The Dobe-/Du/da Environment

Background to a Hunting and Gathering Way of Life

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The mongongo forests north of Dobe and the border road in 1964

The Dobe-/Du/da region[1] lies on the northern fringe of the Kalahari Desert, straddling the international border between Botswana and Namibia. Its limits lie between 20°30′ south latitude and 20°45′ to 21°20′ east longitude, encompassing an area of approximately 11,000 km². The Aha Hills, /Xai/xai (Kaikai), and !Kangwa (Kangwa or Levisfontein) are the regional features labeled on standard maps of southern Africa. "Dobe" and "/Du/da" are waterholes in the northern and southern reaches of this area respectively. This is part of a broader area approximately 290 km by 290 km or 84,100 km², bounded by the Okavongo River on the north and east, the Ghanzi Farms on the south, and the edge of the South West African Escarpment on the west. The topography, characterized by longitudinal or *alab* dunes and dry river beds (Grove 1969), is covered by Tree Savanna (Northern Kalahari Tree and Bush Savanna, and North West Tree Savanna) (Weare and Yalala 1971). Standing water is scarce during most of the year, and throughout the two areas there are only ten permanent water points.

The valleys of three dry rivers with tributaries run roughly from west to east, transecting the Dobe-/Du/da area: the !Kangwa, the /Xai/xai, and the Eiseb. Between the northernmost, the !Kangwa Valley (including the Dobe region), and the /Xai/xai Valley 35 km to the south, rise the Aha Hills, the only large formation of underlying rock exposed in the region. South of /Xai/xai, tributaries of the Eiseb Valley cut through the ≠To/'gana, /Gəm, and /Du/da areas (Map 1.1).

A 90-kilometer waterless strip of land which separates the Dobe-/Du/da region from the Okavongo swamps to the east effectively limits east-west movement during most of the year. But north of Dobe and south of /Du/da other dry river valleys, conforming to the east-west pattern, contain permanent water points that support other !Kung populations. !Kung also live at the Nyae Nyae pans approximately 60 km southwest of Dobe.

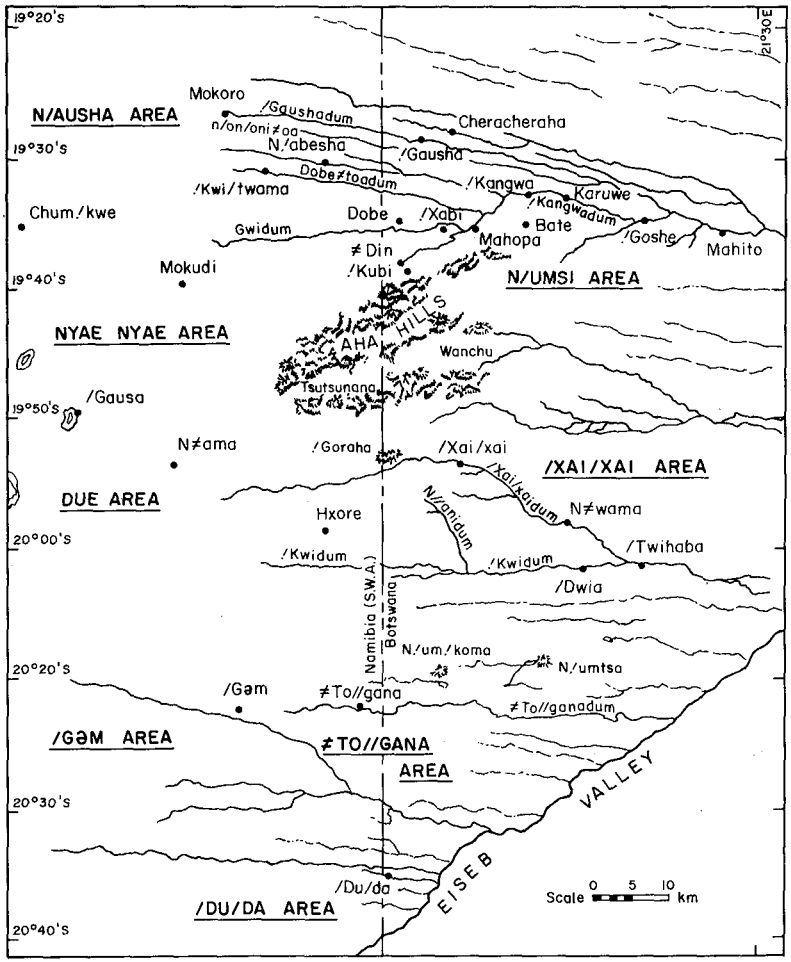
The Dobe-/Du/da area lies on the northern fringe of the Kalahari. It forms part of a transitional zone between the drier shrub savanna (marked on most maps as the "Kalahari Desert"), which lies about 180 km to the south, and the lusher regions near the Okavongo river less than 180 km to the north. And as one moves from Dobe southwards to /Du/da changes may be noted on a smaller scale: the dunes become higher but are spaced further apart; the country assumes a more open character with fewer stands of large trees and more open grassland. Although exact figures are unavailable, the average mean annual rainfall may be slightly lower at /Du/da than at Dobe, and

the ranges of the /Du/da ungulates are possibly slightly larger than those of their northern counterparts. Such small-scale variation, not considered in detail here, may lead to slightly different subsistence strategies for the Dobe as opposed to the /Du/da !Kung.

