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# Ecology of a Pastoral Caste: Gavli Dhangars of Peninsular India

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*The Gavlis are a pastoral caste of the forested hill tracts of India's Western Ghats region. This paper examines their shift under British colonial rule from buffalo-keepers to goatherds to cultivators of increasingly marginal hill tracts, the context of forest exploitation and malaria control as well as more recent dairy development programs of the Indian government. It concludes that if present trends continue Gavlis everywhere will follow the same progression, eventually becoming landless migrants.*

**KEY WORDS:** pastoralism; ecology and development; malarial history; shifting cultivation; ecological history.

## INTRODUCTION

Pastoralism has been practiced by large populations over considerable tracts in India for the last 3,500 years. Sheep, buffalo, cattle, yak, goat, camel, pigs, and ducks have all been associated with a variety of specialist pastoral castes. Yet this vital component of Indian society has been hardly studied, and practically nothing is known of the livestock economy of pastoral groups or the ecological conditions on which it is based (Sopher, 1975). The government has recently introduced a commercial dairying development program, yet we lack information on the animal husbandry practices, life histories, milk yields, and other aspects of the animal populations maintained outside the organized dairy industry by which to judge its effects (cf. Cockrill, 1974). This study looks at the changing ecology

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and pastoral economy of one such group, the Gavlis of the Western Ghats, in an attempt to place recent changes in a wider context of economic development.

The Gavli Dhangars, with an estimated population of 85,000, are one of the 23 endogamous castes of the Dhangar caste-cluster of Maharashtra in Western India. This caste-cluster comprises pastoral and weaver communities, of which the Gavlis are primarily buffalo-keeping pastorals inhabiting the forested hill tracts between the latitudes 19° and 13°30'N. In addition to buffalo, they keep some cattle and, more recently, goats. They also practice shifting cultivation on the hill slopes. While traditionally they have exchanged butter for such needs as cereal, oil, and clothing, they live away from the peasant villages and have little social interaction, apart from economic exchanges, with the rest of the rural population.

Today the Gavlis are undergoing profound change. They now constitute the core of milk-supply schemes for the urban centers of Pune (formerly known as Poona), Kolhapur, etc., and are therefore financially better off than the peasant populations in the hilly tracts they inhabit. At the same time, commercial exploitation of the forest, leading to overgrazing and intensified shifting cultivation of the hill slopes on the part of the local population, is causing rapid deterioration of the fodder, soil, and water resources of their environment. The Gavlis are finding it increasingly difficult to subsist entirely on their buffalo and cattle, and are taking more and more to keeping goats, shifting cultivation and other economic pursuits. This in turn accelerates environmental deterioration, and in parts of their range their subsistence base has been totally destroyed, obliging them to migrate in search of wage labor or other activities. In order to anticipate, and retard, this process, the ecological consequences of modernization must be understood.

## METHODS

The investigations reported here have two independent origins: anthropological and ecological. The anthropological investigations were initiated in 1969 as a part of a major study of the entire Dhangar caste-cluster of Maharashtra from Deccan College, Pune. Since there was no record of the precise number of endogamous groups in this caste-cluster, or of their distribution and way of life, the first phase of the investigation involved visits to selected *tahsils*[3] of every district of Maharashtra, during which it was determined that the Mhaske Dhangars, Gavli Dhangars, and

[3]A *tahsil* is an administrative unit in India.

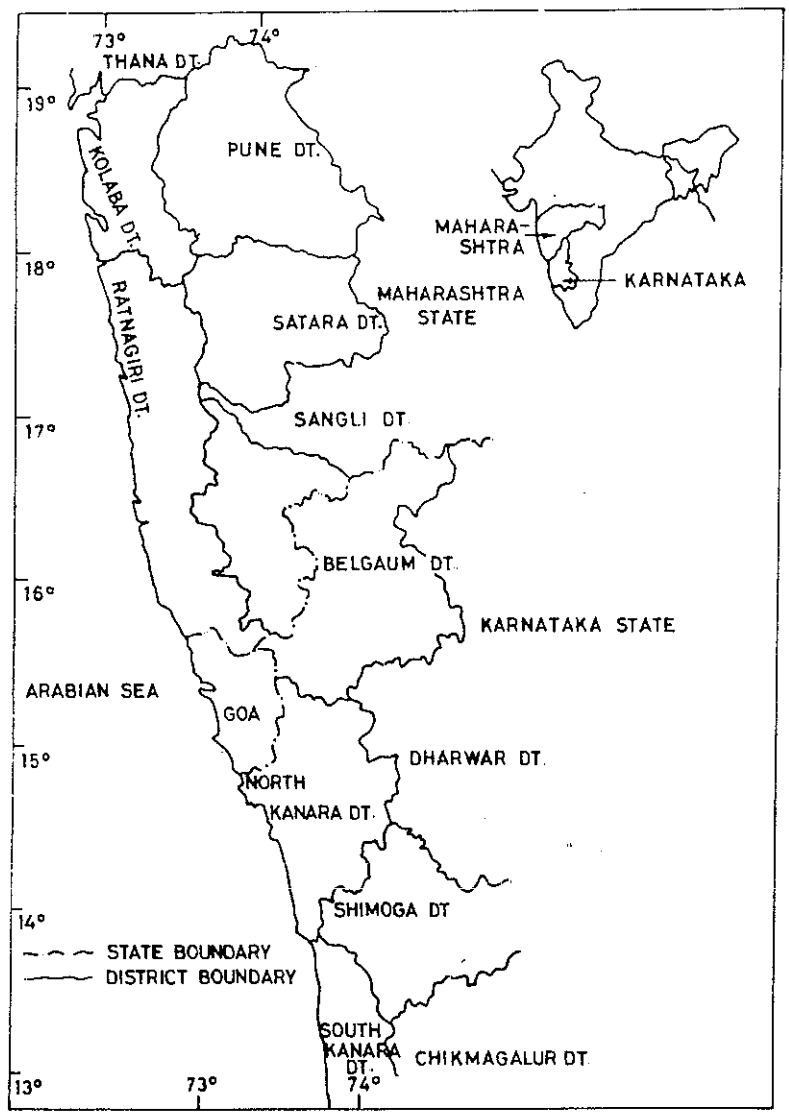


**Fig. 1.** Geographical distribution of the Gavli populations.

Dange Dhangars are a single endogamous group primarily distributed on the hilltops of the Western Ghats region in the high-rainfall zone from Kolaba to Kolhapur districts (see Fig. 1). In the second phase of this investigation (1970-1974) a total of 52 Gavli settlements were visited throughout this range, from which a total of 241 households were interviewed for information on body proportions, blood types, genealogies, kinship organization, rituals, animal and landholdings, economic status, and so on.[4]

[4] Further details of this program are given in Malhotra (in prep.).

In recent times, the Gavlis have migrated south from Marharashtra onto the Western Ghats of Karnataka where they have settled in the extensive forested tracts of the North Kanara, Shimoga, and Chikmagalur districts. As a part of the forest ecological investigations in these tracts, a study of the Gavlis was undertaken in 1975-1976 from the Indian Institute of Science, Bangalore. A detailed study was done in one *tahsil* in the North Kanara district Haliyal, collecting data on the number of households and animal holdings from 57 settlements. A further 14 settlements near Bhagvati were studied in greater depth for family size, composition of livestock, animal husbandry practices, milk production, and the impact of grazing on forest vegetation (Sastri *et al.*, 1977). Additional field work in the Pune and Satara districts of Maharashtra was carried out in 1979 to collect further ecological information from 10 Gavli settlements, particularly the grazing available to the animals and their productivity, dispersion of settlements, and historical information on ecological changes in the Gavli habitat. The present paper is a result of synthesis of data collected in three phases of investigation.

## ECOLOGICAL SETTING

The southern Indian peninsula is a triangular tableland flanked on the west by the hill range of Western Ghats. These hills rise abruptly to altitudes of 1,000 to 2,000 m from the narrow coastal trip and merge gradually with the Deccan plateau, which has an average altitude of 500 m. The Deccan plateau slopes gently toward the much broader plains of the east coast. The states of Maharashtra, Goa, and Karnataka, with which we are concerned, are situated in the northwestern portion of this peninsula.

Rainfall in these areas is restricted to the southwest monsoon months of June to September. The rainfall is heavy on the evergreen forest zones of the West Coast and the Western Ghats, with annual precipitation ranging from 2,500 to 6,000 mm. It decreases rapidly to the east of the hill range to levels of 500-600 mm in a belt 50 to 100 km from the Western Ghats. The climax vegetation along this gradient of rainfall changes from semi-evergreen, moist deciduous, and dry deciduous to thorn forest (Fig. 2). The rivers originate on the Western Ghats, and the major ones flow eastward, the west-flowing rivers being short and mostly seasonal. While the gallery forest along the major rivers once supported many evergreen species, even in the semiarid zone, the climax vegetation has been drastically changed through human interference (Gaussen *et al.*, 1966a, 1966b, 1968). No sign remains of the tropical thorn forest or the gallery forest along the rivers, and little remains of the tropical dry deciduous forest. Of the latter, the only remaining patches of any size are in areas which were malarious

