultivation. The same can be said to a lesser extent, however, for rice and perhaps a number of other staples. Thus it is difficult to define self-sufficiency as a realistic objective without taking into account cost considerations. We are forced, therefore, to create some kind of a working definition such as that these countries would like, if conditions permitted, to eliminate imports of all major food items, such as cereals, sugar, and tea.

There is also a question of when the term self-sufficiency should apply. Clearly, it would be an objective in periods of normal rainfall, but what about periods of drought like that experienced in 1972-74, which

---

[25] Some of the Sahelian countries became acutely aware of this problem during the 1972-74 drought when, just at the moment that they needed to go to the world market for additional food, there was uncertainty as to whether this could be purchased at any price. One should note, however, that this was the first time since World War II that such a problem has existed on an international scale.

occur perhaps only twice a century? The Sahelian countries seem to recognize that it will be many years before they can avoid going to the rest of the world for food under such adverse conditions.

Finally, there is the issue of whether each country must individually seek self-sufficiency or whether that objective might more reasonably be satisfied, at least as an interim goal, at the regional level. If the latter definition is accepted, must the region be defined in terms of the Sahelian countries alone or should it include all of West Africa? This raises questions, in turn, concerning the cooperation between countries which can be achieved and the degree to which their economies can and should be integrated.

The third objective of accelerating economic and social development is broader still. We have a fairly good idea of what this means if we restrict ourselves to the concept of economic growth and efficiency. Most economists would agree that this implies equalizing marginal social costs and marginal social benefits valued over time at some socially defined rate of discount. Economic and social development, on the other hand, is a broader term over which there is much less agreement. Presumably it involves changing the structure of the economy and modernizing economic and social institutions. It may also involve altering the distribution of wealth and income, or at least attaining some minimum standard of nutrition, health, and education for each member of society. In what follows we can be fairly clear about the impact of various policies on economic growth and efficiency. We will have less to say about their effects on economic and social development, not because these are less important but simply because much less is known about them.

In the last analysis, these three objective can only be defined by the governments and peoples directly involved. For only they are able to articulate each of the dimensions of their own welfare. In formulating food policies and programs, moreover, decision makers must also decide how to weigh each of these goals since they are not likely to be always mutually consistent and trade-offs among them must probably be accepted. Numerous examples can be cited.

Although some people have tended to equate food security with self-sufficiency, for instance, it is not at all clear that the two are mutually compatible since this implicitly assumes that the chief source of uncertainty concerning food supplies is the world market on which the Sahelian countries trade. But in a region characterized by substantial annual variations in rainfall, the greatest disturbances may be domestic in origin and the world market may serve instead as a buffer allowing these countries to avoid the worst effects of a dropoff in production.

is fairly certain, too, that the goal of self-sufficiency is in conflict with the objective of economic growth and efficiency. Comparative advantage in international trade implies that economic efficiency is achieved if a country specializes in the production and export of goods it can produce at low cost and imports goods which it does not produce cheaply. If movement toward self-sufficiency involves a shift away from the situation in which a country is trading according to its comparative advantage, there must be some loss in efficiency and probably a decline in the rate of economic growth.

Finally, there may be conflict between the goals of greater food security and economic growth and efficiency. Better control of water, for example, is usually achieved with some decrease in net income. Seed varieties

which provide the greatest insurance against loss typically do not give the best yields. Much recent literature in agricultural economics, in fact, is concerned with how the existence of risk causes or should cause farmers' decisions to be different from those which would be optimal in its absence.

Trade-offs between these objectives reflect the different dimensions of peoples' welfare. If there were no such trade-offs, welfare could be represented by a single objective. Decision-makers must, therefore, make choices as to the relative weights to be attached to each objective and from these choices decide on a feasible course of action. In doing so, they are confronted with not only an array of objectives but also a set of constraints. In the absence of these constraints, of course, all objectives could be attained simultaneously. It is the presence of constraints which forces the decision maker to assign weights and to make choices.

Much has already been written concerning the numerous constraints which exist in the Sahelian countries.[26] We will not attempt to duplicate that discussion here. Suffice it to say that these include low quantity and high variability of rainfall, relatively poor soils, low but growing population density, poor transportation and communications infrastructure, long distances to the sea for the interior countries, low levels of health and education, rapid urbanization, concentration of exports in a relatively few major commodities, lack of research and development in food production technology, lack of basic data required for development of the major river basins, limited capacity of governments to generate tax

---

[26]A useful discussion of these is contained in Report to the United States Congress: Proposal for a Long-term Comprehensive Development Program for the Sahel, Part II, Technical Background Papers, submitted by the Agency for International Development, July 1976, especially pp. 14-21.

revenue, low levels of income for most of the population, and relatively few people with the training required to undertake major development programs. On the other hand, these countries are less constrained than others in several ways. Most of them have relatively stable convertible currencies, fairly low rates of inflation, some examples of successful agricultural programs related primarily to cash crops, relatively favorable market prospects for their major exports, and substantial but undeveloped water resources in the major river basins. In addition, the plight of the Sahelian countries has attracted the attention of the international community, and large sums are currently being mobilized to promote development in the region. Thus planners trying to elaborate a strategy for achieving the objectives of the Sahelian countries confront both formidable problems and important opportunities.

Possible Courses of Action

Given the objectives and constraints of the Sahelian countries, there are a number of alternative, but not mutually exclusive, courses of action which might be taken over the next few decades. These actions differ with respect to their timing and the relative efficiency with which they work towards the attainment of each objective. They also differ in the degree to which they are affected by the constraints listed above. In what follows, several of these actions are described and analyzed with special attention to the trade-offs implied by each for attaining the three national objectives. Where evidence related to a particular couse of action has been unearthed recently by the WARDA, CILSS/Club du Sahel, or other studies,

this is introduced.[27]

1. Increase holdings of foreign exchange which can be used to buy food from abroad when required to fill the gap between consumption and production. This obviously contributes nothing to food self-sufficiency. Whether it increases food security or not depends largely on the origin of fluctuations in food supply. If these are domestic in nature, based on changes in rainfall or flooding, imports may be a fairly secure way of covering food deficits. If there is substantial uncertainty associated with being able to purchase food on the world market or with the prices that prevail on that market at the time when food is needed, on the other hand, security may not be increased by greater reliance on imports.

The evidence presented in the first part of this paper shows the high degree of uncertainty which exists concerning cereals production in the Sahelian countries. In contrast, the world market is usually a relatively secure source of grain supply under all but the most unusual circumstances. Nevertheless, in 1973 a combination of limited supplies, strong demand, and export restrictions resulted in a scramble for rice on world markets that left some importing countries short of their requirements.[28] This strongly concerned those involved in the scramble but was, in retrospect, a very unusual event since it was the first time that such a situation had existed since the end of World War II.

