

# **ACTION PLAN FOR HIMALAYA**



**G.B. Pant Institute of Himalayan Environment & Development**

(An Autonomous Institute of Ministry of Environment & Forests, Government of India)

Kosi, Almora 263643

INDIA



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# **Action Plan For Himalaya**

G.B. Pant Institute of Himalayan  
Environment and Development

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**Minister  
Environment & Forests  
Government of India**

## **FOREWORD**

The Himalaya is vast, gigantic, diverse and youngest mountain system in the world. It is the glory of India on several planes, spiritual and philosophical as well as materialistic, economic and ecological.

It occupies 18% of the geographical area of our country, and regulates climate of the entire Indian sub-continent. There are several valuable plant and animal species, minerals and human societies exclusive to the region, with rare or no alternate options elsewhere. The Himalaya feeds the major river systems of the Indian sub-continent. The difficult terrain and inhospitable climatic extremes coupled with many other factors, seem to impede the pace of development of the region. While there are several pockets subjected to severe environmental degradation, many resource rich pockets still exist.

The Himalaya, on account of its vastness and distinct entity, biological, social and ethical diversity and problems of the region having far reaching local, regional and even global consequences, deserves priority for action - action planned in ways radically different from those being adopted elsewhere.

The magnitude of problems directly or indirectly related to environmental and developmental issues vary from place to place. Much is known about the origin and consequences of these problems but what remains to be done is to find out workable solutions to them.



All are concerned as to how to overcome the undesirable trends of deterioration of environmental quality and unsustainable development, yet preservation of environmental quality and long-term sustainability in development remain to be achieved. In order to negate the possibility of further aggravation, the emphasis should necessarily be shifted from mere 'concern' or 'thinking' to the 'concrete and quick actions' for environmentally sound and economically viable development. Often emphasis is laid more on theoretical aspects of the course of action rather than the much needed specific actions.

It was to fill-in this gap that the G.B. Pant Institute of Himalayan Environment and Development decided to prepare a comprehensive document, "Action Plan for Himalaya", to strengthen the mechanism of ecologically sound economic development of the Himalaya.

We are appreciative of the efforts put in by the Director of the Institute and his team in accomplishing this task within record time. This document, I am sure, will give an integrated flavour to the sectoral development actions to be carried out by various organizations.

In my capacity as President of the Society, as well as the Minister for Environment & Forests, I take pleasure in presenting this Action Plan to the general public for their information. We would be happy to receive suggestions on the subject, which can be followed up by the Institute in its research and extensive effort of working in this magnificent terrain of ours.



(KAMAL NATH)



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## PREFACE

G.B. Pant Society of Himalayan Environment and Development, presided over by Honourable Minister of Environment & Forests, Government of India, Shri Kamal Nath, at its first meeting in March, 1992 assigned the task of preparing an "Action Plan for Himalaya" to this Institute. This document is the outcome of this decision.

Usually seminars and symposia are organised to gather ideas for preparation of such documents. Departing from the beaten path, the scientists of the Institute preferred to follow a different route. Letters were sent to eminent and knowledgeable persons in the country working in or thinking about the Indian Himalaya, seeking their views on the actions needed for an environmentally sound development of the region. Simultaneously, scientists of the Institute conducted a rapid survey of the rural areas in each of the states in the region so as to know about the perceptions of and priorities for development among different sections of the society. In addition, Institute's earlier publication "Himalayan Environment and Development - Problems and Perspectives" was a great help in preparing this document.

It is rightly stated in Shantiparva of Mahabharata (190.9) that इह खल्वमुष्मिंश्च लोके वस्तुप्रवृत्तयः सुखार्थमभिधीयन्ते। *i.e.*, "In this world or elsewhere, all attitudes to obtain the things are aimed at happiness". Therefore, the Action Plan has to be to improve the ways and means to obtain the happiness, which vary with time and space. To obtain happiness, demand for the roads is the top priority in remote and non-accessible areas. Scarcity of food is the most common in areas of limited agricultural land. Priorities include income generating sectors like tourism in the list of elites, issues relating to conservation in the list of scholars, and industries in the list of unemployed youths. In such a scenario, to prepare the Action Plan in accordance with the priorities was found to be an uphill task. However, water and soil conservation followed by forests and energy have been identified as the priority sectors for achieving sustainable development of the region.



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The document only enumerates the sector wise priority actions covering research and developmental activities as well as management aspects required for increasing the pace of environmentally sound development in the region. The methodology and financial outlays to execute the actions will vary from sector to sector as well as from one region to another but these aspects have not been included in the document.

It is relevant to add that during our surveys it was felt that a general perception has grown among the public that development and environmental management are the responsibilities solely of the Government and of its personnel. The fruitful outcome of any Action Plan depends on the worldly morality of all; Government is only an instrument for management of the activities, which should work as 'catalyst' and not as 'fuel'.

The document owes a lot to all my colleagues at the Institute specially, Drs. R. Swarup, K.G. Saxena and K.S. Rao. Special appreciation is extended to Miss Sarita Aswal and Miss Hema Pant for their tireless and devoted efforts in typing the manuscript. The help of Mr. R.C. Prasad and Mr. C.B.S. Mehra in preparing the graphics and data compilation is duly acknowledged.

Kosi  
December 15, 1992

**A.N. Purohit**  
*Director*



## 1. HIMALAYA - A PRIORITY AREA



Ecological Diversity

Himalaya constitutes a unique geographical and geological entity comprising a diverse social, cultural and environmental set up. On account of its being the youngest mountain chain on the planet, the region is believed to be still evolving and thereby not having stabilised from geomorphological and geological considerations.

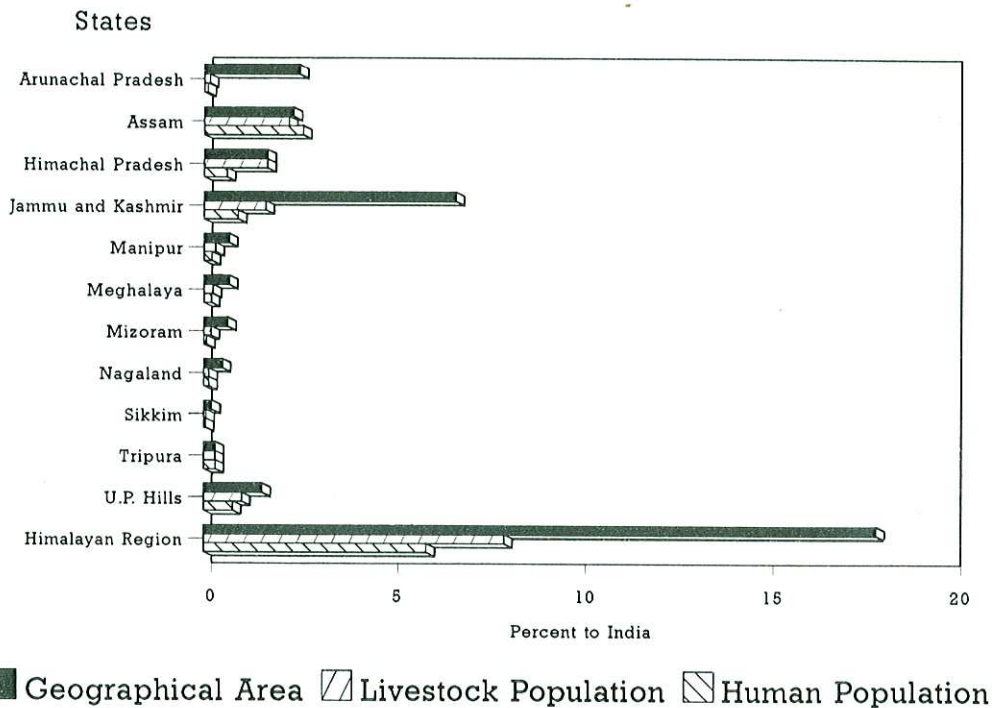
Geological instability interacting with a complex of problems including population pressure, deforestation, landslides, erosion, water scarcity, out migration and poverty manifest fragility to the Himalayan ecosystem. Despite all these problems apparent as degradation of Himalayan environment and poor level of living of its people, the region encompasses several 'resource rich spots'. Alterations in environment and patterns of development in the Himalaya in future are considered crucial not only for the indigenous people but also to those elsewhere. Himalaya influences even the climatic changes in the continent. Himalaya controls monsoonic climate and ensures adequate water flow in major rivers in a part of South Asia. Agriculture potential of Indo-Gangetic plains, the bread-basket of India, depends very much on the Himalayan environment which regulates the water supply to the plains.

More than 2,800 kms in length and 220 to 300 kms wide, the Indian Himalayan region is spread over the states of Jammu & Kashmir, Himachal Pradesh, Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya and a part of Assam, alongwith eight districts of Uttar Pradesh and one district of West Bengal. It has a total geographical area of approximately 591 thousand sq.km (18% of India) inhabited by 51 million persons (6% of India). The region is characterised by sparse population, undulating terrain, farflung small villages difficult to approach, tiny and scattered land holdings more so on slopes with shallow and gravely soil, agro-pastoral economy, scanty irrigation, little use of modern technology and inputs, low productivity, etc., etc. These coupled with almost no industrial development and



thereby low employment potential, stimulate the local youngmen to seek employment away from their homes. The problem of youth moving away gets aggravated in the areas where an inhospitable climate outweighs the sentimental attachment of people with the native land. Agriculture is the primary occupation of the people all through the region but the agricultural land use patterns vary from region to region. While in the north-eastern region, shifting cultivation continues to be the general practice on slopes, settled agriculture on terraced slopes dominates in the central and north-western region. All through the region valleys are characterized by settled agriculture and intensive cropping.

### BROAD FEATURES OF HIMALAYAN STATES



The natural resources of any country or region, and so of the Himalaya too, can be grouped under two broad categories:

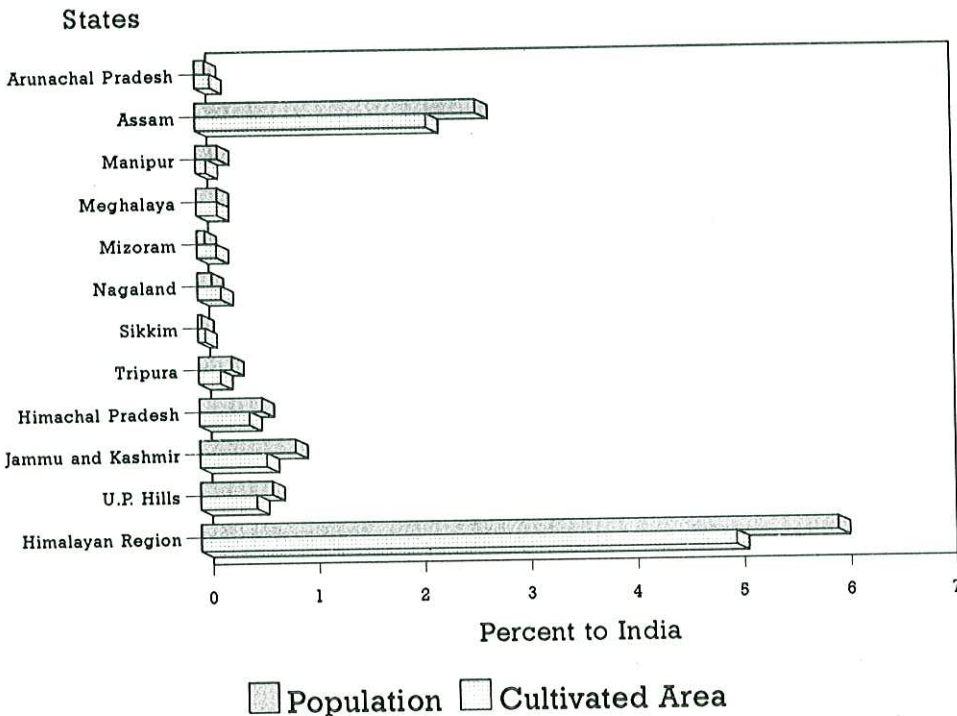
- I. Geophysical:
  - Land
  - Water
  - Climate

II. Biological:

- People
- Livestock
- Flora and Fauna

Amongst these, people are the most important one, as apart from they constituting 'human resource', their actions set the values and use of other resources. Also, it is the welfare of human beings which constitutes the goal of development planning - whatever be the scale - regional or global. The density of population is highest in Assam (284) closely followed by Tripura (262) while Arunachal Pradesh (10) stands at the other extreme in this matter. However, very high population density in Assam is probably due to inclusion of floodplain of Brahmaputra and in case of Tripura because of exceedingly large influx of population from East Pakistan (now Bangladesh). Himachal Pradesh (8.7 % of population in urban centres) followed by Sikkim (9.1 % of population in urban centres) are the least urbanised while Mizoram is reported to be the most (46.2 % of population in urban centres). In the matter of sex ratio, barring the rural areas of hill districts of Uttar