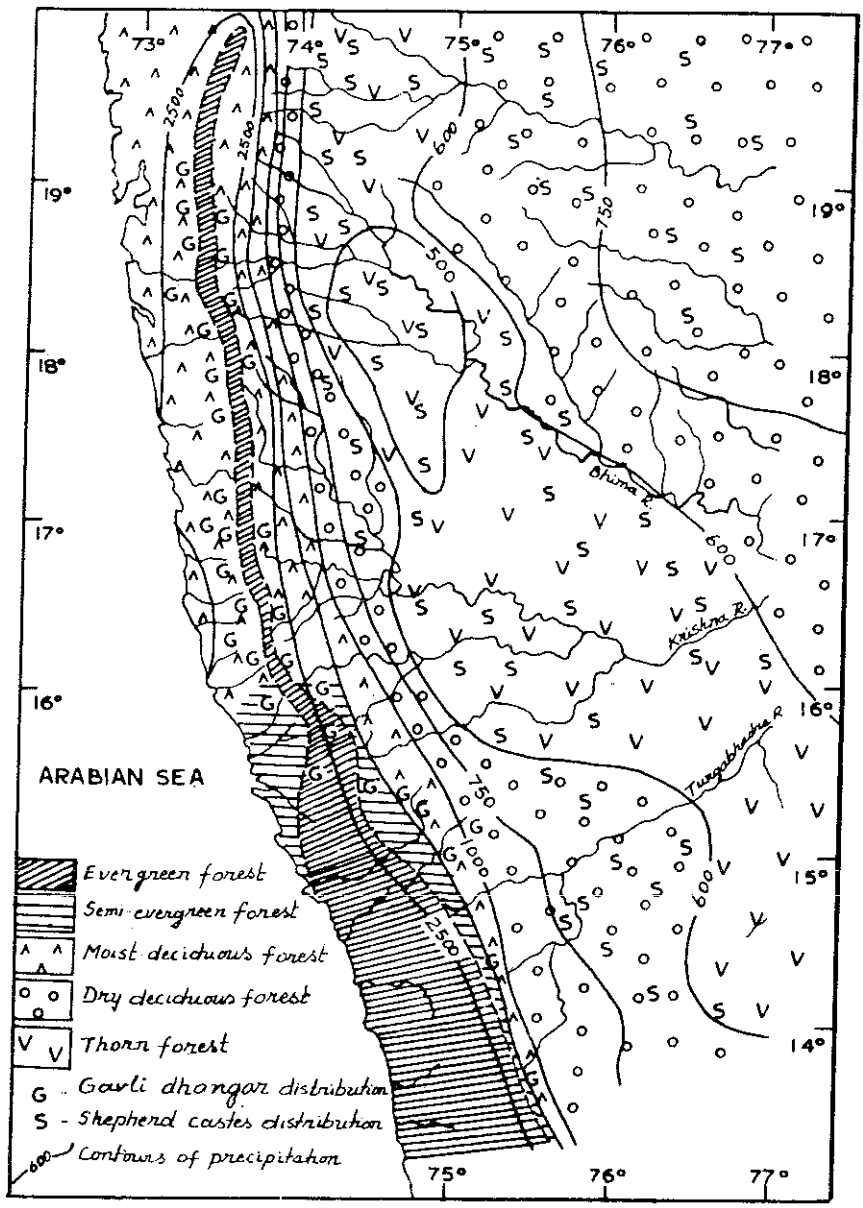


**Fig. 2.** Climax vegetation of Maharashtra and northern Karnataka in relation to normal precipitation and the distribution of Gavlis and shepherd castes over this region (modified after Gaussen *et al.*, 1966a, 1966b, 1968).

until 1950 or continue to be so, as, for example, in the Nasik or Dharwar districts. The moist deciduous forest is somewhat better preserved, and quite extensive tracts remain in Thana and Kolaba districts. The moist deciduous forest has been destroyed to a much greater extent in the intervening tracts of Satara, Ratnagiri, and Kolhapur districts, which have always been largely free of malaria. The destruction of the moist deciduous

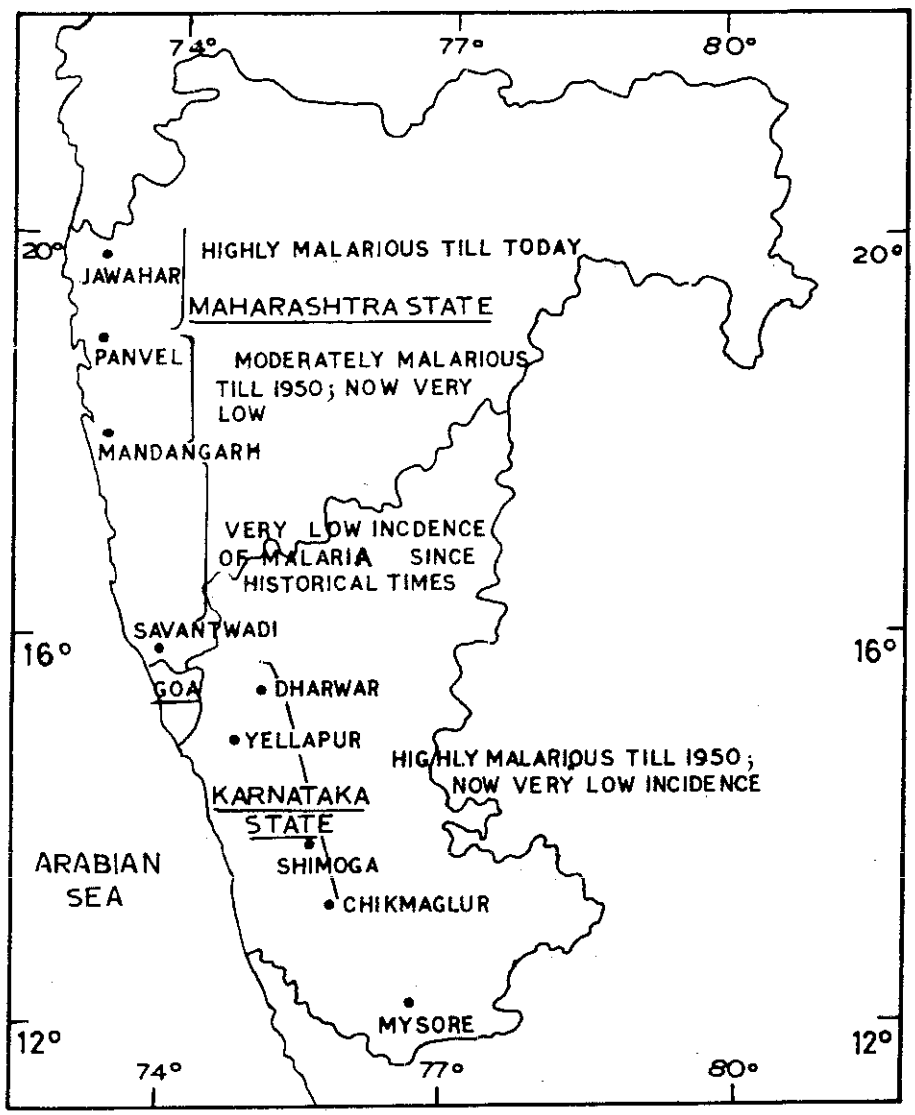


**Fig. 3.** Prevalance of malaria on the Western Ghats [after Vishwanathan (1950) and T. R. Rao (personal communication)].

forest in the moderately malarious tracts of Pune district is more recent and has been a consequence of the heavy demand for wood charcoal from the urban centers of Pune and Bombay (Fig. 3). Where present, the moist deciduous forest has been considerably opened up, leading to a good growth of grass and bamboo and thereby providing optimal habitat for the bovines. The semievergreen and evergreen forest of the west coast have been mostly eliminated. On the Western Ghats this forest type was confined to the relatively inaccessible terrain of the crest and the western face and has therefore been preserved somewhat better. Because of the shorter rainy season, this forest type is much less developed in Maharashtra,

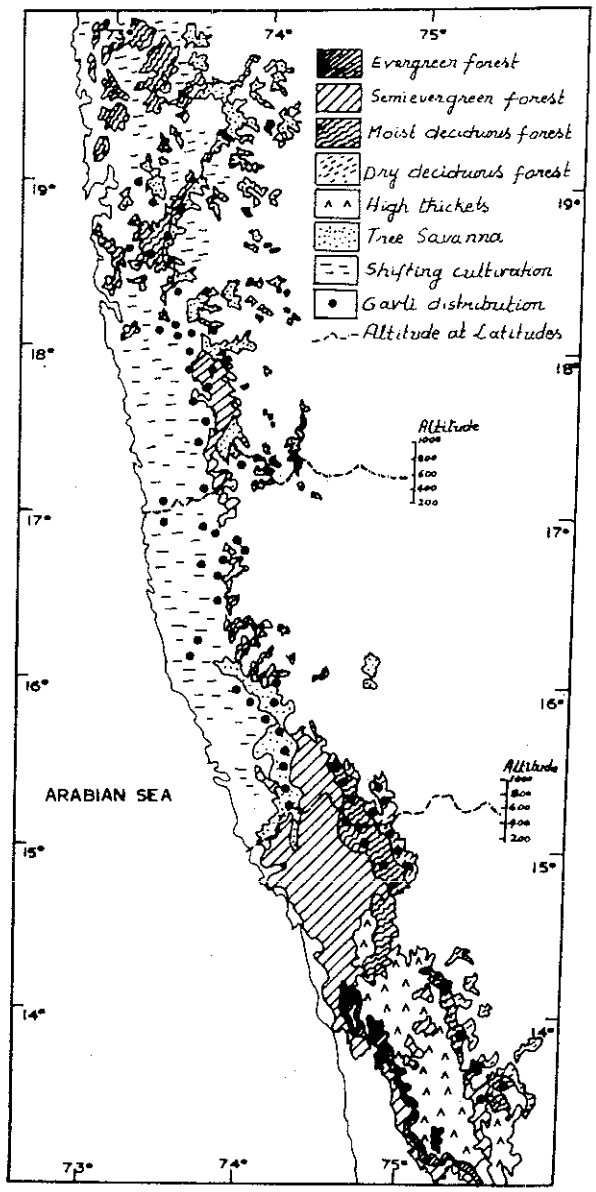


**Fig. 4.** Geographical distribution of the Gavlis in relation to the present-day vegetation (vegetation after Gaussan *et al.*, 1966a, 1966b, 1968).

and reaches its best development in Karnataka. Although very large tracts of semievergreen and evergreen forest have been reduced to high thickets due to the disturbance following the construction of a number of reservoirs, the districts of North Kanara and Shimoga retain tracts of this kind of forest (Fig. 4).

This, then, is the ecological setting in which the Gavli population is distributed. The vegetation governs the availability of fodder, water, and shade for the Gavlis' livestock, as well as indirectly the predator pressure

on their animals. The incidence of malaria regulates the regions to which the Gavlis can adapt, and the occurrence of other human populations influences the availability of grazing lands. We will attempt to demonstrate how these factors have governed the distribution of Gavlis, the strength and composition of their herds, and the extent to which they have come to depend on cultivation and other nonpastoral pursuits.

## THE HUMAN POPULATIONS OF THE WESTERN GHATS

### Origins and History of the Gavlis

The first known records of pastoral populations in this part of the country date from the neolithic period around 1500 B.C., and are confined to the semiarid tracts of less than 600 mm annual rainfall (Allchin, 1963). Pastoralism was primarily cattle-based, with some goats and sheep; buffalo were introduced only later. Agriculture seems to have been a somewhat later development. There is some evidence to suggest that a process of deforestation accompanied the history of this pastoralism. Initially their settlements have good timber fences; later they are replaced by fired dung walls, presumably as timber was exhausted but dung was still available. Still later, dung also seems to have became unavailable, probably as it became necessary to use it as a fuel or fertilizer (Allchin, 1963). We can surmise that as the destruction of trees progressed, the land became the semidesert that it is today, making large herds of cattle hard to maintain. Cattle pastoralists must then have moved, along with agricultural groups to the better rainfall zone toward the Western Ghats.

Since sheep (present in small numbers with the cattle) can be maintained in the treeless semiarid tract, this region gradually became occupied by sheep-based pastoralists, as it is today (Fig. 3). These groups belong to the same Dhangar caste-cluster as the Gavlis and are known as Hatkar and Mendke Dhangars (Mendke = shepherd). Interestingly, the Gavlis, Hatkars, and Mendkes all claim that originally they were one, a claim supported by several lines of evidence. Genetic studies reveal the three groups to be among the closest in the entire cluster (Malhotra *et al.*, 1977, 1978), and the three have a number of clan names in common.