---

[27] Some of these actions are discussed in Report to the United States Congress . . ., Part II, pp. 22-37 as part of a general program for developing the Sahel. Here we are concerned only with those aspects of the program related to food security and self-sufficiency.

[28] FAO, Commodity Review and Outlook, 1973-74, p. 64.

On the other hand, importing countries are also faced with uncertainty concerning the prices they must pay on the world market for food. Even if the price rise during 1972-74 was rather unusual, it did take place, and lesser fluctuations in world prices for cereals are a common occurrence. A weighted index of world food prices expressed in constant U.S. dollars is shown in Table 4 for all food and for cereals during 1950-76. A comparison of this table with Table 1 suggests that world prices of food have been considerably more stable than the production of food in the Sahelian countries. The minimum price was 66 percent of the maximum price, for example, and only 82 percent of the mean.[29] This contrasts with minimum production in Niger which was 47 percent of the maximum and 63 percent of the mean.

Prices of all food, however, have been more stable than those of cereals, the most essential staple in the Sahel. It may therefore be more useful to compare Table 4 with Table 2. As stated earlier, the Sahelian countries as a group can expect a 15 percent decrease in production of millet and sorghum below the average once every 5 years, a 20 percent reduction once every 10 years, and a 30 percent shortfall once every 20 years. A similar calculation for Table 4 suggests that world prices of cereals exceed the average by 16 percent once every 5 years, by 28 percent once every 10 years, and by 42 percent once every 20 years.[30]

---

[29] Perhaps more relevant for the concerns of importing countries, the maximum price was 25 percent greater than the mean.

[30] These estimates were calculated from Table 4, interpolating as necessary to obtain results comparable to those given for millet and sorghum production in Table 2.

Table 4.--Weighted Index of Annual

Average Food Prices

(constant U.S. dollars, 1970=100)

Year	All Food	Cereals	Year	All Food	Cereals
1950	133	154	1964	105	112
1951	122	139	1965	100	108
1952	114	134	1966	97	119
1953	121	140	1967	96	122
1954	149	133	1968	97	120
1955	124	115	1969	98	115
1956	124	114	1970	100	100
1957	118	104	1971	91	91
1958	111	107	1972	92	88
1959	106	104	1973	114	150
1960	97	96	1974	136	176
1961	92	102	1975	100	123
1962	90	113	1976	116	101
1963	98	113			

Source: World Bank

Although fluctuations in world prices of cereals appear to be greater than variation in domestic production, this is not the most relevant comparison, principally because most of the Sahelian countries are much more dependent on domestic supplies of cereals than they are on the world market. What really is needed is some measure of the variation (which we will refer to as the coefficient of variation[31]) in cereals available for consumption divided by the average cost of obtaining those cereals. For cereals produced at home calculation of this coefficient is fairly straightforward. We simply divide the coefficient of variation of cereals production net of seed and losses by the average cost of producing, processing, and marketing those cereals. For imported grain, on the other hand, the procedure is more complicated. First, we must estimate the cost of earning and holding an amount of foreign exchange adequate to assure a given degree of food security with a certain probability. This will depend upon the cost of earning the foreign exchange, the cost of holding it as reserves, the probability distribution of domestic production in relation to domestic needs, the average level of cereals prices on the world market, and the probability distribution of that price level. Once this cost is estimated, we divide it into the coefficient of variation calculated from the joint probability distribution determined by fluctuations in domestic cereals production and in prices of cereals on the world market.

Although these indicators have not yet been estimated, we can make

---

[31]The coefficient of variation, or the standard deviation divided by the mean, is but one measure which might be used, depending upon the type of frequency distribution which exists and the properties of it in which we are most interested.

some judgments about how the results are likely to turn out.[32] First, we have evidence to suggest that it is cheaper for most of the Sahelian countries to produce export crops and to sell them abroad in exchange for wheat and rice than it is for them to produce those cereals at home.[33] This may also be true of other cereals in certain areas, but the evidence on this is scanty thus far. Second, the joint probability of high prices of cereals on the world market and a shortfall in domestic production occurring at the same time is undoubtedly lower than the probability of either of these events taking place alone. Third, the cost of holding foreign exchange is not high since it can be placed on the Eurodollar market where it will earn a fairly high rate of return. For all these reasons, we should expect that the increase in food security associated with the cost of holding additional reserves is fairly high in relation to the risk which results from dependence on the domestic production of cereals.

2. Increase the size of food reserves held by governments in each country to the point where they will be adequate to assure self-sufficiency in virtually all circumstances. To the extent that this course of action is feasible, it clearly fulfills the objective of self-sufficiency. Its contribution to food security, however, is less certain because of the possibility of spoilage and because of problems involved in timely distribution of food where and when it is needed. It is with respect to the third

---

[32] These calculations are being made as part of the Political Economy of Rice in West Africa project being financed by the Agency for International Development.

[33] This assumes no change in the current transportation picture. The possibility of improving transport to lower the cost of exchanging export crops for grain is discussed later as a separate action. The empirical evidence referred to here is contained in J. Dirck Stryker, "Western Africa Regional Project: Mali Agriculture," May 9, 1975 and J. Dirck Stryker, "Western Africa Regional Project: Senegal Agriculture," May 23, 1975.

objective of economic growth and efficiency, however, that this action is most deficient because of the enormous cost involved.

As we have already seen, grain production in the Sahelian countries varies a great deal from year to year due to large fluctuations in rainfall and a close relationship between the amount and distribution of this rainfall and the size of the harvest.[34] Earlier it was stated that these countries as a group could, on average, expect a 30 percent decline in production once every 20 years and that this would be equivalent to the loss of more than . million tons of grain. During the 1972-74 drought over 1.2 million tons were supplied to the Sahelian states from external sources, and with growing population perhaps 2 million tons would have to be stored in the near future to assure self-sufficiency under similar circumstances. The World Bank has estimated the cost of storing each 10,000 tons of grain at $2.82 million for capital investment and $435,000 for annual recurrent charges, including interest.[35] Thus the total cost of a grain storage program to assure self-sufficiency under virtually any conditions would be close to $564 million for investment and $87 million in annual charges. This is an enormous burden for countries whose combined total government revenue is about $500 million per year, or only 6 times the annual cost of holding such stocks.[36]

---

[34] Rainfall variation, according to FAO estimates for the Sahelian countries, explains 50 to 70 percent of the variation in the production of millet and sorghum (CILSS/Club du Sahel, Vol. I, p. 189)

[35] Report to the United States Congress . . ., Part II, p. 35.

