Human Ecology, Vol. 8, No. 2, 1980

The Significance of Latitudinality in Himalayan Mountain Ecosystems

Melvyn C. Goldstein[1] and Donald A. Messerschmidt[2]

This paper argues that the altitude-oriented "mixed mountain agriculture" model in which mountain dwellers move to higher altitudes in summer and lower ones in winter does not fit the empirical situation in many areas of the Himalayas where north-south or latitudinally differentiated habitat and production zones play important and, in some instances, central roles.

KEY WORDS: mountain ecosystems; latitudinality; mixed mountain agriculture; Himalayas; Tibetans; pastoralism.

INTRODUCTION

The past decade has witnessed the growth of substantial interest in the analysis of mountain ecosystems and the human populations inhabiting them. There has been a series of papers, books, and conferences which have variously attempted to analyze, classify, and/or compare human-use systems in mountain areas.[3] This growing interest results partly from the development of ecology as a

[1] Department of Anthropology, Case Western Reserve University, Cleveland, Ohio.
[2] Department of Anthropology, Washington State University, Pullman, Washington.

[3] Recent international symposia on mountain human-use systems include the Munich Conference on Development Problems in Mountain Regions, spring 1974, the Cambridge Conference on Mountain Environments at Cambridge, Massachusetts, September 1977 (S. J. N., 1977; Bailey, 1978), the symposium of Cultural Adaptations to Mountain Ecosystems at the American Anthropological Association meetings in New Orleans, Louisiana, November 28, 1973 (Brush *et al.*, 1976), UNESCO'S Programme on Man and the Biosphere (MAB), regional meeting of Project Six, Integrated Ecological Research and Training Needs in Southern Asia Mountain Systems, at Kathmandu, Nepal, September 26 to October 2, 1975 (UNESCO, 1975; see also UNESCO, 1973), the International Hill Land Symposium at West Virginia University in Morgantown, West Virginia, October 3-8, 1976, the Washington, D.C. Meeting on Mountain Environments sponsored by the National Geographic Society, November 18, 1977 (Bailey, 1978), The international symposium on the Earth Sciences,

0300-7839/80/0600-0117$03.00/0

framework for studying human society and partly from an increased awareness of the pressing plight of a number of mountain ecosystems, an awareness heightened by the recent ecodisaster in the Sahel as well as ecological degradation in all world mountain systems. The rapid deterioration of mountain environments in underdeveloped and poor countries in particular poses serious and immediate problems of well-being and survival for both mountain and adjacent lowland populations. Successful intervention in the spiraling process of population growth, environmental degradation, and poverty in such regions requires a detailed understanding of the sociocultural adaptations that characterize mountain societies and of the reciprocal relationship between human activities and mountain environments.

The growing interest in the social and ecological problems of montane areas has resulted in the publication of several papers that attempt to delimit the general characteristics of the major mountain areas and, in essence, of mountain ecosystems in general. The development of such a general model not only has obvious theoretical importance but also has applied significance since it can be used as a framework for planning interventions in the deteriorating montane areas of the world. Three recent publications, discussed below, exemplify this trend. Each attempts to compare important montane regions and delimit the general characteristics of mountain systems, and each emphasizes the central role of altitude in the creation of habitat and production zones.

The first example is the 1973 UNESCO Programme on Man and the Biosphere (MAB) which brough together an "expert panel" in Salzberg, Austria to discuss the impact of human activities on mountain ecosystems. As part of their final report they characterized mountain regions as ones in which there exists

> an altitudinal gradient in the distribution of barometric pressure, radiation, temperatures and precipitation. This gradient results in vertical zonation of soils, flora, fauna, and ecosystem type. Accordingly, man's way of life, his habitat and land use and exploitation patterns, are *differentiated vertically.* (UNESCO 1973: 8; emphasis added)

A second example is the work of S. B. Brush (1976), in his introduction to a symposium on Himalayan, Andean, and Alpine mountain ecosystems organized for the American Anthropological Association meetings in 1973 and published in *Human Ecology.* Brush emphasized the importance of altitudinally defined

---

Ecology, and Ethnology of the Himalayas at the Centre National de la Recherche Scientifique Paris, December 7-10, 1976 (CNRS, 1977), the Symposium of the International Geographical Union Commission on High Altitude Geocology, Caucasus Mountains, USSR, July 1976 (Bishop, 1978; Uhlig, 1978), and the Nepal Studies Association national conference on Culture Change, Ecology, and Development in Nepal at Chicago, Illinois, April 1-2, 1978. See also published collections such as Jest *et al.* (1976), Dobremez, Jest, *et al.* (1974), and Iijima *et al.* (1977).

production zones:

> the outstanding features of mountain ecosystems are altitude and a steep environmental gradient .... As altitude increases, climatic conditions change ... (1976: 126)

> The basis of these agropastoral economies ... is the exploitation of different production zones that are altitudinally defined and arranged. (1976: 127)

Brush further stated that the material presented on the Alps, Andes, and Himalayas in the symposium suggests parallel cultural adaptation in these regions based on "exploitation of multiple, altitudinally defined production zones" (1976: 131).

The third and most ambitious attempt to construct a general model for all mountain regions is an article by R. E. Rhoades and S. I. Thompson (1975). Their expressed aim was to go beyond the "particularism" of European Alpine studies by comparing the Circum-Alpine area (primarily highland Switzerland) and the Himalayas (with particular reference to the Khumbu region of northeastern Nepal) and to derive from this a tentative model of mountain ecosystems.

