Studies in Power and Class in Africa

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CHAPTER 11

Power, Class, and Traditional Knowledge in Sahel Food Production

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The great Sahel drought and famine of 1968–1974 left dead from one hundred thousand to a quarter of a million people. Precipitation failures in 1977, 1978, and 1980 occurred over large areas of the Sahel, again bringing on localized famines; and in 1984–1985 the region joined east and southern Africa in a famine that has received widespread media attention.

What can be done to develop the Sahel and make it drought proof? The aftermath of the Sahel drought and famine has been the organization of one of the most extensive development programs in modern times. In 1977 the Western powers agreed at an Ottawa, Canada, meeting on a $10 billion program for food self-sufficiency and self-sustaining development in the region by the year 2000. When one considers the fact that the Sahel contains less than 50 million people, the $10 billion aid commitments amounts to one of the highest per capita contributions in the history of Western aid to any poor region, surpassed perhaps only by the Marshall Plan for post–World War II Europe and the large U.S. aid packages to Israel and Egypt.

The postdrought problems in the Sahel are pressing, indeed. The region has suffered many centuries of intensive abuse of its environmental resource base. In some areas, desertification may be permanently removing land from cultivation. The urgency of protecting and reclaiming the Sahel is thus great. On the other hand, most Western "donor" nations have little scientific and historical background upon which to design and implement the vast development program envisioned in the Ottawa document. Indeed, as we have shown elsewhere (Franke and Chasin, 1979, 1980), the historical record so far suggests strongly that Western policies have been major contributors to the current degraded state of the Sahel that renders its food production systems so vulnerable to shifts in the weather.

At the same time, the Sahel *is* a delicate region, bordering the desert, with unreliable rainfall, and in many areas thin or otherwise difficult soils. It thus

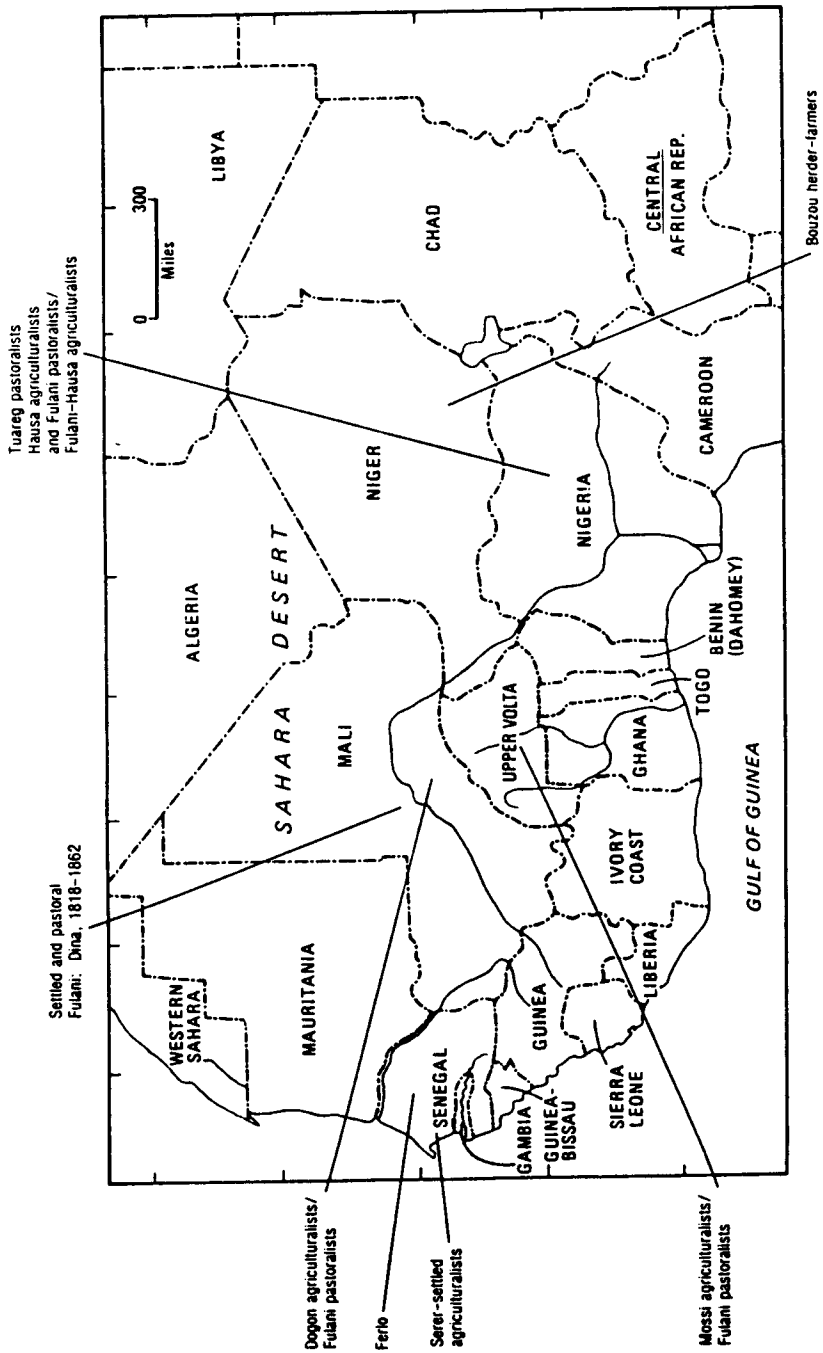

FIG. 11.1

poses serious problems to the development experts, who often seek quick and spectacular solutions.

Over many centuries, the indigenous peoples of the Sahel, despite raids, wars, the rise of slave-based empires, and other human catastrophes, hammered out a series of adaptations to their problematical environment. From the delicate pastures of the desert fringe to the more lush high savannas that grade into the tropical rain forest of the Atlantic coast, Sahelians have developed a wide range of combinations of caravan trading, fishing, animal herding, mixed animal herding—agriculture, and agriculture.

It is one of the major hypotheses of this essay that these adaptations, deriving from many centuries of experimentation with the land and other resources, represent valuable potential elements for any reconstruction of the Sahelian environment. Research into these production systems, however, suggests further that power and class factors have played and continue to play important roles in influencing the course of environmental adaptation. More specifically, the evidence reveals that the most ecologically sound Sahelian production systems have arisen where: (1) farmers and herders have been in intensive contact, exchanging knowledge about plants, animals, and their interrelations; and (2) producing classes have had substantial power vis-à-vis the dominating classes or, conversely, where ruling classes have had the least power and privilege relative to the producing classes.

Why should positive developments in Sahelian food production systems arise in regions with intense herder–farmer interaction? This correlation seems relatively easy to explain. Where two different but related productions systems are in lengthy contact, it would seem likely that experimentation over time would produce mixtures of the systems that would have high survival value.

But why should the power and class factors outlined in hypothesis (2), above, obtain? The key to understanding this feature of Sahelian food production systems and the development and maintenance of traditional knowledge would seem to lie in the nature of the traditional knowledge itself, for, as we shall see, the common feature of the systems to be examined is a positive effect on maintaining the main fixed capital asset for the production system: soil fertility.

This maintenance feature can be best understood by looking first at its opposite. It is difficult to maintain fixed capital resources in stratified societies, and this is most easily seen in the extreme case where a nonproductive but self-aggrandizing class has taken control of the society, become a ruling class. The ruling class needs to expand production to satisfy its needs for luxury, simply to maintain itself as a nonproductive class, to support its repressive apparatus (police and military, who are also mostly nonproductive), and to support its international trade and defense networks. The ruling classes that arose in the precolonial Sahel had all these needs, and in areas where their control and penetration into the villages was most extreme, resource-maintaining practices had to be sacrificed to increased output. This could require excessive use of the soils, as happened in some areas, or it could take the form of intensified exploitation of local labor: farmers and herders responding to the demand for surplus production for their rulers would not have the time or initiative to engage in proper composting, production of high-quality fertilizer, acacia–cattle seed cycles, and the like. The spread of modern power and class relations was thus most likely correlated with the decline of indigenous resource protection practices except in those cases where producers escaped to the fringes of the

empires and could maintain control over their own labor and reap its benefits themselves; or, as in one case to be explained, where an organized movement for redistribution and a lessening of the demands of the rulers could make use of a similar strategy.

Those societies with the least powerful ruling classes, because they produce primarily for needs of the producers, are not as susceptible to pressure to skew the distribution of fixed capital and labor time solely towards increasing the amount of the final product. In agriculture, this means that they can devote substantial amounts of labor time to maintaining their fixed capital resources, much as an artisan spends time maintaining tools and equipment that the factory worker has little concern for.

Societies in which there is little exploitation of labor by a nonproductive ruling class thus correlate positively with a capacity to develop and implement practices that maintain fixed capital such as land and its associated improvements: trees, animals, etc.