**POPULATION AND CULTIVATED AREA**

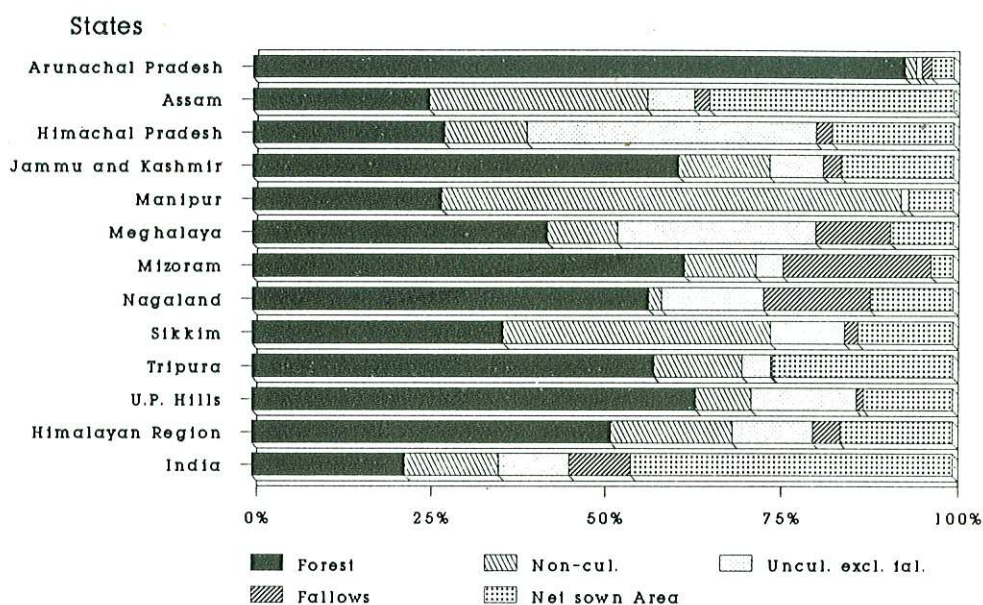




Pradesh and Himachal Pradesh, males out-number females, the difference in the sex-wise relative position is narrower among urban populace. Like elsewhere in the country, the proportion of literates is more in urban areas than in the rural. Literacy is more in eastern states of Himalaya compared to that in the western.

The figures for decadal population growth rates calculated for each of

### PROPORTION OF VARIOUS LAND USES



Percent of total reported area 1988-89  
(Dir. E&S, Min. of Agri., G.O.I.)

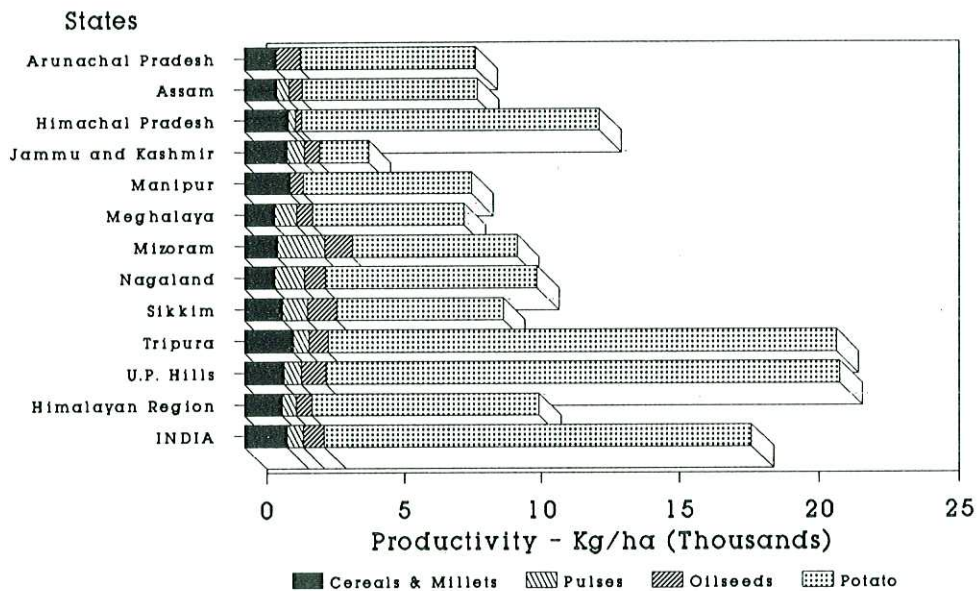
the Himalayan States for the period 1901 to 1991 indicate that the rate of increase has slowed down, though marginally in most of the cases. However, it is still above the national average in all sub-regions excepting Himachal Pradesh and Hill Districts of Uttar Pradesh.

Excepting in Tripura, the proportion of women cultivators is more than that of men. In Tripura, more women are reported to be engaged as agricultural labourers and in other works. This, by and large, supports the general view that in the hills women work more than the menfolk.



The entire Himalayan region accounts for 6.22 per cent of the land holdings covering 4.95 per cent of the area in the country. Thus the average size of holding in Himalaya is smaller than elsewhere and that of the country as a whole. This is so as a large chunk of land is either seized for non-agricultural use, e.g., forest or is not suitable for agriculture, e.g., uncultivable, covered with water or old fallows. All these together pull down the figures of net sown area in all parts of the Himalaya. Despite the poorer irrigational facilities and other modern agricultural technology impacts, the region, except for the states of Mizoram and Tripura, exhibits cropping intensity better than the national average.

### CROP PRODUCTIVITY IN HIMALAYAN STATES



Average of Triennium ending 1990-91  
(Dir. of E&S, Min. of Agri., G.O.I.)

Wheat, maize, ragi, rice, and potato are the most important crops grown all over the region. State averages of yields of these crops are lower than the respective national averages. The region does enjoy monopoly in the production of virus-free potato tubers, temperate fruits particularly apples, and several other high value, cultivated as well as wild, crops which provide scope for designing alternatives or

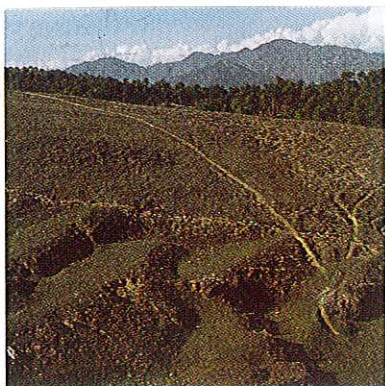


complements to traditional agriculture as an instrument for development in the region.

The causes and consequences underlying the increased deficits in resource demand-supply potential are many and varied. The consequences, social, economic or ecological, apparent at local, regional or global level, are challenges to scientists, planners and administrators. Himalaya, on account of being highly diverse when characterized in terms of physical, biological and socio-economic parameters and far-reaching consequences of the problems in the region, demands a priority for actions for development planning distinct from other regions of the country. The specificities of Himalaya deserve to be made use of and not looked down.



## 2. THE SYNDROME OF PROBLEMS AND FUTURE OUTLOOK



**Land Degradation**

Trends reflecting exploitation of natural resources at rates much higher than those at which these resources get replenished, are presently evident all through the world. The reasons and consequences of these trends are also well known. While dramatic increase in per capita resource demand is identified to be the basic cause of widening the gap between resource exploitation and replenishment

in the affluent regions, population explosion is argued to be the strongest determinant of such trends in the developing and underdeveloped regions. Consequences of these trends appear as deterioration in environmental quality in terms of deforestation, poor biological productivity and utility potential, soil erosion, hydrological imbalances, flood and other natural hazards and socio-economic inequities. With increasing altitude, the "mountain - syndrome" is characterised by: (1) lower rates of abiotic, biotic and cultural exchanges, (2) slower rate of growth, (3) slower aging and late maturity, (4) poorer reproductive efficiency, and (5) higher resistance. Therefore, in such a syndrome the visible impact of environmental problems are less prominent at higher elevations. However, the impact of natural hazards increases with increasing altitude.

In the present day scenario deforestation is considered to be the primary problem paving way for a chain of secondary problems including erosion, land slide and poor crop production. Conflicting views on the causes of deforestation and associated environmental degradation have been expressed. While the governmental agencies invariably argue for excessive extraction and conversion of forests by the rural poor to meet the fuelwood, fodder and food demands, others accuse the forest management policy for giving emphasis to maximizing the revenue returns. *There are indications that population growth (human as well as animal) alone was not responsible for the observed*



extent of deforestation. Forest area and human population data of states in the Himalayan region indicate that though the increasing trend of population growth and decreasing trend of forest area are evident, there seems to be no statistically significant relationship between the two parameters. Nagaland, a state where the rate of population increase is observed to be the highest, shows the lowest extent of deforestation. Manipur, Meghalaya and Tripura exhibit more or less similar rates of population growth but differ considerably with respect to the loss of forest cover during the same period. Data on forest cover and population merely at two points of time are indeed inadequate for drawing any precise trends or relationships. Further, demands on forests by the increasing population may not necessarily get expressed as deforestation in a true sense. While there are deficiencies in the methodology adopted for deducing these statistics, the observations do provide substance indicating that (a) population explosion alone is not responsible for the current scenario of forest degradation, (b) unrealistic picture may emerge if attempts are made to predict the future scenario based upon the available data.

Expansion of pine forest at the expense of broadleaf tree species is the biggest problem in the region which is going to lead to an alarming decrease in recharge of ground water and diminishing discharge of springs. Other consequences are the extensive forest fires leading to warming of micro-environment, loss of vegetational diversity and wildlife.

Agriculture is the primary occupation of the people in India. In the Himalayan region, agricultural systems and resource use patterns which could sustain the mankind under climatic constraints, difficult terrain and poor communication, evolved in the process of advancement of civilization. Although the habit of hunting and food gathering as an exclusive way of sustenance vanished long back, its remnants in various forms are still observed. A number of wildy growing plant species are even presently supplementing the food requirements of some tribes in the Himalaya. Shifting agriculture wherein the resource impoverished as a result of crop domestication, is recovered through the natural process of vegetational succession, continues to be the way of life of majority of tribals in the north-eastern India. Ecosystem stresses induced as a result of repeated crop harvests in terraced agroecosystems in the central Himalaya are still alleviated largely through the organic inputs derived directly or indirectly from the forests. Despite the



apparent differences in the organization of these diverse systems, all have a commonality in that all are dependent upon forest based inputs to sustain crop production. In one situation outputs to man through crop domestication and inputs through forest vegetation are separated in time (*e.g.*, cropping phase alternating with fallow phase in shifting agriculture) while in the other the outputs and inputs are separated in space (settled agriculture on terraces of the sloppy land). The critical separation of input and output sources in space or time needed for the optimal functioning of these systems has been threatened as a result of increasing pressure on land. This in turn has set in the trend of declining agricultural productivity and efficiency of production. Pastoral systems and nomadism representing an elegant example of resource use in favour of the mankind realizing the spatio-temporal variations of climatic constraints does exist. A close association of man, forests and environment observed all across the Himalaya implies a strong perception of ecological principles in the traditional management systems. These systems, however, are getting weak and also diminishing in critical areas. Deforestation appears to be the cause as well as the consequence of this collapse.

Historically, forests had been treated as a common property resource and thereby freely accessible to those inhabiting the region. Restrictions or denial to the rights and concessions pertaining to the forest use by the people through land tenure or ownership regulations are obvious to aggravate pressures on whatever forests are left accessible to the people. This in turn is likely to lead to complete loss of trees *i.e.*, deforestation than what perhaps would have been if the use pressure was diffused in the absence of such controls. Industrial exploitation of forests since the last century till a couple of decades back cannot be denied as a cause of deforestation in the hills.

Poor infrastructure and difficult terrain impede industrial development of the area and thereby low employment potential for the local people. Thus, though the region is rich with a primary production potential, concentration of processing of the primary produce elsewhere debars the Himalayan dwellers in getting a significant share in the accrued benefits. Reduction in productive capacity of the land alongwith many other factors accompanied mass migration, more so of males in many areas. There are instances in Garhwal Himalaya where more than 3/4th of the families migrated out of a village and an equal proportion of cropped land was abandoned during the period 1972-88. It is for the



salaried jobs for which males migrate but ownership of native land is retained. Management of land in such situations becomes the exclusive responsibility of women. Enormous expenditure of energy and time in collecting fuelwood, fodder and drinking water have made the life miserable specifically of the rural women.