Temperature and Climatic Stress

The northern Kalahari Desert has a mean elevation of ca 1100 m above sea level; it lies within the summer rainfall area of southern Africa. These factors contribute to a climatic regime characterized by hot summers with a four- to six-month rainy season and by moderate to cool winters without rainfall. At 20° south latitude, the

Map 1.1. The Dobe-/Du/da Area



sun is directly overhead from early December to early January, but the highest mean temperatures are recorded in October, at the end of the dry season. In June and July, the coldest months of the year, night temperatures fall to freezing or near-freezing, with mean daytime highs of 25° Celsius (C).

The !Kung, in common with most high desert dwellers, experience both heat and cold stress (see Table 1.1). In terms of the work ecology, the critical temperature datum is the daily maximum since it indicates the heat conditions under which the people must hunt and gather. From October to March the people of the Dobe area can expect daily highs of 35°–45°C (95°–113°F), meaning that subsistence work must be carried out under conditions of extreme sweat loss. For example, a person walking in the sun at 38°C (100°F) will sweat at the rate of roughly 800 cc of water loss per hour, an equivalent of 3 liters (over 6 lbs of water!) in a typical working day. At the other extreme during the months of June, July, and August the !Kung can expect about 60 nights when the temperature falls below 5°C.

Rainfall

All the rainfall is concentrated in the hot summer months (October–May), while from June to September the Dobe area is completely dry. The relationships between two major air masses determine weather patterns in the Kalahari. The warming summer sun creates a region of low pressure which draws southward the heavier, rain-bearing equatorial system. The position of the southern and westernmost extension of this system, termed the "inter-tropical front" (ITF), depends on the relationship between this equatorial low and the cool dry air flowing northwards and eastwards from the Atlantic. The ITF, which may be up to 80 or more kilometers wide, is marked by widespread altostratus clouds and heavy rainfall and is followed by convectional rains. Its southward movement marks the start of the rains in the Kalahari, and its subsequent northward movement may account for later heavy rains (Wellington 1955, pp. 216–218). The extreme western edge of this front passes over the Dobe-/Du/da region; even slight year-to-year variations in its position can have a dramatic effect on the amount of rainfall the area receives. In such a climatic regime averages say little. The most striking fact is the enormous yearly variation in amount and distribution of rainfall. Figure 1.1 shows the rainfall at Dobe for two rainy seasons and most of a third. Rainfall varies from 239 mm in the drought of 1963–64 to

Table 1.1. Heat and cold stress in the Dobe Area: percentage of days each month with extreme temperatures

	1967			1968											1969			
Conditions	Oct	Nov	Dec	Jan	Feb	Mar[a]	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb[a]	Mar	Apr
Heat stress																			
Percentage of days																			
33° C or over	56	38	42	40	5		7	4	0	0	39	100	100	50	76	70		0	58
Number of days of	9	24	31	30	22	0	15	27	30	28	28	20	31	26	29	27	0	11	26
valid observations	31	30	31	31	29	31	30	31	30	31	31	30	31	30	31	31	28	31	30
Cold stress																			
Percentage of nights:																			
under 10°	0	0	0	0	0		10	44	93	96	96	75	26	0	0	0		0	0
under 5°	0	0	0	0	0		0	0	77	71	60	0	0	0	0	0		0	0
under 0°	0	0	0	0	0		0	0	37	0	0	0	0	0	0	0		0	0
Number of nights of	3	28	30	30	21	0	16	27	30	28	25	20	31	26	30	29	0	11	26
valid observations	31	30	31	31	29	31	30	31	30	31	31	30	31	30	31	31	28	31	30

[a]No record.

597 mm in 1967–68, a swing of 250 percent. In addition month-to-month and place-to-place variations further increase the uncertainty of precipitation (see Lee, Chapter 3; Yellen and Harpending 1972).

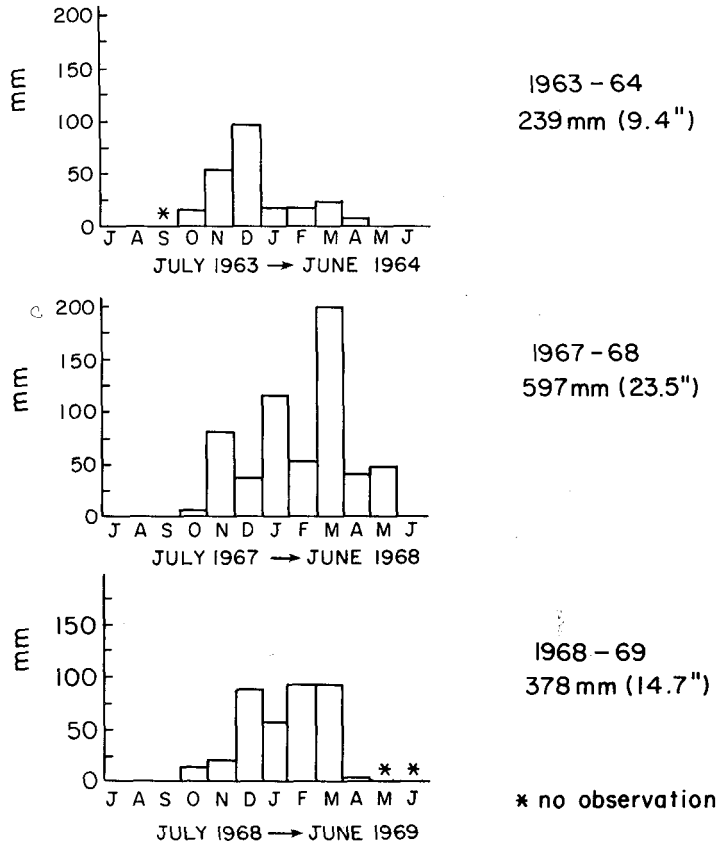
Seasons

The !Kung divide the year into the following five seasons:

(1) *!huma.* The *Spring Rains* generally begin in October with the onset of the first rains consisting of light convectional thundershowers that often fall on one area and miss other areas entirely. The first rains trigger growth and reproduction in both flora and fauna and may transform overnight the landscape from a parched and dry state to one of lush greenery.

(2) *bara.* The *Main Summer Rains* generally fall from December

Figure 1.1. Rainfall at Dobe for three years



to March, but their time of onset and duration are highly variable. During the period of the main rains, the major summer foods appear.

(3) *≠tobe.* The brief *Autumn* season lasts from the end of the rains until rapidly falling nightly temperatures mark the start of winter. The warm weather and lower humidity favor high rates of evaporation.

(4) *!gum.* The *Winter* dry season extends from May through August. It is heralded by a sharp drop in nightly temperatures to freezing or near-freezing. The days are clear and, by tropical standards, cool, often characterized by strong dessicating winds from the south and west with gusts estimated to 40 knots.

(5) *!ga.* The *Early Spring* season begins late in August with a rapid increase in daily temperatures and ends, usually in October or November, with the onset of the first rains. It is an extremely hot dry period during which the supply of water and food reach the lowest annual level.

Land and Water

Geological History

The Dobe area is situated on the western flank of an immense basin extending from the Namibian highlands to the highlands of Rhodesia. The Kalahari Basin was formed during the Tertiary era when surrounding areas were elevated by as much as a thousand meters. The lack of a corresponding rise in the central part of the subcontinent produced this gigantic basin which catches detritus from the surrounding highlands. The Aha Hills, formed of Otavi Dolomite, is one of the few places where these underlying rocks are exposed today. Dolomite, often riddled with sinkholes and caves, serves as an important underground reservoir; and most likely much, if not all, of the subsurface water now in the /Xai/xai and !Kangwa river beds is derived from this source.

Broad sheets of calcrete and silcrete, characteristic of arid and semi-arid environments, underlie much of the Kalahari and are widely exposed both in the dry river beds in the Dobe-/Du/da region and in the area between Dobe and the Aha Hills. Hardpan, composed of calcium carbonate, is derived from underlying bedrock. Slightly soluble, it is drawn upward in aqueous solution by osmotic pressure and deposited in sheets, some up to half a meter in thickness. The age of the oldest deposits is not known, but in some areas hardpan is still in the process of formation. These exposed hardpan areas have had important consequences for the past and present inhabitants of

the Dobe area. Silcrete nodules, which form *in situ* in these layers, have provided a source of raw material for Late Stone Age tool-makers, probably ancestors of the modern day !Kung; and present-day inhabitants use small calcrete nodules as nut-cracking stones. Also, rock-hard layers of hardpan hold rainwater near the surface but, at the same time, they effectively prevent !Kung, using only wooden digging sticks, from excavating wells to tap the underground water supplies often not far below the surface.

Most of the Kalahari Basin is covered with a mantle of sand, generally between 3 m and 30 m in depth. The sands, varying in color from brownish-red to greyish-white, were probably originally derived and accumulated in pre-Quaternary times. However, it is likely that they have been redistributed more than once, with the most recent distribution definitely occurring in the last several thousand years. Conclusive evidence for this is found in the /Xai/xai region where Late Stone Age artifacts, no more than several thousand years old, have been found beneath 2 m of this sand.[2] The Dobe-/Du/da region is the only area of Botswana distinguished by well-established alab dune formations, which are discussed in detail below.

The Dune and Molapo System

Parallel longitudinal dunes, 8 km to 80 km in length and oriented 102°–282° roughly east–west, cover most of the Dobe-/Du/da region in a uniform pattern. The dune crests, situated from 1.5 km to 8 km apart, are designated "alab dunes" by Grove (1969), adopting a term first used by Monod (1958) to describe similar formations in areas bordering the southern Sahara. The term *molapo* is a Setswana word used here to describe depressions or small valleys between the dunes. It corresponds to *omaramba,* a Herero word used by J. Marshall (1957), Story (1958), and others. Formed by prevailing easterly winds at a time when annual precipitation was less than 250 mm, the dunes are presently stabilized by fixed vegetation. Similar formations in Senegal are believed to be younger than 20,000 BP (Michel 1967).