The plan of this essay is first to outline several important features of Sahelian farming and animal herding system in order to establish hypothesis one, above, that traditional Sahelian farmer–herder interaction led to ecologically sound productive systems; then to examine in detail for such systems, in order of increasing degrees of stratification, which further verify hypothesis two, namely, that class inequality undermines these fruitful farmer–herder systems. A final section of the essay will be devoted to consideration of possible development implications of the findings.

SAHELIAN FOOD PRODUCTION SYSTEMS

West Africa south of the Sahara can be pictured as a great flat pan tilted slightly towards the south. From the south towards the north are a series of ecological zones running from east to west, each drier than the last until the desert is reached. As the tropical rain forest shades into dense grasslands, shifting cultivation techniques change with longer fallow periods in the savanna areas. The true Sahel is a region with 300–600 millimeters (12–25 inches) annual rainfall and is characterized by thin, sandy soils and a "parkland" savanna with medium to short grasses and widely dispersed shrubs. The Sahel is a transition zone where agriculture gives way to animal herding.

It is precisely this transitional character of the Sahel that has led to some of the most important human production innovations in integrating plants, animals, and human energy. Because both agriculture and pastoralism are found in close proximity, there have developed a series of exchanges of products, personnel, and knowledge that have co-enriched both food production systems.

Agriculture

From the tropical rain forest through the entire savanna grassland zone and into much of the Sahel, agriculture has become the major food-producing system. Using the widely accepted practice of shifting or "slash and burn" cultivation, Sahelian farmers cut the trees and bushes, allowing them to dry out on the fields during the long dry season. Just before the rains, the fields are fired, allowing the accumulated minerals to be released from the debris in a way that favors their reabsorption into food plants (Russell, 1973; Geertz, 1963). Burning seems to speed up the natural decomposition process without causing major environmental damage (Lamotte, 1975; Moran, 1979: 219–221).

Millet and sorghum are the principle grain crops, being well suited to the brief, intense rains and long periods of hot dry weather that characterize the region. Along with grains, cotton, sesame, sweet potatoes, manioc, eggplant, peppers, and shea butter are grown, and mango as well in the wetter parts of the savanna. Several types of beans, cucumbers, and corn are also produced. West Africa is the scene of an apparently independent development of both dry and wet rice cultivation and, in some areas, of irrigation systems (Portères, 1970: 47; Forde, 1960: 126).

Animal Herding

North of twelve to fourteen degrees north latitude, the absence of the tsetse fly combines with the dry grasslands ecology to favor the herding of animals over agriculture as a major food-producing system. Animal herding makes possible the use of lands that are difficult or impossible to develop for agriculture. Animals can be moved with the shifting rains to make use of the best pasture conditions throughout the year. Diversity of animals—camels, cattle, sheep, goats—and social institutions such as lending of animals to other groups helps herders hedge against the possibility of losing too many of their animals to either drought or epidemics (Smith, 1978; Swift, 1973, 1977). Herders also display substantial medical skills with their animals and ecological knowledge of the pastures (de St. Croix, 1944; Veyret, 1952; van Raay and de Leeuw, 1974).

Herding and Farming Integration

Perhaps of greatest significance in assessing the potential of traditional Sahelian food production systems are the various forms of integration of animal herding and crop cultivation systems that have developed in the region over many centuries.

Herder–farmer symbiosis involves exchanges at two levels. During the dry season, herders camp with their animals on the edge of a farming village. They exchange meat and milk for the grain of the farmers, thus improving the diets of both groups. But another series of exchanges occurs as well. Cattle graze on the harvested fields, gaining dry-season food that helps reduce their weight loss during this period. Simultaneously, the cattle provide several services to the farmers' land: they strip the millet or sorghum stalks and break up ridges with their hooves, thus simplifying the future use of the land for grain production. In addition, the cattle droppings provide manure fertilizer that improves soil fertility and leads to higher grain output.

Social relations between herders and farmers include a mixture of hostility, alliance, tension, amicability, and sometimes violence. Among the major zones of herder–farmer interaction is the region of Maradi in southern Niger. Here Bouzou herders will spend part of the dry season on the fields of Hausa or Bouzou cultivators. Herders develop more or less permanent alliances with farmers, returning year after year to the same fields, the same owner. Part of the millet received by the herders is in payment for the cattle manuring the fields. If the payment is judged insufficient, the herding family may choose to

ally itself in the future with a different cultivator (Mainet, 1965: 51). In addition, some farmers may own animals which they lend out to herders who take them to the northern pastures and the salt cure during the rainy season months (ibid.: 54; Nicolas, 1963c: 6).

A problem with the system, however, is that animals often damage the farmers' crops, causing the relations to degrade into violence (Nicolas, 1963c: 1). One of the most tension-ridden areas where farmer–herder interaction occurs is the Zgaret region in western Niger. In 1916 Bella and Tuareg herders burned the granaries of the Kado agriculturalists, and in 1964 another period of tension resulted in the Bella herders paying fines of 10,000 francs and afterwards refusing the Kado the right to farm lands under Bella control (Sidikou, 1974: 199, 203–205, 209). Nonetheless, the same herders and farmers who are at each others' throats during the early rainy season, when the animals may wreck the crop, have quite a different view of each other in the dry season, when symbiotic needs become paramount:

> This is the time of true peace between the two communities. Bringing a bit of millet or some small gifts, the Bella are allowed to camp on the farmers' fields and install their animals which fertilize the fields. . . . The Bella who visits the village is received with open arms. . . . the somber times of tension are forgotten. (Sidikou, 1974: 209)

Several hundred kilometers west of Niger another pattern obtains. In Senegal's Ferlo, Wolof peanut farmers are pushing onto Fulani pastures, driving the latter closer to the fringe of the Sahara. Despite the social tensions and environmental strain brought on by expansionist commercial agriculture (Franke and Chasin, 1980: 104–106; Klein, 1979: 80–89; Sall, 1978) and despite tensions and complaints over use of water in some cases, cooperative exchanges could still be reported in the 1970s for the Diourbel area just west of the Ferlo:

> The farmer . . . views the arrival of the herdsmen during the dry season quite positively. Cattle are allowed to graze crop residues which provide the farmer the chance for soil enrichment without the problem of transport of organic fertilizer to the fields. There is also the ready supply of milk and butter . . . [for which] the farmer allows the herdsman access to the well or wells in the area. (Ware, 1979: 163–164; cf. Grenier, 1960: 54)

Indeed, Ferlo-area Fulani have proved useful in agricultural development: local farmers were found to have difficulty in training and using animal-drawn farm implements while herders could make this adjustment with relative ease (Ware, 1979: 172). The possibility thus exists for a new set of cooperative relationships based on herders' skills in animal tending, if the competition for land and other resources could be worked out. Throughout the Sahel, with present policies, however, the expansion of commercial agriculture seems destined to work *against* the establishment of new patterns of cooperation and exchange as governments tend to support the interests of the politically more important farmers and the expansion of cash crops, whatever the long-term detriment (Gallais, 1972: 305; McCown et al., 1979; Barral, 1974).

Despite its many imperfections, then, including in particular the problem of violence between the major parties and the difficulties the system has had in surviving the effects of cash crop agricultural expansion, the establishment of herder–farmer integrated production relations nevertheless allowed for the development and maintenance of several highly important adaptations preserving the fragile ecology of the Sahel:

1. It allows the cattle to stay on the northern pastures during the rainy season, helping to maintain plant species variety that inhibits ecological degradation.
2. It allows the cattle to move over large distances, thus spreading the seeds of acacia species, reinforcing plant species variety.
3. It allows the animals a dry-season resting place free of the tsetse but also with grain stalks for food and water resources nearby.
4. It allows for use of the animal dung and other services during the dry season to improve the soils of the grain producers' fields, thus increasing overall output of food.
5. It generally keeps the animals away from the farms during the cultivation season when they can damage the crops and allows the herds to graze a few months in pastures where they do not compete for resources with grain producers.

In addition to these overall features of herder–farmer integration, there are several specific adaptations involving potentially important scientific discoveries that might provide useful starting points for current research into ways to protect the Sahel, stop desertification, and develop the region. It is to these specific adaptations, and the conditions in which they seem to have arisen, that we now turn our attention.

TRADITIONAL KNOWLEDGE AND ENVIRONMENTAL PROTECTION: FOUR CASE STUDIES

Along the several thousands of kilometers of contact between herders and farmers, Sahelians have exchanged milk, butter, grain, manure, animals, and the like for many centuries. Out of this intensive contact between two different adaptations to the environment and two different but mutually interdependent food production systems, Sahelians have developed at least four apparently significant additional mechanisms for maintaining the environment:

1. A highly developed land use rotation among the Bouzou of Niger.
2. A complex system of fertilizer composting among the Dogon of Mali.
3. The intensive use of *Acacia albida* trees among the Serer of Senegal.
4. An innovative set of land use regulations among the nineteenth-century Fulani of the Niger River Inland Delta or Mali.

