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# COMMERCIAL PROSPECTS OF GINGER CULTIVATION IN NORTH-EASTERN REGION

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Spices are high value and export oriented commodity crops, which play an important role in agricultural economy of the country. India is the principal source for supply of spices in the global market, though there are number of other countries viz. Indonesia, Malaysia, Pakistan, Australia, Spain, Egypt, Tanzania, etc., producing and exporting to the international market. Spices contributed 1.24 per cent of India's total export earning. The share of spices in the export earnings from agricultural and allied products is 8.5%. The north-eastern region comprising of states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura has tremendous potential for production of spice crops. The climatic condition of the region is highly suitable for cultivation of a large number of spices such as ginger, turmeric, chilli, tejpat, large cardamom, coriander, and garlic. Though recently introduced, the region has a potential for commercial cultivation of black pepper, cumin, vanilla and saffron.

Among all spices, ginger is the main cash crop supporting the livelihood and improving the economic level of many ginger growers of north eastern region. Ginger is grown in almost all the states of the region but the leading states are Meghalaya, Mizoram, Arunachal Pradesh and Sikkim (Govind *et al.*, 1998). Apart from improved varieties like Nadia, China, Varada, etc., a number of local cultivars exist in north eastern region. These varieties are high yielder of rhizomes as compared to standard cultivars like Nadia and Rio-De-Janeiro but have more fibre content.

## Uses of ginger

The freshly harvested ginger is used for consumption as green ginger in whole northeastern states. Little amount of surplus is sold outside the region through middlemen at a very low prices. Some times due to marketing problem the farmers are not able to sell their produce since there is no local market big enough to absorb and handle green ginger in large quantities. Therefore, it is essential to convert a part of produce into low volume high value ginger to make the crop remunerative. As it is abundantly available in the region, different products like ginger oil, ginger oleoresin can be prepared for export, which are very common in developed countries. Dried ginger (called saunth) can also be prepared and it may be either sold as such or in the form of an off white to very light brown powder. The dried ginger or ginger powder is generally used in manufacturing of ginger brandy, wine and beer in many western countries. Ginger oil is primarily used as a flavouring agent in confectionary and for soft drinks. The ginger is also used for several medicinal purposes.

## Status of ginger in northeastern region

The total area under different spices in the region is 140.00 thousands ha with a production of 436.8 thousand tonnes at a productivity of 3.12 t/ha (anonymous, 2003). The area under ginger in NE region is 33.2 thousands ha which gives total production of 191 thousand tonnes at an average yield of 5.8 t/ha against the national productivity of 3.5 t/ha (Basic Statistics of NER, 2002). Meghalaya is major producer of ginger in the region, which is also second largest producer in the country with total share of 19.59 % after Kerala, which contributes 23.08 % to the total production of the country. The production of ginger is highest in Meghalaya followed by Mizoram and Arunachal Pradesh. However, the productivity is highest in Arunachal Pradesh (Table 1). Meghalaya is having higher per capita/annum availability of ginger than national availability. This shows that farmers are interested for the

cultivation of ginger as soil, climate and other ecological factors favour the growth and development of the crop and there is a tremendous scope to increase the yield per unit area and thereby the total production of ginger in North East region.

**Table 1:** State-wise area, production and productivity of ginger in north eastern region

| States            | Area (ha) | Production (t) | Productivity (t/ha) |
|-------------------|-----------|----------------|---------------------|
| Arunachal Pradesh | 4610      | 38020          | 8.24                |
| Assam             | 4200      | 32100          | 7.64                |
| Manipur           | 2140      | 3530           | 1.65                |
| Meghalaya         | 8400      | 46590          | 5.5                 |
| Mizoram           | 7290      | 45000          | 6.1                 |
| Nagaland          | 500       | 400            | 0.8                 |
| Tripura           | 1000      | 1400           | 1.4                 |
| Sikkim            | 5100      | 24000          | 4.7                 |
| NEH region        | 33240     | 191040         | 5.8                 |
| India             | 67200     | 233900         | 3.5                 |

[Source: Basic statistics of NER, 2002]

### Diversity of ginger in the region

In ginger the region can be considered as treasure house of germplasm. There are several cultivated types of ginger available in the region, which are generally named after the localities they are being grown. Certain indigenous types namely Maran and Jorhat Local of Assam have been reported to be equally good in rhizome yield. Dry ginger recovery of these varieties have been found to be even better than exotic type Rio-de-Janeiro. In Arunachal Pradesh, Basar Local is very much popular due to high yield and its adaptability to the area. In Mizoram, local types Thingpui and Thinglaidon are grown at large scale. Black ginger having rhizomes with bluish black tinge inside is reported to have medicinal properties and is grown by the inhabitants of Mizoram just for their own use. It is also said to be sold at very high price probably due to high medicinal value.

In Tripura also a local selection, Tripura Local performed better in comparison to the other types. In Manipur, Thingpui is commonly preferred in the hills. In Nagaland, a variety having very high pungency but smaller in size is commonly grown by the tribals. Another type of ginger having rhizome with pinkish tinge inside is also found in the state. In Sikkim local types Bhainse and Gorubathan are grown commercially due to their high yield potential and big size rhizomes. In Meghalaya, in addition to local types namely Khasi Local and Tura Local, considerable area has been brought under selected type Nadia (Table 2). At present the variety Nadia is very much popular among all the states of northeastern region due to its low fibre content.

**Table 2:** Promising varieties of ginger in north eastern region

| Sl.No. | Adapted Varieties | Crude fibre content (%) | Dry matter content (%) | Oleoresin (%) | Oil (%) | Yield (t/ha) |
|--------|-------------------|-------------------------|------------------------|---------------|---------|--------------|
| 1      | Nadia             | 4.1                     | 22.6                   | 5.4           | 1.4     | 30.00        |
| 2      | Poona             | 6.4                     | 20.4                   |               | 1.17    | 25.10        |
| 3      | Varada            | 3.2                     | -                      | -             |         | 22.00        |

### Growing pattern of ginger in northeastern region

Ginger prefers warm, humid climate with well-drained soils like sandy or clay loam, red loam or laterite loam for its successful growth. In North East region ginger is grown as rainfed crop while in other parts of the country it is grown both as rainfed and irrigated crop. It is an exhaustive crop by nature and, therefore, not advised to grow in the same field year

after year (Gosh, 1984). In North East region, it is rotated with French bean or soybean, which not only improve the physical condition of the soil but also give additional income to the farmers.

One of the most significant features of the agriculture in the NE region is the prevalence of jhum cultivation in large parts. In the hills of the region ginger is generally cultivated on raised bed (called bun) in the jhum fields (Gosh, 1984). Under this, large tracts of hills are demarcated and the forest in the region is cleared by burning. The land thus available is utilized for cultivation. Raised beds (called bun) of about one meter width are made along the slope and again covered with farm wastes, dried leaves, etc., which are being burnt before sowing of seed rhizomes. The burning of field helps in reducing the weed growth, soft rot disease and increase the availability of certain plant nutrients, particularly the Potash. This jhum land is abandoned after 3-4 years and new piece of land is cleared in similar fashion. This has been the tradition in the region for centuries, and the life style of several tribes is associated with this cultivation. However, earlier the population being less, the pressure on the forest was less. Thus the land after being abandoned got sufficient time (10-15 years) for regeneration of forests. However with increase in the population, pressure on land has increased and time period for this cycle has got shortened (3-5 years). This is causing considerable concern amongst the researchers and environmentalists. In the region usually the seed rhizomes are stored in the pit under soil cover after harvest. By March-April when the rhizomes start sprouting, they are taken out and planted in the fields. In the plains of Assam and Tripura even earthing up and ridge and furrow planting system is observed in ginger fields.

### Commercial qualities

Ginger is generally sold as raw ginger in local markets but there are several other products of ginger like dry ginger, ginger powder, ginger oil, and oleoresin. The oleoresin and oil are known as high value and low volume products, which have great demand in western countries. The varieties with less fibre, high dry matter recovery, and high oil and oleoresin contents are having great export potential in international markets. Therefore, more emphasis should be given to develop those varieties, which are having the above qualities. The variety Nadia is popular in Meghalaya and other states of NE region mainly due to low fibre (4.2%) content (Borthakur, 1992). The Indian Institute of Spices Research, Calicut has evolved Varada, a new variety of ginger, which has a fibre content of 3.2 % (Table 2). This variety is being multiplied at Ginger Development Station, Umsning, Meghalaya and the performance of the variety is quite encouraging. In International market several grades are available and on the basis of that ginger has been categorized in different grades (Table 3). The ginger produced in the region should be at par to this grade for outside export and getting higher prices because the prices vary as per the grades.

