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PERSISTENCE AND CHANGE IN HIGH MOUNTAIN AGRICULTURAL SYSTEMS

HARALD UHLIG¹, EDITED BY HERMANN KREUTZMANN²

ABSTRACT The effects of improved accessibility in high mountain areas have stimulated a discussion on models that depict montane resource utilization, transformation of agricultural practices, and settlement patterns. While significant changes in mountain communities are evident and are perceived to transform socioeconomic conditions, it is argued that the persistence of specific practices related to the mountain environment must be acknowledged and discussed. Thus, persistence in change is analyzed as a parameter for the relationship between ecology, culture, and economy. The cases presented range from the European Alps to the Himalayan arc. Emphasis is placed on the utilization of agro-ecological belts in mountain societies such as the Himalayan communities of the Kashmir Valley and Jaunsar-Bawar in the Dehra Dun District. Their adaptive strategies and the transformation processes are compared with developments in the European Alps.

RÉSUMÉ *Persistence et changement dans les systèmes agricoles de haute montagne.* Les effets d'une meilleure accessibilité dans les régions de haute montagne ont stimulé une discussion des modèles décrivant l'utilisation des ressources montagnardes, la transformation des pratiques agricoles et les modes de peuplement. Bien que des changements importants ont été observés dans les communautés montagnardes et semblent transformer les conditions socio-économiques, cet article insiste que la persistance de pratiques particulières liées à l'environnement montagnard doivent être reconnues et examinées. La persistance et le changement sont donc analysés en tant que paramètre de la relation entre l'écologie, la culture et l'économie. Les cas présentés s'étendent des Alpes européennes à l'arc himalayen. L'accent est mis sur l'utilisation des ceintures agro-écologiques dans les sociétés montagnardes, telles que les communautés himalayennes de la vallée du Kashmir et le Jaunsar-Bawar dans la région du Dehra Dun. Leurs stratégies adaptatives et les processus de transformation sont comparés aux développements dans les Alpes européennes.

ZUSAMMENFASSUNG *Beharrung und Wandel in montanen Landwirtschaftssystemen.* Die Auswirkungen einer verbesserten Verkehrserschließung in Hochgebirgsräumen haben eine Diskussion über Modelle zur Beschreibung montaner Ressourcennutzung, Anpassung landwirtschaftlicher Praktiken und Siedlungsmuster angeregt. In diesem Beitrag werden die bedeutenden Veränderungen in Hochgebirgs Gesellschaften wahrgenommen und in ihrer Wirkung auf sozioökonomische Strukturen bewertet. Dennoch wird gleichzeitig auch die Beibehaltung bestimmter, für die Kennzeichnung von Hochgebirgslandwirtschaft typischer Praktiken konstatiert. Diese Persistenz im Umfeld gravierender Veränderungen im Beziehungssystem aus Ökologie, Kultur und Ökonomie steht im Vordergrund der Untersuchung, die Fallbeispiele aus den europäischen Alpen und aus dem Himalaya-Gürtel präsentiert und vergleicht. Besonderes Augenmerk wird der Nutzung montaner Staffeln im Kaschmir-Becken und in Jaunsar-Bawar geschenkt. Dortige Landnutzungsstrategien und Transformationsprozesse werden mit Entwicklungen im Alpenraum verglichen.

PRELIMINARY REMARKS BY HERMANN KREUTZMANN

To reproduce here the ideas in the same manner that Prof. Dr. Harald Uhlig had elaborated in his draft papers the proper terminology of alpine agricultural systems is given in its vernacular version. As Uhlig presented these papers in the Austrian Alps, it seemed to be appropriate to adopt the local terminology in order to familiarize the audience with the Kashmir situation displayed in his diagrams and profiles. Explanations for the English reader have been added by this editor and additional references to "classical" and recent publications have been provided.

The use of "I," "my," and "myself" indicates direct quotations from Harald Uhlig's original typescript without adding any further comments. The editorial work has been

confined to clarifying certain aspects, merging two papers into one, adding references, and incorporating the diagrams and profiles into the text. The explanations regarding the latter had not been developed by the author in his written draft. For additional information previous publications by Uhlig (1962a, 1963, 1969, 1970, 1973a, b, 1978, 1980, 1984) as well as research results from other authors have been consulted.

The synoptic diagrams and profiles resulted from fieldwork conducted by Harald Uhlig in Kashmir and Jaunsar-Bawar (Chakrata District, Dehra Dun) in 1959. The landscape profiles were designed in the same year, but not published in the form the author had planned. Although extracts of the research results have been published and

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referred to on different occasions (Uhlig 1962a, b, 1969, 1976) the author had retained most of the material for a scheduled book on Kashmir which, however, was never launched. Uhlig intended to publish the diagrams and profiles as part of the Commission on Mountain Geology proceedings and commented on form only recently. Although he had made these diagrams available to interested colleagues earlier, it was his hope to present them to a wider audience. Thus, this publication is in compliance with his wish. In light of his views on developments in mountain geography, his pioneer work in Kashmir is an important source of information for future comparative research and will provide resource materials of enormous

detail in an area where little fieldwork has been undertaken since.

Included here are further fieldwork results from one of Harald Uhlig's last visits (1993) to the Himalayan range where he trekked the southern slopes of the Annapurna region in Nepal. His vast experience of different mountain systems is reflected in the comparison of the Himalayan case studies with developments in the European Alps. The participants of the IGU Commission's meeting were invited to share his long experience and subsequent views of mountain problems within the setting of the Tauern Alps and during a fieldtrip to the Berchtesgaden National Park.

INTRODUCTION

The rapid modernization process—in a technical and in a socioeconomic context—especially affected by improved accessibility to formerly remote mountain habitats has left its mark on the research efforts on high-altitude agricultural systems. The impact has been so extensive that “change” became the dominating topic of most recent publications in this particular field of enquiry.

Nevertheless, in spite of the changes that undoubtedly have occurred a surprising persistence of agro-ecosystems and socio-cultural structures is evident. One of the few publications taking this duality specifically into account is provided by Leidlmaier (1976) who elaborated on the topic of persistence and change in mountain regions. In many cases these structural factors have, however, been modified and modernized. Frequently they result in a better adaptation to the given natural conditions. To mention one example: the conversion of former arable fields and/or of former field-grass systems (the German language technical term for this sequential cropping pattern is *Egarten-Wirtschaft*) into permanent hay-meadows and pastures (*Vergrünlandung*) are evidence of the introduction of a system that is much better adapted to climate, relief, soil stability, and to the diminishing available workforce (due to increased out-migration). I venture to talk of “Persistence in Change,” that is, in spite of changes many phenomena peculiar to certain environments not only survive, but they fit even more efficiently into the modernized situation.

It is emphasized therefore that adaptation is of particular importance. Very few inhabitants of high mountain regions would be so foolish as not to try to adapt themselves, their living space, their agricultural systems, and their lines of communication to the conditions of the natural environment. The fear that such an approach would lead to a reversion into an out-dated determinism—as claimed in Allan's paper published in this journal almost a decade ago (Allan, 1986)—is irrelevant. Because of the very nature of high mountain environments, geographers have to apply the methodological principle of a “man-earth ecosystem in its regional differentiation.”