This suggests that former shepherds and Gavli populations kept both the animals simultaneously. This is certainly possible where major rivers such as the Bhima and the Krishna flow through the semiarid tract. The gallery forests lining the banks of these rivers provide excellent habitat for buffalo, while the semiarid plains away from the river banks provide excellent habitat for sheep. In fact, a parallel situation exists where African

wild buffalo live in gallery forest along the streams of the Serengeti plains, while gazelles live in nearby savanna country. A pastoral group could have combined buffalo and sheep husbandry in this semiarid region at a stage when the sparser tree growth away from the water courses was much reduced, but the denser gallery forests were still largely intact.

Archaeological evidence suggests that domestication of animals and plants as well as sedentarization originated in this semiarid tract and spread into the higher rainfall zone (Allchin, 1963; Zeuner, 1963). This implies a progressive destruction of tree growth into the higher and higher rainfall zones. The destruction of the gallery forests along the water courses in the semiarid tract would eliminate the possibility of a single pastoral group maintaining sheep and buffalo. The shepherds remained in the semiarid tract while buffalo-herders moved upstream of the water courses into the deciduous forest zone to the west. As the tree growth in the deciduous zone was removed and land brought under cultivation, the buffalo-herders would move farther west into the higher and higher rainfall zones toward the crest of Western Ghats.

Further evidence for this process of displacement can be found in the folklore and folk history in Pune district, as we have discussed elsewhere (Gadgil and Malhotra, 1979). During our fieldwork in 1979 we discovered support for our interpretation in a village in Satara, where Gavlis trace their migration from the river valley at Chaphal, to the lower hill terrace at Nanegaon, to the middle hill terrace at Kelawali, to the upper hill terrace at Irewadi, and finally to the hilltop plateau of Sadawaghapur. At every stage they were pushed to higher altitudes by the peasant community (Fig. 5). The ability of the peasant community to displace the pastoralist is traceable to their numerical superiority, which in turn is due to the higher carrying capacity of the land for cultivators in comparison to the pastorals. Thus a peasant household requires 5-6 hectares (ha) of hilly terrain per year to produce enough grain for its subsistence. With the traditional cycle of 3 years of cultivation followed by 15 years of fallow, this implies approximately 25-30 ha of land for the subsistence of a peasant family. In contrast to this, a pastoral household needs at least 100 ha of grazing land. Thus peasant populations can reach 3 to 4 times the density of Gavli populations in the same habitat. In fact, peasants have appropriated much of the area and their populations are 20 to 100 times higher than those of Gavlis. An indication that Gavlis have been pushed to the upper hill terraces and hilltops is the persistence until recently of a few Gavli settlements in the Koyna valley—one of the most remote areas of the Western Ghats.

Prior to the domestication of animals the region supported hunting and gathering populations, at even lower population densities (Braidwood and Reed, 1957), suggesting that hunter-gatherers could persist only in

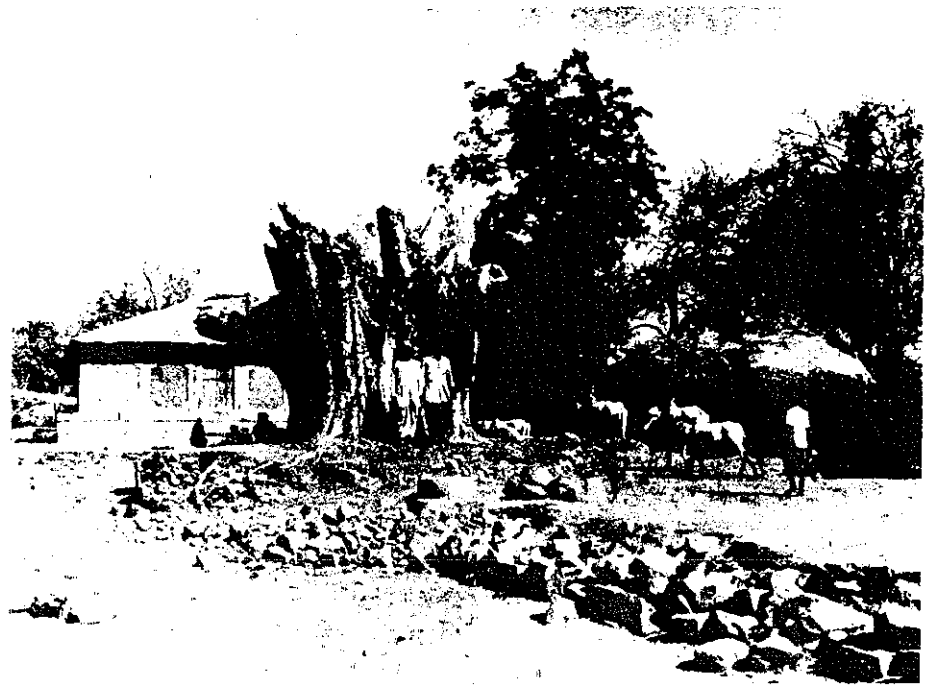

**Fig. 5.** Gavlis in front of a cut-down tree in Nanegaon in Patan tahsil of Satara district. Kunbis who displaced Gavlis from this village are believed to fear divine wrath if they plough the land near this tree (photo by H. C. Sharatchandra).

regions that never permitted colonization by the more numerous pastoralists and agriculturists. Such regions appear to have been the highly malarial hilly tracts of Thana district, which retain a large hunting-gathering population to this date. In other regions the hunter-gatherers appear to have been incorporated into the Hindu caste society at its lowest rungs, classified today as "scheduled castes" (Karve, 1968). It is interesting to note in this context that the distribution of traits conferring genetic resistance to malaria, namely, sickle-cell hemoglobin and G-6-PD deficiency, is largely confined to the tribal and some of the scheduled castes of Maharashtra (Kate *et al.*, 1978). Apparently, the tribal populations and the scheduled castes derived from them have been exposed for a very long time to incidence of malaria in India, while the other Hindu caste population has immigrated into India from nonmalarious regions of West and Central Asia within the last few thousand years (Malhotra, 1978). The probable historical sequence of these changes is illustrated in Fig. 6.

## Historical Migrations

The highest population densities of Gavlis today, in the range of 1.5-5.25/km$^2$, occur in a contiguous tract in the Kolaba, Satara, and

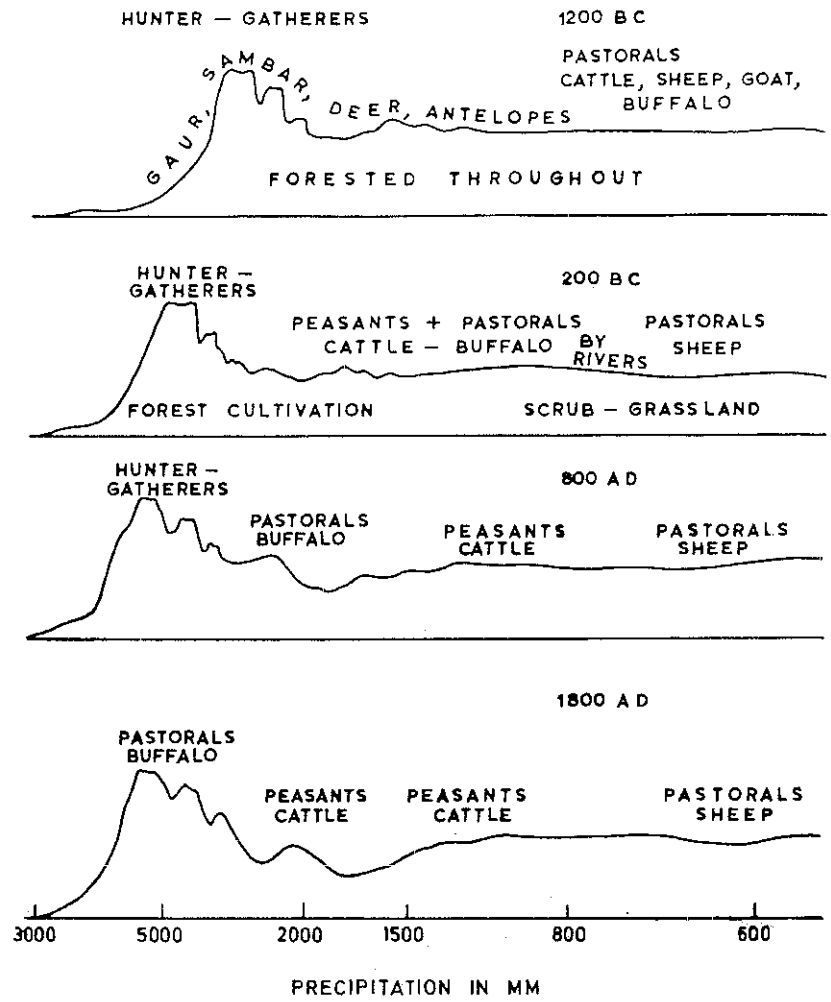


**Fig. 6.** Probable historical changes in the occupation of different ecological zones of Maharashtra by populations adopting various subsistence strategies.

Kolhapur districts (Table I). This region is characterized by very broad hill plateaus around the peak of Mahabaleshwar, the highest in the region. It is also the region of very high rainfall (over 6,000 mm) and must once have been covered by the most extensive tract of evergreen forest on the Maharashtra Western Ghats. There is strong evidence that settled cultivation occurred rather late in this hill tract: the region has been largely free of malaria since historical times, and it does not contain any large hunting-gathering populations such as Katkaris, or shifting cultivators-*cum*-hunter-gatherers, such as Kolis. All these factors must have rendered this region conducive to extensive colonization by Gavlis.

The Gavli habitat in Pune and Kolaba districts to the north, in Ratnagiri district to the south and west, and in Kolhapur district to the

Table I. Population Estimates of the Gavlis in Selected *Tahsils*

| District | *Tahsil* | Area, km² | Rural population[a] | Estimated Gavli population | Gavli population per sq km | Gavli population as percentage of rural population |
|---|---|---|---|---|---|---|
| Pune | Mulshi | 1,039.1 | 91,641 | 1,500 | 1.44 | 1.64 |
| Kolaba | Mahad | 808.8 | 118,988 | 3,000 | 3.71 | 2.52 |
| | Poladpur | 380.2 | 45,832 | 2,400 | 6.31 | 5.24 |
| Satara | Mahabaleshwar | 226.1 | 15,967 | 720 | 3.18 | 4.51 |
| | Jaoli | 892.8 | 91,939 | 1,400 | 1.57 | 1.52 |
| | Patan | 1,330.0 | 194,994 | 3,000 | 2.26 | 1.54 |
| Ratnagiri | Ratnagiri | 925.9 | 151,075 | 1,500 | 1.62 | 0.99 |
| Kolhapur | Shahuwadi | 1,044.3 | 115,286 | 2,500 | 2.39 | 2.17 |
| | Bhudergad | 644.4 | 94,246 | 600 | 0.93 | 0.64 |
| | Ajara | 548.8 | 84,439 | 600 | 1.09 | 0.71 |

[a]Data from Census of India (1971) District census handbooks: Pune, Kolaba, Satara, Ratnagiri, Kolhapur.

south of this heartland of Gavlis possesses much narrower hill plateaus. The northern peripheral tract was moderately malarious and harbored substantial tribal populations. The Gavli populations of this peripheral tract are also much less dense, ranging from 0.5 to 1.5/km². The Gavlis of all of this peripheral tract trace their origin to the region designated above as the Gavli heartland. Some folklore we collected suggests that the migration of Gavlis to this peripheral tract is at least as old as the 15th century A.D. (Gadgil and Malhotra, 1979).