[36] World Bank, World Tables, 1976, Baltimore: The Johns Hopkins University Press, 1976.

In addition, these figures undoubtedly underestimate the total cost of this program. Their derivation assumes, for example, that the stocks are held for two years and are sold for the same price at which they were purchased. But two-year-old grain would undoubtedly have to be sold at a market discount. There would also probably be spoilage losses which have not been taken into account. Furthermore, unless the authority managing purchases and sales is very capable, there are likely to be losses associated with the need to sell time-expired stocks when the market price is relatively low. To the extent that food is distributed in time of emergency for a price which is below its cost, there will also be these additional financial losses. Finally, the cost estimates do not include incremental recurrent expenditures for collection and distribution of the grain which is stored.

The problems involved in turning over a stock of this magnitude without disrupting markets or incurring substantial financial losses are very great. There would have to be very careful coordination, for example, between turnover operations and any price stabilization measures in which the government might be engaged.[37] Initial acquisition of the stock, given the small proportion of grain currently being marketed, would also be very difficult unless provided primarily in the form of food aid.

Perhaps the major disadvantage of holding reserve stocks of this size, however, is its very high cost in terms of management skills, which are in such very scarce supply in the Sahelian countries. This cost is only partially reflected in the estimates given above because salaries,

---

[37] The problems associated with price stabilization operations are discussed in CILSS/Club du Sahel, Vol. I, pp. 203-08.

especially when influenced by government, are a very poor indicator of the true value of these skills. The need to collect, store, and distribute 1 million tons of grain a year in these countries would be an enormous drain on this scarce resource.

What other choices are there? One alternative is to reduce the size of the reserve stocks to levels which would provide adquate food to deficit regions until grain imports arrive. The size of these emergency stocks would of course depend on the expected variation in harvest and the time required for ordering and transporting food to each country. The latter is a function of the financial capacity of the countries to purchase food on the world market, their ability to obtain food aid, their geographical locations, and the transportation infrastructure which exists to handle imported food. As of 1975, the Sahelian countries had as emergency reserve targets:[38]

	Reserve Target (tons)
Chad	10,000
Mali	70,000 (of which 20,000 tons rice)
Mauritania	40,000
Niger	20-25,000
Senegal	50,000 (of which 30,000 tons rice)
Upper Volta	20,000
Total	210-215,000

The World Bank has estimated that this amount could be reduced to 30,000 tons for Mali and 20,000 tons for Mauritania, Niger, Senegal, and Upper Volta, or

[38] CILSS/Club du Sahel, Vol. I, p. 235.

a total of 120,000, exclusive of the Gambia. This would feed from 5 to 35 percent of the population, depending on the country, the equivalent of 150 kilograms of grain per year for a period of up to three months.

A second approach which might be taken would be to establish regional reserves which would be available to each of the countries in time of need. Although this might result in some savings in required grain stocks, there are several reasons why these savings would be minimal. First, a large part of the spatial variation in rainfall which occurs is relatively local in nature. The advantages of having reserves spread over a broader geographical area, in this case, are likely to be captured at the national level. Second, when drought is relatively widespread it tends to affect all of the Sahelian countries at the same time, thus diminishing the value of holding reserves in common.[39] Third, the cost of moving cereals between countries and especially to deficit areas in the Sahel is relatively high, so that part of the gain from having some countries in surplus when others are in deficit is lost. Finally, the problems of national planning and coordination of operations affecting stocks of grain are severe enough as it is. Management at the regional level would be even more complicated.

Neverthless, there is some possibility of greater cooperation between countries which have outlying deficit areas which are difficult to service from their main supplying centers. In the event of drought grain might more easily be supplied to the Gao region of Mali from Niger, for example, than from Bamako or Segou. This kind of cooperation should be encouraged

---

[39] The year-to-year correlation in per capita food production between several of the Sahelian states was shown to be relatively high in J. Dirck Stryker, "The Potential for Intra-regional Cereals Cooperation and Trade in Western Africa," paper presented to the Annual Meeting of the African Studies Association, November 6, 1976, p. 27. The data refer only to the period 1965-74, however, and the result might be excessively biased by the 1972-74 drought. Similar correlations are currently being estimated for a longer period of time.

at the regional level but will probably depend for some time on relatively ad hoc arrangements between individual countries.

One other possibility is the participation of the Sahelian countries in some kind of worldwide reserve scheme which would give them access to central reserves in time of need in return, perhaps, for paying part of the cost of maintaining those reserves. At the international level there is no question but that centralizing reserves yields important benefits by taking advantage of offsetting fluctuations of food supplies in different countries. The major disadvantage, of course, is the increased cost of collection and distribution of food over longer distances. More important, for the time being such a scheme does not exist although it is being actively promoted.[40]

3. Achieve self-sufficiency by raising producer prices to increase domestic production and eliminate imports. This policy is analyzed in considerable detail in the CILSS/Club du Sahel report, especially with respect to coarse grains for which imports are a relatively small proportion of total consumption.[41] To the extent that the policy is feasible and successful, self-sufficiency can be realized, at least in years of average production. Problems arise, however, in trying to achieve this objective under conditions of fluctuating production. In addition, the

---

[40]The World Food Council has recommended, for example, that "all efforts should be made to conclude by June 1978 a new International Grains Arrangement, which should include an international system of nationally held reserves, as well as a new Food Aid Convention." (FAO, "Recent Developments in the World Food and Agricultural Situation," Monthly Bulletin of Agricultural Economics and Statistics, Vol. 26, Nos. 7 and 8, July/August 1977, p. 25.

[41]CILSS/Club du Sahel, Vol. I, pp. 186-202.

policy may have a very high cost in terms of foregone economic growth and efficiency.

In analyzing the effects of price policy, it is useful to proceed one step at a time by assuming initially that there are no fluctuations in production. This enables a government to implement its policy with respect to producer prices without having to worry about the accumulation of surplus stocks in good years. The simplest way in which self-sufficiency can be assured under these circumstances is to prohibit the importation of essential foods.[42] If in the absence of this policy food would otherwise be imported, the effect is to increase food prices to consumers and producers. Consumption falls, production increases, and self-sufficiency is achieved.

