the agencies responsible to carry out the different activities vary resource wise, apart from the fact that several alternative strategies for a particular developmental activity are possible. The question of organizational conflicts and local aspirations can be solved to an extent by formulating integrated watershed management plans involving the local population and the developmental agencies. And this has been demonstrated successfully by various NGO's and governmental institutions in past. However, the answer to evaluation of other possible alternatives can not be ascertained due to lack of a comprehensive evaluation tool. For evaluation of proposed watershed management plan, at present, traditional cost-benefit analysis of tangible benefits are made or occasionally studies on hydrologic response are made, thereby leaving a big question mark on intangible benefits and most importantly on hydrologic evaluation of various possible alternatives.

In view of above facts, it seems more appropriate to have a base where various alternatives could be evaluated before actual execution in the filed. For such evaluation, it is required to have a model which is not only derived from hydrological, physical and biological sciences but from social sciences as well. Because, it is true that models are necessary for understanding the phenomenon, in engineering, the interest in models is to develop tool for optimum planning of a system. Since there can be infinite number of combinations of input and output variables, some criterion is required to select the best model. The most accepted criterion states that the inputs be selected to maximize the welfare of those affected by the system and hence the model should also be capable of addressing the social sciences of economics. GBPIHED have stared to work out the details of the strategy. Initially it is planned to organise a Workshop involving academicians, planners, administrators, and NGO's.

Dr Devendra K Agrawal

Adaptation, survival and entrepreneurship in a stressed environment

The Himalayan high altitude present a complex blend of fragility of natural ecosystems, and diversity of ecological regimes. The capacity of Himalayan highlanders to adjust to their natural surroundings and coping with the challenges is unbounded and unique. This fundamental way of life has woven itself into numerous cultural tapestries, each in consonance with the specific ecological niche that it occupies. The possibilities of economic activity and the ability of these people to handle the constraints and harness the potential of its resource base, in a sustainable manner, is the crux of human adaptation and survival in the high altitude society. The Bhotiyas of Tsokha village in Khangchendzonga National Park region in west Sikkim are a good example of human adaptation to harness the potential of tourist resource base. The entire village migrates to the "second" higher altitude village, and there they provide services to the trekker and tourists for economic gains (Fig. 7 A).

Transhumance pastoralism is the most common and popular adaptive method in the high altitudes to utilize the seasonal pastures located in two or different areas. This system of livestock production makes use of the land resources where other agricultural activities are limited by the climatic, soil, water and other environmental conditions. Transhumance pastoralism is practiced by the Monpas in the high altitudes of Tawang in Arunachal Pradesh, Bhotiyas and Lepchas in North and West districts of Sikkim, Bhotiya Shaukas, Merchas and Jads in Pithoragarh, Chamoli and Uttarkashi districts of Uttarakhand.

But, quite different to these are the Bhotiyas of Tsokha village on the Yuksam-Dzongri-Goechha La Trail, in Khangchendzonga National Park region. These people have harnessed the potential of

relatively recent development related to tourism sector in that region. Most of the trekker arrive during March to June to see some of the most biologically diverse floral and faunal bounty of the Himalaya, which contain over 36 species of Rhododendrons, 400 species of Orchids and many other flowering plants.

Tsokha village is the summer high altitude settlement of these Bhotiyas, where they stay from April to October, and move down to Sachen in the lower altitude during winter when Tsokha gets completely covered under snow. During summer these people engage themselves in vegetable cultivation, and grow cabbage, cauliflower, greenpeas, radish, turnip, carrot and potato (Fig. 7 B). There is great demand of vegetables from the tourists and large groups of Himalayan Mountaineering Institute, and hence they earn good revenue from these vegetables; the cash thus generated helps them to purchase food grains for domestic consumption.