In each of these cases, the agricultural resource base has benefited from association with the knowledge passed on from the herder–farmer interactions. In each case, further, it has been the more egalitarian farming group that has adopted and maintained the improved practice, rather than a more stratified neighbor that presumably had similar opportunities.

A Bouzou Village: Farming with a Herders' Land Use System

Located seventy kilometers west of Zinder, Niger, the village of Zengo Iletafane is composed of former Tuareg vassals who may have originated in the

Aïr region far to the north, but who migrated about 120 years ago into the Zinder region. Here they were given protection and partially absorbed by the highly stratified Hausa agriculturalists (Nicolas, 1962: 155–156).

Despite their cultural and technical similarities with the Hausa—they use the same basic farming implements and cultivate the same crops—the Bouzou of Zengo Iletafane have apparently invented a possibly model system of land use that combines elements of their herder past with those of their farming present.

The essence of their innovation is the creation of parallel land strips, separated by thin rows of tall grasses to mark the extended family property lines. Crosscutting these east–west strips are the temporary compounds of the Bouzou, all of which run along a north–south axis, protected on one side by a fence of thorny bush material which also keeps the animals away from the fields. The system is organized on a total area of 1300 meters wide and 1800 to 2400 meters in length (ibid.: 139).

At any given time about two-thirds of the fields are planted, one-third is fallow. The house and compound row moves each year about one hundred meters east until a certain point is reached. Then the entire village moves back to the western edge and begins moving east again. The entire cycle takes twelve years from west to east (ibid.: 141–143).

What are the advantages of this highly structured land use system? First, it allows for an organized rotation of crop and fallow, thus preventing any particular parcel of land from deteriorating more rapidly than any other. Second, the Bouzou have several animals which are corralled at night along the residential strip so that they fertilize intensively the north–south section that is to be opened for planting the following year (ibid.: 149). Supplemented by human food wastes, ashes from burnt underbrush, and weeds that are pulled twice during the growing season, but left loose on the ground as a mulch (ibid.: 148), the Bouzou fields maintain a high degree of fertility and, by 1962 at least, had not suffered the decline brought on by peanut monocropping that afflicted some of the nearby Hausa farmers who worked essentially the same kinds of soils (ibid.: 160; cf. Franke and Chasin, 1979). In summarizing the novelty and the sophistication of the Bouzou village land pattern, a French observer wrote:

> The entire territory is thus periodically passed over, lived upon, fertilized, cultivated, then left to fallow by a sequence of herds, cultivations, compounds, and people. At the head of this sequence come the animals, followed immediately by the house-compounds; immediately thereafter come the agricultural fields, protected from the animals by a thorny bush barrier. (Nicolas, 1962: 144)

Several aspects of this system of production should be noted. First, the Bouzou come from a herding background and, indeed, their mobile village adaptation to farming suggests an application of herding concepts of land use to farming. Unlike the Hausa, who separate the two enterprises, the Bouzou keep them integrated much of the year, although the herds must be taken fifteen kilometers north to a forest area for late dry-season grazing (ibid.: 150–151). Second, the Bouzou of the village of Zengo Iletafane have resisted—at least until quite recently—the imposition of (Hausa) hierarchy, having maintained instead a basically egalitarian structure. The "chief," recognized by the Hausa, has little authority among the Bouzou and no power to interfere in land exchanges, inheritance, or the like (ibid.: 157). The egalitarian and collective

orientation of the Bouzou—a high level of cooperation is required to maintain the organized passage of the herds, houses, and people—also contrasts with the individualistic and politically more "ambitious" Fulani herders nearby (ibid.: 159). Thus we see an ecologically sound food production system developing out of the matrix of herding and farming and integrated mixtures of both and being maintained in an egalitarian social structure that has resisted pressures from above the village level by more hierarchical neighbors.

The Bouzou crop and fertilizing rotation system is not without its difficulties, however. When studied around 1960, the system was showing early signs of disintegration from a series of related factors. Among these were land fragmentation resulting from population growth, the influence of Islam, the spread of Hausa lifestyle resulting in more polygamy, the investment in textiles rather than in cattle, and the possible development of unmovable houses. All these factors were compounded by the spread of peanut monocropping outside the village that was reducing fallow areas and forests nearby and also spreading consumer and taxation pressures (ibid.: 161). A cattle epidemic in 1958 exacerbated these tendencies, as some extended families were hit harder than others. In the newly expanding commercial environment, this could result in the rise of permanent inequalities and a breakdown of the collective egalitarian structure that was maintaining the cyclical land use pattern (ibid.: 162).

Nonetheless, the village of Zengo Iletafane is of potential scientific interest, a source of experimentation in a rational use of land. It is unfortunate that recent analyses of the Sahel or proposals for reducing its drought vulnerability or developing and maintaining its resources have not made reference to Zengo Iletafane.

Household Composting: The Dogon of Mali

Several hundred kilometers west of Zengo Iletafane live the Dogon of Mali. The Dogon are well known to ethnographers because of their elaborate religious art and rituals (Griaule, 1965). An as yet little researched aspect of Dogon culture, however, is the intricate agricultural adaptation to one of the most varied environments in the Sahel zone and the development of a potentially important form of composting and other methods of maintaining soil fertility.

The Dogon population of about 250,000 in the early 1960s was distributed along an escarpment southeast of Timbuktu. The people inhabit the ridges of the escarpment, where they apparently sought refuge in earlier centuries from Fulani attempts to convert them to Islam. In addition to the fortresslike villages along the ridges, the Dogon now also inhabit the plateau to the northwest and parts of the Seno Valley that lies to the southeast of the escarpment.

In a region where 60 percent of the 500–700-millimeter rainfall (just at and above the Sahel parameters of 300–600 millimeters) falls in July and August (Gallais, 1965: 124), the Dogon make use of valley, plateau, riverbanks, and hillsides to produce staple millet and a variety of dry-season vegetables both for local consumption and for the market.

Dogon rainy-season crops and techniques are similar to those found in other parts of the Sahel. The Dogon, however, are especially expert at associating *Acacia albida* with their millet fields, particularly on the Seno Plain where some of the trees appear to be two to three centuries old and are fairly evenly distributed at about forty to fifty per hectare (ibid.: 126). The trees are protected

in some fields by rings of thorny branches. Burning of these fields is either very rapidly ended or not done at all where the trees are younger and perhaps could be harmed by the fire (Mounier, 1981). Distinctions regarding the length of establishment of the *Acacia albida* lead to different patterns of rotation, length of fallow, and length of cropping (Gallais, 1965: 126, 131). Fulani cattle graze harvested millet stalks and provide a light manuring to these fields.

The originality of Dogon farming practices, however, concerns the use to which the majority portion of the animal dung is put: into an intense composting process. During the dry season, much of the animal dung is collected and placed in a shallow hole in the center of the compound courtyard. Here it is further enriched with millet stalks, peelings from the kitchen, ashes from the fires, baobab fruit and/or peelings, and human wastes. In addition, small animals or even a horse will be tethered on this compost heap at night, adding more dung and, equally important, mixing and breaking up the materials with their stamping and walking about (ibid.: 128). Unfortunately, the precise organic and chemical content of this material may not yet have been subjected to modern analysis, but it is likely of value in enriching the local soils.

Indeed, the Dogon, because they live in a part of the Sahel with steep slopes, and because some river water is available nearby, have focused their agricultural creativity on preserving and enriching the soil rather than on improving water use techniques. During the rainy season, for example, some of the compost will be spread by youth work groups on certain of the millet fields, usually those with the youngest or sparsest distributions of *Acacia albida* (ibid.: 127–128).

During the long dry season, however, the compost is added to another of the remarkable features of traditional Dogon agriculture: dry-season vegetable gardens. These gardens produce peppers, onions, Guinea corn, potatoes, manioc, and tobacco (ibid.: 132, 136). So important is soil preservation to the Dogon that in some places they have created small rock-walled water catchments, in others raised soil dikes, and in others dry-season reservoirs where small wells are dug down to six meters deep and where small terraces are filled with sand and compost to a depth of thirty to forty centimeters. In a few privileged locations, irrigation canals are possible behind cement dams, and banana trees—imported from wetter regions to the south—grow right in the canals (ibid.: 134). For the most part, however, the Dogon irrigate these fields with the laborious technique of splashing the water over the dike in a calabash. This time-consuming practice may allow for closer monitoring of soil and growing conditions than would more technically advanced processes, but it lessens labor productivity. Finally, the soil in these small rockbound catchments is itself transported by youth work groups in ten-kilogram basket loads to the sites where water is easiest to procure (ibid.: 136; Paulme, 1940: 150–153). One might say that Dogon irrigation is half bringing water to the soil and half bringing soil to the water.

A drawback to Dogon agriculture is that the system leaves the Dogon underemployed in general, but they are more productively active in the dry season—the time of the vegetable plots—than are other, comparable African farmers in similar environments (Gallais, 1965: 139–141).