The farmer and the tillage of the land will succeed only when the naturally given pre-conditions are carefully ob-

served. This need not be necessarily a passive approach; it could be pursued under thoughtful use (or change) of the given natural assets, by tradition and experience, and sometimes by a trial-and-error approach. Allan (1986) based his notions of change on the effects of improved accessibility. This view is fully supported by myself as it is obviously a decisive impetus for modernization. Accessibility and the changes instigated by road construction into high-altitude valleys should by all means be taken into account by scholars who wish to develop structural models.

I do oppose, however, Allan's statements that altitudinal zonation expressed in “tiered-belt” models (for example Troll, 1962) will no longer be adequate for mountain areas when these are penetrated by roads (Allan, 1986: 192). According to my experience and observations, altitudinal zonation persists in spite of better access or modernization. The research results of other colleagues support this observation (cf. Grötzbach 1982, 1984a, b; replies by Sopher, Greenland, and myself to Allan's paper, 1986). It should be mentioned that the time-honored von Thünen model—which was developed in lowland horizontal dimensions—focused on differentiation of various zones in relation to the intensity of land use and its changes resulting from increased accessibility (cf. Thünen, 1842 and more recently Nitz, 1993).

Altitudinal zonation models may have to be amended or be used as the basis (or reference point) to evaluate modern changes occurring in mountain regions. Therefore, the two perspectives should supplement each other. Given the verticality of ecological and agricultural systems in the “three dimensional space of high mountains” (Troll, 1959, 1962, 1973, 1975), they are *per se* based on the natural setting (reflecting not only the distributional characteristics of native flora alone, as Allan (1986: 192) presumes. Elevation, climate, aspect, the entire geology-soil-relief-water complex (including gradient and slope), vegetation cover, and the human impacts, are all of vital importance! It is important to recognize the different ecotopes (environments defined by their ecological assets) that complement each other and thus provide for the needs of a mountain community.

Exemplifying this with an altitudinal sequence of re-

source utilization we find various systems that combine the special assets of different levels: from bottom to top the lowest level could be characterized by narrow, steep-sided valleys (for example, rice fields, vineyards) in a probably arid valley bottom where irrigation is available. Rainfed cultivation could be higher above (near the settlements from where the transport of animal manure to the village lands is organized), hay-meadows (*Mähder* = meadows located near the homestead, the grass is cut once or twice a year)—sometimes on steep slopes which could not be otherwise utilized—form the interface between these settlements and high-altitude grasslands (*alpine Matten* = alpine pastures) where *Almwirtschaft* (see below) is practiced and is climatically restricted to the summer season. In a different ecological context seminomadic herdsmen would take advantage of the climatic differences between highland and lowland pastures and migrate seasonally between those altitudinally differentiated regions which themselves offer a peculiar vegetation cover. Furthermore, the high-altitude cultivation of recently introduced cash crops originating from temperate climates, such as potatoes in the Himalaya, market-gardening to replace shifting cultivation, and/or the production of opium from poppy harvesting in Southeast Asian mountains, underpins the selection of suitable growing areas. Nearly all the mentioned possibilities are based (at least climatically) on differentiated natural ecotopes!

It follows from the previous remarks that adaptation to these varying natural environments is vital, for a sustainable agriculture as much as for the reduction of alpine hazards. In no way can such a rationale be branded as a reversion to “determinism.” In several cases, the altitudinal zonation is perpetuated in spite of modern changes. Some factors may have been altered, some might have been even eliminated; nevertheless others will have been strengthened or intensified/amplified by improved access. This is clearly the case for a more rational *Almwirtschaft* in locations where road connections are available. Often this development opens the door for the generation of additional incomes from tourism and is accompanied by improved opportunities for the workforce who can commute over longer distances, thus reducing the need for disruptive seasonal outmigration.

Before proceeding further, it is necessary to clarify the specialized terminology here: the German language term *Almwirtschaft* is used in the Allgäu and in Austria, while westwards the terms *Alpwirtschaft*, *Alpe* (Switzerland), or in French speaking areas of the European Alps *élevage avec estivage* and *alpage* are in common usage; these technical terms are frequently translated as “transhumance” in Anglo-American parlance. Following the International Geographical Glossary, *Almwirtschaft* describes an “economy based on alpine pastures” (Kreutzmann, 1986, 105). Transhumance is an improper interpretation of *Almwirtschaft*, as *transhumance* means a certain form of animal husbandry prevalent in the Mediterranean region. Trans-

humance describes the movements of herds between two (or more) periodic grazing grounds (for example, mountains in summer, lowlands in winter) with no stay for the winter season in the cottages of the homestead. In the interface between Mediterranean coastal areas and the Southern Alps we find the practice of transhumance (Beuermann, 1967; Rinschede, 1979; for a terminological approach and further specifications cf. Scholz, 1982, 1991). In contrast, *Almwirtschaft* is distinguished from transhumance, where hired professional shepherds are year-round caretakers of the flocks, by the very fact that in *Almwirtschaft* the owners of the herds take a strong personal interest in shepherding; often family members or related persons from the community spend time in the high pastures. More important even, is the fact that the animals are part of the farm management within the homestead during the remainder of the year and are not driven to far-away locations in search of forage. The production and storage of fodder for the long winter season is an integral part of *Almwirtschaft*.

In this system the utilization of different ecological zones with fodder potential is essential: the belt (*Staffel*) above the homestead in the alpine context is called *Maiensäss* or *Aste*, i.e., a *pre-Alm* where hay is made and byres are maintained. On route to the highest alpine meadow, which is reached at the peak of summer, variations in vegetation cover are encountered and consecutive belts (*Staffeln*) are utilized when available: these are the lower *Alm* (*Niederleger*) and middle and upper *Alm* (*Hochleger*). It should be noted that a single group within the above mentioned stratification might utilize several belts (*Staffeln*) included within its own stratum. In contrast to alpine *Almwirtschaft*, the Himalayan *Staffeln*, discussed below, comprise arable land also. In the Alps, similar cases—so-called summer settlements with some additional tilling—have been abandoned by now. The most outstanding example of *Staffeln* occurred in the Val d’Anniviers (Eifisch-Tal, Wallis) where in former times the mountain farming families moved periodically between the main village which was located at a medium altitude, the lower-lying vineyards (with additional habitations) in the valley of the river Rhone, and the hay meadows and the alpine meadows at the upper elevations, respectively (cf. Peattie, 1936: 140). Today, this system is defunct due to modern changes in the economy of the residents of the valley. Nevertheless, similar forms of seasonal movements of substantial numbers of the village population to different belts can still be observed in some side valleys of the upper Indus (for example, the Babusar area of the Chilas District (Kreutzmann, 1989: 128, 1993: 33).

For the sake of clarification *Almwirtschaft*, transhumance, and nomadism should be treated as separate entities. These general considerations and remarks are necessary for an assessment of adaptive strategies in Himalayan agricultural systems.