Rhoades and Thompson argue that there are striking parallel socioeconomic arrangements in the two regions which are the result of human adaptation to the "highly specialized alpine econiche" (1975: 537). Both areas utilize the adaptational system known in German as *Acker-Alpbetrieb* and in the anthropological literature as the "mixed mountain agriculture" system. The core of this system is a ladder-like utilization sequence based on seasonal variation along an altitudinal gradient. Rhodes and Thampson describe the mixed mountain agriculture system as follows:

> Essentially, its subsistence base is an agro-pastoral transhumance pattern, with each segment intricately intermeshed with the other and productive only during the short growing and grazing season from spring to early fall. While cultivation of grains, potatoes, and garden vegetables begins at the main village level or lower, the herders begin the slow ascent with the animals toward the *Meyen* (summer settlements), stopping first on the lower individually owned meadows and later moving toward the communally owned *Alm* or *Alp* (alpine high pasture) up near the snowline. When cold weather threatens the highlands, the herders descend to the lower levels and allow the animals to forage and fertilize meadows and fields which have lain fallow since their ascent in the spring. (1975: 537-538)

> The key to the success of agro-pastoral transhumance in the alpine valleys is the constant motion, the vertical oscillation of cultivators, herders, and beasts following the vicissitudes of climate in an effort to exploit micro-niches at *several altitudinal levels.* (1975: 539; emphasis added)

Rhoades and Thompson also use the mixed mountain agriculture system as the prototype of a macroadaptational category. They identify two major adaptive strategies in Alpine areas: generalized and specialized "mountain procurement systems." The generalized procurement system is in essence the mixed mountain agriculture system writ large:

> One [procurement system] which has been discussed in detail above, involves a single population which, through agro-pastoral transhumance, directly exploits a

> series of microniches or ecozones at several altitudinal levels; in the second, a population locks into a single zone and specializes in agriculture or pastoral activities suitable to that altitude, developing elaborate trade relationships with populations in other zones which are also involved in specialized production. (1975: 547)

In other words, the human adaptation to mountain environments in seen by Rhoades and Thompson as involving either multiple use of altitudinally delimited microniches, or specialized use of one ecozone. The Himalayas and the Alps represent the "generalized procurement system."

Despite the general convergence of the UNESCO, Brush, and Rhoades-Thompson studies, we contend that the altitude-oriented model they describe (including the single-zone system proposed by the latter) does not fit the empirical situation in parts of the Nepalese Himalayas and Tibet. Our research in Nepal indicates that while the mixed mountain agriculture type of adaptation exists in some Himalayan areas, there are a number of other areas where people have developed modes of adaptation to the mountain environment which utilize zones but which do not depend on altitude variation. In particular, we refer to areas where populations have utilized latitudinal (north-south) differences in conjunction with altitudinal ones to create habitat and production zones. In some of these regions, moreover, these latidudinally delimited production zones play a central role in the overall adaptation. Latitudinality, as we shall call this variable, refers therefore to situations in which differences in latitude have affected factors such as climate – precipitation, sunlight, and temperature – resulting in variations in soil composition, flora, fauna, etc. Latitudinality, in turn, is obviously part of a larger category of nonvertical or horizontal[4] factors utilized in human adaptation to mountain environments.

Latitudinal differences have been used to explain climatic differences between tropical and temperate mountain areas of the same altitude (e.g., Rhoades and Thompson, 1975: 544-545) but have not been seen to play a part in the adaptation of a single population. This paper will describe and analyze the way in which latitudinally delimited microniches have been utilized in a number of Himalayan populations. In so doing it will illustrate the limitations of the mixed mountain agriculture system as a model for all agro-pastoral mountain regions, or even for all of the Himalayas, and will broaden our understanding of the diverse ways in which human populations have adapted to mountain environments.

To understand the relevance of latitudinality in the Himalayas, several examples will be discussed. The most important of these is Limi (see Figs. 1, 2), a high-altitude agro-pastoral region in northwest Nepal studied by Goldstein (1974, 1976, 1977). The second example is from Ghaisu-Bhot Khola, two

[4] We wish to thank John Hitchcock and James Fisher for suggesting the term "horizontal adaptation."

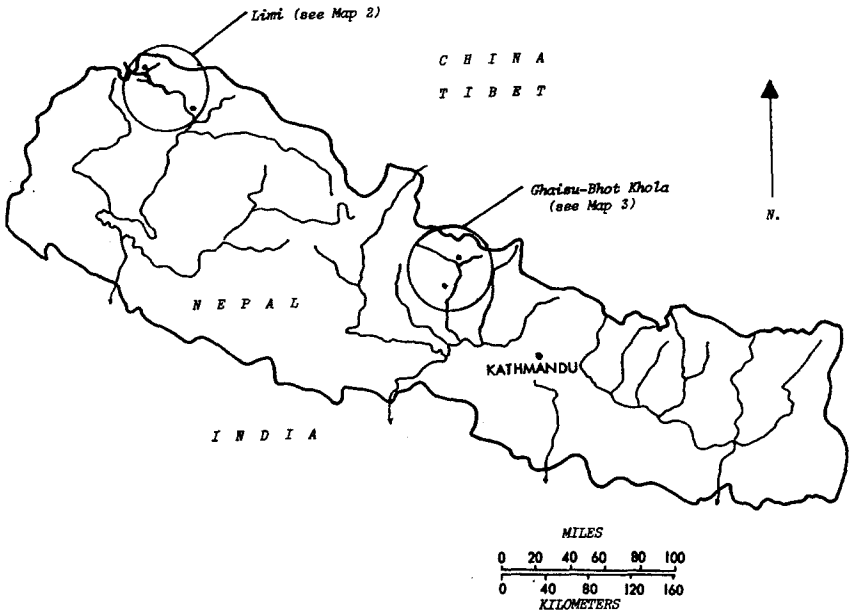

Fig. 1. Nepal.