Hydrological imbalances currently observed in the Himalaya are considered to be linked to the loss of vegetation cover. Further these two factors under the influence of the geomorphological forces in geologically active belts exacerbate the process of landslides and erosion. These phenomena apart from directly deteriorating the local environment, have significant implications for the adjoining regions too. Devastating floods in the Indo-Gangetic plains are considered to be the consequence of deforestation in the Himalaya. However, it is also perceived that deforestation is inadequate as a generalised cause of floods. Run-off from chir-pine forests is far greater than from broad-leaved forests in good condition. Grass cover in good condition is as effective (if not more so) as broad-leaved forests as a check of run-off, and gives a clear run-off, *i.e.*, less silt. The forests are not in good condition specially because of over-grazing which prevents regeneration. Soil erosion is a natural process and gets accelerated under the influence of man induced disturbances beyond a critical disturbance regime. The disturbances are likely to have additive effects on erosion rates in the hills because of topography and geological processes. The observed consequences are thus the resultant outcome of natural and man-induced erosive forces. *Most of the data on regional extent or intensity of problems like denudation, siltation, hydrological imbalances and floods suffer from the drawbacks including generalized surveys and tremendous extrapolation of site specific observations to large heterogeneous areas. Precision of the regional quantifications is found to be quite low.* Similarly, while decline in agricultural production is realized and also attributed as a consequence of deforestation in many instances, the upper and lower limits of soil fertility in relation to crop yields for a given soil type have yet to be defined. There are serious limitations of using the available data to resolve whether the declining yields are due to decrease in productive land area or due to decline in yield rates or if due to both, their relative contribution. Thus it remains a challenge to the researchers as to what extent a given cause, by itself or in interaction with others, contributes to the degradational process. Pressure on government owned forest land and 'government policy - rural interests' conflicts are likely to aggravate with increase in



population density as long as alternative provisions for the sustenance and developmental needs of the people are not provided.

The entire Himalaya suffers from the natural disasters of mass movement and earthquakes, some regions being more sensitive than the others. These disasters would remain in times to come and one has to find out ways not of evading these disasters but to combat or at least reduce their disastrous consequences.

An appraisal of information available for the Himalayan region suggests that management considerations argued to have emanated from scientific studies are already inherent in the traditional systems. In Central Himalaya inter-cropping of 2-6 crops in a single field and crop rotations coupled with fallowing are common. Fallow length ranges from 3-4 months on irrigated fields in lower elevations to 8-9 years in rainfed areas at high altitudes. Material inputs in these production systems are exclusively the locally available ones. Irrigation is provided by diverting water flows along the gravitational force while minerals depleted as a result of crop harvest are replenished through input of organic manure. Crop production system practised in the fertile valley lands is of more intensive nature when compared with terraces.

Another example of traditional knowledge pertains to the shifting agricultural system, still a predominant land use in the north-eastern Himalaya. The number of crops sown together but harvested sequentially may vary from 4 to 35 depending upon the ethnic group involved and climatic conditions. A diverse crop cover is found to prevent losses through erosive forces and helps in optimizing resource use for diverse subsistence needs. The empirical ability of tribal farmers to identify crop composition as suited to prevailing conditions is also reflected. Cereals which are less vigorous and exhibit slow growth in the conditions of poor soil fertility are grown under longer cultivation cycles when nutrients are available in sufficient quantities. On the other hand, under short cycles where nutrient stresses are effective and weeds also increase to serious levels, tuberous and perennial crops which are more stress tolerant and vigorous, are emphasized. The system with sub-regional variations also provides an insight into the linkages of social and cultural values with resource production and use practices. **What is needed is to appreciate the positive points of traditional resource production and use systems and strengthen them through science and technology inputs for further improvement in their values**



and efficiency instead of advocating abrupt changes involving replacement of traditional systems by the new ones found suitable elsewhere and carrying a big question mark in the context of hills.

Development programmes in the past, due to economic, social and political constraints, have affected the food-fodder-energy links. Despite the ambiguity and inconsistency of land use data, reduction in forest cover cannot be denied. Since subsistence systems are dependent upon forest based inputs, yields are likely to be lowered, if not so far, then definitely in the future. As an ameliorative measure, promotion of agroforestry is often advocated to achieve the dual objective of promoting cash economy and environmental conservation. The former objective, in the present scenario, is as important as the latter, but is hard to achieve on account of long gestation periods before the planted trees yield marketable goods. Further, there are strong reservations of the people towards planting trees because of tiny and fragmented crop fields. The knowledge of tree culture ensuring the existing levels of crop production or possible improvements therein with such management itself, is quite inadequate in the hill areas. The ineffectiveness of the afforestation/reforestation programmes is clearly felt, though not quantified precisely. However, the facts that mountain trees are more productive than others, the existence of a rich tree germplasm useful to man for his present needs and the capability of many indigenous trees to improve rather than exhaust the soil fertility must be recognised and realized for future research and development in the Himalaya. Cultivation of medicinal plants has the possibility of getting ready acceptance by the people as it would help in strengthening the economy over short periods. This is an area which should be given priority in the development planning of the region. Promoting the earlier practice of collecting fruits and other useful products from the wild could be another option for benefiting people without any adverse consequences. This would however, necessitate framing an institutional mechanism by which the economic benefits directly reach the people in a wholesome way. There is, thus, immense scope for making use of the existing production systems to improve the well-being of the people inhabiting harsh hill environments. In the present circumstances when ecology and economy of the region have deteriorated to serious levels, development programmes ought to be framed for both short term and long term gains.

Since land and water resources have already been degraded to an alarming extent, restoration of the degraded ecosystems has to be the



core thrust of all development policies. The conceptual course of action in the research and development programmes in this context must attempt on:

- A thorough and objective quantification of resource base and problems;
- knowledge and application of in-hand Science & Technology to rejuvenate the degraded areas;
- undertaking research to refine the science/technology relevant to restoration; and
- ways and means to motivate people to understand the problems, their far-reaching consequences and to seek their participation towards the problem solution.



## 3. DEVELOPMENT PLANNING

### 3.1. Past Scenario



**Marker of Development**

Development is a continuous process; even the most developed countries strive to develop further. Therefore, distinction of 'developed', 'underdeveloped' or 'developing', in a true sense is an illusion. Level of development is measured in relative and not in absolute terms. Further, perhaps with no exceptions, all the indices of development pertain to well-being and comforts of human-beings at varied spatial or geographical scale. Hence, the

term denotes position of a region or country in comparison to others. In this sense, the hill areas of our country are the least developed and considerable efforts have certainly been made to elevate them to the national average. Though the desired has generally not been achieved, but at the same time, the seven Five Year Plans did have their impacts, the important ones worth listing are:

- A realization of special consideration of the peculiarities of hilly terrains and hill societies in development policy formulation and planning process;
- an appreciation of the values of hills in the maintenance of ecological balance, alongwith their long term economic values;
- preference to development programmes relying more on indigenous/local rather than external resources;
- emphasis on the area specific development programmes compatible to ecological and social specificities of an area, rather than a blanket plan for all hills;
- a need for hastening the process of technology transfer;



- importance of long term studies for ecological and economic changes in time and interactions in space for a realistic understanding of the hill ecosystems;
- relevance of integrated management of natural resources and programme implementation in ecological units (say watershed) instead of administrative units (Block/District); and
- over and above, all feel that drastic changes in the strategies so far adopted for development of Himalaya, are needed urgently.

### 3.2.Gaps in Efforts

The glaring gaps are:

- Poor use and performance of the available technologies in spheres like road construction, water supply, soil conservation, processing of fruits, vegetables and wool, *etc.*;
- lack of improvements in the age old designs of farm implements and thereby their efficiency;
- poor provisions and perceptions for linkages, complementaries, infrastructural and organisational support so essential for these areas;
- limited specific researches, technology development and transfer in the areas like varietal improvement in crops and fruits, restoration of degraded lands, water resource management, *etc.*;
- lack of complimentary and coordinated efforts for research and development with end-uses pertaining to progress of societies in the region;
- compromise on short term studies and ignorance for creating long term data base on geophysical, social, economic, and ecological aspects of the region;
- competitive and often antagonistic effects among the endeavours of governmental and non-governmental agencies on dissemination of science and technology;
- discontinuation of programmes like handicrafts; agricultural extension started in 1950s without providing alternative options to their end-users;



- presumptions of inherent inefficiency of traditional systems and thereby emphasis on search of new systems or imposing new systems in the hills without visualizing their irreversible negative impacts; and
- callous attitude of educational institutions towards necessary modification in their curricular and educational mechanisms taking care of the needs of the region.

### 3.3. Constraints

At this stage, it becomes pertinent to question ourselves as to why, in spite of considerable know-how and repeated recommendations of the Planning Commission, gaps in development planning exist and still worse is that instead of narrowing, the gaps are perhaps widening. The following factors have been observed to be generally responsible for such a grim situation:

- low investment per unit of area (one sq. km. on orthogonal projection in map may be twice or more depending upon the slope of land in mountain systems), though due to sparseness of population, the per capita figures appear impressive;
- introduction of technology without assessing the needs and priorities of the people having diverse socio-economic, cultural and ecological settings as well as problems;
- developmental efforts put in a particular direction in isolation and with no consideration to its effect in other related fields;
- technology developed for plains pushed into the hills without necessary and appropriate modifications;
- predetermined norms of development based on experience in the plains applied to the mountains as well;
- lack of extension education programmes appropriate to the needs of women and menfolk in the mountains;
- small, isolated and fragmented holdings;
- principle of 'more incompetent' persons to 'more difficult and undeveloped areas' restricting the hills from getting benefitted from efficient public servants;



- assertions by and privilege to 'pseudo-scientists' and politicians capable of impressively high thinking and propounding new ideas but lacking exposure to the realities in the hills and thereby emergence of local feuds and undesirable changes in programme formulation and implementation process;
- allurements towards comforts and glare of urban centers among the local elites and qualified youth in hill areas;
- political priorities for tertiary activities manifesting in 'abrupt changes' over the primary and secondary activities; and
- absence of government mechanisms to ensure contingencies in the event of natural risks and uncertainties for primary activities, and thereby attraction for salaried jobs rather than self-employment.

The perceptions towards development vary. The people are not satisfied with the pace of development and are less conscious towards the sustainability of development in a long term perspective. Policy framers, programme executors and the scientific community are now concerned more for the sustainability component and perhaps less for the pace of development.

Development in many sectors seems unsustainable for a variety of reasons. In the Himalaya, geophysical constraints and ecological imperatives of preserving the environment often lead one to conclude that whatever development has been possible, is *ad hoc* and merely an eyewash. Though such an extreme conclusion is certainly not true, it is felt that a long lasting strategy of development must be evolved keeping in view the terrain, agro-climatic conditions, background and needs of the local people, as well as their aspirations and the resources. While it is true that Himalayan environment has already deteriorated to an alarming extent and there are many gaps in our knowledge to design appropriate solutions, it is also true that ecologically rich areas and low input production systems (though they are not conceived to be developed on economic criteria), are surviving in the Himalaya to a much greater extent than elsewhere in the country. This appreciation for the environmental values blended with the essentiality of purposeful alterations in the natural resources as well as processes, an integral component of culture and social system of Himalayan man, has been suppressed by the documented knowledge on the 'miracles' of modern science and technology. Strategic approaches of developing new



technologies or thrusting those which proved successful elsewhere, must be replaced by looking into the indigenous repository of knowledge and technology followed by necessary refinements therein. Major components of such a strategy would be:

- Preparation of resource inventories and studies on levels of living of the people highlighting their needs in the context of their habits, traditions, experience, and resources ;
- identification of improved technologies that are simple in adoption, proven efficient under the socio-economic and physical conditions, specific to the problem or to the area;
- imparting extension education to the womenfolk alongwith the men in the target area;
- incentives for primary production activities and interventions for economic benefits of primary production directly to the rural poor;
- creating awareness towards the elements of sustainability in conjunction with the present trends of development so as to contain the unrealistic aspirations of the common mass and, an aspiration for development of society and not of the individuals;
- impact studies focusing on the acceptance or otherwise of the newly introduced technology and further needs in that direction. This would lead to a two-way traffic between the people and the technologists; and
- last but not the least, political willingness free from interference, and dedication of public servants without which nothing would succeed in our system.

It is not easy, though not impossible, to act on the above lines. At the same time, it would never hit the development targets in the real sense of the word unless these are followed. All development efforts aim towards fulfillment of human needs as well as their desires. Further, development has to be sustainable so that the posterity does not have to suffer because of the present mistakes. Therefore development without sustainability amounts to narrowness of thinking and action. Hence hard decisions on the matter would be unavoidable for the upliftment of the hill people who have continued to be hoodwinked so far at each level and by all concerned. The success of strategy depends, apart from many other factors, on the available finances to implement the tasks.



Finances are and will always be limited. Instead of the general development all across the Himalaya which has been attempted so far, it would be prudent to target selective remote pockets in each state in the first phase and then diffusing the strategies to other areas.