HIGH MOUNTAIN AGRICULTURE AND ANIMAL HUSBANDRY IN KASHMIR AND JUANSAR-BAWAR¹

Two distinct patterns of high mountain agricultural systems are compared in the following case studies. First, a cross-section through the large intra-montane Kashmir basin and its surrounding mountain ranges is presented (Figure 1). Here different ethnic groups participate and compete in the exploitation of available natural resources (Figure 3). A system of ethnic stratification (*Schichtung*) is related to these adaptive strategies. In contrast, the second example of Jaunsar-Bawar (Figures 2 and 4) resembles a valley inhabited by only one single social group which seasonally utilizes a vertical sequence of belts (*Staffeln*). The investigation in both areas revealed significant proto-types of utilization strategies which are strongly related, on the one hand, to ecological differentiation such as relief, elevation, climate, vegetation cover, geology, and soil, and on the other hand, to the socio-economic setting incorporating ethnic and social organization, economic practices, and adaptation strategies. The close interaction of all these elements is displayed in a series of diagrams and profiles which are intended to demonstrate the spatial relations between different social groups and different land-use and settlement types. Consequently, a comparison is presented between the peculiar system of altitudinal stratification (*Höhen-Schichtung*) of various ethnic groups in the Kashmir Valley and the complex system of land utilization strategies in which a single peasant group occupies and exploits different sites on the steep slopes and mountain ridges in the narrow valley of Jaunsar-Bawar on a permanent or seasonal basis (*Höhen-Staffelung*).

ETHNIC STRATIFICATION IN THE KASHMIR VALLEY AND THE SURROUNDING MOUNTAIN REGIONS

There are eight different social groups (Figure 1 [= Abb. 1 of Uhlig's colored prints]) to be distinguished by their linguistic affiliation, occupational structure, agricultural strategies utilizing natural resources, period of migration, and/or settlement:

1. The Kashmiri rice farmers. These speakers of a Dardic language are the oldest settlers in the fertile and flat valley bottoms (Figure 3 [= Abb. 3 in Uhlig's colored prints]). They have exploited the ecological advantage of natural wetlands like the *nambal* backswamps on the flat valley-floor (Uhlig, 1969: 2). Supported by a dry climate with warm summers the conditions seem favorable for one wet-rice crop. Since prehistoric times these lands have been cultivated (cf. Stein, 1899; de Terra and Paterson, 1939) while the permanent settlements of rice farmers are to be found on the slightly elevated and protected sites such as levees and terraces.
2. The "lake-farmers" of Kashmir. These are former houseboat dwellers (*Hanji*) who have established artificial islands within Dal Lake and other lakes (Figure 3). Some of the islands and peninsulas are suitable for the construction of houses and extensive

agricultural fields while other groups are floating on the water surface. In an amphibious environment these floating gardens have been established in shallow parts of the lakes and swamps. By constructing barriers and accumulating organic matter from weeds and other plants the lake-farmers have created artificial land and are cultivating highly productive vegetable gardens. The management and tilling is partly executed by boat as is the transport of crops to the markets. This former landless social group has become one of successful and market-oriented smallholders on artificial land.

3. In addition to the aforementioned two types of Kashmiri settlements, a limited number of marginal filial settlements have been established by members of the same ethno-linguistic group (Figure 3). Population growth was the cause of the settlement split. These younger settlements command a small proportion of paddy fields in tributary valleys and a combination of rainfed agriculture and forest exploitation is practiced.
4. Surrounding the flat portions of the Kashmir basin are settlements in which Kashmiri hill-farmers dwell (Figure 3). The population is composed of a group of former Chopan herdsmen who have settled permanently on the higher elevations of the valley floor (up to 2,800 m). Basically their habitations originate from a conversion of seasonal settlements into permanent ones (a similar process has been recorded in the Hindukush-Karakoram and in the European Alps). Their agricultural practices are limited to the cultivation of summer crops (*ek-fasli*). In small plots staple crops such as buckwheat (*Fagopyrum esculentum*), Tibetan barley (*Hordeum vulgare*), amaranthus, and potatoes (*Solanum tuberosum*) are grown. In addition to crop-farming these pioneer settlers are engaged in animal husbandry. Besides small livestock numbers of their own they make extra income from shepherding cattle herds of rice farmers in the valley during summer. Thus, these hill farmers form an intermediate group being both cultivators and herdsmen.
5. Above the settlements of Kashmiri farmers even younger settlements have been established by former Gujur nomads (Figure 3). Initially, these speakers of a Middle Indic (Prakrit) language migrated from the Northern Indian lowlands into the mountain rim of the Hindukush, Karakoram, and Himalaya (Shashi, 1979; Kreutzmann, 1994). In Kashmir this group of herdsmen founded permanent settlements (at approximately 2,000–2,400 m) comprised of single farmsteads with maize (*Zea mays*) cultivation. Their dairy farming system based on water buffaloes and the processing of milk into clarified butter (*ghi*) is supported by the extensive use of summer settlements and high pastures. From a tradi-

¹Figures 1-4 (in color) are enclosed separately as Abb. 1-4. English translations of the Keys to these diagrams are presented at the end of this text.

tion of nomadism, external interventions, such as the loss of grazing grounds in the plains and the subsequent shift into the mountains, this group has adopted practices of *Almwirtschaft*. The Gujur operate their animal husbandry from permanent settlements supported by the seasonal utilization of high pastures. Only relict groups of Gujurs continue nomadic practices and have retained a seasonal migration pattern between grazing grounds with temporary dwellings.

6. The transhumant Chopan (Kashmiri) are professional herdsmen who cooperate with the Kashmiri rice-farmers of the Valley (Figure 3). As a segregated social group, the Chopan inhabit smaller dwellings at the outskirts of the villages and take the rice farmers' cattle and sheep to the summer pastures on the hills. All household members participate in the migration which lasts until autumn when the livestock is returned to the owners and the herdsmen are remunerated in kind or cash.
7. The Bakerwal nomads arrived in Kashmir at the turn of the century. As the ethnonym indicates, they have been primarily goat herders (of the tall Kaghan goat) although in recent years sheep were added to their flocks (Uhlige, 1969: 5; Casimir and Rao, 1985; Rao, 1992: 95). The Bakerwal left their former grazing grounds in the North-West Frontier Province of present-day Pakistan when competition over natural resources increased. Long-distance migration became unfeasible after the cease-fire line separated Indian from Pakistan-controlled parts of the former Kashmir princely state in the aftermath of partition. Now their winter and summer pastures remain to the east of the actual line of control. Only one exception has been reported: a very small group of Bakerwal nomads visit the Pakistan-controlled Chichi Valley of Astor Tahsil (Nanga Parbat region) in summer while their winter camps are near Jhelum in Punjab (Clemens and Nüsser, 1994: 383). Utilizing grazing in the mountain ranges that protect Kashmir, with their flocks they seasonally cross the densely settled valley floor on their way to natural pastures (Figure 1). The altitudinal variation ranges from winter camps at 500–900 m in the Pir Panjal range (the southern rim of the Kashmir basin) to summer camps (2,500–4,200 m) in the High Himalayan Range (northeast of Srinagar; Figure 3). The Bakerwal economy continues to be dominated by animal husbandry. While milk and milk products are reserved for household consumption, the sale of livestock, goat hair, and sheep wool provides the externally derived income (Rao and Casimir, 1982; Casimir, 1991). Relationships with the settled communities in Kashmir and the Ladakhi farmers who practice *Almwirtschaft* are not without strain. Competition over natural resources characterizes these relationships. As a group that arrived in the region rather late, the Bakerwal mainly utilize marginal resources contiguous to the well-established pastures of other groups.