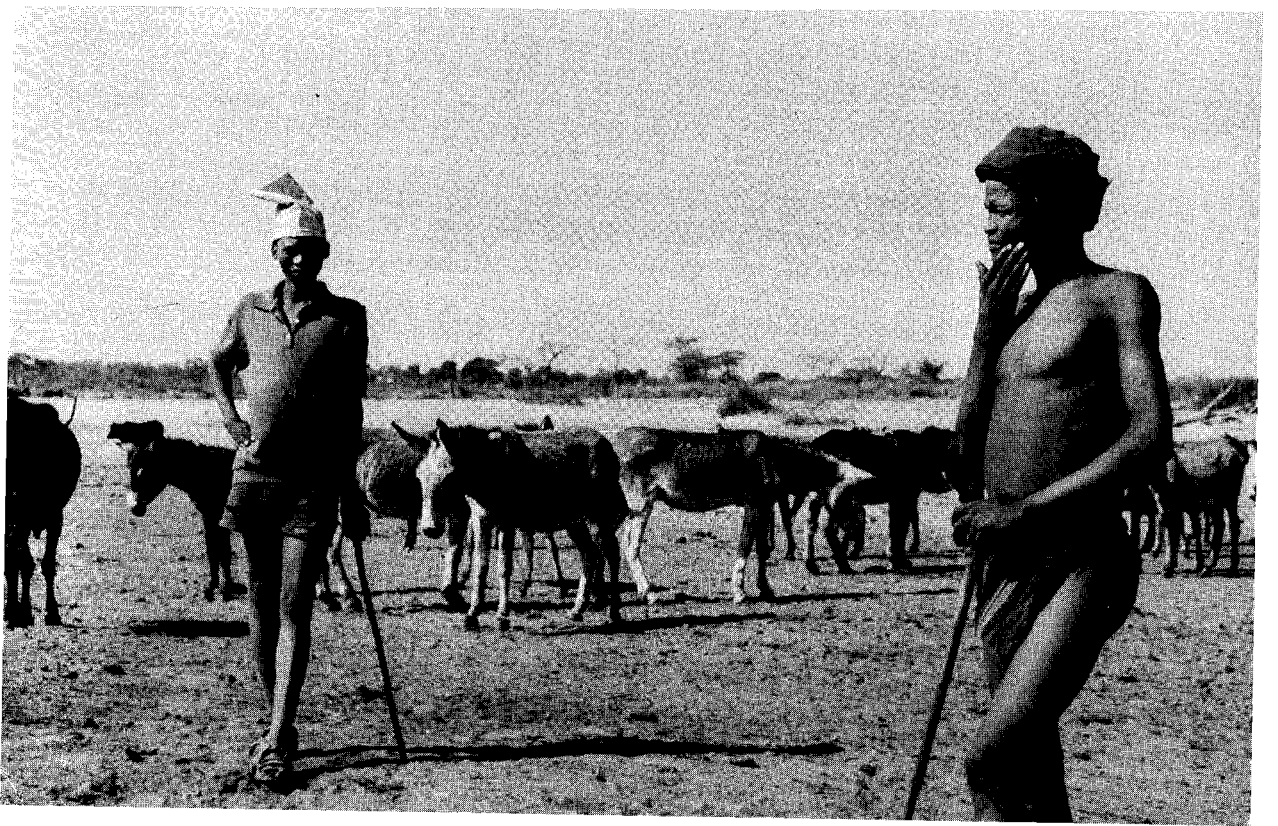
Drainage of rain water from the dune crests and flanks has largely removed the finer silty constitutents of the dune soils and concentrated them in adjacent molapo beds. On the lower flats and in the molapos, this water has reduced the ferric oxide component of the soil to soluble ferrous oxide which has been leached out. The result is a gradual and regular vertical shift in soil composition from loose, iron-rich sand on the dune crests down to a more compact soil, lacking in iron but richer in silt in the molapo bottoms. The consequences of this variation are extremely important since differences

in soil closely correspond to differences in vegetation associations. The following zones have been defined: (I) Dune crest: loose reddish sand; (IIA) Upper flats: loose buff colored sands; (IIB) Lower flats: compacted white sands; (IIIA) Well defined molapos: compact grey silty sand with limestone sporadically exposed; (IIIB) Smaller molapos: light grey compacted sand with lower silt content; (IV) Hardpan (see Lee 1965, pp. 69–81).

Hydrology

Of the three types of standing water sources in the Dobe-/Du/da region—large pans in dry river channels, smaller molapo pans, and holes in large trees—the first is by far the most important, for only these river bed pans hold water throughout the year. The three large rivers probably have carried surface water during more than one period in their history, and the fact that the Eiseb and !Kangwa in places *transect* alab dunes indicates that these rivers were active at least once after the dunes were formed. All three carried water eastward toward the Okavongo swamps, and after exceptionally heavy rains water still flows down the !Kangwa for brief periods of

San herding Herero donkeys at /Xai/xai



time. Some of the larger molapos such as !Gausha and /Du/da have served, during periods of higher rainfall, as small feeders representing tributaries channeled along the prevailing molapo pattern.

Presently the three main rivers carry underground water throughout the year. Transecting this flow at various points along their course are large, roughly circular pans, providing the only permanent water sources in the region. By far the largest concentration of these pans lies in the !kangwa valley, which has seven permanent (!Goshe, !Kangwa, Bate, Karuwe, Mahopa, !Xabi, and !Kubi) and one semi-permanent (Dobe) waterholes (see Map 1.1). The /Xai/xai valley has one permanent (/Xai/xai) and one semi-permanent (/Twihaba) source of water, while one permanent (/Gəm) and two semi-permanent (≠To//gana and /Du/da) sources are located in the sections of the Eisab valley tributaries that lie within our area.

