

Western Himalayan Ecoregion STRATEGY AND ACTION PLAN

CONTENTS

INTRODUCTION	1
LIST OF ABBREVIATIONS USED	2
ISSUE 1A: BALANCING THE APPROACHES OF ENVIRONMENTAL CONSERVATION BY CONSIDERING ECOSYSTEM SERVICES AS WELL AS BIODIVERSITY AND DEVELOP NECESSARY MECHANISM FOR VALUATION AND PAYMENT SYSTEM TO THE PEOPLE, INCLUDE THE CULTIVATION OF CROP VARIETIES AND ORGANIC PRODUCTION OF CROPS AS ECOLOGICAL SERVICES	2
ISSUE 1B: CROP DIVERSITY AND ORGANIC AGRICULTURE TO BE RECOGNISED AND PROMOTED	6
ISSUE 2A: PARTICIPATION REMAINS WEAK, SUPERFICIAL AND INEFFECTIVE, THOUGH PARTICIPATORY MANAGEMENT IS HELD OUT TO BE THE BASIS OF CONSERVATION	9
ISSUE 2B: THE TIME-TESTED AND UNIQUE INSTITUTION OF VAN PANCHAYAT OF UTTARANCHAL NEEDS TO BE IMPROVED AND EXTENDED TO OTHER STATES OF WESTERN HIMALAYA	11
ISSUE 2C: LIVELIHOOD ORIENTED CONSERVATION HOLDS POTENTIAL IN BOTH PROTECTED AREAS AND OUTSIDE	13
ISSUE 3: REVIVE NATURAL FOREST REGENERATION, UNDERMINED DURING LAST THREE DECADES IN ALL FORESTRY PROGRAMMES INCLUDING WORLD BANK SPONSORED PROJECTS	16
ISSUE 4A: RESTRUCTURING AND MODERNISATION OF ADMINISTRATIVE NETWORK OF FOREST AND PROTECTED AREAS KEEPING IN VIEW THE NEEDS OF CONSERVATION OF BIODIVERSITY AND ECOSYSTEM SERVICES	18
ISSUE 4B: MODERNISE MANAGEMENT OF PAS	19
ISSUE 5: BLANKET BAN ON TREE CUTTING IN WESTERN HIMALAYA THOUGH HAS CONTRIBUTED SIGNIFICANTLY TO SAVE TREES, BUT HAS GENERATED NEW FORESTRY PROBLEMS	20
ISSUE 6: GRAZING IS A MAJOR SOCIO-ECOLOGICAL FACTOR OF THE WH REGION AND NEEDS TO BE MANAGED IN AN INTEGRATED WAY BY DEVELOPING AN ORGANISATION OF HERDERS AND MAKING IT ECONOMICALLY VIABLE	21
ISSUE 7: CONSERVATION SITES OUTSIDE PROTECTED AREAS (PAS), AN IMPORTANT COMPONENT OF WESTERN HIMALAYAN ECOREGION (WHE), NEEDS TO BE MANAGED BOTH FOR BIODIVERSITY AND ECOSYSTEM SERVICES	23
ISSUE 8: STRENGTHENING INTRA- AND INTER-ECOREGIONAL CO-OPERATION FOR MANAGING CROSS-CUTTING ASPECTS OF BOTH BIODIVERSITY AND ECOSYSTEM SERVICES	25
ISSUE 9: PROVIDING CORRIDOR FOR THE WESTERN HIMALAYAN FOOTHILL POPULATION OF ELEPHANTS	28
ISSUE 10: LAKE EUTROPHICATION AND POLLUTION IN TOURIST TOWNS OF WESTERN HIMALAYA ARE AFFECTING BIODIVERSITY AND ECOSYSTEM SERVICES INCLUDING WATER SUPPLY	29
ISSUE 11: CONSERVATION OF DRY DECIDUOUS BIOME ALONG THE XERIC SLOPES OF THE RIVER AND WATERCOURSES	30
ISSUE 12: IMPACT OF GLOBAL WARMING ON BIODIVERISTY	31

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Introduction

The Western Himalaya is India's region of forests, meadows and snow. It is the premier component of India's ecological structure, providing biodiversity as well as ecosystem services to the country. Its importance as the provider of ecosystem services far exceeds that of other ecoregions because of its unique river connections. Threat to both biodiversity and ecosystem services emanating from the region is great, and measures taken in the past could not yield desirable results because of failure to involve the people. Out stress in on the entire ecosystem and the services provided by the ecosystem, rather than individual components of the ecosystem. One can no longer regard biodiversity conservation as merely the preservation of a few charismatic mega-fauna. Hence, maintaining the ecosystem function is far more important than maintaining the presence of individual species. Thus it is of little significance if the Himalayan Tahr or Snow Leopard can be saved without saving the habitats that these animals survive on.

Vegetation is highly fragmented with large stretches of natural systems are left only in remote areas because of the presence of humans and their dependence on forests and meadows. Therefore, conserving small fragments is important. While substantial work has been done on reducing the very visible threats to the Western Himalayan Ecoregion – be it large scale commercial logging, hunting or mining, the pervasive effect of man constitutes an insidious threat. The lopping of young trees or grazing of regeneration by domestic animals does not leave immediately any dramatic signs, but has the potential to degrade the entire landscape within a few years. That is why we have focussed on natural regeneration despite human presence, and on corridors to connect fragments. A small forest fragment may not be the ideal habitat for large mammals, but can be enough to save insects and decomposing organisms. No law or policing efforts can stop this kind of damage. Any attempts to reverse this kind of degradation should rely on long term efforts at providing alternatives to the local people. Conserving biodiversity is more about people than animals or plants for it is usually people who threaten the existence of this biodiversity.

The region is important also because people think about conserving crop varieties and producing food organically. All these may be treated as ecological services. But to achieve these on a sustainable basis, women have to be given some relief from daily drudgery. Building local capacity and then empowering local communities to take control is perhaps the most appropriate solution. Locally appropriate solutions should be sought. A blueprint approach, or one administered by a large centralised bureaucracy will not work. While substantial legislation exists to deter the state or large corporations from indulging in the destruction of natural resources, maintaining the regulatory and watchdog bodies is still very important.

Biodiversity must be linked with local livelihood strategies. It is the quest for fuel wood for burning, leaf fodder for cattle, or the open grazing of domestic animals that is responsible for a significant proportion of forest degradation and biodiversity loss in the WHER. Unless due importance can be paid to finding alternatives for these biomass products, preserving ecosystems will be difficult.

If the Government must subsidise society, then it is preferable that subsidies be given for efforts that are sustainable. Hence, rather than promoting heavy agricultural subsidies for the purchase of chemicals that greatly reduce the insect diversity (thereby leading to pollinator problems in orchards) and reduce microflora, subsidies directed at ensuring the sustainability of biodiversity can be given. These might include subsidies for constructing biogas plants, or subsidies for promoting private tree plantations. Similarly commercially proven organic techniques of cultivation can be subsidised. Thus, if the region is contributing to downstream areas (the Indo-Gangetic Plains) by helping maintain favourable water regimes or acting as a sink for atmospheric pollutants, then it is not unreasonable for these regions to help support the hills by paying some sort of an 'environment tax'.

The unit of conservation should not be individual species but instead entire ecosystems. Stress should be on the holistic ecosystem and the services provided by the ecosystem rather than individual components. Ecosystems and biodiversity cannot be treated as static entities. Thus policies that preserve old trees but pay scant attention to tree seedling regeneration will have disastrous consequences. Forest policy, and programmes aimed at forest preservation in the hills over the past three decades have undermined the importance of natural forest regeneration.

Organisational restructuring needs to be seriously looked into among agencies entrusted with biodiversity preservation. Management of protected areas needs to be modernised by including all components and perhaps the formation of an interdisciplinary department to manage such areas and the biodiversity within needs to be looked at. Management plans and strategies must be proactive rather than reactive.

The proposed Strategy and Action Plan has considered these points, and tried to focus on linkages among various issues listed.

List of Abbreviations Used

ACAP = Annapurna Conservation Area Project
ATI = Appropriate Technology India
BCN = Biodiversity Conservation Network, Washington
BD = Biodiversity
BSF = Border Security Force
CHIRAG = A grassroots NGO based in Kumaun
ES = Ecosystem service
FRI = Forest Research Institute
GBPIHED = G.B. Pant Institute for Himalayan Environment Development
GOI = Government of India
HP = Himanchal Pradesh
ICFRE = Indian Council of Forestry Research and Education, Dehradun
J&K = Jammu and Kashmir
JFM = Joint Forest Management
KMTNC = King Mahendra Trust for Nature Conservation
MAP = Medicinal and Aromatic Plants
MoEF = Ministry of Environment and Forests
NGOs = Non-Governmental Organisation
NTFP = Non-Timber Forest Produce
PA = Protected Area
PWD = Public Works Department
RF = Reserved Forest
SFD = State Forest Department
UA = Uttaranchal
VP = Van Panchayat
WH = Western Himalaya / Western Himalayan
WHE = Western Himalayan Ecoregion

IM = Immediate 1-2 years
ST = Short-Term 2-5 years
MT = Mid-Term 5-10 years
LT = Long-Term >10 years or a continuing process

Note: All the steps should be initiated within 2 years time using the existing institutions and establish new ones wherever required. The year years given for the term are indicative of period of completion.

Issue 1A: **Balancing the approaches of environmental conservation by considering ecosystem services as well as biodiversity and develop necessary mechanism for valuation and payment system to the people, include the cultivation of crop varieties and organic production of crops as ecological services**

Keywords: Carbon sequestration, developing payment system, economic valuation, ecosystem variability, WH, the ecosystem service providing region.

Genesis:

Almost nothing has been done in regard to developing a conservation approach that considers ecosystem services in an integrated and meaningful way even at national level. Though the Gangetic Plains owes its origin to geological processes, its fertility is largely due to the flow of ecosystem services from the forests of Western Himalaya (Box 1). There is a need to understand the attributes of different ecosystems of WH, the ecosystem services that are generated from them and their valuation for developing a balanced conservational plan (Boxes 2 & 3).

Problem with the current approach of conservation

One of the serious problems that is affecting conservational plan is the prevailing approach of finding

BOX 1

What are ecosystem services?

Ecosystem services in a strict sense are all the services generated as a result of interaction and exchange between biotic and abiotic components of ecosystems. Within ecosystems the interacting organisms help to mediate flows of energy and materials. These energy and material flows contribute to many ecological or life support services that benefit human welfare. Here in ecosystem services we include numerous invisible but essential services, viz., soil formation and fertility generation, reduction of soil salinity, decomposition and waste dissipation, productivity, carbon sequestration and atmospheric gases balance, stabilisation of climate and mitigation of climatic change, nutrient cycling, check on soil erosion, facilitation, assembly of community and succession (in a way it does ecological healing), water and soil retention, water and air filtration, flood and drought control, regulation of water supply and services such as of recreation, aesthetic and religious values. We have not included, however, various goods such as food, fibre, resin and drugs derived from medical plants. Costanza *et al.* (1997) have estimated the total value of the ecosystems (services plus biodiversity) at global scale at US\$ 33 billion, nearly

ways to reduce costs and maximise benefits of biodiversity conservation. In this approach the focus is on protecting biodiversity-rich areas, as this yields the protection of highest collective numbers of species from the given amount of money input. This approach emphasises on percentage of the global species that can be saved. Contrary to this, a balanced approach to conservation emphasises that people of every region depend on the daily flow of ecosystem services for managing their living, therefore there is a need to value and conserve natural ecosystems of all regions. But it does not mean that biodiversity and ecosystems are separate components of nature.

If details were investigated we are likely to find that both are tightly linked, and decline in species richness can lead to decline in overall levels of ecosystem functioning and resultant services to humans. However, from a pure utilitarian point of view it is convenient to explain to the people how their life depends on ecosystem services. As for biodiversity, it is difficult to explain to the people that they need to conserve all organisms for some of these may yield some useful drugs in the future.

Developing a payment system for ecosystem services

Identification and recognition of ecosystem services may be required at various scales from local to regional, national and global levels. For this connections between ecosystems (such as forest and lake, and forest and cropland) and natural ecosystems and manmade ecosystems are required to be understood. For example, integrating lake and its watershed would be necessary to develop any restoration plan for a degraded lake. The western Himalaya and the adjacent Gangetic plains combine to form one unit of environmental management because of the influence of mountains on the plains through the water courses. Though the Gangetic plains owe

its many characteristic features to its geology, its perpetual fertility and climatic equanimity are largely due to the nursing effect of the forests of the Himalaya. A recent study indicates that soil and tree water potentials are clearly higher in the adjacent plains than in the mountain site, though climatic factors indicated opposite conditions. In the Gangetic plains people dig out more than one meter soil for brick making, and then they are able to resume agriculture after a few years. This could be made possible because of the downslope flow of soil and humus generated by the oak and other forests of the Himalaya year after year. The young and the rising Himalayan mountains are full of energy, which is always restive to get released causing rocks to be crushed, fractured and shattered into pieces. These decomposing rocks readily yield soil under the influence of biota.

To keep this connection going, and flow of mountain services maintained, it is necessary to enable the mountain people to conserve forests and arrangement for payment made for the opportunity foregone. One pragmatic approach can be to provide fuel gas or hydroelectric supply or some non-conventional energy to the people of western Himalaya on an affordable cost so that pressure on forest is reduce to a level that gives respite to the forest to recover. The conservation of biodiversity and forest carbon sink as protective cover of watersheds would be additional outputs of this payment mechanism. For, when we cut wood, we lose both biodiversity and carbon sink. Both the proposed supply of cooking energy and the existing provision of firewood for the forest are a form of subsidy, but the advantages of the proposed subsidy are likely to more than compensate for the cost of supply of fuel gas.

Then the life in mountains requires some level of "modern comfort". The efficient cooking gas energy of fuel gas may prove to be a great relief in daily drudgery, particularly of the women folk.

BOX 2

Ecosystem Service from Western Himalaya

Mountains are regarded as the water towers of the world. The extraordinarily massive Himalayan Mountains have shaped the climate of the Indian subcontinent apart from providing water and soil to the Gangetic plains. Among the contribution of Himalaya are the monsoon pattern of rain, high round the year humidity, mild winters and slow lapse rate of temperature with increasing altitude. These influences are reflected in high biodiversity, forest cover up to considerable altitude, dominance of evergreen forest, rapid soil formation, and agriculture round the year.

