(1984). From Hunters to Farmers: The Causes and Consequences of Food Production in Africa eds. J. Desmond Clark + Stephen A. Brandt Berkeley: U of Calif. Press pp. 328-348

29

Foraging and Food Production among Kalahari Hunter/Gatherers

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Though the origins of agriculture have been a major focus of anthropological inquiry for decades, many of the processes involved in the shift from foraging to food production are still unclear. Relatively few contemporary groups have been well documented both as foragers and food producers. Detailed records on a wide range of topics are, however, available for the Basarwa (San, Bushmen) of southern Africa, many of whom live in the Kalahari Desert of Botswana and adjacent countries (Fig. 1).

The primary reason the Basarwa have drawn so much anthropological attention is that many of them still practice a way of life that characterized

The research on which this paper is based was supported by U.S. National Science Foundation Grants No. SOC75-02253 and No. BNS76-20373, and by a grant to the Remote Area Development Program, Ministry of Local Government and Lands, Botswana. We would like to thank the residents of the Kalahari for the information presented here and to express our gratitude to those of our colleagues who kindly shared with us their data and their ideas.

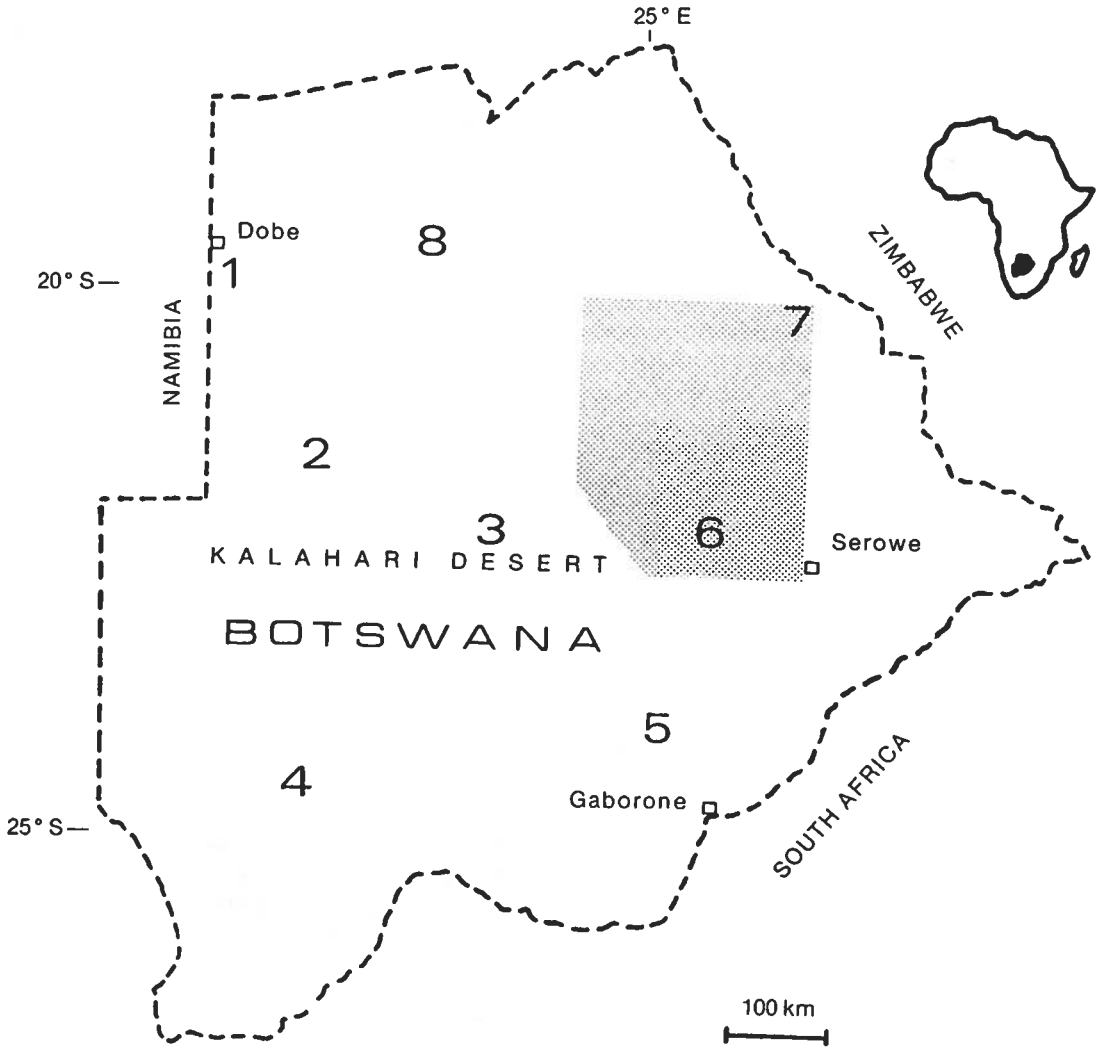

Figure 1. Locations of the major Basarwa groups in the Kalahari, Botswana. (1) !Kung; (2) Nharo and other Ghanzi Farms groups; (3) G/wi and G//ana; (4) !Xō; (5) Kūa (southeastern Kalahari); (6) Kūa (eastern Kalahari); (7) / Aise and other Nata River groups; (8) Bugakwe and other Okavango Swamps and river Basarwa groups.

most of human history (Lee and DeVore, 1968a: 3). In 1965 Richard Lee estimated that of the 24,000 Basarwa in Botswana, 16,300 worked on farms or cattle-posts and 2,000 were practicing a mixed agricultural and hunting strategy, but the remaining 6,100 were traditional hunter/gatherers (Lee, n.d.: 13, 20). A decade later, Lee (1976a: 8) revised his estimate, saying that less than 5 percent of Basarwa were then hunting and gathering for a living.

The purpose of this paper is to discuss some of the ways in which agriculture has come about among foraging populations in the Kalahari Desert of Botswana and to show some of the reasons for the fact that few groups in the Kalahari today are completely dependent on domesticated foods.

Contact and the Origins of Food Production

Most of the discussions of the origins of food production in southern Africa have stressed the significance of incursions of Bantu-speaking populations, saying that the beginnings of agriculture are directly related to the presence of new ethnic groups (Seddon, 1968: 490; Fagan, 1973: 159, 165; Phillipson, 1977c: 145-147; J. D. Clark, 1962: 219–220, 222–223; 1972: 128). However, archeological evidence of sheep in Namibia and the Cape indicates the possibility that domesticated stock existed in southern Africa prior to the incursions of Bantu-speaking groups (Klein, this volume).

One oft-cited reason for the lack of agriculture among Kalahari populations is their lack of contact with outside groups. Archaeological evidence tends to belie this notion. Artifacts found in both Later Stone Age and Iron Age sites reveal that there must have been at least a certain amount of contact between foraging and food-producing populations in the Kalahari that may date back over 1,500 years. At first, contacts may have been sporadic, usually in the form of occasional hunting parties taking on local guides. Later, these contacts would have become more frequent, as trading parties went into remote areas in search of skins and other local goods. The major Tswana towns attracted itinerant Basarwa traders, who brought firewood, wild plant foods (e.g., mogorogorowana [*Strychnos cocculoides*] and mmilo [*Vangueria infausta*]), skins, and handicrafts for sale or exchange. Some Basarwa groups even cultivated domesticated plants, particularly tobacco (*Nicotiana tabacum*) and marijuana (*Cannabis sativa*), which they exchanged with other groups for food and material goods.

By the second half of the nineteenth century, trade had become increasingly institutionalized, particularly after Shoshong, the Bamangwato tribal capital, became a major commercial center (Parsons, 1974: 655). As hunters, traders, and travelers poured into the Kalahari after Livingstone and Oswell's trip across the eastern Kalahari in 1849, ivory, ostrich feathers, and skins were procured in massive amounts for markets in the Cape. Basarwa groups were able to obtain firearms, making them more effective hunters. Many of the larger game species that were once found in abundance in the eastern Kalahari in particular were increasingly restricted both in numbers and distribution by the end of the nineteenth century, a process which was exacerbated by habitat deterioration (Campbell and Child, 1971).

As populations expanded and the market for livestock products opened up, cattle became increasingly important as a source of both labor and food for groups seeking opportunities other than hunting and gathering. Some Basarwa groups began to settle around the peripheries of cattle-posts in order to gain access to livestock products. At first, cattle were taken into the waterless Kalahari only seasonally, primarily to pans where water was available for short periods during the rainy season. As well-digging increased and, later, when boreholes began to be drilled, the availability of permanent water meant that cattle could be kept in the new grazing areas year-round (Devitt, 1977; Hitchcock, 1978a, n.d; Vierich, n.d.a). Although the first boreholes were drilled in Botswana around the turn of the century, it was not until the 1930s and 1940s that drilling of water wells was done systematically. The numbers of water sources expanded in the 1950s and especially during the 1960s drought (Hitchcock, 1978a, b). With the rising numbers of water points, stock rates went up and the chance for obtaining employment as a herder increased. It must be stressed, however, that cattle-posts existed in the Kalahari long before the advent of the borehole, and Basarwa presumably had had access to livestock employment and livestock products for centuries.

