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In 1973 Professor John Caldwell travelled through southern Algeria, Niger, Upper Volta and the countries of the Guinea Coast to assess the drought from the standpoint of a demographer. An attempt was made to compare this region with the conditions in Ethiopia, Sudan, drier parts of Cameroon, the Central African Republic, Kenya and Tanzania. The author reports on the region of the drought, the demographic consequences, the nomadic people of the area, the reaction to the 1970-74 drought, and the implications for the future. He expresses concern with the inability of demographers to react quickly to a crisis and feels that medical and nutritional conclusions are made with inadequate or inappropriate demographic information. He concludes that the drought had no severe effect on population growth. There is a discussion of medium-term development programs and long term assistance for the purpose of helping these countries prepare for drier years. Saving wealth from good years to meet the needs of bad ones is a function of modernization--of monetization and of individual and governmental savings and insurance schemes. So too is the demographic problem of the medium term reduction of mortality and the long term reduction of fertility.

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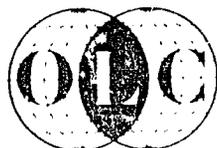
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The Sahelian Drought and its Demographic Implications

by

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Overseas Liaison Committee
American Council on Education

American Council on Education

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Preface

In 1973, the Overseas Liaison Committee (OLC) of the American Council on Education established a Rural Development Network as an outgrowth of its decision to emphasize rural development as a major program activity over the 1973-78 period. The Rural Development Network is a specialized information system designed to further the exchange of information on the planning, implementation and evaluation of rural development programs through a series of seminars, field trips and publications. OLC's Rural Development Network Bulletin, which is published quarterly in French, English and Spanish, commands a wide readership in over seventy countries. OLC's Rural Development Papers by Akhter Hameed Khan, David Norman and an annotated bibliography on rural development by Tekola Dejene and Scott Smith, are standard references in the literature on rural development.

In 1975, OLC assisted the Governments of Mali and Senegal in the organization and execution of a Field Trip/Workshop on "The Drought in Africa." The field trip in Mali and Senegal provided an opportunity for participants from ten drought-stricken African countries to examine medium-term recovery projects in the field and to advance concrete recommendations to donors on how to improve the design of recovery projects.

The Overseas Liaison Committee is honored to publish in French and English, The Sahelian Drought and Its Demographic Implications by John C. Caldwell, who is considered by many to be the leading authority on demographic problems in Africa. Professor Caldwell has conducted research in almost every African country and has repeatedly visited the West African savannah over the past fifteen years. Professor Caldwell is Co-Director of the Changing African Family Project, which is studying the conditions and onset of fertility changes in twelve African countries.

Carl K. Eicher, Chairman
Overseas Liaison Committee
American Council on Education

Table of Contents

1	Introduction
3	The Region of the Drought
6	The Demography of the Region
15	Fertility Control
17	The Drought
23	The Demographic Consequences of the Drought
31	Nomads and Farmers--Their Characteristics and Nature
39	Imbalance in the Savannah
48	Reaction to the 1970-74 Drought
55	Nomadic-Sedentary Relationships
57	Minimization of Risk
59	Fatalism
61	The Future
66	The Demographic Implications
74	A Final Note
77	References
89	Note on Organizations Referred to by Initials

THE SAHELIAN DROUGHT AND ITS DEMOGRAPHIC IMPLICATIONS*

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Introduction

Beginning almost imperceptibly in the late 1960s with a decline in rainfall, one of Africa's harshest recorded droughts fastened upon sub-Saharan savannah Africa in the early 1970s. As world concern about the situation intensified, most of that concern was focused on the demographic aspect of the situation. How many people had died or were likely to do so? What were morbidity levels among the survivors? To what extent had migration streams increased in size or been diverted to new destinations?

However, until late 1972 the nature and magnitude of the drought were misunderstood outside the Sahel and no adequate reports were available in the world beyond. The author, who had personal acquaintance with the West African savannah from 1962, had taken leave from the Australian National University towards the end of 1972 to become the Population Council Regional Representative for Africa. Top priority was given to acquiring an up-to-date and first hand knowledge of African population movements and this was begun with a land-rover expedition from the Maghreb through southern Algeria, Niger, Upper Volta and the countries of the Guinea Coast. It became obvious in northern Niger that the dry conditions were of a more catastrophic nature than had been generally realized and this was reported to the authorities in Niamey. During 1973 the author endeavoured to assess the drought from the standpoint of a demographer, both in northern Nigeria and subsequently in the Sahelian coun-

*This paper is based on a report originally prepared for the Population Council at the end of 1973. It was updated for presentation to a seminar of the African Programme of the School of International Affairs at Carleton University, Ottawa, in March 1975, and was scheduled for publication as an Occasional Paper of the School of International Affairs. Our thanks are due to Professor D.R.F. Taylor, the organizer of the Programme, for permission to publish this report which has now been revised to include material available up to the end of 1975.

tries. At the end of that year he attempted to make a comparison with conditions in Ethiopia, Sudan, and the drier parts of Cameroon, the Central African Republic, Kenya and Tanzania. When it became clear that the 1973 rains were failing, the author began a period of field investigation in Upper Volta, Mali, Niger and Chad, including land-rover journeys to the nomadic areas, and this was supplemented by observations in northern Ghana and northern Nigeria. A base in Ibadan during the rest of the period made possible a study of the reactions of the coastal region to the events further inland and to their own relatively dry conditions.

This experience led to a concern with the inability of demographers to react quickly to the crisis or to provide adequate baseline information from field research already carried out. It also produced a conviction that nutritional and medical conclusions were being made by comparison with inadequate and inappropriate demographic information, and that something more could have been done by demographers, even during 1973, to measure migration flows at certain nodal points, especially on crossings of the Niger River, and to estimate mortality in certain sample areas. It became increasingly apparent that, in spite of the appalling conditions being experienced over most of the West African savannah, population growth had not been halted in the region as a whole and, except in the completely nomadic areas, natural increase may not have been greatly checked. True Malthusian conditions do not easily set in and are usually not permitted to persist in the modern world for long or over great areas.

The drought can, at least for the time being, be viewed in retrospect. In most areas the 1974 and 1975 rains were adequate, at least by Sahelian standards, and the first longitudinal analyses of the demographic experience of specific (sedentary) areas are becoming available and are confirming that population growth was not substantially reduced during the early 1970s [Faulkingham and Thorbahn, 1975].

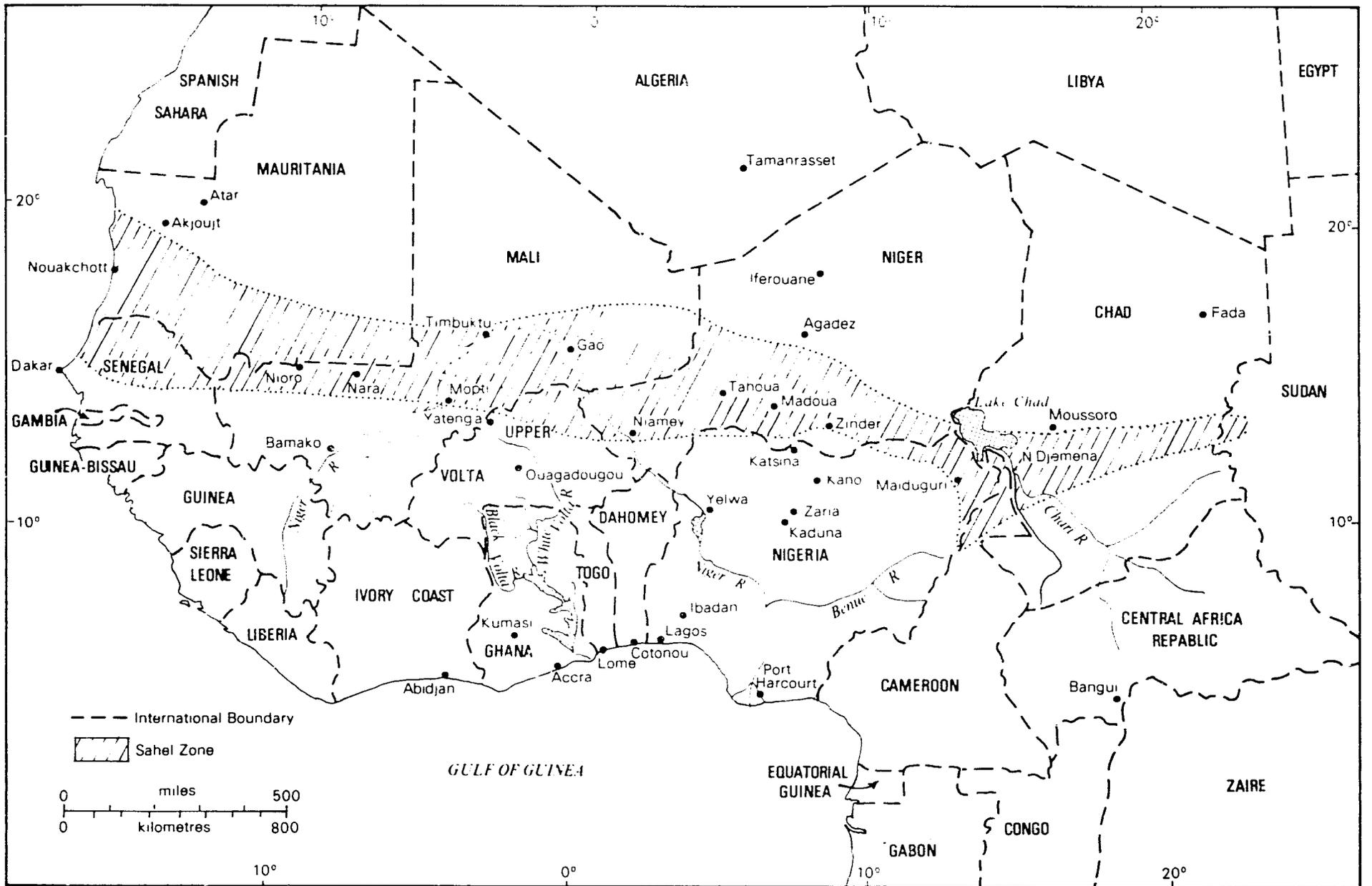
This paper is, then, a report originally prepared for the Population Council, from the viewpoint of a participant observer who was also a demographer, and, apart from a few later additions, is based on personal experience and the documents available at that time in the Sahel.

The Region of the Drought

The drought had a major impact on a belt extending from the central Sahara southward for about 750 miles to where thickening tree cover signals the approach of the equatorial forests. The worst affected areas were those furthest north, not only because rainfall is always sparsest there and the ecological balance the most fragile, but because the shortfall in the early 1970s was also proportionately greater. West to east the area of distress stretched from the Atlantic coast, north and south of Cape Verde, for over four thousand miles to Ethiopia and even Somalia (and, according to some, to north-west India). Low rainfall was registered over three million square miles.

The areas of acute distress probably totalled about one million square miles. Apart from the Ethiopian Provinces of Wollo and Tigre, nearly all this region was in West Africa (counting northern Chad and the extreme north of Cameroon as West Africa). The countries most affected were Mauritania, Mali, Niger, Chad, Upper Volta and Senegal; less affected were northern Nigeria, Gambia and a small part of Cameroon. The most acute crisis has been in the dry, grassland country unsuited to agriculture immediately south of the desert. It is known as the Sahel and receives less than 25 inches of rain annually and is found north of 15°N. Between 10° and 15°N. (except in the far west) is the Sudanic zone, receiving 25 to 40 inches of rain, and supporting agriculture (as well as grazing). The rainfall figures are, by temperate standards, misleading, as they are low compared with the levels of evapotranspiration.

The dominant form of economic activity in the Sahel is nomadic pastoralism centering on cattle, camels, sheep and goats. That of the Sudanic zone is the shifting cultivation of two indigenous grains, bulrush millet and guinea corn (sorghum). The Sahel countries (used henceforth, in accordance with recent United Nations usage, to refer to Senegal, Mauritania, Mali, Upper Volta, Niger, and Chad, although strictly speaking, most of their population live outside the Sahel) suffer from a range of problems which have no easy solutions. All but Senegal and Mauritania are landlocked and must bear the addition of large freight costs in external trade. Apart from the groundnuts of Senegal, cash crops are few and not very lucrative. Only Mauritania has so far found much mineral wealth. Senegal and Mauritania are estimated to have per capita incomes around \$200, while those of the other four are in the \$60 to \$100 range. But, before the drought, incomes were rising; the gross domestic



THE SAHEL AND THE SAHELIAN COUNTRIES

product apparently increased between 1958 and 1965 by 193 percent in Mauritania (because of mineral finds) and by 27 to 67 percent in the other countries (de Lusignan, 1969, p. 321), whittled down on a per capita basis by no more than about 15 percent by population growth during the period. Most of the population is predominantly engaged in subsistence production, and most live a life not very different from their ancestors. Land use is at the mercy of the monsoon (wet season) which sweeps north from the Gulf of Guinea becoming more frugal, in terms both of total rainfall and length of the wet season, with every mile northward until it finally dies on the fringes of the desert. The present drought and its accompanying level of mortality is by no means unique. But it is the first of its severity for over a generation, a period during which the condition of the Sahel has become far better and much more rapidly known to the outside world because of modern communications and during which planned development has come to the West African savannah. Furthermore, it does raise critical questions about the changes which have occurred over the last three decades.

Most of West Africa's characteristics--rain, income, urbanization, the chances of medical treatment, the probability of going to school--have to be seen in terms of marked differentials from north to south; even in terms of the impact of drought on primary production, recent research has shown that Agadez, in northern Niger, waits in justified apprehension to measure the deficiencies of each monsoon, while Ibadan, 750 miles further south and on the edge of the dense forest, had its last great famine just over a century ago (High, Oguntoyinbo and Richards, 1973, p. 116). One of the more unfortunate divisions between the north and south is that determined by the tsetse fly. South of about 14°N. the environment is moist enough for the fly to flourish; and, because it is the vector for a disease which attacks most cattle, all but certain small and rather immune varieties must remain further north. This means that, except for a transitional zone, mixed farming is not practised, with all that implies in terms of inability to manure soils. It also means that an increasing proportion of the animal protein sold in the rich markets of the Guinea coast come in the form of cattle (mostly on the hoof) from the West African savannah, thus giving the nations to the south an economic and dietary interest in the savannah drought.

The Demography of the Region

By mid-1974 the six Sahel countries probably contained about 25 million people--almost 6 million in Upper Volta, and 4 to 5 million in each of the others except Mauritania with only 1 1/4 million. These are low population densities compared with those found in the countries further south. The densities also do not compare with that of northern Nigeria, which is in the savannah zone but not the Sahel (except for a small part of the Northeast State), and which has more than half the population of the whole West African savannah (northern Nigeria's population is in the 30 to 50 million range, the number chosen depending on which population census or estimate is accepted). Of these 25 million, 2 1/2 million or 10 percent are nomads and a similar number live in towns; the remaining 20 million are the rural, agricultural population.

Poor statistics and changing boundaries within the old French Empire make it difficult to estimate long-term population growth within each of the Sahelian countries. Some idea of trends may be gathered from the administrative censuses (taken by adding together the extracts from the District Officers' rolls) for the whole of French West Africa (which also includes Guinea, Ivory Coast, Togo and Dahomey but which excludes Chad). The population of this area appears to have risen from about 13 million in 1921 to 16 million in 1939, 17 million in 1947 and (referring to the independent countries formed from the Empire) to 39 million in 1974. Thus, during the first half of the last half century, the population seems to have risen by less than one-third at an average annual rate of one percent, while during the second half it appears to have increased by almost one and one-third times at about three percent per annum. These figures are highly suspect, but they do indicate the relative change in population growth rates, arising from declining mortality, which has occurred over the last generation. But, in the discussion that follows, we will again concentrate on the Sahelian countries, which almost certainly still have relatively high mortality.

Cantrelle has assembled both uncorrected and adjusted data from the INSEE programs in West Africa (which since 1960 has been carried out in cooperation with the national statistical offices) and selections are presented in Table 1 [Cantrelle, 1975] together with some Nigerian data. Senegal is excluded because its drought situation differs significantly from the other Sahel countries.

Table 1. Vital Levels Calculated from Surveys and Censuses,
Savannah West Africa, 1957-1965

Country	Year	Crude Death Rate		Infant Mortality Rate		Probability of Dying	
		Uncorrected	Corrected	Uncorrected	Corrected	Before 2	Between 1 & 5
						(2 ^q 0)	(4 ^q 1)
Mauritania	1964-65	28	--	--	--	240	--
Nomadic pop.	1964-65	--	--	185	--	242	--
Sedentary pop.	1964-65	--	--	191	--	226	--
Mali	1957-58	41	38	--	354	--	--
Mali	1960-61	29	--	141	--	298	182-189
Upper Volta	1960-61	31	36	182	263	321	208-225
Niger							
Sedentary pop.	1960	27	--	200	212	262	--
Chad	1964	31	--	165	--	249	110-161
Cameroon							
N. Benoué	1960-61	27	31	180	223	274	159-176
Nigeria							
Northern Region	1963	--	25	--	--	--	--

Sources: Pierre Cantrelle, "Mortality", Chapter 4, and P.O. Olusanya, Chapter 11, in John C. Caldwell, et al. (eds.), Population Growth and Socioeconomic Change in West Africa, Columbia University Press, New York, 1975, pp. 102 and 272. (The English edition is to be published at the end of 1975 but the data shown above were available two years earlier in the French edition, Croissance démographique et évolution socio-économique en Afrique de l'ouest, Population Council, New York, translated by Gustave Harcourt, Paris, 1973, pp. 140-141 and p. 368.)

These figures cannot be trusted for a variety of reasons. One reason is the difficulty in eliciting demographic information in West Africa (see Caldwell, 1974). The Faulkinghams believed that it took a year's residence in a Niger village before the population was prepared to cooperate in providing such information [Faulkingham, Belding, Faulkingham and Thorbahn, 1974], yet most of the surveys listed in Table 1 involved over 50 thousand interviews with a single visit to each survey area. Another reason is that most people in the Sahel do not know their ages, while there must be considerable doubt about the accuracy of much of the other remembered demographic data. In some cases the surveyed population was not a national sample: the 1957-58 Mali survey was only a population living around the historic centre of Mopti. Perhaps more serious is the fact that African death rates fluctuate greatly from one period to another as famine or disease sweeps the land. The problem is not overcome by multi-round surveys spanning one, or even two years, for there is usually a succession of good or bad years. Accordingly, it is very difficult to decide what the mortality figures represent, especially as all the surveys listed were taken in the decade, 1956-65, years of good rains and of plenty.