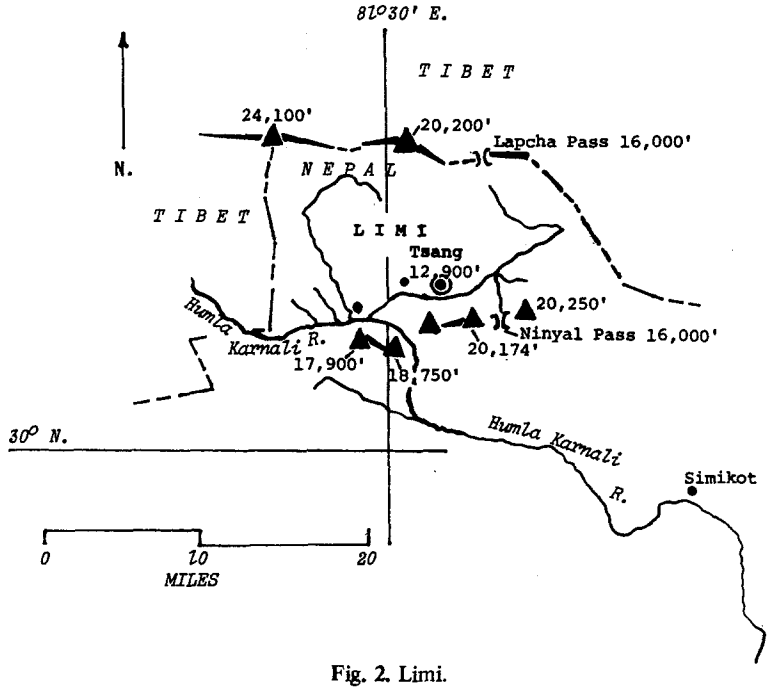

Fig. 2. Limi.

adjacent medium-altitude regions in north-central Nepal studied by Messerschmidt (1972, 1974, 1976a, 1976b, 1976c). We conclude with several other less-documented but supportive examples from central and western Nepal.

AGRO-PASTORALISM IN LIMI

Limi is an indigenous (i.e., not recent refugee) Tibetan culture area of about 200 square miles located in the extreme northwest corner of Nepal in Humla District, abutting the Tibetan (China) border. It consists of a large pasture area and adjacent narrow valley containing three villages which, from east to west, are respectively situated at 12,900 feet, 12,100 feet, and 12,700 feet in elevation. The population of the area is approximately 800 persons. Lying in one of the remotest parts of Nepal, Limi typifies the most common traditional agro-pastoral (*sa ma 'brog* in Tibetan) adaptation found in Tibet proper and in northern Nepal.

Limi is divided into two major ecozones. One is an elevationally narrow agricultural zone undifferentiated with respect to crop cultivation, the other is a wide pastoral zone differentiated partly by altitude and partly by latitude. Local exploitation strategies are directly related to these two zones. The agricultural strategy is characterized by one crop per year, consisting almost entirely of barley produced in a season that begins in mid-May and ends in late September-early October. Located in the Himalayan rain shadow, Limi receives very little precipitation in summer and all fields must be irrigated.

The altitudinal range of Limi agriculture is narrow. In the village of Tsang at 12,900 feet, barley is sown from 12,800 feet (the valley floor) to a maximum of about 13,00 feet. This narrow cultivation zone is homogeneous with respect to crops, exploitive techniques, and growing season. In contrast to the mixed mountain agriculture system used by Sherpas and others, in Limi there is (1) no stratification of different crops by altitude, (2) no sequential planting of the same crop at different altitudes, (3) no fields planted with hay or fodder crops, and (4) no privately owned meadows (i.e., there is no equivalent of the Alpine greenland field typical of Switzerland and Khumbu).

Although agriculture is considered by Limis to be the foundation of their economy, its productivity does not meet the subsistence needs of its population and barley, wheat (or wheat flour), and rice are among the major foodstuffs imported from areas south of Limi. Because most of Limi's 200 square mile area lies above cultivatable altitudes, agriculture cannot be expanded (using traditional technology) and pastoralism provides an indispensable second exploitation strategy. Pastoral animal husbandry is pursued on a large scale and is oriented to trade as well as to subsistence. It involves the maintenance of a variety of different animals and three systems of exploitation. Tibetan-type sheep, goats,

yak, horses, cattle, and hybrid yak-cattle (*dzo*) are all raised, but sheep and yak are economically the most impotant.

The magnitude of Limi pastoralism dwarfs that of Alpine (Swiss) and other Himalayan (Sherpa) herding. Taking into account only sheep and yak, there were about 10,000 animals in Limi in 1977. Moreover, all sheep and all but several hundred yak are neither kept in stables nor fed stored fodder in winter. Rather they are grazed on mountain pasturelands throughout the year and tended by members of family subunits who dwell in traditional yak-hair tents, moving their herds from pasture to pasture, rather than alternating between village, pasture, and village.

There are three patterns of animal utilization within Limi's pastoral exploitation strategy. One is the so-called full-blown type of pastoral nomadism alluded to above. A second is the maintenance of a small number of animals for food and traction. The third is a combination of the two. Each will be described in turn.

1. Full-blown pastoral nomadism. This is the most important animal utilization pattern, in which large herds of Tibetan sheep and yak are grazed throughout the year on pastureland in both Limi and Tibet, spending 8 months in Tibet. Beginning in early October the herds are moved to an area north of Limi in Tibet where they spend the winter, returning to Limi in mid-May.

Production units in this system always include adult males and females, usually nuclear family households (husband-wife-child) of extended families, augmented by hired shepherds and yakherds and/or other relatives. While these herding production units are part of larger family corporations that also possess and utilize arable land, on a day-to-day basis they live in much the same way as traditional Tibetan pastoral nomads. Dwelling throughout the year in traditional black yak-hair tents, they move from pasture to pasture with their animals. Their diet, like that of traditional Tibetan nomads, is rich in dairy and meat items. They also consume grain obtained in part from their family's farming activities but also to a large extent from trade. Local wool and Tibetan salt are typically exchanged for grain with Nepalese merchant-traders living south of Limi.

2. Animals for food and traction. Although only about 14% of the Limi families maintain large herds that winter in Tibet, all but the poorest families keep some animals for food, draft, and load-carrying activities. In this second system of animal utilization which most closely resembles the transhumance of the mixed mountain agriculture system, small numbers of animals, usually only cows and hybrids, are stabled at village houses in winter. They are fed stored fodder, supplemented by daily grazing on the hillsides, weather permitting. The fodder consists mainly of straw and hay cured from cut wild grass, although some turnips are also provided. For many families this is the sum total of their animal husbandry.

Unlike the mixed mountain agriculture system in which some meadows are privately owned, in Limi *all* grassland, meadows, forests, and water resources are communally owned. No fodder is specially sown (there are no hayfields) and no wild grasses are individually owned. The harvesting of grass, for example, is communally organized, just as is the allocation of grazing land. All animals are excluded from the main Limi River valley during the summer growing season, and after the harvest the wild grasses in these areas are cut and distributed. In the village itself, the stalks of harvested crops are the property of the family that planted the field, but anyone's animals can graze on the stubble of any field. Similarly, in winter all animals have grazing rights on the hills around the village.