Many of the Basarwa groups that settled on wells and boreholes began to be incorporated into a system of serfdom or patron-clientage (Silberbauer and Kuper, 1966; Tlou, 1977; Vierich, n.d.a, n.d.b; Hitchcock, 1978a). In exchange for their labor as herders or domestic servants, Basarwa were given in-kind payment, usually in the form of clothes, food, and tobacco. Specific families of Basarwa began to be identified with individual families, particularly chiefly families in the Bamangwato and Batawana tribes (Hitchcock, 1978a; Tlou, 1977). Basarwa serfs were passed from one generation to the next, often being inherited patrilineally. Al-

though we have no idea how old the institution of serfdom is, it has been suggested that "clientship has been a central feature of inter-ethnic relations in Botswana for at least two centuries and probably much longer" (Russell and Russell, 1979: 82).

Whereas at first the relationship between the foragers and farmers could be said to be a symbiotic one, with benefits accruing to both sides, elements of competition soon began to be seen. There are numerous reports of cattle-owners seeking retribution for livestock that had mysteriously disappeared. On the other hand, Basarwa were known to voice their dissatisfaction over the fact that livestock were eating melons they themselves needed (Russell and Russell, 1979: 83). Hunting laws were instituted by chiefs, and violators of those laws were often punished. Basarwa frequently decried what they felt to be laws passed expressly to prevent them from eating. Setting bush fires, a common practice of both foragers and pastoralists in Botswana, was another source of contention.

Simple contact with crop- and livestock-raising populations, however, did not result in the adoption of food-production techniques by the Basarwa. It was only when forced to do so, either as a result of demographic or environmental pressures, that Kalahari foraging populations began to raise their own food.

Foraging in the Kalahari Ecosystem

A second major reason frequently cited for the lack of food production in the Kalahari is the marginal nature of the ecosystem itself, which is a vast tableland consisting of rolling tree-bush savanna dotted with pans and dissected by fossil drainages in some areas. Soils are primarily unconsolidated sands, through which rain-water percolates quickly, a feature that is in part responsible for relatively low crop yields. Because these sands are also deficient in certain minerals, notably phosphate, unless they are fed salt and bonemeal, domestic ungulates often contract diseases such as aphosphorosis.

The interior basin of southern Africa is characterized by a semiarid climate, with rainfall varying from approximately 200 to 700 mm annually along a southwest-to-northeast axis in Botswana. The Kalahari fits the criteria used to define a desert, in that water is the crucial limiting factor for production and water inputs are largely random both in space and time (Noy-Meir, 1973). Unlike some deserts, however, the Kalahari is relatively thickly vegetated, which has led some researchers to suggest that it should more properly be termed a "thirstland." Droughts are common in Botswana and, as a consequence, populations inhabiting the Kalahari and adjacent areas have developed a variety of strategies to deal with stress periods (Devitt, 1977, 1978; Silberbauer, 1978; Hitchcock, 1978b); two of the most effective of these strategies are small group size and flexibility in group composition (Lee and DeVore, 1968a: 7, 9, 11).

Group sizes tend to fluctuate, depending, at least in part, on resource availability. Patterns of aggregation and dispersal also vary in the Kalahari, with !Kung, for example, collecting around water sources in the dry season and dispersing into smaller groups in the wet season, while G/wi do just the opposite (Barnard, 1979).

The determinants of mobility patterning also vary. Yellen and Lee (1976: 43) note that scarcity of water is the most crucial limiting factor for the !Kung, and Marshall (1976: 76) says that "if they have to choose between lack of food and lack of water, they stay by the water and leave the food." In the central and eastern Kalahari, on the other hand, surface water is only available seasonally; consequently, the crucial determinants of mobility patterning are the distribution and abundance of water-bearing plant species, particularly melons (e.g., *Citrullus vulgaris*) (Tanaka, 1971, 1976; Cashdan, n.d.; Silberbauer, 1965, 1972, n.d.). In the southwest Kalahari, water is obtained from sip-wells, and the size of the group and its mobility are determined by the yield of these sip-wells and their distribution, respectively.

The most critical period of the year for Kalahari foragers is the late winter and early spring, when resource abundance is at its lowest point and the rains have not yet begun. The groups adapt by shifting not only their population size and composition but also their spatial location. Before the onset of winter, each group assesses the whereabouts of resources and then breaks down into minimal units,

spreading out across the landscape in such a way as not to conflict with other groups.

Patterns of year-round land use in the Kalahari are far from random. The landscape is divided systematically, which serves both to spread groups spatially and to provide information on the whereabouts of other groups (Wiessner, n.d.: 54). While some Kalahari researchers maintain that these land divisions are "territories" (e.g., Heinz, 1972), this term implies defense of space (Pianka, 1974: 105). Perhaps a better way of looking at these divisions is to see them as "ranges," areas over which humans and animals move for subsistence procurement and other purposes. Essential to these ranges is a variety of resources in sufficient amounts to support a group over the course of a year (Silberbauer, n.d.: 208; Yellen, 1976: 54; Hitchcock, 1978a: 243; Marshall, 1976: 71).

Lee (1968) made a significant contribution to the study of hunter/gatherers when he noted that their work effort was generally low, ranging from 12 to 19 hours per week. Again, there is regional variation even among !Kung, with Draper (n.d.) pointing out that work effort among groups occupying the southern portion of the !Kung range involved more time and labor than among Dobe groups. Another important feature of work effort among foragers is that by and large it is continuous throughout the year, primarily because of the lack of surpluses. In general, Kalahari foragers do not store food for any length of time, since, as Lee and DeVore (1968a: 12) put it, "The environment itself is the storehouse." Most of the work is carried out by adults, with children contributing little, if any, labor (Draper, 1975).

Another characteristic feature for foraging societies is their emphasis on the sharing of resources (Lee and DeVore, 1968a: 11). Given the variation in success rates in food procurement, foragers require social mechanisms that act to ensure the equitable distribution of resources. Links between groups in a region are maintained not only in terms of kinship and affinal ties but also in terms of a network of exchange and trading (Silberbauer, 1972: 273–274). The egalitarian nature of Kalahari foragers is maintained in part by public criticism of stingy individuals, which acts as a kind of leveling mechanism (Marshall, 1961; Draper, pers. comm.). Wiessner (n.d.) has described in careful detail a system of delayed reciprocity known as *hxaro* found among !Kung groups. This system, combined with the patterns of land division and ties among groups through kinship and marriage, acts to provide reciprocal access to resource areas in the Kalahari.

The diet of arid land foragers is a very generalized one, consisting of what Flannery (1969) calls a "broad spectrum" exploitative pattern. Kalahari foragers have a wide knowledge of both plants and animals; they know where they can be found and how they reproduce. They tend to be selective about the species they exploit at various times during the year (Lee, n.d., 1968, 1969; Silberbauer, 1972; Tanaka, 1969, 1971, 1976; Yellen and Lee, 1976). During times of abundance, groups usually exploit a restricted range of species, broadening their diet in periods of less abundance.

A feature of Basarwa diet that has received wide comment is the degree of dependence on plants as opposed to animals (Lee, n.d., 1968, 1969; Silberbauer, 1965, 1972; Tanaka, 1971, 1976). Marshall (1976: 92) estimates that 75 percent of the diet is comprised of plant foods, while the balance is of animal foods; Tanaka (1976: 116) estimates that 80 percent of the diet is from vegetal sources. Once again, there is a range of variation to be found in the Kalahari.

A great deal of attention has been paid to the fact that a single Kalahari plant-food, the mongongo (*Ricinodendron rautanenii*), comprises a significant portion of the diet of !Kung populations (Lee, n.d.; 1968; 1969; 1972a; 1973; 1979: 182–204). This nut species has been described by Lee (n.d.: 192; 1968: 33) as being both abundant and predictable. The fact that the !Kung have what has been termed a "superabundant" resource, combined with the wide variety of other plant and animal foods available, has served to underscore arguments about the security of the hunting and gathering way of life and to supply another explanation for why food production has not come about.