Despite its low labor use capacity, the Dogon food production system demonstrates great appreciation of the properties of soil, the *Acacia albida*, crop rotation, the uses of cattle, and the possibilities of making use of ecological

zones with steep inclines and high erosion danger. The need for further research into Dogon techniques—if examined and improved upon via modern scientific methods—is implicit in the summary of their achievements: "The courtyard compost is exceptional for Subsaharan Africa" (ibid.: 37) and, "In a severe environment of chaotic rock piles blackish hardened stone, and sandstone slabs, Dogon farmers have triumphed over the challenge of nature's austere conditions" (ibid.: 126).

But what kind of society has made these accomplishments? How well do the Dogon fit the hypotheses suggested earlier in this essay and illustrated in the case of the Bouzou?

In terms of the close relations between herders and farmers, the Dogon present a slight variation which nonetheless seems to correspond to the hypothesis that animal herding and farming are mutually enriching production systems. While they resisted absorption into or conquest by the Fulani, the Dogon maintained close contact with Fulani herders whose animals leave behind the droppings that form the basis for the courtyard compost mixture. The Dogon gardens, however, do not coordinate well with the herders' passage through the region in the dry season: the animals often damage the carefully prepared gardens, and conflict ensues between the owners of the land and owners of the beasts (ibid.: 133).[1]

Historically, the Dogon have parallels to the Bouzou. They appear to be made up of refugees from an ancient drought and, more recently, have resisted the imposition of Islam and hierarchical structures and control by installing themselves in the rugged cliffs that provide military protection from otherwise more numerous and powerful neighbors including the Fulani (N'Diayé, 1970a: 246–247; Paulme, 1940: 21–23). By controlling a region that had important productive resources, especially during the dry season, however, the Dogon apparently found it necessary to develop a degree of political integration for defense. This led to the formation of a confederation of four large patrilocal and patrilineal family groupings unified somewhat around a central "chief," the *Hogon* (Griaule and Dieterlen, 1954: 89–90).

The *Hogon*, however, is not a chief with special forces under his control (Palau Marti, 1957: 50). Elected from a council of elder men, the *Hogons* from each of the four family groupings are more representatives of their families. The highest-ranking *Hogon* seems to have mainly ritual duties in the elaborate Dogon cosmological observances that have been the central focus of anthropological studies. Indeed, while one author types the Dogon political system an "elective theocracy" (N'Diayé, 1970a: 249), another considers the term "anarchy" more appropriate (Palau Marti, 1957: 50). The term *Hogon* itself seems to derive from a Dogon word meaning "wealthy one," suggesting a close relationship between economic and political power (Paulme, 1940: 182), but the *Hogon*'s actual political and economic privileges are limited to passing out judgment on criminals—done only with the assistance and approval of the council of elders—and, theoretically, controlling the markets. But the control of the markets appears to be limited to announcing their occurrence with a drum signal.

Aside from the *Hogon* and the council of elders, the Dogon have little other social stratification and no class divisions. Among the peoples of modern Mali, the Dogon are considered to be those with the *least* developed castes (N'Diayé, 1970a: 253), though ironworkers, woodworkers, leatherworkers, and griots are

kept apart and do not marry with the farming people who make up the majority of the Dogon (Palau Marti, 1957: 48–49; Paulme, 1940: 48–50, 288).[2]

In addition to the limited development of castes, Dogon society has minor inequalities between men and women and an elaborate system of age groups around which much of the social and economic life of the people is organized. While not presenting as dramatic an example of egalitarianism as the Bouzou, the Dogon indicate a cultural amalgam that grew out of contacts between farmers and animal herders and that maintained a high degree of egalitarianism by fleeing the powerful empires around them and establishing themselves in a remote and defensible area, where they could prevent the rise of a ruling class. The Dogon thus conform to the power and class hypothesis advanced at the beginning of this essay.

The Serer and the *Acacia Albida:* Maintaining the Soil

The Bouzou are nearly perfectly egalitarian, and the Dogon represent a case of minimal development of castes. The third and fourth examples of traditional knowledge in Sahel food production, however, represent cases where substantial inequality has taken hold. Indeed, in both cases, the Serer of Senegal and the nineteenth-century Fulani empire of Macina, ruling classes have crystallized. In these cases we find that the maintenance of beneficial forms of traditional knowledge occurs where the ruling class's power is checked either by relative power on the part of the producers (Serer) or is in the process of being reversed as part of a political revolution (Macina). In both bases as well, we find the operation of the herder–farmer exchange as a major element in the historical development of the society which has maintained a beneficial practice. Let us look first at the Serer of Senegal who have made use, par excellence, of one of the Sahel's most valuable resources, the *Acacia albida*.

***Agriculture and the* Acacia Albida.** One of the most important potential production resources in the Sahel is the *Acacia albida*. This tree has the quality of shedding its leaves during the rainy season so that they do not block out the sunlight during the agricultural growth period and drop at the right time for the rains to speed the rotting process which transfers nutrients to the soil (Pélissier, 1966: 270). It gets its leaves during the long dry season, providing shade for animals and possibly aiding in water retention of the soil during the times when evaporation is most likely. The *Acacia albida* thus acts as a kind of counterbalance to the depletion which intensive agriculture might bring to a fragile environment. It also helps to maintain even temperatures and, perhaps most important, returns soil nutrients such as nitrogen, calcium, potassium, and phosphate through its leaf droppings, thus improving the agricultural potential of the soil (Pélissier, 1966: 265–271; Giffard, 1971: 20; Giffard, 1964; Charrau and Vidal, 1965).[3] While the effects of the *Acacia albida* can be reduced through trampling of the soil by too many animals and by failure to hoe the soil to maximize its potential by mixing the deposited mineral materials, harvest gains of 37 percent with peanuts and 104 percent with millet have nonetheless, been achieved in the absence of additional fertilizer when the *Acacia albida* is present on the fields (Giffard, 1971: 9–10; Charreau and Vidal, 1965: 625). Thus the *Acacia albida* can be said to provide a major alternative to the (increasingly expensive) commercial fertilizers which seem to add very little beyond what

the debris from the tree is able to put into the soil. The large numbers of birds attracted to the tree's leafy branches in the dry season also leave their droppings around the base of the tree (Nicolas, 1960: 426).

In addition, the effects of the tree in maintaining soil humidity during the dry season are a brake on erosion, so much so that one scientist has claimed that planting of the *Acacia albida*, when combined with grazing of as few as eighteen cattle per 250 acres during the dry season for additional fertilizing, "practically allow[s] for a continuous exploitation of the soil" (Portères, 1952: 147, 149). The presence of sufficient numbers of *Acacia albida* dispersed on an agricultural field may thus vitiate the need for fallow periods (Pélissier, 1966: 272), supporting the development of high population densities and permanent food supplies without environmental degradation.

***Animal Herding and the* Acacia Albida.** The *Acacia albida* has another significant feature: its seed pods are deposited at the end of the dry period and must pass through the digestive tract of a ruminant, apparently cattle or camel, to be able to germinate effectively. The most concentrated sites of the tree are in selected agricultural zones of the Sahel, including parts of Niger, the Dogon area of Mali (Gallais, 1965), and, in particular, the Serer area of Sine in Senegal. A 1952 distribution map of *Acacia albida* in Senegal indicates that the tree is present in its highest densities—ten per hectare—in a region corresponding closely with the Serer ethnic zone of the country. It has relatively little presence outside that zone (Giffard, 1964: 29). The correlation of the high density of *Acacia albida* and the Serer farmers is not an accident of nature. Although *Acacia albida* seeds may require the stomach of a ruminant for germination, the young trees are highly susceptible to destruction by those very animals' grazing activities. They thus require well-planned *human* protection including the resetting of fallen trunks, pruning of the trunk up to certain heights, and keeping grazing animals away from the leaves. So much care and devotion is required that the Serer speak of "raising" a tree with the same expression they use for bringing up a child (Pélissier, 1966: 269; Giffard, 1971: 16).

***The Serer and the* Acacia Albida.** The development and use of *Acacia albida* in agriculture stands out as a striking feature of Serer food production. Indeed, the Wolof, agricultural neighbors of the Serer, make little use of the acacia park with its complex interplay of tree, cultivated crop, animal germinator, and human caretaker. Why should this be so? The rapid twentieth-century spread of the peanut, the expanding monocrop pushing impoverished Wolof farmers off their impoverished soils, seems to contrast sharply with the Serer and their more sound use of resources. As a French geographer noted for the Wolof not long before the 1968–1974 drought hit the entire zone:

> Too many examples, especially from the surrounding areas of the largest villages, have already offered the heartbreaking scene of large areas where shifting sands, pushed by the wind, have replaced formerly cultivable soils on which a complete removal of the trees and cultivation without fallow deprived those soils of their structure and their fertility. (Pélissier, 1966: 169)

One reason that such scenes did not occur among the Serer is that the Serer integrated peanut production into their traditional crop cycles and preserved

much of their soil with the *Acacia albida* (ibid.: 237). But other reasons go perhaps deeper into the history and social structure of the Serer.

