Desertification and Man in the Sahel

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1. Introduction

The disaster of the years 1968–1973 was the culmination of two parallel processes which had increasingly dominated life in the Sahel in recent decades: the destruction of the environment and the marginalization of the region's peasant farmers and nomadic pastoralists. These two processes are a part of the complex framework of political economy and political ecology of resource use in the Sahel, and if tragedies are to be avoided in the future this framework must be analysed and understood. Conclusions based on short-term ecological analyses will lead only to short-term ecological remedies, which will re-establish the *status quo*, preparing the way for another disaster in the next serious drought.

In economic development we have short memories. Famine and ecological destruction are not new in the Sahel. In the sixteenth century the inner delta of the Niger was part of the Songhai empire. Efficient organization of agriculture, of communications and of trans-Saharan trade brought peace and prosperity. Although there are records of several plague epidemics, there are none of famine (Cissoko, 1968). This prosperity came to an end with the conquest of Songhai in 1591 by a Moroccan army. Throughout the seventeenth and eighteenth centuries the area was fought over by competing groups. Famines were recorded every 7 to 10 years during the seventeenth century, every 5 years during the eighteenth century. Timbuktu, in the sixteenth century a prosperous commercial town and a famous centre of learning with perhaps 80 000 inhabitants, was reduced in the early nineteenth century to a miserable village of some 12 000 people. Since there is no reason to suppose that drought was any less frequent during the Songhai empire than in the next two centuries, it appears that drought alone was not the main cause of famine; the historical record can only be explained in terms of different forms of economic and political organization.

Concern about environmental destruction is not new either. A forest belt to contain the Sahara was first suggested by Stebbing in the 1930s, and the issue of Sahelian environmental degradation debated at length by the Anglo-French Forestry Commission (Stebbing, 1937; Aubréville, 1973; Jones, 1938; Anglo-French Forestry Commission, 1937).

2. Land Use in the Sahel

The most important features of the Sahelian environment, from the point of view of a peasant farmer or a nomadic pastoralist, are the scarcity of resources, and the high risk involved in exploiting them, because of large seasonal and annual variations in rainfall and river flow. Rainfall is spatially and temporally unreliable, varying by more than 30 per cent from the long-term mean, with large daily differences in places only 5 km apart. Plant growth is poor and unreliable. Irrigated agriculture is not possible with traditional technology outside the main river valleys. Reasonably reliable rainfed agriculture is only possible south of the 500 mm rainfall line, although some millet and sorghum cultivation takes place as far north as the 220 mm line depending on soil conditions and local drainage. In good years, some cultivation of sand dune hollows and wadi flood zones takes place up to the desert borders; in bad years, large areas of Sahel are without successful cultivation at all, exploited with difficulty only by nomadic herdsmen. Toupet has calculated in Mauritania that the difference between the position of

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the 100 mm isohet in 1941–1942 and in 1951–1952 amounted to an area of 340 000 km², or 31.5 per cent of the total area of Mauritania. In some years this land provides reasonable pasture for nomadic pastoralists, in others almost nothing (Toupet, 1972). The traditional land-use systems of peasants and pastoralists in the Sahel are adapted to the extreme difficulty of making a reliable living in such variable conditions.

A brief description of Serer agriculture gives an idea of the sophistication that has been attained in these difficult conditions. The Serer are peasant farmers inhabiting western Senegal in the region between Thies, Diourbel, Kaolack and the coast (Lericollais, 1972). The Serer country has soils of mediocre quality, and irregular rainfall with an annual mean of around 760 mm. The high human density (80–100 people per square kilometre) is the result of successful maintenance of soil fertility by systematic use of cattle manure, by conserving useful trees and by crop rotation with regular fallows.

The Serer carefully select useful trees, particularly *Acacia albida*, which returns organic matter to the soil and thus increases the yield and protein composition of millet. Each tree improves 100–300 square metres, and 10–15 per cent of the land is thus fertilized. *Acacia albida* seed pods are valuable forage for livestock and enabled the Serer to keep large herds close to the village. Traditional Serer agriculture concentrated on millet and domestic animals. The fertility of short-cycle millet fields close to the houses was maintained by spreading domestic refuse and by letting cattle pass through and manure them during the dry season; the fertility of the large fields of late millet beyond was maintained by fallows every second year, when they were grazed and manured by village herds.