**Table 3:** The quality characteristics of different grades in ginger

| Sl. No. | Quality characters  | Limits  |          |           |
|---------|---|---------|----------|-----------|
|         |   | Grade I | Grade II | Grade III |
| 1       | Extraneous matter % by mass (max.)                                    | 2.0     | 3.0      | 5.0       |
| 2       | Insect damaged matter, % by mass (max.)                               | 1.0     | 3.0      | 5.0       |
| 3       | Pieces less than 25 mm, % by mass (max.)                              | 0.5     | 1.0      | 2.0       |
| 4       | Decayed pieces, % by mass (max.)                                      | nil     | 0.5      | 1.0       |
| 5       | Dry matter, % by mass (min.)  | 22.0    | 20.0     | 18.0      |
| 6       | Volatile oil as ml/100 gm (min.)                                      | 0.7     | 0.5      | 0.3       |
| 7       | Crude fibre content of the dry matter % by mass (max.)                | 8.0     | 10.0     | 12.0      |
| 8       | Non-volatile ether extract content of the dry matter % by mass (min.) | 5.0     | 3.0      | 2.0       |

[Source: Spice India February, 2004]

### Major production constraints in north eastern region

In spite of the fact that ginger is an important and oldest spice crop in North East region, no major breakthrough has been noticed in boosting the production and increasing export of ginger. Since it is vegetatively propagated crop, lack of consciousness in selection of high yielding varieties and several characters must presumably have occurred in the past. There had also been interchange of materials, but with all these there has not been tangible increase in the production. The major bottlenecks are as follows:

- **Shifting cultivation:** In this system agricultural crop is grown at one place for 3-5 years and after that farmers start growing at another place. Earlier this cycle was for about 15 years; therefore in the mean time the soil gets sufficient time for regeneration of biomass/forests. Now due to reduction in jhum cycle up to 3-5 years, the soil fertility has reduced. This system has caused large scale deforestation, soil degradation and depletion of resource base.
- **Land tenure system:** For boosting the production of spices, settled cultivation is necessary like other crops. The productivity is also low due to land tenure system prevailing in the region because the farmers do not feel any sense of belonging to the land and therefore, they do not undertake adequate management practices. Settled cultivation and right of ownership of land to the farmers is necessary for judicious management of land. The owner right is not legalized in the name of entrepreneurs. Patta of the land is still in the name of forefathers or others.
- **Small land holdings:** Because of the terrain, the size of land holding is very small in the region and farmers are taking many crops as per their requirement from the same piece of land. Therefore, the commercialization of crop/variety on large scale is very difficult in the region.
- **Non-availability of quality planting materials and other inputs:** Good quality, high yielding and disease resistance rhizomes are not available to the farmers. The modern inputs like-fertilizers, pesticides, herbicides, etc., are very low in use. Though many high yielding varieties have been identified and recommended by the researchers in the region but quality seed production in a large scale is lacking due to non-existence of agencies responsible for quality seed production.
- **High rainfall:** High rainfall received in the region causes heavy infestation with weeds, pests and diseases and leaching of nutrients.
- **Lack of funds:** Although ginger is major cash crop in the state, but farmers are not getting financial support from Government for purchase of quality seeds and other inputs. There should be a scheme to provide soft loan to the farmers.
- **Low fertilizer and pesticide usage:** This resulted on considerable losses on yield. The average fertilizer usage varies from 2 kg in Arunachal Pradesh to 56 kg in Manipur, as against the national average of 104 kg per hectare. Even the plant protection measures are not taken very seriously
- **Problems of processing and marketing:** For a region like this the success of ginger growing is closely linked with the success of spice processing units, marketing and transport facilities. Till today, there are hardly any cold storage facilities available; few processing units exist but are not functioning up to the desired capacity. Marketing of ginger in the state poses problem due to non-topping of value added products like oleoresin, volatile oils, etc.
- Losses due to faulty storage method and diseases like rhizome rot.
- Lack of trained personnel with sound knowledge in post-harvest technologies.
- Lack of improved production technologies and management practices.
- Remoteness of the state from the national stream:
- With the recent development in the field of telecommunication, net work, the state can be linked with the other parts of the country through internet connection, website for supplying information related to the exact demand and price of the produce in the different markets of the country.

### **Future thrust**

The followings are the areas where more intensive research is needed so that overall scenario of the ginger production can be changed by increasing production and productivity of ginger in the northeastern region.

- **Survey, diagnosis and design:** There is need for survey and diagnosis of lands suitable for ginger and development of area specific farming system model in cluster approach.
- **Introduction, evaluation and improvement:** Introduction of indigenous and exotic high yielding strains of ginger suitable for the state. Breeding should be done for high yielding and better quality varieties with resistance to biotic and abiotic stress.
- **System management research:** There is need to develop micro propagation and other propagation methods for rapid mass multiplication. Use of IPM and Integrated Nutrient Management system is required.
- **Post-harvest management:** Processing and preservation of value added products are required. There is need to develop quality control measures, adequate packing and storage techniques. The processing industry can help in sorting out the problem of proper disposal of perishable commodities. The value-added products can be extracted if processing units are set up in the region. Use of appropriate pre and post harvest practices for spice crops is vital for the success of the crops and to provide good return to the growers.
- **Economics and technology transfer:** The cost benefit analysis of different farming systems is required. There is immense need to strengthen the extension system for transfer of technologies generated and providing training to the farmers.
- **Emphasis on organic farming:** The ginger production in the north eastern region is organic by default because the farmers of the region neither apply the chemical fertilizers nor chemical pesticides in ginger crop. They are only applying the locally available farmyard manures (cow dung, pig manure, poultry manures, rabbit manure, etc.) in whole northeastern region. In this way, the ignorance of the farmers about the technological advances is turning out to be a key to prosperity. Considering the increasing demand for organic produce all over the world, the farmers can definitely hope to get better returns for their produce. But first and foremost they need to have marketable surplus which is available in the region. This surplus than need to be properly collected, stored, packaged and transported to the distant market after due certification. Therefore, there is lot of scope to popularise the organic ginger produce for export in foreign country from the region and establish organic product based ginger industry in the region.

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# VEGETABLE PRODUCTION UNDER PROTECTED CONDITIONS IN NEH REGION : PROBLEMS AND PROSPECTS

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## INTRODUCTION

India is the second largest producer of vegetable crops in the world. However, its vegetable production is much less than the requirement if balanced diet is provided to every individual. The present production of 90.8 million tones (ICAR-2002) is to be raised to 250 million tones by 2024-2025 (Kirti Singh, 1998). There are different ways and means to achieve this target, e.g., bringing additional area under vegetable crops, using hybrid seeds, use of improved agro-techniques. Another potential approach is perfection and promotion of protected cultivation of vegetables (Singh, 1998; Singh *et al.*, 1999).

## Brief about NEH region

The North Eastern Hill (NEH) region comprising of eight states namely Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Sikkim lies between 21.5° N - 29.5° N latitudes and 85.5° E - 97.3° E longitudes. In the whole of NEH region, about 35% area is in the plains and the remaining 65% area is under hills. Net sown area is highest in Tripura (23.48%) while Arunachal Pradesh has lowest net sown area in the region. Cropping intensity is also highest in Tripura (156.5%) followed by Manipur (152.1%), and Mizoram (136.36%). NEH region is not a single entity; it has the area receiving world's highest rainfall and also rainshadow areas receiving very less rainfall. It has valley plains as well as high peaks and warm tropical to temperate climate. Meteorological parameters common to this area is moderate to high rainfall (101 to above 400 cm of mean annual rainfall), cool to moderate temperature (below 20°C to 25°C of mean annual temperature) and high humidity (mean annual humidity above 85%).

The total area under vegetables crops in NEH region is 0.37 million ha while the total production is 4.05 million tones (Table 1). The average productivity of NEH region (11.01 t/ha) is below the national average productivity (15.16 t/ha). Certain factors, i.e., high rainfall, shortage of irrigation facilities from November to March, non-availability of quality seeds and low temperature etc., are responsible for this low yield. Cultivation of vegetables under protected conditions (polyhouse or greenhouse) is one of the solutions that could increase the production as well as productivity of vegetables crops in this region. There are certain vegetables, which cannot be grown due to high rainfall from April to October. From October to February (winter season), the temperature is low. During this period, vegetables can be grown successfully by protecting them from heavy rainfall and low temperature. Production of vegetables under protected conditions involves protection of production stages of vegetables mainly from adverse environmental conditions such as temperature, high rainfall, hail storms, scorching sun etc. Protected conditions for vegetable production are created locally by using different types of structures. These structures are designed as per the climatic condition requirement of the area. Besides temperature, wind velocity and soil conditions play major role in the design of protection structures for growing.

Therefore, in the present scenario of perpetual demand for vegetables and drastically shrinking land holding, protected cultivation of vegetable crops suitable for domestic as well as commercial purposes is the best alternative for using land and other resources more efficiently.

**Table 1: State wise area and production of vegetables crops in NEH region**

Area-000 ha, Production-000 t, Yield-t/ha

| State             | Area production & yield | Vegetables |           |
|-------------------|-------------------------|------------|-----------|
|                   |                         | 1996-97    | 1999-2000 |
| Arunachal Pradesh | A                       | 16.7       | 16.9      |
|                   | P                       | 80.5       | 80.9      |
|                   | Y                       | 4.82       | 4.79      |
| Manipur           | A                       | 8.0        | 9.0       |
|                   | P                       | 53.2       | 60.8      |
|                   | Y                       | 6.65       | 6.76      |
| Meghalaya         | A                       | 41.8       | 29.2      |
|                   | P                       | 412.2      | 252.9     |
|                   | Y                       | 9.86       | 8.66      |
| Mizoram           | A                       | 6.8        | 8.3       |
|                   | P                       | 49.6       | 56.3      |
|                   | Y                       | 7.29       | 6.78      |
| Nagaland          | A                       | 19.3       | 20.9      |
|                   | P                       | 188.4      | 235.7     |
|                   | Y                       | 9.76       | 11.13     |
| Sikkim            | A                       | 12.0       | 9.6       |
|                   | P                       | 54.0       | 43.0      |
|                   | Y                       | 4.50       | 4.48      |
| Tripura           | A                       | 32.0       | 18.4      |
|                   | P                       | 358.5      | 232.8     |
|                   | Y                       | 11.20      | 12.65     |
| NEH region        | A                       | 359.80     | 367.9     |
|                   | P                       | 3270.50    | 4051.8    |
|                   | Y                       | 9.09       | 11.01     |
| India             | A                       | 5515.2     | 5993.0    |
|                   | P                       | 75074.6    | 90830.7   |
|                   | Y                       | 13.61      | 15.16     |

[Source: Agril. Research Data Book, ICAR, 2002]

**Why Greenhouses****1. Socio-economic consideration**

As a profession, agriculture is not attractive for the educated youth, which is partly due to the drudgeries associated with field work. To motivate the educated youth agriculture has to be developed to be a remunerative and drudgery-less industry as competitive as any other industry using agro-technologies like greenhouse. Then only a sense of pride will be associated with agriculture. This is specially true for the NEH region where percentage of literacy among indigenous people is higher than national average.