Ardrey (1976: 60) has attacked Lee's findings, saying that the !Kung case is not representative, but anthropologists working among !Kung have stressed that they were chosen for study specifically because they were atypical (Lee, n.d.: 32; 1976a: 3;

N. Howell, 1979: 4). It has been stressed that foragers do sometimes experience periods of difficulty (Sahlins, 1972: 36; Marshall, 1976: 62). It is interesting to note that although /Aise and other Basarwa in the Nata River region have access to mongongos, they do not exploit them in any quantity, ostensibly because "they do not taste good" (Hitchcock, field notes). Thus, the simple presence of an abundant resource does not guarantee its exploitation. Wiessner (n.d.: xxxi, 154) points out that in 1974, because of intense convective thunderstorms, the mongongo crop in the /Ai/ai area was almost completely destroyed, causing widespread hunger among !Kung populations living there. Nata River Basarwa groups also informed us that mongongo nuts were available in greater quantity in dry years than in wet ones. Other kinds of problems can affect the availability of mongongos: Wiessner (n.d.: 27) and Lee (1973: 312) both mention, for instance, the damage caused by elephants in mongongo groves.

Origins of Food Production in the Kalahari

Given the emphasis on the foraging way of life in the Kalahari it is perhaps not surprising that food production there has received relatively little attention from anthropologists. However, Kalahari populations have engaged in food production, some of them for a substantial period of time. Table 1 contains a listing of a number of Basarwa (San, Bushmen) groups in various areas of the Kalahari, with the types of domestic plants they cultivate and animals they raise, as gleaned from reports of anthropologists, development workers, and others. It can be seen that food production is practiced in almost every part of the desert and that many groups participate in both agricultural production and animal husbandry, if only to a limited extent.

Food production may have come about in the Kalahari as a result of contact with food-producing populations, or it may have begun locally, without other groups having provided either the methods or the domestic plants and animals.

D. R. Harris (1972: 183) points out that agriculture may have been preceded for a substantial period of time by what he calls a "manipulation strategy," involving transformation of selected parts of the environment so as either to stimulate the natural ecosystem or to reduce the diversity only slightly (D. R. Harris, 1969: 6). Perhaps the most important of the strategies in the Kalahari is controlled burning. Reports of use of fire by Kalahari foragers are found in many nineteenth-century explorers' journals; Schapera (1929: 140) says that veld-burning is the closest Basarwa had got to practicing agriculture by the early twentieth century. Bleek (1928: 17) says that burning was done at the end of winter in order to encourage bulb growth. It is also used to encourage the growth of new shoots to attract game (Hitchcock, 1978a), for signaling, and to eliminate pests such as snakes and ticks, as well as to protect humans from large predators (M. L. Murray, n.d.; E. Wily, B. Clauss, pers. comm.). Murray summarizes:

> Fire eliminates competition from undesirable plant species on potentially productive melon sites or gathering areas and apparently promotes reproduction and growth of tsama melon (*Citrullus vulgaris*), gemsbok cucumber (*C. naudinianus*), sour berry (*Grewia* spp.) and *Cucumis* spp. during the wet season. Used in this manner, fire is referred to as a type of "ploughing." (n.d.: 27)

Groups do not usually return to burned areas until the third year. Timing of the burns is critical, since burning at the wrong time of year, such as during the mid-to-late rainy season, may tend to harm the plants. Burning, therefore, is usually done carefully, as an integral part of the overall subsistence system.

Other environmental manipulation strategies that have been observed in the Kalahari include intentional protection of important food-plant species, replanting of certain species in areas near base camps, and intentional cultivation of at least one species of wild melon. Kūa foragers in the eastern Kalahari practice a kind of protection strategy for groves of trees bearing hard-shelled fruits known as *d//ao'a* or *mogorogorowana* (*Strychnos cocculoides*). Since this species is subject to damage by fire, fire breaks are cleared around the groves. In the southeastern portion of the Central Kalahari Game Reserve a camp was found with a number of *bai* plants

TABLE 1. **Domesticated Animals Owned and Crops Cultivated among a Sample of Kalahari Foragers and Food Producers**

Area	Group name	Crops cultivated	Animals owned	Reference
Southwest Kalahari	!Xō (Hukuntsi,etc.)	melons, beans, maize	donkeys, goats, dogs, chickens	Thoma (n.d.; pers. comm.)
Southwest Kalahari	!Xō (Takatshwane, etc.)	melons, beans, maize	cattle, goats, dogs, donkeys, horses	Heinz (n.d.; 1979: 243–245); Wily (pers. comm.)
Western Kalahari	Ghanzi groups (Nharo, ≠Xau//ei, ≠Kaba, G/wi, etc.)	melons, beans, maize, tobacco	cattle, horses, dogs, donkeys, goats, chickens	Childers (1976: 58–63); Guenther (1975/76: 46; 1977: 198–199); Bleek (1928: 17); Silberbauer (1965: 127ff.)
Central Kalahari	G/wi, G//ana (!Xade)	melons, beans, squash	donkeys, goats, horses, dogs	Jeffers and Childers (n.d.: 5, 11–13, 18); Sheller (n.d.); Tanaka (1976: 100)
Central Kalahari	G/wi, G//ana, etc. (Central Reserve groups)	melons, beans, maize	donkeys, horses, goats, chickens, dogs	M. L. Murray (n.d.); Sheller (n.d.); Cashdan (n.d., this volume); Vierich (pers. comm.)
Northwest Kalahari	!Kung (Dobe, etc.)	melons, beans, maize, sorghum, tobacco	cattle, donkeys, goats, horses, chickens, dogs	Wiessner (n.d.); N. Howell (1979); Brooks et al. (this volume); Lee (1976a, 1979); Gelburd (n.d.: 56–59, 64); Draper et al. (n.d.) Hargrove (pers. comm.)
Eastern Kalahari	Kūa	melons, beans, sorghum, maize, tobacco, pumpkins, cowpeas, sweet reed, groundnuts, marijuana	cattle, horses, goats, sheep, chickens, dogs, donkeys, cats	Hitchcock (field notes); Ebert et al. (n.d.)
Southeast Kalahari	Kūa, Tsassi, etc.	melons, beans, maize, sorghum, groundnuts	cattle, goats, donkeys, chickens, horses, dogs, cats	Vierich, Copperman (pers. comm.); Hitchcock (field notes)
Northeast Kalahari	/Aise, Ganade, //Owochu, etc. (Nata groups)	melons, maize, sorghum, millet, groundnuts, beans, sweet reed, tobacco, marijuana, squash, pumpkins, gourds, calabashes, tomatoes, cabbage, sunflowers	cattle, donkeys, horses, goats, sheep, chickens, dogs, cats	Hitchcock (field notes); Cashdan and Chasko (n.d.); Filteau, J. Ebert, M. Ebert (pers. comm.)
Northern Kalahari Okavango Delta, Mababe Depression	Bugakwe, /Tannekwe, Tzexa, Goekwe, !Garikwe, Hukwe, etc.	millet, pumpkins, beans, maize, sorghum	goats, cattle, donkeys, dogs, chickens	Heinz (1969: 746–747, 750); Seiner (1977: 32–35); Campbell (1976 and pers. comm.)

(*Raphionacme burkei*) growing next to the abandoned huts. Subsequent interviews with Kūa revealed that such transplanting was not uncommon and that root and melon plants were sometimes taken from their native habitats and replanted closer to residential locations. One problem with this transplantation strategy was noted, however: often the plants became even more bitter than they were originally.

Story (1958: 7; 1964), among others, has emphasized the detailed botanical knowledge possessed by Basarwa. One species with which they are extremely familiar, and which plays an important role in their economy, is the tsama melon (*Citrullus vulgaris*); crucial to foragers who occupy waterless areas such as those in the Central Kalahari (Story, 1958; Tanaka, 1969, 1971, 1976; Silberbauer, 1965, 1972, n.d., 1978; Cashdan, n.d., this volume). The melons are raised not only to provide moisture for humans but also for the livestock and the small stock they sometimes possess; however, Cashdan (n.d.: 32) notes that the cultivated variety of melon is generally reserved for human consumption, only the rinds being fed to animals. Although we do not know the length of time that melons have been intentionally planted in the Kalahari, it is possible that they have been grown for hundreds of years.

The traditional anthropological view of foraging societies is that they have relatively little impact on their physical environment. Some researchers attribute this limited environmental impact to their inherently conservationist attitude (e.g., Campbell, 1977). A more likely explanation is that forager groups are often characterized by low population density and a wide-ranging mobility that allows resource areas to recover from periods of exploitation.

There is a growing argument in the biological field over the causes of what has been termed "desertification," the process of environmental degradation that was seen most recently in the Sahel zone of Africa. Some scientists attribute this process to climatic factors, noting the frequent droughts that occur in savanna ecosystems; other scientists see man and his domestic animals as the major causes of environmental change. This argument has continued among researchers working in Botswana, with some people holding that habitat deterioration is due primarily to the effects of burning, cutting of trees, overhunting, and, especially, the grazing of domestic herbivores (e.g., Campbell and Child, 1971; Child, 1971; Parris and Child, 1973; Child et al., 1971). Cole and Brown (1976: 195) point out, however, that population density in the Kalahari is generally too low for cutting, at least, to have had much effect. There is no question that human settlement in limited areas has had significant impact (see, for example, the discussion of Parris and Child, 1973: 4, 7), but it is not clear whether the effects are long-term or merely short-term.