8. The Ladakhi mountain farmers form the group occupying the highest permanent dwellings in the alpine steppe north of the Kashmir basin (Figure 1). Their economy is based on cultivation of wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), and buckwheat (*Fagopyrum tataricum*) in irrigated oases. Water resources are derived from glacial meltwaters and directed to the compact village lands commanded by nucleated habitations and Buddhist monasteries. Due to the high elevation of their village lands (about 3,000–3,500 m; Figure 3) only single-cropping (*ekfasti*) during summers is feasible. Their mixed mountain agriculture also incorporates animal husbandry based on yak-keeping (for recent research on Ladakh and Zaskar, see Crook and Osmaston, 1994). Competition over high pastures occurs, especially in their western contact zone towards the Kashmir Valley with recent nomadic immigrants and expanding settled areas. The variations of specific adaptation strategies of different social groups are combined in the landscape profile of the Kashmir Himalaya (Figure 1) and the diagram on settlement patterns and land-use types of mountain farmers and animal husbanders (Figure 3). By this approach it becomes obvious that different utilization strategies exist next to each other and that competition over resources occurs. Changing socio-political conditions must be taken into account for the transformation of these adaptive patterns. Nevertheless, the specific features of different agro-ecological belts, the exploitation of the potential of certain natural belts, and the involvement of different social groups in these practices remain a characteristic feature of this montane environment.

THE CASE OF JAUN SAR-BAWAR

The study area (Figure 2 [= Abb. 2 in Uhlige's colored prints]) described as Jaunsar-Bawar (30°31' to 31°3'30" North, 77°45' to 78°7'20" East) forms a subdivision within the Tahsil of Chakrata. This mountainous part of the Dehra Dun District in Uttar Pradesh borders in the north and east with Tehri Garhwal. In a 19th century gazetteer Jaunsar-Bawar was described as

entirely composed of a succession of hills and mountains ...Even in the hills, Jaunsar-Bawar has the character of being one of the wildest and most rugged tracts, affording naturally very little level ground, and that only in small patches. The mountains are peculiarly rough and precipitous, there is much cliff and rock and few villages, so that the cultivation is necessarily small and very laborious...The ravines are, as a rule, deep and sudden in their descent, often ending in dark chasms, sometimes wooded...Half a century ago, the country on either side of the main ridge was thickly covered with noble forests of *deodar*, and it is along it and its spurs that the existing forests occur. The Deoban hill [Figure 2]...now contains but a few patches of *deodar*, though the south and east faces are well clothed with oak...near the summit, *morinda* or spruce fir (*Abies smithiana*) mixed with *Abies webbiana* known under the same name occur. But the glory of Jaunsar-Bawar is its virgin forest of *deodar*....

(Atkinson, 1886: 341–342)

The impact of central administration reached this "unregulated area" in British India later than the neighboring regions of Tehri-Garhwal and Sirmur-Simla Hill States (Uhlig, 1969: 6). Within one century the population of Jaunsar-Bawar more than doubled: a low estimate of 30,585 inhabitants was recorded in 1860–61, while by 1881 a population of 45,117 was given (Atkinson, 1882–1886: 352). The Census of 1961 returned a population in Jaunsar-Bawar of 66,684 persons in an area of 941 km² (Sharma, 1966: 1). A decade later the population had increased to 79,128 persons (Table 1) of which the overall majority of 94.8% belonged to the Hindu faith, a feature not significantly changed within the last century (Atkinson, 1886: 352; Sinha, 1982: 154–155). This religious homogeneity—nevertheless broken by caste distinctions—conforms with the occupation of the study area by a single agricultural group, the Jaunsari mountain farmers belonging to the Pahari language group. In contrast to the Kashmiri case where different social and ethnolinguistic groups apply their adaptive strategies in a sequence of belts, here the single group of the Jaunsari utilizes different belts in a complex system of the seasonal exploitation of resources.

The environmental setting exemplifies what Carl Troll (1959, 1962, 1975) understood in his concept of the three-dimensional variation of geocological features. The vegetation cover reflects the exposure to a monsoonal-tropical climate including a spectrum from a semi-humid monsoonal deciduous forest to temperate oak and cooler coniferous hill forests. In comparison to Kashmir, the Jaunsar-Bawar region resembles a rather remote mountain region with a population composed mainly of "hill people" (Uhlig, 1969: 6).

Village lands are to be found up to altitudes of 2,000 m. Specific management patterns of the household workforce and the highly complex agricultural and settlement system are interrelated to large extended families, a fact attributed to the continuing adherence to polyandric marriage patterns. The permanent habitations of multi-storied, decorated timber houses form the nucleus of village lands composed of terraces for double-cropping rainfed agriculture (Figure 4). Maize, millets and/or pulses (*masur*) are the principal crops of the *kharif* (in local terminology: *bhadandi*) or summer season, while wheat and barley comprise the *rabi* (*ruri*) or winter crops. In addition to agricultural lands adjacent to the permanent habitations, the farmers utilize other belts above and below where cultivated terraces and seasonal settlements are to be found.

The "hot huts" are located below in the narrow and humid valleys where irrigated rice terraces are worked for a marginal additional crop. Between these lowest fields at about 1,100–1,500 m and the nucleated villages at about 1,800–2,200 m steep slopes carry a degraded subtropical pine forest which is extensively used for grazing. Remnants of a former utilization—most probably shifting cultivation of slash and burn—can be traced in this belt. At

TABLE 1
Population development in Jaunsar-Bawar, 1861–1971

Year	Population total	Population growth ¹ (%)
1860–61	30,585	
1872	40,046	2.3
1881	45,117	1.3
1891	50,697	1.2
1901	51,101	0.1
1911	54,812	0.7
1921	55,623	0.1
1931	56,774	0.2
1941	57,650	0.1
1951	58,469	0.1
1961	66,684	1.3
1971	79,128	1.7

¹average annual percentage growth during preceding decade

Source: calculations based on Atkinson, 1886: 352; Bhatnagar, 1966; Sharma, 1966: 4; Zutshi, 1974; Sinha, 1982: 148

higher altitudes more recent cultivation has been added to the system of resource exploitation. At the highest altitudes (2,200–2,700 m) potatoes are grown as the main cash crop while poppies (*Papaver somniferum*) remain marginal. Potatoes were introduced initially during colonial times and, for the tillage of these high-lying, make-shift terraced fields, migrant laborers from Nepal were hired. Here and in other locations huts for seasonal use are found. They are closer to the permanent village and serve as temporary retreats for household members during work periods at nearby fields and as shelter for livestock during the heavy monsoon rains in summer. While cattle are grazed in the nearby forests, the sheep and goats follow a seasonal pattern between the highest elevations (above 2,800 m) in summer and the post-harvest rice fields in the valley bottoms in winter. The flocks are maintained by household members who perform a highly respected and valuable duty within the economic system of this dualistic mountain agriculture.