Nevertheless, there are enough data in Table 1 to allow an attempt at assessing the mortality position in the Sahel countries, especially if greater reliance is placed on the "corrected" figures and on survival to ages two and five. It is difficult to avoid the impression that a decade ago expectations of life at birth were probably not higher than 35 years, infant mortality was around 250 per thousand and crude death rates were in the upper 30s. Attempts to use stable population models to reconcile these measures suggest that the expectation of life at birth was nearer 30 than 35.

It is difficult to use these estimates to provide a mortality baseline to determine the impact of the subsequent drought for what is needed is a measure of what mortality would have been in the early 1970s if average climatic conditions had prevailed. A decade or more has passed since the data presented in Table 1 were collected. The kind of assumptions about the speed of mortality decline that demographers have been employing around the world when projecting population would suggest that, but for the drought, expectations of life at birth would have risen at least six years, the infant mortality rate would have fallen at least fifty points, and the crude death rate would have declined by six or more points. But there are two awkward problems in this procedure. First, there is growing doubt as to whether West African mortality is declining as

rapidly as precedent elsewhere in the world has by analogy suggested. Second, a baseline should represent an average year--not the good years of the 1950s and early 1960s, nor the bad years of the early 1970s, but something in between. I believe it would be incautious to make any estimate of "normal" levels in the early 1970s other than an expectation of life at birth still under 40 (and probably not above 37 1/2), an infant mortality rate still over 200 (and quite possibly over 225) and a crude death rate no lower than 30 and possibly as high as 35. These are the kind of levels that a long-term trend line might some day indicate as having been the position in the early 1970s. Such mortality is higher than one would have suggested for Senegal or northern Nigeria, both countries largely outside the real Sahel with more developed economies which raise the standards of health services and other infrastructure even in the driest areas (it is the common belief of the rural population of that part of Niger which lies just north of the Nigerian border that the ultimate solution in an emergency is to cross over into Nigeria). However, these estimates do not provide a mortality baseline for the real Sahel or for the nomadic population. The 1964-65 survey of Mauritania failed to show much difference in mortality levels between nomadic and sedentary population, but Mauritania has only a small urban population and lacks rich farmlands. The only specialized demographic survey of nomads in West Africa, that of those in Niger in 1962-64 [Ganon, 1975], reported relatively low mortality with crude death rates of 27 among the Tuareg and 22 among the Fulani. But the survey faced very considerable difficulties and did evidence under-reporting.¹ The only real case for suggesting relatively high mortality for the nomads is the harshness of their environment, the lack of medical or other services available to them, and the higher rate of malnutrition among their children shown by health surveys (admittedly mostly taken during the drought). The writer at least would be surprised if the nomads of the true Sahel (that is excluding the Fulani nomads of southern Niger, northern Nigeria and northern Cameroon who co-exist with sedentary farmers) in a normal year exhibited an expectation of life at birth as high as 35 years, an infant mortality rate under 250 per thousand and a crude death rate much under 40 per thousand.

¹Sex ratios at birth of 110 and 120 males per hundred females among Tuaregs and Fulani respectively suggest understatement of at least female births and almost certainly female infant deaths as well.

There is little available on the health conditions in the savannah. The 1973 London seminar on the drought organized by the School of Oriental and African Studies could not find people to present medical papers on the region except for papers on nutrition [Dalby and Church, 1973, p. 22]. Large-scale vaccination programs did not get underway until about 1950. Surveys in Niger, which is probably not atypical, showed that by 1969 over three-quarters of all the population had vaccination scars. But the program did not provide equal protection for all segments of the population: a 1973 survey discovered scars on less than half of the nomads compared with around three-quarters of the sedentary population [Center for Disease Control, 1973, p. 21]. On the other hand, the low population density of the nomadic areas may help to keep down infectious disease; those in charge of the refugee camps reported that nomadic children were apparently being exposed for the first time to many childhood diseases.

The nutritional survey evidence is surprising. A British team [Seamon, Holt, Rivers and Murlis, 1973] worked in the most northerly and poorest province of Upper Volta at the height of the drought in July 1973 (the hungry period, before the new food from the rains could be harvested). They used three tests of malnutrition: clinical assessment from a range of symptoms, the ratio of upper arm circumference to height, and the ratio of weight to height (the Stuart-Meredith Standard discussed below). The first two tests failed to show any severe malnutrition among either sedentary or migrant (nomads plus others moving because of the drought or for other reasons) population over ten years of age and levels of around two percent below that age. Cases of malnutrition at levels as low as this are more likely to arise from peculiar personal and family situations than from critical shortages of food. The same two tests showed not even moderate malnourishment amongst those over 15 years, but significant levels below this age with some evidence of higher rates of malnutrition among younger children and fairly clear evidence of considerably higher rates amongst migrant children. For those under 10 years, the two tests showed moderate malnutrition among 44 and 24 percent respectively of migrants and 18 and 5 percent of sedentary population.

Considerably higher levels of malnutrition were indicated when judging nutrition by the Stuart-Meredith Standard, a measure evolved some decades ago from studies of Boston and Iowa city children. Taking the extreme case, it indicated some malnourishment among 42 percent of sedentary population over 15 years of age while no cases were recorded by clinical assessment (and the

other method was not used at this age); among the same population aged 10 to 14 it recorded a level of 23 percent compared with 10 percent by clinical assessment and 9 percent by arm-height ratios. It recorded severe malnutrition among sedentary children of 0 to 9, 10 to 14 and 15+ years of age of 7, 9 and 12 percent respectively compared with 2, 0 and 0 percent by the other methods. The point is important because it was the sole method employed in the wider investigation described below.

Teams sent out by the Atlanta Center for Disease Control [Center for Disease Control, 1973] employing the Stuart-Meredith Standard, examined 3,500 children in the following two months (final month of the hungry period and the first month when some new food is usually available) in Mauritania, Niger, Mali and Upper Volta and found 7 percent of sedentary children severely malnourished and 17 percent of nomad children in the same condition (compared with 9 and 10 percent respectively by the British researchers in Upper Volta using the same method; 1 and 4 percent using clinical assessment; and 1 and 2 percent using arm-height ratios). They found significant edema rates (and hence kwashiorkor) only in northern Mali. Testing for avitaminosis was carried out only in Mauritania where its incidence was shown to be significant, mostly in the form of scurvy and beriberi.

This new information is on a larger scale than was previously available, but is difficult to interpret. The demographer is likely to be surprised that in the West African savannah nutritional surveys are no more accurate than his own vital rate surveys (and evidence elsewhere in tropical Africa suggest that medical surveys are equally inexact). The evidence seems at odds with one's own observations of miserably thin children with stick-thin legs and all too visible ribs in the drought refugee camps and the nomadic encampments of the Sahel. Nevertheless, the British medical team in northern Upper Volta reported that the nutritional levels found there were similar to those found at different times and places elsewhere in tropical Africa [Seaman, Holt, Rivers and Murlis, 1973, p. 777], while the American group in Mali observed, "Villages visited in the Niore and Nava areas (both declared disaster areas by the Malian Government) showed insignificant rates of under-nutrition among the child population" [Center for Disease Control, 1973, p. 28].

It should be noted that health conditions alter quite rapidly over small distances. This is partly a function of soil changes, pockets of markedly inferior or superior soils being common, and partly one of extraordinary

differentials in rain each year, especially marked during drought (this occurs because the little rain that has fallen has been derived from thunderstorms over limited areas, a phenomenon which tends to average out rainfall over a number of years but not over a single year). It can also be a function of health care. Doctors are rare: rural Upper Volta averaged only one per 200,000 persons in 1960 and there has been little improvement since. Dispensaries are more common but vary greatly in their efficiency; in any case, they are found in only some of the villages and most of their clientele come from the villages in which they are found [Cantrelle, 1975]. An investigation of similar villages in Nigeria with and without health facilities showed considerably higher mortality in the latter [Orubuloye and Caldwell, 1975]. A study of a single village in Niger distinguished the groups most likely to experience malnutrition: babies after seven months of age because of prolonged breast-feeding with insufficient supplementation; women and children more generally because, although they share with the men the meat that is eaten only on holidays or during festivals or other ceremonies, they do not pick up the occasional meat snacks which men have at the market. However, the study also showed that disease rates were moderate and that a contributory factor to this was probably the careful way that defecation took place outside the village, well off the tracks and in places exposed to sunlight [Faulkingham, Belding, Faulkingham and Thorbahn, 1974, pp. 31-35].

Such high death rates necessarily limit natural increase. The fertility evidence for the Sahel countries is far from complete but is certainly better than the mortality data, partly because the information is easier to collect in the field and partly because there are better and alternative (and hence comparable) methods of analysis (the estimates used here are from Page, 1975, which modifies information previously presented in Page and Coale, 1972 and originally in Coale and Lorimer, 1968). These data suggest a birth rate for the whole population of the Sahel countries in the upper 40s and perhaps very close to 50 per thousand. That for nomads may be a little lower [Ganon, 1975], a differential in fertility between nomadic and sedentary populations that has also been reported in Sudan [Henin, 1968, p. 149]. Thus, a "normal", non-drought rate of natural increase for the Sahel countries might well be little over one and one-half percent, reports of higher levels being explained by more deficient administrative censuses in the earlier years and recent under-

estimates of mortality. That of the northern nomads is probably not over one percent and could be lower.

However, the major demographic response to the drought has not been death but migration. Movement has always been a fundamental aspect of the tropical African economy and society. Relatively rapid and far-ranging movement is the distinguishing characteristic of nomads; much more gradual movement is the lot of the shifting cultivator. But even the latter has meant the development of attitudes conducive to locational change and lacking hostility to the tearing up of one's roots.

In the West African savannah the tendency of farmers to migrate has been reinforced by the pronounced seasonality of the climate. There is really very little for them to do during the dry season. Traditionally they employed their time in this period in carving and other handicrafts, by moving to rivers to fish and in warfare which, when not defensive, was aimed at gaining slaves and other economic benefits. With the arrival of colonial governments, men found alternative employment often far away from where they lived. Such seasonal (and longer term) migration was often made almost obligatory, especially in the French Empire, by head taxes.

Studies of the Mossi of Upper Volta [Courel and Pool, 1975] show that, although much of the migration in the earlier part of the century was for recruitment to the French army or police or to the railway construction gangs, by 1955-60 it was almost entirely for private employment. Such employment was usually in the countries of the Guinea coast, and increasingly in the large towns. Not all migration was seasonal--possibly more than half was for longer periods. The migrants earned enough to keep themselves during these absences, and, on average, saved about \$60 (taking or sending back about \$40 in cash and \$20 in goods). This sum was probably close to twice the annual per capita income of Upper Volta at the time and many times larger than the annual per capita rural cash income--a recent study of a village in Upper Volta gives a figure for money and goods brought back of \$80, which suggests that in terms of real income there has been little change in the last 15 years [Lallemand, 1974].

Such migration is practised particularly by young men, especially 15 to 34 years of age [Caldwell, 1969, pp. 229-243; Lallemand, 1974], although there is some evidence of a broader age range among migrants from the Sahel [Reyna and Bouquet, 1975]. In the farming areas of the southern savannah the proportion of males 15 to 44 years of age away during the dry season has been reported

by various studies in the range of 20 to 50 percent [Prothero, 1973a, p. 6; Hance, 1970, p. 172; Dankoussou, Diarra, Laya and Pool, 1975]. Not all the migration is to destinations outside the savannah: some is to towns--even small towns--in the savannah, as is evidenced by the increase in the population of Mopti in Mali by about one-fifth every dry season [Centre for Disease Control, 1973, p. 30].

Such fluidity of the population has many implications. Income is not solely a product of local resources, but frequently comes from other countries, and urban employment often underwrites rural consumption. The last two decades has seen barriers raised especially in the form of new international borders with restrictions on the movement of both population and money (in the 1950s the pound sterling and the franc were the currency of nearly all West Africa and were freely convertible). On the other hand, the urban employment market has grown immensely, a common currency has been retained by francophone West Africa with the exceptions of Guinea and Mali, currency blackmarkets do exist, and goods can be taken or smuggled across frontiers. At the very least, the migrant is not a charge on local support as food runs low; the Hausa phrase for seasonal migrants is "masu cin rani", literally "people who eat away during the dry season" [Prothero, 1973a, p. 6]. The most valuable asset a rural family may possess is a potential migrant with high earning capacity in some outside economy--the towns of the country, distant West African countries or even beyond (e.g., the oil fields of Algeria or sometimes the Common Market). The high earning capacity may arise from inherent strength or initiative, but is more likely to be the product of training and especially of extended education.

There are significant long-term movements which are less obvious. As modern roads pierce the region there is a shift of people and whole villages to their vicinity. In northern Nigeria those who make such a movement tend increasingly to become part of the modern economy, while those who remain in relatively inaccessible villages live at much the same level and in much the same way as their parents did. There is also a net migrational movement from the north to the south in the savannah countries, which is probably more important than differentials in vital rates in producing differentials in population growth [Reyna and Bouquet, 1975].

The existence of large-scale migration accompanied by flows of wealth in the opposite direction, and the recognition by the community of migration as a

possible alternative way of life provides a strong weapon against the effect of drought. Movement far to the south towards the Guinea coast is an annual event among many sedentary farmers and a possible recourse in times of emergency for the Sahelian nomads.

Fertility Control

Little is known about fertility control in the Sahelian countries, perhaps because the limited nature of such control has reduced research interest. Some information is available for Senegal [Caldwell, 1968, pp. 598-619], Upper Volta [Courel and Pool, 1975], Niger [Dankoussou, Diarra, Laya and Pool, 1975] and Chad [Reyna and Bouquet, 1975]. The following picture emerges. There is practically no evidence of conscious control of fertility except amongst very small urban elites. However, some limitation of fertility almost certainly results from a fairly strict adherence to long periods of post-natal abstinence [Caldwell and Caldwell, 1975] and from the lengthy absences of many migrant husbands. Few married persons have ever considered the possibility of restricting fertility and the matter has been discussed by only a very small proportion of spouses. For nearly all the population, family size ideals are as high as actual fertility (the usual pattern in tropical Africa). Ideals lower than national fertility levels are found amongst a substantial proportion of the population only in the larger towns and amongst those with extended schooling. These groups are relatively small in number and are not amongst those populations examined here who have been scarred by the effects of the drought.

The writer has attempted to utilize all available information to build a model of fertility control and its direction of change in West Africa [Caldwell, 1975]. The model distinguishes the Sahel countries (excluding Senegal) and subdivides the population of the region into rural (over 96 per cent), major urban (capitals and other centres with over 100 thousand inhabitants--3 per cent) and other urban (non-capitals with 20 to 100 thousand inhabitants--less than 1 per cent). The estimated levels of KAP indicators for the Sahel countries is shown in Table 2.

If the model is approximately correct (and only further survey work can establish this), then, even in the capitals and large towns, only one married

Table 2. Estimated Levels of Antinatal Knowledge and Practice
Among Females of Reproductive Age in Conjugal
Union, Sahel,^a 1970

(All levels expressed as percentages
of females)

	Rural	Other Urban	Major Urban
Had knowledge of modern contraception	0.5	1.75	2.5
Had ever used any antinatal practice	0.0	0.5	1.0
Had ever used modern contraception ^b	0.0	0.075	0.15
Currently using modern contraception ^b	0.0	0.05	0.1
Had ever had an induced abortion	0.1	0.2	0.2

^aMauritania, Mali, Upper Volta, Niger and Chad (nationals of the countries only).

^bAppliance, chemical or hormonal contraceptives.

woman in a thousand was currently using modern contraceptives in 1970--only one in forty would have had sufficient knowledge to move in that direction. Table 2 can perhaps be best put into perspective by noting that the levels recorded in each of its residence categories was only about one-twentieth of those recorded in such categories in anglophone coastal Africa (southern Nigeria, southern Ghana, Liberia, Sierra Leone and Gambia). The actual differentials between the two regions are greater still because larger proportions of the total population are found in urban areas in anglophone coastal Africa than in the Sahel. Thus, while the Sahel population made up 12 1/2 percent of all that embraced by the model (western Africa from Mauritania to Zaire), it contributed only 2.8 percent of the females who had experienced induced abortion, 0.7 percent of those who knew of modern contraceptives, and 0.1 percent of those who had used such contraception.

Nor is the use of family planning likely to become a major weapon in the Sahel's battle against disaster and limited resources in the near future. The model suggested that, with a moderate spread of officially supported family planning programmes, the number of married women in western Africa currently using modern contraceptives might rise in the 1970-80 decade by over 800 thousand of whom less than 3 thousand would be contributed by the Sahel-- although the proportion of current users contributed by the Sahel would rise from 0.1 percent in 1970 to 0.3 percent in 1980.

The Drought

Real drought is not a single dry year but a succession of such years. Such successions do not occur randomly; there is a marked tendency of bad and good years to occur in cycles. Drought is a relative phenomenon (by the standards of most countries the Sahel is in perpetual drought). Even locally it is relative, for the population is likely to compare the dry years with the abnormally wet ones. They are likely to have adopted practices during the abnormally wet years which end in disaster during the dry years.

This was certainly the case in the recent drought (which at least temporarily came to an end with the good rains of the 1974 wet season). The 1940s experienced average rainfall for the decade as a whole, although annual fluctuations were probably greater than usual. But the 1950s were bonanza years with the Sahel averaging about one-fifth more rain than average and the Sudanic farming zone about one-tenth more [Bethke, 1973, Annex II]. As good years followed each other in succession, both nomadic pastoralism and sedentary farming moved north [Davy, 1974, p. 20]. Far from such movements being discouraged by the French colonial administrations (up to 1960) and the succeeding independent national governments, the northward shift in the Sahel was facilitated by technical aid which increased dramatically the number of water points in the Sahel (without effecting any permanent change in the pastures). So moist was it that the Fulani (Peul) pastoralists of northern Nigeria and southern Niger drifted as far north as the Air plateau beyond Agadez [Johnson, 1973, p. 8]. Rainfall of average, and sometimes better, standard extended throughout most of the 1960s.

The break came with the 1968 wet season, when rain in both the pastoral and farming belts was one-fifth below normal and one-third or more below that of the 1950s. In 1969 there was a better wet season at least in parts of the savannah, but thereafter a massive drought developed. In the savannah as a whole, 1970 experienced rainfall one-fifth below normal. This was also the experience of the Sudanic farming zone in 1971, while rainfall in the Sahel fell to one-third below normal. In both 1972 and 1973 the Sahel fell to half the normal rainfall while the farming zone was down by about one-third. Thus the rainfall deficit over the four years, 1970-73, was approximately one-third in the Sahel and one-quarter in the farming zone (over the six years, 1968-73, it was something over one-quarter and about one-fifth respectively). These calculations have been made following the World Meteorological Organization's average rainfall figures for the 33 years from 1941 to 1973. The relativity of such work can be seen by comparing these calculations with those made by using the wet 1951-70 years as a base (perhaps the appropriate base from the perspective of middle-aged nomads and savannah farmers); employing this baseline another study was able to demonstrate that the drought was indeed a six-year phenomenon beginning in 1968 [Grove, 1973a, p. 118].