Cycles in the Kalahari environment have been documented, both in ancient and more recent times, though plant and animal species respond differentially to these cycles. While Walter (1973: 86–87) has noted that production in arid ecosystems is related linearly to rainfall, he also points out that there is less year-to-year variation in perennial species than in annuals, suggesting that there may be a lag in the response time of perennials (Walter, 1971: 277). Droughts, therefore, pose serious threats to foragers, particularly since they adversely affect the availability of moisture-bearing plants, such as melons, which are annuals.

Changes in the Kalahari have come about as the result of a number of different processes, some of them climatic, others biotic, and still others technological and even political.

The increased densities of livestock in particular have led to significant changes in the environment, but it is our belief that the processes of change began long before cattle and other domestic stock existed in the Kalahari in sufficient numbers to affect the distribution and abundance of resources.

A major factor that brought about changes in adaptive strategies in the Kalahari was the increasing sedentariness of human groups, caused in part by demographic pressures and in part by technological and environmental change (Hitchcock, n.d.). Increases in population density, such as along rivers in eastern and northeastern Botswana, resulted in competition for residential space. The numbers of residential moves of foraging groups

TABLE 2. **Range Size for a Sample of Kalahari Foragers and Food Producers**

Location	Number of ranges	Range size (km²)	Population size	Population density*	Reference
Central Kalahari	6	457–1,036	21–85	0.046–0.097	Silberbauer (1981)
Central Kalahari	11	505–4,323	41–167	0.02–0.3	Sheller (n.d.)
Central Kalahari	?	4,000	229	0.03	Tanaka (1971; 1976: 100)
Southwest Kalahari	5	1,000–2,200	80–315	0.041–0.247	Thoma (pers. comm.)
Northwest Kalahari	9	300–600	9–52	0.154	Lee (n.d.: 47, 199–200; 1979)
Northwest Kalahari	?	1,000–3,000	?	?	Yellen and Harpending (1972: 245); Harpending (pers. comm.)
Eastern Kalahari	7	675–1,370	19–42	0.021–0.039	Hitchcock (1978a: 259; field notes)
Northeast Kalahari	5	195–400	14–88	0.072–0.27	Hitchcock (field notes)

*Calculated as number of persons per sq. km.

were reduced, and groups settled in areas where they had access to bulk resources, the most important of which was permanent water. As competition increased, so, too, did the degree of territoriality, and range sizes were increasingly restricted. Table 2 contains data on range sizes, population sizes, and population density for a number of Kalahari Basarwa populations. It can be seen that there is wide variation in range size, but, in general, ranges in waterless areas such as the central Kalahari are greater than those in the northwest (the Dobe region) or the northeast (the Nata region.)

When groups spend increasing lengths of time in specific locations the resources there become depleted, necessitating a number of shifts in adaptive strategies. Lee (n.d.: 111) notes the two possible strategies employed by Basarwa when foods are scarce: they can travel farther in order to continue to exploit more desirable species, or they can remain closer to camp and exploit less desirable food species. This latter alternative occurs seasonally as well, with !Kung diet becoming "more eclectic" in the latter part of winter (ibid.: 172).

One major shift that occurs among foragers living in an area for an extended period of time is in the body-size classes of prey exploited (cf. Pyke et al., 1977: 142), a shift known as prey-switching. Yellen and Lee (1976: 39) note that although depletion of larger game has occurred in the northwest Kalahari, the hunting-and-gathering way of life has not collapsed, since groups have developed methods for procuring smaller game species. In several parts of the Kalahari, technological changes such as the erection of veterinary cordon fences have disrupted the migration patterns of large game and sometimes have led directly to a reduction in their numbers (Silberbauer, 1965). Another major change that has directly affected the availability of large game is the introduction of the borehole. With the resulting greater numbers of permanent water sources has come an increase in the numbers and density of domestic livestock, a factor which, perhaps more than any other in recent decades, has resulted in the decrease of hunting and gathering. Cattle require water fairly often and so must stay close to water sources, in contrast to wild Kalahari species which move according to the distribution of rainfall or of the plants that provide both water and food. Being less mobile than wild species, cattle are apt to graze and browse out certain local plants. One result of this has been the replacement of perennial grasses by annuals, and another has been the increase in shrubs. Cattle also eat some of the species favored by foragers, such as *Grewia flava* (Cole and Brown, 1976: 195), as well as competing successfully with wild game, for the food plants and aerial censuses in Botswana have revealed that densities of large wild mammal species are much

lower in ranching areas than elsewhere. On the other hand, the bush encroachment that occurs when cattle overgraze an area may have positive effects for some game species (e.g., small antelopes like duiker and steenbok). Thus, the prey-switching seen among human foragers may be due not solely to resource depletion but also to an increase in the abundance of smaller prey.

While it has been suggested by some researchers that overhunting among foragers is not uncommon and may even account for the widespread extinctions at the end of the Pleistocene, there is no evidence from the Kalahari, at least, that this has occurred; game depletion there is more likely the result of habitat deterioration (Campbell and Child, 1971) or climatic change. Wild animals still exist in substantial numbers in the Kalahari, but they tend to stay away from ranching and residential areas. In the Nata River region large die-offs of wildebeest and buffalo, as well as other species, occurred during major droughts in 1933, 1947, and the early 1960s. Correlated with these die-offs were changes in hunting strategies (Crowell, field notes) and shifts to alternative resources, including aquatic species, especially fish (Hitchcock, n.d.).

One major response to drought among agricultural populations in southern Africa was to fall back on hunted and gathered foods (Scudder, 1971, 1976; Grivetti, 1978, 1979). In drought periods the Kalahari foragers expand the numbers of species they exploit, often including bitter roots, leaves, and barks they might otherwise ignore. J. D. Clark (1976a: 83) points out that a study of the ethnographic literature, particularly that which deals with human behavior in times of food scarcity, may throw light on the processes involved in the beginnings of domestication. Table 3 contains a listing of the numbers and kinds of plant species exploited by a sample of southern African foragers and food producers. The agricultural groups are seen to exploit an even wider array of plant species than do the foragers, and they use somewhat different parts of the plants. Foragers often focus on the reproductive parts—the roots, fruits, and nuts—while agriculturalists often utilize growing tissue, including stems, bark, and leaves. This difference is due in part to the fact that agriculturalists often exploit plants in stress periods, when they are not reproducing, but they also tend to select parts, such as leaves, that can be used as relishes. Agriculturalists such as the Gwembe Tonga of the Middle Zambezi in Zambia also utilize grasses (Scudder, 1971, 1976). In the Near East this tendency may well be related to the trend toward exploitation of

TABLE 3. **Comparative Data on Wild Edible Plant Species Utilized by Foragers and Food Producers in Southern Africa (adapted from Grivetti, 1979: 251, with additions).***

Food plant category	Dobe !Kung	Nyae Nyae !Kung	G/wi	G//ana	Moshaweng Tlokwa	Gwembe Tonga
tubers, roots, bulbs	4	27	6	14	22	17
fruits, nuts, berries, seeds	31	30	8	34	31	53
leaves, stalks	34	4	20	20	47	58
barks, flowers, gums	16	11		9	23	3
grasses						9
mushrooms				1	3	"several"
TOTALS	85	72	34	78	126	140+

*The sources from which these figures are derived are as follows. Dobe !Kung: Lee (n.d.); Nyae Nyae !Kung: Marshall (1976: 109–123); G/wi: Silberbauer (1965); G//ana: Tanaka (1976); Moshaweng Tlokwa (located in southeastern Botswana near Gaborone): Grivetti (1979); Gwembe Tonga (located in the middle Zambezi Valley of Zambia): Scudder (1971: 39–45; 1976: 374–380). It should be pointed out that some of these plants may overlap in use; in the list provided by Marshall (1976), for example, some plants used as tubers are also utilized as nuts or fruits, and the leaves of fruit-bearing plants are also utilized.