The pastoral land-use systems of the Sahel also show a variety of styles and some successful adaptations to a difficult environment. There are a number of features, however, which distinguish them from agricultural systems. The food products of a pastoral economy—milk, butter and cheese—are not readily stored, and for a part of every year most pastoralists rely on millet and dates. The need to acquire grain led many pastoral societies into close relationships with sedentary farmers, by whom dairy products, manure and animal traction were exchanged for millet and the right to graze animals on stubble in the dry season. Pastoral economies are also extremely vulnerable to loss of animals from drought, disease and, until recently, from raiding. Such loss of productive capital means much more immediate destitution than for the farmer who loses one harvest but still has his land for the next season.

The fact that pastoralists are more concerned with protecting themselves from these risks than with making an immediate profit determines a number of salient features of nomad economic strategies (Swift, 1975). Three are relevant here:

(a) flexibility in managing animals so as best to exploit a varied vegetation; this is accomplished by herding several species of domestic animals, each with its own economic and ecological characteristics. Pastoralists commonly spread risk by herding sheep and cattle, which sell well but need lots of grass, water and labour, and camels and goats, which sell less well but which can survive very bad conditions. Goats in particular are able to survive a drought and can breed again rapidly, thus producing milk five months after the first good rain. Various combinations of these species give Sahelian pastoralists a flexible range of economic strategies to follow according to the needs and conditions of the moment;

(b) a second important feature of traditional herd management strategies was the accumulation of large herds above those needed for immediate subsistence in good years. This habit has given rise to misunderstanding and talk of cattle worship. It is nothing of the sort. As several researchers have pointed out (e.g. Gallais, 1967; Swift, 1973), large herds are the adaptive response of a subsistence economy to the demands of a difficult and variable environment; among other virtues, large herds enable food to be stored 'on the hoof' and make it possible for a network of reciprocal gifts and loans of animals to be set up between families, which serves as insurance against individual disaster. Pastoralists use animals surplus to immediate subsistence needs to build social relationships which can be turned back

into food in time of need;

(c) a third characteristic of Sahelian pastoral economies is their relative lack of success in regulating grazing pressure. The variability of rain and pasture, and the need for flexibility in management, makes any precise attribution of land to a particular group of pastoralists difficult. Some efforts at control of grazing have been made by Sahelian pastoral societies, the most successful being that of Cheikhou Ahmadu in the inner Niger delta in the nineteenth century. Here a sophisticated code of rules governing grazing, access to pasture and pasture reserves was set up, and persists to this day, although under pressure of modern developments it is now breaking down (Daget and Ba, 1955; Gallais, 1967). But this was exceptional and among other Sahelian pastoral societies there is no record of detailed land organization systems of this sort. Grazing land is generally considered the property of the clan, other clans not being permitted to graze without permission. Among the Tubu in northern Chad for example, legends record that the ancestor of each clan 'marked out his pastures' on arrival in the Tibesti, but these rights are claimed simply as priority in pasture and water use, not as property rights (Chapelle, 1957). In fact, even if a clan has complete jurisdiction over the pasture of one particular area, members of that clan may still overgraze. The problem of limiting use of common property resources to an ecologically correct rate of exploitation is at variance with group interest and a solution can be found within the framework of a strong political power, such as that of Cheikhou Ahmadu, able to impose limitations on the individual in the interest of the collectivity.

3. Population

In the case of both pastoralists and peasant farmers, the relationship between human exploitation and resources depends on the size of the population and the state of its technology. In West Africa, technology has remained relatively simple; there are none of the highly advanced irrigated agricultural techniques found in South-East Asia. Without an advanced indigenous technology, the main means of adjustment between people and resources in West Africa has always been a limitation of population growth, sometimes by the brutal fact of mass starvation or death from epidemics, but more often more unobstrusively through mechanisms which kept overall population size low in relation to resources and controlled the rate of growth. Indeed before the present century it is not certain that the population of West Africa was growing at all in the long term (Caldwell, 1975).

Peasant and pastoral populations are still highly sensitive to immediate environmental conditions. Mortality rates among Senegalese peasants, for example, vary from month to month and from year to to year, according to shortages of food or disease outbreaks. As a result of general improvements in communications, an end to raiding and warfare, and some economic advance, however, death rates have fallen among peasant populations and for the last few decades there has been a speeding up of population growth.