The drought also had an impact outside the savannah. Rainfall at the source of the Niger in the forested Fouta Djallon mountains of Guinea was well below normal so that the Niger was reported as being at its lowest level for 30 years in 1972 [Thomas and Bouvrie, 1973, p. 3] and at its lowest for 60 years in 1973 [AID, 1973a, p. 1]. Thus the drought severely limited irrigated agriculture as well as dry farming (although it should also be noted increasing irrigation may have tended over the years to diminish river volume and hence cause relatively lower levels during drought). Similarly, the Senegal river has been at an unusually low level. Lesser rainfall than normal in the much more equatorial region in the Chad-Central African Republic-Cameroon border country had so diminished the flow of the Chari that Lake Chad was reduced by August 1973 to one-eighth of its usual surface level and was no longer a single body of water. In the Guinea forests reduced rainfall cut the production of tree crops without seriously diminishing supplies of food (although some rise in prices occurred); Ibadan, for instance, experienced low rainfall in 1972 and 1973 but it has not recorded real famine since 1871 [High, Oguntoyinbo and Richards, 1973, pp. 115-200].

Several points should be emphasized. In the recent drought, as in previous droughts, the proportional deficiency in rainfall has been greatest in the driest areas. The monsoon fails to penetrate as far. In Nigeria, the monsoon advances north at an average of 5 miles per day and finally retreats at 10 miles per day, so that the length of the wet season decreases by one day for every 3.4 miles one moves northward [Kowal and Adeoye, 1973, pp. 147-8]. Normally, in the Nigeria-Niger area, some rain falls as far north as 18°30'N (the Saharan slopes of the Air Plateau); in 1972 it failed to pass 15°40'N (just north of Taouah in southern Niger) [Kowal and Adeoye, 1973, p. 151]. Rainfall in savannah West Africa is extremely variable both geographically and chronologically. Places only a few miles apart may be treated very differently by the monsoon--hence the importance of nomadism in looking for pockets of good pasture resulting from fortuitous showers. For instance, the records of the main meteorological stations in Niger show that in the drought year of 1968 Agadez and Tahoua received above average rainfall; in 1969 Iferouane recorded one-and-a-half times its average but Agadez only half its usual amount; in 1970 Tahoua was once again above average [AID, 1973a, p. 131]--in fact Tahoua was so fortunate that enquiries there about the drought failed to elicit much response. Continuing with the same example, the residents of Agadez and Taouah nevertheless regard 1968 as a dry year because the rains were badly distributed and stopped early. On the other hand, 1973 was a particularly poor year not only because of the deficient total rainfall but also because the monsoon had difficulty in getting underway and several false starts to the rains meant heavy expenditure in seeds and labour in successive replantings [Golding, 1973, p. 5].

Some of the discussion about permanent weather change in West Africa starts with the assumption that the 1970-73 drought was the worst ever. This assumption is highly questionable, and is not believed by most of the older people of the Sahel. Certainly the drought was the first of its magnitude since the Second World War and hence since the people of the Sahel became citizens of independent countries with a direct right to the attention of the United Nations agencies. It occurred in a period of technical aid and of concern about the world's resources and received massive attention from the world's news media.

But listed droughts affecting the Niger Bend in the eighteenth century show that five-year droughts were not unknown [Schove, 1973]. Most of the savannah people believe that the drought centering on 1913 was the worst in memory, and this certainly appears to have been the case in terms of loss of

human life but perhaps not of animals [Mortimore, 1973b, p. 104]. There is some evidence that the 1913 drought was worse than that of the 1970s in the savannah farming zone but perhaps not in the Sahel [Roche, 1973, pp. 53-61]. In some areas the droughts of the early 1920s and early 1940s appear to have been almost as bad. However, it should also be noted that Dakar recorded 1968, 1970 and 1972 as the driest years this century [Davy, 1974, p. 20] and there is some evidence that the early 1970s were at least as dry as 1912-14 and more prolonged [Jenkinson, 1973, pp. 31-32]. One thing is certain: the impact of a drought on human beings depends on many things other than rainfall.

More than any other event, the West African drought led to discussions about secular trends in the world's weather. Sahelian rainfall, it has been said, has been predicated to decline by a change in global air pressure belts dating back 20 to 40 years [Lamb, 1973, p. 27 ; Winstanley, 1973, p. 4]. Yet, extraordinarily, none of the rainfall series for savannah West Africa support any theory of secular decline over decades. Rather do they give evidence of short-term fluctuations: 1912-15, drier; 1916-24, wetter; 1925-28, drier; 1929-39, wetter; 1940-44, drier; 1945-46, wetter; 1947-49, drier; 1950-61, wetter; 1962-67, fluctuating around normal; 1968 onward, drier (employing figures from Jenkinson, 1973, p. 31). The argument for a secular change in climate has resulted in the monsoon sweeping less far north and consequently depositing a higher proportion of its rain near the equator; suggested evidence is the claimed rise in the equatorial East African Lakes parallel to the savannah drought [Allan, 1973, p. 13]. This evidence will not bear examination; the lakes reached their high point in 1964 at the end of a long period of above average and normal rainfall in the savannah. Perhaps the most one can say is that it would be unwise to assume a future Sahelian rainfall pattern very greatly different from that which we have known. All we can say at this stage is that the 1974 monsoon moved northward with its normal complement of rain.

Much has been written about the impact of the drought on the rural activities, but it is difficult to find agreement between the estimates.

The most serious question is that of stock losses because of the clear evidence that the rain deficits were proportionately very much greater in the Sahel with its pastoral economy. The August 1973 Report to the President of the United States on the Sahelian Drought claimed a 50 percent death rate among animals, AID estimates seem to be under 40 percent [AID, 1973a], FAO calculated

a 25 percent loss of cattle in 1973 [FAO, 1974c], and French Development Aid appears to imply something over 20 percent [African Recorder, 1973]. Accurate estimates could not be made because a large proportion of the animals had been moved south and contact had long since been lost with the herdsmen--undoubtedly some died on the way, while others were sold or remained with their owners (often subject to diseases carried by the tsetse fly and other vectors in country with a thicker scrub and tree cover than they had usually experienced). In the north many of the dying animals were eaten, thus fulfilling one of the purposes of the herds, namely, to provide a reserve of food for a crisis situation. Total numbers of animals fell steeply not only because of death, slaughter and movement from the area, but also because calving rates were very low (as they always are in a drought).

Large drops in animal numbers are a response to drought in all savannah farming, even in Australia and the United States. But in the Sahel the problems are far greater than in commercial stock-raising economies, because of the nature of nomad societies, and because of a more limited market system and much less agreement that animals are bred for that system. Nevertheless, animal numbers in the Sahel have always fluctuated, and hence it is not completely logical to measure the impact of the drought solely by the downswing in stock at the end of a particularly good period.

There is a lack of long-term studies of animal numbers. One valuable report covers a third of a century but it is concerned with the Bornu area in north-eastern Nigeria [James, 1973], an area which mostly lies outside the true Sahel and receives various kinds of support from the strong Nigerian economy which as a whole was little affected by drought. The estimates depend on cattle tax figures, which probably understate stock numbers at all times but may not do so differentially over time. During the 1940s cattle numbers appear to have risen about 20 percent. This was followed by a steeper rise which peaked about 1968, a rise which owed something to the construction of a large number of pressure water bore-holes in 1958-62 (although the bores provided the animals only with water for drinking and do not appear to have affected pastures or crop production). Between the mid-1950s and the late 1960s cattle numbers increased in the northern sandy area (marginal Sahel country) by 77 to 129 percent (depending on area), producing an average multiplication since 1940 of about two-and-a-half times. By 1973 numbers had fallen by 5 to 19 percent from the 1968 high, around 4 percent dying in the 1972-73 season in villages

subject to detailed observation. In the southern clay area of Bornu, rises and falls in numbers were much smaller.

This history does not represent the northern Sahel, if only because the Bornu cattle have access to the water-retreat pastures of Lake Chad. A study in the Kanem area of northern Chad concluded that during the drought years 44 percent of the cattle there had died and a further 28 percent had moved south [Marsden, 1973a]. But the Bornu experience does indicate a pattern. It is unlikely that the stock numbers of the Sahel were by 1973 any lower than they were in the early 1940s or even the late 1940s; indeed, their ratio to population may not have been lower. The real problem is to dampen down the fluctuations or to ensure that the declines in drought period are not disastrous for their owners.

Nomads' herds are by no means confined to cattle, but also contain large numbers of goats and sheep, as well as camels in the drier areas and donkeys in moister regions. The goats have the greatest ability to survive drought, which is one of the reasons for keeping them.

Crops are grown in areas where the drought was less severe, but, unlike animals, crops lack the ability to survive by migrating. Losses varied enormously over comparatively short distances. In the worst drought years crop losses of one-quarter to one-half were common in areas of dry-land farming. In irrigated or flood-retreat plots beside rivers or lakes losses were usually much greater, and quite frequently were total because the water just did not reach the area of cultivation. Available food fell less steeply because of drought-relief and other imported food. For the six Sahelian countries, FAO has attempted a comparison of the change in crop production over a decade. Their estimates suggest that 1972 gross grain production was 12 1/2 percent below that of 1963 (a year of average rainfall) and about 29 percent down on a per capita basis [AID, 1973b]. The latter figure should be interpreted carefully for the Sahelian countries were increasingly importing food, especially into their urban areas, even before the drought.

A typical picture might be that which arises from a study of Mirriah and Goure, farming areas near Zinder in southern Niger [CILSS, 1973b]. Millet production per unit area had fallen by 1972 to about half the level achieved in the mid-1960s (i.e., a "normal" level of about three-quarters of a metric ton per hectare or 6 cwt. per acre), but the decline in food production had been

held to about two-fifths by expanding the area of food-crop cultivation by about one-seventh (partly at the expense of the commercial production of groundnuts, Niger's main export crop). However, a study in northern Nigeria, in a particularly badly hit area, where there were no plots of commercial crops which could be taken over by food crops, showed in dry land farming intensifying drought from 1970-71 to 1972-73 reducing food production by five-sixths because of a 13 percent decline in the area planted, a 26 percent decline in the area which produced any crop as a result of planting and a 78 percent decline in the grain collected from the area with any crop [James, 1973, pp. 112-114]. It should be noted that drought in this area was accompanied in 1973 by a locust plague. An explanation given for the decline in the planted area, and also a decline in yield arising from abnormally light broadcasting of seeds, is that seed reserves for planting had been partially eaten. Yields in the flood cultivation area beside the streams of the region were only about 5 percent of those of the years before the drought.

The Demographic Consequences of the Drought

One might anticipate soaring death rates from a halving of the local production of food. The world did indeed report it this way. The headline, "Six millions facing starvation" (out of the 25 million in the Sahelian countries) was commonly used in the press both within and outside Africa in 1973, the figure being obtained from public statements originating in the Sahelian countries and urging more technical aid. The Report to the President of the United States of August 19, 1973 [Faulkingham, Belding, Faulkingham and Thorbahn, 1974, p. 3] put the deaths attributable to the drought and already having occurred at one-hundred-thousand.

There is nothing remotely resembling an actual identification of bodies or count of the dead. Local enquiry about people whose deaths can be largely attributed to starvation or more generally to the hard times elicits little information. The estimate of one-hundred-thousand deaths was probably derived from the following expert report based on work in Upper Volta [Center for Disease Control, 1973, p. 4]:

In view of some of the astronomically high estimates of deaths due to famine in this area (Mauritania, Mali, Niger and Upper Volta) being published by certain media, it is of interest to calculate a limit of mortality due to famine for the survey countries based upon the most extreme data obtained. Using the highest death rate found in a group of northern nomad clusters in Niger (7 percent) and the usual death rate for West Africa (2.4 percent), the maximum number of deaths due to famine this year is calculated to 101,000.

This calculation is therefore based on an estimated population of about 2,200,000 nomads in the four countries and is not an estimate of probable mortality but of an upper bound. Of the remaining sixteen million people, the Appendix of the Report states, "Sedentary deaths are the same as in previous years". Obviously one cannot base such an estimate on the crude death rate for the whole of West Africa. If one were to use the suggested estimate given earlier in this paper of a death rate of close to 40 per thousand for Sahelian nomads, then the calculated deaths would be something over 66,000. The real problem, in a situation where mortality varies over short distances, and even in one group can be very unstable over a short period, is that there is no justification for taking the mortality rate of the highest cluster even for an upper bound.

The writer was shown more graves than apparently were usually brought into existence in three years in the Dogon area of Mali; but the point was emphasized that the massive burials of the 1913-14 drought were not being repeated. South of the Sahel, in a village in Kano State of northern Nigeria in 1973 the conclusion drawn from a survey [Mortimore, 1973b] was: "Although all village heads in Danbatta reported that no deaths or epidemics could be attributed to the famine, they all agreed unequivocally that people were leaner and weaker than normal, and hardship and suffering were very considerable". The heads differed on whether the drought was as bad or not in its effect on farming as that of 1913-14 but all agreed that the present drought was not a killer of people as was the former (testified by documents as well as memory). The U.S. State Department's information about Upper Volta in 1973 was: "Deaths from starvation have apparently been limited to a few thousand, mostly in remote areas which became inaccessible" [State Department, 1973]. Estimates of one-hundred-thousand deaths or more have been made by UNICEF for Ethiopia but these estimates are based upon questioning a small number of people about recent deaths and comparing the reports with an assumed norm.

Death rates do exist for the refugee camps, but there are difficulties in deducing anything from them about overall deaths. In July 1973, when the Timbuktu camp was first formed and gathered the neediest cases together, deaths fluctuated from week to week between limits equivalent to annual rates of 26 to 52 per thousand; by late August the equivalent rates were 10 to 16 per thousand [Center for Disease Control, 1973]. The same report noted that in September 1973, "the percent of children below the malnutrition threshold in Gao nomad camp in September was about the same as that found in sedentary villages in the Gao area" [p. 28] and the report commented quite favourably on the health conditions in these villages. However, by this date there was some doubt about who was in the camps: "It was noted on the return visit to Gao nomad camp that many of the nomads had gone and sedentarists now made up a large proportion of the camp population" [p. 28]. Nor did this investigation find that official indications of areas of greatest distress were necessarily very meaningful: "Villages visited in the Niore and Nara areas (both declared disaster areas by the Malian Government) showed insignificant rates of under-nutrition among the child population" [p. 28].

There are a few village studies which yield mortality data but the total numbers were usually so small as to render the rates of little significance. In Tudu, the pseudonymous name of a village in southern Niger, infant mortality rates for each year from 1969 until 1973 calculated from survey data, were 14, 113, 60, 55 and 150 per thousand respectively [Faulkingham, Belding, Faulkingham and Thorbain, 1974, pp. 27-31], which are all lower than one would anticipate for the area even in normal conditions and which show no real sign of trend except perhaps the rise in 1973. Nor did annual age-specific death rates by sex from 1969 to 1973 show any increase in mortality with deepening drought. Subsequently a full analysis of the 1969-73 demographic trends in Tudu showed that the rate of natural increase fell as low as 2.3 percent during only one year of the drought, exhibiting a 1970-73 average of around 3 percent [Faulkingham and Thorbain, 1975]. The crude death rate for the village of Yatenga in northern Upper Volta in 1972-73 was 57 per thousand, but this was calculated from only 25 deaths. A meticulous relocation in 1973 of individuals among the Samburu of northern Kenya who had been identified fifteen years earlier indicated survival levels of adult males through the severe drought in the area of at least the same order as one would have anticipated without the drought [Spencer, 1973b].

There are some data on different health conditions. On the question of malnutrition, the British team studying the drought-stricken Sahel concluded that data collected elsewhere in tropical Africa were similar and that they did not demonstrate that the drought had had any measurable effect. Infectious disease, especially children's diseases, spread rapidly in the camps (but were usually controlled), but this was more the result of bringing together large numbers of people than of drought. In Ethiopia, gastro-enteritis was reported as soaring, especially amongst the children in the drought areas [UNICEF, 1973a]. There was considerable evidence that measles became both more prevalent and more deadly amongst populations weakened by the drought in every Sahelian country. There was by 1973 a large reservoir of unvaccinated children among the children of the sedentary population, and most nomads had never been vaccinated. Measles, which in Upper Volta had a 5 percent mortality rate, was reported as the cause of death much more frequently than famine, but the majority of measles deaths may well not have occurred but for the drought. Even so, it is doubtful if by 1973 the incidence of measles in the Sahelian countries could have been running at an annual level above a quarter of a million or that mortality could have been much over ten thousand (i.e., it would not have raised the crude death rate half a point).

What conclusions can one draw about the extra mortality arising from the drought of the early 1970s? Primarily that no one knows; the figures in the newspaper headlines were figments of the imagination and many apparently serious reports were little better. The statistical systems did not meet the challenge and demographers utilizing survey methods did not fill the breach. Obviously death rates must have gone up, especially among the nomads, many of the extra deaths being among babies and being ascribed to causes other than famine or to no cause at all. One can play numbers games--a rise of one point in the death rate over the four years of drought in the six Sahelian countries would have meant a hundred thousand extra deaths. Such exercises are futile, they merely prove what large numbers are being considered and they fail to show how long the dead would have survived without the drought.

In the course of the drought, the writer became increasingly convinced that the drought publicity hid the vital truth. The real lesson was not how easily man succumbed to the drought but how tenacious he was in managing his survival. The countryside appeared to be devastated. Not long after the inadequate rains of 1972 and 1973 it was dry and withered again. Crop failure

and animal deaths were widespread. Without question, human deaths did not occur on anything like this scale.

What is the explanation? Much of it seems to be age-old methods of adaptation: the eating of plants known to have food value but little used in good years, the killing of wild animals even though these have diminished in number markedly during the present century, the eating of one's own animals, and the movement to better places. Some of it is economic change which has paralleled the rise in population numbers. The Kano State survey in northern Nigeria reported that the real difference between the 1913-14 drought and the 1970-74 one was the growth of the infrastructure. In the recent drought the new roads with ever-increasing lorries operating within vastly expanded trade networks brought food from the forest markets of southern Nigeria (thereby raising prices there) to the high-price markets of the northern drought region. In the earlier drought people felt that they lacked food; in the latter drought they felt they lacked money [Mortimore, 1973b]. Much also is explained by the scale of national aid (paramount, for instance, in Nigeria) and of international aid, which arrived surprisingly late--nothing before 1973--but ultimately in large quantities. Food aid, and the publicity and demands that set it in motion, may become a periodic way of life in the West African savannah. All these mechanisms are of obvious demographic importance and will be dealt with later in this paper. It seems probable that, in spite of increasing numbers, all these mechanisms will work together to bring about a lower death toll in each successive great drought.