First, the Serer, while currently agriculturalists, seem to have their origins far to the north of the Sine. They share linguistic and cultural affinities with Fulani herders of the Middle Senegal River Valley, where an archaeological site locates an early Serer village between Matam and Podor (ibid.: 192–193).

The Serer may thus have lived in symbiotic relationship with Fulani herders (ibid.: 194). The Serer and their appreciation of the relations between cattle, crops, and *Acacia albida* could have originated in the herder–farmer exchange system described earlier in this paper. As summarized by one of their major European students:

> For these ancient Sahelians, longtime associates of the Fulani, if agriculture is a necessary vocation, herding is a passion. . . . Animal herds . . . are . . . the means of producing a resource much appreciated—milk—and they are especially an instrument for maintaining the fertility of the soils and the permanent capacity of the fields for cultivation. (ibid.: 236)

The Serer are believed to have left the Senegal River Valley in the eleventh or twelfth centuries and moved into the Sine sometime thereafter. At that time, the Serer brought with them an egalitarian social structure and established dispersed communities in which extended family and compound groupings, under the leadership of a group of elders, controlled their production resources for their own consumption and for exchange under their own auspices. Much of the millet was produced on collective fields (ibid.: 225–234).

The level of caste and class stratification that arose more recently among the Serer is a topic of some complexity. According to French geographer Paul Pélissier, the Serer developed little stratification over the several centuries from their migration into Sine and Saloum. Indeed, Pélissier argues that even the imposition of the *guellewar* warrior caste in the fourteenth century had little impact on the Serer, with the *guellewar* never able to dominate a "passive, controlled, frustrated peasantry" as happened among the more hierarchical Wolof neighbors (Pélissier, 1966: 108–109). Even the artisan castes and the *tyeddo*, or more recent warrior replacements of the *guellewar*, who became powerful in Senegal with the rise of the European slave trade (Diop, 1972: 23; Barry, 1972: 90; Franke and Chasin, 1980: 60–61) were a thin Wolof overlay. The artisan castes were absorbed into the Serer farming economy, where they practice their specialties only during the dry season (Pélissier, 1966: 208).

On the other hand, Martin Klein, who has written a detailed history of one period of Serer social development, offers substantial evidence to indicate that the Serer *did* produce caste and class stratification, even to the rise of a ruling class or nobility that lived off taxation of one-tenth of the produce of the farmers and who had direct control over bodies of armed warriors, the *tyeddo*, who made up part of the entourage of the court. In addition, precolonial Serer society also had village chiefs who were representatives of the royal family and nobility (Klein, 1968: 1–17).

At the same time, the producing class appears to have maintained a *relatively* powerful position in Serer society compared to their Wolof neighbors. Klein notes that "there was a constant tension between tyeddo and peasants" (ibid.: 19). In response to taxes and tribute—signs of exploitation and of great power on the part of the nobility—Serer farmers could offer two important forms of resistance. First, they might migrate to the fringe areas of the immense forests of their region where warrior and court control over them was minimal (ibid; Pélissier, 1966: 197–203). Indeed, some Serer, called Serer-N'Diéghem, have managed to maintain egalitarian social structures, avoiding the rise of a ruling class, and in some "fringe areas of Sine, there are no *tyeddo*, and local people can date within the last century or two the arrivals of members of different caste groups" (Klein, 1968: 5, 11).

Another option for Serer peasants was to fight. If they chose to fight rather than migrate, Serer peasants were armed and on occasions could force the *tyeddo* warriors out of their villages if impositions of the nobility were deemed too severe (ibid.: 19). It appears that the tenuous balance between peasants and warriors/nobility was upset in the late nineteenth century when a French military force was put to the service of *merchants*, a class which then rose to greater importance than ever before (ibid.: 44).

The complexities of Serer political and social structural history are thus great, but for purposes of this essay, it is the contrast with the neighboring Wolof that is most striking and of greatest importance. Ruled by powerful chiefs who may have once used a monopoly on animals as a source of their power (Pélissier, 1966: 151), the Wolof have little institutionalized exchange relations with herders except in a few areas such as Diourbel (ibid.: 152; Ware, 1979). The Wolof traditionally make little use of animal manure, and they have leveled much of the forest where animals could be kept during the rainy season (Pélissier 1966: 152).

The Serer, thus, while far more stratified than the Bouzou or the Dogon, and while having an incipient ruling class, are nontheless consistent with our general hypothesis: the precolonial Serer ruling class was checked in extending its powers over the producers by the possibilities of migration to fringe areas in the forests and by the fact that the peasants carried arms and could resist the warrior caste in carrying out what the peasants considered excessive levels of exploitation by the nobility. In contrast to the Wolof, whose agricultural practices and political organization led them, under French domination, to develop the ecologically destructive "Mouride" movement (Franke and Chasin, 1980: 78–82), the Serer producing class held onto enough power to maintain the ecologically viable grain–acacia–cattle cycle.

In each of the three otherwise different instances looked at so far, then, we have seen a positive correlation between the degree of power held by the producing class and the ability of the producers to maintain their fixed capital assets. The fourth and final example to be surveyed provides evidence of yet another type of power and class effect on the maintenance of traditional knowledge. In the early nineteenth century, a vast political movement among Fulani herders of the Niger River Inland Delta produced a series of reforms that included the preservation *and* some innovations of traditional knowledge. This was the Dina, the Fulani empire of Macina.

The Fulani Empire of Macina: Regulated Herder–Farmer Land Use

In central Mali, just before the Niger River reaches its northernmost point near Timbuktu and turns south towards the Atlantic Ocean, there lies one of Africa's

most important potential food-producing regions. Beginning in August and lasting for three to five months, the Inland Delta of the Niger River floods an area as extensive as England and Wales (Church, 1968: 18–19). Today, the region of which the delta is the major economic component contains 20 percent of Mali's people and 25 percent of its animal herds (Gallais, 1975: 354–355). The Niger Inland Delta has been a major site for the development of West African empires and their capital cities, including Jenné, Mopti, Segou, Timbuktu, and, east of the bend, Gao, capital of Songhay. These empires include that of Mali (1400–1494), Songhay (1494–1591), Moroccan conquest (1591–1670), several Bambara kingdoms (1670–1810), and Tukulor rule (1861–1893) just preceding the French colonial takeover (Monteil, 1932: 94–120; Gallais, 1967, vol. I: 82–93).

In the midst of these empires, however, there arose one political system that encompassed major reforms in land use between farmers and herders. Much of the spirit of these reforms is still in place in the region today. This was the Fulani Dina, or empire of Macina, which was founded in 1818 and lasted until overrun in 1862.

The Dina is of interest in the history of Sahelian indigenous food production knowledge because of its apparent positive accomplishments. These include increasing the capacity of the system to feed a large population, the parallel expansion of agriculture and pastoralism, each system providing inputs to the other, and the avoidance of famines that hit nearby areas (Gallais, 1975: 359–360).

How were these accomplishments made? The most important feature of the Dina's food production system lay in regulating the interactions between farmers and herders. This was achieved through a six-part program (Gallais, 1967, vol. I: 94–95; vol. II: 362–365)

1. Fishing areas were marked off and protected.
2. Animal trek routes were marked off and protected.
3. Herding officials had fixed payment scales for hired herders and for damages caused by animals to crops.
4. Standard weights and measures were introduced.
5. Markets were controlled by the central government.
6. Market officials, appointed by the government council, were responsible to higher government authority.

Underneath these general organizational features, the Dina carefully organized and monitored the herding economy so that it would interact in a positive way with the farming base of the empire. In 1821, the third year of the Dina, all government officers were called to the capital city of Hamdallay (near Jenné). There they made an inventory of pastoral camps, trek routes, and pasturing areas (Ba and Daget, 1955: 81). Herds were divided into three types: those kept for reproduction, those kept for milking—and allowed the longest time in the flood recession pastures of the Niger Inland Delta—and a small number of animals kept in the villages year round.

The empire was controlled by a grand council of forty *marabouts* (Islamic clergy) who supervised the district heads of the five provinces. Each province had subdistrict heads who supervised seven head herders each. These head herders were in charge of three main herders who took care of 300 head of cattle, so that each head herder was responsible to the subdistrict officer for a total of 2100 animals and twenty-one main herders (ibid.: 82).

Returns to herding were carefully regulated. For example, animals returning from the rainy-season trek north would be put on farmers' fields for a fee of forty cowries paid by the landowner. Twenty of these cowries went to the herders and twenty to the government escort unit. Milk from the milking herd would be divided as follows: one-third to the owner, one-third to the herder, and one-third to the government for distribution to needy people in the villages (ibid.: 83).