Among pastoral populations, the situation is much less clear. It is widely believed that nomad populations have also been increasing rapidly for some time, leading to pasture degradation and desertification; there is, however, no good demographic evidence to support this belief. On the contrary such figures as exist seem to show a different picture, indicating: (a) that nomadic pastoral populations have low rates of natural increase of population compared to neighbouring agricultural peoples (b) that these low rates of increase are the result of a combination of low birth and high death rates; (c) that pastoralists have low rates of completed fertility, high rates of female sterility and high ratios of men to women (Swift, 1976). These figures suggest, in pastoral societies in the Sahel, that social control of population (through late and unstable marriages, for example) leading to low birth rates, combined with some emigration into agriculture, commerce and urban life, provides a flexible mechanism allowing the pastoral population to be kept relatively low to match available resources.

4. Ecological Equilibrium of Traditional Land-use Systems

We are now in a position to reach tentative conclusions about the relationship between traditional economic systems and the land in the Sahel, in particular to see whether there was ever an ecological equilibrium between man and land. It should be said at once that the idea of equilibrium, in the sense of a static balance of forces, derives from biological thought and does not find much favour among social scientists. Although many African peasant or pastoral cultures show relatively stable forms of ecological adaptation to particular sets of environment conditions, there is and can be no such thing as a 'climax' human society or culture.

The traditional Serer system of village agriculture described earlier is an example of a successful adaptation; slow population growth over time led to a gradual intensification of farming. Measures to conserve soil fertility, particularly the use of cattle manure and the selection and protection of useful trees, made possible by complete village organization and control of its lands, have permitted some of the highest population densities in West Africa without apparent signs of environmental deterioration. Other cases, such as the Dogon country, or Hausaland in northern Nigeria, where high population densities without environmental degradation have been made possible by mixed farming and soil improvement practices, could have been equally well cited. Such cases suggest that under conditions of population stability or slow growth, where villagers were able to control their own lands and work out a flexible and orderly land-use system, long-term conservation of the environment can be ensured.

The case of traditional pastoralism was somewhat different. As has been suggested above, for reasons which are logical in the context of the Sahelian environment and the level of available technology, traditional herding strategy was to maximize herd size without regard for immediate environmental consequences. However, the pressure of this sort of pastoral nomadism on the environment was probably quite slight. There was a fluctuating relationship between pastures and herds, with regular drought, animal diseases and shortage of pasture acting as ecological checks and balances which kept human populations (already controlled by their own demographic peculiarities) and grazing pressure within bounds in the long term. Local damage was done to the environment and there would be some erosion around dry season wells (especially since in the summer rainfall regime of the Sahel rain arrives in violent storms with high winds at a time when there is no grass cover), but the wide spacing of wells and the movement of pastoralists away if overgrazing became severe provided automatic checks to severe or widespread environmental destruction. In these circumstances, it would be incorrect to talk of a stable ecological equilibrium between pastoralists and the environment; there was however a dynamic equilibrium, the main elements of which were demographic controls on pastoral populations, flexible herd management strategies, movement, and the external controls of pasture shortage, disease and war.

5. Changes in the Last Half-Century

The relatively successful ecological adjustment between some peasant farming societies, such as the Serer, and some pastoral societies to specific environmental conditions have been under increasing strain from a number of separate but related causes since early this century. There is no evidence for consistent climatic or environmental changes since that date; the changes to be described are principally in economic, social and political fields.

In the case of Serer agriculture, early attempts to modernize led to a number of unforeseen consequences (Lericollais, 1972). Introduction of simple machines reduced labour 'bottlenecks' but also led to greater peasant indebtedness to pay for the machines; this made higher production and more intensive cultivation necessary. Cultivation of peanuts as a cash crop, in order to raise tax money, led to important changes. Peanuts soon took over a large part of the village lands; this transformed the

crop succession and reduced the amount of land in fallow. As fallow grazing decreased, village herds were obliged to go further away to find food; cattle no longer manure the fields and have to be replaced by commercial fertilizer. This was partly successful, but again increased village indebtedness.

With the spread of a cash economy, money gradually entered the traditional exchange of goods and services. The purchasing power of Serer peasants rose at first with increasing peanut cultivation, but has been eroded by declining terms of trade. The peasant finds himself in a rising spiral of indebtedness and obliged to cultivate more land. Fertility of land declines as the old conservation measures are abandoned. Farmers emigrate in search of new land or jobs in towns. The traditional Serer agricultural system is breaking down; living standards continue to fall and the Serer countryside, once a model of environmental conservation, is being rapidly degraded.