### 3.4. Institutional Facilities

Institutional capabilities, in terms of numbers, for generating and transferring the scientific information and technology have been developed to a considerable extent during the past Plan periods. The Snow and Avalanche Study Establishment at Manali is concentrating on avalanche control measures through civil and geo-technological engineering. The role and charter of the Institute include many other aspects of glacier and snowfed catchment basins in the entire Himalayan zone which might be taken up in the Eighth and subsequent Plans. The Defence Research Development Organisation is doing valuable work on high altitude crops and vegetables. In addition to these, Botanical Survey of India, Zoological Survey of India, Geological Survey of India, Forest Survey of India, Indian Council of Forestry Research and Education and Survey of India since their inception are also engaged in generating scientific knowledge and technological know-how about the hill areas in their respective fields. The Indian Council of Agricultural Research Institutions/ Agricultural Universities have been established in hill zones of the country. North-East Council has been established to look after research and development problems in the north-eastern region. In addition to the government departments representing various disciplines, general universities have also been established in most of the areas with the aim to generate and spread the knowledge and technology specific to the areas in which these institutions are located. In recent past, a healthy trend of the growth of non-governmental organizations is also observed. One of the basic philosophies behind the working of such organisations/ Institutions is to form a link for transfer of technology to the rural areas.

All the aforesaid institutions or bodies can be grouped under three categories namely, academic, managerial and voluntary. A perceptive review indicates that **technological know-how for many problems is available but it is not getting transferred to the users as fast as it should have been.** Remoteness of these areas, lack of communication and transport, lack of incentives to serve these difficult areas, are the reasons put forward for weak delivery systems. More than these, is the lack of



commitment and dedication at all levels. One of the dilemmas being faced is the inevitable fact of the administrators (managerial staff) and the scientists (academic staff) working differently. It is, however, vital that they work as a team. At present this concept of partnership between the two types of institutions is completely lacking and this has further been aggravated by the prolific rise of the third Institution of a recent origin, the non-government organizations, which should have been the 'customers' of new technologies rather than becoming the 'creators' of technology and 'critics' of the government infrastructure. Their deviation from the main role of spreading the technology is creating an independency instead of inter-dependency.

The environment and development related issues are mainly due to increasing conflicts of interests over resources. It is being realised that in spite of all our efforts, the environmental conservation is going at a slow speed. There is now need for a new paradigm or pattern of behaviour to put our knowledge into practice. It is in this connection, that all the partners in the development process review their presently common role and change it in the direction of desirability.



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## 4. ACTIONS - DESIRABLE AND FEASIBLE

It is evident that problems of the Himalayan region are well known by now. The consequences of the problems are also realized. Knowledge gaps exist in the quantification of specific problems and their likely consequences. Multitude of problems demand immediate actions which are economically viable and ecologically sound and, at the same time, appeal to the people. Since there are many problems which are interlinked, integrated development rather than sectoral development oriented actions are needed. The problem in executing desirable actions is as to how sectoral development approaches could be readily transformed into integrated development approaches. Integrated watershed management approach sounds well when the objects of integrated management for development in the region are considered. However, as at present, watershed management programme implementation appears to be dominated by forest management. Further, there also appear problems for people as well as for the development agencies accustomed to consider Block or District as a unit of development planning, to orient themselves to watershed as a unit of planning.

There are significant gaps in the knowledge on designing appropriate solutions to the problems and limitation in finances are invariably felt to ensure effective application of solutions already known. *Application of in-hand science and technology for restoration of degraded environments coupled with economic upliftment of the Himalayan people is required with parallel efforts on strengthening the science and technology knowledge system itself.* The developmental activities in the region should be based on the carrying capacity of the individual areas.

This section enumerates priority actions covering both immediate applications for development in the region and research/development studies for increasing the pace of development in the future. A brief rationale on identification of the actions and the core themes of actions are given separately for the recognised sectors of development. As



financial and manpower resources are also limited, relative importance of and weightage to different sectors will be governed by the national development policy and regional priorities. The environmental consciousness at all levels is a prerequisite for the success. Our education system, in the past has been totally economy oriented. Therefore, it is difficult for the people to come to terms with the ecological approach immediately until we change the educational pattern. All states in the Himalayan region need to give top priority for the environmental education at various levels, only then any action plan will be possible to implement in the real sense.

The task of identification of 'right actions' must receive attention due to it but should not be emphasized to an extent that execution of identified actions is relegated to a secondary and isolated status. Future research and development must be tied up with the timely testing and replication of integrated development packages. It is high time to realize and accept that present environmental-economic-social problem complex in the Himalaya is not solely because of lack of 'technological know-how' but perhaps equally because of neglect of available knowledge while deciding priorities and specificities of actions for development in the region. This document provides a broad framework of actions desired for environmentally sound development in the Himalaya. Issues and actions pertaining to environment and development in broad terms are similar all across the region but the specificities and priorities would indeed vary depending upon a whole range of issues like current economic status, social conditions and organization, state machinery, local and regional concerns and so on. These specificities and priorities alongwith functional responsibilities of different agencies and associated financial requirements could be crystallized for each state by undertaking pilot projects.

The actions outlined here imply three courses *viz.*, research, technology development and extension. The agencies/institutions involved with these actions and whose efforts need to be coordinated from environmental considerations have been indicated broadly for each sector. There are already many existing institutions looking at the three courses independently or with some degree of overlap but are not interlinked to the desired levels. Strengthening the knowledge base by undertaking academic exercises are the priorities of the Universities. A mix of pure and applied research often tagged with experimental demonstrations are the priorities of agricultural and allied Universities



## **ROLE OF PARTNERS IN DEVELOPMENT**

### **Actual**

Blame government for all failures and expect government to provide all resources for every bit of developmental activity with zero contribution from their own.

Create 'illusory impressions' about development without much care for accomplishments.

Conscious of the uncertainty of political process, take *a priori* decisions as per the political directions and give, *ex post facto* justifications.

Apprehensive of the premium put on publications resulting in arm-chair research, remote contact with people and field, and neglecting problem-solving research.

Claim to be providing instant technological solutions to problems posed to them and blame the extension agencies for their non-acceptability.

Kept busy with miscellaneous jobs e.g., local arrangements for visiting dignitaries, etc., and more paper work leaving little time for extension work.

Fault-finding with the above groups and blaming them for all gaps and mistakes in development; depend on public funds for development activities, and too ambitious for public prominence.

### **Desirable**

#### **THE PEOPLE**

Strengthen the governmental efforts for development both by healthy criticisms and actual supports through peoples' participation particularly.

#### **POLITICIANS**

Ensure development all over and in accordance with needs of the people and potentiality of the area.

#### **BUREAUCRATS**

Set the stage for continuously rational decisions and their implementation in letter and spirit.

#### **SCIENTISTS**

Direct contact with people and study area, examine peoples' needs, aspirations and problems, regional potentiality and viability of options, act as conveyer-belt between people and other partners in development.

#### **TECHNOLOGISTS**

Assess problems and needs of the people through scientists as well as directly from the field and provide workable technologies.

#### **GOVT. EXT. AGENCIES**

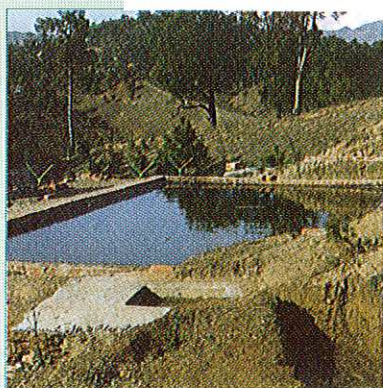
Should be aggressive partners in programmes like 'lab to land' and vice versa, help people in improving their know-how and do-how, and guidance for actions.

#### **NGOs**

Close contact with people and the area to have grass-root knowledge, make people aware of the solutions within their means, and arrange two-way traffic between people, technologists and government agencies.



and scientific, technological and industrial Laboratories/Centres/ Institutes of State or Central Government. Extension presently is the major responsibility of State Governments. During the past couple of decades, quite a large number of non-governmental organizations have also come forward and often complement to the extension network. Thus, creating new institutions and establishments is not as important as strengthening collaboration and cooperation among the existing set-ups. G.B. Pant Institute of Himalayan Environment and Development, as per its mandate, is charged with the responsibility of imparting coherence to the development efforts in the Himalaya. The Institute is to serve as central node of network of all organizations concerned with environment and development in the Himalayan region. The networking has to ensure that available human resource and infrastructure is optimally utilized to progress towards the goal of environmentally sound economic development. The Institute itself is a satellite network with its programme centres/units located in different parts of the Himalaya (as at present Himachal, Garhwal, Kumaon, Sikkim and the north-east) in order to facilitate linkages and coordination in the vast and diverse Himalaya. Ministry of Environment & Forests, Government of India has set up 'Environmental Information System for the Himalaya' in the Institute which would ensure centralized storage of information and its accessibility/flow to the research, technology development and extension agencies - the users and partners in the Action Plan. The G.B. Pant Society of Himalayan Environment and Development consisting of decision makers, policy planners, scientific expertise and peoples' representatives from different States as well as Central Government could serve as forum of formulating guidelines for institutional networking.



**Water  
Harvesting**

#### **4.1. Water Management and Soil Conservation**

Water as a natural resource and fundamental basis of existence of life is abundant in Himalayan ranges. Its uneven distribution both in space and time comes in the way of development needs of the region. Often there is too much water when and where it is not needed or too little of it when and where it is needed most. Flow of water as a result of



gravitational force provides immense scope for power generation and improving upon the efficiency of agricultural systems in the region. At the same time, a short sighted approach of harnessing this renewable resource may accompany social problems, waste of financial resources and hazards engulfing the plains too. The common perception reveals that water during late summers and monsoon is in abundance and scarce during the rest of the year. The intense rainfall during the rainy season causes soil erosion, specially in highlands, deteriorating agricultural productivity, causing instability of hillslopes and landslides locally, and floods and associated catastrophic losses in the adjoining plains. When monsoon is late or weak, water shortage causes serious disruptions of all productive activities. However, Himalayan rivers are considered to be a key to economic prosperity and environmental salvation not only of this area but of the whole country. The limitation is the lack of hydrological information (such as distribution, variability, quality, flow rates and regeneration potential) and technology for designing suitable intake structures and water harvesting and supply systems in the unstable hill regions. It is for this reason that despite the abundance of water resources, a large number of villages do not have even the drinking water facility. Drinking water supply being the most basic need puts water management as the top-most priority. Although numerous small scale water supply projects have been undertaken in many areas, these no longer operate because of faulty pipe lines, joints and/or pumping sets. Such types of lapses indicate poor management of such a necessity.

At present, in all hill areas, excluding river valleys, the main source of sustenance are the sub-surface and surface water flows which need adequate recharging to meet the demand. The recharging depends on vegetational cover in addition to the geological and geomorphological controls. The impact of dwindled vegetational cover and type of vegetation around hill-springs is well documented. Therefore, the recharge of aquifers and conservation of water through appropriate technology is perceived as the first priority. Following are considered of immediate importance in this regard:

- Water harvest through storage in all the streams and development of spring sanctuaries near the village;
- large scale mapping and recharge and discharge capacity measurements of natural perennial springs;



- long term hydrometeorological data along an altitudinal gradient across the latitudinal zones to address: rainfall, water run-off generation and its route through protected and disturbed lands; effect of different types of sediment delivery to rivers, soil porosity, rate of evaporation/transpiration on different slopes, and net water balance;
- evaluation of economic viability of traditionally known methods of water management systems, identification of constraints in their continuation/replication and their remedial measures;
- major technical research needs to find out low cost material(s) increasing infiltration of rain water in recharging areas;
- widespread field trials to test and compare the effectiveness of identified materials in containing the seepage of water in canals;
- identification of species which can help in reducing water loss due to evapo-transpiration and augmenting recharge of ground water;
- identification of tree/ food crop species/varieties with high water use efficiency;
- introduction of centralised water storage and decentralised safe water supply system in the villages helping to stop misuse of water and improve conditions in restructuring the village settlements;
- consolidation of land holdings so as to economise on water requirement for irrigation;
- effective protection of identified perennial springs with barbed wire or deep rooted vegetation; and
- selection of tree species in plantation based not exclusively for economic benefits but also considering their high values in water recharge and conservation.