The policy, unfortunately, has a number of unfavorable consequences. First of all, there is the problem that the government may not be able to implement it because of smuggling. This is especially true where there are relatively long, unguarded borders with other countries, as is generally the case in West Africa. The second problem is that the decline in consumption of food is probably not desired by the government. Indeed, political pressures by consumers in many countries are likely to be such that this type of trade policy is not even considered feasible. This is especially true in the Gambia, Mauritania, and Senegal, where imported foods form a large part of total consumption. Even if trade restrictions or tariffs are confined to such foods as rice and wheat, which are consumed primarily by upper-income groups, in contrast to the millet and sorghum eaten by the majority of the population, it is precisely these wealthier people who are

---

[42] An alternative would be to raise tariffs to levels which would eliminate imports.

in a position to exert the most influence to keep prices low.

One alternative is to maintain consumer prices at relatively low levels and to raise producer prices either by providing direct government subsidies or by attempting to squeeze the processing and marketing sectors. Continuing subsidies are not generally considered to be practicable in the Sahelian countries because of already precarious budgetary situations. The second approach of narrowing commercial margins is tried more often, but it is generally unsuccessful. When a public marketing agency is involved, it suffers losses which have to be covered ultimately by government advances or transfers. Private traders, on the other hand, either do not trade in grains for which their compensation is inadequate or, more commonly, trade on a parallel market in which consumer prices are well above officially established levels.

The third major problem associated with raising producer prices above world market levels is that it stimulates inefficient production and thus decreases economic growth and efficiency. In pure efficiency terms the world prices of tradable goods are their opportunity costs or the prices at which they can be obtained or for which they can be sold in exchange other goods and services on international markets. When producer prices are set above these levels, domestic factors of production are encouraged to move into relatively costly activities. The value of those domestic factors may, in fact, be considerably more than the value of the goods being produced when the latter are measured at their true opportunity costs, i.e., world prices.

The Political Economy of Rice in West Africa project has collected a large amount of data designed to measure the magnitude of this loss through

the estimation of the Domestic Resource Cost (DRC) indicator. This is the ratio of the cost of domestic land and labor used in a given activity to the value of net foreign exchange[43] earned or saved by producing for export or by substituting domestic production for imports. Preliminary estimates for about 75 rice producing activities in 8 West African countries, including 5 Sahelian states, indicate in almost every case that the value of domestic resources used to substitute domestic rice production for imports is greater than the net value of the rice produced. No similar calculations have yet been made for wheat or for the coarse food grains, but it is likely that wheat at least would be even more expensive than rice to produce domestically on a large scale in most countries. Millet and sorghum production, on the other hand, is more likely to be socially profitable because of the low value of these cereals in relation to their bulk, which makes the cost of importing them from abroad relatively high, especially for the interior countries. In contrast to rice and wheat, moreover, previous studies done for the World Bank in Mali and Senegal indicate that the DRCs for groundnuts and cotton, two major export crops, are quite low--that is the cost of the domestic resources used in their production is low in relation to the value of the net foreign exchange earned.[44] Thus from a pure efficiency point of view it pays to specialize in the production and export of groundnuts and cotton and to import wheat and rice. This is clearly what a country like Senegal is doing to a large

---

[43] By net foreign exchange earned or saved we mean its gross value minus the total cost at world prices of all tradable inputs, such as fertilizer.

[44] Stryker, "Western Africa Regional Project: Mali Agriculture"; Stryker, "Western Africa Regional Project: Senegal Agriculture."

extent, and the gain must be counted as considerable.[45]

Once we drop the assumption of zero fluctuations in production, a number of additional problems arise. If producer prices are adequate to assure self-sufficiency in poor years, there will be substantial surpluses in years of abundant rainfall which must be purchased by the government for export, storage, or destruction. If production is inefficient when valued at the CIF price appropriate for import substitution, it will appear even more costly when valued at the lower FOB price applicable to exports. Furthermore, if the government chooses to export at this lower price, it will incur substantial losses. Alternatively, the government can store the surplus grain, but this raises all the problems discussed in the previous section. Finally, there is the possibility of destroying stockpiles of food, but this clearly is very costly from both the national and the government budget point of view.

If the public sector does not support producer prices in years of surplus, these will fall, discouraging farmers from maintaining food production. This will lead to deficits and the need for imports in subsequent years. Even if the government is less ambitious and aims for self-sufficiency in average rather than in poor years, there will always be the problem of surplus disposal when rainfall is abundant. If the problem of production fluctuations is handled by importing in bad years and exporting in good years, a trade subsidy will be required whenever exports are needed to eliminate the surplus. If the government wants to avoid this subsidy, it must pay for costly storage. Only if producer prices are set at levels

---

[45]Estimates of the total size of this gain are being made as part of the Political Economy of Rice in West Africa project.

which achieve self-sufficiency in good years alone, can these problems of surplus disposal be avoided. But this, of course, reduces the effectiveness of the policy in achieving the objective of self-sufficiency since food will have to be imported in years of average or poor rainfall.

4. Increase production of food to levels sufficient to assure exports to other West African countries in all but the worst years of drought. Unless substantial government subsidies are used, this action is available to few of the Sahelian countries. For these, however, it would provide both food security and self-sufficiency. The only question is at what cost, if any, in terms of economic growth and efficiency.

An extensive analysis has been conducted of the cost of rice production processing, and marketing in one potential exporting country--Mali.[46] Another possible exporter appears to be Chad because of its large water resources, but this country was not included in the Political Economy of Rice in West Africa project. There is a need, therefore, to study the structure of comparative costs in that country as well. In addition to rice, it appears that Mali might also export some millet and sorghum to neighboring countries, and the cost of doing this needs to be investigated.

Prices and costs for rice exports from Mali to neighboring countries are summarized in Table 5. Several estimates are given for different techniques of production and destination points. Each technique indicated in the table can be used over a relatively large area, thus assuring an expansion of production large enough to permit Mali to become an exporter.

---

[46] WARDA, pp. 8-12 and Appendix Tables C-6a through C-6e.

Table 5.--Cost of Exporting Malian Rice to the Ivory Coast and Senegal

(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 cost
Farm gate cost	60,300	105,000	58,500	66,500	67,300	95,000
Cost consumption center						
Ivory Coast						
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						
Dakar	124,400	154,100	122,600	115,600	113,400	144,100
Price consumption center						
Ivory Coast						
Abidjan	-	154,900	-	154,900	-	154,900
Bouaké	-	168,300	-	168,300	-	168,300
Senegal						
Dakar	-	115,900	-	115,900	-	115,900

Source: WARDA, Prospect of Intraregional Trade of Rice in West Africa, September 1977, Appendix Table C-6e and work sheet data.