The Dina thus made possible an organized and peaceful movement of cattle from the flood recession pastures of November to April to the Sahelian pastures in July to September (Gallais, 1975: 355).

The nineteenth- and early twentieth-century expansion of agricultural and animal production rendered possible by the Dina innovations make it a case of some importance. Indeed, evidence suggests that recently local officials and some Malian herders and farmers in the area of the former empire have attempted to reconstitute the code of farmer–herder relations of the Dina, albeit with changes in the exact locations of routes, measurement of fees, etc. (Gallais, 1975: 365–366; 1979: 135). Reinstituting the Dina code, however, is a task of major proportions, for during the colonial period many changes were brought about, including changes in land use rights, expansion of chiefly lands, increases in taxes, and allowing Tuareg and other herders from farther away to pasture in the area. These processes were compounded by the independent Malian government's decision in the early 1960s to open the pastures of the Macina area to all herders who wanted access, and yet again by the drought of 1968–1974, which drove many herders from more northerly zones into the Niger River pastures in a desperate attempt to save their animals (Gallais, 1975: 361–362). What was once done by an independent empire is also more difficult to accomplish in local and regional councils unless there is firm backing from the central government and at least an absence of interference from outside projects.

How does the empire of Macina fit with the hypotheses presented earlier? The rise of the Dina at a point of contact with herders and farmers fits easily into our hypothesis that the zone of contact is the zone in which the most valuable innovations would occur. But how is the fact that the Dina was a tightly organized *empire* with a clear ruling class of privileged officials to be reconciled with the correlation noted in the three previous cases? This question is of significance because the Dina bears some resemblances to modern revolutionary societies.

Most knowledge about the Dina comes from oral accounts handed down by local residents of the Macina region (Ba and Daget, 1955: 25, 253). There is thus some chance of romanticization, but the data nonetheless all point in the same direction: the Dina was an attempted social revolution *against* the excesses of authoritarian Bambara rulers and *towards* a greater degree of social and economic quality.

Much of the evidence concerns Cheikou Amadou, the founder and first leader of the Dina. A *marabout* of humble origins, according to the stories passed down about him, Amadou organized the Dina in part to spread Islam to animist Fulani groups. But in part, also, the legends about Cheikou Amadou center on

his nonacquisitive, nonauthoritarian behavior, including his taking and enforcing a personal vow of poverty (ibid.: 44) by living partly from his own labor such as the making of rope, the fibers of which he turned himself, and by selling Korans copied by his hand (ibid.: 53). Although he took one-fifth of various fines and taxes in the empire for himself and the grand council (Monteil, 1932: 106–110, 113), he lived in simple quarters and even had the grand mosque of the capital city built in a simple style without minarets or ornamentation (Ba and Daget, 1955: 47).

Furthermore, Amadou is known in stories for overturning the abuses of middle- and even high-ranking officers of the empire and for favoring the cause of the oppressed and downtrodden (e.g., ibid.: 46, 59). The picture of a political leader of a large region with ample resources engaging in production and renouncing the wealth and privilege that might accompany his power contrasts sharply with the historical evidence concerning the nearby Bambara ruling groups who were expelled by Amadou and his followers from much of the Niger Delta. The most important case in point is the Bambara king of Segou from 1808 to 1827, Da Monson. Da was allegedly a haughty, vain, and tyrannical ruler, full of vindictiveness (Monteil, 1924: 90–97; Ba and Daget, 1955: 59). He looked down on the Fulani herders as inferiors[4] and, after being defeated by Amadou in 1818, continued harassing the Dina, in one case sending a raiding party that stole 5000 heads of cattle and forced the empire to send armed cavalry detachments along with herders and animals during the trek season (Ba and Daget, 1955: 91).[5] It seems almost certain that these raids, which also came from Tuareg herders on the northern edges of the empire, compelled the Dina to strengthen its military rule, tighten its security forces, and probably to increase taxes or tribute to the central treasury.

Although recognized by the great Nigerian political leader Osman dan Fodio and having loose diplomatic relations with leaders as far away as Constantinople (Ba and Daget, 1955: 59; Monteil, 1924: 114), the embattled Dina never achieved peace with its surrounding enemies and, finally, eighteen years after the death of Cheikou Amadou in 1844, Tukulor invaders dismantled the formal political organization that had been established by herders resisting the autocratic domination from Segou. Nonetheless, in this brief period of striving for an Islamic-based just society, Amadou and his followers established a pastoral code that:

> was based upon awareness of the constraints of the natural environment and . . . was inspired by a concern for equity and justice and peace among the peoples of the Delta, [and was] a veritable social and economic revolution that has not ceased to bring benefits and to be adaptable to new conditions for more than a century afterwards. (Gallais, 1975: 359)

The empire of Macina thus corresponds generally to the hypothesis that ecology-maintaining food production practices correlate positively with those societies having the least powerful and exploitative ruling classes: the Dina was a partially successful attempt to oppose inequality and institute less hierarchical relations between herders and farmers while reducing inequality generally. Harassed and attacked from the outside, and lacking a fully developed egalitarian ideology, the empire was compelled to institute militarization of the pastoral economy for protection and had to continue depending on appropriation of surplus from the producers in the form of taxation, tribute, and the reward for its troops through the capture of war booty. What remained of the power and privilege of the rulers of Segou and their vassals intermixed with the less hierarchical structures of the Fulani herders and the impulse of a radical Islamic movement—all in the setting of a rich environment that would yield direct and immediate benefits if more rationally managed.

POWER, CLASS, AND TRADITIONAL KNOWLEDGE

From this survey of four different types of Sahelian societies, it seems that the general two-part hypothesis outlined at the beginning of this essay has been confirmed. Those peoples with experience in both animal raising and farming were likely to create food production practices in which the animal and plant exchanges inherent in the herder–farmer interactions were improved upon or were able to create land use systems that drew on the elements of both systems to minimize ecological harm while maintaining a reasonable output. Furthermore, in each of the four cases representing increasing levels of stratification, the most positive environmental developments were maintained in societies where the producing classes had the greatest power and the ruling classes were either absent (Bouzou, Dogon) or had their power checked (Serer) or where their power was in process of disintegration (Dina). By contrast, among those Sahelian societies where powerful ruling classes *did* emerge, such as the Hausa, Bambara, and Wolof, the maintenance of fixed capital assets was sacrificed to the needs of the nonproductive exploiting classes.

The history of the Sahel did not end with the rise of African rulers, however. From the late nineteenth century up to the 1960s, new and more powerful ruling classes imposed their exploitative powers on the region. The most important of these came from France, which dominated most of the Sahel, pushing peanut production with its severe harm to the land in Senegal and Niger and pushing cotton production in Mali and Chad. For decades a nearly total disregard for the land and for the laborers characterized French colonial rule.[6] Only those groups that lived in regions somewhat marginal to colonial interests or who were difficult to reach because of their location could evade or resist the colonial impositions. The Dogon were not really brought under French domination until the 1930s, for example, while nearby, in the former Dina region, massive changes were wrought in the "Office du Niger" scheme to produce cotton and rice for export. The Bouzou seem to have been left untouched while Hausa farmers nearby became subject to a massive peanut cash-cropping program from 1930 to 1965. The Serer survived on the edges of a major peanut expansion in the Sine Saloum partly because they inhabited some of the least accessible parts of the basin, but perhaps also because the more stratified Wolof responded more easily to commercial exploitation, their own local rulers and religious leaders attaching themselves for gain to the expanding colonial economy and to the great detriment of the ecology of Senegal (Pélissier, 1966; Franke and Chasin, 1980: 63–83; Klein, 1979).

Those Sahelian societies that had the most powerful producing classes and the least exploitative and least powerful ruling classes and that represented an intermingling of herding and farming production systems thus developed and preserved a set of ecologically promising practices for maintaining the principal fixed capital asset in farming: the land. They also left a record of correlations

that has potential implications for our understanding of the relations between social structures and production systems.

And, finally, both the techniques and the correlations may contain elements that could be utilized in the Sahel's search for development without desertification and famine vulnerability. How can the points raised in this essay be integrated into Sahel development, and how do they compare with the Sahel Development Program as it is currently unfolding?

TRADITIONAL KNOWLEDGE AND SAHELIAN DEVELOPMENT

Perhaps the most obvious way in which the evidence and analysis from this study could be brought to bear on Sahelian development would be through what one could call the modern scientific use of traditional knowledge. In our view, this would entail three major efforts:

1. Further research and evaluation of traditional knowledge.
2. Dissemination of findings to other Sahelian peoples than the one producing an innovation.
3. Creative intermixing of modern science with the findings from traditional knowledge.

In each of these areas there has been some development in recent years, but there is much left to be done, and serious questions must be raised about the overall direction of current development policies in this field.