**2. Geographical consideration**

- The topography of NEH region is not uniform. Some of the areas are inaccessible as well as inhospitable where normal cultivation is not possible. To cater the needs of the population in the inaccessible areas greenhouse cultivation could be an answer.
- There is very good and sustainable demand for fresh vegetables around the cities and towns.

## **Principle of greenhouse**

A greenhouse is generally covered with a transparent material such as polythene or glass. Depending upon the cladding material and its transparency major fraction of sunlight is absorbed by vegetable crops and other objects. These objects in greenhouse in turn emit long wave thermal radiations for which cladding material has lower transparency. With the result, solar energy is trapped and raises the temperature inside the greenhouse. This is popularly known as greenhouse effect. This rise in temperature in greenhouse is responsible for growing vegetable in cold climates. During summer months, air temperature in greenhouse is to be brought down by providing cooling device. In commercial greenhouses besides temperature-controlled humidity, carbon dioxide, photoperiod, soil temperature, plant nutrients etc. facilitate round the year production of desired vegetable crops. Controlled climatic and soil conditions provide an opportunity to the vegetable crops to express their yield potentials.

## **Benefits of Greenhouse**

### **1. Vegetable forcing for domestic consumption and export**

During winters in NEH region, the temperature and solar radiations are sub-optimal for growing off season vegetables namely tomato, capsicum, brinjal, cucumber, okra and chilli. In tomato, low temperature and low radiation cause puffiness and blotchy ripening. Hence during extreme conditions of winter season (October-February), these vegetables will be cultivated under polyhouse. In a medium cost greenhouse, an yield of tomato and capsicum can be taken @ 98.6-110.5 tonnes/ha and 87.2 tonnes/ha, respectively. The protected environments would be well adapted in the field where winter is prolonged. A polyhouse can be made which will receive sunlight for growing chilli, tomato, brinjal, capsicum and cucumber. The improved varieties and hybrids of these crops would be evaluated. The high priced vegetables- asparagus, broccoli, leek, tomato, cucumber and capsicum are most important crops for production around metropolis and big cities during winter season or off-season. Thus in the NEH region during winter, it may be useful to grow tomato and capsicum in plastic tunnels as the plants which are protected from cold and frost will manifest faster and better growth resulting in earlier fruiting than the crops grown in the open.

### **2. Raising off season nurseries**

The cost of hybrid seeds is very high. So, it is necessary that every seed must be germinated. For 100% germination, it requires the controlled conditions. The cucurbits are warm season crops. They are sown in last week of March to April when night temperature is around 18-20°C. But in polyhouse their seedlings can be raised during December and January in polythene bags. By planting these seedlings during end of February and 1st week of March in the field, their yield could be taken in one and one and a half months in advance than the normal method of direct sowing. This technology fetches the bonus price due to marketing of produce in the off-season.

Similarly, the seedlings of tomato, chilli, capsicum, brinjal, cucumber, cabbage, cauliflower and broccoli can be grown under plastic cover protecting them against frost, severe cold and heavy rains. The environmental condition, particularly increase in temperature inside polyhouse hastens the germination and early growth of warm season vegetable seedlings for raising early crops in spring summer. Vegetable nursery raising under protected conditions is becoming popular throughout the country especially in hilly regions. Management of vegetable nursery in protected structure is easier and early nursery can be raised. Needless to emphasize, this practice eliminates danger of destruction of nurseries by hail storms and heavy rains because world highest rains occur in this region and the period of rainy season is also wide (April to October). Protection against biotic and abiotic stresses becomes easier.

### **3. Productivity is manifold in greenhouses in comparison to growing the vegetables in open field**

**Table 2:** Performance of tomato varieties under polyhouse and open field conditions in NEH region (Barapani)

| Varieties    | Polyhouse yield (q/ha) | Open field yield (q/ha) | Varieties   | Polyhouse yield (q/ha) | Open field yield (q/ha) |
|--------------|------------------------|-------------------------|-------------|------------------------|-------------------------|
| BT-117-5-3-1 | 342.00                 | 115.00                  | Selection-2 | 233.00                 | 73.83                   |
| KT-10        | 283.60                 | 117.40                  | Selection-1 | 2000.98                | 84.03                   |
| BT-10        | 294.00                 | 111.65                  | KT-15       | 211.60                 | 51.65                   |
| Arka Alok    | 260.00                 | 57.90                   | H-24        | 243.17                 | 58.75                   |
| BT-12        | 302.40                 | 101.00                  | Arka Abha   | 193.50                 | 70.33                   |

#### 4. Vegetable seed production

Seed production in vegetables is the limiting factor for cultivation of vegetables in NEH region of India as well as in India. The vegetables require specific temperature and other climatic conditions for flowering and fruit setting. Seed production of brinjal, capsicum, cauliflower and broccoli is very difficult in open conditions in this area due to high rainfall at maturity stage. To reduce such micro climatic condition, a protected environment is essential. Therefore, the seed production of highly remunerative crops namely tomato, capsicum and cucumber is performed under protected environments. The maintenance and purity of different varieties/lines can be achieved by growing them under greenhouse without giving isolation distance particularly in cross-pollinated vegetables namely onion, cauliflower and cabbage. Hence, vegetable production for domestic consumption and export in low and medium cost greenhouse is a technical reality in India. Such production system has not only extended the growing season of vegetables and their availability but also encouraged conservation of different rare vegetables.

#### 5. Hybrid seed production

In 21<sup>st</sup> century, protected vegetable production is likely to be commercial practice not only because of its potential but out of sheer necessity. In vegetable production hybrids seeds, transgenic, stress resistant varieties, micropropagated transplants, synthetic seeds are likely to replace conventional varieties. Protected environments will be helpful in production of hybrid seeds of cucumber and summer squash by using gynocious lines. Gibberlic acid is used to maintain such lines followed by selfing. The desired pollen can be used for production of hybrid seed of cucumber. Similarly in summer squash use of Ethophan in inducing female flower at every node would help in the hybrid seed production by using desired pollen parent.

#### 6. Maintenance and multiplication of self incompatible line for hybrid seed production

In case of cauliflower, there is problem of maintaining and multiplication of potential self-incompatible lines for the production of F<sub>1</sub> hybrid seed. Temporary elimination of the self-incompatibility with the use of CO<sub>2</sub> gas has solved this problem. For this purpose, the self-incompatible line is planted in a greenhouse and bees are allowed to pollinate the crop when it is bloom. Then keeping the greenhouse closed tightly, within 2-6 hours of pollination, it is treated with 2-5% CO<sub>2</sub> gas which allows successful fertilization by temporarily eliminating the self-incompatibility.

#### 7. Polyhouse for plant propagation

Asparagus, sweet potato, pointed gourd and ivy gourd are sensitive to low temperature. The propagating materials of these vegetables can be well- maintained under polyhouse in winter season before planting their cuttings in early spring-summer season for higher profit.

#### Status

Commercial greenhouses with climate-controlled devices are very few in the country. Solar greenhouses comprising of glass and polyethylene houses are becoming increasingly popular both in

temperate and tropical regions. In early sixties, Field Research Laboratory (FRL) of DRDO at Leh attempted solar greenhouse vegetable production research and made an outstanding contribution to the extent that almost every rural family in Leh valley possesses a polyhouse these days. Indian Petro Chemical Corporation Ltd (IPCL) boosted the greenhouse research and application for raising vegetables by providing Ultra Violet (UV) stabilized cladding film and aluminium polyhouse structures. Several private seed production agencies have promoted greenhouse production of vegetables. In comparison to other countries, India has very little area under greenhouses as is evident from Table 3.

**Table 3:** Approximate area (ha) under greenhouses

| Country     | Area  | Country | Area  |
|-------------|-------|---------|-------|
| Japan       | 54000 | Turkey  | 10000 |
| China       | 48000 | Holland | 9600  |
| Spain       | 25000 | USA     | 4000  |
| South Korea | 21000 | Israel  | 1500  |
| Italy       | 18500 | India   | 525   |

The major share has been in the Leh & Ladakh region of Jammu and Kashmir where commercial cultivation of vegetables is being promoted.

In NEH region, polyhouse cultivation is still a new emerging technology for raising nursery of vegetable crops. Assistance provided under the plasticulture scheme since the VIII & IX plan has helped in generating awareness about the importance of greenhouses in enhancing productivity and production, particularly of horticultural crops. out of 525 ha area under greenhouses in India, 83 ha has been covered in the NE states (Table 4), the maximum area being in Sikkim.

**Table 4:** Cumulative coverage of area (ha) under greenhouse

|            | VIII Plan | 1997-98 | 1998-99 | 1999-00 |
|------------|-----------|---------|---------|---------|
| All India  | 211.12    | 359.35  | 414.05  | 525.05  |
| NEH Region | 29.05     | 42.89   | 59.55   | 83.4    |

### **Types of greenhouse/polyhouse**

#### ***Low-cost greenhouse/polyhouse:***

The low cost polyhouse is a zero-energy chamber made of polythene sheet of 700 gauge supported on bamboos with sutli (ropes) and nails. It will be used for protecting the crop from high rainfall. Its size depends upon the purpose and availability of space. The structure depends on the sun for energy. The temperature within polyhouse increases by 6-10<sup>0</sup>C more than outside. In UV stabilized plastic film covered pipe framed polyhouse, the day temperature is higher and night temperature is lower than the outside. The solar radiation entering the polyhouse is 30-40% lower than that reaching the soil surface outside.