Until recent times the bulk of the Gavli population was restricted to the tract between Panvel in Kolaba district to the north and Savantwadi in Ratnagiri district to the south. Notably enough, Panvel is the southern boundary of the highly malarious forested tract of Thana district, where malaria control has not been fully effective to this date, and Savantwadi was the northern boundary of the highly malarious forested tract of North Kanara district before the recent control of this disease (Fig. 3). Gavlis are known to lack any genetic defenses against malaria (Undevia *et al.*, 1973), and it is likely that their distribution was governed by the incidence of this disease. This interpretation is further strengthened by the fact that the time of Gavli migration into North Kanara almost exactly coincided with the eradication of malaria in 1949 (Vishwanathan, 1950).

## TRADITIONAL SUBSISTENCE PATTERNS

It is possible to reconstruct both the distribution and the subsistence patterns of the Gavlis before the period of population growth and de-

forestation which began in the 1860s. The Gavli population was then distributed on the upper plateaus of the Western Ghats between Panvel and Savantwadi. Duff (1826), who wrote a history of this tract immediately following its British conquest, mentions that all the valleys were under paddy cultivation by the Kunbis—a cultivator caste of Western Maharashtra—while the entire upper reaches of the hills were under a thick forest cover. He also records that the means of communication were practically nonexistent and that these higher reaches of hills were very difficult to reach. Figure 7 presents a schematic cross section through the Western Ghats of Maharashtra, indicating the present pattern of land use by the Kunbis and Gavlis in this region.

The Gavlis traditionally inhabited the thickly forested upper hill plateaus, sharing this habitat with a variety of wild animals that included panthers and tigers. Although good grass growth is confined to about 6 months of the year (from May to October) due to the highly seasonal rainfall the forest harbors a number of tree species with highly palatable browse in which animals could browse during the dry months: e.g., *Grewia tiliifolia, Dalbergia latifolia, D. sympathetica, Ochlandra scriptoria, Eriolaena quinquelocularis, Ficus hispida, Albizzia procera, Trema orientalis,* and *Ehretia laevis*. The forest also has a number of perennial springs.

The Gavlis report that the ideal herd of a household traditionally included 60 buffalo and 20 cattle. In none of the regions we visited did they report the absence of buffalo in their traditional husbandry practices, while absence of cattle in earlier times was reported from many localities. The only other domestic animal traditionally maintained was the chicken, while goat, sheep, and other animals were totally absent.

The Gavlis regard buffalo as most ideally adapted to their traditional habitat because of its ability to defend itself against panthers and tigers. The buffalo is a much more heavily built animal than the Gavli cattle; when threatened, the adults form a circle facing outward, keeping the calves in the center and thus effectively protecting themselves. Gavli cattle, on the other hand, are much smaller and their response to predators is to scatter and run; they thereby fall easy prey to panthers and tigers. Buffalo require more water and shade and much more browse than do cattle, and all these were readily available in a well-forested tract. The buffalo was therefore the mainstay of the traditional subsistence pattern of Gavlis.

Traditionally, and this means up until 1960-1970 for most of the localities, the Gavlis used to curdle all their milk, churn it, and convert it into buttermilk for domestic consumption and butter or clarified butter for marketing (Fig. 8). This butter was accumulated for a week or so and then sold at a weekly market in a nearby village (*Bombay Gazetteer Kanara,* 1883). As the Gavli settlements are all away from peasant villages and

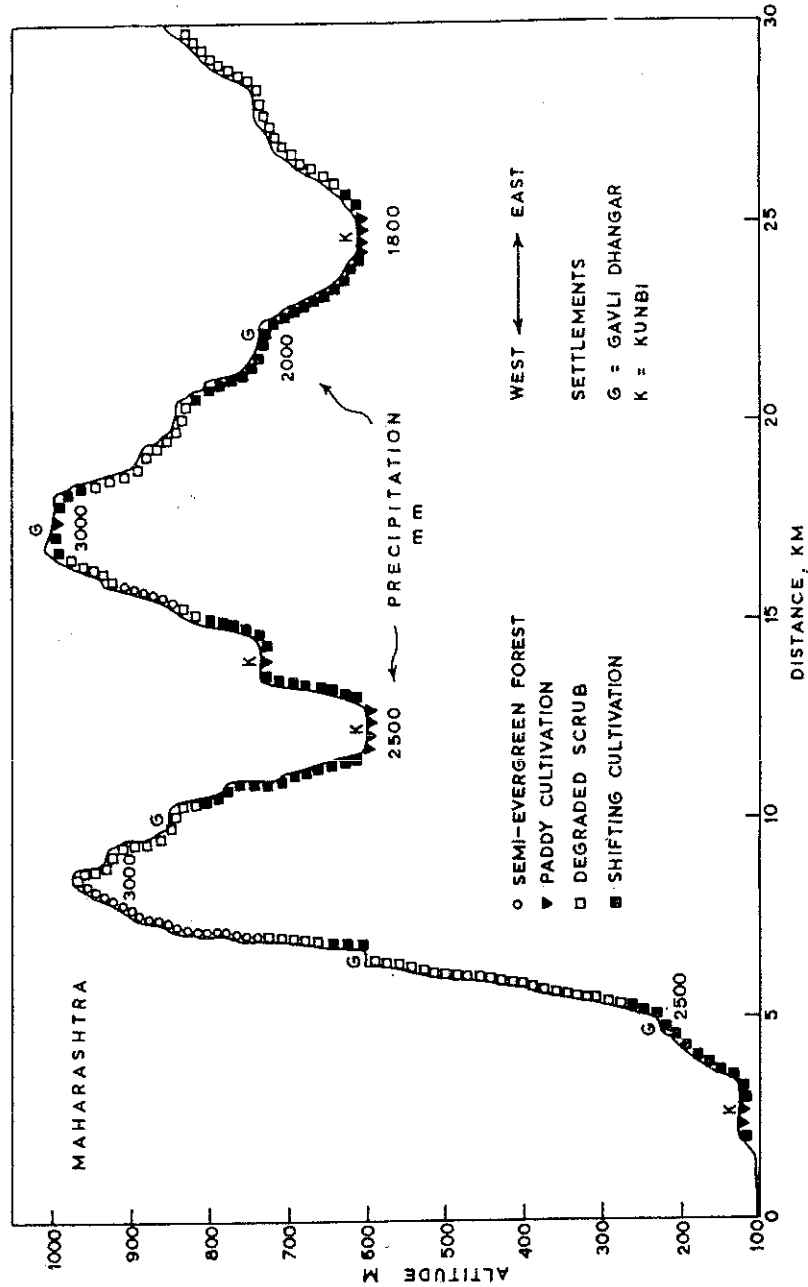


Fig. 7. A schematic cross section through the Western Ghats of Maharashtra, indicating precipitation, present-day vegetation, and the distribution of Gavlis and Kunbis.

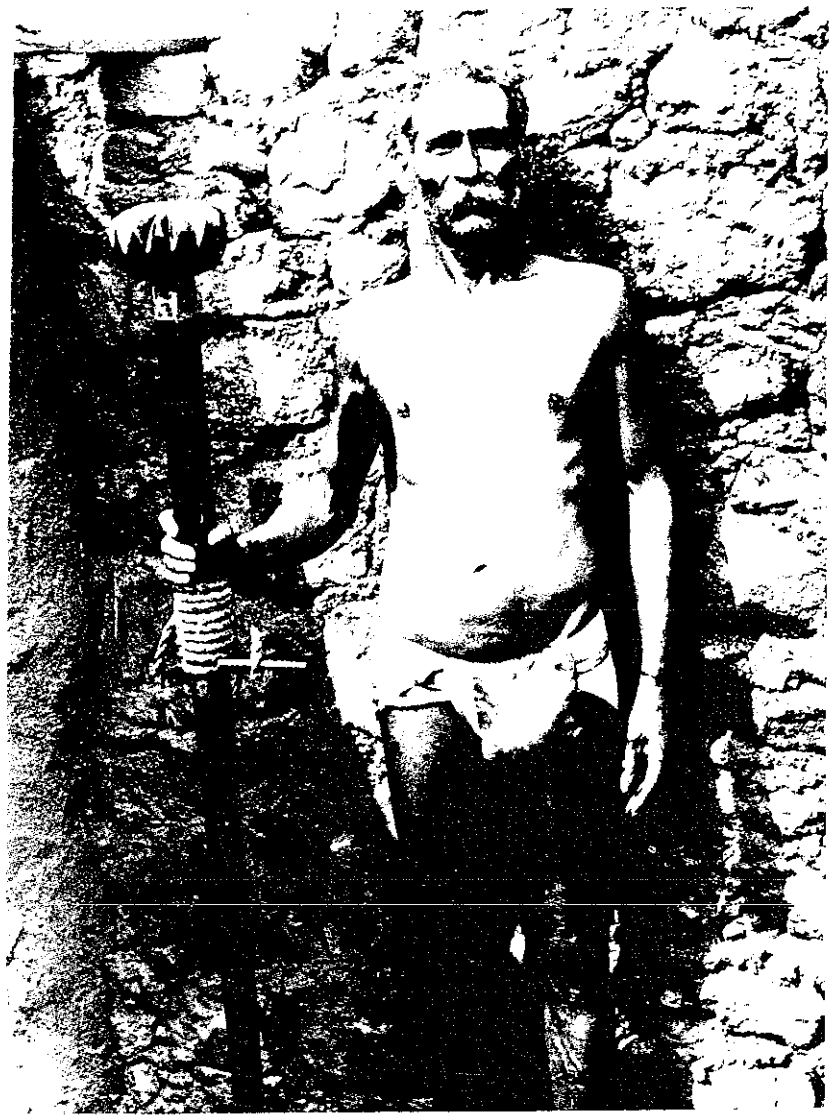

Fig. 8. A Gavli Dhangar with his giant buttermilk churner.

high up in the hills, there was no ready market for the fluid milk and butter was the only marketable commodity. The Gavli subsistence then depended on the exchange of butter for cereal, basically *ragi* (*Eleusine coracana*) or *jowar* (*Sorghum vulgare*). The basic per capita daily requirement for cereals of the rural population in India has been set at 0.5 kg per adult (Indian Council of Medical Research, 1951), and this was also the reported requirement of over 50 Gavli households we interviewed from 10 settlements. Apart from their cereal requirements, the needs of a Gavli household are few, and include edible oil, lentils, *jaggery* (a kind of brown sugar), oil for lighting (now kerosene), clothes, and a few miscellaneous

items such as salt, condiments, tobacco, and dried fish. We have made per capita estimates of all these requirements based on interviews with 37 households in Pune and Satara districts. Table II gives details of these estimates for a household of six adult equivalents. The total annual requirement for such a household equals 2,263 kg of cereal equivalents.