The ecosystem services of the Western Himalayan forests to the people in the Gangetic plains are listed as following:

1. Rapid soil formation, particularly in oak forests, thus nursing crop-fields both in hills and plains by providing soil and nutrients.
2. Controlling flood peaks and erosion.
3. Maintaining water flow in rivers which contributes to pollution control and help maintain aquatic diversity and soil water storage.
4. Maintaining native crop diversity through human efforts, thus allowing evolution to take place (global importance).
5. Organically produced food (through human efforts, utilising forest services).
6. Carbon sequestration and climate stabilization (global importance).
7. Stabilisation of climate (regional and global importance).
8. Forest services of local use are:
 - a. Formation of fertile soil utilised in crop-fields.
 - b. Retention of water as spring water which is the only water source in most areas.
 - c. Water filtration that serves to keep the spring and lake water clean.
 - d. Organically produced food.
 - e. Restoration of landslide sites through the process of succession in which N_2 fixer woody species like alder (*Alnus nepalensis*) and *Coriaria* (a bush) play important facilitating role. *In fact, succession is a composite ecosystem service package, generating soil, nutrients and control over all destabilising physical forces of nature.*

Much of them are due to oak forests, which are not valued commercially. There is a need to value these services in policy decisions.

Apart from the role of facilitators to forest conservation, the people in mountains provide services (i) by conserving crop varieties, such as of rice, rajma (a bean) and pulses (lentils), and enabling evolution to continue; (ii) by producing organically grown food crops. There is a need to create a niche market for such environmentally clean food produce. A mechanism of certification for ecofriendly goods may help hill farmers. NGOs and modern cooperatives can also play useful role in marketing organically produced food, free of pesticides and inorganic fertilizers. Already, some progress has been made in this direction. Application of vermiculture or other forms of manuring may be included as a part of the package.

As for saving seeds, agricultural universities and institute need to interact with the "save seed" groups (see the work being carried out by Mr. Vijay Jagadgari and others) and initiate steps for developing a suitable payment mechanism.

Strategies

1. Integrate ecological, economic and social systems at all spatial scales, and treat the resulting supersystem as the unit of development and management.
2. Identify, monitor and establish at least a first approximation of the magnitude of services in economic terms.
3. Make people aware of their connections with ecosystem services, for on this would depend the people's willingness to pay.
4. Set-up frame for their further analysis, and expand the scope of ecosystem service by considering how ecosystems vary in regard to services they provide and how to manage them to maximize their combined outputs at various spatial and temporal scales.
5. Incorporate the economic values of ecosystem services into decision making even when they accrue directly to humans without passing through the money economy.

BOX 3

Examples of Ecosystem Services

Watershed services

A famous example of ecosystem service is the provision of adequate clean water to New York City by forests in the Catskill Mountains. This was estimated to be equivalent to a capital investment of US\$ 6-8 billion and an annual US\$ 1-2 billion operating cost for a water treatment plant to carry out the service. The city decided on maintaining water quality via improving forests, imposing control on the use of fertilisers and upgrading local sewerage plants, all combining to cost only US\$ 3.5 billion.

A valley-fill (called Sukha Tal or dry lake) catchment of the Himalayan lake Naini Tal provides 40-50% of filtered water to the lake Naini Tal, but zero value has been put on this service. In fact, the valley-fill is being valued negatively and a part of it is being developed into a car parking. The valley-fill serves the society variously: by providing clean water for drinking purpose, by diluting the pollution of lake water, and by keeping the lake water level high, thus increasing its recreational value. There is a need to give special legal backing for protecting such features of watersheds. As far as known to us no attention has been paid to these aspects while undertaking watershed projects in Himalaya, each one involving massive expenditure.

Forest Services

I give below a comparative account of four ecosystems of central Himalaya, out of which three are forests and one dominated by an invasive shrub, *Lantana camara*. The forest ecosystems differ considerably in their ecosystem characters and services they generate. This kind of diversity gives planners opportunity to procure best output for a region keeping in view the human needs and the aspects of sustainability. This kind of exercise needs to be done for all regions, so as to secure a good combination of conservation as well as meeting the people's needs.

Comparison of the ecosystem services of three Himalayan forests

Forest	Ecosystem characters	Ecosystem services
Banj oak (<i>Quercus leucotrichophora</i>)	Large biomass (400-500 t ha ⁻¹); deep roots and deep carbon storage in soil; high amount of investment of photosynthesis in ectomycorrhizae, massive annual return of nutrients to soil.	Rapid soil formation, high soil fertility, effective carbon sequestration; effective nutrient and water retention.
Chir pine (<i>Pinus roxburghii</i>)	Small biomass (200-250 t ha ⁻¹); high productivity on degraded slopes, high nutrient use efficiency; high stress tolerance, effective coloniser.	Supply of ecosystem services in inhospitable conditions; retention of nutrients on steep and rocky slopes; moderate nitrogen enrichment (?)
Alder (<i>Alnus nepalensis</i>)	Very small biomass (<100-150 t ha ⁻¹), very high productivity (up to 30 t ha ⁻¹ yr ⁻¹); rapid coloniser of fresh landslip; very high rate of N-fixation (up to 200 kg N ha ⁻¹ yr ⁻¹).	Facilitation of more useful species, high carbon fixation, nutrient supply to other ecosystems.
<i>Lantana camara</i> (an invasive species)	Very small biomass (<30 t ha ⁻¹), productivity similar to oak and pine; carbon shortage in shallow soils, low biodiversity, cool but frequent fires.	Low soil carbon storage, persistent fire regime, low nutrient and water retention.

There is a need to put values to the various ecosystem services of each ecosystem, and manage the landscape keeping in view their usefulness, which would vary depending upon the needs of the people. The last example is of an exotic invasive species. Its expansion due to human disturbance leads to a clear-cut loss of services, particularly because of depletion of carbon storage and increased soil and water losses.

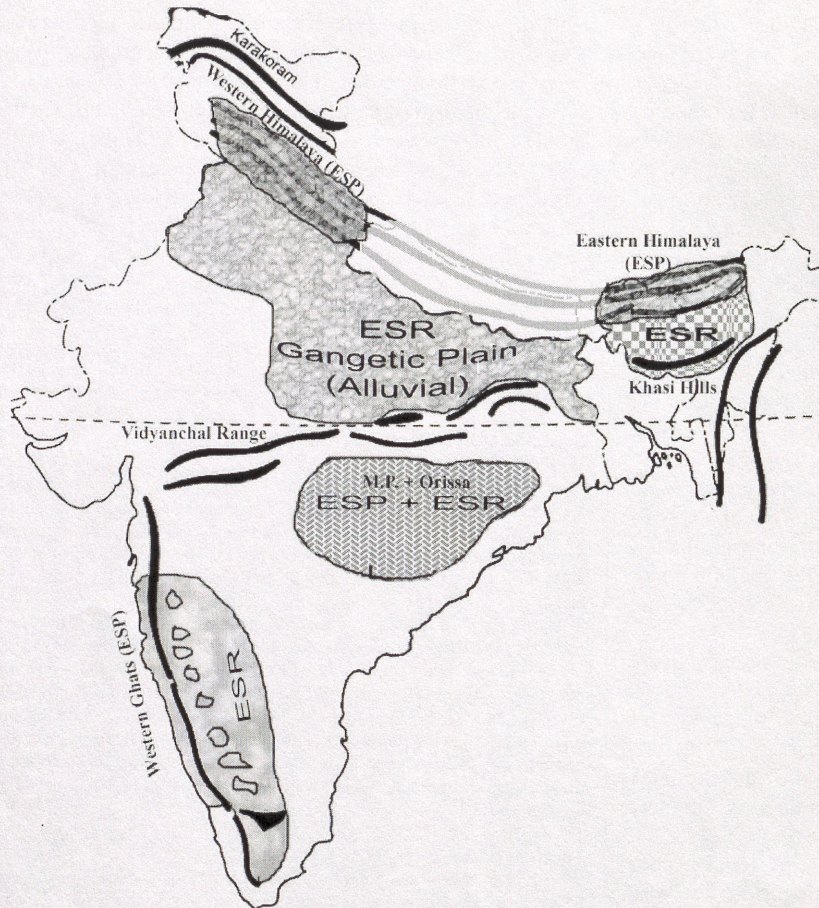


Fig. 1 A representation of principal ecosystem service providing (ESP) regions of India and adjoining service receiving regions (ESR). Areas outlined are approximate. These ESPs are also important in regard to terrestrial biodiversity. Western Ghats and Eastern Himalaya are among the top 22 hotspots. Though not equally important in terms of biodiversity the Western Himalaya exceeds considerably the other regions in terms of ecosystem services, largely because of the large associated territory and river connections.

Actions:

1. Make people aware of (i) the fact that ecosystem services are essential to civilisation; (ii) they operate on such a grand scale and in such intricate and little-explored ways that most of them could not be replaced by technology; and (iii) human activities have already impaired the flow of ecosystem services on a large scale (all concerned institutions including the media).
2. Ecosystems in India are scarcely researched. Undertake detailed studies to understand structure and functioning of ecosystems, linkages among ecosystems and scope of expanding the flow of their services.
3. Undertake additional research to know the entire gamut of ecosystem services at various scales and start with even crudest valuation.
4. Identify and recognise the temporal and spatial scales of the ecosystem service providers (e.g. Western Himalaya) and service user areas, and the people who are associated with conservation or who are facilitators of ecosystem conservation (e.g. people of Western Himalaya) and the people who are getting benefited (e.g. people of Gangetic Plains). Such an exercise is required at all scales: local, regional and global (experts in ecology, economics and social sciences).
5. Create international interest in the ecological importance of WHE in regard to research and management conservation (Scientists, NGOs, Ministry and activists).
6. Modify systems of national and state accounting to better reflect the value of ecosystem services. In many cases economic welfare may indicate decline or levelling in spite of increase in GNP (Financial Institutions, Ecologists, Economists, Planning Commission). It is impossible to do valuation of all ecosystem services at all scales, but there is a need to recognise valuation as an approach or as a process that may help us to bring ecosystem services on to a balance sheet. Valuation of ecosystem

services is also required to assess the economic loss that may occur as a consequence of not conserving a given ecosystem.

7. To achieve the above, there is a need to integrate ecology, economics and sociology both at academic and planning level. Provision of imparting training at various levels is a prerequisite. To initiate the process centres need to be developed where mainstream ecologists of the country are able to interact with social scientists. The University Grants Commission and Department of Science and Technology could take the lead in establishing centres for providing training in such an integrated body of knowledge (continuous efforts at all levels).
8. In project appraisals loss in ecosystem services must be weighed against the benefits. This may apply to construction of a big dam or construction of a car parking in the valley fill of Nainital catchment which provides filtered water to Nainital.
9. To enable people of service providing regions (WHE) to conserve forests, provide alternative energy (electricity and cooking gas, etc.) at affordable costs (Planning Commissions).
10. Using knowledge of ecosystem services and people's need, plans can be developed to maximise the combined benefits at a landscape/regional level (experts and developmental agencies).

Resources needed:

1. Research on ecosystem services and valuation and training - on going process; allocate fund, about Rs.50 lakhs / yr for next 10 years or so for undertaking research project, through MoEF, GBPIHD and DST.
2. Payment for supply of cooking energy / developing alternative energy sources like "gobar gas" / energy saving devices. Rs.100 crores per year, to be continued until economy develops sufficiently to enable people to make payment from their own income.
3. Institute / centres / departments in University to take up teaching, research and training in areas seeking union among ecology, economics and other soil sciences. Ecology group of Kumaun University can play a pivotal role. The goal should be to produce trained persons yearly for managing the WHE with the objective of sustaining ecosystem services. Rs.4 crores per year. → Role?

Prioritisation has not been done as the steps suggested are interlinked. There is the need to apply entire package.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 1B: Crop diversity and organic agriculture to be recognised and promoted

Keywords: Hill agriculture, free-from pesticides, native crop varieties.

Genesis:

Western Himalaya is among the few areas in the world where crop production has remained organic in many areas, and campaigns are being launched to save seeds of native crop varieties (e.g. "Beej Bachao Andolan" of Jadhagaon, Uttaranchal saving about 250 rice varieties, 170 rajmah bean varieties, etc. Throughout the world problems of pesticides and chemical fertilisers and the spread of monoculture for the production of food are regarded as threat to biodiversity and ecosystem services. The traditional cropping in hills is free from these environmental problems and can be regarded as a kind of ecological service. The organic agriculture in hills, however, involves gender issues and aspects of sustainability because it is based on forest energy and excessive workload on women.

Unfortunately, this aspect of hill agriculture has not been given due recognition. Government programmes have helped provide a variety of chemical pesticides, toxic to environment at subsidised rates. Already, extensive land areas have been polluted with high levels of pesticides and it will take many years of expensive operation to bring them to organic cultivation practices again. Currently available organic

The Khulgad Watershed Project of Central Himalayan Environment Association (CHEA)

The Project in Almora, UA is characterised by an integrated approach involving afforestation, organically grown crops, gender issues, providing labour saving tools (such as fodder cutting machines, insect traps and thrashers), water supply, human health and nutrition, capacity building and creation of lasting village level institutions. In this approach CHEA made a detailed guideline in which inter-connections across all components were emphasised. The guidelines were thoroughly discussed with the target community and kept evolving with their inputs. Once finalised, the programme was undertaken only in those villages where the people agreed in principle to these guidelines.

Institutions were built and improved to tackle the issues of water supply (Pani Panchayat), gender equity (Mahila Mangal Dal - was initiated because women were encouraged to participate in meetings giving them labour saving tools and by enabling them to generate and manage money. In some villages an appeal was made by villagers to establish private forests in addition to community forests so that the labour of women on collecting fodder and firewood is reduced) and health groups. For example, the water supply was connected with fisheries and raising fruit trees for local consumption keeping view nutrition problem as well as growing high value crops for marketing (badi elaichi). Cultivation of fruit trees in turn was connected with acceptance of ban on free grazing on the crop field following crop harvest. Each of the village organisations was encouraged to raise funds from their activities to run their organisation. A high percentage of institutions and practices developed about 10-15 years ago

certification criteria are extremely sensitive even to trace levels of pesticides.