The second source of water consists of small seasonal pans located in the bottoms of molapos and other low-lying areas. Ranging in size from a few meters to over a hundred meters in diameter, they serve as the focus for limited areas of internal drainage. Pans of this type, which fill during the rains, are numerous and widely scattered. Depending on their size and the areas they drain, they may hold water from only a day or two up to several months. In years of good rainfall, the largest may retain water until the winter or even to the start of the next rainy season.

The third source of water is from the hollows in the trunks and root systems of large trees which may hold tens of liters of water. While these supplies are continually replenished during the rainy season, they are quickly exhausted when the rains cease. Their main importance lies in their location on the food-rich dune crests for they provide the only water sources in these areas.

Fauna

Because of the broken nature of the vegetation, the area does not support the large herds of migratory plains game that are found on the open stretches of the southern Kalahari. Wildebeest, for example, which occur in herds of several thousand in the Central Kalahari Game Reserve, are seen in groups of ten to twenty in the Dobe area. There has been a diminution of game in the northwestern Kalahari over the past fifty years. Rhino, hippo, and springbok have disappeared completely, while zebra are rare. Buffalo and elephant were formerly numerous but now are only occasional summer visitors.

Of the 40 species of resident larger mammals, the most prominent are kudu, wildebeest, and gemsbok. Giraffe, eland, roan antelope,

and hartebeest are also present. Of particular importance to the San as game are wart hog, porcupine, steenbok, duiker, and springhare.

The major African predators are all represented in the area and include lion, leopard, cheetah, wild dog, and two species of hyena. The smaller carnivores include caracul, wildcat, genet, jackal, and several species of mongoose.

Unprovoked attacks by wild animals on San are extremely rare. The people do not regard the bush as threatening or hostile. They sleep in the open without fires when necessary and make no provision to protect or fortify their living sites. The most common threat to the San homes, in fact, comes from the Herero cattle which periodically blunder into camp to browse on the grass huts.

Bird life is abundant and varied. Some 80 species have been recorded. Ostrich are still common and continue to provide the !Kung with a steady supply of ostrich eggshell water containers and materials for making beads. Only 8 species of birds are systematically hunted by the San for food: guinea fowl, francolin (two species), korhaan, kori bustard, sandgrouse, cape turtle dove, and the red-billed teal.

At least 24 species of reptiles and amphibians, including five poisonous snakes, are named and known by the San. Only two reptiles are of any importance as food: the rock python and the large leopard tortoise.

Fish are not present in the Dobe area, but aquatic species such as terrapins, leeches, clams, and snails found in isolated waterholes indicate that at some time in the past the area was connected to a river system by flowing water.

Of the invertebrates known to the San, there is an abundance of scorpions, spiders, ticks, centipedes, and millipedes, as well as at least 70 species of insects. The most important insects are the mantises (about whom there is a body of myths), bees (highly prized for their honey), flying ants and click beetles (dietary delicacies), and poison beetles (the sources of San arrow poison).

The Resource Base

Of the almost 500 species of local plants and animals known and named by the San, some use is found for 150 species of plants and 100 species of animals. By virtue of their extremely extensive knowledge of the environment, the people are self-sufficient, with a single exception: iron for knives, spear blades, arrowheads, and awls must be obtained through trade and exchange.

The foundation of !Kung subsistence is the over 100 species of edible plants of the Dobe-/Du/da area. These include 30 species of roots and bulbs, 30 species of berries and fruits, and an assortment of melons, nuts, leafy greens, and edible gums.

To illustrate the richness and high nutritional quality of the !Kung diet, the composition of 5 of their major food species is set out in Table 1.2, along with 2 common Western foods for comparison. The most important of the food plants is *//''xa,* the mongongo or mangetti nut *(Ricinodendron rautanenii),* a superabundant staple which yields both an edible fruit and a kernel. The latter has a caloric content of 600 calories per 100 g and a protein content of 27 percent, a level of nutritional value that ranks it with the richest cultivated foods, such as peanuts and soybeans. Thousands of kilos of these nuts are consumed each year by the San, yet thousands more rot on the ground for want of eating.

The baobab fruit (*Adansonia digitata*) *≠m,* is another staple. It yields a delectable and refreshing powdery fruit rich in vitamin C, calcium, and magnesium and a kernel which compares favorably in calories and proteins to domesticated nuts.

The tsin bean *(Bauhinia esculenta) ts'hi,* is comparable to the mongongo in calories and proteins and can be harvested for months after ripening because of its tough outer shell. In parts of our area, especially in the southern reaches where mongongo is scarce, tsin beans are the primary plant staple.

The vegetable ivory fruit *(Hyphaene ventricosa)* and the *!gwa* berry *(Grewia retinervis)* are very localized in distribution but yield hundreds of kilos of food during their four-month seasons.

These are only a few of the more abundant and attractive foods available to the !Kung. The nut and bean species (mongongo, baobab, and tsin) are particularly important since they contain high levels of high quality vegetable protein and fats that substitute for meat when game is scarce. Not all the foods are attractive, however. Some of the larger roots and melons have a decidedly bitter taste and a high proportion of roughage. These the people eat only when other more desirable foods are depleted.