TABLE 4. **Daily Foraging-Trip Distances for a Sample of Kalahari Foragers and Food Producers**

Location	Group	Foraging trip distance	Comments	Reference
Central Kalahari (!Xade)	G//ana	10 km	movement determined by availability of plants, not by hunting; water critical only part of year (p. 113)	Tanaka (1976: 116)
Central Kalahari	G/wi	8 km 6–7 km (Dec.–May) 0.414 km^2/person/day (winter)	year-to-year variation in amount of tsama melons available and amount of territory necessary to exploit them (1972: 300)	Silberbauer (1972: 287; 1978: 115, 116)
Northwest Kalahari (Dobe)	!Kung	10 km radius	day's round trip of 20 km serves to define a "core" area 10 km in radius . . . except for a few weeks each year (Lee, 1968: 35); June: 10–15 km round trip, August: 20 km (Lee, n.d: 107); 32 km. av. max. distance (Lee, n.d.: 144); rarely more than 15 km (on straight line) from camp and generally no more than 10 km (Yellen and Lee, 1976: 43)	Lee (1968: 35; 1969: 57; n.d.: 107, 143–145, 150–151); Yellen and Lee (1976: 43)
Northwest Kalahari (Nyae Nyae)	!Kung	13–20 km round trip	within area women zigzag another km or so looking for roots to dig	Marshall (1976: 106)
Eastern Kalahari (Ramokgophane)	Kūa	4–20 km round trip	av. approx. 12 km	Hitchcock (1978a: 237; field notes)
Eastern Kalahari (Mmasana)	Kūa	7–46 km round trip	group mostly sedentary; long-distance gathering trips undertaken with donkeys	Hitchcock (1978a: 237; field notes)
Northeast Kalahari (Man/otai)	/Aise	2–60 km round trip; 20 km average	group sedentary and produces food; gathering trips include salt and palm leaves procurement	Hitchcock (field notes)

wheat, barley, and other grains toward the end of the Pleistocene (Flannery, 1969, 1973), when foragers may have had to increase their utilization of less desirable foods, including grasses, thus setting the stage for manipulation and intentional cultivation of such plants.

Table 4 presents a record of daily foraging-trip distances for Kalahari groups. Distances covered in a day generally average up to approximately 20 km. As groups become increasingly sedentary, the daily foraging-trip distances may well increase. There are also changes in the frequency and in the length of trips, measured in terms of number of days' duration. Whereas foragers rarely go on overnight gathering trips, such trips are not uncommon among sedentary groups. Long-distance gathering trips of a few days to a few weeks in duration have been noted in the Ghanzi Farms area of western Botswana (Guenther, 1976: 125) and in the borehole area of the eastern Kalahari (Hitchcock, 1978a: 237). The same is true for hunting trips. Long-distance hunts, often involving several men, are not characteristic of mobile foragers, whereas they are quite common among settled groups such as those in the Nata River region (Hitchcock, n.d.), the eastern Kalahari (Hitchcock, 1978a: 236), and the Ghanzi Farms region (Guenther, 1976: 125). In this sense, Grivetti's (1979: 245, 251) statement that the Tlokwa "regularly" exploit more wild food resources than do hunter/gatherers is incorrect.

With reduced residential mobility, many groups no longer have access to areas where resources may be seasonally available. As a result,

TABLE 5. **Wild Edible Plant Species Found Stored in Households of Eastern and Northeastern Kalahari Foragers and Food Producers (adapted from Vierich and Hitchcock, 1978).**

Scientific name	Common names	Description and uses	Seasonality	Reference
Bauhinia macrantha Oliv.	coffee bean, machancha (Setswana), ≠en ≠e (Kūa), /en (G/wi)	60–90 cm high shrub, with long pods containing 4–8 beans; roasted and ground, or brewed like coffee	ripens January–June; found stored 1 year after harvesting	Marshall (1976: 114); Silberbauer (n.d.: 47, 301); Tanaka (1971: 17, 36; 1976: 117); Clauss (n.d.: 3a)
Citrullus vulgaris Schrad. (or *Colocynthus citrullus*)	tsama melon, d/un (Kūa), n≠a (g/wi), n//an (G//ana), mokate (Setswana)	melons growing 2–3.5m runners attached to deep mass of roots; annual plant similar to the cultivated melon grown by Kalahari groups; cut into strips and dried for storage	ripens April–June, stored through August but sometimes longer	Marshall (1976: 120); Silberbauer (1972: 283; n.d.: 48, 301); Story (1958: 48–49); Tanaka (1971: 17)
Grewia flava	raisin berry; moretlwa (Setswana), kxum (Kūa), kxam (G/wi)	woody shrub with small berries; eaten raw, sometimes pounded and mixed with meat or porridge	ripens November–March, stored year-round	Marshall (1976: 113); Silberbauer (n.d.: 303); Story (1958: 33–34); Clauss (n.d.: 3a)
Raphionacme burkei	water root, leditsa (Setswana), bai (Kūa), //an (!Xō), bi (G/wi)	small, woody, slender-leaved plant with tuber	year-round; sometimes transported to camp and replanted	Marshall (1976: 122); Story (1958: 38–39); Clauss (n.d.: 3c); Tanaka (1976: 117)
Ricinodendron rautanenii Schinz	mongongo nut, mokongwa (Setswana), /um (/Aise)	tall tree growing on dune crests; nut has outer fruit cover, boiled, nut roasted and broken	fruit ripens April–November, nut available all year	Marshall (1976: 114–116); Lee (1973); Yellen and Lee (1976: 40–41)
Tylosema esculenta Burch (or *Bauhinia esculenta*)	tsin bean, morama (Setswana), //odu (Kūa), /oi (G//ana)	large underground storage organ with long vines attached; bean grows on vine; both beans and tuber consumed	ripens November–May, bean found stored year-round	Cole and Brown (1976: 180): Marshall (1976: 109, 113–114); Story (1958: 26); Clauss (n.d.: 3d)
Vangueria infausta Burch	wild medlar, mmilo (Setswana), /duru (!Kung)	2.5–3.0m tree with small round yellow fruits, either eaten raw or boiled	fruit ripens in rainy season (November–April)	Lee (n.d.: 109; 1979: 472); Grivetti (1979: 249)

they must develop a means for extending the use-life of the resources they exploit; Binford (n.d.) has described these methods as a way of gaining "time utility" from resources. Whereas foragers consume foods immediately, sedentary groups are forced either to trade for them or to develop storage methods so as to have the resources on hand in periods of scarcity. Table 5 contains a listing of some of the edible plant species stored by eastern and northeastern Kalahari Basarwa households. Some of these plants had to be specially processed for storage—mmilo (*Vangueria infausta*), for example, had to be pounded in wooden mortars and then formed into cakes which were kept in baskets in people's houses.

Animal foods obtained in quantity were also processed for storage by sedentary groups. In the winter, Nata River groups sometimes went on

expedition hunts during which large game was killed, sometimes in substantial numbers. Runners were then sent back to the residential locations and groups of men, women, and children came out to the kill sites. Animals were cut up by special butchering parties: the meat was cut into strips and hung to dry on trees or on racks built for the purpose. (In the rainy season the meat was smoked, since drying was then relatively ineffective.) The processed meat was taken back to the camps and shared among those who had stayed behind, any left-over meat being placed in the eaves of houses or on racks in the compounds. However, food storage not only necessitates an increase in procurement time but also, in some cases, specialized processing and preserving. The processed food also requires the development of protective facilities such as storage baskets or even storehouses. Many Nata River compounds contain drying racks and mud storehouses in which both wild and domestic foods are kept. As groups become more residentially stationary, therefore, work effort tends to increase. Table 6 sets out data on work effort for a number of Kalahari groups. It has already been pointed out that Lee's (1968) research emphasized that labor time of !Kung was relatively low, ranging from 12 to 19 hours per week. Draper's (n.d.) data, also collected among !Kung but in a region ecologically somewhat different from Dobe, reveal that foragers under certain conditions do expend a fairly substantial amount of time in subsistence work. It is interesting to compare the work effort of !Kung with that of the Nata groups, who are engaged in food production. It is clear that work effort for Nata groups is higher than that of foragers in either the northwest or the eastern Kalahari region. However, the data for the Nata groups were obtained during the rainy season (February) and dur-

TABLE 6. **Subsistence Work Effort for a Sample of Kalahari Foragers and Food Producers**