Strategy:

Make organic food production sustainable and treat this along with cultivation of native crop varieties as ecological service and develop market and payment mechanism.

Actions:

1. Sustainable organic food production: It depends heavily on natural forests (nearly 6 energy units in terms of forest floor litter and fodder are collected for each energy unit of grain yield), and causes heavy workload on women, resulting in their health problem and depriving them from adequate childcare (also see issue on Participatory Management). To make it ecologically sound and socially healthy the following steps may be suggested:

- a. Provide women with simple labour saving tools like thrashers for wheat, cottage scale mills for rice and ropeways for transportation (also see issue on Participatory Management). (**Agencies dealing with rural development, agricultural plans and related institutes and NGOs** – see efforts made by CHEA in Khulgad Project and by Agriculture Dept. of HP). [IM]
- b. Grow trees, bushes and grasses next to crop fields under small individuals' farm forestry (in addition to community forests) to save women's time and energy and to reduce pressure on natural forests. [IM]
- c. Introduce practices of low-tillage and mulching to cultivation. Low tillage slows down the loss of organic matter and soil moisture, and saves labour energy. While mulching would cut down dependence on livestock for manure, and would thus reduce workload on women. [LT]

2. People of the region are accustomed to buying food, as the agronomic yield caters to needs of 6 months only on an average. By earning more from organically grown crops, the people can buy more food. Further, people of the region suffering from acute poverty can benefit from the money generated by such organically grown crops. This could enable them to cater to their health and nutrition needs better.

Marketing food items is often suggested to cause nutrition deficiency and health problems. To address these problems additional health and nutrition awareness campaigns would be required rather than depriving people from earning more. As society learns and matures with respect to health issues, the people would be able to manage themselves better. For example, in Khulgad Watershed Project an integrated approach was followed involving such diverse aspects as water supply, organically grown food, human health and nutrition, fodder plantation both on community and private lands, introduction to fruit trees (from human health viewpoint), marketing viewpoint), marketing agricultural, produce, etc.

3. We could also consider linking crop diversity to the Public Distribution System and with an arrangement that the ration shops actually stock grains other than rice and wheat, and ensure buy-back arrangements with farmers; this would provide an incentive to farmers to continue growing diverse crops as it would give them a secure market. [LT]

The marketing of organically produced food could have the following highlights:

- a. Safe and healthy food
- b. Develop Safe Food Certification system at a regional level (**Agriculture Universities can be entrusted with this task**).

Changing Cropping Patterns

The past years have seen some substantial changes in cropping patterns in the Western Himalaya, improved roads and better marketing linkages have allowed many hill farmers to transform, their subsistence yet sustainable cropping patterns into a market driven system. Much higher value off-season vegetables have replaced traditional cereals. This transformation has been largely supported by the administration in the name of agricultural diversification or modernisation. However, little thought is given to the impact of this change.

Vegetable crops usually require much higher input of nutrients than the traditional crops they replace. As chemical fertilizers are not suitable for the sloping rain-fed fields, compost manure continues to be used. However, to generate more compost, a larger amount of leaf litter needs to be gathered from the forest. This leads to depletion of nutrients from forest soils and damage to young regeneration. In addition, larger amounts of dung are required to make the compost and hence more cattle are kept. As a result, the primary function of many hill cattle is to produce not milk, but cow dung. There is little incentive to improve cattle strains. With cattle of poor quality, stall-feeding remains uncommon and cattle are allowed to graze in the forests thereby damaging hardwood regeneration. Also, despite the higher nutrient inputs, the nutrient status of the soil tends to get depleted after many years of these crops.

Unlike the traditional cereals, vegetable crops yield little or no residue that can be used to feed cattle thereby further exacerbating the fodder storage and increasing dependence on the forest. There are also implications for food security by this excessive dependence on the market and price fluctuations that can be quite sharp are added on as yet another variable in the farmer's life. Vegetable production also tends to be more influenced by climatic factors and disease than production in traditional crops.

While vegetable crops do help local farmers to increase income, at least in short term, there are several issues of long term sustainability, both of agricultural land and the surrounding forests that need to be carefully looked at before promoting these in the name of agricultural modernisation.

- c. Begin with marketing in big cities, both within and outside the country.
- d. Create an atmosphere for such safe, healthy, and tasty food through media and extension work.
4. Conserving native crop varieties: **It is a major service initiated in the region, because by cultivating various crop varieties further evolution is ensured.** In contrast, the ex-situ germplasm collection amounts only to the storage of the products of past evolution.
 - a. **The State** should make payment to the identified, selected and certified farmers (about 3000 in the entire ecoregion) for their biodiversity service, and try to get support from international granting agencies. These can be tagged with agricultural universities and institutes. [MT]
 - b. The material can be used as a research resource **(Agricultural bodies like ICAR needs to take initiative).** [ST]

Limitation in developing Orchards

The use of pesticides would continue in orchards and would be in more use as the proportion of orchards increase in size since the development of resistant fruit trees takes longer time than in case of annual crops. The use of pesticides in mountains would mean their spread to a much larger areas than when it happens in the plains.

The opportunity foregone in view of the larger interest should be taken into account while developing payment system.

Case Study: Survey of Pesticides Use in Kullu District

This study was undertaken in the villages of Jigala in the Banjar Valley and in Jhiri and Jate of the Kullu valley, District Kullu. The major findings were:

1. With changed traditional land-use patterns there is an increased use of new on-farm technologies in the forms of horticultural tree species and on non-renewable resources.
2. Introduction of chemicals in the forms of insecticides, pesticides and fungicides in the study villages started 20-25 year back; the pace has increased tremendously over the past few years due to spread of apple growing.
3. Some of the banned, dangerous and harmful chemicals are frequently being used by the farmers.
4. Some of the non-recommended synthetic chemicals are being used by the farmers.
5. Availability of desired chemicals at required time to the farmers is lacking.
6. Varieties of chemicals usage has subsequently resulted in a number of short-term and few long-term health impacts on human beings; intensity and frequency of new diseases has increased in the area.
7. Overall ecological, environmental and socio-economic changes have been noted in the study villages.

Suggested corrective measures

1. Number of recommended chemicals in the forms of insecticides, pesticides, and fungicides should be curtailed down to a minimal number based on proper scientific study and the introduction of bio-chemicals.
2. Infrastructural facilities like masks, goggles and body covers should be provided on subsidised price.
3. More technological alternatives are still needed. Knowledge is sorely lacking about sustainable on-farm management.

Source: State of the Environment Report Himachal Pradesh. State Council for Science, Technology and Environment, Shimla, HP

5. Removal of perverse agricultural incentives, such as subsidies on Green Revolution technologies and inputs; also tackling the fact that there are no financial and other incentives for organic, biodiverse farming.
6. Training and sensitisation of agricultural extension workers towards agrobiodiversity issues, including through workshops with knowledgeable farmers and farmer groups. GBPIHED has done a good documentation work on agrobiodiversity.
7. Reorientation of the R&D at the agricultural research institutes and agricultural universities, such as the G.B. Pant University of Agriculture and Technology and others needs to be done. Already orientation has been initiated. For example, in Uttaranchal, a senior IAS, has initiated several steps including establishment of a network centre of organic manure at Pantnagar University. Vermiculture is being popularised in HP through NGOs.

Resources needed:

The 3000 identified farmers would need to be compensated @Rs.2000 ha/yr for their biodiversity services.

Priority:

1. Recognise the maintenance of crop varieties as a service of national and international importance.
2. Improve women's participation condition to enable them to participate.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 2A: Participation remains weak, superficial and ineffective, though participatory management is held out to be the basis of conservation.

Keywords: Equity, labour saving tools, women participation.

Genesis:

People have become alienated over the years in regard to forest management. For example, in the past community used to help the state in fire-fighting, but now their contribution is weak and less reliable. In recent years the realisation that forests cannot be protected without people's help has made a place in policy decisions. However, participation still remains weak.

Strategy:

Promote participatory management through the strengthening of village level institutions (VLI's), and by expanding its scope and considering all possible interconnections and bringing about necessary social changes. For example, the salient features of the Van Panchayat of Uttaranchal needs to be studied and extended to other states of Western Himalaya

Action plan:

While participatory management is held-out as the basis of conservation, participation remains weak and ineffective. Building local capacity and then empowering local communities to take control is perhaps the most appropriate solution. A blueprint approach to biodiversity conservation where centralised planning is implemented across a multitude of conditions will not work. Attention must be paid to local conditions and locally appropriate microplans must be developed.

1. Improve equity within the community and between community and outside partners (e.g. community and forest officials) involved in forest and biodiversity management.

a. Within-community equity:

i. Ensure that women and weaker social groups are well presented in the community organisations. Women's issues need to be given special consideration in Uttaranchal and other hill areas there they are over-worked. To achieve this:

- Take necessary steps to make conditions favourable for women participation (State, NGOs and community). [ST]

Provide labour and time-saving tools and using efficient devices such as "gobar gas", pressure cookers, improved stoves to women to reduce their drudgery at affordable costs, as their daily routine of hard physical labour hardly allows them to attend community meetings For example, a single small sized (1 cu.m) biogas plant can, over its life, can prevent the degradation of over 1 ha of forest (State may initiate). [ST]

- Sensitize men so that some of the work of women is shared, and that they feel their participation is important (NGOs and other social groups). [MT]
- Adjust meetings timings to suit women (Community). [IM]

Finding Alternates

Collection of biomass from the forest by local villages is today one of the chief causes of forest degradation and biodiversity loss in the Western Himalaya. Chief among these are fuel wood for cooking and heating, and green-leaf fodder for animal feed.

An effective way then to save the forest and the biodiversity they hold is to find alternatives to these products. CHIRAG has been doing this for over a decade and some of the successes are impressive. Biogas was popularized as a means to save fuel wood and also improve the lives the hill women who spend several hours very day collecting wood. Biogas generation is a chemical process where organic matter such as cattle dung is digested anaerobically by microbes (in the absence of oxygen) to yield a mixture of methane (about 65%) and carbon dioxide (about 35%) Methane (CH₄) is a highly combustible gas and can be used for cooking heating or lighting applications. While, it was initially felt that biogas technology would not work well in the cold mountain environment, CHIRAG has had considerable success working at altitudes as high as 2,000m (6,000 feet). Small sized biogas plants, 1-2 m³ are built which can be run from dung product off 2-5 cattle - a typical number for families in the region. Biogas allows for a 30-100% saving on fuel wood (depending on the altitude, season, and care taken by the users). In the warm season, fuel wood requirements are typically completely fulfilled by a biogas plant. A survey carried out in December 2001 by CHIRAG found that average fuel wood requirement that had been between 10-30 kg per family before biogas plants were installed, today range from 0-12 kg, a 75% reduction in firewood or a saving to about 15 kg per day. Over the past decade, CHIRAG has built over 1,100 biogas plants resulting in a saving of over 6,000 tonnes of fuel wood annually.

Other programmes that have had an impact in saving biodiversity through a reduction of people's dependence on forest include the popularisation of pressure cooking and a fodder management programmes. As the boiling point of water is low at high altitudes, and hence cooking time light, the use of pressure cooking (which out down on cooking time by raising cooking temperatures) is a particularly effective method of saving energy. CHIRAG also had success in a fodder promotion programmer where people were convinced to stall feed animals and village forests were closed to cattle. This helped increase the production of natural grass from these protected forest and village with a deficit of fodder started producing a fodder surplus within a three-year period, silage production was also promoted as a way to store fodder for the winter. People no longer had to lop large amounts of green fodder from oak and hardwood trees during the winters thereby protecting these and the forest ecosystem.

Thus, an integrated development approach aimed at improving the quality if life of the local people can have major benefits for biodiversity as well.

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- ii. Contribute to the reduction of collection work by providing access to firewood, fodder, and litter species near homesteads, and by improved manuring (SFD and community managed plantations of these species). [ST]
- b. Equity between community and the State
 - i. The state officials should be sensitised to make people their effective partners. The officials need to be considerate to the constraints of people, and respect the knowledge they have. The people should be given training and knowledge to contribute effectively (State). [ST]
 - ii. Ensure community participation when programmes and projects are conceived and developed. Developing agencies often seek people's participation after they are ready with the finalised programme (State). [ST]
- 2. Participation should not be reduced to being an "add-on" to a programme. It may be realised that it can be quite time-taking and may involve costs. Effective application of information technology to it may improve participation.
 - i. Ensure participation of experts, social workers, relevant institutions, etc. when big projects such as of the JFM-scale are undertaken (State). [IM]
 - ii. Participation in programmes relating to conservation should be regarded as a kind of necessary duty of the Indian citizens. It amounts to achieving an expanded form of democracy (State). [IM]
 - iii. Therefore, it calls for educating people, participation and training of concerned institutions, universities and colleges, and monitoring changes periodically (State and agencies involved in education). [IM]
 - iv. Given the widespread importance to participatory management, all concerned agencies need to have a participation cell from their resources (State and political institutions). [IM]
 - v. Apart from the State in general, state forest departments, NGOs, forest ecologists, forestry experts, social scientists (with forest as main areas of research) of universities and institutions, and politicians are expected to play significant roles in participatory management of biodiversity. [ST]

Resources needed:

Most of the action plan can be undertaken with the help of the present infrastructure after necessary adjustments, change in attitude and restructuring guidelines. Some of the energy saving devices are already subsidised and some need a subsidy, but their popularisation and acceptance among the locals is to be strengthened.

However, financial support would be required for raising plantations next to crop fields and for providing labour saving tools. These can be accomplished through Gram Panchayats, VPs, and NGOs. About Rs.2 crores would be required annually for next five years. See also the issue relating to organic food production.

Priority:

There is a need to give the highest priority for human participation and creating an environment for it by providing labour saving devices and improving access to fodder and firewood species next to homesteads.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 2B: **The time-tested and unique institution of Van Panchayat of Uttaranchal needs to be improved and extended to other states of Western Himalaya.**

Keywords: Community forest, JFM.

Strategy:

Make the functioning of Uttaranchal's VP more autonomous, self-sufficient and financially viable. It should not be disturbed by creating parallel JFM institution.