Costs are low for the controlled flooding technique because it involves relatively simple perimeter dikes and a minimum of irrigation construction. The system depends on natural river flooding, the height of which varies from year to year, and it is therefore relatively insecure. This is not true of the other two techniques at the Office du Niger, which involve complete water control. Costs are low here primarily because investment in the retaining dam and major irrigation works are treated as sunk since production can be expanded markedly without enlarging this basic system. The major difference between the gravity irrigation technique currently being used at the Office and the more intensive technique being promoted there is that the cost of the latter is greater despite the higher yields obtained. Expansion of production, however, requires either an extension of the area irrigated or an increase in yields on the land now under cultivation, and intensification appears to be the slightly more profitable alternative.

There are some differences between private and social costs of production because of taxes and subsidies on various inputs. Farmers in the controlled flooding perimeters, for example, do not pay all of the interest, depreciation, operation, and maintenance cost of the system. This results in a private cost of production which is less than its social cost. Farmers using the existing irrigation technique in the Office du Niger are also subsidized, but to a lesser extent. Post-harvest activities are on balance taxed, however, so the total private cost of rice delivered to the major consuming centers is greater than its social cost for this technique. The intensive Office du Niger technique, on the other hand, has a subsidy on land development and irrigation operation and maintenance which is sufficiently large that the total social cost of exporting rice exceeds

its total private cost.

Costs have all been calculated to three major delivery points--Abidjan and Bouaké in the Ivory Coast and Dakar in Senegal. These appear to be Mali's major potential markets, with Bouaké representing all of the interior region of the Ivory Coast.[47] The relevant costs can be compared with the prices of rice imported from the rest of the world and delivered to each consumption center. For Abidjan and Bouaké this rice is 25-30 percent broken; it is 100 percent broken in Dakar. Prices are based on constant dollar projections close to those used by the World Bank for 1985.

The major conclusion is that Mali should be able to compete effectively with the rest of the world's exporters in each major center of consumption. All techniques appear to be competitive if the center is Bouaké, and the Office du Niger is almost able to match competition from third countries in Abidjan using its more intensive technique. The existing Office technique is competitive everywhere, including Dakar where the price of rice is quite low because of its poor quality. Since the rice produced in Mali is about 50-60 percent broken, this could be sorted into separate quality categories for the Ivory Coast and Senegal, and the weighted average of the prices obtained should come close to covering the cost of production and delivery.

The preceding estimates depend heavily on the projections used for rice prices on the world market. These are uncertain, of course, though there is no reason to suppose that there is bias in any particular direction.

---

[47] It is implicitly assumed, in this case, that the interior of the Ivory Coast cannot satisfy all of its own needs so that rice has to be imported, with additional transport costs, into the center of the country. If the interior is supplying Abidjan, on the other hand, the price there should be higher than that prevailing in Bouaké.

Even if not all social costs are covered, however, the government of Mali might consider the possibility of subsidizing exports in order to derive other benefits. One of these is self-sufficiency, at least in rice and possibly also in millet and sorghum, depending upon the amount which can be exported in relation to the size of fluctuations in production. The other benefit is improved food security. Production shortfalls would result in a diversion of potential exports to the domestic market. To the extent that millet and sorghum needs might not be fully covered in this way rice could still be partially substituted for these cereals.

All this could take place through the functioning of the market as the rise in domestic prices resulting from the production shortfall attracted local sales of grain which would otherwise be exported. More likely, however, would be a diversion of at least some exports by OPAM, the state marketing agency. In any event, the public sector would undoubtedly remain responsible for redistributing food to those in greatest need.

A major problem with this action is that it may be difficult to get the coastal countries to agree to buy from Mali when supply is uncertain. To the extent that the market functions effectively, of course, buyers are always on the lookout for low cost sources of supply, and they may not be very concerned to purchase from the same source each year. But most rice imported into Senegal is handled by the state marketing agency, ONCAD, and rice in the Ivory Coast has been customarily purchased from abroad by a cartel of importers operating through the Chambre du Commerce. These buyers may be less willing to import rice from Mali unless they can be assured of supply. Then, too, there may be substantial price advantages for the importing countries if they enter into long-term contracts over a

period of several years, something which Mali would be unable to do on a large scale.[48]

On the other hand, Mali may be able to bargain because of the preferences it grants to Ivorian and Senegalese manufactured goods through the Communauté Economique de l'Afrique Ouest (CEAO). Reciprocal advantages might be obtained in the form of some degree of tariff preference for Malian rice vis-à-vis that imported from third countries. Alternatively, the coastal countries might agree to purchase part of their import requirements from Mali with the stipulation that the Malian government could intervene in the event of a severe decline in local production to assure adequate food for the local population. Whatever arrangement might be made, however, will require a degree of cooperation and coordination which has not characterized the recent past.

There is one additional way in which the Ivory Coast and Senegal might benefit from this type of arrangement. As noted earlier, the concept of food self-sufficiency must be defined with respect to whether it is a national or a regional objective. To the extent that it is accepted as a regional goal, the coastal countries presumabaly derive some direct benefit by importing from interior countries rather than from the rest of the world.

5. Undertake large-scale irrigation projects to increase the amount of food which can be produced securely within the major river basins. This approach was discussed extensively in the 1976 AID report to Congress

---

[48] A comparison of CIF prices of rice imported into Dakar with price quotations from Thailand indicates that Senegal may have been doing this for a number of years.

referred to earlier, which pointed to the urgent need for gathering additional data and planning carefully for rational development of these river basins.[49] The report also noted that "although irrigation, especially when combined with upstream storage, will substantially decrease the variability of yields normally associated with fluctuations in rainfall, it does not provide complete security if there is severe drought which lasts for several years in succession."[50]

Since the issue of this report a substantial amount of data on the cost of growing irrigated rice has been gathered by the Political Economy of Rice in West Africa project. Except for the Office du Niger, where most investment is considered as sunk, the costs of irrigated production appear to be very high. This is especially true of some of the large-scale, mechanized schemes along the Senegal River.[51] Furthermore, there is a close relationship between costs and the amount of subsidy furnished by government. Thus not only do those schemes decrease economic growth and efficiency directly, but they also are an important drain on public revenues which could be used to finance development elsewhere. Because of their need for substantial subsidies and the limited resources available to the Sahelian governments, moreover, it is unlikely that these schemes will be able to contribute much to the achievement of self-sufficiency. In summary, then, this approach may lead to somewhat greater food security, but it is very

---

[49] Report to the United States Congress . . ., Parts I and II.

[50] Report to the United States Congress . . ., Part II, p. 29.

[51] This was equally true of the large-scale, mechanized techniques used in the Office du Niger until fairly recently when they were abandoned because of their high cost in favor of peasant use of animal traction.

inefficient in attaining the other objectives.