River water as a resource, far exceeds the quantity required for development needs of the region and so deserves special attention for having implications for both regional economic development and national power and irrigation needs. For a consistent and effective planning in this sphere, following inputs not listed above are essential:

- Data on temporal trends - seasonal as well as daily snow accumulation, snow and glacier-melt-water-flow and evaporation to improve the designs and operational efficiency of the proposed hydroelectric and irrigation projects (at present Snow and



Avalanche Study Establishment of the Department of Defence Research & Development Organisation, Manali, is collecting some data but its main focus is on avalanche control);

- creation of a sampling station network for computerised measurements of water flow rates, sediment yield and soil load in major rivers. (Although there are more than 1,5000 sites for recording the river flow in India, only a few are located in the Himalaya. This limited data with unknown precision are used to extrapolate the flow rates of ungauged sites);
- emphasis on a large number of small run-of-the-river projects, involving low investments, simultaneously with executing major dam projects on appropriate sites to meet national demands selected on the basis of authentic data base; and

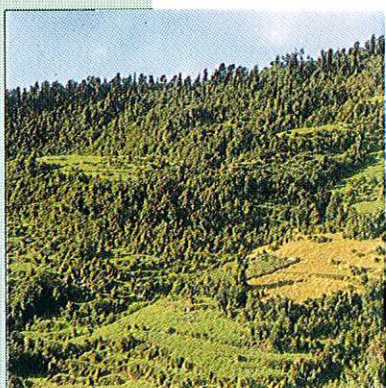
<b>Research</b>	<b>Technology Development and Demonstration</b>	<b>Extension/Execution</b>
- Central Soil and Water Conservation Research & Training Institute	- ICAR Centres/stations in the Himalayan region	- State Government Deptt. of <ul style="list-style-type: none"> <li>- Agriculture</li> <li>- Forest</li> <li>- Public Works</li> <li>- Rural development</li> <li>- Irrigation</li> <li>- Hill Development</li> <li>- Mining</li> </ul>
- Universities in the Himalayan Region	- Universities of Agriculture and allied subjects in Himalaya	- Planning Wings of District Administration
- All India Soil & Landuse Survey Organisation	- Integrated Watershed Management Projects in Himalaya	- Non Governmental Organisations
- National Bureau of Soil Survey & Landuse Planning		
- Wadia Institute of Himalayan Geology		
- National Institute of Hydrology		
- Water Resource Development & Training Centre		
- Central Road Research Institute		
- Indian Council of Agricultural Research and its Institutes		
- Indian Council of Forestry Research & Education		
- Geological Survey of India		



- identification and execution of institutional mechanisms which ensure that benefits accrued as a result of water resource use in the region meet the local essential needs (drinking water, irrigation and power) first and the excess for needs elsewhere (water resource as a natural asset of the region should be harnessed for national needs following the local needs instead of maintaining a competition between the two).

Water resource management and soil conservation in mountains are closely linked issues. In fact, inputs listed above will also be essential for soil conservation. However, the success of soil conservation programmes mainly depends on the active involvement of farmers. Promoting tree crops in agricultural land, improvement in terrace construction, drainage and irrigation could greatly reduce surface erosion and slope failure. Soil conservation, as conceived by the local people and the methods traditionally practised for the purpose, should be investigated and recorded for an in-depth understanding of their rationale.

## 4.2. Forests and Forestry



**Forests  
Supporting  
Agriculture**

Amongst a variety of resources in the Himalaya, forests have received perhaps maximum attention, but more as a subject of administration than of management in a true sense. Deforestation is known to aggravate soil erosion, floods, reservoir sedimentation, drying up of wells and springs, droughts, desertification along with many other adverse impacts. However, an impression that a poor vegetational cover is a cause or a consequence of these degradative processes still remains uncertain. But the fact remains that forests are being used at a rate faster than their regeneration. While it is accepted by all that tree cover is continually declining, the rate and extent of decline are not confidently known. Even more confusing is as to whether the reasons for loss in forest cover are rooted in the rural hillmen or elsewhere. Although the exploitation of forests for fuel, fodder and other domestic needs of hill people are commonly argued as causes of deforestation, yet there are evidences of poorly stocked forests in well managed government owned forest lands suggestive of some fundamental and



serious lapses in the forest management system itself. Forests, being among the basic resources for development, have to be provided necessary protection and inputs to make them more productive so as to meet the developmental as well as environmental demands. In connection with forest productivity, it has to be recognised that with an increasing demand for food, urbanization and industrialization the competition for 'favourable' sites is growing steadily. Additional inputs like, irrigation (which are hardly available even for the crop production) in forestry sector in the hilly areas of the country will be hypothetical for some decades to come. Therefore forests have to remain confined to marginal sites. Historically, forests were open to the hill people to meet their forest based domestic needs while ownership of forest land and revenue therefrom were the objects of the rulers. Therefore, forests, whatever restrictions are framed for accessibility to them, will continue to be treated by the local people as a 'free natural resource' as long as suitable alternatives are not provided. It is logical to keep 2/3rd of land area under forest for maintaining ecological balance in mountains but illogical to anticipate that people will let this policy succeed even in the absence of appropriate alternatives.

The forest based demand structure and trends in hill areas should form the basis for the types of forests to be raised. Villagers' priorities affiliated with forests are fodder, twigs for fuel, forked poles, fruits *etc.* These should be considered while selecting the species for plantation. Another important factor which needs to be taken into consideration in the forestry programmes for the mountains is that the man-made forests should be as close as possible to the natural one. The productivity of this resource has to be increased to a level higher than the demand of the people so that it could supplement the cash requirement of the community. The spectacular standardized pine or eucalyptus plantations do not meet the villagers' priorities. In a subsistence economy, if their basic needs are not met, people are forced to meet them at all costs and risks, legal, economic or environmental. Following are suggested on this subject based on the interviews with rural people:

- The local needs of fuel, fodder, small timber, grazing and the like have to be met from the forests. Therefore, if wasteful uses can be reduced through extension education, it will do a lot good;
- needs of the people be estimated scientifically, there is twenty-fold variation in figures worked out for fuelwood consumption;



- likewise, to give the local people a sense of belongingness, the forest land could be given to the people on perpetual lease to individuals for production of under-canopy cash crops, collection of grass, *etc.*, with no rights of cutting the trees. Such a practice, it is understood, in some form exists in Sikkim and Himachal Pradesh. However, such provisions, may necessitate modifications in existing Laws and Acts;
- it is observed that the forest areas are put to fires to burn the fallen leaves and dry grass cover. This practice is believed to help in healthy growth and improved palatability of grass with the onset of monsoon. If the fallen leaves (pine needles) are purchased and utilised in manufacturing boards, that would be of great benefit in several ways - avoid lot of damage, provide employment and income to people who might collect and sell, and a good substitute to wooden planks;
- efforts for rural electrification not only for lighting purposes but also for cooking and heating requirements would reduce pressure on forests automatically;
- to make villagers feel that this resource should be used judiciously, needs to be protected, and should be allowed to regenerate, it would be useful to establish wild edible fruit and seed collection centres, purchase and processing units in different areas. Further, industries operating on the basis of raw inputs from Himalayan forests (*e.g.*, paper and resin industries) should be located in the hills, *i.e.*, close to the source of availability. The mountain constraints will certainly permit a large number of small industries and not big enterprises at many locations;
- legislations have been framed for compensation of loss in tree cover as a result of developmental activities. However, the spirit of these legislations as far as the object of conservation of Himalayan environment is concerned, is often not met. Compensatory afforestation elsewhere in the plains, whatever the reasons may be, in lieu of forest land in the Himalaya, though important, does not serve the purpose of maintaining the quality of environment in the Himalaya. Further, development agencies assign the task of compensatory afforestation or catchment area treatment to other agencies, invariably the government owned, thereby part away with their responsibility except for diverting the funds. It should be ensured that compensatory afforestation is carried out by the concerned developmental agencies within the



Himalayan region. The success of these remedial measures must be ensured and made apparent by the development agencies before they start production process;

- proper understanding of seed physiology, nursery practices, growth of nursery stocks and transplanting is the basic requirement for successful plantations. Unfortunately, very little work on Indian tree species has been done to cover these aspects. Since direct seeding in forestry is yet to get accepted and practised in management of hill forests, afforestation programmes have to depend on nursery stocks. Technology should be developed for raising containerised stocks so as to ensure least damage and transport costs;
- finding a way to maintain favourable internal water balances of forest trees at the time of transplanting is a problem of paramount importance and should be vigorously researched. It will be rewarding to find out some cheap anti-transpirants which will reduce transpiration without affecting photosynthesis;
- any massive plantation programme should be launched on the basis of long-range environmental compatibility of species and acceptability of their values to the local people;
- while introducing a species in agroforestry, its effects on associated crops/vegetation should also be worked out in advance;
- it is a scientifically established fact that fast growing species will use higher amount of water as compared to the slow growing ones. Plantation of species imposing higher demands of water under canopy radiation loads should be avoided in the areas with perennial water resources like wells and springs;
- water and organic matter being limiting factors on marginal lands, species with higher water use efficiency and fast rate of leaf decomposition should be selected. The nitrogen fixing trees should be preferred over others;
- study of root-systems of various forest species needs immediate attention for agroforestry as well as for raising the plantation on denuded areas. There are many tree species like *Celtis* sps., *Grevia* sps., *Sapium* sps., *Ficus* spp. in agroecosystem in Central Himalaya but a comparative account of their contribution in maintaining or improving soil fertility and crop yield have not been



investigated. It is better that the species already known are researched before recommending for alien introduction;

- genetic improvement of selected species should form a priority item in forestry to get species with combination of low transpiration rates, higher photosynthesis, high calorific value, and desirable shade and shelter effects;
- it is a general perception that tree-line (upper elevation limit of tree growth) all over the world is descending and at the same time the regeneration rate under Himalayan climate is relatively poor. This means that in the near future the sub-alpine forest will also decline. Technology need to be developed to mitigate this situation. In this connection, a detailed understanding of sub-alpine ecosystem has to be developed and technology should be evolved for plantation in sub-alpine areas;
- one of our most serious deficiencies is the lack of understanding of reproductive biology of Indian tree species. The reproductive growth of many tree species is disturbingly irregular. A detailed knowledge of reproductive biology to overcome this irregularity is essential;
- cultivation practices for medicinal and aromatic plants should be developed so that these could be grown beneath tree crops in the social forestry programmes;
- grassland management should receive priority and taken-up on a scientific basis. For this purpose, integrated approach of developing grazing lands inside and outside the forests, frequent reseeded of these areas with desirable species of grasses and legumes is needed. May be, the grass and legume seed banks have to be established for different localities. Depending upon the area and the conditions of habitat, improved strains of grasses should be produced and introduced. The soil macro and micro-nutrient conditions are also to be taken care of. While introducing legumes, the application of phosphorus or lime in high rainfall zones might be necessary;
- with increasing elevation, leguminous elements in the flora decrease. Therefore, high altitude-stress-tolerant strains of Rhizobium as well as leguminous species need to be developed; and
- alpine pastures and semi-arid and arid cold deserts need special attention in connection with grassland development. A wild type



of lucerne is another species which is relished by domestic animals and has resistance to high altitude stress. Such species need to be explored on scientific lines.

<b>Research</b>	<b>Technology Development and Demonstration</b>	<b>Extension/Execution</b>
<ul style="list-style-type: none"> <li>- Forest Survey of India</li> <li>- Indian Council of Forest Research &amp; Education and its Institutes/Centres</li> <li>- Department of Space at                             <ul style="list-style-type: none"> <li>-NNRMS, Bangalore</li> <li>-SAC, Ahmedabad</li> <li>-NRSA, Hyderabad</li> </ul> </li> <li>- Universities of Forestry and of Agriculture in Himalaya</li> </ul>	<ul style="list-style-type: none"> <li>- Indian Council of Forestry Research &amp; Education at its various Institutions</li> <li>- Universities of Forestry and of Agriculture in the region</li> <li>- Forest Department of concerned States</li> </ul>	<ul style="list-style-type: none"> <li>- State Government Department of Forests in the region</li> <li>- Universities of Agriculture and of Forestry in Himalaya</li> <li>- Non Governmental Organisations</li> </ul>

### 4.3. Energy



**Age-old Energy Source**

If per capita consumption of energy is considered to reflect the level of development, hill areas have been considerably neglected. Legislative restriction on the traditional uses have been framed but delivery of alternate energy sources have not been ensured. The Sixth and the Seventh Five Year Plans laid emphasis on the introduction as well as popularisation of non-conventional sources of energy but not much is observed to have been done in

this direction. Following actions are listed for overcoming this situation:

- Mini and micro-hydroelectric projects should be established at suitable sites throughout the Himalayan region. In order to hasten the process of transfer of this technology, these projects should form part of Watershed Management Plans which are suggested to be area specific. Direct involvement of locals should



be ensured before execution of project in order to avoid conflicts during execution of the project. Training to local people and institutional mechanisms to ensure their adequate participation in installation and operation of the project should be given due care in the project planning phase;

- there are certain areas where the conventional methods of extending power supply by construction of transmission and distribution lines may not be feasible due to topographical conditions. Energy supply in such areas should be attempted through alternate technologies like diesel sets supplemented with biomass gassifier. Certain perennial biomass of obnoxious weeds like, *Lantana* should be used for this purpose. The technological know-how already generated in this direction should be utilised. Further, this programme too should form a part of Watershed Management Authorities in different localities;
- other technology which could use forest weeds like, *Lantana* is Hot Air Engine (10 KW). Technical know-how should be generated to use this technology in the rural areas of the hills;
- biogas plants have been installed at several places and these are reported to be working successfully upto 1200 meter altitude. Identification of proper catalysts to increase fermentation even at lower temperatures will help in extending this technology significantly;
- the use of pressure cookers is accepted to be markedly reducing consumption of energy. This equipment should be provided at highly subsidised rates not in hills only, but all over the country;
- the technical know-how to harvest the wind energy as well as solar energy is now fully established. However, round the year data on wind profile of selective sites across the region should be collected for proper designing of wind generators;
- although some photovoltaic systems have been installed at several places but due to lack of technical and financial back-up required for their maintenance in the remote areas, these have yet to become successful. Technological inputs are required to minimise the bottlenecks of the installation and maintenance; and
- use of high carbohydrate accumulating plants starchy-annuals which grow abundantly on marginal sites in mountains is another source of renewable energy. Ethyl alcohol from these can be produced by simple fermentation. However, this option should



be used only if there is no risk of inducing the social evil of alcoholism in the hills where the evil already exists in a big way.