The vegetable foods are so plentiful for most of the year that the !Kung can afford to exercise selectivity in their diet. They tend to eat only the most attractive foods available at a given season and to bypass those that are not as tasty or easy to collect. Over the course of a year only 23 species of plants make up about 90 percent of the vegetable diet by weight, and one species, the mongongo nut, accounts for at least half of the total (Lee 1968, p. 34; 1973b).

Game resources are less abundant and less predictable than plants. Meat provides 20–50 percent of the diet by weight, depending on the season and the number of men hunting in the camp. The general diminution of game in the northwestern Kalahari has not led to the collapse of the San way of life, however, because of excellent techniques for capturing smaller mammals; and the meat from these kills supplements a diet primarily based on vegetable sources.

At some camps for short periods the amount of game brought in may be much higher. In December 1964, for example, a camp with four hunters killed twenty-nine animals over a seventeen-day period.

The big antelopes, kudu, wildebeest, and gemsbok are regularly hunted with poisoned arrows, but a good hunter feels he has done well if he kills as many as six of these in a year. The general scarcity of game and their frequency of movement raises obvious difficulties for !Kung hunters. Except in a very rough way, it is rarely possible to predict on a day to day basis where the big antelopes will be located. This in part explains why considerable attention is given to the hunting with dogs of wart hogs, steenbok, and duiker—three species with very limited ranges. The owner of a well-trained pack of four or five dogs can count on twelve to fifteen of the 50–80 kg wart hogs a year. Duiker and steenbok, small antelopes weighing 10–20 kg, are next in importance. These are taken with dogs, trapped in rope snares, or, more rarely, shot with poisoned arrows. In the birth season (December to March) the young are often run down on foot or brought down with throwing clubs.

An unorthodox but highly effective hunting technique is the probing of underground burrows. Four important species are taken this way. The springhare is killed with a flexible 4-meter pole with a metal hook at the end. These nocturnal animals sleep in long narrow burrows by day. The hunter finds an occupied burrow, probes it with the pole until he has hooked his prey, and then excavates the soft sand until he can retrieve the animal. The large African porcupine is also an underground dweller which the !Kung hunt. They often light a fire at the burrow mouth in an attempt to half-suffocate the animal and drive it from the burrow. Sometimes they dig down on the den from above, or actually crawl down the narrow burrow to spear the occupant. The Antbear (up to 65 kg) also lives in burrows, and men dig down on the prey from above to spear it. Finally, warthogs, when run to ground, are flushed from their holes by lighting a fire at the entrance and then speared when trying to escape. The underground species are highly desired because they are very fat, and animal fat is one of the elements most scarce in the San diet.

The game birds, guinea fowl, francolin, and bustard, are captured in ingenious snares when the opportunity arises, as are the small mammals such as hare, bat-ear fox, mongoose, genet, and aardwolf. Occasionally the dogs flush these animals out of the bush and are allowed to eat them. When there is no other meat in the camp, however, the people eat these themselves.

Table 1.2. Composition of some major San wild foods, 100 grams as eaten[a]

Common name	Mongongo nut	Mongongo fruit	Baobab fruit and nut
San name	//"xa	//"xa	≠m
Botanical name	*Ricinodendron rantanenii*		*Adansonia digitata*
Season of use	year round	Apr–Nov	May–Sept
Composition in g/100 g eaten			
Moisture	4.2	13.4	5.2
Ash	4.0	5.7	7.3
Protein	28.3	6.6	14.3
Fat	58.4	0.6	13.9
Fiber	1.5	3.5	10.7
Carbohydrates	3.7	70.2	51.4
K calories	654	312	388
Composition in mg/100 g eaten			
Ca	249	89.6	272
Mg	500	195	630
Fe	2.07	0.74	9.51
Cu	1.90	0.45	2.47
Na	2.0	1.01	76.3
K	686.6	1760	4173
P	704	46.0	1166
Zn	4.09	1.39	6.96
B-Carotene	–	0	–
Thiamin	0.127	–	–
Riboflavin	0.139	0.113	–
Nicotinic Acid	–	0.121	–
Vitamin C	0.57	8.51	–

[a]Analyzed by A. S. Wehmeyer, National Nutrition Research Institute, CSIR, South Africa, based on samples submitted by Harvard Kalahari Research Group Oct.–Dec. 1967, June 1968.

[b]Watt, B. K., and A. L. Merrill (1963) *Composition of Foods: Raw, Processed, Prepared.* U.S. Department of Agriculture Handbook No. 8, Washington, D.C., p. 43 (Item no. 1495).

[c]*Ibid.*, p. 52 (Item no. 1870).