#### ***Medium-cost greenhouse/polyhouse***

With a slightly higher cost, a Quonset-shaped polyhouse (greenhouse) can be framed with GI pipe (class B) of 15 mm bore. This polyhouse will have a single layer covering of UV-stabilized polythene of 800 gauge. The exhaust fans are used for ventilation. These are thermostatically controlled. Cooling pad is used for humidifying the air entering the polyhouse. The polyhouse frame and glazing material have a life span of about 20 years and 2 years, respectively.

#### ***High cost greenhouse/polyhouse***

It is constructed on the structure (frame) made of iron/aluminum structure, designed domed shaped or cone shaped (as per choice). Temperature, humidity and the light are automatically controlled as per requirement of the users. Floor and a part of walls are made of concrete. It is highly

durable, about 5-6 times costlier, required qualified operator, proper maintenance, care and precautions while operating.

The low and medium-cost greenhouses have wide scope in production of domestic as well as export-oriented vegetables. NEH region recorded highest rainfall in the world. The duration of rainy season is also wide (April-October). During this period, growing of vegetables such as cabbage, cauliflower, broccoli, tomato, brinjal and French bean in open conditions is very difficult. Severe attacks of pest and diseases occur due to heavy rains. So, growing of vegetable crops in low cost polyhouse during this period is very profitable. Control of disease and pest in polyhouse is also easy.

### Other plant protection structures

1. **Plastic low tunnels:** Plastic low tunnels are miniature form of greenhouses to protect the plants from rains, winds, low temperature, frost and other vagaries of weather. The low tunnels are very simple structures requiring very limited skills to maintain are easy to constructs and offer multiple advantages. For construction of low tunnels, film of 100 micron would be sufficient. The cost of a 100-micron thick film would be about Rs.10/m<sup>2</sup>.

2. **Net houses:** Net houses are used for raising vegetable crops in high rainfall regions. Roof of the structure is covered with suitable cladding material. Sides are made of wire mesh of different gauges. Such structures are useful for NEH region.

### Approximate cost estimate

Cost of production (for one year) for 100 m<sup>2</sup> polyhouse cum rainshelter

#### A) With hired labour

|                     |                    |
|---------------------|--------------------|
| Cost of labour =    | Rs. 6400.00        |
| Cost of inputs =    | Rs. 1500.00        |
| Cost of structure = | <u>Rs. 3000.00</u> |
| Total               | =Rs. 10900.00      |

#### B) With 50% hired + 50% family labour

|                     |                    |
|---------------------|--------------------|
| Cost of labour =    | Rs. 3200.00        |
| Cost of inputs =    | Rs. 1500.00        |
| Cost of structure = | <u>Rs. 3000.00</u> |
| Total               | =Rs. 7700.00       |

#### C) With family labour only

|                     |                    |
|---------------------|--------------------|
| Cost of inputs =    | Rs. 1500.00        |
| Cost of structure = | <u>Rs. 3000.00</u> |
| Total               | =Rs. 4500.00       |

### Cropping sequence

| Crop        | Duration  | Income (Rs.) |
|-------------|-----------|--------------|
| Tomato      | Feb- June | 6000         |
| Spinch beat | June-July | 1500         |
| Tomato      | Aug.-Nov. | 6000         |
| Cucumber    | Nov.-Feb. | <u>6000</u>  |
|             |           | Total 19500  |

Or

|             |           |             |
|-------------|-----------|-------------|
| Tomato      | Feb- June | 6000        |
| Spinch beat | June-July | 1500        |
| Capsicum    | Aug.-Nov. | 2250        |
| Cucumber    | Nov.-Feb. | <u>6000</u> |
|             |           | Total 15750 |

Gross income from cropping sequence  
 Tomato + Palak + Tomato + Cucumber = Rs. 19500.00  
 Tomato + Palak + Capsicum + Cucumber = Rs. 15750.00

Annual net return from 100 m<sup>2</sup> polyhouse cum rainshelter

| Nature of labour        | Gross income | Net income | B:C ratio |
|-------------------------|--------------|------------|-----------|
| With hired labour       | 19,500       | 8,600      | 1.79:1    |
| With 50% hired + 50%own | 19,500       | 11,800     | 2.53:1    |
| With family labour only | 19,500       | 15,000     | 4.33:1    |

[Source: Phookan and Saikia, 2003]

### **Constraints in protected vegetable production**

In NEH region polyhouse culture is in infant stage and has not become popular as yet. High cost and non-availability of various components are the two major limiting factors in the adoption of polyhouse technology for commercial cultivation. Many of the polyhouse components like fibreglass, cooling pads, fans, etc., have to be imported at high costs including freight and custom duty. Greenhouse and other structures design for different agro-climatic of the region is not standardized. Lack of awareness among farmers pertaining to potentials of protected vegetable production and lack of major research programme on protected vegetable farming are other limiting factors.

### **Prospects of protected vegetable production in NEH region**

There is a good potential to promote the technology in this region for cultivation of vegetables. The Assam Agricultural University, Jorhat has developed low cost technology for construction of green houses and rain shelters with the use of locally available material like bamboo, which could be availed.

In temperate areas, vegetable growers can increase their income by raising early crops in protected structures mainly in low-cost greenhouses. Raising of vegetable nursery in protected structures has many fold benefits such as easy management, early nursery, and protection from biotic and abiotic stresses. This technology is highly productive, amenable to automation, conserve water and land. In 21<sup>st</sup> century, protected vegetable production is likely to be common commercial practice not only because of it potential but out of sheer necessity.

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# IS GOAT FARMING A THREAT TO ECOLOGY?

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## INTRODUCTION

Goat popularly known as poor man's cow is widely distributed and clearly associated with poor people, their economic contribution is extremely important for the security and livelihood of these people throughout the developing countries. This contribution is varied, and the importance is reflected in terms of revenue generation, cash security and enhanced qualitative human nutrition. The contribution of goat to all the above said is well documented (Devendra, 1992; Kumar and Singh; 1992; Kumar et al., 1992; Naidu et al., 1991; Singh and Ram, 1987).

A lot has been said about the goat farming vis-a-vis threat to ecology. There is enough evidence that goat farming is not a threat to ecology (Acharya and Singh, 1992) The comparative destructive behavior of goat, sheep and other livestock is studied by Shankarnarayana, 1985 and given clean chit to the goat species. The role of goat in regeneration of vegetation is well documented (Sharma and Ogra, 1987; Harsh and Shankar Narayana, 1992). Further role of goat in controlling weeds and prevention of forest fire is studied by Holgate (1980), Edward (1981), Holga (1984), Mitchel (1984), Kolars (1966). Lastly the Government of India in the year 1987 constituted a task force under the chairmanship of Prof. K.H. Rao one of the leading economist of India. This task force observed that there was no definite evidence to prove that goat posed threat to the ecology as was generally believed. They further recommended that sheep and goat should not be categorized as animals responsible for the destruction of ecology.

In spite of above evidence in favour of goat farming, there is still firm beliefs among the forest officials, administrative officers, people of financial institution and even with the veterinary officers who have a big role to play in the development of animal husbandry that goat is a threat to ecology.

The population of goats shows a rising trend globally with more increase (56%) in developing countries than in developed countries (33%) during 1975-95. No other livestock species excepting pig (56% increase) has registered this much increase over the years in developing countries (Schillhorn von veen, 1999). This indicates the emerging importance of goat production globally. The statistics also indicates the concentration of goats in marginal areas like mountainous region, rainfed dry land and deserts of developing countries. Notwithstanding a long debate on goats and environmental threat, the rising trends only indicate that the choice of majority is in favour of goats.

Given the above background, this paper based on empirical studies done among farmers of Himalayan region, researchers, forest officials, bank officials, development administrators, and veterinary officers tries to explore the controversies associated with the goat husbandry.

## MATERIAL AND METHODS

The target group of respondents consisted farmers of Himalayan region, researchers from various disciplines of animal science from Central Sheep and Wool Research Institute (CSWRI), Avikanagar, Central Institute of Research on Goat (CIRG), Mathura, Sher-e-Kashmir University of Agriculture and Technology (SKUAST), Srinagar, Izatnagar campus and Palampur campus of Indian Veterinary Research Institute (IVRI), Forest officials of Kumaon range, Bank officers of Nainital and Almora district of Kumaon Hills, Veterinary officers of Kumaon Division and the development

administrators of the Kumaon range. For this study a total of 100 farmers, 25 researchers, 25 administrators, 10 forest officers 20 bankers and 25 veterinary officers were interviewed by either mailed questionnaire or by personal interview. The results were analyzed and presented as below.

## **RESULTS AND DISCUSSION**

### **Farmers' view**

All the farmers unanimously declared that goat rearing was a profitable enterprise. According to them through goat they were earning a good amount of cash and it acted as a security. The surplus family labor was engaged for this purpose along with the kitchen waste. 76% of the farmers were of the opinion that the goat was not a threat to ecology. The rest of them who were thinking that it was threat to ecology, said that the regeneration of commercial plants were slow after the grazing of the plants by goats only during the initial phases of the plants. When asked, if the goat could be stall fed, the 78% of them answered in affirmative. However, as most of the farmers used to graze their goats in the nearby forest without any supplementary feeding, they expressed that it would be costly and difficult in stall-feeding of the goats. 100% of the farmers agreed that the human factor (management/conservation) was more responsible for the present status of the ecology than the animals particularly the goats. The farmers were aware about the carrying capacity of their area and they themselves controlled the numbers of their animals which adequately reflects a lot about the wisdom of our poor farmers. They further demanded their participation in the on going development works which were directly affecting their ecology like construction of roads, building, and irrigation structure in their area.