<b>Research</b>	<b>Technology Development and Demonstration</b>	<b>Extension/Execution</b>
- Tata Energy Research Institute, New Delhi	- Department of Non-Conventional Energy G.O.I. through its Institutions and Organisations	- Voluntary Organisations - Extension Agencies of State Governments
- Department of Non-Conventional Energy, New Delhi	- Institutions of Engineering Education and Research	
- Central Power Research Institute, Bangalore	- Council for Advancement of Rural Technology (CART)	

#### **4.4. Farming Systems**



**Fertile Valley Land**

The agroclimatic conditions of the Himalayan region render agricultural production quite uncertain. Though there is a wide spectrum of diversity in the farming systems operating in the region, yet there are quite a few commonalities *viz.* crop diversity involving mixed cropping as well as crop rotations, subsistence rather than commercial values of agriculture, maintenance of soil fertility through natural processes (alternating crop-fallow

phases in shifting agriculture or addition of organic manure consisting of animal dung and litter from forests in other systems) and strong linkages between crop husbandry, animal husbandry and forests. Climatic conditions optimal for growth of many food crops occur in the mountains and the need is to exploit these opportunities for economic upliftment of the region without degradation of environment. Introduction of horticultural crops is a more recent phenomenon and has penetrated the traditional farming systems in a few pockets such as Himachal Pradesh, Jammu & Kashmir. Invariably, horticultural crops are given importance more for their commercial benefits than for local consumption.



#### 4.4.1. Crop husbandry

As much as 84 per cent of the net sown area in the Himalayan Region depends on rains - the range being 97 per cent in Arunachal Pradesh and Mizoram to 65 per cent in Assam. Mixed and multiple cropping with crop rotations involving a large number of annual and perennial crops have been in practice in these areas for ages. The basic aim behind this practice probably was to grow all that was needed and harvest whatever could be possible under unpredictable situations. This is literally true in higher hills where it is not possible to have more than one crop in any year. Multiple cropping increases total production per unit of area, raises farm output, increases the range of products available to diversify the diet, make efficient use of available nutrients and water, and enhances soil fertility. Mixed cropping also avoids to some extent the possibility of pest problems. These traditional systems conceived earlier as weak on account of involving low external inputs and economic gains, are now being considered to represent an "Advance Sustainable Technology" in crop husbandry sector. Thus, the blends of this traditional technology and modern scientific know-how offer a great potential to make the present crop husbandry commercially viable in addition to meeting the food requirement in the region. A strategy for the development of hill areas is possible provided the following constraints are mitigated on priority basis:

- (i) **Consolidation of Holdings:** Economic advantages of this are too well known and those hold true no where more than in the hills. This is so because of the terrain and long distances. Fragmented holdings make crop husbandry uneconomic and cause all types of hinderances in making use of the productive potential of land. Governmental efforts should be strengthened to take up the task of land consolidation on priority. Such tasks are difficult to accomplish. Strong public opposition coupled with technical difficulties faced by the officers in the land measurements led to failure of the efforts made in areas like Kumaon and Garhwal. However, success stories do exist, e.g., Himachal Pradesh indicating that consolidation in mountains is difficult to carry out but certainly not impossible. Public awareness of the various advantages of such a step should be developed.
- (ii) **Land Abandonment:** As a consequence of the uneconomic production from inconveniently located plots and attraction for outside employment, a significant portion of agricultural land



gets abandoned. Such a situation is an expression of out-migration from the rural areas in hills and, at the same time, unwillingness of the absentee owners(non-resident) to part away with the land. Land abandonment under these conditions is observed to accompany perpetual loss in the productive potential of land. This issue needs **immediate intervention on the part of the government as well as that of the people so that legal provisions of private ownership do not restrict land use for the benefit of people.**

- (iii) **Irrigation:** The importance of this input is well accepted. As already suggested, in hills there is no scarcity of water as such and the only problem is in its management and distribution. Till recently the hillmen used to manage this entire thing themselves but for some unknown reasons (perhaps to inflate the figures of providing employment), the irrigation 'gools' or 'kuhls' have been taken over by the State Irrigation Department (in U.P. hills). Since then, all sorts of problems have come up in the system. The traditional system has been discarded while the new system doesn't work because the persons at the helm of affairs have neither the knowledge nor the willingness for obvious reasons. **Traditional systems should not be disrupted unless government interventions are found superior to the indigenous technologies based upon a rigorous performance assessment in mountainous areas.** Therefore, it will be necessary to consider all aspects of this subject and tackle it on war-footing.
- (iv) **Marketing:** With these steps, the hill areas too will have some marketable surplus. At that stage, an efficient marketing system will be needed. At the same time, the farmers may be advised to diversify their production pattern and go in for high value crops like amaranthus, buckwheat *etc.*, and off-season vegetables which could be grown exclusively in the region and thereby bring larger income. **An Institution like 'public purchase system' or cooperative marketing would be more useful for promoting trade in inaccessible areas of high hills.**
- (v) **Diversion of Prime Lands to Non-Agricultural Uses:** There is no dearth of barren and uncultivable land in any part of the Himalaya. This is confirmed by the official figures. Yet, the construction activities whether it is residential colony or dam or laying of roads, the fertile agricultural land, which is generally irrigated also, is the first victim of development. This is equally, if not more, true for non-agricultural activities of the government.



This practice should be arrested by non diversion of agricultural land to such uses. This may have to be done through legislation.

(vi) **Others:**

- Science and technology can help in a big way by devising and suggesting appropriate engineering measures for better terracing;
- high yielding varieties of field crops should be thoroughly tested for their performance under the local farming/cropping system before releasing to the farmers. Recommendation for their introduction should be based not merely on the basis of crop yield, but also considering the quantum of inputs required to maintain higher yields in long term in mountain perspective;
- one of the reasons for ineffective use of chemical fertilizers in the hills (alongwith all those applicable in the plain areas) is the inconvenient size of the bag. Carrying the currently used large sized heavy weight bags, on human backs is problematic. Further, since majority of farmers have small land holdings, large packages far exceed the requirement and capacity of individual farmers. Therefore, in these undulating areas, it would be helpful if smaller bags of 10 kgs. each are provided;
- the use of chemical fertilizers should be kept to minimum so as to avoid the downstream pollution problem and residual effects. Thrust should be not on fertilizer use to obtain 'maximum possible yields' but to hasten organic recycling to obtain 'improved yields'. Chemical fertilizers are needed to strengthen and to improve the efficiency of the traditional organic manuring systems rather than their replacements;
- another important barrier to transfer of technology is the fact that it is the women who carry on almost all operations in crop production (excepting ploughing and construction of retaining walls for terraces), but not only the agricultural extension workers are males, these are the male members too who are given training in farm activities. This situation needs to be corrected so as to ensure effective transfer of technology;
- efforts should be to introduce new/modern technology after exhaustive testing and gradually, rather than aiming a revolution. Effect of field demonstrations is reported to be the most appropriate in all such situations. Cases are not lacking where poor farmers have become poorer because all aspects of the technology were not considered/tested before its introduction;

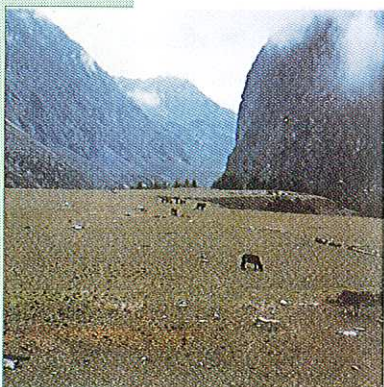


- cultivation of medicinal plants would prove to be an effective practice particularly in the high elevations. Apart from meeting the national needs, it would strengthen the rural economy and would not involve drastic changes in the land use. Further, many medicinal plants could be raised under forest canopy for which appropriate changes in the land tenure measures would be essential;
- action oriented researches for long term benefits of perennial crops in reducing soil erosion and maintaining water balance should be undertaken on mass scale in agricultural land dominated by annual crop farming *e.g.*, in Central Himalaya; and
- a network of demonstration plots for practices like drip irrigation, strip cropping, relay cropping, alley cropping, not known in the region, should be laid so that farmers themselves evaluate the advantages of such practices over the traditional ones. Local knowledge and traditional practices should not be discarded without going deep into their rationale. This would necessitate thorough investigations, recording, analysis and drawing of inferences thereafter.

<b>Research</b>	<b>Technology Development and Demonstration</b>	<b>Extension/Execution</b>
- Agricultural Universities and Institutes in Himalayan Region	- Agricultural Universities and Institutes through their Departments and Regional Centres in Himalayan region	- State Government Deptts. of - Agriculture - Horticulture - Rural Development - Hill Development - Community Development
- ICAR through its various Institutions and Regional Centres	- Central Potato Research Institute, Shimla	- Universities in Himalaya
- Agro-Economic Research Centres at Delhi, Shimla, and Jorhat	- ICAR Research complex, Shillong	- Youth Wings
	- IARI Regional Stations at Shimla, Katrain and Sikkim	- Non Governmental Organisations
	- Vivekananda Parvatiya Krishi Anusandhanshala, Almora	



#### 4.4.2. *Animal Husbandry*



**Open Grazing**

Livestock being an integral part of hill life and hill farming, the economy in all parts of Himalaya is basically agro-pastoral. This is so for several reasons. The land holdings being very small, livestock supplement the income and are considered to constitute capital asset. The animal dung and bedding material is the only manure for the crops. Almost the entire energy requirement of hill agriculture is met either from bullock power or human power. This scenario is not likely to change much in the future also for reasons of the terrain. Of the 449 million domestic animals in the country, nearly 9 per cent

are in the Himalayan region whereas geographical area of the Indian Himalaya is 18 % of the country. Of the various types of livestock cattle are the most important (47.5 %), followed by buffalo (12.3 %), goats (15.8 %) and sheep (10.4 %). Generally, cattle, goats and sheep constitute an important livestock wealth in Western and Central Himalaya, pig and poultry in Eastern Himalaya, and ovine in alpine zones. Yaks are also reared in alpine areas. Equines are essential for transportation.

Open grazing by livestock in all these areas is an age old practice and probably will continue even if the laws to restrict grazing are strictly enforced, unless workable alternatives are provided to the people. Planners concerned with protection and development of forests and range ecosystem consider open grazing as a problem. Stall feeding, although not as common as in the plains, does exist in some area of Sikkim. Effective community action for avoiding over exploitation and open grazing does exist in an area like Himachal Pradesh where rangelands, specifically those dispersed in the habitated zone and under community ownership, are divided into temporary plots- one each for a farmer.