Actions:

1. The involvement of the SFD in the activities of the VP should be reduced and the govt. should limit its role to only advisory and supervisory say, as and when required (SFD). [ST]
2. The process of budget making and utilisation should not only be made less bureaucratic but more transparent and participatory. Instead of strengthening the control of SFD, the community should be made more capable to handle finances. There should be a provision for getting approval of the village by involving representatives from all households. To achieve this, a kind of **General House of the Van Panchayat** can be instituted that would include representative of each household. They can meet once or twice a year for the purpose. (SFD and VP) [ST]
3. There are many success stories in VPs in which degraded/ deforested land was restored and made a VP forest. This shows that such a kind of participatory institution can be used to recover deforested land under even reserved forests category. In brief all the deforested land which the SFD has been unable to reforest in over a decade time or so should be handed over to the VPs. This would lead to an adequate size of VP making sustainable forest use feasible. Once the adequate size of VP forest is achieved, forest use of the people in the reserved forest can be stopped. This would enable in fixing clear-cut responsibilities of the Govt. in the case of RFs and the people for VP forests (SFD). [LT]
4. Given that only a small amount of money is generated from the VP forests, it is ridiculous to think that its money can be used for other welfare activities in the village. Since the forest degradation is the biggest issue in most

A note on: Uttaranchal's Van Panchayat (Forest Council or Forest Committee)

Van Panchayats (forest council or forest committee) were introduced to Kumaun in 1920s following agitation against British expansion of control over forest areas. The landmark Van Panchayat Act 1931 handed over control of designated community forests to elected Van Panchayat (VP) members in place of the State Forest Department (SFD). The VP probably represents one of the largest experiments in common property management in collaboration with the state (both SFD and State Revenue Department). In this an elected body, called forest committee or forest council holds responsibility of using and managing village forest resources. However, the various activities are under the control of rules of the Revenue Department, and the SFD is supposed to provide technical inputs. In a way, the village forest is a resource, used by a definite user group (the village people) and is liable to degradation due to over use. Though called village property, the land in reality belongs to the State, however, village people consider it as a collective property and resent government interferences. It is not a common property of Hardin (1968) with open access and no rules for governing the use of or control over a resource.

Most community forests were initiated on degraded sites. Officially on a kind of civil/soyam forest, falling under administration of the Revenue Department. But unlike Civil Soyam forests the community forests are not open-access forests. Depending on the number of households in a village, there are generally 5-9 elected members in a VP, who elect a "sar panch" from among themselves. Elections are held after 5 years. At least one scheduled cast and/or woman member should be elected to the committee.

Responsibilities:

The responsibilities are laid out in the law as following: (i) To

Continued...

A note on: Uttaranchal's VP

Role of NGOs

NGOs in certain cases have made useful contributions. For example, CHIRAG, while working in Kilmora and Katural VPs Nainital districts redefined the forest guard as "forest maintainer", and he was also trained to improve the growth condition of tree seedlings and saplings, repair boundary walls and protect trees from excessive lopping.

Gender Issues

Though at least one woman is required to be in the VP, her forced inclusion has not led to genuine representation at least in above VPs of Nainital district. The female representatives either send their son or husband, they are reluctant to attend the VP meetings. The most obvious constraint is the heavy workload involving bulk of childcare, collection of fuel wood, fodder, litter and water, cooking, other household and agricultural activities. Also they feel that they are not encouraged by men to attend meetings. In recent years this issue has been raised repeatedly and men in some cases seem to welcome women participation, but not much progress has yet been made.

Success and failure

At present there are about 5000 VPs in Uttaranchal occupying nearly one-fourth of the forest area. Typically, the VPs become dysfunctional where village forest area is inadequate to meet the community needs (at least 1 ha of forest is required per household), where villages are very small (less than 30 households) or very large (over 100 households), where out-migration is high, where government officials are insensitive, and where members are busy along with other occupations like maintaining shops and jobs in nearby areas. The fact that in many areas VPs have been successful in conserving forests clearly indicates their importance.

Apart from this, village forest in way represents (i) a kind of empowerment to the people, and (ii) people's participatory role in the functioning of the nation. It represents important social institution in which more creative activities can be initiated.

Present scenario

There is a fear that the JFM scheme funded by the World Bank may disrupt the VP functioning that had been working without any outside financial assistance. The funding would stop once the scheme tenure is completed and it might be difficult to revive old the culture once the people get used to the outside support. The recent Forest Van Panchayat Niyamawali, though an improvement in certain aspects has still not freed the VPs from the irksome bureaucratic practices.

VP, achieving the goals of conservation and sustainable use themselves are a big accomplishment from the money generated. Thus the VP should not be diverted to activities other than VP forests. (SFD) [ST]

5. The JFM scheme though has a noble objective of involving people in the management of forests did not do so in a way that would also make them independent. On the other hand through injection of large amounts of funds it disturbed the existing institution of Van Panchayat of Uttaranchal that was hitherto being managed by the village people from their own resources. Further, JFM does not have a successor for financing activities and this could create a void if funding is not available for the existing JFM Committees (SFD). [ST]
6. To accomplish the extension of the VP institution to the remaining villages of UA and other states, orientation workshops, public hearings, and meetings need to be undertaken at different levels by the states and make necessary amendments to the Forest Act. (SFDs, NGOs, MoEF) [ST]

Therefore, let the VP remain the sole institution for community forest management in Uttaranchal and this model should be applied to other states of Western Himalaya, with necessary adaptive measure. If required, the positive points of JFM could be incorporated in the functioning of VP. Rather than any large inflow of govt. funds, the villagers should be encouraged to use any revenue generated from the VP forest to further improve its quality. Incentives can be given for VPs that are well protected and external support should be largely restricted to activities that help build community ownership and build local capacity to manage forests.

Resources needed:

1. To determine adequate VP forest size (would depend upon site quality, forest type, level of degradation, population that it would support, etc.) about Rs.1 crore / yr and to be completed in about 15 years.
2. One time expenditure of about Rs.5 crores would be needed for creation of VPs and the requisite training / orientation of the villagers.

Priority:

Stop creating a parallel institution of VP, and extend VP to the remaining areas of WHE.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 2C: Livelihood oriented conservation holds potential in both Protected Areas and outside

Keywords: Union between income generation and conservation, sustainable harvest, Himalayan alder, medicinal and aromatic plants.

Genesis:

Seeking union between money generation from biodiversity and its conservation is one of the new areas being tried and tested in developing countries. The idea is that by sustainably harvesting biodiversity, processing the products meaningfully (value addition), and earning money, the people can reduce acute poverty, which in turn may enable them to be more conservation oriented. Indeed it is very hard to figure out the rate of sustainable harvest from natural ecosystems, and to make people to bring it in practice, and earn money from the goods. This conservation approach needs to be tried in WH at least, where harvest of biodiversity is already going on in an inefficient way. The emphasis should be on developing products without affecting integrity of ecosystems.

The products may include numerous NTFPs, nature tourism, and others (Crook and Clapp 1998¹). It is implied that the harvest from natural systems would be sustainable and the system would remain intact. The resin extraction from pine and the trade based on it may be recognised as one of the major NTFPs based commercial activities carried out by the SFD in the Western Himalaya. In recent years community based marketing of products like tusar silk, medicinal plants, nature tourism, honey, etc. have been attempted in the Himalaya, particularly projects sponsored by BCN, Washington. Outside India, such attempts are being carried out in several Southeast Asian countries and in tropical forests.

Livelihood opportunities from sustainable harvest of oak: A Case Study

Appropriate Technology India has carried out a unique project supported by BCN in which the main objective is to seek union between conservation of oak forest and improving people's livelihood opportunities. The main features of this success story are the following:

1. The NGO has successfully obtained the participation of very poor villagers and VPs.
2. The ecologists developed the level of sustainable harvest of oak leaves for rearing silk worms and made it socially acceptable. A monitoring institution involving representatives of several VPs is being used.
3. A number of experts on rearing silk worms using modern techniques was made out of the village people.
4. A limited Company was established in which people living in subsistence level were made shareholders. The people were the rears of silk worms. All subsequent activities leading to the production of silk cloth has a substantial representation of women.
5. Naturally recruited seedlings of *Quercus semecarpifolia*, a major oak of Himalaya encountering regeneration problems were given protection with the participation of villagers who made a solemn promise in temples to protect and nurse the oak seedlings like their own children.

The unique combination of conservational and entrepreneurial approaches is the most distinguishing feature of this exercise.

¹ Crook, C. and Clapp, R.A. 1998. Is market oriented forest conservation a contradiction in terms? *Environmental Conservation*. **25(2)**:131-145.

Strategy:

To seek union between community-based biodiversity conservation and livelihood issue.

Action:

1. Identify NGOs, village based communities, resource persons and research groups for undertaking pilot studies. In this respect the experiences of ATI at Ukhimath, Uttaranchal in which village community has been involved in tusar production (oak based silk) and the marketing of its products, and honey should be examined critically for possibility of future replication. [MT]
Similarly experiences of ANSAB, Nepal in case of medicinal plants and handmade paper, and that of GBPHIED in case of ecotourism may also be analysed.
2. Certain measures which emerge from experiences and analysis throughout the world are as follows:
 - a. combine several market oriented activities for a given area. For example, from an area having oak forest near a river or lake with the backdrop of snow-clad mountains and cultivated terraces around, several commercial activities including nature tourism, collection of medicinal plants and lichens, production of tusar can be generated. In many situations one or two may not be sufficient as an alternative to other forest use or other economic activities. If activities like ecotourism are to be promoted, it is necessary to promote infrastructure to support such activities. This includes "green resorts" and also information about the ecosystem through good guidebooks and a network of information centre. (Ministry of Tourism and State Tourism Depts.) [ST]
 - b. Livelihood oriented conservation should be undertaken in areas with limited alternative uses of land. Such areas are very common in Western Himalaya. [ST]
 - c. The resource density should be high so that time and energy required to collect them are convenient. For this purpose, the WH forests generally provide good material. For example, oak leaves for tusar culture are high density resource, while *Taxus* bark for taxol is a low density resource. [ST]
 - d. Activities which involve the use of plant parts such as leaves and that does not kill the whole plant are likely to be more sustainable, i.e., non-destructive harvesting.
 - e. Before undertaking activities on given biotic resource its biology and ecology should be comprehensively investigated and changes monitored. Special emphasis should be given to

Himalayan alder

Himalayan alder (*Alnus nepalensis*) is of family Betulaceae to which belongs birch (bhoj patra)

Sites colonised by alder include landslides, debris and alluvial deposits along rivers, and any geologically young site; it does well even when drainage is poor. Easy to established through seeds: at least some species, e.g. red alder of NW Pacific are propagated vegetatively.

Tripartite symbiosis- it involves alder, *Frankia* a nitrogen fixer actionmycete and mycorrhizae, both ectomycorrhiza as well as vesicular arbuscular mycorrhiza (VAM).

Alder holds a great potential as light - wood timber species. Red alder (*A. rubra*) of NW Pacific, as an example provides raw material for a thriving industry, producing furniture, cabinetry, specialized Veneers and plywoods, shipping pallets, turned-wood novelties, interior furniture, paper pallets and paper products. The Himalayan alder is used in house construction, and in other places where direct contact with water is not a problem. Colour stability, low shrinkage and high nail holding ability are important features of wood. In Oregon, USA 75% of the hard wood harvest was red alder in 1991. For these regions the Oregon and Washington export of alder timber to Asia has increased from zero to over 65 million broad feet in 1991, accounting for nearly 10% of the total US hard wood timber export to Asia and Europe. In USA alder provides production-time jobs to 23,500 people. There is every reason to believe that the Himalayan alder can be used in the same way as red alder, as it resembles it in many properties. Remember, even in the USA alder industry is quite recent.

Information required: Little is know about Himalayan alder, except that is it among the fastest growing species, a great nitrogen fixer (upto 200 kg ha⁻¹ yr⁻¹), can attain net primary productivity in excess of 20t ha⁻¹ yr⁻¹.

Research is required on the following: (1) Ascertaining plantation density for various uses. (2) Establish database on NPP and yield and N₂ fixation. (3) Ecological factors stimulating and suppressing growth in pure and mixed stands. (4) Stand dynamics both in monoculture and associated species, both broadleaved and conifers. (5) Detailed understanding of tripartite symbiosis, and biodiversity promoting activities. For these apart from plants, ectomycorrhizae and other fruiting fungi, and other microbes may be considered. (6) Ecosystem services associated with alder, such as rate of soil formation, generation of soil fertility, water filtration, facilitative role, and etc. (7) Organizing village communities to take up alder as an industry. (8) Producing useful items and marketing them.

Why alder so suitable for Himalaya?

1. It is a disturbance dependent (early successional) species, and disturbances (landslides, erosion, and alluvial deposition, etc) is major and permanent feature of the Himalayan landscape.
2. Its rotation cycle is quite short and can be put to use right from 8-10 yrs.
3. It is a great N₂ fixer and a facilitator species, helping several other important timber species.
4. It is already present in large amounts

regeneration processes. Species responding favourably to disturbances and resultant opening of the canopy are suitable species.

- f. The ecological aspects should not be limited to only the species to be harvested but also to related biotic and abiotic components and functioning of ecosystems on which depend various ecosystem services. Recall the value of ecosystem services in monetary terms is enormous, exceeding US\$ 33 trillion annually (Costanza *et al.* 1997. The value of the world's ecosystem services and natural capital. **Nature** 387:253-260).
- g. Species which respond well to disturbance such as alder (*Alnus nepalensis*) and pine (*Pinus roxburghii*) make very suitable material to initiate such activities (see box) in Himalayan mountains which are prone to natural disturbance. [LT]
- h. All the uncertainties relating to access to natural resources should be removed. Uncertainties may be related to change in government policy with regard to forest resource use, its transportation, other related factors (e.g. enterprises based in *Carpinus viminea* had to suffer heavy losses subsequent to Govt.'s decision to ban its cutting and use), exposing the entrepreneurs to high risk factors. The approach should be to anticipate the problem well in advance by considering the amount of available resource, rate of harvest, demand, regeneration processes, etc. so that such drastic changes in policy are avoided. [MT]
- i. Enterprise based on only such species would be cost effective which are not planted nor have synthetic substitutes. For example, the active compound of *Taxus* bark has no synthetic substitute. [MT]
- j. The community maintaining and benefiting from sustainable forest use must be able to enforce exclusive rights and control over use of forest and other natural systems. VPs/forest user groups in Nepal are good examples of forest institutions. They however need to be strengthened by giving them legal support. [MT]

To conclude, we can imagine a forest system as an example, which has its structure and functioning intact for providing ecosystem services; and supporting bird watching and other activities of nature tourism; and from which market goods are generated by processing leaves or seeds of a tree for by collecting mushrooms and morels.