But there is a specific demographic reaction of very great importance: both survival and better living standards have in tropical Africa long depended to a considerable degree on the possibility of migration.

The 1970-74 drought produced large-scale movements often of a type not known at all in the good seasons. Tuareg from the Sahel, conspicuous because of what Nigerians regarded as their desert clothing, became a common sight on the streets of Kano. Fulani nomads arrived with cattle, and stayed on while new crops were planted, in the country of the forest verge west of Ibadan and only about fifty miles from the sea. In areas where only nomad men had been seen in previous dry seasons whole families arrived. In late 1973 a large Malian Tuareg group of men, women and children arrived in Ibadan in southern Nigeria and camped (and traded) around Mapo Hall on the top of Mapo Hill, the traditional center of the city.

Migration from the north to the south occurred in every Sahel country. International migration was also on a large scale: from Mauritania to Mali and Senegal; from Mali to Senegal, Ivory Coast, Upper Volta, Dahomey, Togo, Nigeria and even Ghana, in spite of its restrictive immigration policy; from Upper Volta to the Ivory Coast, Ghana (where Mossi, who are found on both sides of the border, can easily enter), Dahomey and Togo; from Niger to Nigeria and the Sudan. From northern Mali and Niger pre-existing small-scale movements into Algeria grew in volume (as they presumably also did from northern Chad into Libya), encouraged by the good seasons that North Africa has been enjoying as well as by employment in the oil and other industries. Some of this northerly movement went further north to the Common Market, thus supplementing a small direct migration from francophone West Africa which had been increasing in magnitude during the 1960s.

No accurate measurement of any of these streams of people exists--not even those across frontiers. Movement from Niger to Nigeria has been on a large scale. At its height, late in the 1972-73 dry season, the writer asked Nigerian frontier officials on the Niger border about the numbers they had recorded. They had in fact recorded no additional migration--only the traders, bus drivers, officials and tourists who always report to the border post. They regarded the question as ludicrous and pointed back behind them to the bush, indicating that those without papers, and often with animals, suspecting officialdom and with memories of ancient rights to come this way in times of emergency, would inevitably cross the lonelier parts of the border.

By 1973 the migrant flow had developed many distinctive characteristics. That which distinguished it most markedly from good season movements was the focusing of some of the streams, especially in Mauritania, northern Mali and northern Niger, on drought-refugee camps. The camps were not merely places where helpless destitutes were placed. Mostly they were the targets of migration chosen deliberately by nomads as offering the best option available. If they had not been established there would undoubtedly have been more deaths and greater misery, but the greater majority of those who chose to stay in the camps would otherwise have continued south. Indeed by the time they had reached the camps the harshest areas were already behind them. In many cases the men and older boys did continue south (or had already gone there) leaving the women, young children and old people in the camps.

Nomad movements also appear to be focusing on the towns more than in the past, partly because many are no longer moving with animals and partly because the drought-stricken countryside has few jobs to offer. This may, however, be an indication of future trends, for nomads, like food gatherers and hunters in other parts of the world, are often happier, if forced, to take the leap from their kind of life to urban employment than to farming which is a far more specialized way of life with a mystique all of its own. In some places the refugee camps tended to operate as sectors of the town and as bases for both urban relief and urban employment (the camp at Nouakchott, the capital of Mauritania, was developing this way by mid-1973). In the Sahelian countries, the towns increased considerably in population, most of the refugees apparently being able to claim accommodation with relatives (thus demonstrating the importance even to nomads of having family members as permanent migrants to the towns forming beachheads there). Among the larger towns most affected were Nouakchott, Bamako, Mopti, Gao, Ouagadougou, Niamey, Zinder and N'Djemena (formerly Fort Lamy), but the impact was also considerable on such smaller Sahelian towns as Akjoujt and Atar in Mauritania, Agadez and Iferouane in Niger and Moussoro and Fada in Chad.

An unprecedented number of nomad family groups moved southward from the normal area of seasonal cyclic movement into the towns of the savannah or even the better watered areas nearer to the coast. A large number of nomads still with animals either failed to move north at all during the 1973 wet season or moved only far enough to reduce the impact of the tsetse fly on their cattle.

Specific area studies during the drought were few, outside the real Sabel, and were concerned only with agriculturalists. The study of Yatenga [Lallemand, 1974] in northern Upper Volta showed that almost all adult males except the old men left during the 1973 dry season, even, for the first time, most men in their forties. The great majority went to the Ivory Coast, more seeking their fortune in Abidjan than in any other centre. The study of Tudu in southern Niger [Faulkingham, Belding, Faulkingham and Thorbahn, 1974] showed that, as the drought years rolled on, the proportion of 15 to 44 year-old males emigrating during the dry season rose progressively from a third to three-quarters. In the 1972-73 season, 32 percent of the migrants went to Lagos and 20 percent to Kano while a further 16 percent went to other locations in Northern Nigeria, 14 percent travelled to Abidjan in the Ivory Coast, and 18 percent moved elsewhere in Niger (of whom only 3 percent went to Niamey). The

pattern is clear. Seasonal migration was to the countries of rapid economic development, Nigeria and the Ivory Coast, with two-thirds going to three cities which are successfully industrializing. Ghana, the magnet for migrants of a generation ago is no longer a lure, partly because of its restrictive immigration laws but partly also because its economy is in trouble. Niamey, the capital of Niger, has not been experiencing rapid economic growth, and, although it has middle-class jobs to offer, it has few for emigrant farmers seeking unskilled seasonal employment. The size of the movement from Tudu to Nigeria is influenced both by the closeness of that country but also by the fact that the people of Tudu are Hausas, who also form the largest single ethnic group in Nigeria. Thus Hausas are not strangers in Nigeria, and their language is a lingua franca not only in Kano but even in Lagos. The Tudu investigation showed little longer term or family migration from Tudu, but the few neighbouring hamlets by 1973 had experienced losses ranging from 55 to 80 percent to north-west Nigeria. The difference is apparently explained by the existence of kinship links between the hamlets and Nigeria which did not exist in the case of the Tudu population. The explanation of the movement across the border into areas in Nigeria similar in climate, farming practices and extent of drought is the strength of the southern Nigerian economy especially now that it is fed by oil revenues. Some of this wealth flows to the north, channelled both by a government with a strong northern Nigerian representation and through international trade links. The survey of Kano State, within northern Nigeria itself, showed little family movement [Mortimore, 1973b]. Three families had moved from the survey area, two of them with their cattle, but people reported that movements had been greater from some of the other villages.

Some of this movement may be permanent: many refugees from the 1913-14 drought in Niger to north-west Nigeria settled down and they and their descendants can still be pointed out by their neighbours. The drought seems also to have accelerated other long-term movements, especially the movement of whole communities from inaccessible areas to the roads and other creations of the modern economy; this has been particularly commented on in the case of Mauritania [Scheyven, 1973a, p. 3].

The target of much of the migration was then the towns and the better watered areas, especially in the relatively strong economies of some of the coastal countries. Such migration is not without friction, especially when its volume is increased suddenly by a severe drought. There was in Abidjan,

for instance, much increased competition for jobs from the large number of Malians and Nigerians who supplemented the strong competition usually provided by Voltaiques. In various centres of northern Nigeria, Tuaregs displaced local people from nightwatchmen's positions, partly because they were willing to work for less money and partly because of their reputation for effective fierceness. There was no estimate of the number of Tuareg refugees in Nigeria, but figures of 40,000 for Niger and 35,000 for Upper Volta were suggested [Center for Disease Control, 1973, p. 31]. The difficulty of the situation in the Sahel towns can be imagined when it is realized that Nouakchott and Agadez, with their relatively inelastic economies, doubled their populations in 1973. The real problems came when there were ethnic differences between the migrants and local populations and misunderstandings arose because of language and culture: "The situation has exacerbated certain north/south ethnic problems caused by the civil war in Chad, and there have been reports of clashes between [southern] villagers and [northern] newcomers in eastern Chad" [Marsden, 1973a].

Many demographic questions about both normal and emergency migrations remain unanswered. What, for instance, is the effect on mortality and fertility? Do long absences on the part of husbands lower the family fertility? The writer argued earlier that this is apparently the case even in normal times in northern Ghana [Caldwell, 1967, pp. 97-98].

The basic questions raised by the drought concern the nature of the way of life and economy of both pastoralists and sedentary farmers and the efficacy and likely future efficacy of their reactions to drought.

Nomads and Farmers--Their Characteristics and Nature

The nomads and settled farmers of the West African savannah cannot be treated completely separately because their lives do intersect: contact is frequent, the nomadic existence is possible only because farming is carried on in the same general region, and many of the farmers benefit from the existence of the nomads. It is a symbiotic relationship which allows the efficient use of the open grasslands beyond the rainfall limit for crops as well as the use of grasslands within the farming areas. Five characteristics have been identified as being common, and presumably essential, to all the world's nomadic societies: the use of a variety of animals, small family-

animal units, ecological rationality (often to an extent which astonishes the observer as he unravels the whole pattern), movement (which is an essential part of the rationality) and a dependence on agricultural communities [Johnson, 1973, p. 3].

West Africa has well over 2 1/2 million nomads (counting the cattle Fulani of northern Nigeria and other settled areas) but only about 2 1/4 million are ever found in the Sahel for even part of their time. They invariably herd cattle, goats and sheep; in the more northerly areas camels are also important, while further south their functions are performed by horses and donkeys. Pigs are sometimes found although these are usually associated more with settled agriculture.

In the Sahel the essence of life is movement and this determines most aspects of the nomad's lives. This life is markedly seasonal. From perhaps late July, when the annual grasses from the monsoon are first available in quantity until early the following year (as late as March if the rains have been plentiful and sustained), the nomadic groups and their animals move slowly over the whole landscape, while the latter eat the annual grasses, especially in favoured areas which have benefitted from capriciously heavy storms, and find pools and other water fairly easily. The weather is relatively cool and thunderstorms may occur far into October. Thereafter the rains cease, the temperatures climb and the air dries until the hot, parching days stretching from March into June are experienced. The nomads either retreat south or go to the nearest permanent water holes (depending on the area in which they live); sometimes they divide so as to do both these things. During the hot, dry season, when the annual grasses have either been eaten or have withered, those remaining at the northern waterholes usually live on a semi-permanent site to which they have returned many times. From this base, they travel out radially each day so that their stock might find perennial grasses, shrubs and sometimes tree leaves. Those who move south in the dry season reach flood-retreat pastures on such rivers as the Niger or on the shores of such bodies of water as Lake Chad or, by arrangement, use the recently cropped or fallow land of farmers. These nomads also have a "home" settlement in this area. Some cattle are sold locally or to traders who take them to the larger markets further south, but most, on the onset of the rains, return with their owners to the north thus avoiding tsetse and leaving the fields to the farmers and their crops. This is a simplified picture of a very complex situation

which varies markedly from place to place. Sheep, goats and camels can pasture further north than cattle, whilst camels rarely come as far south as the Niger (although they did in the recent drought). Even after the rains, much of the country in the far north has little grass and the movement is often to valleys and high plateau grasslands; similarly the dry season movement is not in every case southward, but sometimes to moister or better grassed areas in the north which are unusually favoured because of topography or soils. South of the Sahel seasonal movements are mostly from plateau tops to valley bottoms. In much of the savannah, settlements are found near the bottom of the pediments around higher land (often only just perceptibly higher) where the water table is likely to reach the surface. Fodder is not collected for the dry season; neither the available time nor the quantity and quality of the grass permits it.

These highly specialized activities dictate the way of life. Camels can go for a week without water and hence have a range from the base camp water hole of about 50 miles; cattle must have water every second day and hence are limited to 30 miles; sheep and goats are even less mobile [Oliver, 1968, p. 235]. Even the pastures eaten vary: goats, for instance, feed much more on shrubs than do cattle. These facts have important demographic consequences. The herds must consist of different types of animal: they have different values of food, as means of transport and as stored wealth; they make use of pasture of different types and at different distances from the camps, and hence nothing would be gained and much lost by aiming at single species herds; they have different levels of survival in bad times and of increase in good times and hence both human survival and prosperity depends on diversity. But these herds must be split up into more homogeneous groups for pasturing although sheep and goats usually remain together except along the Niger [Morgan and Pugh, 1969, p. 137]--and this division means having separate herdsmen. In a society where trust is a thing felt above all between members of the same family, this diversification of grazing puts a premium on having sufficient of one's own children to act as herdsmen.

More generally, the centering of life around animals means that society tends to break down if the herds are destroyed, and this is the major social problem of the drought. Not all nomads own animals, but those without animals have reasonably settled herding relations with those who do, and these nomad proletarians were left just as helpless as stock owners when the herds withered

away. Enquiries in Mauritanian drought refugee camps invariably received much the same answer when families were asked about the number of animals needed to set them up again: 10 camels, 20 head of cattle and 40 goats [Center for Disease Control, 1973, p. 15].

The nomads are not ranchers: their aims are to live in the country rather than to make their fortune out of it; their chief concern is not to profit out of the good times but to survive the bad times and to see that their families and society remain intact. They do not even have a predominantly meat diet: nomadic children in the drought camps demonstrated specific symptoms of continuing protein shortage to a greater degree than the children of sedentary farmers [Center for Disease Control, 1973, p. 28].

The nomads live chiefly off the milk of their cattle, sheep, goats or camels and off the grain they secure by selling milk, or less often animals, to settled agriculturists. Some Fulani even settle down to become middle men in this process, but most of the marketing is done by the nomads themselves who enjoy visiting the crowded markets and thus escaping their often lonely existence. The transactions in northeastern Nigeria are almost entirely in cash [Hopen, 1958, p. 154]. Meat is eaten in ceremonies or when an animal dies, but comes mainly from goats. Cattle are used as a source of wealth and as a standby for hard times--not surprisingly in a society where there is only a limited trade in non-animal goods of value and where the main animal products cannot be stored for long (camel's milk cannot even be used for making cheese). The only attempt at a rigorously quantitative survey of nomadic life, that of nomads in Niger [Ganon, 1975], showed the diet to be overwhelmingly of milk and millet, supplemented by meat during ceremonies and a small but regular and important intake of condiments, tea and sugar (as well as tobacco). A basic problem of a diet that consists largely of milk or of consumption which is paid for largely by the sale of milk is that the cattle of savannah West Africa produce surprisingly little milk: half a gallon a day was measured by a study in Chad and this is probably above average [Reyna and Bouquet, 1975]. Certainly there is evidence of competition for milk between the nomads themselves, their calves and the market. Nomads usually grow small quantities of their own food as well in gardens around their wet season camp.

Nomads certainly have expenses, much of it of a type not known to their ancestors. The Niger survey of nomads [Ganon, 1975] showed the Tuareg household as consuming about \$225 worth per year, of which \$125 was value-imputed

subsistence consumption and \$100 was goods bartered for or bought. Food, clothing, and taxes each make up about one-quarter of the non-subsistence consumption; also over the years the family has had to acquire hide tents, beds, cooking utensils, gourds, matting, weapons, tools, harnesses and saddles. The Fulani pattern was similar but at a lower level of consumption: \$145 per year of which \$70 was subsistence and \$75 cash and barter. The division of expenditure was much the same as for the Tuareg; food made up a slightly greater fraction as also did the payment of fines to both nomads and sedentary farmers for animals trespassing and damaging growing food plants. In addition, both Tuaregs and Fulani have the occasional large expenditures associated with marriage.

The Niger survey [Ganon, 1975] also attempted to measure the sources of earnings that allowed this expenditure. Among the Tuareg (who have less constant contact with sedentary farmers than the Fulani), by far the largest source of income was the sale of stock with similar amounts of income being derived from the sale of camels, cattle and sheep and goats taken together. But an important supplement is provided by the sale of handicrafts: wallets, sandals, sabres, agricultural tools, axes, jewelry, wickerwork and the like. In addition some Tuareg still derive money from caravanning while others gain something from hawking tea, sugar and tobacco. Some of the women become servants. Among the Fulani, whose handicrafts have always remained relatively crude and are rarely marketed, income is earned almost solely from their animals. Cattle are sold-- in the surveyed population households marketed two or three animals a year-- as are goats and sheep. But amongst the Fulani there is also a continuous sale of animal products, milk, butter and skins, which are usually taken to the market by the women. Similar patterns are reported in other studies. Even the Kel Adrar Tuareg of the Adrar n Iforas mountains in northern Mali sell some cattle to itinerant traders going south and take sheep north for sale in Algeria [Swift, 1973, p. 71]. In Mauritania about 8 percent of cattle are sold in a normal year [FAO, 1973d, p. 9], while in Chad sufficient cattle are now sold to keep two slaughterhouses producing 12,000 tons of meat per year some of which is exported by air [Reyna and Bouquet, 1975]. Indeed the Guinea coast, with its growing towns and rising incomes, is becoming increasingly dependent on the savannah for meat and for certain other foodstuffs such as beans from Kano and Sokoto [Mortimore, 1973c, p. 100]; so much so that the most general comment on the coast about the drought to the north was on meat shortages and rising prices.

One final point about occupations and occupational structure should be made for it has some importance in the reaction of the more southerly populations to the drought: both the Tuareg and the Fulani have an occupational caste system with the lower castes being blacker [Morgan and Pugh, 1969, p. 141].

The life of the farmer in West Africa is determined mainly by rainfall and hence by the distance inland from the Guinea Coast (and this in turn is reflected on maps in degrees of latitude). North of 18°N (to the north of the Niger bend and the northern foothills of the Air) there is no agriculture except rare pockets of oasis cultivation; between that latitude and 14°N (the upper reaches of the Inland Delta, 50 miles north of the Nigeria-Niger border and Lake Chad) livestock and cropping are both found with the latter becoming progressively more important as one moves south; from 14°N to 8°N (the southern border of the "middle belt") savannah agriculture is dominant with a transition from millet-dominated agriculture in the far north to areas where guinea corn or sorghum is more important to yams and cassava or manioc in the south; below 8° increasing tree cover finally leads to forest, and cassava (manioc) and yams are joined by maize, plantains, cocoyams (the taro of the Pacific), rice and tree crops [following Church, 1963, pp. 101-102]. Of these four zones the drought had a marked effect on the first three, completely upsetting the rhythm of life in the first two.

Shifting agriculture is the practice in the whole area, permanent cultivation (apart from that of tree crops) having been achieved only in parts of northern Nigeria, the Lama-Kara District of northern Togo and in vegetable plots around the large cities [Church, 1963, p. 102]. The land is cleared with axe, fire and hoe (and also with cutlass or machette in the forest where the process is known as slash and burn). The migration of fields has been made easier by communally owned land (usually still given in the traditional way by village, clan or tribe for a lifetime, but increasingly being replaced by more complex forms of tenure). Although villages also migrate, shifting cultivation of a variety of separated holdings usually means farmers spend a surprising amount of time walking to fields--the Yelwa survey in northwestern Nigeria reports that a radius of ten miles around the village probably included over 90 percent of all villagers' fields. The movement is usually highly selective: to micro-soils of above average quality and to micro-climates (one slope will receive more rain than the opposite one) with the most rain.