The case of Jaunsar-Bawar exemplifies a rather different pattern compared to Kashmir. While in the fertile and populated Valley of Kashmir a number of separate groups apply different adaptation strategies, the Jaunsari mountain farmers make use of the varying eco-potential by a combination of crop-farming and animal husbandry. This pattern is quite similar to those described above for the European Alps. The landscape profiles (Figures 1 and 3) indicate in their function as descriptive models, that the natural setting (relief, geology and soils, water household, vegetation, and climate) is closely connected with settlement and agriculture. Thus, a transect through a basin or a valley enables the presentation of varying adaptive strategies (Figures 2 and 4) and their interlinkages.

RECENT DEVELOPMENTS IN THE HIMALAYAN ARC

In spite of improved accessibility by road construction (partly for military purposes, but with significant impact on general aspects of regional development), extraordinary growth of tourism and the related infrastructure in recent years, and increasing outmigration of laborers, the existing structures have not been fundamentally changed. A remarkable phenomenon is the diffusion of certain cash crops into the mountain areas, most notably the cultivation of apples and other fruits. Originating from temperate climates they are well adapted to the lower mountainous belts where they have been introduced for cash crop production. In Kashmir, these developments have changed certain areas of former poor rainfed cultivation on the Karewa terraces (Figure 1).

Kulu (Himachal Pradesh) has extended its fruit gardens—early attempts go back to colonial times—and participates in a market economy favored by convenient road transport to lowland urban centers. In the more humid climates of the eastern Himalaya (Nepal, Darjeeling) the cultivation of oranges (tangerines) has increased. At higher altitudes seed potatoes play a growing role as an important cash crop, as in Hunza, Kaghan, and Lahul (Uhlig, 1980; Grötzbach, 1989; Kreutzmann, 1995). Furthermore this practice eliminates the import of seeds from overseas. Road access has partly replaced the troublesome transport by porters or pack-horses. Apart from such examples, the basic altitude zonation has not fundamentally changed. This is not surprising, due to the fact that the various belts as part of the vertical sequence—irrigated rice terraces in the lower valley floors, as well as rainfed crops and pastures of higher elevations—remain in place and continue to form the primary resource for the rural population. The basic needs in food stuffs are derived from these assets.

Terraced village lands—either irrigated or rainfed—appear to be well-maintained and are immediately repaired when damage occurs. Usually soil erosion is controlled by the communities (cf. recent research by Haffner (1986), Müller-Böker (1986), and Pohle (1986) in Gorkha). My own observations in 1993 confirm this evidence from the Nagarkot and Dulikhel areas in Central Nepal. The mountain hazard mapping by Kienholz *et al.* (1984) reveals some critical areas, but confirms the above given picture in general (cf. Ives, 1987; Ives and Messerli, 1989).

Seasonal and/or long-term outmigration can most certainly be encouraged by improved road transport conditions. However in principle, these phenomena existed long before the introduction of asphalt roads. There is evidence that migrants from Ladakh and Lahul and other regions migrated to the lowlands in search of wage labor; the case of Nepali seasonal migrants to the potato fields of Jaunsar-Bawar has been mentioned above and their journey involved week-long marches across high passes (Uhlig, 1976). Enforced and facilitated by modern traffic infrastructure, outmigration helps to reduce population pressure, but does not necessarily change existing systems of settlement and agriculture as a whole. Some settlements are more affected, however, by tourism growth, be

it by the construction of new recreational facilities, mainly serving domestic tourists from the lowlands, as in Kulu and Manali (Grötzbach, 1985, 1994), or by the many lodges and restaurants, installed in existing farm houses or newly built hotels along the main trekking routes, especially in Nepal (Kleinert, 1993 a, b). In many cases these developments have contributed to great extensions of existing settlements, for example in Kyangjin, the highest monastery, and the well-known Swiss-inaugurated cheese-processing high pasture (*Alm*) of Upper Langtang. However, this was not accompanied by far reaching changes to the former agricultural structure.

My own observations (1993) of Gurung villages (Modi Kola, on the southern slopes of Annapurna) confirmed this. In spite of sizable contributions from trekking and other tourism-related enterprises managed and operated partly by retired Gurung mercenaries, the agricultural landscape has survived undisturbed and permanent habitations are surrounded by well-maintained terraces. These fields are worked with a rotation of barley or millets, maize, and winter wheat. Lower down irrigated rice terraces are found. As in Jaunsar-Bawar they are seasonally maintained and operated from temporary settlements. Above the villages, maize is cultivated on partly unterraced slopes; where these fields are remote from the villages, temporary huts for overnight stays are found. Finally, the livestock-related belt for pasturing cattle and sheep lies in the higher forests and the alpine meadows (*Matten*) which are utilized during summers with *Alm*-type settlements. The additional income from tourism has affected the economic structure and contributed to a shift of agricultural activities towards part-time farming. Taking this and other changes into account, it still remains important to emphasize that the pattern of utilization of the natural resources of the higher belts (*Staffeln*) survives.

The seasonal migrations of herdsmen have not been affected by road access. However, where there are existing roads they are used as convenient routes for herd movements.

An interesting parallel is the movement of large herds of sheep, still driven every summer over glacier passes from Schnalstal, South Tyrol, across the political border to the high grazing grounds of the Otztaler Alps for use of traditional grazing rights there. This compares well with the crossing of the glacier passes by the Gaddi and Bakerwal to access remote summer pastures. In the case of the Bakerwal, competition and conflicts with neighboring groups over access to natural grazing grounds have been reported (Uhlig, 1962b; Rao, 1992: 115). The Gaddi prefer to cross the Rohtang pass and they now return from their summer pastures in Lahul on the surfaced road, while military as well as tourist traffic waits patiently to let the large herds of sheep pass by. In a similar fashion, the Bakerwal walk with their goat herds across the Banihal and other mountain pass roads of Kashmir. The strong military presence there provides them with a ready market to sell some live animals. From sources like these some Bakerwal have acquired money to purchase plots

and build houses in the Siwaliks. Somehow they are adjusting the locations of their winter camps. A process of change occurs in Gujar areas as well: on the slopes above the Kashmiri rice terraces (Figure 3) they are beginning to improve their traditional flat-roofed huts with mud-walls (*kotha*) by rebuilding them in a form of wooden houses, thus copying designs of urban Kashmiri houses. All these examples underpin the observation of significant changes due to effects of modernization in the Himalayan arc. Fundamental changes, including substantial

outmigration, followed conditions of improved accessibility, as observed in Hunza (Karakoram) by Kreutzmann (1991, 1993) and others. Apart from traditionally mobile trading groups, such as the Thakkali in Nepal (Füerer-Haimendorf, 1975), this resulting mobility remains restricted to certain routes in the Himalaya. In general, the use of improved road access seems to be outweighed by the stabilizing effects from additional sources of income from tourism and/or trade.