The data upon which this assessment is based apply to the existing stage of development of the river basins. As salt water retention and upstream storage dams are constructed, the costs of production may change. Regulation of river flows, for example, will probably simplify the construction of protection dikes. An effort is currently under way to estimate the implication of some of these changes for production costs, but no results are yet available.

There are data, however, on the cost of producing rice and other crops in small perimeters using very labor-intensive techniques. These data exist primarily for the area around Matam in Senegal. The schemes there involve mostly hand labor in construction. Pumps are the only pieces of mechanical equipment generally employed. Yields are averaging in excess of 4 tons, and costs appear to be relatively low. The area is perhaps somewhat special because of the high density of population concentrated along the Senegal River in the Moyenne Valley, but the technique appears at least to be reasonably profitable under these kinds of conditions.

Aside from the high cost of production generally associated with large-scale irrigation, there is a distribution of benefits problem. If these schemes were to be expanded on a large scale, they could supply the urban market and replace imports, but they would contribute relatively little to increasing food security for farmers not involved in irrigated production. In the event of drought and a decline in dryland yields there would have to be some mechanism for transferring food from irrigated

areas to those suffering from lack of rain. Such transfers, however, would decrease the food available to irrigation farmers and to the urban population. There would still be a need for surpluses in average years, giving rise to the usual problem of what to do with those surpluses. The alternative of moving a large part of the population to regions which can be irrigated raises, on the other hand, questions concerning the pace at which social change required by a radical transformation in agricultural techniques can and should take place.

6. Develop food and cash crop production on small, rainfed farms by introducing improved varieties, fertilizers, ox-drawn equipment, and other farm inputs and by establishing systems of support services, including credit. This is likely to be much more successful in promoting economic growth and efficiency than the development of food crop production alone. For one thing, although there is no widely acceptable technical package for improving millet and sorghum cultivation in isolation, there are substantial possibilities for expanding their production when these cereals are grown in rotation with cash crops such as groundnuts or cotton. Yield increases can occur, for example, because of the residual effects of fertilizer used on cash crops even if the direct use of fertilizer on food crops is unprofitable.

A second advantage of associating food and cash crops together in the same farming system is that this facilitates the introduction of agricultural inputs and credit. Without cash income the farmer is unable to pay for chemical fertilizer, improved seeds, and agricultural equipment. It is especially important for the establishment of a viable system of credit

that the farmer have an assured market for his crop. In most of the Sahelian countries this is guaranteed by the state agencies that buy the principal cash crops. As we have seen, these agencies are much less successful in maintaining support prices for foodgrains.

Closely related to this is a third reason for farmers to grow both food and cash crops. If the production of foodgrains alone is increased, their prices will decline discouraging farmers from further expansion. Although some decrease in domestic food prices may be helpful in reducing imports and increasing consumer satisfaction, the process is ultimately self-defeating insofar as the farmer is concerned. On the other hand, if the cultivator is expanding his production of cash crops as well as cereals, he is able to regulate the amount of land and labor devoted to each in response to changes in their relative prices.

A combination of food and cash crop production is also a desirable way of increasing economic growth and efficiency simply because it is more socially profitable than growing food crops alone.[52] This is not always apparent because the governments of these countries frequently tax cash crop production, keeping prices to farmers below the world levels.[53] But if we correct for these distortions, it is quite clear that cash crops are usually more profitable than the production of food.

Aside from its contribution to economic growth and efficiency, this approach also helps to achieve self-sufficiency by lowering the cost of

---

[52] Stryker, "Western Africa Regional Project: Mali Agriculture"; Stryker, "Western Africa Regional Project: Senegal Agriculture."

[53] As was mentioned earlier, producer prices for cash crops have substantially declined in real terms over the past decade or two.

food production, inducing farmers to expand output and reducing the need for imports. Whether farmers will grow more food when they have or do not have cash crops as an alternative depends on the relative size of two effects. The first is the extent to which the existence of cash crop cultivation encourages farmers to purchase new inputs and to adopt new techniques which lower the cost of food production. The second is the relative degree to which output of food is responsive to a decline in food prices in the two situations, with and without cash crops.

This action may also contribute to improved food security. Development of lowland areas, particularly for rice cultivation, can be encouraged to decrease risks somewhat because of greater availability of water. Better soil preparation also helps to preserve moisture. Nevertheless, it must be recognized that with the existing technology this action is relatively ineffective in improving food security, especially in years of severe drought. There is an urgent need, therefore, to develop techniques which can assure this type of farmer, by far the most numerous in the Sahel, a more secure source of food supply. In part this might be done through agricultural research, e.g., the development of short-cycle cereal varieties; in part it could occur through innovations to improve on-farm storage.

In the final analysis, however, this approach is applicable primarily to the more accessible, higher rainfall areas where cash crops can be profitably grown. In the drier, more remote regions food crops assume greater relative importance. Some of these areas could be brought into the cash economy to a greater extent by improving transportation, but in others the cost of extending cash crop production is very high. While

innovation in food production might still be worthwhile in some cases, other areas may be so marginal that it is undesirable to encourage farming there because of potential damage to the environment.

7. Expand and improve transportation facilities in order to stimulate agricultural and commercial activity and to allow for the distribution of food in emergencies. This action can do a great deal to improve food security. One of the great problems during the 1972-74 drought was the delay and high cost experienced in getting food from the ports along the coast to the interior countries and in distributing food within each country, especially to the more remote areas. Even if grain is produced and stored domestically, there is still the problem of internal distribution in the absence of an efficient transportation network.

With respect to the goal of food self-sufficiency, improvements in transportation would have several effects. First, to the extent that transport costs from the coast to the interior are reduced, the terms of trade would turn in favor of exporters in the interior and encourage the importation of food. This would be more important in Chad and Niger than in the other countries which are better served by rail or roads to the coast. A second effect of this type of improvement would be to speed up the importation of food in the event of an emergency. Given the transport bottlenecks that currently exist, this could be important for each of the interior countries. It would probably encourage them, however, to depend more on the rest of the world for food supplies in time of drought. To the extent that transportation between countries is developed, on the other hand, intra-regional trade would be enhanced and regional self-sufficiency encouraged.

Transportation improvements within each country would clearly further the goal of self-sufficiency as well as that of food security. This would allow deficit areas to be supplied by surplus areas and would make more efficient use of reserve stocks of food. A major constraint on achieving self-sufficiency is the absence of a well developed commercial network to supply urban areas with food from the surrounding countryside. The construction and maintenance of an extensive road system, including feeder roads to villages, is a vital step in its development. Of even greater importance, perhaps, improvement in domestic transportation would allow remote areas to be supplied from domestic sources rather than having to rely on emergency air shipments of food aid by foreign donors.