Any programme of developing Himalayan region has to necessarily include the development of livestock, and for which, the following steps deserve consideration:

- Some potential solutions to reconciling the conflicting interests of forestry, agriculture and animal husbandry: These three sectors



should be looked not in isolation and competitive but in conjunction with one another in an integrated perspective. A concern for ownership of land (e.g., government ownership of forest land) should have an additional dimension for the optimal use of land based resources. Such an approach is reflected in traditional management systems and thereby their rejuvenation could be one possibility e.g., "Gharpal System" (a system of backyard feed-lot raising) still in practice. In group of villages situated in compact and continuous areas in upper as well as lower foot-hills, this system could be taken up as "Pilot Scheme". This system will be more suitable for sheep and goat husbandry. The kids and lambs introduced at the age of 3-4 months are reared for 3-5 months and sold thereafter;

- spatial separation of forests and pastures: clear separation of forestry and pastoral land use seems to be the best solution for avoiding conflicts. This has been the most successful approach taken in many parts of the temperate zone. This can be achieved by separation of forestry and pastoralism by fencing. Such methods could be applied particularly for protecting important or sensitive forest areas and environmentally fragile zones by fences or by guards so that grazing takes place only after a defined period. More effective management combined with increased productivity would, however, be facilitated if such activities could be concentrated on the most suitable sites. This would imply a reduction of the total area under forest management but an increase of high yield forestry, without the risk of permanent encroachment. On the other hand, intensive pastoral management could be performed, eventually supplemented by the cultivation of fodder crops;
- secondary utilization of forests by regulated grazing: The present open grazing practice should be replaced by controlled grazing so that both forestry and pastoralism could mutually benefit. Some known promising methods are:
  - (a) partial substitution of animals in incompatible situations: Under this concept goats are partly replaced by similar animals causing less damage. Damage in a high forest is likely to be less severe than in a selection forest or in shrub plantations;
  - (b) reduction of the number of animals per unit area through introduction of better breeds, upgrading of local breeds, and culling of uneconomic animals. It will be useful to encourage



production of dual purpose mutton and wool sheep and also small to medium size backyard feed lot system by villagers;

- forage production as a forest management goal would mean:
  - (a) plantations for the protection and improvement of pastures;
  - (b) enrichment of natural forests with fodder plants;
  - (c) establishment of special fodder plantations; and
  - (d) alpine pasture improvement.
- mechanical methods of shearing and ginning of wool should be introduced. Incentives be given for the use of improved wool spinning wheels; and
- cottage industries utilising wool, skins, horns and other animal by-products should be encouraged. Training in the crafts be imparted for self-employment, not for salaried jobs. Improved technology, new designs and products should be introduced alongwith adequate market outlets and facilities.

<b>Research</b>	<b>Technology Development and Demonstration</b>	<b>Extension/Execution</b>
- Agricultural Universities in Himalayan region	- National Dairy Research Institute, Karnal	- State Government Deptts. of - Animal Husbandry - Rural/Community Development
- ICAR and its regional Centres/Stations	- Indian Veterinary Research Institute, Izatnagar and its Centres	- Universities
- Indian Veterinary Research Institute	- Central Institute for Research on Goats, Mathura	- Voluntary Organisations
	- Central Sheep and Wool Research Station, Dehra Dun	
	- Indian Grassland & Fodder Research Institute, Jhansi	
	- National Research Centre for Yak, Nikmadung, Arunachal	



#### 4.4.3. Horticulture



##### Untapped Potential

The Himalayan region is now known to be producing several types of fresh fruits, dry fruits, vegetables, flowers, seeds of vegetables and flowers, mushrooms, *etc.* Crab apples and other wild species of temperate fruits are reported to have been grown in the Himalaya for hundreds of years. Production of fruits on commercial scale is only a recent phenomenon and has picked up well, the best example being apple production in Himachal Pradesh.

Following suggestions are listed for a sustainable development of horticulture in the region:

A long-term horticultural development plan should be prepared, incorporating a crop diversification programme and indicating what crops should ideally be grown where in the future, and at what scale. Based on the diversification programme long term planning of all facets of the industry can be done from nursery requirements to research/extension, and processing and marketing, and the appropriate roles of public and private sectors determined;

- planting material be improved and made available to growers through: (a) introduction and testing of new varieties; (b) establishment of a Himalayan repository of all commercially grown varieties in the region; and (c) development of the private sector nurseries to utilize improved scion wood produced from the repository;
- availability of credit to fruit growers through adoption of improved branch level banking methods identified by ongoing Credit Delivery Pilot Project;
- boosting of research and development into alternative fruit storage, packaging and transport, including cardboard cartons and wire bound wooden boxes; and into on-farm cool storage and bulk transport of perishables;
- expanding use of existing cold stores by private sector for medium and long term storage of fruit, and precooling of direct marketed fruit. This should be done using the cold stores



currently owned by agencies like the Horticultural Corporations of hill states;

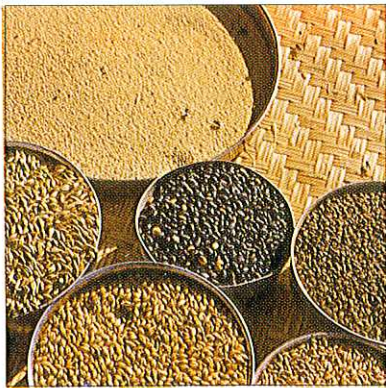
- initiating long term planning for a phased establishment of cold storage and fruit processing plants both in production and consumption areas, matched to increasing demand for these facilities. Developing incentives to encourage the maximum private sector involvement would be an important facet of this planning;
- improving technology availability to farmers through reorganization of extension services. Two additional aspects are important: (a) the need to convert existing government nurseries into demonstration farms/orchards, and (b) the establishment of a large training and technical assistance component necessary to facilitate adoption of overseas technology which is available today and directly applicable to horticulture in the region;
- initiating studies on the production of different fruit crops, marketing for apples and other crops and the financial incentives to intermediaries at different stages of the marketing and processing chain;
- developing common grade standards of fruits for efficient marketing and introduction of these into the industry;
- continuing the development of research capabilities of agricultural and horticultural Universities in the region. Both facilities and research programmes should be reviewed by experts taking the region as a whole, to avoid duplication of efforts, and to develop the concept of lead institution in temperate fruit research;
- off-season vegetable cultivation needs special attention. There are as many as 20 species of cucurbits which are grown or grow naturally in hilly areas and many of them have high potential market in the plains. These need to be improved and their agronomical requirements worked out in detail. In addition to cucurbits, about 26 types of vegetables, 15 greens, and 17 species of spices and condiments are cultivated by the farmers. All of them can form a sound base for cash returns. The eco-physiological requirement for obtaining high yields and genetic improvement in crops need to be researched;
- processing of culled and lower grade fruits at household level be encouraged with quality control and necessary marketing arrangements; and



<b>Research</b>	<b>Technology Development and Demonstration</b>	<b>Extension/Execution</b>
<ul style="list-style-type: none"> <li>- Universities, Institutes and Colleges of Agriculture/ Horticulture in the Himalaya</li> </ul>	<ul style="list-style-type: none"> <li>- Indian Institute of Horticultural Research, Bangalore</li> </ul>	<ul style="list-style-type: none"> <li>- State Government Deptts. of                             <ul style="list-style-type: none"> <li>- Horticulture</li> <li>- Rural/Community Development</li> <li>- Agricultural Marketing</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>- ICAR Institutions and Regional Centres in Himalaya</li> </ul>	<ul style="list-style-type: none"> <li>- National Mushroom Research and Training Centre, Solan</li> </ul>	<ul style="list-style-type: none"> <li>- Universities</li> </ul>
<ul style="list-style-type: none"> <li>- Agro-Economic Research Centres Delhi, Shimla and Jorhat</li> </ul>	<ul style="list-style-type: none"> <li>- Horticultural Experiment and Training Centre, Chaubatia</li> </ul>	<ul style="list-style-type: none"> <li>- Non Governmental Organisations</li> </ul>
<ul style="list-style-type: none"> <li>- Indian Institute of Horticultural Research, Bangalore</li> </ul>		

- finally, before launching any massive campaign of extending horticultural activities, facilities needed for efficient marketing of the produce must be ensured.

#### **4.5. Biodiversity and Conservation**



**Crop Genetic Diversity**

Conservation is important both for the development of the present generation and that of the following ones. The need of conserving the available resources is felt by the planners and administrators, but the strategies for conservation have yet to penetrate to grass-root level. In Himalaya, as also elsewhere, creation of sanctuaries and national parks has been adopted as the major task of achieving the objects of conservation. Restricting human

interference to conserve biological diversity, is an act repealed by the rural masses of hill areas already facing a complex of problems including small land holdings, meager employment opportunities and, over and above, natural hazards and environmental uncertainties. Conservation strategies must address to the needs of conservation for posterity but, at the same time, should not neglect the present needs of the people.



Further, the current strategy involves conservation of wilderness areas of the forest land. Conservation of cultivated crops is a neglected subject. A variety of food and medicinal crops exist in the region, many of which are not much known outside the region and may have a potential of providing food alternatives in the region and elsewhere as well. Such crops are also known to be insect resistant and stand long storages. Arbitrary distinction of 'coarse' and 'fine' grains and other recent socio-economic changes are among the factors discouraging the cultivation of these crops. These aspects should also be given due consideration in the conservation policies and planning. There are many facets of 'conservation' on which relevant research and development inputs are altogether lacking.

The Botanical and Zoological Surveys of India have prepared provisional lists of threatened flora and fauna. There is however neither any biological information nor the adequate knowledge of causal factors that have led to the rarity of these plants and animals in their habitats. It has also been stated that many more are on their way to extinction. In addition, in the present situation of intense competition among alternative land uses, minimal area required to achieve the objects of conservation ought to be worked out. Following inputs will be required for the sustainable utilization, management and multiplication of the endangered genetic resources of the region:

- Educational institutions from primary to University level in the region deserve special attention both for incorporating an environmental conservation course and action oriented work in their curricula. Financial assistance for developing a piece of land through afforestation/ reforestation within or adjacent to the campus should be provided. Further, the successful demonstrations must be distinguished by instituting awards. This will infuse an 'ethos of conservation' in the coming generations apart from increasing the forest cover with no land ownership problem, in the Himalaya;
- survey of endangered species on regional basis;
- behavioural and reproductive biology, development of technology for propagation of flora and captive breeding of fauna in natural habitats;
- domestication and development of tissue culture techniques for mass multiplication of medicinal plants;



- establishment of alpine/temperate botanical garden/zoological parks to conserve specimens of alpine/temperate flora and fauna;
- development of management plans aiming to avoid conflicts between conservation goals and people's needs for Sanctuaries and National Parks;
- research and development on indigenous food and medicinal crops much less known elsewhere in the plains; and
- long term quantification of ecological benefits emanating from Parks and Sanctuaries.

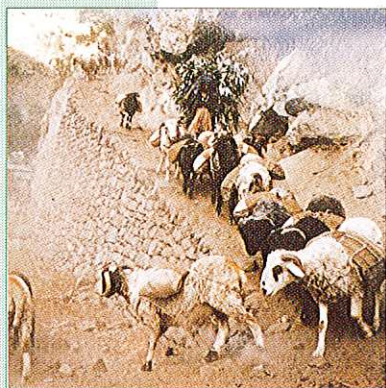
In addition to plant and animal resources some past human cultural resources of Himalaya are either unknown or are endangered. For a better understanding and conservation of these the following inputs are needed:

<b>Research</b>	<b>Technology Development and Demonstration</b>	<b>Extension/Execution</b>
- Botanical Survey of India	- Concerned State Government Department of	- World Wildlife Fund (India)
- Zoological Survey of India	- Forest	- Rural Development Agencies
	- Agriculture	
- Forest Survey of India		- Voluntary Organisations
	- Rural Development Agencies	
- Anthropological Survey of India	- Institutions and Centres of	- Department of Bio-Sciences at Universities of Himalaya
	- ICAR	
	- CSIR	
- Tribal Research Institute, Shillong	- ICMR	- Universities of Agriculture and of allied subjects in Himalaya
- National Bureau of Plant Genetic Resources	- National Botanical Research Institute, Lucknow	- State Government Deptts. of
		- Forestry
- Indian Council of Agricultural Research	- Universities in Himalaya	- Agriculture
		- Animal Husbandry
- Indian Council of Forest Research & Education		
- Wildlife Institute of India		
- CSIR Institutes in the region		
- Concerned Departments of Universities in Himalaya		



- Investigation-cum-study of the material-culture, biotic and food residue remains from archaeological sites to develop the understanding of past human ecology in these areas;
- conservation of monuments of cultural heritage. This will also give a great fillip to tourism industry in the Himalaya; and
- technology based documentation of the gradually vanishing material-culture and pattern of life sustenance of the ancient societies of the mountain areas.

#### 4.6. Transport and Communication



##### **Traditional Modes of Transport**

Primary goods and commodities, agricultural or industrial are generally of very little help unless those are provided place utility and/or time utility and/or form utility. This, in turn requires that the primary outputs are subjected to transportation, storage and processing. Each of these and a few more components of marketing are important but transport is the essential one. Any amount of production is of no use to the farmer unless he can exchange his products with the goods he needs. This is possible only after his produce is sold and which, if carried to the place of consumption, would bring him higher returns generally.

Hilly areas being sparsely populated, have fewer roads which are accepted as the nerves of development. It is also claimed that wherever roads have been laid, the rate of deforestation and landslides get aggravated. Therefore a workable compromise deserves to be accomplished so that the benefits are harvested with least damages. Any planning in this regard must take into account the fragility and perishability of the fruits and vegetables which shall remain the major commodities produced throughout the Himalayan region.