Among pastoral societies comparable changes have taken place. Modern interventions such as well digging and animal disease control reduced the traditional ecological checks of pasture shortage and epizootic disease. The result was a rise in total herd numbers, although probably not in animals per nomad family; new wells meant that dry season overgrazing was now spread over much larger areas of pasture. Dry season reserve pastures in the river valleys have been lost to agriculture. These consequences have stemmed in part from a single-sector approach in which individual technical 'bottlenecks', such as water shortage or animal disease are relieved without regard for the wider ecological network of interconnections by which the different parts of the social and ecological system are related to each other. Administration, too, is fragmentated along technical lines, sector by sector, so that animal disease is the responsibility of one department, water policy of another, the market price for food grains of a third.

But other processes are also at work, augmenting the effects of these ecological and technical changes. Since the beginning of the century economic policy has been influenced by the view that pastoralists hoard livestock because of an unhealthy love of cattle; the aim has been, by high taxation, to force a part of these animals onto the market to the benefit of the national economy and of the pastoralists themselves who would thus participate in economic exchanges. But, as has already been pointed out, the subsistence pastoral economy has as its aim survival, not profit, and its objectives are not at all compatible with those of a market livestock economy; the beginning of a transition from one to another has reduced the ability of pastoralists to exploit a difficult environment with an adequate safety margin.

Comparable changes took place in the exercise of traditional political power. The French conquest at the turn of the century set in motion a process by which political power was transferred from many small competing local sources, based principally on a fluctuating balance between traditional ethnic organizations, to a central bureaucratic organization. This transfer had important economic and ecological consequences. The new central governments were inevitably less responsive to local conditions, including local ecological conditions, than previous locally-based power had been; bureaucratically appointed people are not subject to local pressures (their constituency is the bureaucracy itself, located in the national capital) and so can remain unresponsive to the actual needs and conditions of local people and of the environment. Control over many aspects of natural resource use and conservation became vested in the machinery of central government, and land users increasingly lost real power to make decisions concerning their land. For a number of years they did well out of the increased security, better communications and technical improvements such as the new wells. But they were losing ecological and economic flexibility; they were being forced into a market economy and their own self-help mechanisms were breaking down. The natural environment was being used more intensively, in a less ordered and controlled manner, allowing little margin for variations in rainfall or the pasture's limited capacity for self renewal. Increased desertification and increased susceptibility to famine were the consequences of these long-term trends in the Sahel.

6. Lessons for the Future

Population projections for the six Sahelian countries, based on conservative assumptions about changes in vital rates (an increase in life expectancy at birth of 5–10 years, a decrease in crude death rates from the low 30s to mid 20s per thousand, and a stable birth rate in the high 40s per thousand) suggest that there will be an extra 17 million people by the year 2000. Making no allowances for migration and assuming no intensification of pastoralism is possible, their probable distribution is shown in Table 1.

TABLE 1

POPULATION PROJECTIONS FOR THE SIX SAHELIAN COUNTRIES
(in millions)

		1975	*2000*
Total population		25	42
Urban population		2.5	8
Rural population:	sedentary farmers	20	31.5
	nomads	2.5	2.5

Source: Caldwell (1974).

In fact, migration to the coastal cities of West Africa is likely to increase. But, if the Sahel is to be more than a convenient breeding ground for cheap labour for coastal industries and a producer of low cost calves for fattening elsewhere, substantial development will be needed for both peasant farmers and pastoralists. This development will have to avoid the pitfalls of earlier development policies outlined above; new policies will have to have the twin aims of improving subsistence food production, and stopping and reversing desertification. The achievement of these two aims is closely linked and depends on pursuing integrated economic, social and ecological strategies.

It has been suggested above that, in the Sahel, economic stagnation or recession and ecological destruction have been the result of the way in which Sahelian subsistence economies have been increasingly moved towards a market economy in which they occupy the most peripheral position. They are also a result of the way in which centralized bureaucratic power has replaced local sources of power, and the way in which fragmented modern science has been unable to grasp the ecologically integrated nature of traditional ecosystems. These research findings have important policy implications; they suggest a need for Sahelian governments to break with past development models imported from the exterior and to invent, on the basis of ancient and modern African experience, a typically Sahelian style of development firmly rooted in the traditional techniques, experience and wishes of the peoples of the Sahel. The essential role of development of this sort would be to reduce dependence on other people and to return to land users themselves control over important decisions concerning their economy and their environment. Only people who have this power are safe from famine and, in the absence of very strong governments with powerful means (unlikely in the Sahel) only people who have responsibility for their own land will conserve its resources in the long-term. The role of government should be to provide the framework within which such policies can be worked out.