3. Combined strategy. The third pastoral utilization pattern manifests some of the characteristics of each of the first two. On the one hand, it involves the maintenance of herds of yak, *dri* (female yak), and goats, while on the other, it is based on stabling and feeding stored fodder in winter. This usage pattern is found only in the village of Til, where there are adjacent pasture areas that can be used in winter. Though not all Til families utilize this strategy, many Til families keep from ten to 30 yak and *dri* in the village over the winter as well as goat flocks averaging about 30 animals.

Pastoralism alleviates the agricultural deficit by directly providing meat and dairy products, by producing trade items such as wool which can be converted through trade into grain, and by providing transport animals for trade. It also generates surplus wealth which sustains a level of affluence not commonly found in Humla District or, for that matter, in village Nepal generally.

Limis utilize their sheep and yak in a number of ways to produce substantial surplus income. The most important of these are trade in animals (yak and sheep) and animal products (wool), and the use of yak and sheep in the transportation of salt, lumber, and wood products. Wool garments are worn by Hindus and Tibetans throughout Humla and adjacent Jumla districts, and raw wool, particularly the superior wool from Tibetan sheep, is scarce because the Chinese authorities in Tibet have virtually stopped selling or trading Tibetan wool. The only other available Tibetan sheep wool in the region of northwest Nepal is Limi, and the Limis can therefore sell as much wool as is left after their own local needs are met.

Sheep wool is sold (usually bartered) in Limi for approximately nine local volume measures (*pagtrin tre*) of barley (equal to 36 Nepalese rupees) for the wool of one adult sheep. A family with 300 adult sheep (i.e., one of the largest herds) could have sold their wool in the summer of 1977 for about 10,800 Nepalese rupees (U.S. $864.00), a sum that would be an excellent annual salary for a Nepalese college graduate living and working in Kathmandu, the capital city. There are no formal records regarding the wool trade (or any other trade in Limi), but it is estimated that at least 100,000 rupees worth of wool is sold or bartered annually on the local market.

The salt trade is equally lucrative. Yak and sheep are used in summer and fall to carry rock salt from Tibet to Limi, where most of it is sold to traders from areas just south of Limi. These, in turn, carry the salt in winter to still more southerly areas all over western Nepal. Yak, and to a lesser degreee, sheep, are necessary not only for the transportation of Tibetan salt to Limi, but also for the transportation of trade goods to the Chinese trade markets in Tibet. The Chinese in Tibet *will not* sell salt directly to the Nepalis for paper or coin currency, either Nepali or Chinese. An intermediate step involving the sale of acceptable goods to the Chinese is required, and even then, the Limis (or other Nepalis) are permitted to purchase salt only up to the value of the items they sold. Because the adjacent areas of Tibet are treeless, wood products such as bowls, saddles, tent pegs, beams, and planks are in great demand in Tibet, and the Limis utilize wood in Limi and in areas south of Limi to produce these items. Yak are used to transport these and other goods to Tibet where they are exchanged for salt and manufactured goods. They are also used to pay the crucial "grass fee" (*Rtsa Rin*) for the Limi's use of winter pastureland in Tibet. One yak, for example, can carry eight house-sized beams which, when sold in Tibet, bring about 28 Chinese dollars (yuan) per yak load according to 1977 prices. This money (and the essential permit to purchase salt worth that amount) converts to about two yak loads of salt or about 720 Nepali rupees (U.S. $58.00) in 1977. This would be the gross income of one yak working less than 2 weeks. Multiply this by even the modest number of ten yak and it is easy to see the lucrativeness of pasturalism in the salt trade. It is extremely difficult to generalize regarding the volume of the salt trade since the Chinese vary the amount of salt available for sale year by year. In 1976, however, Goldstein estimated that about 500 yak loads of salt were obtained by Limis and sold or bartered for about 150,000 rupees. It is clear that the salt trade, like the wool trade, produces substantial income for the Limi area.

Just as pastoralism is crucial to the Limi adaptation, latitudinally differentiated habitat and production zones are esential to the success of animal husbandry. All Limi sheep, almost all yak, and many horses are wintered for 8 months *north* of Limi in Tibet at elevations higher than many of the more southerly pasture areas in Limi itself. Thus, rather than move to higher altitudes in summer and lower ones in winter (which is typical of most montane pastoralism), the Limis move to southern pastures (in Limi) in summer and northern pastures (in Tibet) in winter.

The reason for this directional orientation lies in the different climatic conditions found north of Limi in Tibet. Limi animals, as mentioned earlier, graze all winter and are not fed any stored fodder. Consequently, winter pasture areas must be ones in which snowfall is low and wind velocity high. Low precipitation is necessary because heavy snowfall would cover the standing grass and prevent grazing. However, even in areas of low snowfall, storms occur and snow falls,

and at these times relative presence or absence of high-velocity winds becomes a crucial factor.

The typically high-velocity winds of this region are essential because they blow the snow into drifts, leaving portions of the naturally cured grass continuously open to grazing. Without the cold, arid, relatively open plain-like areas and the vicious winds of the Tibetan plateau, it would be impossible for the Limis to graze their herds successfully all winter. The devastating effect of heavy snow on herds is frequently discussed in Limi and is the greatest source of animal mortality. This condition has been dramatically described in Tibet by Dawa Norbu (1974: 29-30):

> After the first day of continuous snowfall the herd of sheep and goats, numbering about two thousand, were well covered with snow. The next morning the yaks, numbering about a hundred, were covered up to their horns. Father recalled sadly that when he looked through the tent-flap there was not the slightest movement where the suffering sheep and goats had been standing. A few yaks feebly moved their horns in utter helplessness and desperation under the white avalanche, and even they, the sons of snow, perished.