Cultivation is very labour intensive, with little assistance even from animals, the tools consisting usually only of the hoe and/or digging stick. "The total return per acre is remarkably high when one considers the poor quality of the seed, the shortage of manures, the lack of fertilizers and the limitations of technique. High total return is the result of hand tillage and the attention to individual plants in a system of mixed cultivation" [Morgan and Pugh, 1969, p. 66]. Such a system of farming necessarily limits both the area that a family can cultivate and the subsistence or cash income it can derive from farming.

The reason for shifting cultivation is the deterioration of poor soil which is not built up by fertilizers or other means during cultivation. The Yelwa survey in northwestern Nigeria found that field fertility became too poor for use in three to eight years from the onset of farming [Roder and Dupree, 1972, p. 2]; while a general summary of West African practice reported the common situation as being 3 acres in cultivation with 10 to 20 acres in fallow [Morgan and Pugh, 1969, p. 71], i.e., 13 to 23 percent in cultivation at any given time. However, two out of three ground surveys which formed part of the 1973 ERTS program aimed at interpreting satellite photographs of the earth, reported half or more of all fields in cultivation [Reining, 1973, pp. 65 and 97].

The major change in cultivation since the arrival of Europeans in West Africa has been the introduction of new crops [Caldwell, 1976]. The effect has been dramatic on the coast where cassava, maize and rice have become major staples and cocoa, coffee and copra have dominated vegetable exports. In the savannah there has been no equivalent impact in the subsistence sector: bulrush millet and guinea corn continue to be the main crops as has probably been the case for two millenia or more. There has been change in the market sector which is however, still much smaller than on the coast: cotton and groundnuts are widely grown, while in the moister south tobacco is also cultivated.

There is a growing area of distinctly different cultivation, that on irrigated fields, long practiced beside river and lake, and expanded this century by using stored water in barrages across small streams and dams on larger rivers to supply downstream areas during the dry season. Sometimes the old and the new work together: three harvests a year have traditionally been achieved on the north-west side of Lake Chad by holding retreating water in arms of the lake by small sand barrages; but since 1950, crops have been diversified by

the Government introducing wheat, potatoes, cotton, sugar and new types of vegetable [Reyna and Bouquet, 1975].

When measuring the cash income of a sedentary farming population, the Yatenga Village Survey in northern Upper Volta [Lallemand, 1974, p. 1] found that most women could grow and sell about \$20 worth of groundnuts or sesame seeds each year, while, with help, most men could grow and sell from \$25 to \$50 worth of cotton. In the latter case, the amount varied in direct proportion to the size of the conjugal family from whom assistance could be obtained-- a fact of considerable demographic significance. In addition, in the course of a year, households would sell some sheep and goats, while men would earn a little extra by weaving and women by spinning; these earnings ranging during 1973 from \$2 to \$28 per household. Blacksmiths and potters, active mostly in the dry season, earned \$20 to \$60 by selling their manufactures and carrying out repairs. Thus we get a picture of an average monogamous family with several fairly old children earning up to \$100, with the possibility that an older son will bring back another \$60 from his labour migration. Thus most sedentary families probably have more to spend than nomad families. The survey of Tudu in southern Niger supports this picture, dividing the year into a farming season, June to September, and the balance of the year, October to May, characterised by "a plethora of trading and craft specializations oriented towards village internal distribution and local markets" [Faulkingham, Belding, Faulkingham and Thorbahn, 1974, p. 7]. It was reported in Tudu that clans used to be the basis of craft specialization, but this is now but a memory; and in fact blacksmithing, weaving and tanning appear to be declining because the modern sector of the economy (especially that over the border in Nigeria) is both providing jobs with high incomes and supplying the market with machine made goods that compete with the products of these crafts. The importance of cash cropping varies tremendously from village to village, depending partly on soil and weather conditions and partly on distance from transport arteries (remote villages find it hard to get their produce out and to compete with producers near road, railway or navigable river).

In one sense the farming system is far from being completely successful. Even when there is no drought, the end of the dry and the early wet season usually sees food stocks near exhaustion and the hungry season begins. Accordingly some of the planting is of low-yielding, quick crops to provide some food as quickly as possible. In Yatenga (and elsewhere) even before the

major drought, every few years saw a critical gap of up to two months during the dry season when the guinea corn gave out before the late millet could be harvested [Lallemand, 1974, p. 1].

Imbalance in the Savannah

Neither the picture sketched above of the society and economy of the savannah nor the one drawn earlier of the region's population depict a changeless position. Many aspects of the savannah ecology have changed very greatly this century and not all changes have yet brought about a new balance with some resilience to disaster. This is partly because of the fragile nature of the ecology of an area where man has had to accommodate himself to low and savagely seasonal rainfall reduced at unpredictable intervals by harsh drought.

It is clear that the savannah population has risen very substantially this century and that the extra food thereby needed has come almost entirely from an extension of the cultivated area and not from greater productivity [Church, 1973a, p. 16]. This raises questions about both the failure to improve agricultural techniques and the limits of cultivable land.

But there is some logic in first considering the position of the nomads of the northern fringe areas² for they must also be fed from the crops of the savannah and some believe that they must increasingly be settled in the crop-growing areas. The underpinning of the nomadic way of life began to be weakened a long time ago: when European ships arrived off the Guinea coast in the late fifteenth century, thus providing alternative routes of goods from and to West Africa and breaking the monopoly of the trans-Saharan caravans for which some nomads worked and which they often taxed or attacked.

Drought was always the nomads' greatest enemy, but until the end of the nineteenth century they possessed an armory of methods for combatting it. In all nomadic areas of the world, families safeguard themselves against periods of disaster by accumulating valuable possessions for sale in time of need. In the Middle East and Central Asia such valuables take the form of jewelry, rugs and similar artifacts. But in the Sahel there has been little development of crafts producing high cost ornaments and coverings--although some valuables

²In this section and elsewhere, I have benefitted greatly by reading Swift, 1973.

of this kind probably have been bought for security and other reasons, as is suggested by the age-old use of the markets to sell not only slaves but gold, ivory, kola nuts and cloth [David, 1973, p. 86]. Rather have savings taken the form of increased herd size, and, now almost entirely in the past, slaves. Animals have always had the disadvantage that, as a form of savings, they become debased just when they are needed: by the time the decision was made in the drought to sell them, they were already scraggy and weak, and the price was forced lower still because by this time they were a glut on the market. In contrast, slaves had none of these disadvantages: there was still a market to the south towards the Guinea Coast (bolstered until the nineteenth century by purchases on the coast by European slave traders) or towards the Middle East, and more slaves still could be acquired by raiding and sold during the drought because the nomads had little else to do during the time and the drought had usually driven them much closer to the groups to be raided. Some of the raiding was to secure other valuables (which could be traded), or alternatively animals and food. This system began to collapse with the suppression of the slave trade on the coast and was destroyed with the spread of French administration this century.

During droughts the nomads also turned their attention to the thousand-year-old trans-Saharan and intra-Saharan caravans by participating in the trade or by raising the level of levies or even attacking the caravans. By the eighteenth century caravanning was dwindling as an ever greater proportion of West Africa's trade came round the bulge of Africa by ship (gone were the days when the florins of the Italian Renaissance were minted with gold carried to the Mediterranean by camel from the Fouta Djallon or Ashanti or when the Moroccans sold valuable "Morocco" leather originating in the vicinity of Lake Chad). The final blows have fallen this century as railways reached the savannah with the construction of the Dakar-Bamako, Abidjan-Ouagadougou and Lagos-Kano (and later--Maiduguri) railways and as road or even more complex transport systems were constructed (e.g., the Pointe Noire-Brazzaville railway connecting with the Brazzaville-Bangui river boat service and then with the road from Bangui to Fort Lamy and beyond which began to supply goods as far north as Tibesti, successfully competing, in spite of an eight-thousand-mile route from western Europe, with camel transport from Cairo only a thousand miles away or from even closer Cyrenaica and Tripolitania). The last decade has seen the near disintegration of what has remained of the caravan trade as roads have improved and

as trucks (which first appeared in any number in the middle Niger in the 1930s) are beginning to operate regularly even on the sandy tracks of the real desert (by the early 1980s one of the greatest of the trans-Saharan routes, that which passes through Ghardaia, El Golea, In Salah, Tamanrasset and Agadez to Katsina and Kano will be a bitumen highway from Algiers to Lagos). Nor are the trucks likely to be owned or driven by Tuaregs or Fulani, but rather by the trading people from south of the Sahel: Songhai, Hausas or even Yorubas and Ibos. Thus, the suppression by the French of the raiding and taxing of caravans has been followed by the near disappearance of the caravans themselves. Some still trek from Agadez to remote parts of northeast Niger and the camels still bring salt from northern Mali to Timbuktu but even these remnants are living on borrowed time.

With the dwindling of their usual sources of food during drought, nomads have long been forced back upon more ancient sources of food: the native plants and the wild animals. The berries and leaves are still there, and were used extensively in 1970-74. But the numbers of wild animals have decreased markedly even during the last decade because of indiscriminate shooting (often apparently by people who were looking for sport rather than food--by the rural teachers and administrators who had access to both motor vehicles and high powered guns). Nor are those of the nomads' children who go to school as adept at finding either the plants or the animals as their ancestors were.

Before the present century the nomads had undeniable rights to pasturage further south, and to access to the fadama or river-retreat areas and to more favoured areas in plateau or wadi country. These rights were based on traditional understandings and agreements ultimately resting on the threat of force and sometimes strengthened by kinship links deliberately forged. Colonial power nullified the possibility of threatening war to secure adherence to agreements or the recognition of rights. The spread of farming, as the numbers of farmers grew, reinforced later by State irrigation schemes, reduced the area of fadama available for dry-season pasturage and jeopardized its very existence. Before 1960 the French had limited nomadic movement and after Independence in that year some disaster-period routes were found to cross national borders instead of the internal frontiers of the French empire: the Tuareg of northern Mali discovered that the Hoggar Plateau was not in Algeria and the Air Plateau and most of the great wadi that leads into the Niger River downstream from Niamey were in Niger [Swift, 1973, p. 76]. It became ever more difficult to

cross these borders: migration officials regulated the passage of people and veterinary officials questioned the right of animals to cross and demanded customs payments.

Other equilibria have been disturbed in the Sahel. The partial control of disease, especially by vaccination and immunization, has allowed human and animal numbers to rise more rapidly than the basic resources warrant. This has been paralleled--and, to a degree, allowed--by the new deep water technology. New wells have been dug, and deep bores equipped with water pumps have been put down. Invariably this was desired by the local populations, all influential citizens of the new States. All these measures were safe and even beneficial as long as the good seasons of the 1950s and early 1960s were sustained, but they did nothing to improve the pastures and hence to raise the ability of the country to support either animals or human beings. Even before the drought, larger herds had begun to cause deterioration of the pastures around the waterholes (and this deterioration increased greatly during the drought around those water points where water was still available).

Probably every sustained period of good seasons has seen a northward movement of both the pastoral and farming frontiers, only to be followed by a retreat in the following drought. But what happened during the 1950s and early 1960s was something new. The movement to the north was on a much larger scale (partly because it was supported by a new technology that worked well in good times) and implied subsequent tragedy. Since the 1913-14 drought, technology and the market economy had penetrated the region. New roads, new forms of transport and quicker ways of digging wells made the movement possible; new markets and the desire for higher incomes encouraged it; growing human and animal populations provided the impetus. The changes of this period hastened some longer term movements tending to create disequilibrium [Dalby, 1973, p. 19]: social controls over grazing rights deteriorated; some previously transhumant farmers became settled crop-growers in fairly dry areas; and the division between the rich and poor in the savannah rural areas probably widened with the spread of the market economy.

Unresolved debate continues as to whether or not the underground water resources are being depleted, as some believe [Grove, 1973a, p. 35], or the fertility of the soil is declining, as others hold [Church, 1973a, p. 16]. But there is no question that before the drought the pressures on pastures had intensified, not only because nomads were running more cattle, but because

sedentary farmers increasingly owned small herds [Grove, 1973a, p. 40], and because, in some areas previously used only seasonally for pastures, year-round grazing was made possible by the new wells [Church, 1973a, p. 16]. Pastures around wells have been destroyed partly because the local people have not been able to control the extra cattle coming to the wells--there may, in fact, be a case for an increase in both fencing and local rights of regulation (although these are hard either to enforce or justify in a crisis). It is suggested that over-grazing has reduced the proportion of the important perennial grasses [FAO, 1973k, p. 1] but the evidence appears to be inconclusive. All these problems of changing balance or of attaining imbalance are interlinked with two other problems. One is that of erosion which can result from population pressures especially during the time of drought, and which has been blamed for the permanent destruction of land in northern Ghana [Hilton, 1968, p. 279]. The other is the problem of disease, which may aggravate distress in drought but which may also offer some future respite: considerable areas of apparently good riverain land, especially in Upper Volta and Ghana, are sparsely settled because of fear of river blindness, thus providing a reserve of land which may be made available if a costly eradication programme coordinated by WHO is successful.

The difference between balance and imbalance is not as fine in the farming areas, but nevertheless even these areas are amongst the world's potential trouble spots. There is some evidence that agriculture in francophone Africa is in trouble and that food production per farmer has fallen substantially over the last generation, possibly by as much as one-third [de Lusignan, 1969, pp. 320-324, quoting Bairoch, 1967] and that the deficit has increasingly been made up by imports. Even so, these calculations suggest that per capita production at present is no lower than in Europe before the eighteenth century agricultural revolution although it may be no more than half that found in Europe at the onset of the industrial revolution. Just how good these figures are is a matter of debate; United Nations experts have been so uncertain both as to what the existing trends are in agriculture and how productivity can be improved that their priority recommendation on savannah agriculture is for more research [UNDP, 1973b].

There is evidence of various changes in savannah agriculture which are of very great significance and which are partly caused by increasing population pressures and partly by "modernisation". Shifting cultivation in Africa has

in the past meant not only shifting fields but also shifting villages; this has in part been a response to soils which, with existing techniques, take many years to recover their original fertility. However, in recent years many village households have acquired an increasing number of possessions, some of them being additions to the house or its equipment which are difficult to move. The village itself often also acquires immovable property such as a school, health clinic or deep well. Accordingly there is a growing tendency for villages to become fixed in location, although more temporary housing may be built at a distant farming area where the adults often live while their children stay with the old people back in the village [French Government, 1973, p. 101]. The market economy and more money in villagers' hands, together with a host of other social and economic changes including the temporary disposal of land under the control of emigrants from the area, has led to more land being rented or being in a condition of de facto ownership. The variety of tenures has been shown for northern Nigeria [Goddard, Mortimore and Norman, 1975] while studies further north have shown that renting has long been a way of allowing someone from another village to use surplus village land [Reining, 1973, pp. 47-49]. Another source of imbalance is the increasing demand for wood, especially for fuel, by both townsman and villager: trees are now being cropped for up to 50 miles around Ouagadougou and long lines of little carts pulled by donkeys bring the wood to the city.

The fundamental questions of the savannah are its carrying capacity at the present levels of technology and the possibility of technological change. In an area of full and continuous cultivation, it should be possible to measure the fields in use and out of use in order to determine how many times longer the field must stay in fallow than under cultivation in order that the cultivation cycle can continue indefinitely without injuring the soil. The additional measure of the length of time a field stays in cultivation will then yield a measure of the time it must stay out of cultivation. Techniques for such calculations have been worked out [Allan, 1965] and have been applied during the recent drought as part of the ERTS project [Reining, 1973].

Many problems arise. The techniques will not establish carrying capacity unless that capacity has already been reached; the ratios of land under cultivation to fallow land mean nothing if land continues to remain unused once it has regained its full fertility. William Allan in his pioneering work of this type seems to have assumed that most of Africa was already at the critical level

of use at the existing level of technique. Indeed it is difficult, in view of the long period of occupancy of the land, to see why the critical level should not have been reached. If it has not, one would have to argue that the level of mortality which must have long kept natural increase around zero, so that the population could not grow slowly to fill the area available to it, had been determined, not mainly through available cultivable land and hence food supplies, but by disease (and further that deaths caused by disease had little to do with nutritional levels), warfare and other causes. But, if it has been reached, there should be many occasions when there is a tendency to exceed it by invading the fallow land before the cultivation-fallow cycle has quite run its full course and hence before the fallow has quite regained its original fertility. This would be evidenced not only by declining crop yields resulting from decreased fertility but also by spreading erosion, as fertility decline also leads to structural change in tropical African soils [Allan, 1965, pp. 385-386]. Such fertility decline has been identified in parts of southern and eastern Africa but only in pockets in West Africa. In the shorter run it is almost impossible to show that the balance between cultivation and non-cultivation is not the result of a recent premature invasion of the fallow, such as may be a normal response to drought.

Applying the Allan formulae to three villages in Niger and Upper Volta during 1973, Reining concluded that the villages were overpopulated in terms of their farming capacity. In the Mossi village area studied (which may be the most representative of the savannah farming areas), one-quarter of the land was uncultivable waste, while cultivation was being carried out on only 23 percent of the remainder [Reining, 1974, p. 130]. If the drought had caused some extension of cultivation, it seems a reasonable estimate that normally about one-fifth of the cultivable land and one-sixth of all land was used at any one time.

The major problem of this kind of study (which may be partially overcome when fuller use of the satellite photographs is possible) is that it leaves one unconvinced that there is not less intensively used land far from villages--land to which a migrant village or a migrant agricultural family might some day go to settle. Reining's density of settlement in the studied villages would, if applied to the agricultural areas of the whole six Sahel countries, yield a total population of over 50 million people (or about two-and-a-half times the present rural population) suggesting that average

densities could be achieved approaching those of northern Nigeria or Ghana's Upper Region or (assuming moderate mortality decline) that growth could occur at the present level of techniques for another half century. This argument may be very far wrong; the areas with few or no villages may be largely uncultivated wasteland. The point is that there are no reliable estimates for the whole or major parts of the region of either uncultivable wastelands or of fallow which has regained its original fertility. Nor are there estimates of the extent to which migrants' earnings allow villagers to buy food from outside the village or even the region (although presumably most earnings of this type are intended for non-food purchases).