The livestock in Tsokha consists of Dzo (sterile offspring of Yak and cow), Dee (female offspring of yak and cow) goats, horse, and dog. Dzo and horse are used as pack animals, whereas Dee is used for milk. Sale of milk and milk products is yet another good source of revenue, and is considered very important in their society. During summer the pack animals are engaged in transpiration, and the earnings per animal amount Rs. 110 to 125 day (Fig. 7 C). The average livestock holding in Tsokha consists of 4 to 5 Dzos and 3 to 4 Dee and cow, these animals are left to open grazing in the forest areas surrounding Sachen from December to mid March, during the lean period.

Trekking in west Sikkim started some 45 years ago and became a very important economic activity for the rural hill tribes of the region (Fig. 8 A & B). The people of Tsokha village had fled from Yatung, a business centre in the southern part of Tibet. The then Chogyal Thutob Namgyal allotted them Tsokha village and permitted them to utilize forest resources like fuelwood and timber for domestic consumption within an area of 30 acres from their village; in return these people had to look after the Yak herds of Chogyal Thutob Namgyal. In fact the name of this village was also given by these people, it was named after an existing small pond; hence the place was called Tsokha (Tso-water, Kha-mouth/source).

Availability of trekker and tourists at a

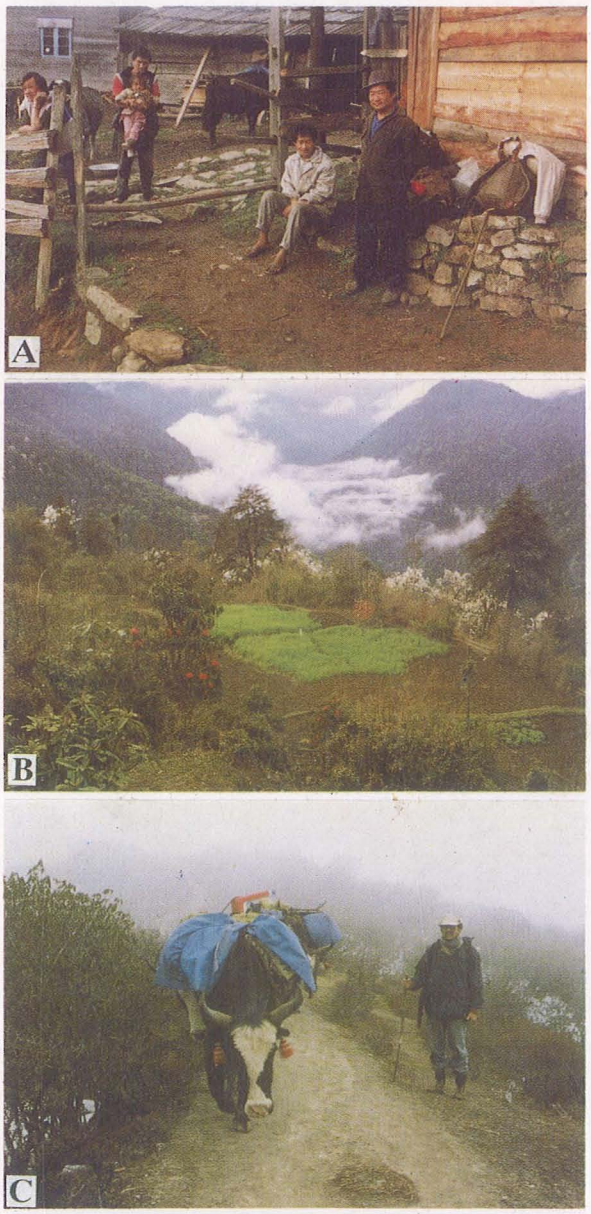

Fig. 7. Features of Tshoka village: (A) services to trekkers and tourist, (B) cultivation during summer, (C) pack animals