DISCUSSION OF LIMI ADAPTATION

Central to the success of Limi pastoralism, and the trade therein, is the winter utilization of a latitudinally differentiated pasture zone located north of Limi in Tibet. The success of the entire Limi adaptation depends on pastoralism and trade as supplements to local agriculture. Altitude clearly does not underlie the choice of summer and winter pasture zones based on climatic factors since, as indicated above, some summer pasture areas in Limi are lower in altitude than the winter ones located in Tibet. For this reason, we argue that latitudinality lies at the core of the Limi system of cultural adaptation to the mountain ecosystem.

Latitudinality is also an important factor in the traditional Limi salt trade since salt is found in the numerous alkaline lakes hundreds of miles *north* of Limi in western Tibet. Moreover, even lumber and wood products have a latitudinal dimension. Though completely treeless, a number of Tibetan areas north of Limi are either at the same or lower altitude. Limi, however, has some sparse stands of birch and pine along the Limi-Karnali river valley. The absence of trees as one goes further north into Tibet is in part the result of latitudinal differences affecting precipitation, sunlight, and wind, rather than altitude.

In summary, the Limi adaptational system involves two altitudinally delimited production and habitat zones (agriculture and pastoralism) and several pastoral and trade production zones delimited primarily, or partially, by latitudinal differences. Through consumable and salable animal products, and through the transport function of animals, animal husbandry is central to successful adaptation in Limi. It not only redresses the agricultural shortfall or deficit, but also generates substantial surplus income.

AGRO-PASTORALISM IN GHAISU AND BHOT KHOLA

Ghaisu and Bhot Khola are two adjacent regions in the north central Nepalese administrative districts of Lamjung and Manang in Gandaki Zone. Together they encompass the major portions of the upper Marsiangdi River watershed. Although local montane adaptations in agriculture, pastoralism, and trade are not entirely comparable to those of Limi, they do demonstrate certain similar effects of both altitudinality and latitudinality. The two neighboring regions have distinct cultural and climatological characteristics yet share certain sociocultural affinities. Two key elements link the people of the two regions: networks of trade which may be described in terms of a symbiotic system of exchange, and, among the Gurung-speaking populations of each place, ties of kinship, language, and common origins.

In the discussion which follows, the bulk of the data are from Ghaisu and are based on intensive field research in 1972 and 1973 (Messerschmidt, 1976c). The data from Bhot Khola, north of Ghaisu, are less comprehensive. Only those data directly relevant to the discussion of altitude and latitude factors in adaptation are discussed here. A fuller discussion of the region of Bhot Khola and vicinity (also called Tin Gaun and Gyasumdo, or Ghyasumdo, in the literature) may be found in Messerschmidt (1972), Messerschmidt and Gurung (1974), Gurung (1976), and Snellgrove (1961).

The Gurung village of Ghaisu (pseudonym) is located in northern Lamjung District on the steep southern slopes of the Lamjung Himal at the extreme eastern end of the Annapurna Himalayan massif. The village is located at 6200 feet on a ridgetop below the high forest, making it one of the highest inhabited Gurung villages in Nepal; most of its neighbor villages are situated at elevations below 6000 feet. Ghaisu's terraced fields descend eastward down the steep hillside to the Marsiangdi River at 3000 feet, directly below (see Fig. 3). Ghaisu has a population of 621 persons in 131 households (1972); 123 households are Gurung, seven are Kami (Blacksmith caste), and one is Magar (an ethnic group, culturally similar to Gurung).

Like Limi, Ghaisu presents us with a well-integrated system of agricultural and pastoral adaptation, one which is representative of northern or *lekhali* Gurungs throughout the high hills (*lekh*) of west central Nepal (cf. Pignede, 1966; Toffin, 1976; Alirol, 1976). Agricultural production in Ghaisu is practiced on steep terraced fields, on both irrigated (*khet*) and unirrigated (*bari*) lands, at altitudes of from 3000 feet to 7000 feet. Unlike Limi, however, double cropping is important in Ghaisu: rice, maize, and millet are the primary summer (rainy season) crops, while wheat, buckwheat, barley, and small amounts of mustard seed (for oil) are the principal winter (dry season) crops.

Unirrigated agriculture is also practiced near Ghaisu to a small degree on unterraced, deforested lands directly above the village from 7000 feet to 9000 feet, and some slash-and-burn agriculture is practiced in the nearby high forest

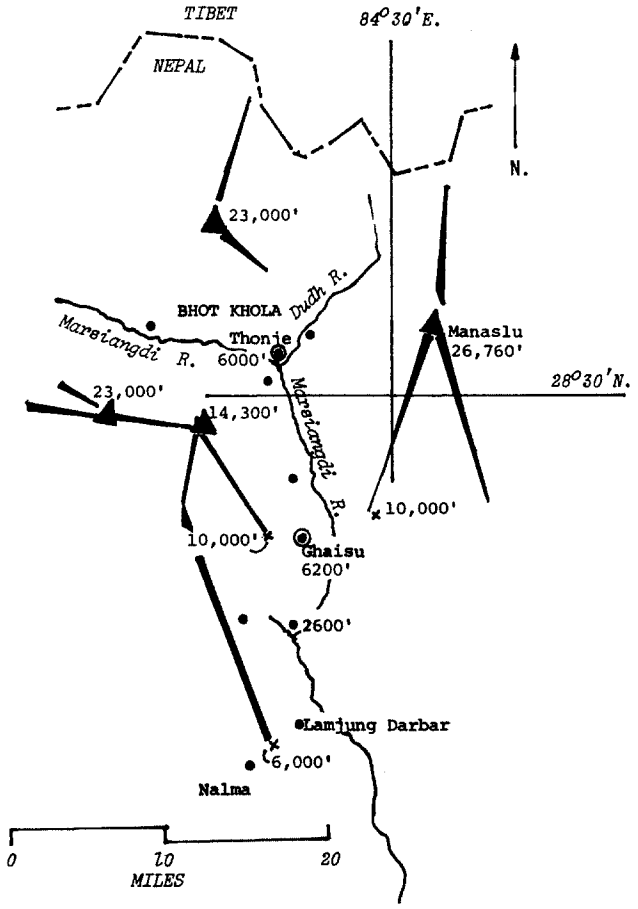

Fig. 3. Ghaisu and Bhot Khola.

at about 10,000 feet. These practices are reminiscent of an earlier and more predominant form of agriculture described over a century ago by Hodgson (n.d.) and more recently by Messerschmidt (1976a). Today, swidden production is minimal compared to agricultural production by means of terrace, irrigation, and plow common to the greater middle hills region of Nepal.