[The market and livelihood oriented conservation is a difficult and challenging area, requiring inputs from various experts and organisations (ecologists, economists, NGOs, state, etc.). A nodal agency at ecoregion level may be required, keeping in view the above factors, particularly relating to marketing.]

Resources needed:

1. About Rs.2 crores would be required for period of pilot studies.
2. About Rs.1 crore would be needed for a research into the options and preparing a detailed guideline for determining the optimum combination livelihood oriented for different places.
3. About Rs.3 crores for undertaking pilot project for enterprise development. AT India could play a leading role in this field.

Priority:

1. Undertake sufficient number of pilot studies.
2. Ensure certainty and community right.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 3: Revive natural forest regeneration, undermined during last three decades in all forestry programmes including World Bank sponsored projects

Keywords: Plus trees, selective filters, seedlings

Genesis:

Species regeneration is the very process that enables forest and grasslands to perpetuate, maintains their dynamism, and leads to selection of individuals and other evolutionary processes to take place. Regeneration of trees in natural forests was given due importance in early forestry plans of India, particularly in Western Himalaya. Troup (1921), who worked in India, was among the first in the world to describe tree regeneration of numerous forest species. However, with the initiation of plantation forestry and target-based plantation in big way during 1970s in the plains of India, issues of natural regeneration were gradually trivialised and sidelined even in hills. Plantations are the need of plains where most of forest were cut long ago, but in hills where natural forests occur, regeneration should be given due importance (see the issue on Blanket ban on tree cutting). In subsequent decades a forestry set-up has come to be established in which not many are familiar with various management practices required to promote natural tree regeneration.

The ban on tree cutting in Himalaya, which became the principal step of forest conservation, further sidelined the regeneration processes. In recent years selection and promotion of plus trees further reduced its importance. **In brief, over-emphasis on plantations, protection of individual trees to protect forests, and promotion of a few types of fast growing individuals (plus trees) have led to the trivialisation of forest regeneration.** It is possible that by planting plus trees, we may increase productivity of a good forest site, but we cannot ignore the intensity of selection that takes place during seed germination and initial years. By ignoring selective filters consistently, we would be limiting genetic material existing within trees.

Plus Trees: All is not good with them

The plus trees are selected by taking all prescribed parameters of superior phenotypes, i.e., rigorously growing healthy trees, straight clean bole, wood quality, compact and narrow branching system, disease and pest resistance, thin and small branches with large branch angle, absence of forking and buttressing, good natural pruning ability, etc. A point scoring system is used.

Comment: This approach would eventually narrow down the genetic base of the species. A given character may be useful in a certain condition but may prove to be of no use in other conditions. For example, a straight bole is irrelevant in case of a fodder tree where high protein in leaves and greater foliage mass is most desirable. Similarly, the resin concentration in pine is greater in twisted trees than in straight bole trees. More allocation to roots than stem would be required on a nutrient-poor dry site. The main problem of the area is to restore forest on the bald and degraded hills with little soil and holder holding capacity. Profitable plus tree forestry can be practiced only in lands where agricultural crops are grown.

Strategy:

Revive natural tree regeneration as the very process for forest revival with the additional benefits of:

- i. conserving both species, and intra-species genetic diversity, and
- ii. saving cost of future plantation activities.

Action plan:

1. Develop a modern training course and provide training to selected foresters, NGOs, all VPs and JFMs on regeneration of trees (involve forest ecologists in universities who have done research, and persons working at - FRI, SFDs, Training institutes. This can be done by combining efforts of the three states of WHE.) [ST]
2. Take-up long term research and develop database, considering seed-crops, seed germination, seedling establishment and conversion to larger age/size class (through Universities and institutes). Seek relationship among these and canopy gap size requirement, effect of disturbances and role of wildlife in promoting and suppressing regeneration. [LT]
3. Identify seed masting in various species and declare it as special event of protection of regeneration. There are evidences to suggest that mast crops can be used to revive regeneration of all oaks and sal. (The three states of WHE need to combine theirs efforts.) [LT]
4. Make communities familiar with the importance and mechanism of natural regeneration, and initiate measures required to promote natural regeneration through them and NGOs. (SFDs) [IM]
5. Make necessary changes in Forest Act and declare promotion of regeneration processes and protection of seedlings and saplings as part of duties of all forest users. Declare damage to regeneration even a greater crime than tree cutting, and impose punishment legally. It is better to use a tree, and save seedlings and saplings because one damages them unnecessarily without any gain. (MoEF) [LT]
6. Identify location of sites regenerating well and ensure their protection for a suitable period. Involve communities, schools and colleges in this exercise and establish demonstration plots. (SFDs) [LT]
7. A community based monitoring would be required periodically. **Since most of the dominant forest tree species are common to all the three states, it would be useful pooling together of their efforts**

to deal with various aspects of regeneration. The three states of WHE must form a joint body to implement the above steps. This would not only strengthen the programme but also save expenditure. Other states having natural forests can also adopt the programme of natural regeneration. The committee may consist of senior forest officials of the states, scientists working on regeneration issues (indicated by published documents, and field experience), and community representatives. The committee may be constituted by the MoEF with the help of state's officials, institutes and universities. Only those foresters who have experience of working in regeneration should be considered. The committee should be endowed with capacity and rights that enable it to take work crop all concerned people, and contribute to capacity building at community level. Sufficient resources should be ensured to deal with the various aspects of regeneration, such as regeneration from free grazing, fire and lopping. [LT]

Resources needed:

1. About Rs.25 lakhs for development of course and for holding training, workshops, demonstrations, etc. involving consultants about Rs.15 lakhs over a period of 5 years.
2. Using Preservation Plots, PAs and experimental sites establish a forest research network of national and international stature involving the services of scientists from different parts of the world. It would require establishment of field stations. The initial cost of the set-up would be about Rs.40 crores and would need about Rs.50 lakhs annually.
3. The database development and related research would need about Rs.10 lakhs annually.
4. The remaining could be done by the SFDs from their own resources.

Priority:

1. Make necessary changes in forest acts so as to promote natural regeneration.
2. Undertake research and train community for monitoring regeneration.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 4A: Restructuring and modernisation of administrative network of forest and protected areas keeping in view the needs of conservation of biodiversity and ecosystem services.

Keywords: Ecologist forestry, FRI and ICFRE

Genesis:

The recruitment of forest officials is open to candidates of all science streams, qualification in disciplines related to forest ecosystem studies is not required. This practice began during the colonial times when utilisation of forest and policing were the main functions of the State Forest Department. The idea is to appoint administrators on the line of civil services. The problem is that no distinction is made between the knowledge of technical and social aspects of forestry and administrative experience. The aim then is to create generalists, good at everything but experts at nothing. If administrators are given charge of silvicultural operations or are supposed to be social experts, problems will occur. **But now when conservation of biodiversity and management of ecosystem services are going to be the principal goals there is a need to orient the departmental structure accordingly.** Many changes are taking place. For example, when the state forest service came into being, PAs were not the main component of conservation, and forestry and forest ecology were not the major disciplines in Indian universities and other academic institutions.

Forms of forestry over the years

1. **Custodial Forestry** - focussed on protecting the forests from over exploitation and fire. This was practised when the forests were in abundance and level of harvest was low and natural regeneration was not a problem. Market demand was also low.
2. **Sustained Yield Timber Production Forestry** - focussed in assuring a continuous supply of timber. In this sophisticated management was required to maintain a sustained yield of timber with a focus on rotational harvest.
3. **Multiple-Use Forestry:** In this forests are managed also for produce other than timber. Though practised from time immemorial, this management practice was codified in law recently.
4. **Production Forestry** - Focuses on intensive efforts to maximise timber production following agriculture paradigm. This started in 1960.
5. **Ecological Forestry (also called New Forestry / Forest Ecosystem Management):** In this, emphasis is placed on natural pattern and processes, understanding them, working in harmony with them, and maintaining their integrity even when it becomes financially difficult or inconvenient to do so. In this approach value of forest as a source of biodiversity and ecosystem services is of paramount importance, all others are secondary to it.

Strategy:

Undertake the required structural changes in SFDs consistent with the system in which conservation of BD and sustenance of ES have become the overriding objectives.

Actions:

1. Divide the state forest service between administrators and experts. While administrators could be appointed in the same manner as in the past, the experts should be appointed from different disciplines. The number of administrators should be reduced drastically, and they should not affect service conditions of the experts.
2. Recruitment of candidates having requisite background (MoEF) **[IM]**
 - a. in disciplines relating to ecology and biodiversity for forest management,
 - b. in wildlife for Protected Areas
 - c. in social sciences with expertise in participatory management and specialised experience in working with the people in institution building in certain areas of the forest service where interaction with people is to be crucial. This applies in particular to the Western Himalaya where some of the village level institutions have worked effectively for several decades.
3. Provision should be for recruiting experts from different services at all stages, i.e. junior, middle, and senior level posts.
4. Orientation of the existing staff by providing refresher courses and training, etc. in the required areas as mentioned above. **[ST]**
5. A separate department or service should be created to manage the PAs at Western Himalaya Ecoregional level and similar arrangements could be made for other regions. It could become a part of central services if such an organisation were to be developed. In addition to utilising some of the existing personnel from SFDs in the new department about 100 persons at various levels would be needed. (MoEF) **[ST]**
6. There should be incentives for (i) good research publications, (ii) providing effective services, such as taxonomists who identify organisms for the sake of others, and (iii) excelling in institution building at village level and in participatory management.
7. The FRI and ICFRE should be restructured so as to promote the cause of research. In no case generalists having inadequate understanding of research should be recruited as head of these

institutions. However, administrators having excelled in generating knowledge could be allowed to join these institutions.

8. Identify ecologists and other scientists from different areas for seeking opinion on consultation basis, e.g. Dr. Rahul Kaul for pheasants, Mr. Sanjeeva Pandey for PAs, Dr. Zutshi for lake management, Prof. S.P. Singh for Forest Ecology, Drs. R.R. Rao, Y.P.S. Pangtey, G.S. Rawat and Dr. S.S. Samant for plant diversity, Dr. Lakhan Pal for mycorrhiza, etc.
9. It is important to note that the working conditions in the mountainous regions are quite different from the plains. Often the remote areas are considered as 'punishment postings'. More allowances and field equipments will have to be provided to the field staff. There is hardly any scheme for human resource development within the forest department. A devoted and qualified ranger cannot dream of attaining a higher position in the department. Such a trend also needs to be changed if the morale of the field staff has to be revamped. J&K has a separate cadre of Wildlife Department. In this state one need not qualify IFS to become a park warden or director. Any graduate with basic degree in Wildlife Science or Ph.D. in Wildlife Ecology is eligible to join the wildlife service in JK. Other states(HP and UA) need to create suitable job opportunities for the trained Wildlife Biologists/ Botanists/ Zoologists/ Ecologists in order to boost the scientific management and monitoring of forests and wildlife (SFD, MOEF, GOI) [MT]

Resources needed:

The process of change needs to be undertaken at the level of MoEF, India. It may emphasize that ecosystem should be the unit of conservation and ecological knowledge its main basis. Without proper ecological leaning, biodiversity and ecosystem services can not become the main goals of conservation.

1. About Rs.6 crores annually for the new department for managing protected areas.
2. About Rs.5 crores annually to the SFDs for sustaining the researches of the experts who are going to be the key component in the reformed Forest Service.
3. About Rs.10 lakhs annually for obtaining consultation services.

Priority:

1. Create a balanced structure of SFDs by recruiting administrators (generalists) and specialists in an appropriate proportion.
2. Create a separate service for PAs. Other actions can follow

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 4B: Modernise management of PAs.

Keywords: Corridors, hydroscape

Genesis: PAs are important components of WH landscape accounting for about 10% of geographical area. However, their management is still primarily in the hands of administrators/generalists and the research component and monitoring are still weak.

Strategy:

Upgrade the management considering the principles of ecology and wildlife management.

Action:

1. Separate the PAs from SFDs and create a separate department for Pas, recruiting persons having expertise in wildlife and other relevant areas. [ST]
For resources refer to Issue on Restructuring of Forest Service
2. Take a stock of biodiversity and develop a monitoring system using services of trained persons. [LT]
3. Integrate hydroscape with landscape from management point of view. Throughout the world, hydrological components which play crucial role in the ecological functioning are ignored in PAs. There is a need to treat hydroscape as a part of terrestrial ecosystem of PAs, this may also include glaciers and changes occurring in them due to the mounting anthropogenic pressure. To start with the following steps may be taken [LT]:
 - a. Understand the significance of water bodies for terrestrial wildlife and initiate steps for their conservation.
 - b. Identify the role of stream vegetation as a corridor for terrestrial, aquatic and amphibious biodiversity.
 - c. Develop an understanding of the effect of water flow in higher ranges on various ecosystems of PAs located in lower ranges. For example, fish and other aquatic fauna, grasslands on floodplains.
 - d. Analyse the effect of pollution, including the use of pesticides in the crop fields, on the PAs and wildlife on down slopes.

- e. Understand the effect of deforestation both in lower and higher ranges on regional climate and consequences on hydrology and biodiversity.
 - f. Analyse the interconnection across, terrestrial, riparian and aquatic ecosystem health at regional scale may be introduced for managing hydroscape and landscape in an integrated manner.
4. Map and develop an understanding of corridors (i) between and among PAs, and (ii) between PAs and outside areas, especially where large mammals are important such as between India and Nepal (see Issue on Elephant Corridors). The PAs should not be limited by state boundaries, e.g., the area Great Himalayan National Park (H.P.) can extend into northwest Uttaranchal. Services of institutes having remote sensing and GIS can be sought. [MT]
 5. Wherever there are human settlements inside and along the periphery of PAs, effective people's participation should be sought and not made a mere add-on. The role of the PA managers should be encouraging and facilitating an equal partnership, in which the knowledge, skills, traditions, and needs of local people are as much part of the management system as the formal science and practices of outside officials. Surely we need to move towards a truly joint or collaborative system of PA management which no longer treats local communities as outside the wildlife conservation system whose needs have to be met, but rather as rightful partners in the conceptualisation, implementation, and monitoring of wildlife habitats. [LT]

The resources needed can be estimated only on a case to case basis.