Some general guidelines can be suggested. The most important is to create a framework of social and economic organization which gives marginal peasant and pastoral societies the capacity to define their own objectives and to compete for the means to achieve these objectives with other more powerful interests within the national bargaining process. An improvement in the real economic position of these populations means increasing security and self-sufficiency in food production, including a stored surplus for drought years. Flexibility in food production needs to be safeguarded; in the case of pastoralists this means, for example, encouraging a diversification in flocks used by pastoralists for different purposes beyond the usual cattle and sheep. Increased integration of agriculture and pastoralism at

the level of small production units should also be encouraged. Overall economic strategies and technologies should be chosen with a view to encouraging a tendency towards a more equal distribution of income, wealth and employment. Long-term security needs to be protected by systems of food crop or herd insurance schemes. Only when measures like these have put subsistence food production on a secure base should development programmes be concerned with cash crops or livestock for export.

Ecologically, a framework of spatial organization needs to be created which restores responsibility and control of users over their own land, and combines this with simple conservation measures. In the case of peasant farmers, the aim might be to facilitate the use of animal manure from village herds or from neighbouring pastoralists' herds. On pasture lands, the most feasible course might be the attribution of exclusive grazing rights to a defined collectivity with an organized pattern of grazing control, based perhaps on rotational use of water through wells which were opened and closed in turn in order to distribute grazing in an ecologically satisfactory manner. Provision could be made within this framework for conservation of wild plant and animal communities and genetic resources. Exploitation techniques should be based on simple improvements of traditional techniques which can be understood and controlled by participant peasants and herdsmen, which are well adapted to local ecological conditions, and which do not require expensive imported material inputs and skills to run.

It seems probable that the organizational framework most able to meet these diverse requirements is of a cooperative sort; in particular, cooperatives of nomadic pastoralists, although successful elsewhere, have not been tried yet in the Sahel. But whatever the form adopted, it seems likely that the solution to the twin problems of famine and environmental destruction in the Sahel lies not in huge, technically advanced and expensive projects imposed by increasingly powerful central governments and international aid agencies and aimed at tying the Sahelian economies into a regional and global economic system in which they will always be the least powerful, but instead in technological modesty, decentralized decision making and local self-sufficiency with reduced dependency at all levels on the outside world.

7. Summary

The main contribution of social science research to land-use planning in the Sahel should be to understand the political ecology of resource use, and the related processes of environmental and marginalization of peasant and pastoral populations.

Traditional peasant societies, such as the Serer of Senegal, often set up sophisticated land-use systems which ensured soil protection and fertility by protection of useful trees, manuring by cattle and long fallows. Pastoral societies were less successful in conserving their immediate environment, because of their economic strategy of accumulating herds to safeguard subsistence and because of their inability to solve the problem of restricting use of common pasture resources; but the scattered distribution of wells and movement by pastoralists made overgrazing a local problem only.

Peasant population growth was until recently low, but has recently started to increase due to modernization. Pastoral populations were probably always low in relation to resources, with slow growth rates even now. Traditional socio-economic methods of population control and emigration provided a flexible method of adjusting pastoral populations to available resources.

Recent changes have upset traditional peasant and pastoral land-use systems. Monetization of the economy, taxation and some types of technological innovation have led to an intensification of cropping and a breakdown of traditional agricultural organization and conservation practices. In the Serer countryside the result is environmental degradation. In the pastoral areas technical, economic and political changes have reduced the ability of pastoralists to exploit a difficult environment safely and have led to increasing desertisation.

These conclusions suggest that new, specifically Sahelian, styles of development are needed which reduce peasant and pastoral dependence on the outside world, and return to land-users themselves control over the important decisions concerning their economy and environment. The role of government should be to provide the frameworks within which such new policies can be worked out. The solution to the twin problems of famine and environmental destruction in the Sahel may lie in technological modesty, decentralized decision making and local self-sufficiency with reduced dependency on the outside world.

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