Research into Traditional Knowledge

Most of the information from earlier sections of this study has been derived from other research in the Sahel. That there is awareness of traditional knowledge in the Sahel at some level is thus apparent, but it is also apparent that most of the data had to be culled from two sources: (1) widely scattered comments usually not part of a major investigation or (2) the work of a small group of French geographers and plant scientists who were able to conduct initial studies of some traditional food production systems, especially during the 1950s and 1960s. Thus a very limited amount of evidence exists on a subject which might well yield much more information if priority were given it. Indeed, British geographer Paul Richards has called for just such studies of "folk ecology" as part of the construction of alternative strategies for environmental maintenance in the Sahel and had conducted some research into this area (Richards, 1975).

However, other studies, for the most part, nearly totally neglect the possibilities of learning from traditional systems and presume the expansion of modern imported methods of production with virtually no role for locally developed techniques. In a recent study of the possibilities for increasing irrigated rice production in the Sahel, for example, two specialists survey a wide range of factors including world prices for inputs and shadow prices for numerous variables. Significantly, one of the main areas treated in their essay, which was financed by USAID and is probably a major policy paper for the region, is the Niger Inland Delta. The essay offers not a word on the Dina, herder–farmer

relationships, or, indeed, the existence of animal herding alongside rice cultivation (Humphreys and Pearson, 1979/1980). The monocrop spread of modern irrigated rice, however, may well endanger the remaining elements of the old Dina system and could well lead to unintended soil erosion of the areas outside the irrigated zones as the nomads could lose their dry-season pastures and be forced to overconcentrate their animals on the fringes of the delta.[7] Similarly, a detailed study of the Niger Inland Delta, also commissioned by USAID, ignores the relations between herders and farmers. Ironically, this second study, while more in depth than the rice analysis just mentioned, makes use of Gaillais's history of the delta (Gallais, 1967) but neglects entirely the history of the Dina and its implications, which Gallais himself made one of the cardinal points of the history (McC. Netting et al., 1980). A related study of Fulani herders in the same volume ignores with only minor exceptions the importance in many parts of the Sahel of the herder–farmer relationship (Reisman, 1980). Even a special review of the state of knowledge concerning the *Acacia albida*, commissioned by USAID in the late 1970s, limits itself to questions concerning agricultural yields, soil effects, general botanical properties, and pod nutritive potential, neglecting the herder–farmer and cattle–tree–land interractions (Felker, 1978).

Work by researchers outside the United States appears to reflect similar bias. An FAO-sponsored "Expert Consultation" held in 1977 on the topic of "Organic Recycling in Africa" concluded in part with the recommendation that "technicians and scientists need to study more closely the basic practices of the small farmers," but the scientific papers presented were based almost entirely on the supposition that outside research and techniques are to be imposed. Indeed, even in the recommendation, the only reason is "so that proposals for the introduction of new systems could be easily understood, integrated, and accepted by these farmers" (FAO, 1980: 1).

And at a 1978 Sahel Symposium in London, two well-known British experts discussed the Sahel's future problems and potential without a mention of the folk ecology that had been called for by Paul Richards only three years earlier (Grove, 1978; Cloudsley-Thompson, 1978). Finally, in one of the very few scientific studies to focus on the herder–farmer relationship, the authors conclude, after a superficial survey of some types of linkages between the production systems, that "adaptation to former conditions are proving nonadaptive to new conditions and new adaptations are slow in developing" (McCown et al., 1979: 330). The authors, however, do not investigate the specific ecology-maintaining techniques that have been discussed in this study.[8]

The importance of this neglect both general and specific should be evident. If the research on the *Acacia albida*, its effects, and possible similar phenomena is not made prominent, it is easy to advocate the settling of herders on the one hand or the expansion of irrigated cropping on the other. Both these projects threaten to sever or further erode the integrated herder–farmer systems presently existing in the Sahel. Ranching schemes in particular may break up the farmer–herder integration unless that integration is worked into the design of the ranch—a difficult task if the ranch is primarily established to produce large numbers of animals for the market.[9] One or the other of these policies might indeed be appealing for reasons of expanding the supply of grain or meat, but what will happen to the overall environment, especially on the desert fringe? If the cattle are important in spreading *Acacia albida*, are they also important

in spreading *Acacia raddiana, Acacia seyal,* and other varieties (cf. Monnier, 1981: 187)? And if cattle are removed from the ranges or if their trek routes are drastically interfered with, what alternative methods are being investigated to maintain the tree distribution when the cattle—perhaps their main vector for spreading the trees—no longer appear as they once did on the ranges or, indeed, are forced to overgraze and trample them? A more serious appreciation of this potential problem would derive, it seems to us, from a more serious appreciation of traditional adaptations by Sahelian herders and farmers.

Another area where traditional knowledge is not being applied is with fertilizer. The Dogon composting technique provides a dramatic contrast with current policy. Rather than seek to elaborate, improve, and disseminate this practical and possibly effective composting system, which might be adapted to other Sahelian cultures and might be relatively inexpensive, many of the Sahel development projects utilize or project the use of commercial imported fertilizers. Commercial fertilizers greatly simplify matters for the outside agencies that already know where to order them and are already familiar with the kinds of scientific tests needed for their application. Development of the Dogon system or a related system would be far more difficult for outside agencies to effect.

But whose development is it, after all? If the Sahel trades immediate production gains for a new form of dependency, this time on outside fertilizer, mechanical equipment, and the like, how and when will it be able to develop its own resources in a way that will allow it to control those resources? In the long run, it may be more advantageous for the Sahelian countries to have the resources and knowledge to develop Dogon composting, which can be done mostly with their own materials, rather than risk falling victim to a sudden massive increase in the world price of fertilizer or even sudden shortages. The many recent economic crises among the wealthy nations ought to provide a rationale for not tying oneself too closely to the economies of those nations. The creation of a people's science with an emphasis on developing local knowledge and techniques would be an important element in such a strategy of independence.

Dissemination of Scientific Knowledge in the Sahel

Whatever its achievements and potential, traditional knowledge in the Sahel has been severely limited by its isolation, with a small number of societies relatively cut off from the main interchanges of ideas and experience. This is precisely an arena in which modern science could compensate for a weakness inherent in traditional knowledge. In the case of the Dogon, for example, would it not be possible to conduct modern experiments on their composting practices and, if these indeed turn out to be beneficial, to disseminate them to other parts of the region where they might also be of use? The recent establishment of a Sahel Institute in Bamako, Mali, would bode well for such a possibility, but only if the institute receives funds and other assistance for this kind of endeavor. At present, however, it appears more likely that the Sahel Institute will be a clearinghouse and repository for more of the kinds of research that brings a modern agricultural agenda with no concern for or interest in the findings that could derive from a serious study of traditional knowledge and its implications. Fortunately, many Sahelian scholars are intensely nationalistic and interested in what can be learned from their own cultures; but, unfortunately, most of the financial resources for scientific research come from organizations such as USAID, the World Bank, and French Overseas Aid, which do not as yet seem to have a commitment to the kinds of studies that would be required.

Creative Mixing of Traditional Knowledge and Modern Science

In addition to discovery through more research and dissemination through modern communications, the application of modern scientific research techniques could result in new, creative syntheses. Earlier French studies in the 1950s and 1960s verified the value of the *Acacia albida* and made possible proposals for its use in reestablishing soil fertility in Senegal. Some scientists who studied the *Acacia albida* in detail also made use of their knowledge of other experiments in other parts of the world, noting the possibility of creating bands of trees interspersed with fields as has been developed in arid zones of China and the Soviet Union (Charrau and Vidal, 1965: 623; Giffard, 1964: 32). It appears that small-scale experiments were carried out but did not sufficiently interest either the colonial government at the time or the independent state of Senegal in more recent years.

But the example remains, and a few others have followed. One of the most persistent proponents of an amalgam of traditional knowledge and modern scientific creativity is French geographer Jean Gallais. Gallais, who has attempted to draw attention to the importance of the land use system of the nineteenth-century Dina, has also advocated its modification to modern conditions, including smaller units of territory to correspond with the greater population density, a new classification of land types with regulations for their use, and new controls over the use of different types of pasture, with local councils to supervise these controls and relate the different regions to each other (Gallais, 1975: 365–366; cf. Barral, 1974). This process has led to a proposal in 1979 that Mali become the first of the Sahelian countries to develop and implement a pastoral land use code (Gallais, 1979: 135).