Resources:

1. For Action #2. The PA management should allocate about Rs.20 lakhs annually (see also Issue on Restructuring of Forest Service).
2. However, for actual management and conservation of these corridors would require one time grant of about Rs.5 crores plus an annual recurring expenditure of about Rs. 10 lakhs for building capacity of local people and officials on integrated land/water use management, incentives for cropping patterns that are conducive to wildlife, empowerment of communities to enforce sustainable land/water use options, and so on.
3. Other resources needed can be estimated only on case to case basis.

Priority:

1. Active participation of people and undertake periodical monitoring.
2. Integrate hydroscape and landscape in management.
3. Creation of separate department/service for PAs.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 5: Blanket ban on tree cutting in Western Himalaya though has contributed significantly to save trees, but has generated new forestry problems

Keywords: Chronic human disturbance, holistic approach, natural regeneration of trees.

Genesis:

The blanket ban has been implemented strictly in Uttaranchal only while in Himachal Pradesh and J&K there are other laws which allow the local people to have access to timber. The ban on tree cutting in the hill regions has led to the following problems:

1. Area and proportion of chir pine (*Pinus roxburghii*) and other conifers has increased resulting in depletion of regional biodiversity.
2. Natural regeneration of many broadleaved species has been suppressed.
3. It has stopped progress in developing local economy based on forests.
4. The unit of conservation has shifted from holistic ecosystem approach to reductionist approach of saving individual trees.

Excessive lopping of tree branches continued in broadleaved forests, particularly of oaks, to meet the day-to-day fodder and firewood needs of the people resulting in denuded, diseased and dying trees such as oaks. Conifers like pine took advantage of these disturbed conditions by regenerating better and expanding at the cost of broadleaved species, the regeneration of which was suppressed due to chronic human disturbance involving fodder, firewood and litter collection along with free-grazing by domestic animals (see the issue: Revive natural regeneration). Dead trees and fallen branches were inadequate to meet the needs of the people, resulting in illegal tree cutting.

Strategy:

Ban on green tree cutting needs to continue, but with some required relaxations and modifications.

Action Plan:

1. Tree cutting in conifer forests, particularly chir pine, for generating economy both by the community and the State Forest Departments (SFDs) needs to be allowed with proper conservational and

- ecological measures. These species are favoured by disturbances, such as tree cutting, provided ecological principles are followed. (State Govt., VPs and JFM Committees) [MT]
2. Enterprise development based on timber and NTFPs should be established at community, corporate and State levels. (VPs, JFM committees, corporate houses and experts in marketing) [LT]
 3. Ban on tree cutting in broadleaved forests in principle should continue but operations required to promote regeneration should be allowed. [LT]
 4. Plantation forestry in productive areas (tarai, foothills, and moist and fertile sites in hills) should be taken up by VPs, JFM committees, corporate houses and SFDs. The tree cutting operations carried out to improve the economy of local community should be allowed. [LT]
 5. As far as possible whole tree cutting, which is closer to natural processes, should be in practice rather than lopping of branches. Where lopping of branches is unavoidable and necessary it should be made sustainable. For this, research on proper harvest practices would be required in consultation with forest ecologists. [MT]
 6. Research on regeneration of broadleaved species in relation to canopy gaps and on sustainable harvest of branches should be undertaken keeping in view the ecological factors. (Scientists in Universities and Institutes, particularly known ecologists). [ST]
 7. Emphasis on natural regeneration should be revived and it should be given the same importance as plantation in State Forestry Plans. Extension wing should be established at Universities to undertake this task of natural regeneration. [IM]
 8. Review of the existing forest policy and laws related to use of timber for the poor people versus mass extraction of timber for commercial purposes. (Ministry of Environment and Forests, GOI) [IM]

Resources needed:

The existing SFDs can be reallocated for creating awareness and operations required to promote regeneration. About Rs.50 lakhs on yearly basis would be required on a long term basis to undertake the required researches.

Priority:

Initiate understanding of natural regeneration of forest species in relation to forest disturbance and canopy gap formation.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 6: **Grazing is a major socio-ecological factor of the WH region and needs to be managed in an integrated way by developing an organisation of herders and making it economically viable**

Keywords: Alpine meadows, herders, livestock, moderate grazing and species diversity, transhumance, wild herbivores.

Genesis:

Western Himalaya is India's ecoregion of snow, alpine meadows, and forests. The alpine meadows carries biodiversity far removed in kind and space from that of the rest of the country. In UA and HP the alpine meadows are like islands, generally surrounded by forests on the lower side and rocks and snow on the higher side, whereas, in J&K they occur in large stretches. Grazing by domestic animals (cattle, buffalo, goat, sheep and yak) of both nomads and settled populations has been a major socio-ecological factor for WH region for centuries. (The term grazing is also used to cover browsing.) Because it is also transhumance, this issue requires strategies combining efforts of more than one state.

Not all kinds of grazing can be treated as a negative factor in relation to biodiversity. Moderate grazing in grasslands is known to promote diversity and contributes to ecosystem functioning. However, grazing is generally deleterious in forests as it inhibits regeneration of trees. But, the concept of carrying capacity needs to be considered even in the case of grasslands (meaning treeless vegetation) and while doing so the demands of wild animals on the system should also be given due consideration because overstocking of domestic animals may result in overgrazing which in turn may result in a decline in the population of wild herbivores. The decline in wild animal population may lead to depredation of livestock by carnivores and retaliatory action against carnivores by herders.

Overstocking in rangelands and its implications

Mishra, C., Prins, H.H.T., and Van Wiem S.E. 2001. Overstocking in the trans-Himalayan rangelands of India. *Environmental Conservation*. 28:279-283.

A study in traditional agropastoral system in four villages in the Spiti Valley (HP) in and around Kibber Wildlife Sanctuary has shown reduced animal production due to overstocking (Mishra *et al.* 2001). The overstocking resulted in overgrazing, which in turn has led to a marked decline in the density of wild herbivore, bharal. One of the major consequences is depredation of livestock by carnivores, and their retaliatory persecution by herders. Arrangement for alternative grazing area to reduce the stocking density can be the part of management of the sanctuary. Grazing within a limit may be useful for biodiversity conservation, but means to keep it within limit should be developed.

Strategy:

Do not treat grazing as a menace, but consider carrying capacity of grazing lands for livestock, demands of wild animals and other uses of systems and socioeconomic factors while developing a plan.

Actions:

Different action plans are required for alpine and sub-alpine grasslands (generally above 3000 m), hereafter referred to as grasslands, and forested zones generally below 3000 m)

A. Grasslands

1. Given the fact that moderate grazing can promote species diversity and the economic dependence of people on livestock, blanket ban on grazing is undesirable and not required. **(MoEF) [IM]**
2. Carrying capacity of grasslands needs to be estimated in view of the grassland type, factors driving productivity such as rainfall and soil, population of wild animals competing for the vegetation. This particularly applies to all PAs. In addition to these, the grazing pressure of the herds on the forests while migrating to alpine meadows and returning should also be taken into account. **(To be carried out by Grassland Ecologists.) [ST]**

Wherever carrying capacity is likely to be exceeded, the livestock population should be diverted to other areas to keep the pressure within limits. The herders are familiar with most of the meadows and of the time suitable for camping there. Using their knowledge, the movement schedule can be developed and regulated. **(Joint team of foresters from the three WH states may be formed to monitor and regulate various activities with the local assistance of herders.) [MT]**

3. Mapping of all alpine grasslands, their size, assessment of BD and productivity in them. Already information is available on some of them **(one time through a research project - nodal agency can be Indian Institute of Remote Sensing, Dehradun) [ST]**
4. Regulation of herd size and monitoring of grassland health using indices like biodiversity and productivity. (SFDs) **[ST]**
5. Instead of charging fee from the herders, they should be made responsible for regulating the herd size, protecting the meadow diversity and wild animals against illegal exploitation of medicinal plants and poaching. In order to achieve this there can be an organisation of herders with legal backing in a fashion similar to Van Panchayats of UA for policing the area. **(The SFDs could act as facilitators, trainers and participators in enforcing regulations.) [LT]**
6. In time the herder's organisation can be developed to act as nature guides for trekkers and expeditions as they are familiar with the area. Moreover, their moving camps could also be used by the trekkers and experience their lifestyle as a kind of cultural tourism. This would generate money both for the organisation and the member individuals. **(NGOs, SFDs, Tourism Dept. and researchers) [LT]**
7. All herders should be registered by SFDs, along with information on their herd types and size and the areas visited by them **(SFDs) [IM]**

B. Forests

1. There are only a few examples (like in some parts of Africa and S. America) in the world where heavy grazing of domestic animals is not considered unsustainable. Grazing (to remind here it includes also browsing) degrades forests by damaging seedlings and saplings of trees, therefore it is not sustainable in the long term. Therefore, ideally free-grazing should be replaced with stall-feeding except where because of persistent burning or some edaphic factor grasslands have been established permanently, and conversion back to forest is very costly.

There is a need to replace the present system of high stocking density of low quality animals with low stocking density of high quality animals. To support this system organised dairy with

Migratory Graziers in HP

At present grazing permits are issued by the SFD with the sole purpose of reducing grazing pressure. Customary grazing rights also exist for pasturing of certain areas. These had been granted for generations by the Rajas of Chamba, Kangra and Kullu or were fixed in settlement records under the British Administration.

The annual cycle of migration to alpine regions motivated the then government to adopt some measures to regulate summer migration. This led to the adoption of Kangra Forest Settlement in 1847, wherein the following parameters were outlined:

1. The flock size of each shepherd was regulated.
2. The pastures of shepherds were listed.
3. The first grazing rules were introduced in view of the pastoral cycles.

In Kangra district the shepherds meet once every year and then decide who goes where. Some of the flocks go to the same area every year while others go to different pastures.

According to Lyall (1874) the grazing rights to a previously unused area were given to the leading shepherd who further gave it to smaller shepherds on a fee. The present practice of sub-lending which started during 1874 is still in practice in Spiti Valley.

Source: State of the Environment Report Himachal Pradesh. State Council for Science, Technology and Environment, Shimla, HP

CHIRAG's animal husbandry programme has had success with crossbred bulls which, when mated with local cows lead to vigorous, yet fairly productive offspring. Milk yields are twice as high while calving time is quite a bit lower. At the same time these hybrid offspring can survive local conditions.

Often the biggest benefit that cattle bring to local villages is dung production which can be used for making compost fertiliser. If local people are more interested in dung than milk, then the very hardy local cattle make economic sense. Perhaps, the solution is to look at what crops are grown

provision of adequate nutrition and marketing needs to be developed. Keeping in view the problems of terrain, climate and monetary constraints, in most situations, it may not be possible to introduce highly productive animals as Jersey cows. But, the present state of unproductive animals is also not acceptable, there is a need to bring about improvement using existing stock so that some productivity enhancement is achieved and made more economic. Often unproductive livestock is justified on the ground that it can thrive upon even unpalatable forest vegetation. But unpalatable and the so-called useless vegetation play key role in ecological functioning and in generating ecological services. From the standpoint of the forest health, unpalatability is not a negative factor. [MT]

The likely economic gain and reduced labour should be made the driving force to make people adopt this system rather than impose the system on them. **(Identifying proper NGOs in the initial phase would be important. SFDs, Animal Husbandry Dept and all Agricultural University would play the leading roles. Concerned depts. can allocate funds)**

Resources needed:

1. The research on determining the carrying capacity and associated parameters for the grasslands on the short-term basis would require about Rs.30 lakhs and using the inputs from the short-term project the mid-term project would require about Rs.50 lakhs.
2. The mapping exercise using remote sensing techniques would require about Rs.30 lakhs.
3. Money for training, workshops, etc. would initially require about Rs.1 crore later on Rs.10 lakhs or so per year.
4. Other activities could be carried out by concerned depts. by reallocation of funds.

Priority:

1. Develop database on alpine meadows having information on distribution, ecosystem features and carrying capacity.
2. Organise herders.
3. Stop free grazing in forests.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 7: Conservation sites outside Protected Areas (PAs), an important component of Western Himalayan Ecoregion (WHE), needs to be managed both for biodiversity and ecosystem services

Keywords: Miniature reserves, forest preservation plots, urban community organisation for participatory forest management.

Genesis:

Apart from nearly 10% area under PAs, the WHE still has numerous sites of natural forests and meadows, under varying levels of human pressure. Administratively, most of them are in the reserved forest and civil forests under the control of SFDs and district administration, and community forests managed variously by communities under specific guidelines formulated by the State. Then, there are numerous small patches of forests and meadows in cantonment and urban areas, within the premises of Universities, Institutions, and Government offices. Temple forests and sacred groves represent another kind of forests or tree collections contributing to biodiversity and ecosystem services. Many of the reserved forests, under the control of SFDs are in good shape, but degradation in them is common, particularly because of severe commercial exploitation in the past and ongoing pressure to meet the day-to-day needs of the people. It is getting obvious that even to protect government forests, people's participation is required at various levels. Many of these forest patches are located in middle elevations where there are no protected areas (Askot and Binsar Sanctuaries are exceptions) and corridors are required to connect highland with lowland protected sites.

Strategy:

Record and recognise all small forest patches outside PAs under a great variety of control/management and develop a composite plan involving all stakeholders.