### **Researchers' view**

Hundred percent of the researchers were of the opinion that goat farming was a profitable enterprise for the entire region. No researcher agreed that goat was threat to ecology; however, they were worried about the increasing number of the species that too of the poor breed. They emphasized the need for the upgradation of the local breed by suitable breeding technique. 28% of them believed that goat keeping through stall feeding would be economical and they recommended the stall feeding at least for the ecologically fragile region of the country. 100% of the researchers were of the view that human factor was more responsible for the down gradation of the ecology and not the animals.

### **Administrators' view**

A majority of the development administrators' opinion regarding the profitability was same as that of the farmers and the researchers. However, 30% of them said that goat was threat to the ecology and in support to their hypothesis they said that deforestation was only due to this species although it was their preconceived notion without any evidence but they were at the helms of affair related to the inclusion of goat in the rural development program of their area of influence. 100% of them believed that the goat could be stall fed and 80% of them said that the stall fed goat farming was economical. One very interesting observation was that about 40% of them believed that human factor was not that important for the ecological degradation.

### **Forest officers' view**

Here also all of them agreed that the goat farming was a profitable enterprise. Surprisingly 60% of them said that goat was a threat to the ecology and in their support they said that goat reduced the good quality fodder from the forest and the regeneration of forest was affected by grazing done by the goat. All of them advocated stall-feeding of the goat and 60% of them declared it as economical. When asked if the goat should be banned most of them answered in affirmative and said that at least from the area like Kumaon hills it should not be allowed as free grazing animals. 60% of them accepted the contribution of human factor in ecological damage.

### Bank officers' view

All the bank officers who responded were of the view that goat rearing was a profitable enterprise and 20% of them said that goat was a threat to ecology. When asked to give reason in their support for this none of them said any thing. 100% of them advocated stall-fed goat rearing and all of them accepted it as economically feasible. They did not give any figure for the funding on goat husbandry as they were maintaining it as a joint figure with piggery. But the farmers of the region said that banks discouraged the finance for goat farming and even in the government sponsored rural development activities the goat did not figure.

### Veterinary officers' view

The role of veterinary officers in deciding the animals for inclusion in the rural development program is very important. 30% of the respondent in this section believed that goat was a threat to ecology and 60% of them believed that stall fed goat rearing was economical and stall fed goat rearing only should be encouraged in the hilly region.

**Table 1:** Views on different aspect of goat farming a threat to ecology by people concerned with goat husbandry

| Attributes                           | Farmers' view | Researchers' view | Administrators' view | Forest officers' view | Bankers' view | Veterinary officers' view |
|--------------------------------------|---------------|-------------------|----------------------|-----------------------|---------------|---------------------------|
| Profitability                        | 100           | 100               | 100                  | 100                   | 100           | 100                       |
| Threat to ecology                    | 76            | 00                | 30                   | 60                    | 20            | 30                        |
| Can goat be stall- fed               | 78            | 100               | 100                  | 100                   | 100           | 100                       |
| Stall-fed goat farming is economical | 20            | 28                | 80                   | 100                   | 100           | 60                        |
| Human factor in ecological damage    | 100           | 100               | 40                   | 60                    | 60            | 60                        |

### CONCLUSION

Goat is universally accepted as a profitable animal. Despite various studies in support of this animal people still believed it as a threat to ecology. This reflects the poor coordination between research and development. People at the research station used to do research, publish the results and believe that their job is finished. The people at the extension say that they require some tangible thing to convince the people and the literature only will not serve their purpose. On the other hand the people of the development machineries regard themselves as master of all trade and do not seek the opinion of the experts of the field. This demands a system approach in which the entire component should work towards the development of the goat enterprise as a whole. Further the role of the farmers should be acknowledged and their participation should be ensured and it is only possible through bottom-up approach.

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# FOREST FRAGMENTATION : A THREAT TO GLOBAL BIO-DIVERSITY

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## INTRODUCTION

Expanding human population has caused increased resource exploitation and alteration of land use pattern. This has resulted in fragmentation of habitats, ecosystems and landscapes. The processes of habitat loss and fragmentation are inextricably linked. As a large habitat becomes fragmented, all that is left are disjointed fragments of varying size. A fragmented forest habitat is reduced in size but tends to retain ecological characteristics and organisms of the forest. Up to a point, in fragmentation, no species are lost. However, as the process continues, the remaining area is reduced to a critical size below which it will not support many of the original species and a number of them would disappear (Whitecomb et al., 1976; Robbins et al., 1989).

Populations in fragmented ecosystems are more likely to become extinct due to effects associated with smaller size of remnant habitat, greater isolation from neighbouring populations and increased amounts of 'edge' habitat and this should consequently lead to an overall reduction in biological diversity in the region (Jules, 1998). The fragmentation of natural habitats is indeed the greatest single threat to the global bio-diversity.

Degree of species survival in a forest fragment is influenced by the proximity of fragment to large reservoirs of primary forests, time since fragment isolation, and the fragment size. Tropical forests are particularly vulnerable to species loss because of their extreme biotic richness. A much greater number of extinction is likely to result eventually from the severe loss and fragmentation of tropical rain forests.

Forest fragmentation causes changes in physical processes along the edges of the fragments. These changes are described as edge effect. In continuous forests, habitat edges are rare but in heavily fragmented landscape, forest edges become a major feature. Edge effects the physical and biotic changes and in association with remnant forest have a major impact on the ecology of fragmented forests. Edge effects are now considered the principal cause of population decline in fragmented habitats.

Edge effect can include elevated wind turbulence and temperature variability, lateral light penetration and reduced humidity. Biotic effects can be extraordinarily diverse and include the proliferation of secondary vegetation along forest margins, invasions of weedy or generalist plants and animals, alteration of ecological processes such as nutrient cycling and energy flow, etc (Laurance and Bierregaard, 1997). Many animal species are both vulnerable to fragmentation and respond quite rapidly to habitat change. Invertebrate communities, in particular, can change very quickly, both because of their short generation times and because of their small size and ectothermic nature. Vertebrate populations may also change rapidly.

Plants have been less actively studied than animals in habitat fragmentation research (Laurance and Bierregaard, 1997). Taken as a whole, vascular plant populations appear less vulnerable to fragmentation than those of many vertebrates. Plants have smaller area requirements and many species are long-lived and have many reproductive episodes. Despite the general resilience, certain plant taxa or functional groups are probably strongly affected by fragmentation. Epiphytes and orchids, for example, seem unusually vulnerable, possibly because they are sensitive to microclimatic changes in fragments. Plants that have obligate mutualism with vulnerable pollinators or seed dispersers may also be vulnerable to fragmentation.

Habitat restoration has an important role to play in conservation and wild life management. Restoration practices can help to reverse the ecological degradation of small forest remnants. Restoration can be relatively expensive and time consuming but efficiency of reforestation can be improved by exploiting natural regeneration mechanisms. Forest fragments are often not self sustainable and require restoration efforts to maintain their ecological functions and bio diversity in the long run (Viana et al., 1997).

### **CAUSES OF ECOSYSTEM FRAGMENTATION**

The problem of ecosystem damage is international and no country in the world is unaffected. The intriguing question that comes to our mind is what causes ecosystem damage. The answer is the burgeoning human population. Due to population explosion there is dearth of space, paucity of food and fuel. Anthropogenic pressure on natural resources leads to ruthless cutting down of forest trees leading to deforestation which is occurring at an alarming rate in the tropics.

It has been estimated that by 1990, 24% of the lowland tropical rain forest on earth had been cleared, largely to create agricultural land. By the turn of this century, deforestation will lead to increase soil erosion, watershed destabilization, climate degradation and the extinction of a large number of species. Processes like random genetic drift and inbreeding may increase the probability of extinction still further. The massive changes in land use patterns across the world have resulted in fragmentation of habitats, ecosystems and landscapes.

Forest fragmentation occurs when a large area of native forest is transformed into a series of smaller remnant patches isolated by an intervening matrix hostile to forest organisms (Burgess and Sharpe, 1981; Harris, 1984; Wilcox and Murphy, 1985; Saunders et al., 1991; Harris and Silva-Lopez, 1992; Zipperer, 1993). This phenomenon has become a great menace to the global bio-diversity. The destruction and fragmentation of habitat has resulted in the conversion of relatively continuous ecosystems, such as forests, into archipelagos of natural habitat surrounded by a sea of agriculture and urban development. Forest fragmentation is a widespread phenomenon that is almost invariably associated with frontier expansion in both tropical and temperate regions (Harris, 1984).

Plant reproductive output is affected by micro-climatic changes induced by fragmentation, which in turn leads to changes in animal interactions. Human encroachment into forested regions diminishes the total forested land area. Remnant forest fragments rapidly increase in number as a result of incomplete deforestation. Such fragments form a mosaic of small (often 1-5 ha) habitat islands embedded in a human modified matrix in which abiotic and biotic processes are dramatically altered (Harris, 1984; Bierregaard et al., 1992).

An outcome of industrialization and urbanization is ever expanding network of roads and rapid growth of human settlements, which cause massive ecosystem fragmentation. Internal fragmentation occurs when natural habitat is fragmented and wildlife populations subdivided by linear clearings such as roads and powerlines.

One of the important causes of deforestation and forest fragmentation is slash and burn agriculture carried out by subsistence farmers through out the tropics. The grasslands resulting due to abandonment of slash and burn agriculture in forested landscapes are also burned annually to promote the growth of nutritious green shoots for cattle. This prevents shrub and forest regeneration and gradually erodes forest margins leading to habitat fragmentation. Shifting agriculture practiced in various hilly-forested regions e.g. Jhum cultivation in north - east India by the tribals, have resulted in forest fragmentation. Natural forest fires and anthropogenic activities like mining for limestone, coal etc. also play a role in forest degradation and fragmentation. Fragmentation in large tracts of forest and grassland may begin intrusively with clearing within the tract, such as clear - cuts, wildlife food plots and housing development (Harris and Silva-Lopez, 1992). Insular habitats may be further reduced by fragmentation pressures encroaching from one, several or all sides.