Projects of expanding the road network should be carefully formulated. Road alignments should be worked out on the basis of geotechnical



feasibility instead of the desire of the people, which is more often put forward and emphasized to serve political motives. Broadening and metalling of existing foot paths or bridle paths or cart roads should be restricted. Instead, necessary changes in the design of vehicles for transport in the hills should be given priority.

It is most surprising that the matter of constructing ropeways or cable transport has not been given the attention it deserves. This is an excellent alternative to roads in steep and remote areas for the transportation of humans as well as goods. These are much cheaper in the long run and environmentally more benign than long stretches of winding mountain roads. Therefore, it is suggested that ropeways, several times more than what has been proposed in the Eighth Plan, be constructed all over the Himalayan region. Modern technology of satellite communication should be expanded and utilized to overcome the difficulties of accessibility.

<b>Research</b>	<b>Technology Development and Demonstration</b>	<b>Extension/Execution</b>
- Central Road Research Institute, New Delhi	- Engineers India Limited	- Public Works Department of concerned States
- Telecommunication Research Wing of G.O.I.	- Indian Institutes of Technology	- Telecommunication Department
- Indian Institute of Technology at New Delhi, Kharagpur, Madras, Kanpur, Bombay, and Varanasi	- Institutes and Colleges of Engineering and of Technology in Himalayan States	- Border Roads Organisations
	- Telecommunication Department of G.O.I.	- Engineers India Limited
- Jawaharlal Nehru Technological University, Hyderabad		- Non Governmental Voluntary Organisations
- State Engineering Colleges in Himalayan region		
- Road Research Institute, New Delhi		



#### 4.7. Tourism



**Potential of Adventure Tourism**

The region offers all sorts of attractions to tourists; the problem is to ensure that the benefits of tourism industry are disseminated for development of the region without any adverse impacts on the environment and culture. The region offers opportunities for developing “Ecotourism” as well.

Tourism generates lot of local employment particularly for traders, craftsmen, transporters, hoteliers and to those who have the knowledge of the local places and would like to work as guides. In this direction, following would be of great use:

- New places of tourists’ attraction should be explored, developed and given proper publicity;
- tourism be declared an industry throughout the Himalayan region so that various benefits of establishing an industry in the industrially backward area can be reaped by those who may like to invest in this venture. This, it is learnt, has been done in Himachal Pradesh where this step has been welcomed and utilized by the locals. However, at present this model does not reflect the concept of eco-tourism;
- rest houses, hotels and restaurants managed by government do not enjoy good reputation amongst visitors in general. Therefore private parties should be offered incentives so that a healthy competition is created between the public and the private sector in offering better services to the visitors. A general policy should be to promote use of indigenous resources;
- government intervention to give tourist a taste of local identity rather than creating same type of facilities as existing elsewhere in the plains. Multistoried building complexes should be avoided on grounds of seismological sensitivity;
- while it is more paying to attract visitors from high income groups, those of middle and even of the lower income group should not be neglected. It is a matter of common knowledge that a very large bulk of our people fall in the middle class. The facilities created for the people of this category will cross the break-even stage much earlier as the investment will be lesser and utilization rate would be higher; and



- local people should be educated to view long-term gains of tourism and should therefore ‘not kill the goose that lays golden eggs.’

<i>Research</i>	<i>Technology Development and Demonstration</i>	<i>Extension/Execution</i>
- Department of Tourism in Himalayan Universities	- Professional Trackers and Mountaineers	- Tourism Departments of G.O.I and of Himalayan States
- Amateur Clubs	- Manufacturers of Mountaineering equipments	- Hoteliers and Travel Agents
- Nature Clubs	- Local Peoples	- Airlines and Organisations operating Buses, Taxis etc. - Voluntary Organisations - National Cadet Corps

#### **4.8. Industrialization**



**Agave-Potential for Cottage Industries**

Planning for establishing industries utilizing locally produced raw materials for marketable production is likely to follow multiple benefits like employment generation and trade expansion with concomitant strengthening of primary production activities already existing in the region. Keeping in view the available resources, socio-economic and topographical conditions of these areas, labour-intensive and capital-saving technology should be prioritized in these areas.

Constraints on industrial development in the hill areas have been felt. Recommendations for establishing of some footloose industries which would produce high value and low-weight products like pharmaceuticals, thermometers, watches, precision instruments and electronics have been made. Some units of such type have been established but their number should be increased further. However, such industries are capital intensive and are possible only through



government patronage. These require fine technology which cannot so easily be learnt without some level of prior industrial training or experience. Unfortunately, as soon as training is imparted in such technologies, the trained persons migrate to the places which provide them more comforts with the same income that they might earn while working in hills.

At present many cost as well as labour-intensive industries are being established in the foot-hills. These are providing very good employment. However, such set-ups are going to cause depopulation and abandonment of lands in the villages as well as in small urban units of the hill areas. Point centred growth adjacent to urban centres must be avoided in any attempt for industrial development in the mountains.

The alternatives are available in the form of setting up of small scale industries in large number. The Science and Technology know-how is already available for establishing such units and it is now simply a matter of transfer of technology on priority. Swaminathan Committee on Eco-development of Hill Areas recommended establishment of units such as the wild and cultivated fruit processing units, pine needle hard-board plants, small turpentine factories, oil presses, carding machines, saw mills, wood-wool, chip boards, traditional handicrafts, and many others. Some of these have been given incentives and others need the same. Cultivation of fruits has gone up in many areas but at present these are being sold unprocessed and a sizable quantity is not utilised at all. Similarly wool is harvested in good amount but is supplied as raw-material to the markets in plains and then comes back in finished form to be consumed in hills. Such a system can be changed for better if the processing of wool, (as suggested under animal husbandry component) can be arranged locally. Goat and yak hairs have received little attention but offer indigenous resource potential to fetch more income to the local people. The marketing facilities still continue to be a big constraint, specially in "Hill Areas". Meat, wool, and potato chips are a few more to add to the list which will be highly economical and where Science and Technology know-how is well established. However, alongwith incentives to local craftsmen marketing facilities should be created to encourage these activities. Also the time and money consuming processes of administrative clearance for micro level and rural industrial units should be simplified.

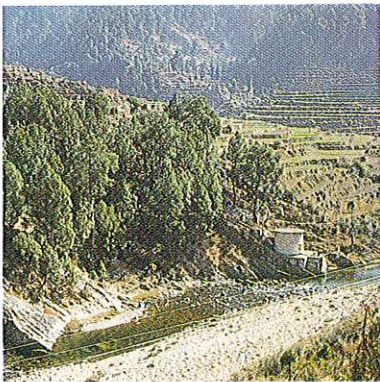
There are several 'wild fruits' traditionally used to supplement diets but remain unexploited for their economic values. Technology for the



<b>Research</b>	<b>Technology Development and Demonstration</b>	<b>Extension/Execution</b>
- Department of Mining Engineering, Institute of Technology, BHU	- Regional Engineering Colleges - I.I.T.s	- Departments of Industry of concerned State Governments
- Geological Survey of India		- NGOs
- Wadia Institute of Himalayan Geology, Dehra Dun		
- National Hydro Power Electric Cooperation, New Delhi		
- Department of Non-Conventional Energy (DNES) Sources		
- Industrial Corporations/Boards/Departments of State Governments		

extraction of their active component and preservation should be developed. Small scale industries need to be established in the appropriate pockets of the region.

#### **4.9. Health and Nutrition**



**Water and Sanitation**

Deficiencies in the areas of housing, water supply, sanitation, health and nutrition are often visible in villages as well as in urban centers. Improving health is basic to improving the quality of life, which is one of the main goals of hill area development. Storage and supply of drinking water for large areas currently being practised by public agencies suffer from several drawbacks. To achieve the physical and financial targets and to expose the governmental

efforts on creating the basic amenities, costly technologies involving pumping of water against gravitation force are adopted. Undulating terrain and damaging processes of landslides and erosion render a short life span to the expensive piped supply systems. For all these drawbacks, decentralized schemes of water storage and supply targeting small areas and managing flow of water along and not against the gravitational force should be emphasized.



Almost the whole population in hills consumes unsafe water, disposes human excreta recklessly and are constantly exposed to insects and rodents. These are the major causes of several predominant communicable diseases. *If adequate and safe water and disposal of wastes could be provided to all the hilly areas, most health problems will disappear automatically.* Following efforts will supplement the planning to reduce the health hazards:

- The basic principles of hygiene should form a compulsory part of primary and secondary education, as well as of family welfare programme;
- very often it is claimed that people in rural areas do not have balanced nutrition resulting into poor health. Since the nutritional requirements vary with the climate, it is essential to undertake studies on the nutritional requirements and intake of the people at different altitudes and its relationship with various disorders;
- traditional medicine systems should be encouraged to continue alongwith the new or modern ones;
- comprehensive studies on levels of living including cooking and eating habits, practice of cleaning, washing and bathing *etc.* should be on a continuous basis. This would indicate the gaps and the changes therein;
- studies should also be undertaken on thermoregulatory mechanisms, physical and mental performance, endocrinology and reproduction;
- the raw water supply in the villages/urban areas should be through sand filters or some other appropriate purification reservoirs constructed with local material and manpower inputs;
- the water supply through pipes in the villages should be decentralised;
- the water supply in the villages should be coupled with appropriate arrangements for disposal of waste water;
- appropriate low-cost technology should be introduced for the disposal of human excreta;
- some of the important medical problems relating to higher altitudes like, cold acclimatization, pulmonary oedema, ophthalmic problems, should receive high priority;



<i>Research</i>	<i>Technology Development and Demonstration</i>	<i>Extension/Execution</i>
<ul style="list-style-type: none"> <li>- Agricultural and allied Universities of Himalayan region through their Departments/Faculties of Home Science and of Nutrition</li> </ul>	<ul style="list-style-type: none"> <li>- Institute of Research in Indian Systems of Medicine, Joginder Nagar</li> <li>- Regional Centres for Ayurveda, Jammu</li> </ul>	<ul style="list-style-type: none"> <li>- State Departments of                             <ul style="list-style-type: none"> <li>- Health and Welfare</li> <li>- Community Development</li> <li>- Hill Development</li> <li>- Rural development</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>- Central Food and Technological Research Institute, Mysore</li> </ul>		<ul style="list-style-type: none"> <li>- Voluntary Organisations</li> <li>- Philanthropists</li> </ul>
<ul style="list-style-type: none"> <li>- Indian Council of Medical Research</li> </ul>		
<ul style="list-style-type: none"> <li>- Central Council for Research in Homeopathy, New Delhi</li> </ul>		
<ul style="list-style-type: none"> <li>- Central Council for Research in Unani Medicine, New Delhi</li> </ul>		

- smokeless 'Chulhas' should be introduced, reasons for their non-acceptance recorded and carried to technologists for the needed improvements;
- dark glasses should be distributed at nominal costs to people in high altitudes to guard against snow blindness; and
- similarly, for sun-burn also, some effective way should be found out to help the people escape it.

#### **4.10. Management of Natural Hazards**



**Hazards—Natural and Man Made**

Earthquakes, hail storms, lightning and avalanches are common in Himalayan region. Our ability to mitigate these hazards is limited at present. These natural events affect the life through the variations in their magnitude, frequency, duration and temporal spacing. Therefore, the impact of these hazards on the developmental attempts are only mitigated through some minor adjustments which we can make within



our socio-economic frame work. At present the scientific knowledge is limited to forecast about these events. In case of earthquake, sensitive zones in Himalaya are well known. However, in case of hail storms, lightning, avalanches and other natural hazards even the prediction about the areas is difficult at present. It is, therefore, time for us to strengthen our R & D efforts in this direction. Following suggestions are put forth in this connection:

- Methodology to predict the possible earthquakes;
- design of earthquake stable shelters;
- development of forecast systems for hail storms, lightning and avalanches;
- methodology to suppress hail storms and lightning by cloud seeding; and
- biological and physical methods for avalanche control.

Since all these studies need detail investigations, concerned R & D agencies should be issued directions to take up studies on these aspects on priority.

<b>Research</b>	<b>Technology Development and Demonstration</b>	<b>Extension/Execution</b>
- Department of Earthquake Engineering, Roorkee University	- Central Building Research Institute, Roorkee	- Central and State Government Department of - Planning & Development
- Central Mining Research Station, Dhanbad	- River Research Station, Guwahati	- Hill Development
- Central Building Research Institute, Roorkee	- Indian Institute of Meteorology, Pune	- Voluntary Organisations
- National Environmental Engineering Research Institute, Nagpur	- Snow and Avalanche Study Center, Manali	- Philanthropists
- National Geophysical Research Institute, Hyderabad		
- Defence Research & Development Organisation		
- Directorate/Departments of Geology and Mining of concerned State Governments		
- Indian Meteorological Department, New Delhi		



## ***Publications***

***from***

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R. Swarup

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E. Sharma *et. al.*,

1992

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