The butter production from Gavli milk ranges from 50 to 80 g/liter which agrees with the known high fat content of 6-9% in buffalo milk. The exchange rate of butter to cereal today ranges from 12 to 20 kg of cereal for 1 kg of butter, and has remained largely stable, although the absolute prices have increased greatly. This implies that 1 liter of milk could produce enough butter for the purchase of 1 kg of cereal; in addition, buttermilk will be consumed. In a buffalo herd such as that represented in Table III, about half the buffalo will be adults, and with an intercalving interval of 2 years, half of these will yield milk in any given year. Thus one buffalo (or cow) out of four will yield milk in a given year. The annual milk yield per buffalo in good condition, as at Asanwadi, will be 200 liters; some 70 liters per cow. Thus a herd of 11 buffalo or 32 cattle would be required just to meet the subsistence requirements of Gavli household, assuming that part of the butter produced is exchanged for grain and other goods at 1979 prices (see Tables II, IV). Such a diet implies a daily per capita protein intake of 74 g and calorie intake of 2,250 kcal. (Ranganatham *et al.*, 1937).

Since this represents the average consumption of a household, including adult males, females, and children, protein and calorie intake is probably adequate. This diet is supplemented by eggs from domestic poultry, honey, and wild edible plants, making it fairly complete. Under favorable conditions, a herd of 11 buffalo or 32 cows could provide a

Table II. Annual Consumption of Basic Requirements by 37 Gavli Households Normalized for a Household Size of 6 Adults[a]

| Item | Annual consumption | | Equivalent in kg of cereals for the mean |
|---|---|---|---|
| | Mean | S.D. | |
| Cereals, kg | 1,100.00 | – | 1,100.00 |
| Oil, kg | 13.85 | 6.96 | 103.87 |
| Lentils, kg | 430.92 | 27.84 | 136.40 |
| Jaggery, kg | 48.96 | 35.40 | 122.40 |
| Kerosene, liters | 39.00 | 17.52 | 65.00 |
| Clothes, Rs | 521.90 | 335.15 | 434.92 |
| Miscellaneous, Rs | 360.00 | – | 300.00 |
| Total | – | – | 2,262.59 |

[a] The expenditure on clothing and miscellaneous items is based on 1979 price levels.

Table III. Reported Survivorship and Fertility[a] of a Female Buffalo/Cow from Bhagvati and Neighboring Gavli Settlements of Haliyal *Tahsil* North Kanara District[b]

| Age, yr | Prob. of survival from birth | Expected No. of female calves |
|---|---|---|
| 1 | 0.7 | 0 |
| 2 | 0.65 | 0 |
| 3 | 0.61 | 0 |
| 4 | 0.56 | 0 |
| 5 | 0.52 | 0.5 |
| 6 | 0.49 | 0 |
| 7 | 0.45 | 0.5 |
| 8 | 0.42 | 0 |
| 9 | 0.39 | 0.5 |
| 10 | 0.36 | 0 |
| 11 | 0.34 | 0.5 |
| 12 | 0.32 | 0 |
| 13 | 0.29 | 0.5 |
| 14 | 0.27 | 0 |

[a] Survival and fertility decline very rapidly beyond 14 years of age and may be ignored.

[b] $\sum_{1}^{14} l_x b_x = 0.995$ Proportion of calves in the population = 0.14, and of adult animals in the population = 0.52. Overall annual mortality = 9.94%

Gavli family with very adequate nutrition and other necessities. As noted above, the Gavlis report a herd of 60 buffalo and 20 cattle per household as the traditional norm; such herds are even today maintained by some households of Haliyal *tahsil.* At such levels the animals would evidently provide a very good living for a Gavli household.

These computations suggest an explanation for the complete absence of any tradition of hunting among the Gavlis. They live in a habitat rich in wild animals, including mouse deer, barking deer, sambar, wild pig,

Table IV. Mean Per Capita Daily Consumption of Major Items in the Diet of Gavlis and Their Protein and Caloric Value

| Item | Daily consumption g | Protein content, g | Caloric value, kcal |
|---|---|---|---|
| Ragi | 500 | 35 | 1,700 |
| Vegetable oil | 6.67 | 0 | 58 |
| Lentils | 18.33 | 4 | 58 |
| Jaggery | 21.67 | 0 | 84 |
| Total | -- | 39 | 1,900 |
| Buttermilk | 1,000 | 35 | 350 |
| Total | -- | 74 | 2,250 |

porcupine, blacknaped hare, junglefowl, and peafowl—all regularly hunted by the Kunbi peasants with whom they share these hill tracts. But the peasants produce only cereal crops plus some lentils and traditionally keep very few milch animals, making them dependent on wild animals for their protein requirements. Since the Gavlis' protein requirements were met by their buttermilk consumption, they did not have to depend on wild animals for protein and hence did not develop a tradition of hunting.

We also calculated the amount of grazing land required for a Gavli herd of 60 buffalo and 20 cattle per household. The mean weight of a Gavli buffalo can be taken to be 150 kg and of Gavli cattle 100 kg. The herd of a single household would then represent a biomass of 11,000 kg. Eisenberg and Seidensticker (1976) have reviewed the known biomasses of large grazing herbivores in Asian tropical and subtropical forests, estimating about 1,500 kg of wild and 4,500 kg of domestic livestock per square kilometer for moist deciduous forest, the optimal habitat for such animals. The levels of domestic stock show considerable overgrazing and a level of perhaps half of this total biomass, namely 3,000 kg/km$^2$, reflects sustainable levels in a very good habitat. In other words, the traditional herd of a single Gavli household would need 3.66 km$^2$ of grazing land. Gavli animals utilize an area of up to 3 km around their settlement for grazing. Thus if the terrain were flat and all the land in a circle of 3-km radius were available for grazing, about eight Gavli households could sustain their livestock together. However, the terrain typically comprises narrow valleys with steep hills forming stepped terraces leading to the flat hilltops. The Gavlis can utilize the upper slopes and the hilltops where the available grazing land tends to be in strips of ½ to 1 km wide. Thus the average area available for grazing around a settlement would be 3-6 km$^2$, sufficient for utilization on a sustained basis by one or two households maintaining herds of traditional size. The social preference, as indicated by the Gavlis in our interviews as well as displayed in the actual distribution of the number of households per settlement at the present item, is between 5 and 10 (Table V). This implies livestock densities of 2-10 times what can be sustained on a long-term basis. The Gavlis in fact shifted camp every 3-4 years, evidently seeking fresh pastures when an area became overgrazed.

## SHIFTING CULTIVATION

The Gavlis traditionally carried out some shifting cultivation, though the activity was quite subsidiary to their animal keeping. In fact, even today Gavlis own very little land compared to the peasants in the valleys or lower hill terraces. The kind of cultivation possible in the hilly

**Table V.** Frequency Distribution of the Number of Households per Gavli Settlement

| Locality | Number of settlements | 1-5 | 6-10 | 11-15 | 16-20 | 21-30 | 31-40 | 41-60 | ⩾ 61 | Maximum recorded |
|---|---|---|---|---|---|---|---|---|---|---|
| Mulshi *Tahsil*, Pune district | 31 | 19 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 11 |
| Satara district | 4 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 100[a] |
| Haliyal *tahsil*, N. Kanara district | 42 | 13 | 12 | 10 | 4 | 3 | 0 | 0 | 0 | 29 |

[a] These 100 households of the village of Sadawaghapur are situated on an extensive plateau and constitute a single administrative unit. They are, however, divided into seven clusters of 10-15 households, separated by a minimum distance of 1 km.

**Fig. 9.** Shifting cultivation: A Gavli couple stacking vegetation for burning the land in Mulshi *tahsil* of Pune district (photo by H. C. Sharatchandra).

terrain they occupy is shifting or slash-and-burn cultivation for inferior millets (Fig. 9), in particular *nachani* or *ragi* (*Eleusine coracana*), *varai* (*Setaria italica*), and *sava* and black *sava* or *kathal* (*Panicum milliare*), besides a little paddy cultivation on flat terraces, along with minor crops such as *til* (*Guizotia abyssinica*), *rala* (*Papsalum scrobiculatum*), *pavta* (*Lablab niger*), and some wheat (Table VI). Cultivation in earlier times was probably more significant for opening up the forest canopy in small patches. Particularly in the high-rainfall tracts, this would allow good grass growth for some time after the cultivation has shifted to another patch, and would provide excellent grazing for animals (Wharton, 1968). The Gavlis also used to benefit from the grazing produced by shifting cultivation by the peasants.

## PATTERNS OF CHANGE IN THE WESTERN GHATS

The pattern of subsistence of Gavlis reconstructed above must have persisted for several centuries after they were pushed to the upper hill

**Table VI.** Major Cultivated Crops of Gavlis

| Local name | Scientific name | Season | Slope | Quality of soil | Frequency | Preparation of land | Method of planting | Burning of vegetation | Addition of dung | Yield, kg/ha |
|---|---|---|---|---|---|---|---|---|---|---|
| *Bhat* (rice) | *Orvza sativa* | Monsoon | Flat, terraced fields | Good | Every year | Ploughing | Transplant seedlings from seedbeds | Regular | Regular | 500-700 |
| *Nachani* (*ragi*) | *Eleusine coracana* | Monsoon | Flat to steep slopes | Moderate | 1st year of slash and burn | Ploughing | Transplant seedlings from seedbeds | Regular | Regular | 100-400 |
| *Varai* | *Setaria italica* | Monsoon | Moderate to steep slopes | Moderate to poor | 2nd year of slash and burn | Ploughing or hoeing | Transplant seedlings from seedbeds | Regular | Occasional | 80-300 |
| *Sava* | *Panicum milliare* | Monsoon | Moderate to steep slopes | Very poor | 2nd or 3rd year of slash and burn | Hoeing | Broadcast seeds | Occasional | Never | 80-300 |
| *Kathai* or *Kala sava* | *Panicum milliare* | Monsoon | Moderate to steep slopes | Very poor | 2nd or 3rd year of slash and burn | Hoeing | Broadcast seeds | Occasional | Never | 80-300 |
| *Til* | *Guizotia abyssinica* | Monsoon | Moderate to steep slopes | Extremely poor | 3rd or 4th year of slash and burn | Hoeing | Broadcast seeds | Never | Never | 50-200 |

plateaus of the Western Ghats. As mentioned above, folklore dates this push to the hilltops to the 15th century for a locality in Pune district (Gadgil and Malhotra, 1979). There was probably a slow rate of population increase and colonization of new terrain over the several centuries until the British conquest of Maharashtra in the early 19th century. Maharashtra was the seat of a powerful kingdom extending over much of India throughout the 18th century, and historical records show that the population of Maharashtra and the number of settlements increased considerably in this period. While the pattern of subsistence probably remained qualitatively unchanged for several centuries (Enthoven, 1920-1922; Russell, 1916), changes began with the incorporation of Maharashtra into a wider economy—first as part of a British mercantile colony, then, after 1947, as part of an independent country embarked on a program of national economic development.