Area	Observation period	Group size	Total days	Number of work days	Percentage of days worked	Number of days worked per week
Foragers:						
Dobe[1]	1 (7/6–7/12, '64)	25.6 (23–29)	114	37	.32	2.3
	2 (7/20–7/26, '64)	34.3 (29–40)	156	42	.27	1.9
	3 (7/27–8/2, '64)	35.6 (32–40)	167	77	.46	3.2
/Du/Da[2]	1 (2/27–3/4, '69)	25.3 (16–29)	74	42	.57	3.99
	2 (3/27–4/1, '69)	32.0 (29–35)	142	62	.44	3.1
	3 (5/15–5/21, '69)	41.0 (34–43)	187	55	.29	2.0
	4 (6/1–6/6, '69)	54.6 (51–56)	173	35	.20	1.4
	5 (7/15–7/18, '69)	19.0 (19)	48	4	.08	0.6
	6 (8/15–8/25, '69)	56.5 (44–69)	439	142	.32	2.2
	7 (10/5–10/9, '69)	50.8 (44–59)	205	68	.33	2.3
Food Producers :						
Khwee[3]	1 (1/28–1/30, '78)	28.5 (24–33)	57	29	.51	3.6
Uwe-Abo[3]	1 (2/14–2/17, '78)	26.5 (23–30)	44	21	.48	3.3
Bae[3]	1(1/9–3/9, '78)	15.0 (11–19)	24	9	.38	2.6
Nata[4]	1 (2/3–2/6, '76)	7.0 (5–9)	32	24	.75	5.3
	2 (2/21–2/25, '76)	9.5 (9–10)	48	40	.83	5.8
	3 (8/2–8/6, '76)	6.0 (5–7)	37	25	.68	4.8

[1]Lee (1968)
[2]Draper (n.d.)
[3]Hitchcock (field notes, eastern Kalahari groups)
[4]Hitchcock (field notes, northeastern Kalahari groups)

ing the latter part of the harvest season (August). There are other periods when agriculturalists do little, if any, work related directly to food procurement, living instead on stores from the previous harvest. Overall, though, the amount of labor expended by agriculturalists is higher than that of foragers. This is one reason why eastern Kalahari Kūa told us they did not want to grow food. As they put it, "It's too damned much work."

Changes in work effort are correlated with changes in the organization of labor. Organizing trips to collect wild plant and animal foods in the rainy season tends to conflict with activities closer to home, particularly that of food production. To facilitate the work, children are increasingly being brought into the labor force (Draper, 1975; Hitchcock, n.d.), and tasks become increasingly differentiated, with young boys and girls taught to do separate kinds of things.

It should be emphasized that stress on groups due to food scarcity does not necessarily lead to intensification of effort. Marshall (1976: 107) notes that in the late dry season, when resources are at their lowest ebb, women tend to work less than in periods of abundance. People may opt for any one of an array of different strategies, including becoming dependents, going to visit relatives who have sufficient resources to share, trading, doing specialized work for others such as healing (Guenther, 1975/76; J. B. Wright, 1971: 9), raiding (M. Wilson, 1969: 64), or simply making do with less food. The important point is that people choose what they perceive to be the most secure strategy. Agriculture is in many ways less efficient than foraging, since it involves a greater expenditure of time and effort. It is also less secure, crop failures being frequent in the Kalahari (Schapera, 1943: 17) necessitating returns to hunting and gathering (Scudder, 1971, 1976; Grivetti, 1978, 1979; Devitt, 1977, 1978; Hitchcock, 1978b).

At some point in the intensification of foraging strategies a threshold must have been reached where the benefits derived from increasing labor time, distances covered, and bulk resources procured, and developing processing and maintenance strategies resulted in diminishing returns. Although it is difficult to pinpoint the exact threshold, there is no doubt that at some point foragers began to intensify local exploitation, manipulating their environment to increase productivity. It is very likely that it was in this way that the tsama melon began to be intentionally cultivated by Basarwa. Other less desirable foods, particularly grasses and herbaceous plants, would also have received increasing attention, as noted by Scudder (1971, 1976).

The model that has been presented for the changes in foraging strategies and the beginnings of environmental manipulation is by no means simple, nor is it a one-way process. Cashdan (this volume) has pointed out that food production may have come about in the absence of range restriction. It is also clear that groups may not opt for food production but instead trade for the domestic food products they want—as, for example, at Nata. Foragers in this way may receive from the food producers not techniques of food production but, rather, the domestic foods themselves, thus reducing their need for growing their own food. They may also work in the fields of other groups, getting a portion of the crop produced in exchange for their labor. Agriculture was not so much a revolutionary phenomenon as it was an evolutionary one. Food production began simply as a buffer against scarcity; it was only after a substantial period of time that domestic foods became the staples and wild foods the buffering resources.

Strategies of Agricultural Production in the Kalahari

Guenther (1975/76: 45–46, 52; 1977: 196) has described the Basarwa of the Ghanzi Farms as "marginal herders and cultivators." Many other groups in the Kalahari would fit this description, since they do on occasion raise crops and care for domestic stock. Nonetheless, few Basarwa groups depend completely on domesticated foods. Lee (1976a: 8–9) notes that hunting and gathering plays an important role in the economy of the !Kung, and he goes on to imply that wild foods continue to be significant in the diet of even the most acculturated of Basarwa communities. Although nearly 40 percent of the Ghanzi Farms Basarwa were involved in agricultural production in

1975, domestic food crops made up only 6 percent of their subsistence (Childers, 1976: 62). Sheller (n.d.: 20) estimates that 5 to 20 percent of the diet of the G//anakwe of the Central Kalahari is made up of what he describes as "supplemental" agriculture and stock-raising. Even the Bakgalagadi, a Bantu-speaking group of Sotho stock who are related to the Tswana, have a diet which comprises only 15 to 35 percent domestic foods, according to Sheller's (ibid.: 30) investigation for the Central Kalahari Game Reserve survey of 1976.

The agricultural techniques used by food producers in the Kalahari are almost exactly the same as those used by foragers. Nearly all the agriculture can be described as a kind of swidden system. Small areas are cleared, either by hand or with cutting implements such as knives and axes. The debris is then piled up and burned, a process that not only rids the area of unwanted material but also adds nutrients to the soil. Small holes are dug in the ground with digging sticks and seeds are dropped in and covered with soil.

Crops are grown either in gardens near the houses, or in fields (*masimo*), agricultural areas usually some distance from people's homes. The gardens are small and are cultivated with the aid of either a digging stick or a hoe. Most Kalahari foragers and part-time food producers grow crops in gardens rather than fields. By contrast, the more sedentary populations usually plant fields, which they cultivate with ploughs. One advantage of having the gardens close to the houses is that potential competitors such as baboons or antelopes probably stay away from the crops when people are living there; D. R. Harris (1976: 338–340) has suggested that the tending of gardens near people's homes is probably the earliest system of cultivation in the tropics.

Planting is done in the early part of the rainy season, which usually begins in November. After that the groups may leave the area, continuing on their annual rounds. Occasionally they protect their small gardens with low thorn fences, but more often than not they leave them unenclosed. Sometimes individuals or small foraging parties will check on the progress of the crops if they happen to be in the area, but generally the gardens are forgotten until the group returns to the rainy-season camp the following year. If they are lucky, if the seeds have sprouted and no animals or birds have eaten the crop, they are able to harvest some melons, beans, or whatever else they may have planted. If the group remains in camp they usually weed only once, often in mid-February or early March. Crops that ripen early, such as green maize, sweet reed, and melons, may be harvested in late March or April. An important crop, sorghum (*Sorghum vulgare* or *S. bicolor*), begins to seed in April or May, and then it is necessary for people to keep birds away from the crops. We observed as many as fifty people involved in bird-scaring in field areas in the eastern Kalahari in 1978. In some areas whole crops of maize, sorghum, and millet were destroyed by depredations of Quelea finches and other birds. Harvesting of crops is carried out from June through July and sometimes into August, depending on field size and yield.

Following harvest, there is a period of processing in which crops are threshed on mud and cow dung threshing-floors known as *diboa*. The grains are winnowed to get rid of the chaff, and the processed material is put into bags, often mixed with burned dung and ash to protect it from insects. The bagged material is then placed in houses or in special compartmentalized storehouses. In some cases, expecially when yields are low, crops are processed and then simply kept in baskets or stored in the eaves of houses. Once the harvest is over, cattle are frequently allowed to graze on the stubble, thus increasing soil nutrients through the addition of manure. However, they also harden the ground surface by trampling, as well as spreading weeds.

Crop failures are common in the Kalahari, and food-producing groups have developed a number of different strategies to deal with problems incurred by low or poorly timed rainfall and destruction by insects, birds, and animals: (1) spatial diversification; (2) temporal diversification; and (3) crop or product diversification. Some Kūa groups in the eastern Kalahari were observed to have planted crops in several different places, thus increasing the chances that at least one of them would receive sufficient rain or would not be preyed upon by competing animals. A kind of temporal diversification strategy was also observed. Groups of !Xō in the southwest Kalahari, for example,

stagger their planting, cultivating one patch of about 10 by 10 m each week for five to six weeks (A. Thoma, pers. comm.). This strategy increases the chance that at least one patch will receive rainfall at the correct time. Finally, a variety of crops are planted in the hope that at least some of them will grow. A combination of melons, beans, maize, sorghum, pumpkins, and millet is sown. Since the crops have different degrees of drought-resistance and different soil and moisture requirements, some of them may grow while others will not. It is significant that foragers in the eastern Kalahari who used these strategies had fewer unsuccessful plantings than did plow agriculturalists, who, theoretically, are far more familiar with crop-production techniques (Hitchcock, 1978a: 352).