### **Size and shape of the fragments**

Area alone is not the important parameter in determining the size of the fragment. What is important is the ratio of edge (or perimeter) to area. The length of perimeter is directly proportional to the square root of the area. Some small size fragments is all edge, if the depth of the edge is allowed to remain constant while increasing the area, the ratio of edge to interior decreases as the size of habitat increases. An interior starts developing when the island size becomes large enough to maintain mesic and interior conditions. However, size is not the sole determinant of edge – interior conditions. The shape of the fragment is also critical. For example a rectangular wooded fragment may contain 39 ha of land; yet because of its shape it can be entirely edge, if its width does not exceed the depth of its edge, or to put it differently, it has a high ratio of edge to area then, none of its species is interior. By contrast, a square woodland of 47 ha having a core interior area of 20 ha, has atleast some of its species as interior species which are sensitive to fragmentation. As island size increases, the interior area increases and the ratio of edge to interior decreases. This relationship of area to edge holds for circular or square fragments, but not for irregular or rectangular fragments.

### **GENERAL EFFECTS OF FRAGMENTATION**

Different components of an ecosystem can respond in different ways to habitat fragmentation (Robinson et al., 1992). The effects seen among populations can be hidden at the level of aggregated community variables. Therefore understanding the consequences of habitat fragmentation requires documenting the system attributes that do not change as well as those that do.

It has now become increasingly necessary to understand the consequences of the destruction and fragmentation of natural habitats (Robinson et al., 1992). Habitat fragmentation can influence the entire suite of ecological processes, from individual behaviour through population dynamics to ecosystem fluxes. In a study of effects of habitat fragmentation, (Robinson et al., 1992) found that ecosystem processes (soil mineralization and plant succession) did not vary with the degree of subdivision, nor did most measures of plant and animal community diversity. However, they observed that fragmentation affected vertebrate population dynamics and distribution patterns as well as the population persistence of clonal plant species. Over time, clonal plants resemble amoebae moving across the landscape and are at greater risk in highly fragmented habitats because fragmentation reduces the opportunity for re-invasion by vegetative growth (Robinson et al., 1992). Fragmentation is a system level phenomenon. To estimate the effects of fragmentation, one should have a first hand knowledge of how the entire system operates. Remote sensing technology and geographic information systems (GIS) are the tools, which can be used in detecting the potential effects of fragmentation on target species over large areas.

Almost three-quarters of the humanity reside in the tropics, generating tremendous pressure on various ecosystems in this region. Most studies on fragmentation have been carried out in temperate regions. Only a few studies have been done in the tropical regions. One important study on tropical forest fragmentation is the Biological Dynamics of Forest Fragments Project based near Manaus in Amazonian Brazil.

Fragmentation destroys natural biotas resulting in habitat loss and alteration. This immediately reduces the sizes of species populations, increases their isolation and commonly changes their abiotic environment. Original species get exposed to wind and insolation at the edge and experience mortality. The exposure to wind and insolation invite certain species to proliferate. So immediately after fragmentation diversity increases but later on decreases. If the fragment is very small the condition is all edge. If the fragment is large there is interior surrounded by edge. The microclimate changes are different at the edges and interior. The biological diversity of the fragment will depend upon conditions conducive to different kinds of species.

- (i) Edge species are mostly xeric species.

- (ii) Area insensitive species are the species, which can grow and multiply in small as well as large areas.
- (iii) Area sensitive species are the species, which require large areas for foraging or for movements.
- (iv) Interior species are food or habitat specialists, for example shade tolerant tree species. Interior species are most affected by fragmentation.

Levenson (1981) found that the species richness of plants was the greatest in edge situations where xeric species coexist with some interior species. The total number of woody species in Wisconsin woodlots increased with woodlot size up to approximately 2.3 ha. At that point vegetation achieved a maximum balance between edge and residual interior species. Beyond that size species richness declined and leveled off at 9.3 ha (23 acres), as mesic conditions and shade-tolerant species persisted. A similar situation occurred in islands of prairie vegetation (Simberloff and Gotelli, 1984), Yorkshire limestone pavements, chalk quarry reserves, and lowland heaths in Great Britain (Higgs and Usher, 1980). There appears to be a negative correlation between edge species of plants and the size of the forest fragment and a positive correlation between interior species and increased area.

In general, larger forests have more species than smaller forests. The latter are occupied by edge and ubiquitous species at home in any size forest tract (Moore and Hooper, 1975; Galli et al., 1976; Ambuel and Temple, 1983; Blake and Karr, 1984; Freemark and Merriam, 1986). A study in New Jersey suggested that maximum bird diversity was achieved with woodlands 24 ha in size. However, those woodlands held no true forest interior species such as the wormeating warbler and the ovenbird, which are highly sensitive to forest fragmentation and require extensive areas of woods (Lynch and Whitcomb, 1977).

### **Vegetation Survey**

A vegetation survey was done from the roadside edge towards the railway line, stopping 15 m from the rail-line itself along the edge of a soil scrape. Transects were 20 - 30 m apart. At 10 m intervals, along each transect, all species growing in or projecting above a 1 - m<sup>2</sup> quadrat were identified, recorded and assigned a Braun Blanquet cover – abundance value (Kent and Coker, 1992). The median of each scale interval was used in calculations of total cover for individual species. Percent bare ground was also estimated, although this category included cryptogamic cover and (minimal) litter. A total of 110 quadrats were sampled.

The vegetation survey revealed that of the 102 species identified during the survey (Morgan and Rollason, 1995) for details 60 (59%) were native and 42 (41%) were non-native. 23 non-native species (52% of the non-native species) occurred at less than 5% frequency and only seven non-native species (16%) occurred in greater than 50% quadrats. Mean cover per m<sup>2</sup> was <1% for 77% of non-native species. There were several obvious differences in the growth form composition of the two floras. Therophytes were more common in the non-native flora (52% Vs 7%); hemicryptophytes were more common amongst native species (65% Vs 31% in the non-native flora); phanerophytes and chamaephytes were absent from the non-native flora but represented 18% of all native species. Total species richness did not vary significantly at most locations across the remnant (range 11.4 – 16.9 species m<sup>-2</sup>). However, non-native species richness was significantly higher at the roadside edge than at all locations within the remnant ( $p < 0.001$ ). Similarly, the rail – line edge (90 m) also had significantly higher non-native species richness ( $p < 0.001$ ) than most locations within the remnant itself. Percent overlapping cover of non-native species was significantly greater at the roadside edge than at all locations within the remnant ( $p < 0.001$ ). Throughout the remnant, overlapping cover of non-native species did not vary significantly. Richness and cover of native plants were significantly lower ( $p < 0.001$ ) at the remnant edge bordering the roadside than at all locations within the remnant where there was no significant difference.

## PLANT POLLINATOR RELATIONSHIP

Jennersten (1988) found that the perennial herb, *Dianthis deltoides*, shows pollination limitation of seed set in meadow fragments but not in continuous habitat. In Argentinean dry thorn forest, Aizen and Feinsinger (1994) found that the number of small bee species caught in traps was lower in two small forest fragments than in continuous forest. It is not necessary that species become locally extinct. The composition of the pollinator community could change if floral densities or distributions are altered with fragmentation. In another example, it was found that long-tongued bumblebees were more common in large, dense patches of flowers whereas short-tongued bumblebees were more common on plants in small, scattered patches. Fragmentation can also restrict pollinator movement, which may reduce gene flow and result in increased inbreeding.

Plant pollinator relationship, which is an example of a vital interaction, gets tremendously affected by forest fragmentation. All available evidences show that pollinator abundance and diversity declines with fragmentation. The loss of plants or pollinators can cause cascading extinction throughout the community (Rathcke and Jules, 1993). Additional genetic processes in small population, like random genetic drift and inbreeding, may increase the probability of extinction. Habitat fragmentation locally changes plant species richness, in most cases this is followed by a decreases in species richness of the assemblage of pollinators and consequently pollination effectiveness changes. Therefore an immense loss of bio diversity will occur due to fragmentation.

Pollinators that are specialists on one or few plant species, like euglossine bees and solitary bees, may be especially vulnerable to habitat fragmentation for many reasons. Because specialist pollinators often exist in small, patchy populations, small fragments are more likely to exclude them, and environmental or demographic stochasticity is more likely to cause their extinction. For a specialist, the loss of its host plant will cause extinction. For specialists that exploit sparse, scattered floral resources, a reduction in floral abundance caused by fragmentation could also be threatening. Bronstein (Bronstein et al., 1990) presented a striking example from figs and their specialist fig wasp pollinators. Because a tree, releasing wasps must be synchronized with another tree receptive to wasps in order to be pollinated, tree density is critical to wasp success and to tree pollination. They estimated that at least 95 tree individuals were necessary to maintain wasp populations for four years. Because figs can act as keystone species that provide food for many frugivores during periods of resource scarcity, the loss of figs could generate cascading extinction throughout the animal and plant community far beyond the fig pollinator wasp population. In contrast, generalist pollinators may be less vulnerable to fragmentation than specialists. Generalists often originally exist in widespread populations and thus are less likely to be excluded in small fragments. Furthermore, because many plant species can act as substitute or interchangeable resources for these pollinators, the loss of one or few plant species should not directly threaten their survival. However, Bowers (1985) found that floral composition of meadows was a major component determining the probability of local extinction of bumblebees, which are generalized floral visitors. On the other hand, many floral-species generalists are actually specialists for high-density resources. If fragmentation reduces the abundance of these resources, these generalists may be highly vulnerable and experience high extinction rates as Pimm and Pimm (1982) have suggested for Hawaiian honeycreepers. Even if species do not become locally extinct, the composition of the pollinator community could change if floral densities or distributions are altered with fragmentation. For example, it was found that long-tongued bumblebees were more common in large dense patches of flowers whereas short-tongued bumblebees were more common on plants in small, scattered patches.