Just as in Limi, and unlike the situation in the mixed mountain agriculture system, there is one primary agricultural-use zone in Ghaisu, although it is much larger than at Limi, spanning about 4000 vertical feet. Within this zone, however, crops are not stratified by altitude. All of the summer and winter crops are sown like a patchwork quilt through the zone, although specific crops are planted sequentially. For example, maize is sown before millet, but on fields scattered

throughout the agricultural zone. Two types of rice, wet and dry, are also found across the entire farm-use zone, although wet rice is not found in abundance above the lower valley. The reason for this is not altitude *per se,* but the availability of requisite irrigation required for wet rice cultivation. Thus, as in Limi, there is no ladder-like sequence of planting and cultivation.

The patterns and styles of animal husbandry in Ghaisu also reflect the predominant montane pastoral adaptation of other highland middle hills people of Nepal. Common cattle, water buffalo, sheep, and goats play dominant roles in Ghaisu pastoral pursuits; cattle to breed plow oxen (for traction), water buffalo to produce milk for *ghiu* (*ghee,* or clarified butter) and meat for sacrifice and feasting, sheep for wool, and goats for ritual sacrifice (according to Hindu and indigenous shamanic custom; see Messerschmidt, 1976b). None of these animals are utilized for transport, as they are in Limi, although some of their byproducts are used in very limited local-regional trade networks (as between Ghaisu and neighboring Bhot Khola, for example). It suffices here to point out the dominant pastoral animals and to compare them with the principal pastoral adaptation of Bhot Khola.[5]

In contrast to Ghaisu, the economy of Bhot Khola is based on a combination of pastoralism and trade, with considerably less emphasis on agriculture. Bhot Khola is a mixed Gurung and Tibetan (Bhotia) culture area, approximately 15 miles (or two arduous days' trek) *north* of Ghaisu. This region, incorporating the eastern and lower third portion of Manang District bordering Tibet, is sometimes locally referred to as Gyasumdo. It consists of approximately 1700 people (1970 census) in over 300 households, strung out in villages and hamlets along the upper Marsiangdi River and the tributary Dudh River between Chame at the west and Tilje at the northeast. There are altogether 12 communities, five inhabited by Bhotias and seven by Gurungs. The Gurungs comprise approximately two-thirds of the population. They have dwelled here the longest, while the Bhotia are immigrants or descendants of recent immigrants (but not refugees) from Tibet (Gurung, 1976; Messerschmidt, 1972).

Thonje village, lying at 6000 feet (slightly lower in altitude than Ghaisu), is at the center of the predominantly Gurung portion of the region. Adjacent to it are Bhot Khola's oldest and all-Gurung villages of Taje, Naje, and Tamrong. Thonje is a trade town, inhabited predominantly by Bhotia. Taje, Naje, and Tamrong are almost within sight of Thonje and slightly higher in elevation, while Tilje, another, newer, mixed Gurung-Bhotia town, is the highest, at approximately 7500 feet elevation northeast of Thonje. Three other Gurung and three Bhotia villages lie at approximately the same elevation as Thonje on steep mountain slopes overlooking the Marsiangdi River.

[5] For a more detailed discussion of Ghaisu Gurung pastoral strategies, see Messerschmidt (1974, 1976a), and compare Toffin (1976) and Alirol (1976).

The montane economic adaptation of both the Gurungs and the Bhotias of Bhot Khola is dominated by trade and pastoralism. What little farming is practiced is limited by several factors. Thonje, as indicated, is very slightly lower in elevation than Ghaisu. Yet despite the altitudinal similarity, great differences exist between these two village areas, many of which can be directly tied to climatic variation due, in great measure, to latitudinal differences.

Ghaisu, situated on a northeastern facing ridge, is both wetter and warmer than Thonje and its surrounding villages, despite the latter's equivalent altitude and southern exposure. Whereas the predominant agricultural crops of Ghaisu are rice, maize, and millet, with small amounts of wheat, buckwheat, and barley, only the latter crops are sown in Bhot Khola. In contrast to the ability of Ghaisu villagers and their neighbors throughout Lamjung District to raise rice up to 6000 feet, rice does not prosper at Thonje and vicinity even in the presence of easy irrigation and southern exposure. The main reason is undoubtedly climatic. It is much cooler in more northerly Bhot Khola than in Ghaisu, reflecting the conditions of a higher latitude, and it is much more arid in Bhot Khola, reflecting conditions of the intermountain region, which is shielded from the seasonal rains that are the lifeblood of farming in more southerly villages of Nepal's middle hills and highlands. Whereas the cattle and water buffalo of Ghaisu are commonly husbanded and pastured as high as 10,000 feet in summer, and herds of sheep and goats are herded as high as 15,000 feet seasonally, in Bhot Khola only yak, *dzo* (yak-cattle hybrid), sheep, and goats are kept. Water buffalo, a warmer-climate animal, are completely absent in Bhot Khola (just as yak are in Ghaisu).

Although altitude and the effects of terrain are clearly important parts of the Ghaisu and Bhot Khola adaptational systems, latitudinality-delimited climatic factors also appear to play an important role. In terms of cultigens and animals, the higher-latitude, colder, and more arid Bhot Khola area differs substantially from the more southerly but equivalent altitude Ghaisu area.

OTHER EXAMPLES OF HIMALAYAN LATITUDINALITY

The dearth of available data on this issue (due in no small part to the lack of awareness of the relevance of latitudinality) does not permit a comprehensive examination of the role of latitudinal adaptation throughout the Himalayas. Nonetheless, several additional examples from Nepal will be useful, if only in outline, to indicate other ways that latitudinality has been utilized in adaptational systems.