Table 2 lists the domesticated plants grown by foragers and food producers in the Kalahari. Not all of these plants are grown for food. Bottle gourd and calabashes (*Lagenaria* spp.), for example, are used as scoops and containers; also, tobacco and marijuana are often cultivated not so much for home consumption as for exchange. Some groups in the Kalahari were observed to exchange smoking products for food and sometimes for cash.

The most popular crop among Kalahari groups was melons. Several reasons were offered for their popularity: first, they provided a source of water; second, they were relatively drought-resistant, especially when compared to seed crops like sorghum and maize; and, third, dried melons are an article of food for both humans and livestock and, after they have been cut into strips and hung on thorn trees to dry, they are easy to store. The second most popular plant was beans (*Phaseolus* spp.). Although sorghum and maize were well liked by Kalahari groups, success in growing them was not as high. It is interesting to note that, overall, groups that only recently began planting crops tended to have greater success than food-producing populations such as the Bakgalagadi and Bamangwato, the reasons being that they selected crops specifically for their ability to withstand drought and that they used the diversification strategies mentioned previously. In addition, the Tswana sow by throwing a mixture of seeds by hand, or broadcast, as the earth is turned over by the plow. Foragers and part-time food producers preferred instead to make a hole with a digging stick and drop a single seed into it; this far more efficient method resulted in higher yields in terms of return per unit of seed planted.

In the Kalahari, groups do not have to be sedentary in order to practice food production, nor does it necessarily lead to people becoming sedentary. Some of the groups at Khwee in the eastern Kalahari made as many as nine residential moves a year, and they had gardens at several of their campsites. They returned to harvest the crops in April and May of 1978, going from one abandoned campsite to another collecting the melons and maize and taking them back to their dry-season camp on donkeys.

It is difficult to obtain data on yields in the Kalahari because the growers frequently consume the crops immediately after harvest. In a few cases, however, it was possible to get rough estimates of how much food was obtained by a given household. Hitchcock (1978a: 351, table 12.7) was able to collect data on yields of 45 households in the eastern Kalahari. Of those households 14 (31 percent) got nothing whatsoever, 22 (49 percent) got melons only, and the remainder got relatively small amounts of sorghum, maize, millet, beans, cowpeas, and a few other crops. Data obtained in the 1977/78 agricultural season revealed that three of the twelve groups of independent or "intact" foragers planted gardens, but in the previous year nine of the twelve had done so. Comparison with part-time food producers residing on cattle-posts revealed that the success rate was higher among mobile foragers than among sedentary groups.

Field sizes of food-producing groups in the Kalahari vary tremendously, but in general the Basarwa have relatively small fields. This is due at least in part to the fact that the vast majority of the Basarwa use either digging sticks or hoes in cultivation, as opposed to other groups, which mainly use single-furrow plows drawn by oxen or donkeys. Table 7 presents data on field sizes among Basarwa populations in the Kalahari, as reported by anthropologists and development workers. It can be seen that the average field size is small—about one-half hectare, when the entire data set is considered. Fields in the southeast Kalahari and those at Nata, which tend to be larger than other fields, were cultivated with plows. The introduction of the plow in

TABLE 7. **Comparative Data on Field Sizes of Bushman Populations in Botswana**

Location	Group	Size in hectares (1 ha = 2.471 acres)	No. of fields	Reference
I. Southwest Kalahari				
a. N!haite/Hukuntsi	!Xō	0.2–1.0 ha	7	Thoma (n.d.)
b. Pepane/Lehututu	!Xō	0.2–0.6 ha	10	Thoma (n.d.)
c. Monong	!Xō	0.5–0.6 ha	2	Thoma (n.d.)
d. Ngwatle	!Xō	0.3–0.4 ha	2	Thoma (n.d.)
e. Kwakai	!Xō	0.2–0.3 ha	2	Thoma (n.d.)
f. Tshotswa	!Xō	4.5 ha	1 (communal)	Thoma (n.d.)
Subtotal		average = 0.5166 ha	24	
II. Southeast Kalahari				
a. Thotayamarula	Kūa	5.875 ha	1	Vierich (n.d.b)
b. Mazane	Kūa	0.62–8.4 ha	3	Vierich (n.d.b)
Subtotal		average = 3.2 ha	4	
III. Southern Kalahari				
a. Molopo Farms	Balala	average = 0.027 ha	30	Lawry (1978: 23)
IV. Northwest Kalahari				
a. Dobe, etc.	!Kung	0.532 ha	64	Matlhare (1978)
V. Northeast Kalahari				
a. Nata River region	/Aise, etc.	average = 1.146 ha	12	Cashdan and Chasko (n.d.: 28)
VI. Eastern Kalahari				
a. Western Sandveld region	Kūa, etc.	0.01–1.1 ha average = 0.14 ha	18	Hitchcock (1978a: 350)
TOTAL		0.501 ha average	152	

the nineteenth century led to an increase in field sizes and yields and also had implications for the division of labor in agriculture. Among the Tswana, hoe agriculture was done mainly by women, men taking little part, but once the plow came into use men were needed to control the oxen that pulled them. Among the Basarwa, on the other hand, men were observed taking part in food-production activities nearly as often as the women, both mainly using digging sticks and hoes.

We have stressed repeatedly that the Kalahari is subject to cycles of wet and dry years, and rainfall frequently comes at the wrong time of the year for good crop-production. The result is crop failure, which forces people to rely on hunting and gathering. Among the !Kung, for example, Lee (1976a: 19) mentions that they planted gardens in the good rainfall years of 1967 to 1970 but fell back on foraging in 1972/73, a drought year in the northwest Kalahari. By 1975/76, many of the same people were again cultivating crops in the Dobe area (Gelburd, n.d.; T. H. Hargrove, pers. comm.).

Another constraint on agriculture is lack of access to seeds, implements, oxen to use for drawing the plows, and labor. A characteristic feature of foraging societies is their emphasis on immediate consumption of food; frequently they do not even save seeds for the next year's planting (Reid, n.d.: 12). Competition from both wild and domestic species also results in crop failures, particularly in areas near villages, where there are large numbers of domestic animals. Building of thorn fences and close herding of cows and smallstock will help to protect the crops, but destruction of crops is still an all-too-frequent occurrence. The emphasis on sharing among Kalahari foragers also militates against agricultural production. Guenther (1977: 200) mentions that individuals owning livestock are

TABLE 8. **Estimated Percentages of Kalahari Populations Engaged in Agricultural Production**

Location	Group	Size of population	No. doing agriculture	Percentage	Reference
Northwest Kalahari	!Kung	38	12	31.6	Gelburd (n.d.: 79–82, table 8)
Northwest Kalahari	!Kung	?	?	7.0	Wiessner (n.d.: 85, table 3)
Western Kalahari	Nharo, G/wi, etc.	4,512	?	nearly 40	Childers (1976: 62)
Southeast Kalahari (Kgatleng)	Tsassi, etc.	52	23	44.2	Caye and Koitsiwe (n.d.: 26)
Southeast Kalahari (Kweneng)	Kūa, etc.	136 hh's	66 hh's	48.5	Vierich (pers. comm.)
Eastern Kalahari	Kūa, etc.	666 hh's	147 hh's	22.1	Hitchcock (1978a: 339)

often asked to slaughter their animals and share the meat. Wiessner (n.d.: 370) notes that in order for people to become successful agriculturalists they must take certain items, such as agricultural implements, out of the sharing network. These must begin to be seen as the personal property of their possessors, a fact that is anathema to egalitarian-minded foragers. Sometimes there is social pressure not to farm. Wiessner (n.d.: 151) mentions a !Kung man who was heavily criticized for his agricultural and livestock-raising activities, the reason being that his friends and relatives were afraid he would cease foraging, which would have had adverse effects on the group as a whole.

Estimated percentages of Kalahari groups engaged in agricultural production are set out in Table 8. It is apparent that the numbers range from very few among some !Kung groups to nearly half the households in the Kweneng District area. Two other areas, not shown in this table, are the Nata River region and the eastern hardveld region, e.g., along the Motloutse River in the Central District. Basarwa in these areas are engaged in agriculture to a greater extent than they are in other parts of Botswana. However, in virtually all these areas people still derive a substantial portion of their diet from foraging.

If we accept the diffusionist model of the spread of agriculture, we would expect those groups in closest proximity to food-producing people such as the Tswana to be the ones most involved in agriculture. Just the opposite is the case. Those groups which live on the peripheries of the major Tswana towns tend to be least involved in agriculture. The reason is twofold: first, these people have access to alternative ways of obtaining domestic products, through trade or employment; second, near towns, the crop damage by livestock is the highest, so people have less success in raising crops. The result is that the Basarwa groups most involved in agriculture are usually those in marginal areas, away from food producers. It is also interesting that the areas with the greatest diversity of resources are not usually those where food producers are found.