Major changes in the Gavli subsistence pattern began to take place after the British consolidated their hold over India in the 1857 War of Independence. They initiated two major activities in the 1860s, namely (a) the construction of a vast network of railways and (b) the appropriation, for government reserves, of forests formerly held by village communities (Dutt, 1960).

## Commercial Forestry

Before this time the commercial exploitation of forests was largely restricted to wood needed for the local shipbuilding industry and to precious woods such as sandalwood. The laying down of the railway networks generated an unprecedented demand for timber. Many rail lines began to use wood charcoal as fuel. To meet these requirements without having to pay for them, the British government took over vast areas of communally owned village forests, a move that was initially resisted by the entire local population in the forest tracts (Dikshit, 1902). The resistance was, however, largely unsuccessful, and most of the forest was incorporated into government reserves and subjected to fairly heavy commercial exploitation. At the same time, wherever people retained control over extensive forested tracts, as in the Ratnagiri district, they also sold off these trees in large quantities for the production of wood charcoal.

## River Valley Projects

The British also introduced the construction of large reservoirs, for irrigation and hydroelectric power. The high-rainfall tracts of the Western

Ghats are particularly favorable for reservoirs, and series have been constructed throughout the length of the Maharashtra Western Ghats, particularly since the 1920s. The construction of these reservoirs led to the submergence of the rich paddy lands of the Kunbi cultivators, who, until very recently, were not provided any alternative lands, but only paid wholly inadequate compensation for the lands that were submerged. The Kunbis then moved up the slopes and intensified shifting cultivation. They also began to cash crop economically valuable trees such as mango, which they had earlier retained during the course of their slash-and-burn cultivation. Deprived of their paddy fields they were unable to subsist on the shifting cultivation of hill slopes alone, and began to encroach on the reserved forests of the upper hill slopes and destroy them through large-scale slash-and-burn cultivation (Gadgil, 1979).

## Population Growth

The population of the Western Ghats, along with that of the rest of the country, began to grow rapidly after the 1920s with the control of epidemic diseases such as influenza and plague (Misra, 1970). This population growth, with a doubling time of 20-25 years (Agarwala, 1967), added to the pressure on land and on forest resources for fuel, grazing, etc., and together with the factors mentioned above was responsible for very extensive destruction of the tree cover of Maharashtra. This has been maximum in the coastal district of Ratnagiri, where the vegetation has been almost totally reduced to scattered scrub. It is a little less in Pune and Kolaba, where scattered tree growth interspersed with scrub covers the hills (Fig. 10). The more rugged hilly terrain of Satara and Kolhapur districts has suffered relatively less than the aforementioned areas, although these two have also lost considerable tree growth (Fig. 4).

The Gavlis of Maharashtra thus experienced a drastic shrinkage of available territory, with the Kunbis pushing into the upper reaches of the hills for shifting cultivation. The reduction in tree growth in the forested tracts also meant difficulties with water and browse for the animals in the dry season. Faced with these difficulties in maintaining animals, the Gavlis began more and more to seek other means of subsistence. First, they began to intensify the shifting cultivation of the hill plateaus and upper hill slopes. Because they had traditionally not established ownership rights over land, this meant encroachment on government-owned forest land and conflict with government officials. Second, they began to accept other nontraditional occupations, such as gardening, tailoring, and bicycle repairing, especially near the hill resort of Mahabaleshwar in Satara district. Third, they began to migrate out. An estimated 8,000 Gavli adult

**Fig. 10.** A view of the Maharashtra Western Ghats in Pune district. The circle indicates a Gavli settlement on the middle hill terrace. Note the sparse tree growth. The hill slopes are under shifting cultivation (photo by H. C. Sharatchandra).

males have migrated as laborers to Bombay, visiting their families once or twice a year and remitting part of their earnings regularly; several hundred have joined the army from the localities near Raigad in Kolaba district; and an estimated 15,000 have migrated into the Karnataka Western Ghats.

## Colonization of Karnataka

The Western Ghats region of the North Kanara-Shimoga-Chikmagalur districts of Karnataka, into which the Gavlis migrated, is even today a deciduous forest with lush bamboo growth under a partially open canopy, and many perennial streams. It is therefore a habitat favorable to Gavli exploitation (Fig. 11). This terrain was highly malarious until 1948.

Before this only a small number of Gavli families were settled in this locality, and they maintained regular contacts with their ancestral populations in Maharashtra. The *Bombay Gazetteer Kanara* (1883) reports a population of 1,700 Gavlis for the district of North Kanara. The census figures show a decline on the order of 25% of the total population of the

**Fig. 11.** The undulating terrain of the Karnataka Western Ghats in North Kanara district. Note the peasant cultivation in the low-lying area in the midst of profuse tree growth (photo by P. V. K. Nair).

Western Ghats areas of the district between 1901 and 1941. One-fourth of this population decline is attributable to the excess of death rate over birth rate, and the rest to large-scale emigration (Vishwanathan, 1950) Gavlis have no special genetic defenses against malaria (Undevia *et al.*, 1973), hence their population can be expected to have declined by at least 6.25%, and perhaps more if they also participated in the exodus out of the district in this period. A reasonable estimate of their population around 1946, when a serious campaign for malaria control was launched, may be 1,200-1,500; as a result of this campaign the area became largely free of malaria by 1948 and has remained so to this day (Vishwanathan, 1950; T. R. Rao, personal communication). It is of interest that the large-scale migration of Gavlis into this region began only after 1945, coinciding almost exactly with the control of malaria. This migration gathered real momentum in the period 1955-1960, and largely ceased thereafter.

The 20-year history of the newly migrated Gavli community from 1956 to 1976 as they recount it is most instructive. The Gavlis emigrated with very few animals. They settled in the forest, cultivated paddy on encroached forest land, and purchased some buffalo from their savings. In early years the grazing was excellent, and the Gavli herds increased

rapidly. During this period they shifted camp to better grazing grounds every 3-4 years. In the meantime, more Gavlis were coming in and their animals were multiplying. As the grazing was gradually depleted, the herds began to stabilize and in the process cattle began to replace buffalo. With Gavli settlements developing everywhere, periodic shifting to previously unexploited grazing grounds became impossible. In addition, a composite weed, *Eupatorium glandulosum,* spread over vast areas wherever canopy had been opened up, beginning in the late 1960s. This weed is quite unpalatable, and has been responsible for destroying vast tracts of grazing for the Gavli animals. The Gavlis therefore had to abandon some areas, and today the habitat appears fully saturated with only around 3 ha of grazing land per head of livestock in many localities. The dry season, in particular, is a difficult one, with the livestock facing starvation. The herds have now stabilized. Further immigration into the area has ceased, and there is even some return migration, although this must be due largely to social factors, because conditions are still superior to those in the ancestral habitat.

The immigrant families have settled in the new localities in clusters based on their origin in the ancestral habitat. Thus in Haliyal *tahsil* we know of three clusters: the one around Bhagvati derives from Ajara tahsil of Kolhapur district, the one around Barchi from Khanapur tahsil of Belgaum district, and the one around Pradhani from Goa. The families within such a cluster of 10-15 settlements form a social group with considerable contact within the group, but very little outside it.

## Dairy Development

Over the last two decades extensive schemes have been developed to supply milk from rural areas to urban centers in Maharashtra, in which the Gavlis are major suppliers (Fig. 12). While the infrastructure to facilitate this flow, including truck routes, chilling plants, powder plants, etc., has been developed, there has been no effort to improve the fodder base, health, or genetic quality of the milk-producing animals.

The development of the dairy industry so far has been tantamount to a diversion of the milk from the rural population, in particular the Gavlis, to the urban centers. As may be seen from Table IV, the average Gavli diet, as reported by the Gavlis themselves, is equivalent to a per capita daily intake of 39 g of protein and 1900 kcal without the supplement of buttermilk, a diet that is just barely adequate to meet the nutritional needs of an average Indian. The additional consumption of at least 1 liter of buttermilk would render this diet nutritionally fully adequate. With the coming of dairy schemes, the Gavlis market most of their milk, losing

Fig. 12. Collection of milk by the cooperative society employees from the Gavlis of Haliyal *tahsil* in North Kanara district (photo by P. Sastri).

buttermilk almost entirely as a source of protein. The 1.5-fold increase in their cash income that this has brought about is not being used to supplement the diet appropriately; rather, it is being used for more expensive clothing, housing, and other new wants that have arisen with participation in the market economy and contact with the urban culture.

## Nutritional Status

In order to see the effects on the nutritional status of the Gavli of a change-over from selling butter and consuming buttermilk to selling milk and the consequent reduction in fat and protein consumption, we compared measurements on the skin folds at four sites from butter-selling and milk-selling adult male Gavlis and adult males of three other communities from Maharashtra. The Gavli measurements were obtained as a part of the current project, whereas the measurements on other communities have been made in connection with the Joint Indo-Soviet Anthropological Project (Abdushelishvilli and Malhotra, 1981). As seen from Table VII, the skin-fold measurements of butter-selling Gavli groups are higher than those of the milk sellers at all four sites. However, this difference is statis-

**Table VII.** Skin-Fold Measurements Among the Gavlis Compared to Other Population Groups from Maharashtra[a]

| Population group | Biceps | | | Triceps | | | Subscapular | | | Suprailiac | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | *N* | Mean | S.D. | *N* | Mean | S.D. | *N* | Mean | S.D. | *N* |
| Gavlis | | | | | | | | | | | | |
| Milk sellers (I) | 2.68 | 0.72 | 59 | 5.71 | 1.99 | 59 | 8.5 | 1.94 | 59 | 6.57 | 2.44 | 59 |
| Butter sellers (II) | 3.26 | 1.07 | 68 | 6.23 | 2.41 | 68 | 9.28 | 2.97 | 68 | 7.04 | 3.33 | 68 |
| Katkari (III) | 2.69 | 2.3 | 100 | 4.64 | 3.35 | 100 | 7.12 | 1.78 | 100 | 4.5 | 1.18 | 100 |
| Maratha (IV) | 3.26 | 0.99 | 93 | 5.78 | 4.8 | 93 | 8.82 | 2.45 | 93 | 6.27 | 2.47 | 93 |
| Deshastha Rgvedi Brahmin (V) | 3.33 | 1.01 | 81 | 8.25 | 3.51 | 79 | 13.24 | 12.47 | 80 | 8.6 | 3.47 | 80 |

[a]The following comparisons are statistically significant at the $p \leq 0.05$ level:
Biceps: II > I, II > III, IV > I, V > I.
Triceps: I > III, II > III, V > I, V > II.
Subscapular: I > III, II > III, V > I, V > II.
Suprailiac: I > III, II > III, V > I, V > II.

tically significant only in the case of the biceps. The reasons for the lack of significant difference at the other three sites may be that milk selling has begun only within the last one or two decades, and even among the milk sellers there are households with large livestock holdings which retain substantial amounts of milk for domestic consumption. The three groups from the general population chosen for comparison are (1) Katkaris, a tribal, originally hunting-gathering group which is now very much impoverished due to the destruction of forest and wildlife resources; (2) Marathas, predominantly an agricultural caste, whose members are also workers in urban areas from which section the present sample is derived; and (3) Deshastha Rgvedi Brahmins, a priestly caste, largely engaged in white-collar jobs in the cities. Both the milk-selling and butter-selling Gavli groups have significantly higher subcutaneous fat levels than the Katkaris, are at essentially the same level as Marathas, and have significantly lower fat levels than the Brahmin group.