In the far west of Nepal, in the area along the Humla-Karnali River just south of Limi, near Simikot, the problem of winter pasturage is solved by moving local herds of sheep 50 to 75 miles south to pastureland in mountain areas not covered by snow. Although these southern mountain areas are lower

than the summer pasture areas in northern Humla, altitude is not the sole criterion, for there are areas of equivalent elevation far nearer their home villages in Humla (i.e., farther north than those actually used). Temperature difference is the essential factor, since in the more *southern* areas there is little or no snowfall in winter. In this particular case, the transhumance adaptation is intimately linked with the salt trade since the Humlis' sheep (and goats) are used to carry Tibetan salt south and southern cereal grains north in trade.

A similar north-south adaptation occurs in Gurung ovine pastoralism in central Lamjung District along the Marsiangdi river valley and adjacent hills south of Ghaisu. There, sheep (and goats) are taken to winter pasture a week's trek (15 to 20 miles) south of, and at the same or a slightly higher altitude than, the more northerly and plentiful pasture areas nearer the shepherds' home villages. And although there is no threat of snow (except in the very highest pastures well above the villages), the critical factors in this pasturing strategy is unquestionably latitudinal: the more southerly but equally mountainous and equally high pasture areas (in the vicinity of Nalma and Lamjung Darbar) enjoy a more moderate climate, hence they provide more grasses for grazing. Here, and in the cases of the relationships between Limi and Tibet and Ghaisu and Bhot Khola, the common assumption in Nepal that more northerly latitudes = higher altitudes does not hold up to empirical observation. (Obviously, on the other hand, there are many instances where the north = higher hypothesis *is* proven.) To conclude, although the Gurungs' sheep are not used in transport and trade as are those of Humla, it is nonetheless clear that without access to the southern winter pasture areas, the typically large sheep herds of the Humlis and the Gurungs could not be maintained.

Another example of the latitudinal influence concerns agricultural use in parts of western and central Nepal where latitudinal differences in soil and climate are utilized along with altitudinal ones. For example, Caplan (1972) reports that some high-caste Hindu families in Belaspur District (pseudonym) of west Nepal also own agricultural land in valleys south of them:

> Six Brahmin households own land either in a valley south of Belaspur District or in the Terai, which together produce an additional two hundred *muris* of grain annually. This land is worked by tenants on a share-cropping basis (*adyan*, or half to the tenant and half to the owner). Allowing for the tenants' share of the produce this still means an extra hundred *muris*, or about 25 percent of the production by Brahmin households on village lands. (p. 23)

This same pattern has been observed by Goldstein among groups in the Karnali Zone, such as the Dangali Khambas, who have purchased land in the tropical and subtropical areas of southern Nepal such as at Surkhet and in the Terai. Their land-use patterns are somewhat different from those of the Brahmins described above since the Dangali Khambas normally migrate south at the start of winter and return to their home villages in June where they plant a small summer crop.

Likewise, Messerschmidt has observed similar practices of north-south migration and seasonal settlement by Manang Bhotias who spend their winters as far as 50 or more miles directly south of their home villages. He has also observed large numbers of Gurung families from Lamjung and adjacent districts in Gandaki Zone who own land both in their highland villages as well as in the fertile Rapti Valley which lies 40 to 50 miles south of them in the Inner Terai region near the Indian border. Finally, Peissel (1970) describes the manner in which nomads of western and central Bhutan "escape the snow, not by changing altitude but by changing latitude." He writes:

> In summer they follow the narrow ridges northwards right up to the foot of the snow-fields and glaciers . . . . Then as winter approaches they retreat slowly along the crests of the mountains, moving southwards for nearly a hundred miles, passing above all the valley villages. (p. 100)

CONCLUSION

Constructing models of mountain ecosystems, like any system, involves identifying the important variables and explicating the manner in which they interact to maintain the system, i.e., their basic structure and function. We argued that the mountain ecosystem model in which utilization of microhabitats based on altitude is central (the mixed mountain agriculture system) does not adequately depict a number of Himalayan ecosystems where latitudinal differences are utilized together with altitudinal ones. In the case of Limi, moreover, we have illustrated the central role latitudinality plays in the operation of the system.

While it is impossible to determine with currently available date the extent to which latitudinality is relevant throughout the Himalayas, let alone the mountain areas of the world, our research suggests it is potentially a significant factor. In fact, it may well be one of the salient factors distinguishing the Himalayas from the Alps. We contend that the lack of data on this dimension in the Himalayas, and perhaps elsewhere, is to no small extent a result of the conceptual monopoly that the vertically oriented model has held. We hope this paper will help to rectify this situation and thereby contribute to the development of a general model of human use of mountain ecosystems.

ACKNOWLEDGMENTS

The research for this paper was conducted under grants (for Goldstein) from the American Council of Learned Societies, the National Institutes of Health, NICHHD, Center for Population Research (HD 08984-10), and a Case Western Reserve University Biomedical Grant, and (for Messerschmidt) under a

National Institute of Health graduate traineeship (5 TO1 GM 1382 07 BHS) in Anthropology. We wish to express our thanks to our colleagues in Nepal and our village hosts, all of whom were helpful during the field research, and to various colleagues and students who have read earlier versions of the paper and offered cogent criticism and suggestions.

REFERENCES

Alirol, P. (1976). Animal husbandry in the Ganesh Himal Region (Nepal): An essay in ecological synthesis. *Contributions to Nepalese Studies. Journal of the Institute of Nepal and Asian Studies* 3(1): 47-61.

Bailey, C. (1978). Meetings on the topic of mountain environments. *Nepal Studies Association Bulletin* 16/17: 13-31.

Bishop, B. C. (1978). The changing geoecology of Karnali Zone, Western Nepal Himalaya: A case of stress. *Arctic and Alpine Research* 10(2): 531-548.

Brush, S. B. (1976). Introduction to cultural adaptations to mountain ecosystems (a symposium). *Human Ecology* 4(2): 125-133.

Brush, S. B., Netting, R. McC., and Messerschmidt, D. A. (1974). Cultural adaptations to mountain ecosystems, a symposium given at the annual meeting of the American Anthropological Association, New Orleans, November 28, 1973. *Human Ecology* 4(2): 123-185.

Caplan, A. P. (1972). *Priests and Cobblers: A Study of Social Change in a Hindu Village in Western Nepal.* Chandler, San Francisco.