The risks posed by fragmentation will also depend upon other non-food requirements and interactions with other species. For example, small bee species often have specialized nesting requirements, whereas most honey bee species have relatively generalized requirements. Aizen and Feinsinger (1994) suggested that the prevalence of honeybees in a fragment might partly reflect their

ability to nest in the matrix area between fragments. Butterflies and moths have specific larval host plant requirements, which may partly account for their observed decline in fragments. Pollination levels, fruit set and seed set among small forest fragments, large fragments and continuous forest were compared by Aizen and Feinsinger (1994). In some, plant species the absolute quantity of pollen grains transferred to stigmas decreased with fragmentation. In *Cercidium*, *Prosopis* and *Atamisquea* the quality of the grains transferred apparently changed. Number of pollen tubes produced per pollen grain on the stigma declined with increasing fragmentation, and at least in the latter two species seed production declined as well.

In a study of *Silene regia* in prairie fragments, Menges (1990) found that germination success was lower for plants from small populations (< 150 plants) than from larger populations. He suggested that this reduction most likely reflects higher inbreeding depression resulting from small population size and possibly from shorter pollen dispersal distances caused by humming birds foraging in small patches (Menges, 1991).

The pollination success of one plant species can also be influenced indirectly by the presence of other plant species that maintain pollinators. Waser and Real (1979) documented that a failure in flowering of an early flowering species caused migrating humming birds to leave the area, as a result, a later flowering species experienced lower visitation rates and lower seed-set. The disruption of such sequential mutualisms by fragmentation could cause cascading extinction through the community.

### **Demographic changes**

The influence of forest fragmentation was studied by Jules (1998) on an understory herb, *Trillium ovatum*, in the Siskiyou Mountains of Oregon, where logging practices over the past 35 years have created a mosaic of fragments surrounded by clear-cuts and tree plantations. The age of *trillium* plants was estimated by counting the annual constrictions on their rhizomes. *Trillium* is restricted to smaller amounts of remnant, uncut forest. It was demonstrated that populations in forest remnants that were within ~ 65m of forest clear-cut edges have had almost no recruitment of young plants since the time of the adjacent clear cutting, while forest interior populations contained higher recruitment levels. Thus this study provided the first evidence of demographic changes in plant populations resulting from habitat fragmentation.

### **Species loss**

Fragmentation causes a pronounced acceleration of tree community dynamics. The most important proximate cause of elevated tree mortality, damage, and turnover in recently created fragments is probably edge effect, particularly alterations in forest microclimate and greater wind turbulence near edges. Wind striking an abrupt forest edge causes increased turbulence and vorticity, leading to elevated wind throw and forest structural damage (Laurance and Bierrehaard, 1997; Chen et al., 1992). Fifty four Wisconsin prairie remnants studied by Leach and Givnish (1996) showed that 8 to 60% of the original plant species were lost from individual remnants over a 32 to 52 year period. The pattern of species loss in the above study was consistent with the proposed effects of fire suppression caused by landscape fragmentation.

### **Species invasion**

The invasion by non-native plant species of an urban remnant of a species rich *Themeda triandra* grassland in Australia was quantified and related to abiotic influences (Morgan, 1998). Native species richness and cover were lowest at the edge adjoining a roadside but then showed little relation to distance from edge. Three classes of non-native plants invaded this species-rich grassland. (i) Generalist species (ii) Resource limited species (iii) Species of intermediate frequency.

Native species richness and cover were negatively affected by increases in non-native cover. Declines were largely evident once the non-native cover exceeds 40%. Widespread, generalist non-

native species were numerous in intact sites and had to be considered a permanent part of the flora of remnant grasslands. Management must aim to minimize increases in cover of any non-native species or the disturbances that favour the establishment of competitive non-native grasses if the native grassland flora is to be conserved in small, fragmented remnants.

## **RESTORATION AND MANAGEMENT OF ECOSYSTEM FRAGMENTS**

When reduced to isolated patches magnificent forest ecosystems will break down affecting human beings at large. It becomes our duty then, as philanthropists and plant scientists, to save mankind and to save the forests from disappearing. In such an alarming situation restoration and management of these ecosystem fragments have become a prime requisite. Restoration is an attempt to bring back a forested area to its presumed original condition. A new forest would contain the same complement of species and would have the same general structure as the original forest. For restoring the species composition of damaged sites, management activities, which include the use of tree plantations, are very useful. Forest remnants can be linked by vegetation corridors that serve as potential target areas for forest restoration. Keeping in mind the potential threat to biological diversity due to habitat fragmentation, the restoration and management of ecosystem fragments has become the need of the hour.

As a result of deforestation, there is loss of species and degradation of tropical forestlands. To evaluate the relationship between extinction of species and deforestation certain models are prepared based on biogeography theory. There is an opportunity to couple natural processes with management activities to reduce species extinction and restore species richness to degraded lands (Lugo et al., 1993). Well-directed human actions provide us the means to conserve bio diversity and restore it in locations previously degraded. Potential target areas for forest restoration include the following:

- Habitats of particular species: Generally restoration prevents further species loss. Thus, habitats of endangered species should be the sites for restoration.
- Streamside: Riparian ecosystems are productive and comparatively species rich. Restoration of such habitats allows populations of species to increase and enhance their capacity to colonize other areas.
- Degraded areas within and around conservation reserves: Here restoration should aim to consolidate irregular boundaries and reduce the adverse ecological changes that occur at edges and often penetrate some distance into forest remnants.
- Corridors: Vegetation corridors that link together several forest remnants should be major targets for restoration. Enabling species to move between remnants may also enhance opportunities for genetic or demographic interchange or facilitate seasonal movements.
- Islands: Degraded island ecosystems may be particularly attractive target areas for restoration because they are one of the few locations in which pest species can be completely eradicated with a greatly reduced possibility of re-invasion (Downs and Ballantine, 1993).
- In the matrix between remnants: Restoration of matrix areas can be used to create new habitat between existing fragments. The size and potential conservation benefit of this habitat will depend on the restoration effort, the landscape pattern of current fragmentation and the presence of species that can colonize the new habitat. This strategy also offers the advantage of further increasing the biological heterogeneity of the 'sea' between remnant forest "islands".

Habitat restoration clearly has an important role to play in conservation and wild life management, especially in regions experiencing rapid forest fragmentation. Restoration practices thus, can help to reverse the ecological degradation of small forest remnants.

## Management actions

Land management encompasses a diverse range of activities. Restoration measures can improve the viability of small forest remnants, expand key wild life habitats, and increase landscape connectivity by revegetating stream margins. Forests can regenerate on denuded lands quite rapidly if the land is protected from fire, grazing, and encroachment, and if small forest patches have been retained as sources of forest seeds, mycorrhizae, and seed dispersers. Intensively managed areas such as timber plantations can harbour a surprisingly diverse array of native plants if natural regeneration is permitted in the understory. For landscape management and restoration, especially in terms of reducing or mitigating the effects of forest fragmentation, various methods, tools and technologies are involved. Active habitat management is usually a time consuming and expensive activity. Resource management agencies and organizations commonly operate on very limited and inadequate budgets. Thus, there is a great need to target management projects carefully and to spend scarce resources wisely. The type and spatial configuration of matrix habitats surrounding fragments can strongly affect the dynamics and composition of fragment biotas. Because the matrix is so important, reforestation initiatives are likely to play an ever-increasing role in tropical landscape management.

Management actions that increase the number of species on biologically impoverished or degraded sites include:

- Recycling of sewage and other non-toxic organic wastes through degraded sites to increase soil organic matter, stimulate soil microbial activity and accelerate natural succession.
- Use of proven reclamation techniques in mining areas and/or derelict industrial and urban sites.
- Diversification of habitats within agricultural landscapes through adoption of agro-forestry systems, maintenance of vegetation in uncultivated corridors, or tree islands between fields, along roads and waterways and around wetlands and other uncultivated sites.
- Multiple seeding of deforested, severely degraded sites.
- Use of tree plantations as foster ecosystems for native tree species.
- Control of fire, unregulated livestock grazing, and excessive fuel wood collection to allow natural recovery processes to enhance biological diversity. Improving soil fertility, particularly soil organic matter.

## CONCLUSION

In conclusion, as we reach the turn of the present century, we find that the cumulative impacts of industrial civilization have jeopardized the future of a large number of species, leading to mass extinction. The causes for this major catastrophe are habitat loss and fragmentation, unplanned introduction of exotic species and over-exploitation of plant and animal resources (Singh et al., 1994). Forest fragmentation is a widespread phenomenon and is recognized as one of the major threats to ecosystems and bio - diversity. Habitat fragmentation results in habitat loss and alteration increased edge effects, increased isolation of forest populations, and invasion by exotic species. Fragmentation can also restrict pollinator movement, which may reduce gene flow and result in increased inbreeding. Remnants commonly persist in steep inaccessible (or low productivity) areas and in areas protected from fire. Many tropical regions exhibit an alarming combination of high biological endemism, severe deforestation and inadequate protected area systems.

One of the greatest challenges is the conservation of locally endemic species. It is therefore vital to conserve existing forest remnants, which may harbour relic populations of local endemics. Tropical forest biotas are highly vulnerable to habitat fragmentation because of greater species richness, patchy distributions and presence of rare species with small populations. Habitat specialists and species with coevolved interdependencies such as plant-pollinators, host-parasite etc. are particularly vulnerable to fragmentation. Long-lived tree species are living dead, as they are likely to

be functionally extinct in fragments well before their populations have actually disappeared. Some forest vertebrates avoid even small clearings and thus their population may become fragmented by narrow linear barriers such as roads. Linear clearings also facilitate invasions of non-forest species. A fragment from landscape is often not self-sustainable and requires restoration efforts to maintain the ecological function and bio diversity.