With the marketing of milk, calves are not being allowed to suckle as before, thereby stunting their growth, delaying the age of reproduction, and hence worsening the fodder-to-milk conversion ratio. Moreover, the initiation of dairy development schemes has prompted the Kunbi peasants to maintain animals for the marketing of milk. Kunbis used to keep a few cattle, primarily to serve as draft animals, so that the grazing from their fields under shifting cultivation was largely available to the Gavlis. With the Kunbis taking to keeping milch animals themselves, this grazing has also become unavailable to the Gavlis.

## CONSEQUENCES OF CHANGE ON GAVLI HOUSEHOLDS

The traditional ideal herd size, as expressed by the Gavlis, was 60 buffalo and 20 cattle. However, as narrated earlier, the habitat has significantly degraded over much of the Gavli range and the present-day herd sizes and composition fall drastically short of the ideal. Figure 13 summarizes the data on the average holdings of livestock from 433 households collected from eight *tahsils* representing nearly the entire range of saturation and degradation of the Gavli habitat. Figure 13 also schematically represents the condition of vegetation in the habitat as well. The vegetation is well preserved in Haliyal *tahsil* of North Kanara district (Fig. 14) and progressively degrades towards the Ratnagiri district.

The Gavli herds show two kinds of changes along this gradient. The herd biomass declines with degradation of habitat and the composition shifts from an emphasis on buffalo to cattle and then to goats (Fig. 15). The Gavlis relate these changes to two major factors, namely deterioration of tree growth and substantial decline in predation pressure. In comparison

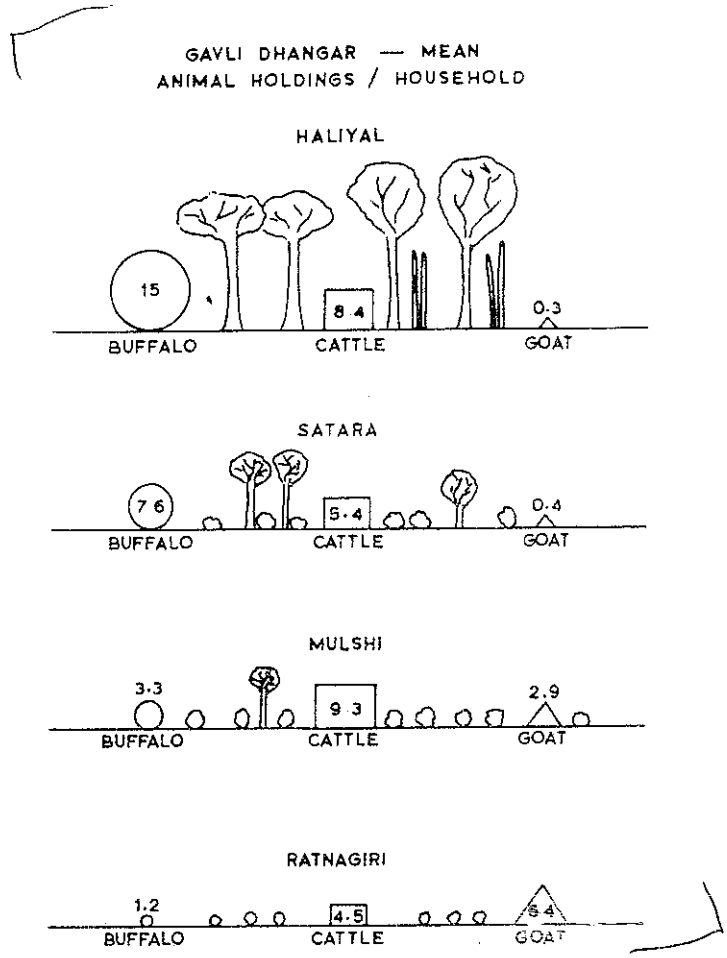


**Fig. 13.** Mean animal holdings per household and the condition of the vegetation in four *tahsils* of the Gavli range.

with cattle, buffalo require better grazing, more water and shade, and can defend themselves better against predators. Since browse is no longer readily accessible to the animals themselves, in the dry season the Gavlis have to search out palatable browse, lop off the trees, and bring the foliage to their animals. With the lack of shade the buffalo are now kept indoors and stall-fed throughout the summer in many localities, severely limiting the number that can be maintained by a Gavli household. Cattle and goats are hardier and can better tolerate scarcity of fodder and water, particularly in the drier season (Fig. 16).

A comparison of the milk yields of buffalo and cattle for two localities, Asanwadi and Bhadaskhonda in Pune district, is instructive. Asanwadi has 10 ha of grazing per animal and has fairly good tree growth; it is the only village in Maharashtra we surveyed in which people did not claim fodder shortage. In contrast, there is an acute shortage of fodder in

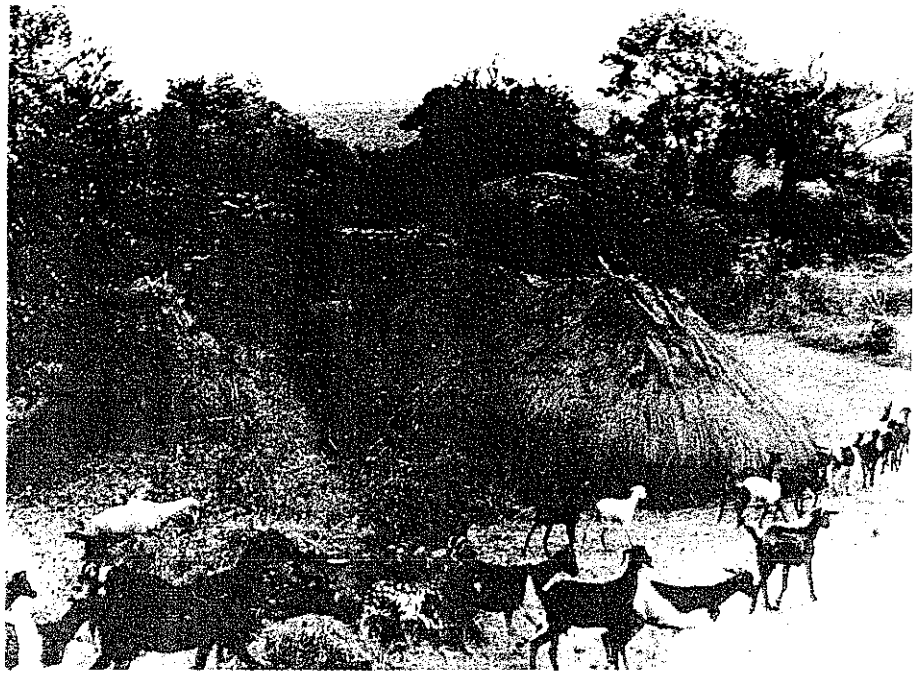

Fig.16. A herd of goat in front of a Gavli settlement in Ratnagiri *tahsil* of Ratnagiri district (photo by B. V. Bhanu).

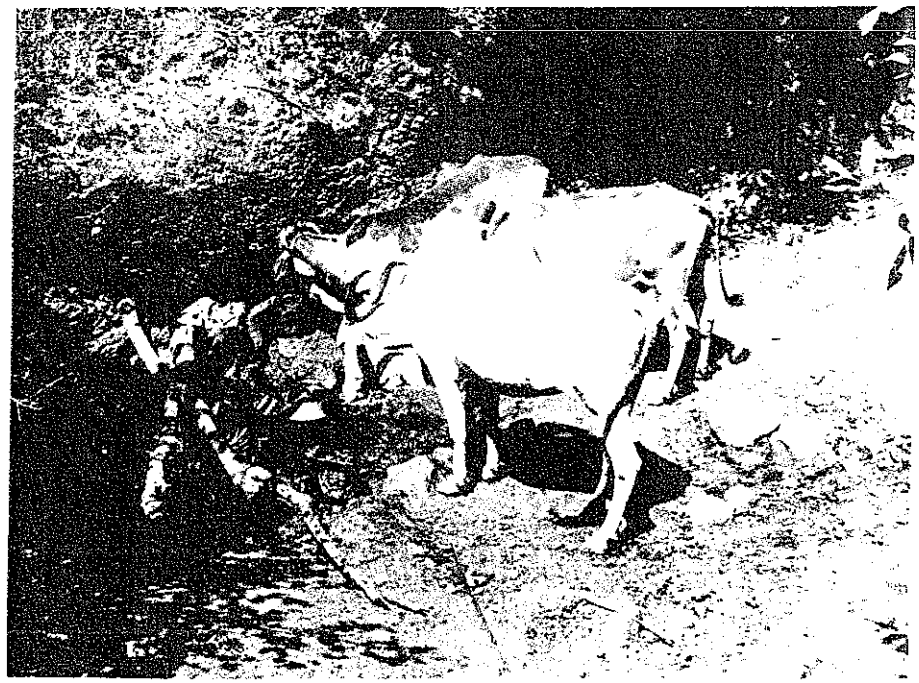

**Fig. 15.** Cattle being provided water in a pot by a Gavli woman in Pune district (photo by H. C. Sharatchandra).

**Fig.14.** Buffalo in front of a Gavli hut in Haliyal *tahsil*. Note the good tree growth in the background (photo by C. J Saldanha)

Bhadaskhonda; the Gavlis of this locality report that the first flush of grass produced by pre-monsoon showers is so completely grazed by their animals that very poor grass growth is generated during the monsoon proper. The milk yields fluctuate greatly over the year, with a peak in the second half of the monsoon and with very low yields (many animals being totally dry) in the later part of the summer. Although the much heavier buffalo yields more in both localities, the cow suffers considerably less reduction in its yield under the more adverse conditions prevalent at Bhadaskhonda. The cattle, being smaller in size, can graze in terrain quite inaccessible to the heavier buffalo. Consequently cattle become the preferred animal in the more degraded habitat, where their greater vulnerability to predation also ceases to be a handicap since panthers and tigers also disappear with the depletion of the forest. When the habitat degrades further, over-grazing and soil erosion lead to a great depression in the availability of grass, the vegetation gives way to thorny scrub, and it becomes difficult to maintain even cattle; goats then become the preferred animal.