The impact of improvements in the transportation network on economic growth and efficiency of course depends on the economic benefits which are achieved. Little can be said in general about these except to note that there is substantial evidence to indicate that investment in transportation facilities in the Sahelian countries would be socially profitable even in the absence of other benefits associated with improved food security and self-sufficiency.[54] Criteria for evaluating transport projects in terms of user costs are often so narrow, unfortunately, that observers fail to recognize the important role that transport plays in initiating development. Once we add on the benefits related to greater food security and self-sufficiency, the argument for stepped up investment in transportation becomes compelling.

---

[54] Stryker, "Colonial Investment and Agricultural Development: The French Empire."

8. Encourage migration of people out of areas of limited potential and into regions where the environment is more suitable for agricultural development. The Sahelian zone in particular has areas which are very marginal in their capacity to support an expanding population. On the other hand, there are substantial zones of higher rainfall in the south which are relatively underpopulated. To some extent diseases such as onchocerciasis and trypanosomiasis have limted settlement in these regions, but eradication efforts are under way and the area available for cultivation will be expanding. This could contribute in an important way to greater food security because not only is there more rainfall in these areas, but it is also more regular. Migration might also help to increase self-sufficiency because of the higher yields which can be obtained and because there would be less pressure on the soils in the marginal zones from which the migrants come. On the other hand, greater specialization in cash crops could reduce self-sufficiency, albeit at a higher level of net income.

As with transportation improvement, the influence of this action on economic growth and efficiency would depend on the relative costs and benefits associated with the migration. To the extent that it took place spontaneously and there were no associated externalities, we could expect economic efficiency to be increased because people would perceive it in their interest to migrate. Spontaneous migration usually is self-selective, however, and those left behind may be less able to support themselves. There may also be negative externalities in the region of settlement associated with competition to exploit unused resources in a wasteful manner. The costs of government sponsored resettlement schemes, on the other hand, frequently are quite high and may outweigh their benefits.

The largest resettlement program in West Africa, the Office du Niger, has relied less on organizing migration than on providing immigrants with the necessary credit and facilities to establish themselves in a new way of life. Although there have been problems and many previous immigrants have left, they are being replaced by others who understand the desirability of a relatively secure system of cultivation.[55] In evaluating the costs and benefits of this scheme, moreover, one must take into account the important training effects which have occurred, even for those who have left the Office. In Upper Volta, for example, one finds farmers undertaking irrigated agriculture which was learned while they were at the Office du Niger.

9. Encourage consumption of domestically produced foods by developing improved techniques for processing and preparing them in order to increase their competitiveness with foods which are imported. The most obvious example, mentioned earlier, is the development in Senegal of new ways of processing millet and maize in order that these may substitute more effectively for imported rice. To the extent that these kinds of innovations reduce costs or the time involved in food preparation, they increase economic growth and efficiency. If these efforts are concentrated specifically on locally produced foods, there should also be some increase in self-sufficiency. On the other hand, food security is increased only if consumption is redirected to a more assured source of supply. If domestic production is riskier than the world market, the shift to local foods may actually decrease food security.

---

[55] A detailed description of those problems is contained in John C. de Wilde, et al., Experiences with Agricultural Development in Tropical Africa, Baltimore, The Johns Hopkins University Press, 1967, Vol. II.

Conclusion

From the preceding analysis and presentation of empirical findings certain actions appear to be more efficient than others in attaining each of the three major objectives. Further study is required, however, to identify the particular ways in which the most efficient actions can be combined to present the policy maker with "best sets" of alternatives. It is up to the decision makers of the countries concerned, of course, to choose from among these best sets those which correspond most to their weighting of each nation's objectives.

As a first step we can eliminate certain actions which appear from our analysis and empirical findings to be inferior in all respects.

1. Hold food reserves adequate to assure self-sufficiency in virtually all circumstances. This would be extremely costly in terms of foregone national income, public revenue, and scarce management skills. It would also not necessarily assure food security because of spoilage and problems involved in the distribution of food stocks. Turnover operations could have an important disruptive effect, too, on the normal functioning of grain markets.

2. Encourage the production of food by establishing high producer prices. The major problem with this policy is the inability of most Sahelian governments to implement it. Without massive buffer stock operations there is no way of maintaining a high support price for millet and sorghum. Producer prices of cereals which are imported on a large scale can be influenced through trade policy, but powerful consumer interests prevent raising prices very much. Squeezing of marketing margins, on the other hand, results in financial problems for public distribution agencies

and encourages the development of a parallel market among private traders where prices established by government are ignored. If this policy were to be implemented, moreover, it would result in inefficient production and substantial losses of consumer welfare unless producers proved to be quite responsive to price changes.

3. Heavy subsidization of current and capital expenditures associated with large-scale, mechanized irrigation schemes. Experience in Senegal and in the Office du Niger suggests that these are very costly, can be an important drain on the public budget, and contribute very little to overall food security and self-sufficiency.

Each of these three actions is inferior, either by contributing relatively little to the attainment of each objective or, if relatively effective in achieving one objective, by having a high cost in terms of the others. There are other options, however, which appear to be more effective.

1. Hold foreign exchange for the purchase of food from abroad in emergency situations. Although precise calculations have not yet been made, this is almost certainly the least costly way, with the exception of food aid, of filling the gap between domestic consumption and production of food during a time of poor harvest. It is probably also a relatively secure means of assuring an adequate supply of food, though the risk associated with this option needs to be assessed more carefully. The action does not, by itself, contribute to food self-sufficiency.

2. Build up emergency reserves of grain required to cover food deficits until imports can arrive and be distributed. This action complements the holding of foreign exchange reserves for the purchase of food.

It is fairly costly but much less so than trying to cover all foreseeable needs out of existing grain reserves. Its most important contribution is toward food security; it does little to further food self-sufficiency.

3. Apply a modest amount of protection to domestic food production through the use of trade policy on imported foods. This policy contributes most effectively to food self-sufficiency. By raising consumer prices, primarily of rice and wheat, it encourages increased consumption of locally grown foods. It also provides some stimulus to production, not only of foods normally imported but also of coarse foodgrains, because the shift in consumption encouraged by higher prices of imported cereals tends to increase prices of millet and sorghum. There clearly is a trade-off here between food self-sufficiency and economic growth and efficiency, but consumer resistance to high prices is unlikely to allow too much economic inefficiency to exist as long as no government subsidies are provided.