The big leopard tortoise, weighing up to eight pounds, is a great favorite and is easily collected by men, women, and children. It is baked in the shell and can feed a family of four. The nonpoisonous rock python also makes a good meal. Few of the many other snakes, lizards, and amphibians are sought as food. Nor, for that matter, do insects play more than a negligible role in the diet. A species of

Tsin bean	Veg. ivory fruit	Grewia berry	Peanuts roasted w/skins[b]	Brown rice cooked[c]
ts'hi	!hani	!gwa	—	—
Bauhinia esculenta	*Hyphaene ventricosa*	*Grewia retinervis*	*Arachis hypogaea*	*Oryza Sativa*
Feb–July	June–Oct	Mar–June	—	—
5.2	6.6	10.6	1.8	70.3
2.9	9.0	3.7	2.7	1.1
31.6	4.9	5.4	26.2	2.5
31.6	0.4	0.2	48.7	0.6
1.0	9.6	12.6	2.7	0.3
23.2	69.6	67.5	20.6	25.5
544	302	293	582	119
136	103	157	72	12
258	196.5	172	—	—
3.3	2.04	4.7	2.2	0.5
1.0	0.47	0.4	—	—
89.0	544.9	31.0	5	282
849	2560	655	701	70
484	155.8	—	407	73
3.8	0.56	1.6	—	—
0.22	0.06	—	—	—
0.936	—	—	0.32	.09
0.815	0.096	—	0.13	.02
1.86	4.62	—	17.1	1.4
2.19	19.7	—	0	0

flying ant has an annual two-day outbreak around the beginning of December; thousands are collected and roasted, mainly by the young women and children.

By and large, the snakes, insects, and lizards that Service (1966: 101) says are the staples of the "Bushman" diet are despised by the San of the Dobe area.

The overwhelming bulk of the animal protein which !Kung consume is provided by mammals, and of these 14 are hunted systematically. These include antbear, duiker, eland, gemsbok, giraffe, hare, hartebeest, kudu, porcupine, roan, steenbok, springhare, wart hog, and wildebeest. The porcupine and springhare, both relatively abundant, easy to locate, and readily killed within their burrows, are the most frequently obtained. Less attention is paid to the hare which usually must be stalked and shot with bow and arrow, and to the relatively large antbear which must be dug from its burrow with a great expenditure of effort and a not very high likelihood of success.

Success in hunting ungulates appears inversely related to size. The steenbok, which may be either trapped, shot with poisoned arrow, or run down with dogs is most frequently killed, followed by the duiker, which is usually too large to trap. The wart hog, successfully run down and brought to bay by dogs as well as hunted by the bow and arrow, is the next most frequently killed. Of 151 hunters interviewed in the Dobe and /Xai/xai areas, 75 percent have killed at least one, and 39 percent have killed 10 or more.

The other larger ungulates, all of which are hunted with bow and poisoned arrow, are less common and more difficult to locate and stalk. After they are wounded, some may travel long distances and take several days to die. Consequently rates of hunting success are proportionally lower. About half of the animals wounded by !Kung hunters are allowed to escape, either to recover or to be eaten by carnivores. Among the !Kung, gemsbok is most frequently killed, followed by kudu, wildebeest, eland, roan, hartebeest, and giraffe. Of the same group of 151 hunters, only 28 percent would admit to killing a single giraffe, and only 6 percent claimed 10 or more kills.

People and the Environment

The Environment's Effect on People

In outlining briefly the most important environmental factors influencing the !Kung way of life and the resultant annual subsistence strategies, one finds the prime considerations include the rela-

tive scarcity of water during most seasons of the year, the occurrence of a number of discrete vegetation associations, an additional, uneven distribution of resources within vegetation zones, the relative abundance of plant and animal foods, and the effects of changing seasons. Each of these is discussed separately below.

This entire region of some 11,000 km^2 includes only nine permanent and four semipermanent water sources; the !Kung are forced to depend exclusively on them for four to five months each year and during this time must locate their camps near them. This means that even utilization of the entire range is not possible throughout the year, and in some areas abundant, readily available, and desirable foods are not collected since they lie too far from standing water. (While !Kung will sometimes make brief trips into this hinterland during the dry season, carrying water with them and relying on water roots, they do so only a few days or weeks at a time.) Thus, from May to October, utilization of the hinterland is extremely uneven, and intensity of utilization is related inversely to distance from permanent water. During a day's trip, an individual will rarely travel more than 15 km (on a straight line) from camp, and generally no more than 10 km. Thus scarcity of permanent water is the most crucial limiting factor with which the !Kung must contend.

The widespread system of alab dunes—the regular progression of dune crest, upper and lower dune flanks, and shallow and deeper molapos—each with its characteristic soil and floral associations, gives the region a varied character. All of these different associations may be reached in the course of an average day's collecting trip from most of the permanent waterholes. Added to these are the more limited areas of river valley and flatlands with exposed hardpan which also provide their unique food sources. Compared with flatter areas in the southern Kalahari which receive a similar amount of rainfall, the number of plant species is relatively large just because of this diverse character of the landscape, making the number of food plants available to the !Kung for exploitation unexpectedly large. The list now numbers some 110 species; and although many of these are only rarely utilized, they form a cushion in times of stress.

While all elements of the dune and molapo system can be exploited from most of the waterholes, a caveat must be added, for within the areas readily accessible to each of them, some resources are relatively abundant and others relatively scarce. The people of !Goshe, for example, have extensive mongongo groves located within 10 km of their waterhole, while, by contrast, Dobe lies about 7 km from the nearest dune, and the nut grove on it is small. Dobe is noted for its concentration of vegetable ivory palms, !Xabi for its morula

trees, and !Kubi for its baobabs. The tsin bean is absent in the north but is superabundant south of the Aha Hills on the open flats west of /Xai/xai. Eland are relatively common south of the Aha Hills and rarer to the north, while kudu concentrate in the flatlands around !Kubi during the winter to utilize the winter browse there. The result is a movement of people throughout the year for either short or extended visits to other waterholes, and it is not unusual for some individuals to live alternately at two different waterholes. Ostensibly these visits are undertaken for social reasons, but in large part they reflect this fact of underlying resource variability.