There is scattered evidence of fertility decline, but this is often under special conditions. In Yatenga village, Upper Volta, the soil which has grown cotton is demonstrably impoverished as is evidenced by the diminished size of food crops it can subsequently yield; this position was repeatedly discussed by the villagers during the drought when it became clear that cotton earnings could not buy enough millet (at inflated prices) to cover the grain shortage [Lallemand, 1974, p. 4]. Concern about the inability of the soil to support cotton without major, and perhaps lasting, damage is widespread in the savannah and is particularly common in Chad. Around Zinder in southern Niger, the fertility of the soil has declined markedly and the need has been suggested for imposing longer fallow periods and introducing organic fertilizers [CILSS, 1973b, pp. 2-3]; problems like this may be common near large towns. The use of ploughs in northern Cameroon led to a decline in crop yields, and accordingly the 1968-71 period saw a swing back to hand cultivation [David, 1973, p. 90].

This analysis does not mean that in the average year food production is exactly equal to that required by a meagre diet. Cultivation errs on the generous side in case there are unexpected setbacks during the growing season; more often than not there is a "normal surplus" [Allan, 1965, pp. 38-48]. This surplus is available for the market if there is any demand (as there may be if there is drought in other parts of the country), as gifts, for use in religious ceremonies, for fermenting and so on. It may also be carried forward towards hungrier times. However, there are very great problems in doing this. In many villages, almost as much building effort already goes into food stores as into housing (and the variety of food stores is one of the fascinations of the savannah). Grain must be kept from stock and rodents; every effort must be

made to prevent mould and other fungus attacking the food, especially in the steamy conditons which develop as temperatures rise again after the rains; and water must be kept out. In Yelwa, northwest Nigeria, only 31 percent of farmers believed that they could successfully carry any food through to the following year [Roder and Dupree, 1972, p. 8]. Such problems can produce apparently inefficient forms of agriculture: cassava is being increasingly grown in the savannah, in spite of low yields there and occasional complete crop failures, because it can be stored in the ground for up to three years and because its products, fufu or gari, will keep [Morgan and Pugh, 1969, p. 87].

There appears to be little evidence of available technologies that can quickly raise productivity in savannah agriculture. It is true that the Kano close settlement zone in northern Nigeria exhibits dense farming and the repeated cultivation of the same fields, but it is doubtful what lessons it has to teach. The dense settlement occurs apparently only on one particularly favourable type of soil, and the agriculture is oriented towards the wealthy market of prosperous Kano and, because of the railway, towards overseas markets (for groundnuts) [Mortimore, 1968, pp. 301-302 and 305]. Certainly the rise of urban markets over the decades to come will probably improve the lot of fortunately situated farmers. Equally, the Kano example demonstrates that the use of manure (from animal enclosures in the city) can help soil retain its fertility--an example the value of which is diminished by the limitations on mixed farming in West Africa where the tsetse fly provides a southern bound for most cattle and the rainfall a northern bound for most crops. Perhaps the most dangerous temptation is large-scale irrigation. In West Africa the opportunities are limited and the cost frequently does not justify the return. The available land along the Niger is limited and is shared now by pastoralists in the dry season, while the riverside flats can be irrigated by relatively simple means without employing expensive modern engineering techniques [Dumont, 1969, pp. 52-55]. There have been both successes and failures in the large Malian irrigation scheme developed by the Niger Office, but the experience has been sufficiently chequered to urge caution on any planners.

Reaction to the 1970-74 Drought

How was it then that the vast majority of people living within the precariously balanced ecosystem survived the drought? How was it that the British nutritional survey team in northern Upper Volta in 1973 concluded that their data could not show that the physical condition of people was worse than at other times and in other places in West Africa [Seaman, Holt, Rivers and Murlis, 1973, p. 2]?

The point should not be misunderstood. The drought was immensely distressing: it caused pain and sickness; it broke up households and herds; and it forced many to sell treasured articles. But it did not cause massive erosion of human numbers and it did not halt population growth. It is doubtful whether deaths in the Sahelian countries during the 1970-74 period numbered more than a quarter of a million above what would otherwise have occurred. This number would have been sufficient to have raised the death rate by 2 1/2 points or perhaps to have lowered the rate of natural increase by one-sixth, from possibly 1 1/2 to 1 1/4 percent per annum. Perhaps the birth rate also fell a little because of enforced separations (although some families who would normally be apart during dry seasons were kept together by the drought).

Some of the answers to the problem are given by the farmers' own responses in the survey of Yelwa, northwestern Nigeria, when asked how they react to drought [Roder and Dupree, 1972, p. 7]. In descending order according to the proportion giving the reply, they said they: (1) go hungry and suffer--99 percent; (2) pray to Allah or other Gods--98 percent; (3) sell firewood and the products of their skills (blacksmithing, ferrying people over the river, playing music, weaving, mat and rope making, fish trap making, fence making, etc.)--84 percent; (4) spend more time fishing--74 percent (the area is on the Niger River); (5) seek help from relatives--59 percent; (6) seek labouring jobs--55 percent; (7) plant late crops, especially cassava--19 percent; (8) sell belongings, including clothes and pots--11 percent. Two significant points should be noted: 7 percent had some wage income even before the drought; and only 16 percent knew that it might be possible to secure some help from Government even though the newspapers of the town made this their major drought news story.

All local surveys agreed on the central importance of organized fasting and of eating the natural flora. A (Niger) household census, in January 1974,

found that half the households had fasted for at least four of the preceding ten days and that a quarter had cooked and eaten tree leaves at least once a day [Faulkingham, Belding, Faulkingham and Thorbahn, 1974, p. 11]. At the same time in Yatenga, Upper Volta, another study showed that the heads of households were rationing food and that everyone was being sent each day into the bush to gather wild plants and edible leaves, which although sparse in the dry season and particularly in the drought, completely replaced grain for some families [Lallemand, 1974, pp. 2-3]. Foodless days were reported widely among the families of the region [Townley, 1974, p. 4]. In the villages of Kano State, northern Nigeria, farm and wild trees and other native plants were being used on a large scale, especially in soups, being, in some areas, the main source of food for people and a valuable supplement for cattle [Mortimore, 1973b, pp. 105-106]. The populace was in fact increasing its use of types of food identified and used as staples for tens of thousands of years before the institution of grain culture perhaps two millenia ago and always used to a more limited extent since during famines and even during the hungry period occurring at the end of the dry and in the early rains. An examination of the value of the wild foods being eaten in Upper Volta at the height of the drought showed their calorific and protein value to be as high as that of the cultivated crops [Seaman, Holt, Rivers and Murlis, 1973]--the benefits brought to the region by the neolithic revolution were the greater quantities of food that grain cultivation allowed to be grown in a given area and the reduced labour input needed to secure an adequate diet (thus allowing labour to be used for other production).

Another supplement to the current grain production was, in the earlier part of the season and for some of the population, the limited food stocks carried over from the previous season. Most of this had been stored by the farming families themselves (perhaps 90 percent), but traders' holdings and national buffer stocks were also of some importance [FAO, 1973k, p. 19]. Government emergency stores were probably most significant in northern Nigeria, especially the large holdings in Kano which form part of Nigeria's Strategic Grain Reserve.

The nomads' largest store of wealth was their animals, and these they were forced progressively to sell. Such sales, even to distant commercial markets, are not a new phenomenon: the markets of Kumasi in Ghana were deluged by cattle driven overland from the Niger Valley and beyond during the great 1913-14 drought [Grove, 1973b, p. 134]. In 1970-74 stock prices slumped, partly because

of the poor condition of the animals but largely because of the glut on the market. By early 1973 average cattle prices in Mali had fallen from \$120 per head to \$20, and so desperate were the sellers to realize on the animals, that they were little concerned with rebuilding herds as is evidenced by the fact that 60 percent of those animals offered were pregnant [Thomas and Bouvrie, 1973, p. 5]. In northeast Kano State, Nigeria, prices plummeted from \$60 to \$100 to as low as \$4; by July 1973 cattle were being picked up by the middlemen (for resale in the Kano market) for, on average, one-tenth of their usual price [Mortimore, 1973b, pp. 103 and 107]. In Yantenga, Upper Volta, prices for sheep fell only from \$6 to \$2.80 and for goats from \$2.40 to \$1 [Lallemand, 1974, p. 3] partly because these animals do not lose condition to the same degree as cattle and partly because the money outlaid by other villagers for purchase is a comparatively small amount. The reaction of the nomads was to slaughter more animals themselves, thus increasing the proportion of meat in their diet, and to store the food by smoking, drying and salting.

This reaction was partly necessitated by the steep rise in the price of plant foodstuffs which meant many more animals were needed to pay for the same amount of human food and also that the price of emergency fodder was soaring. In Yatenga a goat fetched only five days' per capita consumption of millet by early 1973; normally at the end of the year (following the November harvest) a 38 lb. tin of millet (20 days' per capita consumption) sold for 60 cents but in 1972 it reached \$1.40; in mid-year the price rose before the drought to \$1.20 but in June 1973 it was \$4 [Lallemand, 1974, p. 2]. In the villages of Kano State, mid-1973 food prices reached five times their normal level; except in the case of rice, where government food releases (not otherwise very evident) kept the multiplication down to twice.

These price rises were not wholly harmful. They did partially compensate some of the crop growers for their losses. More importantly, in a region with startlingly different falls of rain over short distances, they tempted the luckier areas to do with minimum food and to sell their surpluses to the most badly off areas. In due course merchants and lorry drivers reacted to the price differentials between coast and savannah and unfamiliar trucks began to appear in inland markets offering admittedly high-priced food.

One contrast between the Ethiopian and Sahelian droughts resulted from the different land tenure systems; in the Wollo and Tigre Provinces of Ethiopia the farmers sold land as well as cattle [UNICEF, 1973a, p. 3].

One aspect of the economy that the rural population cannot control (except at times, especially in the case of the nomads, by riot and insurrection) are the routine head and cattle taxes. These are high, usually amounting in the francophone savannah to about one-quarter of household expenditure, and, apart from their revenue-raising purpose, were intended by the French colonial administrations to foster development by forcing the nomads to orient their cattle raising towards the market (which has largely failed) and some settled farmers towards periodic or permanent wage employment (which has been more successful, though usually at the expense of breaking up families for these periods). In rural Upper Volta, 1973 taxes were mostly deferred until 1974 [Lallemand, 1974, p. 3]; but in Kano State tax collection got underway just as cattle prices reached rock bottom [Mortimore, 1973b, p. 103].

Not only did animal prices fall, but so did the money paid for the services and products offered by those who were normally farmers. The nomads forced down the price of nightwatching in Kano, and in Yatenga non-food prices fell steeply both because of the potential surplus of goods and services and because the anticipated clients had little money [Lallemand, 1974, p. 3]. In many savannah towns the price of charcoal went down because charcoaling is a frequent alternative employment to farming.

The alternative to selling and eating animals was to head south almost indefinitely with the knowledge that eventually moister areas (and richer ones) must be reached. This, great numbers of nomads did, beginning the movement, for instance, from Upper Volta as early as October 1972, instead of February 1973, which would have been the usual time. They had already taken the precaution of not being caught too far north by failing to go to the Wan-Irhazer west of Agadez after the 1972 rains which was a usual transhumance destination [Thomas and Bouvrie, 1973, p. 3]. Often the sedentary farmers lost a greater proportion of their cattle than did the nomads, because the former cannot begin to move with the first indication that things are going wrong: for example, the Hausa of Kano State lost more animals than did the Fulani [Mortimore, 1973b, p. 103]. This was not always so. Some northeastern Nigerian villages, where many of the villagers are normally nomadic in the dry season, realizing in 1972-73 that their crops were failing, decamped in their entirety to Lake Chad where the very low water level had exposed more than the usual dry season pasture [James, 1973, p. 110].

Great herds of animals descended on waterholes that they had previously not frequented, causing bitterness and sometimes fights, and continued south across international borders with neither documents nor permission for such crossings. Most governments were tolerant regarding the movements as having justifications in either tradition or technical aid, although Ghana retained most of the restrictions it has enforced since 1969 and the Senegalese army was used to deflect Mauritians to Mali. In addition, Niger insisted on Malian refugees in the Niamey camp being returned to Mali. Administrative tolerance has not always been the case: the movement of the Tuareg during the 1913-14 drought into the Valley of the Tilemsi (the wadi entering the Niger at Gao) led to friction with the French and consequent revolt [Grove, 1973b, p. 134]. At the popular level there was friction in 1970-74 too, although my experience provided no justification for the claim in a United Nations publication that, "Life in capital cities like Bamako, Niamey and Ouagadougou is becoming a 'nightmare'" [United Nations, 1973a, p. 3]. Many of the nomads and their cattle stayed in the south during the 1972-73 and 1973-74 wet seasons, often being allowed to use failed crops for grazing in the same way as they are usually given access to stubble during the dry season. In contrast, some nomadic groups were less mobile than in the normal dry season, usually for one of two reasons. In the Sahel, some nomads were reluctant to move from a waterhole either because they suspected that waterholes they had previously frequented on the way south might have dried up on this occasion or because they were acutely aware of their ignorance of the whereabouts of more distant permanent water [Johnson, 1973, p. 12]--this type of decision led to some of the worst tragedies of the drought when the hole on which they were based dried up leaving no longer any practicable route of escape. Further south, as amongst the Fulani of Bornu, north-east Nigeria, the distance covered in dry season grazing was reduced as the cattle weakened [James, 1973, p. 112]. The decision to stay in the south also apparently led to higher mortality amongst herds and a fear that sick cattle would return north. At least the matter was discussed extensively in reports, although it was difficult to find examples further south, perhaps because in reality large numbers of these cattle were sold. An incentive was that, under the spur of the drought to the north, meat prices on the coast were at that time unusually high, although many of the weaker animals were not easily saleable for high prices because of the fear that they would die on the hoof before

reaching the consumers (the fear was mitigated in those areas where cattle were usually trucked south, particularly Nigeria).

Amongst sedentary farming families, the equivalent to the mass movement of nomadic families was most commonly an expansion in the numbers of those going to distant places, usually outside the savannah, to work. In good seasons, such exoduses are concentrated heavily in the male age group, 18 to 34, and are more likely to include single than married men. In contrast, the position in Yatenga by 1973 was that most males, from the very young to those in their forties, participated in at least seasonal migration [Lallemand, 1974, p. 3]. This kind of reaction was widespread (and could be regarded as an example of flexible response), although undoubtedly it was not as extreme in most cases, for the savannah villages were demonstrably not denuded of all young and middle aged men (the exact position will never be known because there were no large-scale surveys during this period).

In distress, the savannah population (like other African populations) has always assumed that the usual demands on kin could be extended and intensified. Certainly the kinship network absorbed much of the shock of the drought. Relatives in the town took in the drought migrants (a better term than "drought refugees" even in the case of the camps) and sent them money. Most town relatives were as well off as usual. Some were better off: the truck drivers who were carting the relief food [Golding, 1973, p. 4] and officials and merchants who managed to make a profit from the distribution of relief supplies. Rural people, even nomads, invest in the education of children and other kin so that they may become "big men" in the towns wielding power and earning income which is useful on many occasions but vital in a crisis. Even the poor rural-urban migrant had secured a toe-hold in the town which meant accommodation for his relatives and sometimes contacts and employment. When the granaries were empty, family-stored wealth consisted of the money, possessions and employment (especially urban employment) existing within the kinship network. Money came from kin not only in the Sahelian countries and on the Guinea coast but also from France and the other countries of the Common Market. Certainly pressure was put on relatives, but remarkably little bitterness was felt when acceding to this pressure. Obligations and demands extended beyond kin relationships, as in Hausaland (northern Nigeria and southern Niger) "where the poorest are dependent on them [the richer] even at the best of times for occasional employment, gifts or loans of seeds, food or money" [Mortimore, 1973c, p. 100].

This was a system into which the international relief effort and its camps fitted remarkably well. Pressure was put on the world's conscience in much the same way as an appeal is made to relatives: the September 1973 CILSS (the permanent committee of States to combat Sahelian drought) meeting in Ouagadougou resembled nothing so much as an extended family hearing the details of a family disaster. The camps were urban toe-holds which would supply food and might provide a base for securing a job. The nomads (and an unknown number of local farmers) entered them with the dignity that they would enter relatives' houses and with a feeling that succour was their right. Nor was the movement to the camps that of a blind refugee stream; knowledge of the camps spread through the Sahel and much of the movement was directed migration--caused admittedly by terrible times but a type of calculated rural-urban migration for all that.

Those still in the rural areas supplemented their support in all ways they could: money, goods and food from relatives from national and international relief efforts, as well as returns from their own non-farming activities. In the Sahel little grass germinated during 1972-73 and 1973-74 and the rate of calving fell sharply--on the whole a good thing as cows bearing young were less mobile and the calves faced probable death, but it did jeopardize the milk supply. Further south repeated sowings of crops often failed and many areas normally used for irrigation were bereft of water; finally, in some areas, locusts appeared. In many areas, necessity led to land usually employed for cash crop production being used for subsistence food farming, which is probably part of the explanation for the decline in groundnut production in Nigeria, Niger and Senegal and in cotton exports from Senegal and Chad. Nevertheless food was still exported for cash returns; at the height of the drought, groundnuts (a protein-rich food) and groundnut excess (a cake which makes good cattle fodder) were still stored at Maiduguri and Kano for export [Mortimore, 1973c, p. 98] and there was competition for transport between these exports and the incoming relief foods. The longer one stays in the area, the less illogical even this seems: the groundnut growers need the money partly because of the drought for which they, in any case, were not responsible; and the people prefer to eat millet and sorghum, which are in fact cheaper (and which are more likely to be provided by international aid). Meanwhile the people, and especially the children, put up with higher rates of measles and gastroenteritis, the latter probably aggravated by irregular and unusual diet.

Nomadic-Sedentary Relationships

Economic and other relationships are closest, and at times friction is greatest, between the Sahel nomads and three groups of sedentary farmers: farmers who till the marginal agricultural country on the edge of the Sahel; those who farm the lands adjacent to the Niger and who are usually guaranteed water from the river even in the desolate area between Timbuktu and Gao where the Niger penetrates deep into the Sahel; and those, often well to the south of the Sahel, who live in areas also frequented by the Fulani.

The nomads have always needed the farmers, for, except in emergencies, grain forms a central part of their diet. This dependence is continually growing [Monteil, 1959, p. 575], for this century has seen a steady rise in the importance of various conventional necessities, especially tea and sugar, that the nomads expect to buy in the markets. The list can be extended: salt for humans and animals in areas where the nomads do not have their own sources, cloth, metal for the artisans and so on. The temptations are increasing; each group now certainly needs a transistor radio (although this is likely to be purchased in the town from town earnings). There are other new ways in which the nomads look south to the sedentary farming areas. Most schools (and nearly all secondary schools) are in the south, and nomads are becoming increasingly aware that the most reliable way of saving for bad years is to prepare children by schooling for salaried positions in the town; so are most health facilities; and in the future this may also be true of semi-permanent disaster camps providing food during hard times.