PERSISTENT FEATURES OF ALTITUDINAL ZONATION IN THE EUROPEAN ALPS

Persistence in change can be demonstrated in the practices of *Almwirtschaft* in the European Alps where the utilization of different belts (*Staffeln*) follows similar principles as those of the Himalaya. *Almwirtschaft* has survived despite thorough modernization and the improved accessibility of permanent settlements. Although these developments began more than a century ago, *Almwirtschaft* survived, not only in remote villages but even in urbanized Bavarian resorts such as Garmisch-Partenkirchen and Mittenwald. In spite of a social structure in Mittenwald where only a few full-time farmers are found in comparison to 80 part-time farmers (commuters, craftsmen, and clerks) alpine livestock-keeping makes use of high pastures (*Alm*) and distant hay-meadows (*Mäher*) with numerous huts and barns (*Stadel*). Ancient access rights to pastures and timber exploitation (*Servituts-Alm*) pose problems of grazing within forests (*Waldweide*). Presently, Mittenwald's herds consist of 280 cattle and 400–500 sheep belonging to a cooperative society of about 90 members. In the Karwendel Mountains (southeast of Mittenwald) they migrate between three belts (*Heimweide*—lower *Alm*—High *Alm*). Similarly, the communities of Garmisch and Partenkirchen each graze still larger flocks in the Wetterstein Mountains during summer. It should be mentioned that due to a more favorable geology, the well-established system of high pasturing in the Allgäu supports approximately 47% of Bavaria's *Almwirtschaft*, in contrast to the very rugged limestone relief of the Garmisch-Mittenwald district. There, the surviving 39 high pastures (*Alm*) contribute only 3.1% of the total, while in the Berchtesgaden district 4.3% of Bavaria's high pastures are found on the high limestone plateaus where access is restricted by steep and rocky terrain. In neighboring Tyrolia, many more high pastures are still in use. A recent survey (Padele, 1994) reveals that the number of *Almen* rose from 1,964 to 2,609 in the period between 1974 and 1986 while the number of abandonments was negligible (78 and 61 respectively).

These remarks do not deny the fact of change. While dairy farming tends to be concentrated in the valleys the high pastures continue to be utilized by young cattle (*Galtvieh*). A most significant factor has become accessibility! There has been an obvious preference, accessibility has enhanced the persistence of practices at those high pastures (*Almen*) where now access is facilitated by roads or tractor trails. In most cases, cattle are no longer driven into the mountains, but they are most conveniently trans-

ported by truck. Nevertheless, there are exceptions here as well: in the Berchtesgaden Alps, steep rock walls have prevented the construction of roads; seasonally the cattle are driven up on small, exposed paths and in some cases are transported by boat across the Königssee on their way back to the homesteads.

Thus, accessibility did not lead to a decrease, but—to the contrary—to a more modern and efficient use of *Almen*. It is not only the remote “traditional, limited access, subsistence-orientated village practicing *Almwirtschaft*”—as indicated in Allan's (1986) model as “variant 1”—but also all the other modernized and accessible sites (variants 2–4) that also participate in *Almwirtschaft*, including the transport and market centers in the larger valleys.

Tourism, which is enhanced by accessibility, does not normally destroy the older structures but frequently supports their preservation through additional incomes from these activities. In general, the existence of the traditional *Almwirtschaft* contributes to the attractions for tourists (Ruppert, 1965; Grötzbach, 1982). However, it cannot be denied that in certain regions, or within existing settlements developments have occurred such as holiday apartments, second homes, and hotels built with external capital and with proprietors from outside. In some cases the traditional *Alm* landscape is heavily disturbed and transformed by these developments represented most significantly by modern ski resorts in the French Alps or in the Swiss Wallis/Valais (P. Messerli, 1989). But in other cases, agricultural use and modern touristic installations coexist. Roads, cable-car services, and such infrastructure support the needs of both tourists and local people.

There is also considerable regional differentiation. The eastern parts of the Austrian alpine region are predominantly occupied by former forest farmers (*Waldbauern*) who usually command only small holdings and have a long tradition of generating additional incomes from off-farm work, such as jobs in small iron-ore processing industries (the Eisenwurzen region of Lower Austria and Styria). Further impact on the regional structure relates to the buying-out of *Alm* areas from smallholders by parties interested in forestry and hunting (Lichtenberger, 1965). Nevertheless, a continued practice of *Almwirtschaft* can be observed in the higher Alps of Tyrolia, Salzburg, and the Tauern despite—or rather thanks to—modern accessibility. Permanent outmigration from the mountain villages (*Bergflucht*) was replaced in many cases by the phe-

nomenon of the abandonment of agriculture as the sole occupation (*Agrarflucht*) but the maintenance of residences. The people here derived their incomes from a number of sources, such as part-time farming, tourism, newly introduced industries, and commuting to work into the main valleys or cities such as Innsbruck. The traditional setting of the mountain habitat has been expanded and modernized significantly and many mountain villages are growing rather than becoming deserted (Lichtenberger, 1979).

The southern French Alps and the lower parts of the Italian pre-Alps have been more strongly affected by negative change and outmigration. Whereas the southernmost parts have been heavily impacted by depopulation, others have not. Bonneval in the Haute Maurienne has become known for the revitalization of its traditional stone-built farm houses, now offering comfortable accommodation for tourists, whereas the former arable land has been converted into grass land. In the Tarantaise in the Isère Valley, densely populated settlements on the valley floor and some older habitations on the slopes above also continue to flourish. Many commuters travel from here to industrial plants down the valley or have found jobs in the modern ski resorts such as La Plagne and Meribel. These activities supplement the somewhat reduced mountain agriculture and the utilization of high pastures (*Alpages*). Other regions which are again those of the higher mountains and which possess a more strongly surviving *Almwirtschaft* and a flourishing tourism trade are those of Southern Tyrol (Italy) and the Northern Trentino, especially the Dolomites with their ethnic Ladinian (Raeto-Roman), Italian, and German populations.

A further important aspect to be considered are the subsidies directed by governments towards their respective mountain regions. In order to sustain a viable community of mountain farmers agricultural subsidies are provided by the European Union, and the Swiss and

Austrian governments through support programs (*Bergbauern-Hilfsprogramme*). A premium is paid to those households that continue the practice of *Almwirtschaft* or of regularly mowing hay-meadows (*Wiesmahd*). These external subsidies guarantee the survival of traditional practices even in the distant meadows (more than 10 km from the homestead), and those on steep slopes or on hummocky terrain (*Buckelwiesen*) where scythes or special mowing devices have to be used. These programs, which are bound to accessibility but are safeguarding a certain persistence of local practices, are aimed at preserving the rural economy and the alpine cultural landscape as well as protecting habitations and preventing damage by soil erosion, mud-flows, and other processes.