It has been emphasized that, overall, plant foods are relatively abundant, varied, and easy to locate and collect while large game is scarce, difficult to find, and hard to kill. The result is that vegetable foods provide the mainstay of the diet while meat rarely constitutes more than 40 percent of it. (Incidentally, this is true of the great majority of hunters and gatherers in tropical and subtropical regions, see Lee 1968a.) The !Kung have a hierarchy of vegetable food preferences; they concentrate their attention on preferred species in times of plenty and broaden the variety of their diet during the less abundant times of the year. These plant foods are, of course, adapted to a semi-desert environment; and although they may be less plentiful in drier years, they never completely fail. They provide a secure, dependable subsistence base.

The subsistence strategy is, of course, closely related to the seasons. Briefly, under the precontact system, there was a movement of small groups away from the permanent waterholes during the rainy season and a gradual consolidation into much larger aggregations during the dry months of the year. Even today, with the onset of the rains, pairs or small groups of families move to the seasonal pans to eat roots and last year's crop of mongongo nuts. The main rains herald a time of plenty as the leafy greens, fruits, and berries ripen. Game is more plentiful at this time; and since water is available in most areas, the !Kung can move their camps to good hunting areas. It is at this time of year that people can afford to be most selective and concentrate on their favorite foods. In late summer, while pans still hold water, the new crop of mongongo nuts falls; and the !Kung can eat both the nut and sweet fruit surrounding it (see Table 1.2). This is also the honey season, when both men and women concentrate their attention on locating and opening hives.

In autumn the seasonal pools start to dry and population begins to concentrate, first at the larger seasonal pans and then back to the

permanent water sources. From early winter until the start of the next rains food becomes increasingly scarce; people must work harder to obtain it and must utilize less-preferred species. Early winter is still a time of relative plenty, when the last of the summer berries and the mongongos near the water sources provide fairly easy pickings. In the later winter gums and roots provide major items in the diet. Men set out snares for the smaller buck and for birds. Late winter and early spring—before the first rains—is the most difficult time of the year. The areas within easy walking distance of the waterholes become depleted of choice foods, and diet consists largely of roots, edible gum, and whatever other less desirable foods may be found. People scan the skies and await anxiously the first rains.

People's Effect on the Environment

The !Kung hunt and set bush fires; both of these practices alter the environment to some extent, but how much and in what ways is uncertain. Our own guess is that the traditional hunting system has little, if any, adverse effect on the ungulate population. A possible explanation is merely that they have hunted with poisoned arrows for hundreds or perhaps thousands of years, and the equilibrium between predator and prey was reached long ago. The effect that burning has on vegetation patterns is quite substantial. The !Kung set fire to large areas in late winter and early spring in order to facilitate the growth of new grass which, in turn, attracts game. Tinley (1966) points out that the effects of burning can vary depending on where and when it is applied. He states that to maintain and favor the spread of grassland valuable for either wild or domestic grazing animals, burning should take place only after the first inch or two of rains have fallen, and that earlier burning, such as the !Kung practice, promotes the development of shrub at the expense of grassland. Thus, it is possible that San burning is working to decrease open grassland, a topic we plan to investigate in future research.

In contrast to the !Kung, the effect of Bantu inhabitants, who both plant crops and maintain herds of cows and goats, has been profound. Bantu hunters use rifles, horses, and donkeys; and the decrease in game since their advent in the early twentieth century has been significant. Not only do rifles provide a more effective means of killing than poisoned arrows which must be fired at close range, but also the use of horses and donkeys enormously extends a hunter's mobility. A mounted hunter can scout a significantly larger area than a man on foot; he can range farther afield and remain there for a longer period of time because he can carry water with him. He

also can use his mounts as pack animals to bring fresh meat back to his village.

But more important is the effect of livestock which Bantu maintain at all the permanent waterholes in both the !Kangwa and /Xai-/xai valleys. Overgrazing is considerable, and both cattle and goats compete directly with the different species of wild grazers and browsers. Their effect on the vegetation is also considerable since they shift the balance away from the grasslands and in favor of extensive shrubland and thicket. As Tinley points out, in semi-arid environments this delicate balance is easily disrupted, so that it is essential for stock numbers to be kept low if equilibrium is to be maintained (1966, p. 79). Luckily domestic animals must drink regularly, and the effects of their overgrazing are limited primarily to the river valleys and the immediate surrounding areas. What is more, since they are excluded from Namibia by a patrolled wire fence, the western portion of the Dobe-/Du/da region remains off limits to domestic stock.

Left to their own devices the !Kung would continue indefinitely to carry out this skillful exploitation of their resources. Their present level of population makes only modest demands upon the environment, and the mechanisms that maintain this level of population appear to be functioning adequately (see Howell, Chapter 6). A mixed agricultural-pastoral way of life is rapidly replacing hunting and gathering in the Dobe-/Du/da area. Success, over the long run, depends on maintaining the natural vegetation cover. It remains to be seen whether such an adaptation can prove as viable as the traditional !Kung subsistence techniques.