While the sedentary farmers could survive without the nomads, many of them could not enjoy the same standard of living. The farmers have no way of using the northern grasslands themselves; the only way they could conceivably do so would be to hive off some of their numbers to spend most of the year wandering far away with cattle (and hence becoming in effect nomads). But the existence of the pastoralists means the ability to sell off some of their millet or sorghum both to vary their diet with milk and sometimes meat and to obtain skins needed for clothing and other purposes. Nomadism is essentially the way agricultural societies use the grasslands which are too dry for crops. The relationship can go further than this: some farmers actually manage the nomads' cattle while on the southern pastures; while some farmers in Bornu

give their cattle (and their milk during this period) to the Fulani to take them to the transhumance pastures around Lake Chad [James, 1973, p. 109].

The welcome given by the farmers to the cattle is occasioned by the animals' manure. The savannah farmers are well aware of the benefits of manure: animal manure is carefully gathered and used wherever available; human excrement is fairly widely employed; in places, termite mounds are pulverized and spread [Morgan and Pugh, 1969, pp. 69-70]. The arrival of the tsetse with the rains renders round-the-year mixed farming hazardous, and hence the advantage of allowing the nomads' animals to feed off the stubble and fallow pasture during the dry season (although mixed farming with small cattle fairly resistant to trypanosomiasis is on the increase). Such relationships do not prevent the farmers from denying the nomads ancient rights of pasturage if it is in their economic interest to do so (as has happened in irrigable areas, where the State has supported the farmers).

Nomadic culture does not make it impossible for them to settle down as farmers. Fulani have long done so, usually becoming mixed farmers. This is particularly the case with those Fulani who have become middlemen in the cattle trade.

The symbiotic relationship developed between the nomads and the sedentary farmers has not prevented the existence of real antagonism. This is partly based on the resentment of nomadic raiding which is still a vivid folk memory. But it is based also on nomadic claims to cultural, racial and religious superiority. Both the Tuareg and the Fulani are very colour conscious and the Tuareg claim to a superiority based on greater whiteness than the peoples further south is particularly galling. Southern governments, all in the hands of sedentary farming populations except in Mauritania (although the position has been strongly contested in Chad), have publicised the drought and requested more development aid; but little of that aid would be designed to support the nomadic way of life. Perhaps there is relatively little that such investment could do for nomads, but perhaps the desire of Governments and their experts to do so is not particularly strong either.

Minimization of Risk

Profit maximisation is probably the main aim of economic man only where there is a floor at not too unendurable a level below which disaster cannot drag him. Ill fortune in West Africa can be utterly disastrous and completely capricious in its timing and its disregard for many of the safeguards erected against such disaster. In the circumstance, the society (probably like many of the societies of the developing world) places much more stress on mitigating the effects of downswings in economic fortune than in getting the most out of the upswings. This is true even in the urban areas of the Guinea Coast, as has been shown for the small businesses of Ghana [Garlick, 1971, pp. 110-118].

Much of this insurance against bad times takes the form of "investing in social relations rather than in capital goods, equipment or land" [Davy, 1974, p. 85]. In such times assistance is most likely to come from relatives, than one's own community, and possibly from neighbouring communities. The primary importance of relatives was underlined by the 85 percent of Nigerian respondents who agreed in a 1973 survey to the proposition (translated out of the Yoruba original), "I can ask relatives (even relatives by marriage) for things or services that I cannot ask non-relatives" [CAF II, 1974, p. 86], and by one of the three most common values ascribed to daughters being their ability through marriage to link families and so greatly increase the number of relatives [CAF II, 1974, p. 84]. The survey of Tudu, Niger, noted that, "Where a single household experiences a harvest shortfall relative to its neighbours, traditional institutions requiring sharing become operative" [Faulkingham, Belding, Faulkingham and Thorbahn, 1974, p. 3]. This does prevent disputes over debts, and it was reported that the 1970-74 famine increased both the indebtedness of Tudu villagers to each other and the disputes over debts which were taken for decision to the moot presided over by the headman [Faulkingham, Belding, Faulkingham and Thorbahn, 1974, p. 36]. But the system is not without limits in the Dogon country of Mali food was given fairly generously by those who had most to those with least in 1971 and 1972, but there was a hardening of willingness to do so in 1973 which led to both hunger and bitterness. Nomads lend each other not food but animals (these do, of course, supply milk), hoping for the acceptance of such loans in periods of personal well being so that return loans might be made in less fortunate circumstances [Swift, 1973, p. 75].

One result, that is often ignored, is that there is a limit to the protection that can be afforded by storing food, because the larger one's store the greater is the pressure to share out the food; hence there is a ceiling to the likely provision of family storage facilities and family planting.

This means that the strength and number of personal contacts is very important. "Petty trading is engaged in as much to create and maintain social networks, and this security, as for elusive material gain" [Dalby, 1973, p. 86]. The demographic significance of this situation can hardly be overstated. The most certain way of creating very close relatives is by breeding them, and the larger one's own family is then the greater number of very close relatives there will be--and ultimately there will be children-in-law and grandchildren too. This is, of course, the case for polygyny as well as high fertility.

Insofar as the protection these close relatives can give is proportional to their wealth and the security and power of their positions, the most obvious investment is in increasing their income-earning potential through education. On this point too the findings of the 1973 Nigerian survey programme were absolutely clear: 97 1/2 percent of respondents agreed that, "The best investment is in the education of one's children (or relatives)" [CAF II, 1974, p. 86]--the parenthetical addition of relatives being needed because the relation with one's nephews and nieces can be as strong or stronger than that with one's own children. A survey of aged people in Ghana a decade earlier had shown that most parents receive a very substantial return from the education of their children [Caldwell, 1966, pp. 5-26]. Two points might be noted. The first is that most of the rural savannah population have few alternative good investments open to them: the nomads can increase the size of their herds but this investment is not drought-proof. The second is that the reasons for wanting to educate one's children are more complex than this bald economic analysis might indicate: pride in having a child who has broken into the elite is strong in the savannah as it is in many other societies.

Fatalism

"Fatalism" is an unsuitable term because it can be used in two ways: to mean the rational acceptance by those living in a traditional society that they have little control over the forces affecting their lives; and to mean such a reluctance to attempt any control that they are more battered by such forces than need be the case.

The acceptance of the blows of fate is often so great in traditional society that it is difficult to measure the personal impact of disaster or even to discuss it properly. Often technical aiders give up the attempt and go to talk to other technical aiders who seem to speak the same language, and thereby sustain the conventional wisdom and often lose all chance of adding to worthwhile knowledge about the situation. Sometimes they wonder if they have been entirely misled about the reality of the position. In one of the few honest reports ever written on this question, a transport expert working intimately with the truck drivers bringing food relief in the recent Sahelian drought and having substantial contact with the rural population reported that at first none of the local population seemed ever to have heard of the drought; later he concluded that they felt it deeply and were taking rational steps to minimize the hurt in ways they had known all their lives [Golding, 1973, p. 3]. In Yelwa, northwest Nigeria, it was reported that, "The Emir of Yauri and the Divisional Officer, head of the Local Administration, held that drought did not occur in Yelwa and that no problem with shortage of rains was extant". Even the farmers talked of locusts, weeds and lack of good lands as much as drought [Roder and Dupree, 1972, pp. 4-6].

There are many reasons for this kind of reaction. One is that the matter is irrelevant to the outsiders, whose lives are demonstrably not affected by the climatic conditions. Another is a belief, held also by the outsiders, that nothing can be done to alter the weather. Actually this view is usually more rational still--a feeling that the bad years are as much part of the totality of what must be experienced as the good years and that the lot of man is to bend with each wind. Such attitudes are embedded deep in the culture; they find religious expression and are reinforced by religion. In much of the savannah and desert of Africa, people take drought to be a necessary divine warning that religious and moral standards are slipping and that a revival is due.

Drought provides assurance that Providence is paying attention and is still concerned. It indicates a need for religious leaders to intercede with God. If the drought is long and severe, resort will also be made to age-old methods, long predating Islam, for encouraging rain [Dalby, 1973, pp. 18-19]. From the Western Sahel to Somalia drought and religious observations are deeply linked [Norris, 1973, pp. 143-144; Andrzejewski, 1973, pp. 139-142]. In profane literature and oral tradition references, the need for water are equally pervasive. In these circumstances it is not surprising that the common man is somewhat apprehensive about recalling the last drought or predicting the next one. The Yelwa survey reported that, although there was clear agreement about the nature and seriousness of drought, there was complete disagreement in the farmers' responses as to when the last one occurred and three-quarters did not wish to encourage bad luck (or to trespass into the domain of Allah) by suggesting that one would ever again occur [Roder and Dupree, 1972, pp. 4-5].

A study in Zambia [Richards, 1939, p. 208] concluded:

The Bemba consider it more or less normal for food to be scarce, and both their agricultural system and methods of distribution make it impossible entirely to prevent such a happening. Traditional magic belief teaches that only by supernatural means can the dangers of a shortage be avoided. This firm conviction combined with the temperamental optimism of the Bemba and their lack of interest in hard agricultural work makes them believe that somehow something will happen.

Not only is the origin of drought either divine or in any case not to be influenced by Man, but so is death--a proposition that is still true over most of the Sahel most of the time. Western doctors working in the drought refugee camps were disturbed when the mothers of dying children seemed to be more concerned about obtaining cloth to serve as shrouds for their dead or dying babies than they appeared to be about the fact of death itself. Their reactions were partly explained by the fact that the babies had symptoms which have always presaged death in the savannah. Part too was the religious conviction that the babies were being called away and had been destined at this time to leave the world (the Fulani express it as the child wanting to go). These are not societies in which determined efforts are likely to be made to counter the condition of an apparently dying child or indeed to prevent the births of children. Urbanization and other types of economic modernization ultimately lower child mortality both by providing greater health services and by convincing people that one can and should intercede with the forces that determine children's sickness and death.

The Future

The drought has occasioned both doubt about the future of savannah tropical Africa and the drawing up of lists of projects which might be assisted by technical aid so as to ensure a brighter picture. While the drought was still raging, the most detailed assessment of this sort carried out by experts and politicians of the Sahelian countries was that made at the CILSS meetings in Ouagadougou in August through September 1973. Apart from suggestions for emergency relief and for the re-establishment of the rural economy in its pre-drought condition, the needs were divided into three groups [CILSS, 1973b, pp. 1-2]. National needs included better water supplies, pasture management, control of herds and their health, re-afforestation and road construction in the arid zones. Subregional needs concentrated on the construction of dams, roads, railways, navigable water routes (primarily the Niger), plant breeding together with seed distribution, and a Sahelian fund for emergencies and development. The suggested areas of subregional cooperation were largely in research. As the Sahelian countries have not since changed this list of priorities, it is pertinent to ask how all this fits in with what we know of the region and its possibilities.

The list clearly implies that the need is rapid economic development with an opening up of rural areas to the full market economy. It can be inferred that the future of those who remain nomads is in achieving a quick turn-over of stock for commercial sale, made easier by trucks plying south on the improved roads. Nothing was said about population problems (although a United Nations Economic Commission for Africa paper to the conference did raise the question).

The West African savannah region is not one of insoluble economic problems, although the four inland countries may never have per capita incomes as high as those of most of the coastal countries to the south and all may be prone to periodic disasters. The real problem is to dampen down the magnitude of these disasters which will almost always be the result of insufficient rain (although, on a subregional level, floods, insect plagues and epidemics can each have a marked impact, as could major war for the whole region). Grain is commercially grown on inland grasslands with capricious rainfall in other parts of the world, on the plains of North America, Australia and U.S.S.R., usually on the assumption that the losses of the bad years will be more than compensated by the profits of the good years. There is here a parallel with

the West African savannah. It may long have to endure bad times by retaining a fluctuating systems whereby people flow out of the Sahelian countries and food flows in on these occasions. This does not necessarily mean that every drought will be a matter of international alarm. Even the recent drought led to an import of relief food no greater in value than about one-seventh of the average annual value of imports in the late 1960s and equal to about one-half the usual deficiency in the trade balance during those years. The relief effort cost twice as much as this but the costs climbed because of haste and included high transport and other logistic costs. But a crisis of this magnitude will not necessarily occur more frequently than once every half century. Lesser droughts may be contained by building up overseas balances to pay for imports (or obtaining credits during the droughts), beginning imports at an early stage after warnings from some kind of food monitoring system, and by strengthening the transport and other infrastructure so that food can be delivered as a matter of course.

The real problem area is the Sahelian grasslands. Water cannot be got to it on a sufficient scale to sustain the grasslands and it is unlikely that fodder can ever be produced in sufficiently great quantities or at a cost that will allow any addition to feeding other than that needed during a crisis or at the end of the dry season in the southern transhumance pastures. Something may be done to introduce better perennial grasses, but the effect will probably be only marginal. Better roads with larger cattle trucks may, with increasing commercialization, allow cattle to be taken to the southern markets as soon as grass begins to fail so providing money to sustain nomads through drought. Meat processing works may be viable on the edges of the pasture country or even within it. But these remedies are not immediately available. The nomads do not see themselves as inefficient cattle breeders waiting to have their marketing standards raised--their existence with their herds is largely a way of life. This way of life is in most of the Sahel changing only slowly, although the Moors of Mauritania have become surprisingly market-oriented, and the savannah as a whole already sends two-thirds of a million cattle annually to the southern markets (Seaman, Holt, Rivers and Murlis, 1973, p. 774]. Nor would a cattle industry easily attain the levels of efficiency of the temperate zone: while British cattle can attain an annual rate of natural increase of up to 28 percent, that of Fulani cattle is only 5 to 9 percent (and hence, even with minimum slaughter, takes a decade to recover from a disastrous drought)

[Stenning, 1959, p. 171]. Nomads frequently assume that governmental efforts on their behalf are an attempt to improve the taxing base [Reyna and Bouquet, 1975].

It seems inevitable that population increase in the Sahelian grasslands must be checked and that long-term population growth must be at a very low rate or possibly that decline must take place. The difficulties faced in penetrating such areas with schools, hospitals and other amenities and of designing institutions to fit in with the nomadic way of life (not impossible, as is evidenced by the mobile tent-schools of Iran's tribal people) are so great that the last generation has seen a very marked fall in nomadic living standards relative to those of their sedentary compatriots [McGinnies and Goldman, 1969, p. 307]. In Libya, population is already spontaneously declining in some of the more arid areas by massive outward migration in order to be able to share in the prosperity oil has brought to more favoured parts of the country [Grove, 1973a, p. 43]. In a 1973 London conference on the African drought, some delegates called for a withdrawal from the true Sahel because it would increasingly need aid and developmental expenditure, which, on a per capita basis, would be unduly expensive compared with other expenditures of this type in Africa [Dalby, 1973, p. 21]. National planners assume that enforced sedentarization may well be necessary and that this will involve the allocation of land and the teaching of farming skills. This may well be wrong: neither food gathering nor nomadic people can easily be turned into farmers, for the culture of cultivators is highly specialized and many of their duties and attitudes are imbibed only over generations. It is often much easier for these groups to settle down to urban occupations (as is the case with the Australian aborigines who are increasingly seeking factory employment). In the Sahel, the drought relief camps near the larger towns fitted in with such a pattern. In Mauritania, a survey of displaced nomads found most maintaining that they would remain in or near the large towns (chiefly Nouakchott) even if they had animals again [Center for Disease Control, 1973, p. 15]. Certainly nomads' children are now more likely to seek schooling (or jobs) in the south and subsequently to stay there; if the children do not receive as much education as the rest of the society they will be progressively proletarianized. Administrators frequently wish to settle nomads because of annoyance with the inability of pastoralists to fit in with bureaucratic planning: their location is never

certain, local administrators find their charges moving away from them, no easy solutions exist for locating schools and other amenities and so on.

The long-term solution for the nomads' problem may be some kind of compulsory savings or insurance scheme, whereby, as they become more oriented towards stock raising for the market, a proportion of their sale price is held in reserve by government or a statutory nomad cooperative organization to be used during disaster to alleviate the position. The solution (especially the shorter-term one) may have to include international agreements about the rights of nomads and their animals to cross borders without being troubled by immigration and customs officials.

Most population growth in the Sahelian countries will undoubtedly take place in the crop-growing region. This century has already seen substantial population growth, and, at the same time, economic growth as the demand from other countries has increased successively for cotton, skins and hides, groundnuts and now meat [Church, 1973b, p. 62]. Most of the area is in fact sufficiently moist for some tree growth, and it is almost certainly swiddening (slash and burn) and associated bush fire that has created the savannah from the dry forest [Davy, 1974, p. 85]. The farms produce little in the way of food surplus, but this may well be the result of limited labour inputs discouraged by the lack of markets and the low prices in the markets that do exist. Excluding Senegal, the region has an urban population of only about 7 percent and many of these town people have access to food from relatives that does not pass through the market (by comparison, in 1960 one-eighth of Ghana's population lived in centres with over 20,000 inhabitants, a level which the inland Sahelian countries may not reach by the end of the century). Savannah farmers, like other African farmers, have not been slow to experiment with new crops, and they do grow some of these newcomers as supplementary crops and in microclimates [David, 1973, p. 86]. But, unlike the position in the forest, no imports have challenged sorghum and millet as the staples of the area. For the first time, major research is now underway on breeding better or more prolific sorghum [IDRC, 1974, pp. 1-2], but it is difficult to see what benefits success would bring to the Sahelian countries except to reduce the number or area of fields under cultivation. The region has been little affected by the green revolution and this position will probably continue, for land is not at present short and the possibilities for extending irrigation are limited. The one exception is rice; higher yielding varieties will probably allow the irrigated areas along

the Niger to grow more of this food or will allow the release of land for other purposes. There is little inducement to produce more food. In the circumstances, improved agricultural efficiency could have little meaning in the subsistence sector except to reduce the man hours needed to produce a certain volume of food (for the full implications of this argument and for an analysis of the likely changes in agricultural technique with increasing population density, see Boserup [1965]). To the outsider this conclusion might seem to beg two important questions, malnutrition and land shortage. However, malnutrition is not endemic in most of the savannah, is not recognized by the vast majority of the population as being a problem, and, although presumably a matter of growing supplementary foods and securing higher meat consumption, is not at present regarded as a matter of prime importance by agricultural extension services. There is at present little evidence of land shortage; it may come into existence or alternatively agricultural techniques may change, as Boserup argues largely with African data, to yield food increases in proportion to population growth.

At present the question of improved agricultural techniques is more one of growing additional export cash crops to earn money to purchase industrial products. Cash cropping is not nearly as profitable as in the forest area of the coast, but, in considerable areas of the wetter savannah, groundnuts and cotton will grow. The problem for the inland Sahelian countries with groundnuts is less one of agricultural improvement than of reducing transport costs to the coast so as to allow competitive marketing with those grown in Senegal within a few hundred miles of Dakar by rail and those in Kano State which can be freighted down Nigeria's railways to Port Harcourt or Lagos. Cotton, compulsorily introduced in Chad but now providing 80 percent of its export revenue, will remain a problem crop in that it impoverishes soils quite rapidly.