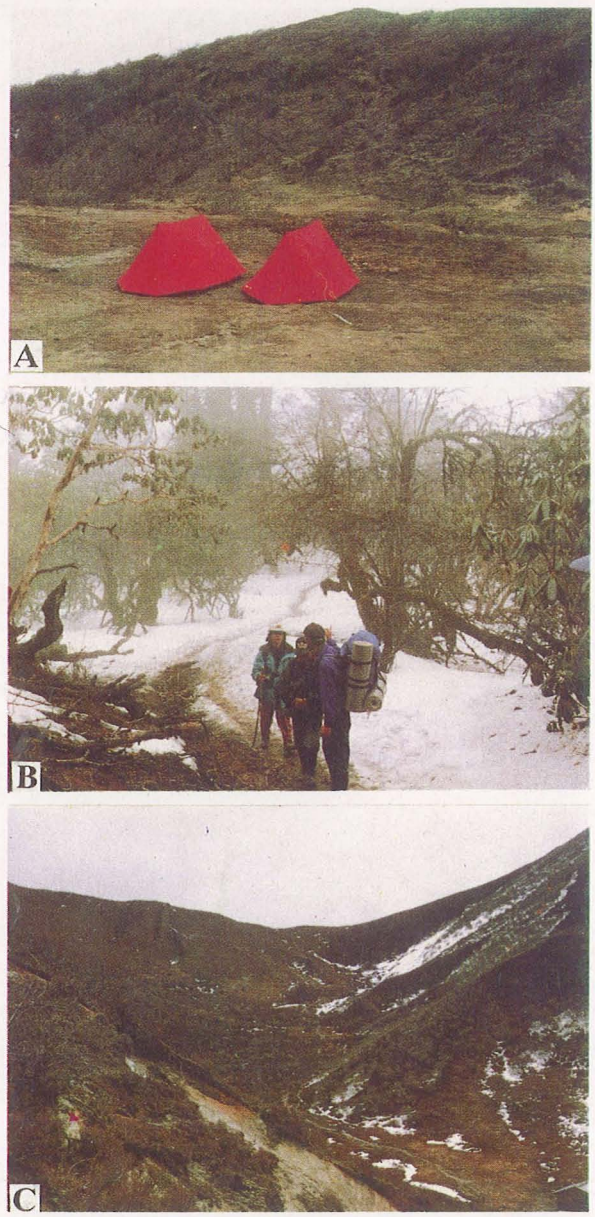

Fig. 8. Harnessing the resources: (A & B) Tourism; (C) Wilderness

particular period of time in the high altitude was regarded as a resource base by these people, and accordingly they adapted themselves to utilize such a resource base. The villagers of Sachen migrate to their high altitude Tsokha village well in advance, in order to prepare themselves to cater to the requirements of trekker and tourists (Fig. 8 C). This highlights the entrepreneurship of Tsokha Bhotiyas. The economic activities have been well handled to the best of their ability to harness the full potential of existing resource base, and is the crux of human adaptation and survival.

Nehal A. Farooquee, R. C. Sundriyal and E. Sharma

Application of remotely sensed data in biodiversity studies: a promising hope for unexplored Himalaya

Advance Remote Sensing techniques (visual and digital image processing) alongwith the support of Geographic Information System (GIS) has opened a new era in resource management. Until recently aerial photography, carried out on a very small range i.e. 1 to 2 km. was considered to be the best remotely sensed data for resource management. No doubt, aerial photography provides large scale coverage for inaccessible terrains with 3-D viewing facility. However, it is expensive and carries with it the problem of cloudless coverage, relief displacement and scale variations which has rendered it to be the second choice. The first one being the optical (satellite) and microwave (RADAR) remote sensing technique with various options of band selection i.e. wave length ranges, scales, less expensive and frequent availability for multi-date, multi-temporal and multi-season remote sensing data for various resource mapping applications. Few other remote sensing devices such as thermal remote sensing and spectro-radiometry are also coming up.

The Conservation of Biological Diversity Core has initiated a project on "Biodiversity Study Using Remote Sensing Techniques in Indian Himalayas." funded by ICIMOD, Kathmandu. This was the outcome of a series of discussion of experts from ICIMOD and the Institute. In order to address various issues on Himalayan biodiversity assessment the need for a collaborative project using advance remote sensing technique was felt.