To sum up: improved accessibility—by modern traffic infrastructure—definitely changes and considerably modernizes high mountain habitats. In most cases, however, this does not lead to a complete loss of the former agricultural practices—including the utilization of altitudinally defined belts by systems such as *Almwirtschaft*, and the adaptation of human activities to the natural mountain environment. Accessibility models therefore cannot replace, but should supplement the altitude zonation models. Both, taken together, will serve to a full understanding of the mountain cultural landscape. However, a considerable degree of persistence—frequently in more rational form and function—will survive. Under adequate modernization, present-day high-altitude agriculture is more viable and economically rewarding, as it frees itself from the necessity of having to provide self-sufficiency even under the often extreme and harsh conditions of earlier times. In effect, changes have been occurring in the high mountain areas for centuries; the current, often beneficial adaptation to improved communication is best viewed as the most recent stage of a long-term continuum.

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KEYS 1–4 FOR THE ENCLOSED DIAGRAMS (ABB. 1–4)

KEY 1

1	Abb. 1: Landschaftsprofil Kaschmir-Himalaya	Figure 1: Landscape Profile Kashmir-Himalaya
	<i>Natürliche Vegetationsstufen</i>	<i>Natural vegetation types</i>
1	Subtropische Dornbuschsteppe	subtropical thorn-steppe
2	Subtropischer immergrüner Hartlaubwald	subtropical evergreen sclerophyllous forest
3	Subtropischer Kiefernwald	subtropical forest of <i>Pinus roxburghii</i>
4	Temperierter Eichen-Koniferen-Mischwald	temperate mixed oak-coniferous forest
5	Temperierter Koniferenwald	temperate coniferous forest
6	“Kaschmir-Busch”	“Kashmir-scrub” (according to Troll and Schweinfurth)
7	Subalpiner Birkenwald	subalpine birch-forest
8	Alpine Matten	moist alpine meadows
9	Fels und Felsschutt	rock and rock detritus
10	Gletscher	glaciers
11	Alpine Steppe	alpine steppe
	<i>Wasserführung</i>	<i>Hydrography</i>
12	Schotter-Trockenbetten mit Stoßhochwassern	nala = riverbeds with large, mainly dry gravel-beds, but affected by sudden strong floods
13	Periodische Wasserführung während des Monsuns	periodical flow during monsoon rains only
14	desgl., mit starker Schotterführung	substantial gravel load during periodical flows
15	Seitental mit dauernder Wasserführung (Gletschereinzug)	tributary valley with perennial flow (glacier-fed)
16	Haupttal mit dauernder Wasserführung; (Gletschereinzug) gefällsreich	perennial flow in main valley (glacier-fed) and high gradient
17	Haupttal mit dauernder Wasserführung; (Gletschereinzug) mäandrierend, rückgestaut	perennial flow in main valley, meanders, low run-off; partly naturally dammed

Key 1 (Continued)

<i>Siedlungen</i>	<i>Settlements</i>
18 Alte Dorfsiedlungen	old, nucleated villages
19 Junge Dorfsiedlungen	younger villages in recently cleared areas
20 Ältere Einzelhof- und Weilersiedlungen	older single farmsteads and hamlets
21 Junge Einzelhof- und Weilersiedlungen	younger single farmsteads and hamlets
22 Sommersiedlungen	temporary settlements (in summers)
<i>Wanderungen der Nomaden und Hirten</i>	<i>Migrations of nomads and shepherds</i>
23 Voll- und Halbnomaden mit Büffeln	nomads and semi-nomads with buffalo herds
24 Vollnomaden mit Ziegen und Schafen	nomads and semi-nomads with goats and sheep
25 Lokale Hirten mit Schafen und Rindern	local shepherds with sheep and cattle
26 Bäuerliche Transhumance zur Trockenzeit	dry season transhumance of peasants to higher shielings
27 Bäuerliche Almwanderung	seasonal migration of hill farmers to high pastures
<i>Landnutzungsband</i>	<i>Land Utilization</i>
a "Seebauern" von Kaschmir, starker Gartenbau	market-oriented gardening of the Kashmir "Lake-farmers"
b Bewässerungsfeldbau, ganzjährig (Sommer: Reis, Winter: Mais, Weizen, Futterpflanzen)	irrigated cultivation; double-cropping: rice (summer); maize, wheat, fodder (winter)
c Bewässerungsfeldbau, nur im Sommer (Reis)	irrigated cultivation; single main crop of rice (summer)
d Bewässerungsfeldbau, nur im Sommer (Gerste, Weizen, Buchweizen)	irrigated cultivation; single-cropping: barley, wheat and buckwheat (summer)
e Trockenfeldbau, ganzjährig (Sommer: Mais, Hirse; in den Siwaliks z. T. Bergreis; Winter: Weizen, Gerste, Ölsaaten)	rainfed cultivation; double-cropping: maize, millets (summer); wheat, barley, oil-seeds (winter)
f Trockenfeldbau, ganzjährig, mit starkem Brachanteil (Mais, Hirse)	rainfed cultivation; maize, millets, long fallow periods in between
g Sommer-Trockenfeldbau (Mais, Hirse)	rainfed cultivation; single-cropping: maize, millets
h Trockenfeldbau auf Hangterrassen (Mais, Hirse, Buchweizen; nur z. T. im Winter Weizen, Gerste usw.)	rainfed cultivation on terraces; double-cropping: maize, millets, buckwheat (summer); wheat, barley (winter)
i Sommer-Trockenfeldbau mit starkem Brachanteil (Gerste, Buchweizen, Hirse, Amaranth; Kartoffeln, im Frühjahr z. T. berieselt)	rainfed cultivation (summers only; long fallow periods): barley, buckwheat, millets, amaranthus, potatoes
k Weidewirtschaft	natural grazing on high pastures
l Forstliche und bäuerliche Waldnutzung	forest pasture and timber exploitation for fuel and construction purposes
m Dornbuschwälder, Winterweide, forstlich geringwertig	thorn-scrubs, winter pasture, less valuable woods
n Extensive Trockenweide der Alpen Steppe	meagre natural pasture in arid alpine steppe
o Ungenutztes Hochgebirge	unutilized high mountain areas

KEY 2

<i>Natürliche Vegetationsstufen</i>	<i>Natural vegetation types</i>
2 Abb. 2: Landschaftsprofil Jaunsar-Bawar (Himalaya)	Figure 2: Landscape Profile Jaunsar-Bawar (Himalaya)
1 Tropischer Monsunwald (Fall-Laubbwald)	tropical deciduous (monsoon) forest
2 Tropischer Monsunwald mit Einsprengung von Trockenvegetation	tropical deciduous (monsoon) forest with spots of vegetation adapted to arid conditions
3 Subtropischer Kiefernwald	subtropical forest of <i>Pinus roxburghii</i>
4 Temperierter Eichen-Koniferen-Mischwald bzw. reiner Koniferenwald	temperate mixed oak-coniferous or pure coniferous forest
<i>Hydrographie</i>	<i>Hydrography</i>
5 Durchschnittliche Untergrenze der Winterschneegrenze	average lower limit of winter snow cover
6 Ständig wasserreicher Hauptfluß (Gletschereinzug)	perennially flowing main river (glacier-fed)
7 Nebenfluß, wasserreich nach Schneeschmelze und im Monsun (Stockhochwässer)	tributary river, seasonal high flow conditions after snow melt and during monsoon rains