More can certainly be done in the way of irrigation, but there are both limits and difficulties. Large dams are expensive and much of the investment may be wasted if, for physical and social reasons, the best use is not made of the water when it reaches the irrigated areas. International problems also arise: the most suitable dam site on the upper Niger would, if used to impound a reservoir, flood good land in Guinea in order to provide a controlled water supply for Mali and Niger. However, more can certainly be done with barrages

and small earth dams, not only for providing people and animals with water, but also for allowing downstream irrigation of small fields.

In the short run, artificial fertilizers are not likely to be used on any considerable scale except on cash crops. The main reason is that there is no economic way for farmers to buy fertilizer for producing largely subsistence food crops or for the State to distribute free fertilizer. The main result, if the fertilizers worked, would be to reduce the cropped area. Actually there are problems in using some of the fertilizers: nitrogenous fertilizers can cause soil to dry out faster if rain is inadequate. In the long run there is little doubt that green and animal manuring will be employed on a wider scale (especially if the tsetse fly can be beaten by economic vaccination or the breeding of largely immune cattle) and that artificial fertilizers will be employed more as more of the produce is sold.

An unresolved problem is that of nucleating savannah populations. The present spontaneous movement could be speeded up with government assistance. Such a grouping of the populations would make it easier and cheaper to provide facilities and to bring most farmers closer to transport arteries. But all these advantages might be insufficient to counterbalance the inevitable tendency to overuse the land around the towns (unless techniques changed to compensate and the savannah became dotted with the equivalents of the Kano close settlement zone).

The Demographic Implications

The basic implication is clear: the drought did not signal the end of an era: economic and demographic change will continue in the savannah at the kind of modest rate that the environment dictates, probably with a progressive dampening down of the wilder oscillations.

For the rest of this century the growth of savannah populations will probably be very largely determined by the rate of mortality decline. In the past, mortality has had three noteworthy characteristics. It has been very high and is probably now the highest of any major region in the world. For at least some decades it has been falling and this had allowed substantial population growth in the region. The level of mortality like that of pre-modern

Europe, has not been similar from year to year; the average has been determined by a "usual" plateau level itself irregular, together with soaring mortality in a smaller number of disaster years.

One reason for declining mortality is that some success is being achieved in reducing the mortality peaks of the disaster years. It is easy to see it in terms of the millions said to have been facing death by newspaper headlines. The real significance of the experience is that people did not die on anything like the predicted scale and almost certainly not on anything like the scale of the 1913-14 drought. Better roads, greater commercialization of the whole region, more awareness of what was happening assisted by modern communications and administration, national governments, and massive international relief efforts all helped the people's own efforts and reduced a potentially murderous period into a very painful one. There is little doubt that the same forces will come into play in the next drought and the chances are that the success then will be greater than in the early 1970s. Probably some of the relief camps will be kept in a condition where they always serve some function or can be quickly opened again. Possibly they will become a permanent instrument for assisting nomads and perhaps an essential part of their accultivation to urban life. International relief may long play a role in the savannah; in a world conscious of its differences in living standards, and where relief efforts serve real psychological and economic functions in developed countries as well as providing roles for national and international agencies and experts in various fields, famine assistance is likely to increase in volume and efficiency.

It is a reasonable guess that future mortality peaks will be lower than the recent one, and a certainty that the reduction of these peaks will mean lower and declining average mortality. Even the mortality levels of the good years are undoubtedly declining under the impact of both medical advance (especially the campaigns against infectious disease) and modernization. The latter term is meant to cover a host of changes: towns, commercialization which allows food or other help to be more easily bought, a reduction in the fatalistic acceptance of death associated both with the arrival of new religions and the impact of outside secular influences, and many other things.

However, the savannah remains poor. It is highly unlikely that the six Sahelian countries, taken as a unit, will experience anything like the gain of half a year in expectation of life at birth for every year passed as is commonly

assumed in United Nations' projections. Perhaps half this rate of improvement is more likely in the near future rising to two-thirds around the end of century as towns and market-oriented production grows. This would mean an expectation of life at birth still only in the mid-40s by the end of the century and in the mid-50s half a century from now.

Nor is there any likelihood of much movement in the birth rates before the end of the century. It is difficult to demonstrate any social or economic forces operating at the family level which are likely to encourage the reduction of family size. Experimental family planning programmes are few and are at present in an exploratory stage (the most notable have been the IDRC one in Bamako and the ORT one in Say near Niamey); nevertheless, they indicate little evidence of the likelihood of such programmes having much success in the years immediately ahead. Urban fertility may decline slowly but this will have little total impact over the next decade or two because of the small proportion of the population living in towns. Indeed it is possible that such a trend would be counterbalanced by some rise in the rural birth rate consequent upon improved health and other aspects of modernization; this might particularly be the case in those parts of eastern Niger and Chad which are part of the Central African low fertility belt and which have (or have had) abnormally low fertility presumably arising from medical causes which could be changed. Eastern Niger, for instance, has been credited with a birth rate little more than half that generally prevailing in West Africa [Page, 1975, figures for Stratum 1 from the 1960 Sample Census).

The position of one population group is particularly noteworthy: the nomads. Their way of life is, without question, being imperilled by their growth in numbers. Rising standards of living on the grasslands can probably be maintained only by reducing the size of the population. They are faced with the possibility of the compulsory sedentarization of considerable numbers of their people, or a life in urban fringe camps (which admittedly many may not find unappealing) unless their rate of natural increase can be reduced. Yet it seems exceedingly improbable that they will be prepared to resort to contraception in the years immediately ahead.

A plausible estimate then would be for the birth rate to remain close to fifty per thousand (and the total fertility ratio between six and seven) for the rest of this century; with the possibility of a decline in the birth rate to perhaps forty per thousand half a century from now.

One country does not completely fit in with this generalized picture of Sahelian demography: Senegal, with one-sixth of its population living in Dakar, a far from traditional city, and in addition a sizeable commercialized rural sector. If mortality or fertility decline somewhat more rapidly than is suggested here, it will probably be because of particularly steep declines in Senegal.

Given the suggestions above, the estimates shown in Table 3 follow.

Table 3. Sketch of Possible Demographic Trends
in the Six Sahelian Countries

Trends	1975	2000	2025
Mortality - expectation of life at birth (in years)	high thirties	mid forties	mid-fifties
crude death rate (per 1,000 population)	low thirties	mid twenties	under twenty
Fertility: crude birth rate (per 1,000 population)	high forties	high forties	around forty
Natural increase: annual rate ^{a/}	1.7%	2.4%	2.2%
Population (in millions) ^{a/}	25	42	74
Population index (1975 = 100) ^{a/}	100	168	296

Note: ^{a/} Exact figures employed so as to make calculation possible.

The trends, as depicted in Table 3, suggest an increase in total population by the end of this century of two-thirds and a trebling within the coming half century. They also suggest that it will be the end of the next century before a post-demographic-transition population characterized by low birth and death rates and a low rate of natural increase is achieved and that the total population by that time might well be around 175 million. This is, of

course, entirely speculative--governments may be so concerned about population growth long before that time that they take strong measures with some success to bring down birth rates more rapidly than the projection assumes--but it might be noted that this figure implies a population density in the agricultural parts of the Sahelian States considerably above that now found in northern Nigeria as a whole and approaching that of Kano State.

What is less speculative is that the next quarter of a century will see about 17 million added to the population. Probably the period will witness urban populations trebling with the populations of the national capitals growing from about 1 1/4 million and that of other urban areas from somewhat more than 1 1/4 million to around 4 million each. Thus the towns will absorb over 5 million extra people. In contrast, the Sahelian grasslands may not be able to sustain their present numbers. Consequently, the farming areas will have to add about 11 1/2 million people to their present 20 million (minus whatever number migrate to the coastal countries--see below for a discussion indicating that migration might reduce this 11 1/2 million to about 10 million).

Three points should be made. The first is that the least certain figures are those for present and future mortality levels. Some researchers have suggested lower levels for mortality than the ones employed here [Clairin, 1968, pp. 199-213, for Chad, but he agrees in the case of Upper Volta; Harrington, 1973, p. 15].

The second is that the situation could be radically altered by the exploitation of major mineral finds, especially oil. This would raise incomes faster than is assumed here and would provide more nonagricultural jobs both where the strikes occurred and in the towns where growth would be likely to be faster than is shown in Table 4. Major mineral finds have already been made: iron ore in Mauritania (resulting in exports now worth about \$100 million annually) and uranium in Niger. Much of the Sahel is geologically suited to the existence of major mineral bodies [ECA, 1973, pp. 7-8]. Prospecting and cooperation in developing finds are among the bases for cooperation between Mali, Niger and Upper Volta in the Liptako-Gourma scheme. Petroleum and natural gas explorations are being conducted at present in Chad, Mali, Niger and Mauritania.

The third is that a considerable area of relatively good land will become available, especially in Upper Volta, if the vastly expensive scheme (\$200 million over 20 years) for cooperation between WHO and various national governments for onchocerciasis (river blindness) control proves successful.

Table 4. Probable Distribution of Population Increase, 1975-2000

		1975	2000	
(a) Total population (millions)		<u>25</u>	<u>42</u>	
Capitals		1 1/4	4	
Other urban		1 1/4	4	
Rural: sedentary farmers ^{a/}		20	31 1/2	
nomads		2 1/2	2 1/2	
(b) Total population (% distribution)		<u>100</u>	<u>100</u>	
Capitals		5	10	
Other urban		5	10	
Rural: sedentary farmers ^{a/}		80	74	
nomads		10	6	
(c) 1975-2000 population (growth)	Total Growth (millions)	Share of Total Growth %	Percentage Growth	Annual Rate of Growth
<u>Total population</u>	<u>17</u>	<u>100</u>	<u>68</u>	<u>2.1%</u>
Capitals	2 3/4	16	220	4.7%
Other urban	2 3/4	16	220	4.7%
Rural: sedentary farmers	11 1/2	68	58	1.8%
nomads	0	0	0	0.0%

Note: ^{a/}This total assumes no absorption by countries outside the Sahelian countries.

The 1970-74 drought may well give an impetus for a type of population movement that increasingly seems inevitable: organized resettlement schemes, which are widely recommended as a partial solution to the problems posed by the growth of nomadic populations [UNICEF, 1973b, p. 10; ECA, 1973, p. 5; Dalby and Church, 1973, p. 9]. Such enforced migration might well lead to further spontaneous migration onward from the settlements either to the nearest large towns or the countries of the Guinea Coast.

However, the most distinctive demographic phenomena of the West African savannah will remain for years to come the huge migration streams. Both the seasonal and the longer term migration are remarkable human adjustments to the problems of life in the savannah, to the severe annual changes and the unpredictable periods of drought or pestilence. The success of this adjustment depends very much on the continued ability to move into and out of Nigeria, Ivory Coast and Senegal. Political decisions in these countries similar to that made and enforced by Ghana in 1969 (although subsequently modified in the case of Upper Voltans going to work as labourers in the cocoa-growing areas) could change both the economic and demographic future of the Sahelian countries.

In terms of the expansion of market oriented agriculture, perhaps the most important economic change that is taking place in the savannah, the key question is the rate of growth of the towns. Many influential local citizens are apprehensive about the growth of the larger towns, seeing such populations as a burden on government expenditure and as potentially politically unstable; many outsiders express fears of unemployment and underemployment in the towns. On the latter point it might be noted that underemployment also exists in rural areas and that there is evidence that the addition of populations to the towns may well speed up the growth of urban employment (partly just the urban residents providing goods and services for each other but with a consequent slow increase in the goods manufactured for the rural population).

The magnitude of the unknowns, even in the years immediately ahead, with regard both to international migration and to movement to the cities is very great.

The greatest of all lies in the relationship between Nigeria and the savannah countries. Nigeria's population, now 80 million according to the 1973 census and possibly around 65 million if an earlier estimate is accepted [Okonjo, 1968, p. 96], is likely to pass 150 million by the end of the century. The projected growth of oil exports will give it great economic strength.

Lagos, now a city of 2 to 2 1/2 million people, will certainly have over 10 million people and perhaps very many more and will probably have a substantial proportion of its work force in manufacturing. If the northern border remains relatively open to migration, the French-English language problem will not prevent massive immigration from the savannah countries.

Ivory Coast and Ghana have no oil (or at least none to date) but they have strong economies compared with those of the savannah. By the end of the century both Abidjan and Accra-Tema may well have populations of over 3 million.

The coastal attraction to savannah migrants--illegal as well as legal--will be very great. Unless stringent measures are taken to keep the migrants out, the Guinean coast countries at the end of the century might well have absorbed 1 to 2 million of the projected 17 million increase in the savannah (thus reducing the 11 1/2 million to be absorbed by the sedentary farming areas to perhaps 10 million) as long-term or permanent migrants, and be taking in another 2 to 3 million as seasonal migrants each year.

Urbanization in the savannah itself will be considerable; probably none of the inland capitals will have attained the million mark but all capitals except Nouakchott may well be close to three-quarters of a million (Dakar may be over 2 million).

One non-coastal influence and example will probably bear quite heavily on the Sahelian States. At the end of the century northern Nigeria--and possibly just the four most northerly states which form Nigeria's real savannah north--will exceed in population the six Sahelian States. Kano will certainly be a city with more than a million inhabitants and probably with more industry than any other savannah city. Other cities with more than half a million people will be Maiduguri, Zaria and Kaduna. It is not impossible that by the end of the century the gross domestic product of northern Nigeria could be almost double that of the six Sahelian States. Certainly not all immigrants from the north into Nigeria will continue to the cities of the coast to seek employment.

A Final Note

By the end of 1975 the Sahel had experienced two seasons of reasonable rainfall, and emergency relief had very largely been replaced by what was described as "medium-term development programs" and "long-term assistance" [AID, 1975, pp. 11-15]. The medium-term programs centred on increased food production through more efficient cultivation and animal husbandry, better plant varieties and similar measures. The longer-term AID strategy is to concentrate on the rotation of subsistence food and cash crops, to increase the use of draft animals, to maintain and possibly improve the savannah's position as the provider of meat from livestock for the coastal countries and to strengthen internal and international applied agricultural research.

These measures are all of value but they must be seen within the total development framework which might be summarized as follows. Savannah farmers do not grow more food than they do because in most years they produce all the staple foods that they and their families can bear to eat, can manage to store without most of it deteriorating, and can sell. They are not going to expend needless energy producing wasteful surpluses in most years so as to benefit in the relatively few years of bad drought. Better plant varieties and methods of cultivation are not going to increase per capita subsistence production greatly, although they should reduce hours of work and the area of cultivation and make for a better life. Drought-resistant varieties might help during the crisis years. The introduction of different types of food might do something to vary diets, although how much this would be appreciated remains to be seen. Better food storage facilities and methods might be of marginal help although it would mean dumping stored food during successions of good years. In the long run, the only real method of saving the surplus from the farmer's labour, and of raising his standard of living is by increasing the amount of production he can sell.

This increase in the market can be achieved in a variety of ways, all of which will be necessary and none of which will be quick. Probably basic, as in the modernization of Europe, will be monetization, which will allow flexibility in production, consumption and saving. It will help to erode the homogeneity of the rural economy where everyone produces and eats the same thing, but that very homogeneity provides the greatest resistance to the coming of an exchange economy. The sooner the rural people take in each others' washing,

instead of always their own, the better. The production of cash crops is essential for this (although a balance of cash and subsistence crops and rotation of cultivation is almost certainly highly desirable, as are methods for ensuring that soils do not deteriorate rapidly and irreversibly under the impact of the new crops); hence the importance of new cash crops and better techniques for farming old ones, new international markets and easier transport to them, and larger local markets for selling food. The latter will be determined only by the rate of growth of urban population (or, at least, of non-farming population) and of per capita income. These are interrelated--for instance, the proportion of urban population and its per capita purchasing power would probably both increase if mineral production were to grow rapidly. The non-farming market would also increase if urban and other populations were to produce more goods for sale to the farmers and each other and if they were able to process more of the agricultural goods before export. But all these things will be of value only if they are done efficiently.

The food problem is then really a problem of economic development. The saving of the wealth of the good years to meet the need of the bad ones is also a question of modernization--of monetization and of individual and governmental savings and insurance schemes. So too is the demographic problem--of the medium-term reduction of mortality and the long-term reduction of fertility. The demographer should note that the growth of urban population may well be a good thing both in terms of modernizing the rural areas and of reducing mortality and fertility levels. The towns provide both commodity markets and labour markets for short or long term rural-urban migrants, both types of market having a rather similar impact on the farming areas.

No equal optimism can be expressed about the grasslands of the true Sahel. Ultimately they can participate in modernization only by becoming vast cattle ranches employing ever fewer people. No technological breakthroughs which will double or treble the available grass can be anticipated. The demographic answer is going to be that the rest must live elsewhere. in moister rural areas or in towns.

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Note on Organizations Referred to by Initials

AID	Agency for International Development, Department of State, United States Government, Washington, D.C.--the American Technical Aid Organization.
ASECNA	Association pour la Sécurité de la Navigation Aérienne, Paris--a semi-governmental service organization for air services which produces the best collected records of weather in francophone Africa.
CILSS	Comité Permanent Interetats de Lutte contre la Sécheresse dans le Sahel, Ouagadougou--a permanent committee of the governments of the six Sahelian countries to combat the drought and with a secretariat in Ouagadougou.
CAF	Changing African Family Project, Ibadan--a project involving research projects in twenty or more African countries focused on the conditions of early fertility decline; based in the Sociology Department of the University of Ibadan with assistance from the Department of Demography of the Australian National University. Three survey projects carried out in Nigeria in 1973 are known as CAF I, CAF II and CAF III.
FAO	Food and Agricultural Organization of the United Nations, Rome.
IDRC	International Development Research Centre, Ottawa--an institution of CIDA, the Canadian International Development Authority, the Canadian Technical Aid Agency.
INSEE	Institut National de'Etudes Démographiques, Paris--the national statistical organization of France.
ORSTOM	Office de la Recherche Scientifique et Technique d'Outre-Mer, headquarters in Paris and research centres in most francophone West African countries--a government research organization which gives part of its attention to demography and other social sciences.
OSRO	Office for the Sahelian Relief Operation, FAO, Rome.
UNICEF	United Nations International Children's Emergency Fund, Paris--United Nations organization concerned with providing assistance to children and others.
USAID	United States Agency for International Development, Washington, D.C.--also known as AID (see above).
WMS	World Meteorological Service, Geneva--a United Nations organization.

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