Consequences of Food Production in the Kalahari

While food production clearly did not at first substantially alter the subsistence, mobility, and social systems of Kalahari populations, it did eventually lead to some important changes among those groups that began to depend on domestic foods. These changes are perhaps most marked in the nutritional state of those using domestic foods for a large proprotion of their subsistence.

Grivetti (1978, 1979) maintains that nutritional stress is not a characteristic feature of most Kalahari groups even during drought periods, but

there are signs of at least a certain amount of malnutrition among cattle-post populations (H. Vierich, pers. comm.; Hitchcock, field notes). The major foods of most Botswana groups—maize meal and sorghum porridge—are high in carbohydrates, and substantial amounts are usually consumed at each sitting. Obesity is, therefore, more often found among agriculturalists than among foragers. Also, vitamin and protein deficiency is more common among groups using domestic foods than among foragers, whose diet is more mixed and reasonably well-balanced nutritionally. Another problem, far more common among agriculturalists than among foragers (Scudder, 1971: 6), is seasonal hunger. Under these circumstances it is not surprising that foragers are loath to take up agriculture as a way of life.

Lee (1972b) has suggested that the availability of soft foods, especially porridge made of grains, may have implications for rising fertility levels among Kalahari populations. He argues that the earlier weaning such foods allow would mean that lactation would no longer be a factor in suppressing ovulation, thus decreasing the interval between births. Binford and Chasko (1976) have examined this hypothesis as well as several others and have concluded that although lactation may indeed be a factor, it is less important than dietary changes, especially increased carbohydrate intake, among sedentary populations. The three most important variables causing changes in conception frequencies among Nunamiut Eskimo were: (1) changes in miscarriage rate; (2) changes in male absenteeism; and (3) dietary changes, with the latter variable accounting for over 87 percent of the observed patterning (ibid.: 130). The findings of Wilmsen (1978) tend to corroborate those of Binford and Chasko. Working among !Kung populations, Wilmsen found that foragers dependent upon wild foods were subject to annual periods of nutritional stress, resulting in seasonal fluctuations in conception frequency. Populations dependent upon milk and grain products, on the other hand, tended to have less fluctuation in weight and larger numbers of births. Wilmsen attributes these differences to varying hormonal levels in females. N. Howell (1979), basing her arguments on the ideas of demographer Frisch (e.g., Frisch, 1975), notes that women must achieve a critical level of fatness in order to ovulate. The increased availability of domestic products would facilitate the maintenance of appropriate body-fat levels, making the women more prone to become pregnant. Thus, fertility levels are said to increase as groups have greater access to domestic foods. However, Harpending (1976: 160) disagrees, noting that fertility has not increased among !Kung to any great extent. Rather than an increase in fertility levels, Harpending (ibid.: 165) favors the idea of a drop in mortality levels, a suggestion in accordance with traditional Malthusian demographic theory.

A number of other changes have occurred as a result of increased dependence on domestic foods. As Hitchcock (n.d.) has pointed out, increased investment in land and facilities leads to the emergence of inheritance patterns and to greater inequality in the distribution of wealth as sharing begins to break down and individuals and families accumulate property for themselves. This means that food production, in the long run, leads to hereditary inequality, though among most Kalahari groups the process has not yet gone far enough to occasion such organizational changes.

Conclusions

Study of the emergence of food production among Kalahari foraging populations reveals that many of the assumptions about how agriculture evolved in southern Africa need to be reexamined. The suggestion that this evolution was the result of contact with immigrating Bantu-speaking agriculturalists is now open to doubt. Information on the distribution of food-producing Basarwa groups shows, on the contrary, that the closer they are in space to food producers the less likely they are to take to raising their own food. Ethnohistoric and ethnographic data on forager/farmer contacts reveal that foragers will trade with farmers, work for them, and even become their dependents, and so gain access to non-local goods, including domestic foods, without resorting to food production themselves.

A second major conclusion is that foragers may

not immediately opt for food production, because they do not necessarily perceive it to be a more secure or more efficient strategy. Stress on foragers, brought about as a result of either environmental or demographic change, causes them to employ a number of responses, ranging from doing nothing at all to intensifying their foraging activities by increasing trip distances, expending more time and effort in food procurement, accumulating resources in bulk for storage purposes, and investing greater amounts of energy in the manufacture and maintenance of storage facilities. A major response is broadening of the diet to include new plants and aquatic species.

Kalahari foragers also employ a number of environmental-manipulation strategies to enhance the productivity of wild resources, the most important being the use of controlled burning and special treatment of favored plant species through protection, transplanting, and even a degree of cultivation. Increasing attention paid to specific plants such as melons, in the local area, may have led to intentional cultivation in gardens around residential camps; thus, there is no clear dividing line between environmental manipulation and food production.

While some (e.g., Phillipson, 1977c: 56) have argued that food production "secured man's vegetable diet," thus allowing him to become sedentary, data on Kalahari foragers reveal that some groups are sedentary in the absence of food production and others are food producers while still remaining mobile; the two are not necessarily correlated. The security of agriculture as a way of life may also be questioned in the light of Kalahari data. Most domesticated plants are annuals, highly responsive to rainfall variations, which in the Kalahari are extreme both in space and time, so that it is not uncommon to find localized crop failures. Foragers, who often depend on perennial species such as mongongo and morama nuts and fall back on roots in times of severe stress, are not as subject to environmental fluctuations and seasonal hunger as are agriculturalists.

By itself, therefore, agriculture is not a secure strategy in the Kalahari, but when combined with foraging and other kinds of strategies (e.g., trading or working for others), it provides a much-needed buffer against resource scarcity.

Lack of familiarity with agricultural techniques is also not the reason that people in the Kalahari have not begun to produce food in quantity. In fact, examination of the agricultural methods of foragers and part-time food producers reveals that their techniques are often more effective than those employed by groups with a long history of food production. Kalahari groups tend to choose their crops carefully and to try a number of different methods to ensure success.

The transition to food production in human society probably did not occur just once but many times. There is abundant evidence in the Kalahari that groups fall back on foraging in drought years, while in years of higher rainfall they may plant some crops. Even their domestic animals are said to cycle directly with rainfall, with higher calving rates among cattle in wet years. There may also be an inverse relationship between rainfall and high productivity among, say, sheep and goats, which tend to do poorly in heavy rainfall years, possibly because of increased numbers of intestinal parasites. The relationship between rainfall and food production in the Kalahari is thus not a simple and direct one, though there is no question that food production is becoming increasingly important among the populations there. One reason for this is the decrease in the availability of wild foods. Game has been reduced, partly by habitat deterioration and partly by overhunting, as well as by modern technological change (as we have seen above).

It should be stressed, however, that environmental degradation and population pressure alone may not account for the decreasing reliance on hunted and gathered foods in the Kalahari. Availability of manpower may also be a factor. As wage-labor opportunities increase, there is a decrease in the labor available for either foraging or food production. Also, the introduction and strict enforcement of game laws in remote areas has made many Basarwa afraid to hunt. Even prestige sometimes plays a part; many people in the eastern Kalahari told us they did not like to hunt and gather because "some people might think we are animals." Another change that should be mentioned is the effort on the part of governments and people interested in development to introduce agriculture to Kalahari groups. Three major examples of this are: (1) the

South African settlement scheme at Tsumkwe in eastern Namibia; (2) Bere, a settlement in the western Kalahari where H. J. Heinz and others have worked; and (3) the development work undertaken by the Remote Area Development Program, especially in the western parts of Botswana.

However, the success of such schemes has not as yet been very marked and, although self-help input is now increasing among Kalahari groups, none of them is yet able to depend totally on the products of their fields. There is no doubt, however, that Basarwa groups would like to produce their own food, and they are openly appreciative of the efforts being made on their behalf.

Food production did not come about because people were suddenly exposed to a new way of making a living: it was a gradual process and one that was by no means unidirectional. It began as a buffer in times of resource depletion and, even today, forms only a part of the total subsistence system of the Kalahari groups. The main determining factor was competition for increasingly scarce resources, exacerbated by increase in livestock and human populations and by competition from more highly organized groups. Before other groups had become an important factor, the processes leading to food production had already been set in motion; indeed, for a long time it was one of the several strategies employed to overcome increasing resource scarcity. In many ways it was a last resort undertaken with great misgiving by foragers in whose eyes it appeared a far from secure way of life. It was only when it became painfully apparent that foraging activities would no longer support the group that the Kalahari peoples began to relinquish their time-tested hunting and gathering in order to become food producers.