Key 2 (*Continued*)

<i>Siedlungen</i>	<i>Settlements</i>
8 Dauersiedlung	permanently inhabited, nucleated villages
9 Temporäre Filialsiedlung zum Trockenfeldbau	temporarily used filial settlement during work in rainfed cultivated fields
10 "Heiße Hütten" (temporäre Siedlung für Reisbau und Winterweide)	"Hot Huts" (temporarily used settlement for paddy cultivation during monsoon; additional winter pasture)
11 Temporäre Hochsiedlung zum Kartoffelanbau ("Hohe Hütten")	temporarily used settlements for potato cultivation at high altitudes ("High Huts")
12 Lagerplätze der bäuerlichen Schafhirten	shepherds' campground (property of individual households)
13 Bezeichnung der jeweiligen Hauptdörfer und der zugehörigen temporären Siedlungen	each letter indicates one permanent settlement and its affiliated temporary settlements
14 Dauersiedlung am Gebirgsfuß ohne temporäre Höhsiedlungen)	permanent villages of the lowland (Dehra Dun Valley) without relation to seasonal or temporary hill settlements
<i>Landnutzungsband</i>	<i>Land Utilization</i>
a Bewässerungsfeldbau, ganzjährig	irrigated cultivation; perennial crop cultivation
b Bewässerungsfeldbau im Sommer, Weide im Winter	irrigated cultivation; rice (summer); stubble pasture in winter
c Trockenfeldbau, ganzjährig, mit langen Brachen	rainfed cultivation throughout the year; long fallows
d Trockenfeldbau, ganzjährig (Sommer: Mais, Hirse, Amaranth, Hülsenfrüchte, Gewürze; Winter: Weizen, Gerste, Ölsaaten)	rainfed cultivation; double-cropping: maize, millets, amaranth, pulses, spices (summer); wheat, barley, oil-seeds, poppy etc. (winter)
e Kartoffeln (Sommer)	potatoes (summer)
f Weide	natural grazing
g Wald mit forstlicher Nutzung und Waldweide, Almrodungen	forest exploited by peasants, some clearings for shielings
h wie "g," mit Winterweide von Nomaden	same as above; winter pasture for nomads' herds

KEY 3

<i>Abb. 3: Lebens- und Nutzungsräume der Bauern und Wanderhirtentypen in Kaschmir</i>	<i>Figure 3: Diagram of settlement and land-use types of farmers and herdsmen in Kashmir</i>
1 Haufendorf (Altsiedlung)	nucleated village (old-settled area)
2 Kleines Haufendorf, Weiler (Jungsiedlung)	small nucleated village, hamlet (young settled area)
3 Wintersiedlung landloser Hirten (Weiler oder eigener Dorfteil)	permanent winter huts of landless Kashmiri herdsmen
4 Einzelhöfe (Jungsiedlung)	single farmsteads (young settlement)
5 Almhütten mit Milchwirtschaft	summer shielings (with dairy farming)
6 Almhütten	summer shielings (without dairy farming)
7 Zeltlager auf den Hochweiden	nomadic camp site (tents) on high summer pastures
8 Almwanderung	seasonal migration to peasant's shieling
9 Almwanderung mit Fremdvieh	transhumance with cattle of other farmers (Chopan taking the cattle and sheep of rice farmers to the high pastures)
10 Nomadenwanderung	migration of nomads
11 Ehemalige Nomadenwanderung bzw. nur noch Reste	former migration routes of nomads and/or relics of it
12 z. T. winterliche Wanderarbeit	outmigration for seasonal wage earning (winter)
a Reisbau (Naßfeld, nur im Sommer)	irrigated rice fields (summer)
b Künstlich bewässerter Anbau nordischer Getreide (nur im Sommer; Weizen, tibet. Gerste, Buchweizen)	irrigated cultivation of cereals: wheat, Tibetan barley, buckwheat (summer)

Key 3 (Continued)

c	Ganzjähriger Trockenfeldbau (im Sommer: Mais - Hirse, im Winter: Weizen - Gerste; lange Brachen)	rainfed cultivation throughout the year: maize, millets (summer); wheat, barley and/or fallow (winter)
d	Trockenfeldbau (nur im Sommer): Gerste, Weizen, Buchweizen, Kartoffeln (Kartoffeln z. T. im Frühling berieselt)	rainfed cultivation: barley, wheat, buckwheat, potatoes (summer). In exceptional cases irrigated potato plots in spring.
e	Trockenfeldbau (nur im Sommer): Mais, Hirse	rainfed cultivation: maize, millets (summer)
f	Obst-, Mandel-, Maulbeerpflanzung; Walnüsse	orchards: mulberry, walnuts
g	Waldweide, Wildheu; Schneiteln, Holznutzung	forest pasture, hay cutting in the forests, lopping, timber, fire- and torch wood etc.
h	Heuwiese	meadow for hay cutting
i	Heuwiese mit Bewässer	unirrigated meadow for hay cutting
j	Extensive Weide, Wildkheu	natural pasture, occasional hay collection
k	Obst- und Gemüseanbau auf künstlichem Land	market-oriented gardening on artificially created land parcels: fruit and vegetables
l	Schwimmende Beete	floating gardens
m	Seenutzung	utilization of lake resources: fishing, lake weeds, reed, water nuts, lotus, etc.

KEY 4

4	Abb. 4: Siedlungs- und Wirtschaftsstaffeln in Jaunsar-Bawar (Himalaya)	Figure 4: Diagram of the settlement and land-use stages of Jaunsar-Bawar
1	Hauptdorf der Bergbauern	permanent nucleated settlement, main village of Jaunsari peasants
2	Abseitiger Dorfteil der niederen Kasten	separate quarters of low-caste villagers, huts
3	Temporäre Siedlung	temporarily used settlement
4	Almhütten der Gujars mit Milchwirtschaft	shieling of Gujar nomads (dairy farming with buffaloes)
5	Saisonwanderung der bäuerlichen Schaf- und Ziegenherden	seasonal migration of Jaunsari peasants' flocks (sheep and goat); shepherds are household members
6	Nomadenwanderung	migration of Gujar nomads
a	Ganzjähriger Trockenfeldbau (Monsunfrucht: Mais, Hirse usw.; Winterfrucht: Weizen, gerste usw.)	rainfed cultivation throughout the year: maize, millets etc. (<i>kharif</i>); wheat, barley, etc. (<i>rabi</i>)
b	Reisbau (künstlich bewässert; nur im Sommer)	irrigated rice cultivation (during monsoon season)
c	Kartoffelbau (nur im Sommer)	potato cultivation (summers only)
d	Früherer Wanderhackbau	former shifting cultivation
e	Extensive Weid	extensive pasture
f	Waldweide, Wildheu; Schneiteln, Holznutzung	forest pasture, exploitation of forests for hay cutting, lopping, timber, fire- and torchwood etc.
g	Extensive Weide im zerstörten subtropischen Kiefernwald	degraded natural pasture in area of former <i>Pinus roxburghii</i> forest