While Gavlis in the newly colonized North Kanara district report that their herds, which were earlier on the increase, have now stabilized, those in Maharashtra uniformly report that their herds are actually in a decline. To verify both reports we constructed a survivorship and fecundity

table for their bovine populations. The most accurate figures concern buffalo from Haliyal *tahsil* of North Kanara district (Table III). The parameters of Table III lead to a replacement rate of almost exactly unity, suggesting that Kanara buffalo herds are stable. Their overall mortality rates are 10%, the lowest when compared to other areas.

Earlier, we stated that in favorable habitat a herd of 11 buffalo or 32 cattle is adequate to meet the subsistence requirement of a Gavli household. This requirement may be reduced further if we allow for the income generated by selling the male buffalo and/or bullocks, and marketing the milk instead of butter. Selling of the male animals would reduce the minimum herd by about 20%. Marketing of milk enables the Gavli to exchange 1 liter of milk for 1.5 kg of cereal instead of 1 kg exchanged for the butter produced from 1 liter of milk. Thus completely forgoing the nutritional supplement, particularly protein, provided by the buttermilk, the milk-selling Gavlis can meet their basic needs with 66% of the herd necessary for the butter-sellers.

The minimum required herd will then be 5-6 buffalo or 18-12 cattle, or a mixture thereof. Only in Haliyal *tahsil* are the buffalo and cattle holdings comfortably above this minimal level; they are close to it in Satara district and considerably below it in the other six areas from Maharashtra. Distribution of holdings increases in inequality as overall levels decline (Table VIII) In Haliyal most households have enough animals to provide an adequate living from livestock alone. Only 50 out of 188 households have fewer than 11 animals, roughly two-thirds of which are buffalo. Moreover, almost all of these 50 are recent emigrants from the impoverished areas of Maharashtra, and are likely to be the households which have emigrated without any animals. By contrast, in Bhadaskhonda only one-third of the total livestock are buffalo, making an adequate herd 4 buffalo plus 8-10 cows, or a total animal strength of 12-14. Moreover, since the milk production in this overgrazed area is much lower, a herd of approximately 6 buffalo and 15 cows would be needed for adequate subsistence. Only 2 out of 11 households have such a herd.

Bhadaskhonda households, like most of Maharastra, have turned to two other major activities: goat-keeping and millet cultivation. Goat-keeping is a recent activity, and requires a considerable investment of human labor. Goats are highly susceptible to predation by panthers, jackals, and foxes, as well as thieves, and therefore require the constant attention of a goatherd. The goats breed twice a year and a herd of four goats allows the marketing of one goat a year, producing an income of Rs 100-150 at 1979 prices. This is equivalent to marketing almost 14 kg of butter, which would require the maintenance of one buffalo. However, the goat population is rather small except in the Ratnagiri *tahsil*. Moreover, in much of the Gavli range in Maharashtra, buffalo- and cattle-keeping,

Table VIII. Frequency Distribution of Total Bovine Holdings per Household for Bhadaskhonda Village, Mulshi *Tahsil*, and for a Total of 57 Gavli Settlements in Haliyal *Tahsil*

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bhadaskhonda[a] | | | | | | | | | | | |
| Number of animals | 0 | 1-5 | 6-10 | 11-15 | 16-20 | 21-25 | 26-30 | 31-35 | ⩾ 36 | | |
| Number of households | 0 | 2 | 4 | 2 | 1 | 1 | 0 | 1 | 0 | | |
| Haliyal *tahsil*[b] | | | | | | | | | | | |
| Number of animals | 0 | 1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80 | 81-90 | ⩾ 91 |
| Number of households | 9 | 41 | 39 | 47 | 22 | 10 | 10 | 6 | 3 | 1 | 0 |

[a]Median = 10; mean = 13.09; S.D. = 8.15; $N$ = 11.
[b]Median = 20.1; mean = 24.59; S.D. = 18.5; $N$ = 188.

even when supplemented by goats, is inadequate to sustain the household, obliging them to engage more and more in shifting cultivation. Shifting cultivation in this region is highly labor-intensive, because animals cannot be used to prepare the rocky upper hill slopes. One household can cultivate only about 2 or 3 ha, producing some 600-800 kg of cereals, enough to meet one-half to two-thirds of their cereal requirements. By so doing they reduce their livestock requirements to about 2-3 buffalo and 7-10 cows or 2 buffalo, 6 cows, and 8-10 goats. Whereas herds in Mulshi *tahsil* of Pune are adequate at this level, those of Mahad, Mahabaleshwar, Shahuwadi, and Ratnagiri *tahsils* are not. Thus Gavlis in this area engage in various jobs, including the only household in our survey that has reported begging as a means of livelihood.

## CONCLUSIONS

The overall picture that emerges is one in which buffalo- and cattle-keeping, even when supplemented by goats, is inadequate to sustain the Gavlis over much of their ancestral range, obliging them to engage in shifting cultivation on an increasingly marginal basis. Where this, too, is inadequate Gavlis are joining the increasing numbers of urban migrants. If present trends continue, the Gavlis will progressively pass through the stages of buffalo-keepers to cattle-keepers to goatherds to cultivators of marginal lands to unemployed migrants. This progression can be retarded only if the government and development planners begin to question the current policy of equating development of natural resources with nonsustainable commercial exploitation.

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## REFERENCES


Abdushelishvilli, M. G., and Malhotra, K. C. (1981). *Biology of the People of Maharashtra.* Academy of Sciences of the USSR, Moscow.

Agarwala, S. N. (1967). *Population* National Book Trust, New Delhi.

Allchin, F. R. (1963) Cattle and economy in neolithic South India. In Mourant, A. E., and Zeuner, F. E. (eds.), *Man and Cattle,* University Press, Glasgow, pp. 149-155.

*Bombay Gazetteer Kanara* (1883). Vol. XXV, Part I. Government Central Press, Bombay.

Braidwood, R. J., and Reed, C. A. (1957) The achievement and early consequences of food production: A consideration of the archaeological and natural-historical evidence. In *Cold Spring Harbor Symposia on Quantitative Biology,* Vol. XXII, *Population Studies: Animal Ecology and Demography,* Long Island, pp. 19-46.

Census of India (1971) District census handbooks: Pune, Kolaba, Satara, Ratnagiri, Kolhapur.

Cockrill, W. R. (1974) *The Husbandry and Health of the Domestic Buffalo* F.A.O., Rome.

Dikshit, K. D. (1902). *Mahabaleshwar.* Gyan Prakash, Pune (in Marathi language).

Duff, J. G. (1826). *A History of the Mahrattas,* Vol. I. Longman, Rees, Orme, Brown and Green, London.

Dutt, R. (1960). *The Economic History of India,* Vols. I, Government of India Press, New Delhi.

Eisenberg, J. F., and Seidensticker, J. (1976). Ungulates in Southern Asia: A consideration of biomass estimates for selected habitats. *Biological Conservation* 10: 293-308.

Enthoven, R. E. (1920-1922). *Tribes and Castes of Bombay Presidency,* Vols. 1-4. Government Printing Press, Bombay.

Gadgil, M. (1979). Hills, dams and forests: Some field observations from the Western Ghats. *Proceedings of the Indian Academy of Sciences* C2: 291-303.

Gadgil, M., and Malhotra, K. C. (1979). On the role of religious myths in symbolizing the conflict of dispersing human groups. *Indian Antrhopologist* 9: 83-92.

Gaussen, H., Legris, P., Labroue, L., Meher-Homji, V. M., and Viart, M. (1966a). *International Map of the Vegetation and Environmental Conditions, Mysore.* French Institute, Pondichery.

Gaussen, H., Legris, P., Labroue, L., Meher-Homji, V. M., and Viart, M. (1966b) *International Map of the Vegetation and Environmental Contiditons, ~~Mysore~~* Bombay. French Institute, Pondichery.

Gaussen, H., Legris, P., Labroue, L., Meher-Homji, V. M., and Viart, M. (1968) *International Map of the Vegetation and Environmental Conditions, Kathiawar.* French Institute, Pondichery.

Indian Council of Medical Research (1951). Results of diet survey in India 1935-48. Special report, New Delhi.

Karve, I. (1968). *Maharashtra Land and Its People.* Maharashtra Government Press, Bombay.

Kate, S. L., Mukherjee, B. N., Malhotra, K. C., Phadke, M. A., Mutalik, G. S., and Sainani, G. S. (1978). Red cell Glucose-6-phosphate dehydrogenase deficiency and hemoglobin variants among ten endogamous groups of Maharashtra and West Bengal. *Human Genetics* 44: 339-343.

Malhotra, K. C. (1978) Morphological composition of the people of India. *Journal of Human Evolution* 7: 45-53.

Malhotra, K. C. (in prep.). *The Gavli Dhaganrs of Maharashtra. A Biosocial Profile.*

Malhotra, K. C., Morton, N. E., Lalouel, J. M., and Yee, S. (1977). Population biology of the Dhangars of Maharashtra, India I. Phenotypic bioassay. *Proceedings of the Fourth Annual Conference, Indian Society of Human Genetics, Madras,* Abstract No. 67, Madras University, Madras.

Malhotra, K. C., Chakraborty, R., and Chakravartti, A. (1978). Gene differentiation among the Dhangar caste-cluster of Maharashtra, India. *Human Heredity* 28: 26-36.

Misra, R. P. (1970). *Medical Geography of India.* National Book Trust, New Delhi.

Ranganatham, S., Sundararajan, A. R., and Swaminathan, M. (1937). Survey of the nutritive value of Indian foodstuffs. Part I. The chemical composition of 200 common foods. *Indian Journal of Medical Research* 24: 689-706.

Russell, R. V. (1916). *Tribes and Castes of the Central Provinces in India,* Vols. 1-4. Macmillan, London.

Sastri, P., Gadgil, M., and Malhotra, K. C. (1977). A proposal for the compatible development of animal husbandry and forestry interests of North Kanara. Technical Report, Karnataka State Council for Science and Technology, Bangalore.

Sopher, D. E. (1975). Indian pastoral castes and livestock ecologies: A geographic analysis. In Leshnik, L. S., and Sontheimer, G. (eds.), *Pastoralists and Nomads in South Asia,* Otto Harrassowitz, Weisbaden, Heidelberg.

Undevia, J. V., Malhotra, K. C., and Dudhwalla, F. (1973). G-6-PD deficiency and abnormal haemoglobin among the Dhangars of Maharashtra. *Proceedings of the Conference of Indian Physicians, Udaipur,* Abstract No. 41, Udaipur.

Vishwanathan, D. K. (1950). *Malaria and Its Control in Bombay State.* Chitrashala Press, Poona.

Wharton, C. (1968). Man, fire and wild cattle in southeastern Asia. *Proceedings of the Eighth Tall Timbers Fire Ecology Conference,* pp. 107-167.

Zeuner, F. E. (1963). The history of the domestication of cattle. In Mourant, A. E., and Zeuner, F. E. (eds.), *Man and Cattle,* University Press, Glasgow, pp. 9-19.