Finally, a most intriguing proposal has been made by R. H. MacLeod of the Earth Resources Development Research Institute in Washington, D.C. MacLeod specializes in the interpretation of satellite photographs of the Sahel—certainly one of the most modern of scientific advances—but he also has an interest in and respect for the traditional production systems of the regions. Studying both the traditional and the modern has led MacLeod to propose a system of food production for the Sahel which he calls "climax agriculture." MacLeod defines climax agriculture as a system of production which "recreates the characteristic conditions of the original ecosystem, but does so through use of crop, forage, and timber plants in a carefully managed fashion" (MacLeod, 1976: 3–4). The variety that would be produced by nature, left alone by humans, is thus simulated with its many advantages in water retention and wind protection, thus lessening the changes of desertification as well as preventing outbreaks of pest damage by not allowing individual species to be concentrated over one large area. The proposal leads to alternatives to many current ranching schemes in the region. The current schemes emphasize the use of single species of grasses as cattle feed. "But," as MacLeod notes, "in the Sahel, shrubs can provide dry season feed while grasses cannot" (1975: 7). If MacLeod is correct in his observation, shrubs of a variety of species, including perhaps some aca-

cias in the desert fringe areas, would contribute towards this modified recreation of some of the most primitive production systems of the Sahel. With the tools and techniques of modern science, MacLeod's proposal points in the same direction as does a remark by Gallais, summarizing the approach he has attempted to develop:

> . . . so much remains to be discovered, to be subjected to experimentation. The most immediate goal is to convince the technocrats that a modern undertaking can rest upon sociological knowledge of tradition. (Gallais, 1977: 280)

Power, Class, and Development in the Sahel

Finally, what is the development implication of a positive correlation between ecologically beneficial practices and those social structures with the *least* powerful and exploitative ruling classes? The implication, in our view, is clear: nonexploitative modern forms of society have the best chance of maintaining their fixed capital resources. Producing primarily for local needs, the Bouzou and Dogan were able to maintain their environments relatively well because they were not subject to the expansionary production schemes of nonproductive ruling classes. In the present-day Sahel, however, with higher population densities, the rise in urban centers, the spread of industrial commodities, and the like, it is surely not reasonable to propose a return to the isolated, self-sufficient, more egalitarian past. Is there a way, however, to recreate a modern version of the nonexploitative character of these more ancient societies?

The full answer to this question will only be given by developments among Sahelian social groups and nations, but there are some intermediate signs of the potential. On a small scale, local governmental bodies and democratic herder and farmer groups have joined with some development projects in the creation of nonexploitative production experiments in the Sahel (Franke and Chasin, 1980: 228–239). These projects, while not the final word in offering what may be needed, do have one common feature to which we can point: they all emphasize the management and control of the means of production—land, labor, technology—by the producers themselves, that is, those people closest to and with the greatest interest in protecting their resources.

Similarly, but on a larger scale, the temporary creation of a society moving towards greater equality by the nineteenth-century Dina is one example of an experiment that might be attempted in a twentieth-century form. The Dina was cut off by intrigues and attacks from other Africans, and eventually by French colonial expansion. Later, during the anticolonial movements, many African nationalist leaders espoused radical egalitarian—usually socialist—ideas, but these ideas often did not come to fruition because the class base of the leadership of the nationalist movements was usually from one of the exploiting classes themselves (Markovitz, 1977: Chapters IV–VIII). The modern social structure of the Sahelian countries includes powerful exploiting classes with a strong interest in increasing production and controlling the labor of the farmers and herders no matter what the cost to the fixed capital of their countries. These classes include merchants, landowners, and, perhaps most important in the Sahelian countries, government bureaucrats, all of whom together constitute an "organizational bourgeoisie" (ibid.). This organizational bourgeoisie is a nonproducing class that derives its wealth and power from two very different

sources in the current development situation. On the one hand, it must exploit the land and labor of the producers—mainly farmers and herders in the Sahel—to maintain its privileges. At the same time, it is offered various opportunities for self-aggrandizement by participating in the administration of the massive Sahel Development Program that itself will bring some $10 billion into the region between the years 1975 and 2000.

In its relations both with the producers to whom it looks down and the foreign aid establishment to whom it must look up, the Sahelian organizational bourgeoisie is pressured, and has as its own self-interest, to expand production and follow the advice of experts of the "donor" nations. Expansion of production is dictated locally because the organizational bourgeoisie stands to benefit by the high prices for cereals and the possible opportunities for cattle sales in the rich markets of the heavily populated coastal countries to the south. Expansion of production is dictated internationally because the Sahel Development Program has been devised with the counsel of Western experts, who see food self-sufficiency or its near equivalent as a way to stabilize the region politically and help to halt the spread of revolutions generally in Africa.[10]

Perhaps they have other goals as well, but the outside experts do not have an immediate material interest in fashioning a slow, careful, producer-oriented strategy of development with environmental maintenance. Their entree into the region is, after all, not by means of their connections with the producing classes, but via the class that makes international contacts—the organizational bourgeoisie.

This set of power and class relations may well explain the reluctance of practitioners or theorists of Sahel development to devote time or resources to serious evaluation of the potential of traditional knowledge. The Western experts have an internationally approved agenda. The local organizational bourgeoisies have an interest in getting "development" as fast as possible, so why offer major criticisms of the program when there is grain to be marketed and meat to be sold?

Careful studies and evaluations of the possible development implications of the herder–farmer integrated food production system and of the effects of nonexploitative forms of society are both likely to be of little interest to the majority of current Sahelian developers. Such studies may be of great interest, however, to Sahelian farmers and herders and their friends and allies in other parts of the world. In our view, this study has demonstrated the need for future research in this field. Despite powerful social forces inhibiting it, perhaps there will be those who do such work in the interest of the producers, the land, the animals, and, ultimately, of the entire people of the Sahel.

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Chapter 11 Power, Class and Traditional Knowledge

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1. The Dogon also have special, institutionalized relationships with the Bozo fishing specialists of the Niger River bend (not to be confused with the Bouzou farmers described in the previous section of this paper). See Paulme (1940: 22–23), Griaule and Dieterlen (1954: 107–110), and Roberts (1981).

2. The Human Relations Area Files entry on the Dogon has only one page under the heading "classes" and a very small section on social stratification in general, mostly the age groups and castes. Information on castes in Mali appears in Diop (1971) and N'Diayé (1970b).

3. Another important tree in Sahel food production is the baobab, whose leaves and fruits are rich in those vitamins lacking in millet (Pélissier, 1966: 265; Owen, 1973).

4. According to Fulani legends, Ba's vassal at Macina, the Ardo Ngourori, said of Amadou: "In my eyes he will remain nothing but a house to house beggar while I am like an eagle" (Ba and Daget, 1955: 107).

5. Gueladio, one of Amadou's opponents and a vassal of the king of Segou, escaped from Amadou's control through treason by one of Amadou's confidants. Gueladio was able to raise an army and carry on a debilitating seven-year war against the Dina before being eliminated (Ba and Daget, 1955: 119).

6. For detailed examples and additional references, see Franke and Chasin, (1980: 63–83).

7. For cautionary examples from similar parts of the Sahel, see Franke and Chasin (1980: 192–194 and 207–214).

8. An even more superficial analysis led one animal health specialist to propose that "Cattle are of such cultural importance in Africa that means must be found for limiting the ecological damage that they cause. . ." (Ormerod, 1978: 377). Refutation of the logic on which this argument is based as well as empirical data contradicting it can be found in Franke and Chasin (1979; 1980: 84–108, 120–122).

9. Some critical comments on ranching in the Sahel are contained in Beauvilain (1977), Dunbar (1970); and Gallais (1979).

10. For some of the evidence supporting the characterization of the political motivations in Sahel development and their possible effects on the trajectory of the program, see Franke and Chasin (1980: 145, 148–164, 192–194).

Chapter 12 Transnational Corporations and Party Realignment

This essay is part of a larger work which attempts to reconceptualize the nature of dependency relationships among the states of southern Africa (Libby, 1987). I wish to express my appreciation to Irving Leonard Markovitz, C. van Onselen, Leonard Thompson, Jeffrey Butler, Heribert Adam, and Hermann Giliomee for helpful criticism and suggestions for revision. Special thanks to Jeffrey Butler for his detailed comments. However, the views expressed herein are solely the responsibility of the author.

1. The states in the southern African region which by definition have important regional economic interests include South Africa, Zimbabwe, Botswana, Lesotho, Swaziland, Namibia, Zambia, Malawi, Mozambique, and, to a lesser extent, Zaire and Tanzania.

2. For the results of a survey of white opinion on how best to cope with "hostile" black states on South Africa's borders, see Geldenhuys (1982).

3. For a discussion of the role which representatives of large corporations had in planning South Africa's "total national strategy," see Geldenhuys (1984: 140–141, 149–155, 160–165). For an elaboration on the theme of the NP's political alignment with large-scale corporations, see Prinsloo (1984: 20–42), Innes (1983: 171–183), Wolpe (1983), O'Meara (1983: 248–256), and Davies and O'Meara (1985).

4. Giliomee (1985) questions the proposition that white political opposition to the NP flows from the latter's political alliance with large industrial capital. Instead, he argues that their opposition to the NP is based upon ending state subsidies for lower-income whites through inflated white salaries and job reservation. According to this logic, the state undertook the change out of the recognition that it had to modernize "racial domination." However, there is evidence that