CNRS (Centre National de la Recherche Scientifique) (1977). *Himalaya: Sciences de la Terre and Ecologie-Ethnologie. Colloques Internationaux du Centre National de la Recherche Scientifique, Sevres-Paris 7-10 December 1976.* CNRS, Paris, two volumes.

Dobremez, J. F., and Jest, C. (eds.). (1974). L'homme et le Haute Montagne: l'Himalaya. *Objets et Mondes* 14(4): 205-359.

Eckholm, E. P. (1976). *Losing Ground: Environmental Stress and the World Food Prospects.* W. W. Norton, New York.

Goldstein, M. C. (1974). Tibetan speaking agro-pastoralists of Limi: A cultural ecological overview of high altitude adaptation in the Northwest Himalaya. *Objets et Mondes* 14(4): 259-286.

Goldstein, M. C. (1976). Fraternal polyandry and fertility in a high Himalayan valley in Northwest Nepal. *Human Ecology* 4(3): 223-233.

Goldstein, M. C. (1977). Culture, population, ecology and development: A view from Northwest Nepal, Himalaya: *Proceedings of the 1976 CNRS International Conference on the Ethnology of the Himalayas.* CNRS, Paris, pp. 481-489.

Gurung, N. J. (1976). An introduction to the socio-economic structure of Manang District. *Kailash: A Journal of Himalayan Studies (Kathmandu)* 4(3): 295-310.

Hodgson, B. H. (n.d.). Miscellaneous notes on Nepal. India Office Library, London, Vol. 5, pp. 9-12, 44-45, 75-78, handwritten, unpublished.

Hoffpauir, R. (1978). Subsistence strategy and its ecological consequences in the Nepal Himalaya. *Anthropos* 73(1-2): 214-252.

Iijima, S. (1977). Ecology, economy, and cultural change among the Thakalis in the Himalayas of central Nepal. In Iijina, S., *et al.* (eds.), *Changing Aspects of Modern Nepal: Relating to the Ecology, Agriculture and Her People.* Institute for the Study of Language and Cultures of Asia & Africa, Tokyo.

Jest, C., Toffin, G., and Alirol, P. (1976). The Ankhu Khola Valley. *Contributions to Nepalese Studies, Journal of the Institute of Nepal and Asian Studies* 3(1): 33-61.

Macfarlane, A. (1976). *Resources and Population: A Study of the Gurungs of Nepal.* Cambridge Univ. Press, Cambridge.

Messerschmidt, D. A. (1972). Rotating credit in Gurung society: The Dhikur Associations of Tin Guan (Nepal). *The Himalayan Review, Journal of the Nepal Geographic Society* 5(4): 23-35.

Messerschmidt, D. A. (1974). Gurung shepherds of the Lamjung Himalaya (Nepal). *Objets et Mondes* 14(4): 307-316.

Messerschmidt, D. A. (1976a). Ecological change and adaptation among the Gurungs of the Nepal Himalaya. *Human Ecology* 4(2): 167-185.

Messerschmidt, D. A. (1976b). Ethnographic observations of Gurung shamanism in Nepal. In Hitchcock, J. T. and Jones, R. L. (eds.), *Spirit Possession in the Nepal Himalaya*, Aris & Phillips, Warminster, pp. 197-216.

Messerschmidt, D. A. (1976c). *The Gurungs of Nepal: Conflict and Change in a Village Society*. Aris & Phillips, Warminster.

Messerschmidt, D., and Gurung, N. J. (1974). Parallel trade and innovation in central Nepal: The cases of the Gurung and Thakali Subbas compared. In von Furer-Haimendorf, C. (ed.), *Contributions to the Anthropology of Nepal*, Aris & Phillips, Warminster, pp. 197-221.

Norbu, D. (1974). *Red Star over Tibet*. John Murray, London.

Peissel (1970). *Lords and Lamas: A Solitary Expedition Across the Secret Himalayan Kingdom of Bhutan*. Heinmann, London.

Pignede, B. (1966). *Les Gurungs: Une Population Himalayeene du Nepal*. Mouton, Paris.

Ragsdale, T. A. (1979). *Ethnicity and Educational Change: The Gurungs of Nepal and the New Educational Plan*. Unpublished PhD dissertation, Duke University, Durham, N.C.

Rhoades, R. E., and Thompson, S. I. (1975). Adaptive strategies in Alpine environments: Beyond ecological particularism. *American Ethnologist* 2(3): 535-551.

Schmidt, R. (1976). Review of E. P. Eckholm, *Losing Ground* (1976). *Nepal Studies Association Bulletin* 11: 10-14.

S. J. N. (1977). Montology: The ecology of mountains. *Technology Review* 79: 64-66.

Snellgrove, D. L. (1961). *Himalayan Pilgrimage: A Study of Tibetan Religion by a Traveller through Western Nepal*. Bruno Cassirer, Oxford.

Sterling, C. (1976). Nepal. *Atlantic Monthly* 238(4): 14-25.

Takaya, Y. (1977). The agriculture of Nepal: Its ecological and historical development. In Iijima, S., *et al.* (eds.), *Changing Aspects of Modern Nepal: Relating to the Ecology, Agriculture and Her People*. Monumenta Serindica No. 1, pp. 38-68.

Toffin, G. (1976). The peoples of the Upper Ankhu Khola Valley. *Contributions to Nepalese Studies, Journal of the Institute of Nepal and Asian Studies* 3(1): 34-36.

Uhlig, H. (1978). Geoecological controls on high-altitude rice cultivation in the Himalayas and mountain regions of Southeast Asia. *Arctic and Alpine Research* 10(2): 519-529.

UNESCO (1973). Impact of human activities on mountain ecosystems. Expert Panel on Project 6, Programme on Man and the Biosphere (MAB), Salzburg, 29 January-4 February 1973, Final Report.

UNESCO (1975). Regional Meeting on Integrated Ecological Research and Training Needs in the Southern Asia Mountain Systems, Particularly the Hindu Kush-Himalayas. Programme on Man and the Biosphere (MAB), Kathmandu, 26 September-2 October 1975, Final Report.