4. Tax cash crops as a means of collecting public revenue which can be plowed back into agriculture and of encouraging the production of food crops in response to altered relative prices. The efficacy of this policy depends, of course, on the extent to which public resources are actually channeled back into agriculture. It also is dependent on how farmers react to reduced cash crop incomes as well as to the changed structure of relative prices. In the absence of better empirical information, it is difficult to say how effective this policy might be in influencing food self-sufficiency. One can be fairly sure, however, that increased specialization in food production will lead to many of the problems mentioned earlier in the discussion of cash and food crop farming. Furthermore,

greater food self-sufficiency is achieved in this way at the expense of economic growth and efficiency. The cost may not be very great, however, if taxes on cash crops come largely out of implicit land rents and if the government makes more productive use of these resources than would the holders of land.

5. Develop food and cash crop production on small, rainfed farms and irrigated perimeters by introducing new technology, intermediate inputs, and systems of support services. This is one way in which the government can make productive use of its tax revenue. Current experience indicates, moreover, that this is probably the most effective means of increasing economic growth and efficiency for relatively large numbers of farmers. It may do less to promote food security and self-sufficiency, but some contribution toward these objectives is probably achieved as well.

6. For countries which have the potential, increase production of food to levels sufficient to assure exports to other West African countries in all but the worst years of drought. At present Mali is the only country for which we have evidence that this is an efficient strategy option. The situation in Chad should also be studied, however, because of that country's large water resources. The option is highly desirable where the potential exists and costs are low, because it satisfies all three objectives simultaneously. The major impediment to its implementation appears to be the need to establish satisfactory cooperative arrangements between importing and exporting countries.

7. Expand and improve transportation facilities. This action can contribute in an important way to greater food security. Whether it will also increase economic growth and efficiency depends on the relative costs and economic benefits associated with transportation development. Its influence on food self-sufficiency will depend principally on the type of improvements that are made, that is whether they facilitate movement within the Sahelian countries or between these and the coastal ports.

8. Encourage migration from ecologically poor areas to those capable of supporting greater levels of population density. As long as the government does not become involved in costly resettlement schemes, this should contribute to economic growth and efficiency as well as to greater security. Its impact on food self-sufficiency depends on whether the increase in yields and labor productivity in the production of food is offset by a shift to cash crops. It also depends on what happens to food production in the region of emigration.

9. Encourage consumption of domestically produced foods by innovation in processing and preparation. To the extent that these innovations can be developed, they will increase food self-sufficiency and economic growth and efficiency. They may not, however, improve food security if foods produced domestically are subject to greater fluctuations in supply than those which are imported.

These actions may be combined together in many ways in pursuit of the three objectives. Some of these combinations are likely to prove better than others, however, even before any decisions are made as to how the objectives should be weighed. To determine the best combinations, though, we need some additional information. The following is a list of some of the gaps in our knowledge which prevent us from establishing the most efficient sets of policy combinations.

1. The structure of prices and costs of wheat or wheat flour and coarse foodgrains imported into the Sahelian countries. We have this information for rice except in Chad.

2. Several years of data following the 1972-74 drought to verify what has been happening to the variables listed in Table 3 (self-sufficiency ratio, composition of imported cereals, average cereal yields, and labor productivity in cereals) since the early 1960s. If the decline in labor productivity in cereals is continuing, a high priority should be assigned to finding out why.

3. The probability distribution of yields for different foodgrains in different regions and using different techniques. There is some evidence to indicate that the probability of attaining a given set of yields in the controlled flooding projects of Mali has been seriously overestimated.

4. The correlation between grain yields in the Sahelian countries over a period of at least 25 years to establish any advantages which might be obtained through common storage. There should also be some investigation of particular localities in which cooperation in grain storage between two or more countries might be mutually beneficial.

5. A great deal more information is needed about consumption. We know virtually nothing about how consumption of different foods is related to income, urbanization, population growth, changing age/sex structure of the population, adoption of new crops, relative food prices, etc. Senegal, for example, has experienced a decline in per capita rice consumption for the past ten years which we are completely unable to explain. Current projections of cereals consumption all over the Sahel could be substantially in error, and there are few guidelines for policy makers. As an example directly related to a policy designed to promote food self-sufficiency, we have little idea of the magnitude of consumer response to increased prices of imported cereals.

6. It is commonly stated, but deserves repeating, that better estimates of agricultural area and production are sorely needed.

7. The choice of price policy versus investment in agriculture depends very much on the differential response of farmers to changes in crop and input prices and to the availability of credit, intermediate inputs, and extension services. What, for example, is the farmers' response in planting food crops to a change in the prices of his cash crops?

8. What changes can be expected in the cost of irrigated production as a result of the development of the major river basins through construction of upstream storage dams, salt water retention dams, etc.

9. Are there Sahelian countries other than Mali which are potential exporters of cereals within the West African region? The structure of costs of production, processing, and marketing in Chad needs to be examined. What potential is there for Mali to export millet,

sorghum, and even maize to other West African countries?

10. The migration experience within West Africa should be assessed carefully to determine the best ways in which governments can be involved to assure order in this process without incurring very high costs.

11. A study is required of the comparative cost of providing a given degree of food security by holding foreign exchange reserves, holding stocks of food, developing irrigation schemes, improving transportation systems, and creating export capacity as a buffer against reductions in domestic food supplies.

This list is by no means exhaustive, but it does indicate some of the most important data requirements needed to present policy makers with the fundamental choices they must make. In the absence of this kind of information alternatives remain confused, and there is no assurance that choices are made from among the best sets of options.

One important overall conclusion which emerges from this analysis is that progress in achieving most of these goals is likely to be fairly slow as long as each alternative is assigned a fairly high weight. Self-sufficiency in essential foods is unlikely to occur very quickly in the Gambia, Mauritania, and Senegal, for example, unless these countries are willing to experience substantial decreases in economic growth and efficiency. Niger and Upper Volta are nearer to self-sufficiency, on the other hand, but their supplies of food will probably remain relatively insecure for some time to come. In addition, both these countries suffer from poor agriculture conditions in areas where population density is high and rising in relation to the resource base, so that they cannot sacrifice

much in the way of economic growth and efficiency to move quickly to a situation of greater food security. Only Mali, and perhaps Chad, appear to be in a position to make much progress toward achieving their objectives reasonably soon by developing a substantial capacity to export grain.

In view of the difficulty most of the Sahelian countries seem to face in trying to attain all their goals simultaneously, they may want to explore alternative ways of avoiding the worst consequences of this situation. Countries which are going to remain dependent on food imports for some time, for example, may want to develop long-term contractual arrangements which will allow them to have access to world markets on favorable terms. What is required above all, though, is the development of a realistic long-term strategy which will enable these countries to pursue their national objectives as quickly and efficiently as possible.