Action Plan:

1. Constitute a management network (authority) involving all concerned parties (municipal boards, universities, college and school authorities, district administration, people's representatives, etc.). Record and map all urban, cantonment and sacred grove forest/meadow patches, and ecosystem features including tree species composition and wild animals (involve experts). (SFDs) [ST]
2. Make it mandatory to maintain records of regeneration status (also see the issue relating to natural regeneration), canopy cover, total tree basal area, and to develop working plan, and have them available to public (SFDs to follow adaptive management). [MT]
3. Some of these may be made available to researchers for undertaking long term investigations and for educational purposes. [LT]
4. Create new sacred groves (given in a separate issue) and make it compulsory for educational and scientific institutions to have biodiversity centers, based mainly on native species and crops, in the same way as provisions are being made for parking places and playing fields.
5. WHE States need to create extension wings in their universities in support of biodiversity and ecosystem services conservation in the same fashion as Agriculture Universities have extension departments for promoting agriculture practices. (State, NGOs and related institutes) [LT]
6. Develop miniature reserves particularly in middle altitudinal zone where human pressure is high and protected areas could not be developed. Though small fragments (20-2000 ha) of vegetation may be inadequate for large mammals, they can serve the purpose of conserving populations of smaller animals and many plants and microbes. The miniature reserves could be developed by (i) considering natural forests away from human settlements (e.g. Kilbury-Kunjakhark in Nainital); and (ii) by linking several patches under control of different or same administrative set-up. This may include urban areas. For example, cypress (*Cupressus torulosa*) forest (about 40 ha) on the China Peak slope of Nainital is one of the few natural forests of this type in the entire Himalaya, and can be treated as a miniature reserve. Preservation plots once established throughout the Western Himalaya, may also be promoted as miniature reserves.
7. It is possible to develop thousands of miniature reserves, without removing humans. The miniature reserves may include other ecosystems such as lakes and river banks connected with the forest. In fact a participatory management involving people, public institutions, district administration, forest department and educational centers would be required for them. Money can be generated by using them sustainably by developing NTFPs-based industries, nature tourism and for giving education to various institutions. [50% MT - 50% LT]
8. Somehow participatory management is thought to be applicable only to village communities and has failed to involve people in the urban areas. The situation in the WH region is different from other ecoregions. In this ecoregion, municipal, cantonment and nearby areas still have considerable biodiversity and natural ecosystems warranting community participation. A new kind of urban community organisation is required for participatory forest management of these forests and other ecosystems such as lakes in Kashmir and Uttaranchal.

Many of urban forests are not in good shape because of illegal and legal exploitation by the urban people, particularly during winters for keeping warm. Almost no proper silvicultural practice is operative in these forests, and are faced with problems of failure if regeneration, parasite infestation, excessive lopping for firewood, fodder and construction work. Much of the disturbance is not need based as is done by people who can afford other sources. Any one type of participatory approach may not work. Each one has clear-cut ownership like SFDs, district administration, cantonment board, municipal or institutional authorities. In certain cases there is a combined responsibility. For example, the forest is of the SFD, but in practice in the possession of a university, a school or an institute. Many times responsibilities are not well defined or no attempt has been made to define them. Purposes of these forests and importance of communication have never been outlined.

The chief strategy should be to seek cooperation of occupants and other uses without changing ownership. The owners need to be educated and trained by SFDs with the help of experts in various areas of conservation. A joint monitoring team (consisting of individuals from SFDs, controllers and experts) need to be developed to keep a watch over regeneration, exploitation and health condition. They can be treated as reserves for research and education, and put to use by educational institutions, scientists, etc. on a certain fee. They in turn help documenting all structural features and processes (species composition, mushrooms and morels, birds and animals, regeneration, three dynamics) to be used by future workers.

Resources needed:

1. About Rs.5 crores for a period of 5 years would be required to be distributed to the different agencies involved in constituting the management network (authority).
2. About Rs.10 crores would be required over a period of 10 years for the maintenance of various records and developing a working plan.

Priority:

1. Constitute a management network involving all parties concerning with various miniature reserves.
2. Develop participatory approach for urban areas forest reserves.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 8: Strengthening Intra- and Inter-Ecoregional Co-operation for managing cross-cutting aspects of both biodiversity and ecosystem services.

Keywords: Intra- and inter-ecoregional cooperation

Genesis:

Both intra- and inter-ecoregional connections in managing biodiversity and ecosystem services are weak or non-existent largely because of sectorial administration resulting in inefficiency of management and wastage of funds. There is a need to strengthen these spatial connections including involvement of neighbouring states and countries.

Strategy:

The MoEF should establish Intra- and Inter-Ecoregional Cooperation Cell and undertake the following:

Actions:**A. Intra-Ecoregional**

1. The time-tested institution of VP can be extended to the other two states of the ecoregion after making appropriate changes to its structure and functioning consistent with the specific requirements of the states. For example, the condition and role of women are different in J&K than in UA. Similarly the proportion of meadows is much greater. [LT]
2. Establish combined cell to tackle uncontrolled exploitation of medicinal and aromatic plants, and poaching of wild animals both being similar across the three states. The two are similar and the related trades are inter-connected.

Potential of apple orchards as an economic activity in view of biodiversity and other ecological factors.

HP is considered to be quite successful in generating economy through apple cultivation, and the new state of UA is suggested to follow the model. Clearly apple orchards can be the source of much needed cash to the people. Its rotation cycle is short (but not so short for the very poor people), the labour input is low, and once established it can serve for several years. However, it has ecological costs. The pesticides used are said to have reduced the population of pollinators, particularly bees. While estimating cost benefit ratio we also need to consider this ecological cost, apart from cost of wood used for fruit cases, and of the manure collected from forests. Then, damage due to year-to-year fluctuations in climate (hailstorms,

Table: A comparative account of three ecosystems with varying degrees of human intervention.

Parameter	Agricultural crops	Apple orchards	Forests/Tree plantations
1. Soil disturbance	High	Intermediate	None
2. Nutrient and carbon loss	High, but in many traditional practices such as baranaja, where nutrients are continuously re-introduced through appropriate cropping and natural fertilisation.	Intermediate to high	Low
3. Pesticide use	Used (but none in organic agriculture)	Used	None
4. Dependency on outside energy	High (forest litter, dung/chemical fertilisers, pesticides)	High (forest energy, pesticides)	None
5. Labour	High	Intermediate	Low in natural forests where only measures to keep extraction within limits would be required; plantations may require moderate labour.
6. Rotation cycle	Very short	intermediate	Intermediate to very long
7. Minimal holding size	Small	Large	Large
8. Impact on biodiversity	Spread of invasive exotic species, but where the land is continuously tilled, impact is limited.	Decline in pollinator populations	Little
9. Money generation	Low	High	Low to high, highly variable

This cell could include officers on deputation from various departments such as SFD, BSF, Police and members from the community, e.g. VP, Gram Panchayats from across the three WH states. This cell could be put under the direct control of MoEF so that a better interstate co-operation is achieved. Further, with the help of Ministry of External Affairs this cell could tie-up with similar or other organisations across the border for better management [LT]

Strategy of using Intermediate Forests:

Integrate crop fields, orchards, agroforests, tree plantations and natural forest in such a way that overall land cover gives impression of an intermediate "forest type" with a mix of natural and human made components. Here the intermediate forest type includes a range of modified and transformed forest types evolved with local communities.

Their intermediate nature is in respect to their position between natural forest and plantations in vegetational composition, between low intensity of natural forest exploitation systems and high intensity of plantation system with selected cultivars (Wiersum and Gonzalez 2000).

The approach should be to link and nest various forms of agricultural, horticultural, plantations, and natural forests with varying degrees of mixes depending upon natural terrain, climate and socio-economic needs of communities.

Departments of Horticulture, Agriculture and Forest need to interact and develop a participatory approach to develop a balanced mix of different systems giving an overall impression of intermediate forest system so that a certain level of ecosystem services continue to flow. This would be a highly dynamic and linked system, for example, natural forests would provide litter for manuring crops and orchards. This needs a landscape or bioregional/ecoregional approach, which attempts to see entire ecological units as one, and integrate various land/water uses within this and by assessing the impacts of one use or value on the other; one also needs the central involvement of local communities, NGOs, and scientific institutions is such an approach is to work.

Wiersum, K.F. and Gonzalez, I.C. 2000. Intermediate forest types as nature-human systems: Characteristics and future potential Workshop, cultivating (in) tropical forests, the evolution and sustainability of intermediate systems between extractivism and plantations, Lofoten, Norway, June 28 – July 1, 2000.

1. **Between WH and Gangetic Plains** for recognising the flow of ecosystem services from WH and developing a payment system (see the issue on Ecosystem Services). Corridors for upward migration of species when global warming takes place and need to be jointly developed that may particularly apply to dry deciduous forest vegetation along the river courses in the mountains which connect tropical plains, foothills, Shiwaliks and part of Lesser Himalaya and involve tree species such as *Anogeissus latifolia*, *Bauhinia retusa*, *Terminalia* spp., *Sapium insigne*, *Engelhardtia* spp., *Lannea grandis* and associated animal species.
2. **Between WH and Nepal:** Continuous collaboration between foresters of Kumaun (UA) and Western Nepal is required to jointly deal with the following issues:
 - a. Illegal trade of medicinal and aromatic plants, poaching of wild animals.
 - b. Elephant corridors (refer to the Issue on Elephant corridors).
 - c. Experiences and know-how of participatory forest management. The concept of forest user groups in Nepal has worked well in restoration of forest, from which India could learn.
 - d. Experiences in ecotourism (see box) may be exchanged and analysed to work out a better model.
3. **Between WH and China and Pakistan:**
 - a. Exchange of experience and knowledge for strengthening the management of illegal trade of medicinal plants and in managing cold desert ecosystems.

3. Issues of global climatic change, such as changes in vegetation of timberline areas, species migration from east to west, and receding glaciers can be tackled effectively by joint efforts in the areas of research, monitoring and management. The cell will be established with the MoEF having branches in the three states of the WH, and could similarly be applied in other ecoregions. Since, these cells would be collecting information from other agencies involved in research, monitoring and management their main role will be of maintaining cooperation and coordination among these agencies. [LT]
4. The economic model of H.P. based on apple orchards and others, may be examined with regard to their impact on biodiversity and ecosystem services, to be adopted with necessary modifications by the other states. [LT]
5. Redrawing of PA boundaries, transhumance grazing, and development of corridors for wildlife, establishment of institutes and training centres are among areas where the three states may join hands (see the issue on Grazing). [MT]

B. Inter-Ecoregional (including neighbouring countries)

Ecotourism in the Annapurna Sanctuary in Nepal

The major problems associated with tourism in Himalaya are that (i) profit is limited to a few rich individuals, not directly connected with the region, and (ii) it adversely affects the environment.

The Annapurna area is the most popular trekking destination in Nepal. Mass tourism in the area started in the early seventies. The impact of trekking tourism to the area's ecology and culture was realised during the early eighties, a decade after the beginning of tourism. As a response, the Annapurna Conservation Area Project (ACAP), an undertaking of the King Mahendra Trust for Nature Conservation (KMTNC), was initiated in 1986 with a pilot project in the village of Ghandruk. Tourism Management (TM) is one of many integrated conservation and development programmes of the KMTNC/ACAP. The TM Programme of the ACAP has been implemented into two modes. One is inside the Special Zone (SZ) where the ecological impacts are new and primarily due to tourism and the other is in the General Zone (GZ) where the local communities had some ecological impacts before the tourists came and added to the impacts.

The major objectives of the participatory ACA Project were (i) to maximise the communities' share in the profit from tourism that is evenly distributed, and (ii) to take measures so that tourism does not adversely affect environment and biodiversity of the

- b. Combine knowledge and experiences about *Pinus gerardiana* (chilgoza) for managing wildlife associated with this important and endemic pine for improving livelihood of local communities. Experiences and knowledge may pertain to genetic diversity and selection of useful providences, distributional range, ecological tolerance, and management practices. Hitherto no attempt has been made even at scientific level in regard to such an important endemic species of the region (the region may include HP, J&K, and parts of Pakistan and Afghanistan).

Resources:

The establishment of cell at central level with its branches in the three states would involve an initial expenditure of about Rs.1 crore and Rs.50 lakhs annually.

Priority:

1. Cooperation between WH and Gangetic Plains for recognising the flow of ecosystems services from WHE and developing a payment system.
2. Learning from the time-tested institution of VP of Uttaranchal and Forest User Groups of Nepal and extend them to other areas after due adaptive measures.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

The tourist attractions included nature, terraced crop fields, and local cultural traits. Since the majority of the tourists visiting this area were foreigners certain minimum standards of hygiene and sanitation were desirable and hence certain programmes were undertaken, keeping in view the conservation of environment as well:

1. **Training and education of the local communities** – The importance of using local raw materials in food preparation was stressed, so much so that indigenous liquor was promoted. The community were also made aware that local nature and culture are the basis for tourism.
2. **Alternative energy programmes** – to save the forest from the use for cooking and heating a kerosene-only policy (no fuel wood use) in the Annapurna sanctuary area. Electricity from microhydel projects is also to be made available.
3. **Sanitation programmes** – were initiated to handle especially the human excreta and the non-biodegradable waste generated by tourism activities, septic tanks & incinerators were also set-up for the purpose.
4. **Institutional development** – The executive lodge management committee standardises facilities and fixes the minimum rate in the menu of all the lodges. Penalties are set for persons breaking the rules. A lodge is shared by at least two households and the partners run the lodge by taking turns. The area is also a no "mule zone"; this generates income for the porters and involves the least damage to trails.
5. **Relocation of the lodges at strategic locations** – the lodges are set-up together at one place and the distance from one site (settlement) to another has been maintained approximately between 2 to 3 hours trekkers with an experience of wilderness and at the same time providing security to the tourists.
6. **Services and information to the trekkers** – Adequate and informative signposts have been maintained along the trail.

Some interests of the ACAP discussed and passed by the assembly of the lodges owners are: (i) limiting each lodge size to a maximum of 15 beds, and (ii) shifting scattered lodges to strategic locations.

The community has a hidden rule that comes from a general consensus to allow no outsider to run a lodge in the area. If someone wants to discontinue running a lodge, he has to sell it to a local person, although this is not supported by the law.

Each lodge raises an amount of US\$1500.00 a year which makes US\$39000.00 for the 26 lodges in the area. The lodge owners use this money to repair and maintain the trails. This money is also used to support health, education and drinking water programmes in the village.

Conclusion

For the highlands in Nepal where the opportunities for alternative livelihoods are limited, tourism is one of the available alternative livelihoods to the local communities. However, on the other hand, the fragile ecosystem of these areas may be negatively impacted by a sudden influx of tourists if it is not well planned or pre-planned. The intended economic benefits may also not be sufficient to pay for maintaining the local ecology and culture.

An integrated tourism management programme has been found effective with the experience of the KMTNC/ACAP for maximising the benefits to the local economy and ecology and minimizing the negative impacts. The KMTNC/ACAP experience shows that **strong community participation is required for effective local tourism management.** The government or the implementing NGO is to facilitate the long term vision of the tourism management programme that results from participatory planning with communities. It is very important that the vision is clearly and transparently passed on to the minds of the community. **Frequent and regular contact with the communities as a process of education is mandatory.**

Issue 9: Providing corridor for the Western Himalayan foothill population of elephants

Keywords: Restoration of elephants' habitat, poaching, Lagga Bagga corridor

Genesis:

While habitat fragmentation may be unavoidable, it is important to (a) recognise the importance of corridors specially for megafauna (a case study of elephants is illustrative), and (b) even small forest fragments can play an invaluable role in saving microflora and fauna.

About 1000 elephants make the elephant population of Western Himalayan foothills (includes, tarai, bhabar and Shiwalik belts), ranging from Dehradun to Western Nepal, occupying sal and mixed broadleaved forests generally with *Mallotus* in undercanopy, pine mixed broadleaved forests, and grasslands distributed in them. The major problems that the elephants face are:

1. Habitat loss due to the transfer of land to other landuses and encroachment.
2. Degradation of habitats due to cutting of trees, grazing pressure of domestic animals and excessive fire.
3. Poaching
4. Fragmentation of habitats due to various factors.

Since 1960s nearly 64540 ha of habitat available for elephants has been transferred for human rehabilitation and developmental activities. Singh (2001) has estimated the grazing pressure of domestic animals of approx. 460 t of green biomass per day from the area under elephants' habitat. The human pressure on the elephant habitat can be expressed in terms of the human population that lives within 10 km of it and which is 1.17 million including about 70,000 Gujar and other resident human populations depending on forests for their day-to-day living. Firewood collection and burning have further degraded the elephant habitats. Excessive fires along with chronic biomass removal have contributed to the spread of many coarse grasses and invasive exotic species. Elephants are frequently faced with the problems such as of poaching for ivory, death due to indiscriminate shooting and accidents (railways, electrocution by power transmission lines, etc.). Unlike other regions of India poaching was less common in WH until recently. Due to the proximity of human settlements to the elephants' habitats, they are also under threat of being killed as they enter the crop fields. By one estimate they damage about 15% of the crops (Singh 2001).

One of the major problems is that of obstruction of the free movement of elephants across their habitats due to construction of roads, increased vehicular traffic during the last five years, construction of dams and barrages, human habitations both legal and encroachments. These obstructions have resulted in fragmentation of habitats, isolation and genetical drift.

Habitat fragmentation and degradation in the area has also resulted in the decline of other wild herbivores in the area that has also affected the tiger population in the region. The foothills of Uttaranchal form the northernmost range of distribution for Asian elephant, tiger, sloth bear and hog deer. Similarly, foot-hills of Himachal Pradesh support the northern limits of Sal forest and tiger habitat.

Strategy:

Maintenance of elephant corridor and wildlife habitat along the foot-hills of WH.

Action:

Fresh assessment of the existing corridors and proposal for revival of rapidly degrading corridors both national and international (Uttaranchal State Forest Department, Ministry of Environment & Forests, GOI, Wildlife Institute of India. International donors need to be approached for the financial aid to rehabilitate the human populations from the crucial corridor areas).

The existing corridors have problems. For example, the corridor that connects Motichur and Johara blocks to Chilla sanctuary to Duhia block is converted into a dumping place for ammunition by the army and has been used to settle the evacuated people from the Tehri dam. There is a need to provide alternative corridors as given below:

1. Khamia block corridor. This includes about 2200 ha land on Khamia block near river Gaula which is under encroachment. If it is evacuated then it will serve as a good corridor for elephant migration on either side of Gaula. (SFD) [ST]
2. Adjacent to Khamia block there is a 500 ha government land that has been leased out. If restored, it can serve as a good corridor for migration of isolated population of elephants on the two sides of River Gaula. (SFD) [ST]
3. International corridor between India and Nepal. There is a need to develop Laggabagaa corridor of about 600 ha connecting Pilibhit and Sukhaphanta Sanctuary in Nepal. This would enable the movement of elephant populations from Dudhwa and Kishanpur, right up to Nepal. The tract is severely denuded due to biotic pressure. This warrants restoration. (SFD) [LT]

4. Animal bridges can be made wherever roads cross the path of elephant movement so that the animals can either walk under the bridge or a bridge for the animals to use and the vehicles could pass underneath them. Bridges are required at places such as to cover gaps created due to River Gaula near Kathgodam, Uttaranchal. (SFD and PWD) [MT]
5. The foot-hill forests of Western Himalaya, from Jammu to Sharada river need to be accorded highest priority in terms of protection and frequent monitoring (State Forest and Wildlife Departments, Indian Institute of Remote Sensing for monitoring and NGOs). [LT]
6. The Management Plans for the Protected Areas and adjacent forested tracts along the foot-hills need to incorporate the provisions for reduction of people-wildlife conflicts and measures to check the process of habitat degradation (State Wildlife Wings).[LT]

Resources needed:

About Rs.20 crores for construction of bridges and recovery processes on degraded land.

Priority:

Creation of the international corridor between India and Nepal needs to be given priority. MoEF needs to take a clear-cut stand on the maintenance of corridors and the size of elephant population (called NW elephant population of India) that can be maintained without much conflict with the people.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

[Ref.: Singh, K.N. 2001. Ecological studies of North-western populations of Indian Elephants. Ph.D. Thesis, Kumaun University, Nainital]

Issue 10: Lake eutrophication and pollution in tourist towns of Western Himalaya are affecting biodiversity and ecosystem services including water supply.

Keywords: Watershed approach, valuation of services of lake and watershed.

Genesis:

The region is known for its numerous lakes, having bearing on tourism and other recreational activities, fisheries and agriculture. The lakes (including wetlands) of Kashmir such as Dal, Aanchar and Wular, and of Lake Nainital in Uttaranchal, which are major centres of tourism, are highly eutrophic and heavily polluted. They are shrinking both in area and volume, so much so that the famous Dal Lake is on the verge of ecological collapse. Until recently organic pollution was the main problem, but due to a sudden increase of vehicular traffic heavy metal pollution, particularly of lead, has become a major threat to human health. Over the years almost all plans have not considered the problem by integrating the lakes and their catchments, nor have attempts been made to evaluate the decline in ecosystem services and the cost that may be required for their restoration.

Due to extreme eutrophication, for example in Lake Nainital, about 12-15 phytoplankton species have become extinct, their species composition has shifted from more palatable to less palatable, resulting in a drastic fall in the fish population and even extinction of the famous game fish – mahasheer (*Tor tor*) and rohu (*Labeo rohita*) in the lake, from Dal Lake population of several indigenous species are disappearing including *Schizothorax esocinus*, *Bauhaunia diplostoma*, *Botia birdi*, and *Glyptothorax kashmiransis*.

Strategy:

Develop management plans for lake areas by using the available scientific information plans that integrating lakes and their catchments, and considering the ecological services and their economic valuation.

Action Plan:

Both curative and preventive measures are required. Since the lakes are heavily pollution and highly eutrophic they need to be treated and restored by applying such as:

1. Aeration of the lake. [IM]
2. Deepening of extremely shallow lakes, such as Dal lake, and removal of floating islands to maintain its structure and ecological integrity. [ST]
3. Removal of nutrient and metal rich sediment from the lake bed (because it acts as a permanent source of pollutants). [ST]
4. Use of metallophytes, for the removal of nutrients by precipitation. [IM]
5. Biomass harvesting including that of the weed fishes. [IM]
6. Bio-manipulation to improve the food chain and arrest the growth of undesirable populations. [ST]

- B. Preventive measures, mainly focussed on the catchments may include:
1. Control over input at point and non-point pollution sources. [IM]
 2. Taking steps to direct all inputs through identifiable point sources which would be easier to handle. [ST]
 3. Treatment of watershed, restoration of forest/grassland cover to check erosion and to increase water retention, maintenance of spring points and areas that filter water (such as valley fills), creation, upgradation and maintenance of drainage, sewer and waste disposal system, estimation of carrying capacity of the watershed, especially from the standpoint of tourist activities, control of vehicular traffic. Water treatment costs less when watershed is treated properly (see example of New York). Such treatment of watershed generates several other services such as filtration of water, air, carbon sequestration, control over erosion and siltation, recreational value, etc. [ST]
 4. Valuation and monitoring of all the services of the watershed and lake ecosystems and of their degradation or of not maintaining them. The valuation may pertain to recreational value of water – fishing, bird watching, swimming, boating and other water sports, aesthetic, filtration of water, pollution abatement through forests, etc. [LT]
 5. To discourage pollution in future "polluter pays" principle should be applied and mechanism to impose fines and use the money generated for lake conservation and treatment. Also a kind of cess may be imposed on tourists for keeping a regular fund to be used for continued maintenance of lakes.

Agencies to be primarily entrusted with the work – separate lake development authorities such as J&K Lakes and Waterways Development Authority and Lake Area Development Authority (Nainital, Uttarakhand) should be entrusted with the above responsibilities jointly with other bodies such as Municipality, Pollution Board, PWD, etc. in consultation with the experts in lake ecology.

Resources needed:

1. Operation of machines needed for curing and purging activities and technical consultants and experts such as aquatic ecologists, geologists, engineers, etc. Rs.40 crores.
2. Item nos. 3 & 4 under preventive measures would require about Rs.15 crores.

Priority:

Undertake curative measures immediately and prepare a long-term plan by implementing preventive measure.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 11: Conservation of dry deciduous biome along the xeric slopes of the river and watercourses

Keywords: Xeric vegetation on slopes along river courses.

Genesis:

Throughout the WH region on the steep slopes along the rivers a desert like vegetation dominated by deciduous species and evergreen palms and cactus like plants (*Euphoria royalina*) has established. Several tropical species are able to intrude deep into the mountains through the river courses e.g. *Malotus*, *Erythina*, *Anugius*, *Bahunia*, *Sepium*, *Marmatus*, etc. Though occupying large areas in the region, this biome is generally ignored from the management point. The slopes are either loose or are extremely rocky and highly fragile in the absence of vegetal cover. Anthropogenic pressure has degraded them further. Keeping in view the importance of hydrological systems these special sites should be allowed to be restored through natural succession. Since people do not get much out of these degraded vegetation they should be kept free from any kind of vegetal use and should be designated as a kind of sanctuary area.

Strategy:

River courses and areas where such vegetation occurs should be mapped and kept away from human use.

Actions:

1. Using appropriate methods record spatial distribution of riverside deciduous forests their characteristic species, growth forms and the amount of biodiversity. (SFD in consultation with vegetation ecologists) [ST].
2. Investigate forest structure and function processes in particular reference to hydrology and the role of this vegetation containing river slope erosion and mast-wasting. Investigate the corridor values of these biomes. [MT]

3. Keeping in view the important role of plant cover in controlling slope erosion and resulting siltation of river beds, it should be kept free from any commercial or day-to-day use. Only some medicinal plants or other plants of high economic value could be harvested keeping in view sustainability. There should be blanket ban on fire in these areas even as a management practice [LT].
4. Due to recurring erosion and human disturbances the system remains arrested at early successional stage. The management practices should see that succession progresses to later stages. This biome requires substantial restoration work using both bio- and civil-engineering technologies for stabilisation of slopes and allowing natural progression of succession. Researches would also include restoration techniques [MT].

Resources:

1. For research, experts from universities, institutes and SFDs could be used. A 5-10 yr research project needing about Rs.30 lakhs annually would be required.
2. Restoration work would require inputs from various departments, e.g., SFDs, PWD, universities and institutes and would involve an expenditure of about Rs.30 crores annually.

Priority:

Pay attention to restoration of this biome established on immature and highly fragile hill slopes and which has never been recognised even listed in any management plan.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

Issue 12: Impact of global warming on biodiversity

Keywords: Refugia for woody species, species migration.

Genesis:

1. WH would provide the refugia for woody species marching upward due to the rise in temperature.
2. Greatest threat would be to the forests making the timber line or just below such as karsu oak (*Quercus semecarpifolia*), silver fir (*Abies pindrow*), and bhojpatra (*Betula utilis*) which already occur as islands. These forests have occurred in large areas during one of the previous glaciation periods but are already on the move towards higher altitudes during the last several thousand years.
3. Many species including these would move from east to west in search of cooler habitats but because of their island like distribution and anthropogenic pressure their natural movement would almost be impossible. This applies particularly to species *Q. semecarpifolia* which is viviparous (seed germination taking place while seeds are still on tree as a consequence of which it perishes if it doesn't find appropriate condition at the microsite at the moment it falls to the ground) (Singh *et al.* 1997).

Action:

1. Assist the species migrating in the search of suitable sites. Assistance does not mean transferring a forest from one place to another physically. The forest destruction due to climatic change is expected to occur over several decades. What humans can do is assist the migrating species in their process of establishment in favourable areas. For example, seedling establishment can be promoted by transferring seeds to favourable microsites, or seedlings recruited could be helped to become trees. Management can help by restricting the loss due to grazing or burning of species during its migration and requirement in new sites. WH, in particular J&K, is an important area from the standpoint of biodiversity management feature. (SFDs, Universities, NGOs, Institutes, and village community) [LT]
2. Continuous monitoring of species movement, changes in vegetation (such as colonisation of meadows by woody species), receding of glaciers, and changes in water flow should be undertaken. Eventually the monitoring has to be community based, since they are the ones dealing with vegetation in their day to day life, and are observing the changes. Some orientation on regular or systematic monitoring would probably yield a lot of valuable information from them. However, scientific studies would be required to make an effective prediction of possible impact. The idea is to monitor the track of migrating species and give a hand in support to protect them from additional stress due to anthropogenic pressure (Scientists, SFDs, Research Institutes and members of the community) [LT]

Resources:

1. Once the microsites for migrating species are identified the establishment of the species could be achieved by the SFD with the aid of village communities and NGOs. This process could involve about Rs.5 crores per microsite.

2. The monitoring process may be undertaken in the form of a long term project and would involve about Rs.15 lakhs annually since most of the monitoring could be achieved through the SFDs.

Priority:

1. Monitoring the changes occurring under the influence of global warming and keeping a record of the track taken by the migrating species.
2. Facilitating the establishment of species migrating in search for suitable sites.

(Agencies to be primarily entrusted with the work as indicated in the parenthesis).

[Ref.: Singh, S.P., Y.S. Rawat and S.C. Garkoti (1997). Failure of brown oak (*Quercus semecarpifolia*) to regenerate in central Himalaya: A case of environmental semisurprise. **Current Science**, **73**: 371-374]