Restoration of ecosystem fragments is a challenging problem and requires a thorough understanding of the ecological principles. Bradshaw (1987) called restoration as an acid test for ecology and Ewel (1987) as the ultimate test for ecological theory. The first step in any restoration strategy is to protect the disturbed habitats and communities from being further wasted, and from losing the extant genes. In areas with an extremely dense and still growing human population, conservation and restoration biologist will have to learn to manage intensively smaller protected areas, as opposed to the laissez-faire, approach. A successful restoration programme attempts to accelerate the natural recovery processes artificially in order to achieve the goal in a short-time (Singh and Jha, 1993). Therefore, restoration and management of ecosystem fragments should be given special emphasis and appropriate measure should be taken to stop fragmentation.

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# ASSESSMENT OF BIOMASS AVAILABILITY FOR POWER GENERATION IN SELECTED TALUKAS OF UTTRANCHAL STATE

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## INTRODUCTION

Biomass is a natural product of solar energy (Grover, 1996). World wide, energy stored in the form of biomass through photosynthesis is nearly 10 times the world's annual energy use (Hall and Overend, 1987). The growth and the economic utilization of biomass, for power generation, as an alternative to fossil fuels has been on the rise and is being considered seriously (Dua and Rao, 1996). Assessments indicate that even if a small percentage of this vast potential were tapped, it would be possible to meet the total energy requirements of the country for years to come (Rajan, 1995).

Being the forest rich state, Uttranchal has a potential to contribute significantly to power needs of the state through biomass gasification technology. Gasification is the thermo-chemical conversion of biomass into a gaseous fuel by means of partial oxidation at elevated temperature and pressures (Rao, 1996). This gas can be burnt directly for thermal applications or used for replacing diesel oil in dual fuel engines for mechanical and electrical applications (Singh, 1996). Therefore, the recommendations of bringing all kinds of the degraded waste lands under the afforestation schemes, especially with the fast growing species, not only will help in the increasing the forest cover, but would also minimize the effects of global warming through carbon sequestration, reduce air pollution, and check soil erosion and land sliding, which are the serious environmental problems (Ravindranath and Hall 1995; Johansson et al., 1993).

## STUDY AREA AND METHODOLOGY

This study was conducted in four talukas (tahsils) of Uttranchal state: Rishikesh, Puroila, Champawat and Almora, as a part of the country wide National Biomass Resource Assessment Program (NBRAP) launched by the Ministry of Non-Conventional Energy Sources (MNES), Government of India in 2002-03. The major objective of the study was to estimate the availability of surplus biomass based on the generation and consumption pattern and assess the potential for power generation from this surplus biomass.

The Uttranchal State is located between 28°45' and 31°30' N latitude and 77°30' and 81°5' E longitude covering an area of 53,485 km<sup>2</sup>. The state shares international boundaries with Tibet in the north and Nepal in the east, while towards west is located another Himalayan state, Himachal Pradesh and towards northwest are Gangetic plains of Uttar Pradesh. The topology of the state is mountainous, constituting 88% hilly terrain, while the rest is the plains, continuing with Gangetic flood plains of Uttar Pradesh. Administratively, the state comprises of 2 divisions (Garhwal and Kumaon), 13 districts (Figure 1), 49 talukas, 95 developmental blocks, 71 towns and 15620 villages. The human population of state is 84,79,562, with a density of 159 person per km<sup>2</sup>. Literacy rate (72.28%) is noticeably higher than the national average of 65.38% (Census of India, 2001).

The state has its own potentialities and resources, which need to be harnessed in the best possible way. Forests are one of the most important of these natural resources and cover 64.81% of the total geographical area of the state. The agriculture sector, though covers only about 13.21% of total geographical area of the state, engages about 71% of the total population (Dutta and Pant, 2003).

Figure 1: Map of State of Uttranchal showing the location of study taluks



**Sample survey**

The present study is based on the field surveys and secondary data collection from various sources. Of the total four, two talukas, Rishikesh and Purola were selected from Garhwal Division while Champawat and Almora were from Kumaon Division (Figure 1). The selection of talukas was based on variation in agro-ecological zonation, productivity status, socio-demography, altitude and the status of electrification. Within the selected talukas, villages were sampled for conducting primary

field surveys, which were chosen randomly to represent the entire taluka. Since agriculture is one of the major sources of biomass production, intensive field surveys were carried out for both the cropping seasons. In each of the surveyed villages, all categories of farmers were interviewed, ranging from marginal to large landholders. Secondary data were collected from various government departments like Forest, Agriculture, Taluka, Block and Statistical offices, etc. Except Rishikesh, rest three talukas are located in the hilly terrain. Champawat is the largest in terms of geographical area as well as number of villages (696 villages), in which, only 411 (59.09%) villages are electrified. In the selected talukas, on an average 54% villages (n=458) were visited to collect the primary and secondary data on the production and consumption of biomass under different sectors.

**Table 1:** Baseline information on the study talukas

| District   | Taluka    | Total geographical area (TGA) (ha) of taluka | No. of surveyed villages | % agriculture area of TGA | % forest area of TGA | % other land of TGA |
|------------|-----------|--|--------------------------|---------------------------|----------------------|---------------------|
| Dehradun   | Rishikesh | 25,371                                       | 88 (100)                 | 37.80                     | 22.90                | 36.80               |
| Uttarkashi | Purola    | 31,644                                       | 170 (88)                 | 24.50                     | 21.00                | 51.00               |
| Champawat  | Champawat | 1,68,011                                     | 100 (15)                 | 10.50                     | 43.78                | 42.75               |
| Almora     | Almora    | 94,233                                       | 100 (11)                 | 39.42                     | 15.78                | 40.12               |

Values in parenthesis refer to the percentage of total villages in the respective taluka

### **Biomass generation and consumption**

The biomass production and consumption was studied in two major sectors of the study talukas, *i.e.*, Forestry and agriculture sectors. The forestry sector comprises of forestlands, village commons and other wastelands and farm bunds. Following is the details of methodology adopted for each of the two major sectors:

#### ***Forestry sector***

The forest includes the entire area under the administration of forest department of the study taluka. Other land use categories included the different categories of wasteland, such as tree crops and groves, culturable fallow, permanent pasture and grazing land, fallow land other than current fallow and barren unculturable land. The assessment of biomass production for these land use categories is essential in view of their productivity potential for developing tree crops for biomass generation (Sudha et al., 2003). For farm bunds, biomass assessment was done for the tree crop grown on the bunds of agriculture fields in the form of farm forestry or agro-forestry. Under this category, since the majority of the production, mainly tree trunks, are sold for commercial purpose, we accounted other parts such as twigs, dry branches and roots, those are used for domestic fuel wood purpose, for assessment of biomass production.

Regarding the productivity, it has been documented that from the forest land, on an average 2.25 t/ha/yr can be harvested on a sustainable basis, while from farm bund forestry, the average productivity comes to around 0.5t/ha/yr and from other wastelands it is around 1.5t/ha/yr (Ravindranath and Hall, 1995; Jagdish, 2003). These figures were further verified through the field visits in the study talukas and considered for calculating the biomass production from different land use typologies mentioned above.

To account for consumption patterns at household level in the selected villages, the families were selected randomly for questionnaire interview related to the quantity of fuel wood needed for cooking three meals in a day. The record of consumption of other fuel types such as LPG and Kerosene oil was also maintained during household interviews. Since dung cakes are not a popular source of fuel in this region, the villagers were not interviewed on this aspect.

### ***Agricultural sector***

Biomass from agriculture sector mainly included the residues of different crops. Based on the area under different crops and their per unit area productivity, the biomass production was calculated by using the standards of grain to residue ratios. The secondary data on the above aspects were collected from agriculture departments and agriculture research institute at Pantnagar. Further, the calculations of residue production from secondary data were verified through the sampled field surveys and interviews with farmers conducted for major crops in both the seasons in the selected villages.

### **Surplus biomass and power generation potential**

The data on the production and consumption of biomass from both the sectors were used to calculate the surplus by subtracting the consumption from the generation. The data collected on per capita consumption of fuel wood at household level and the proportion of households dependent on this were extrapolated to calculate the consumption of biomass from forest lands and other wastelands. However, in agriculture sector, the produced biomass was mainly consumed in the form of fodder for animals and fuel for domestic purposes. Other forms of consumption were manuring agriculture fields by crop residues and sometimes thatching the kachcha houses. Information on this was generated through sample surveys with farmer and non-farmer households.

For calculating the annual power generation potential, formula worked out by Ministry of Non-conventional Energy Sources (MNES) was used as follows (MNES, 2001):

Annual power generation potential = (Total surplus biomass) X (collection efficiency)/(365 days X 24hrs X 1.5)

Where, it is assumed that 1.5 tons of biomass can produce 1 MW of electricity (Ravindranath et al., 1995) and the collection efficiency has been kept at 75% of total surplus on a conservative scale.

## **RESULTS**

### **Biomass generation**

#### ***Forest and other lands***

Forests and other land resources, including farm bunds, wastelands, roadside areas, horticulture areas and village common lands are important source of biomass generation. The area under other land is significantly high at about 135163 ha, which contributes 42.3% of the total geographical area of all the four study talukas, followed by forest area (31.6%) and farm buds (22.6%). Due to less extent of agriculture areas, the biomass production from the farm bunds is significantly low. It has been estimated that annually about 465606 tons of biomass can be harvested from all these sources on a sustainable basis. The forestry sector alone contributed maximum (48.71%) to the total production, followed by other land categories (43.54%) and farm bunds (7.8%).

**Table 2:** Biomass production (tons) from forest and other land use categories

| Talukas   | Area under forest land (ha) | Area under other land (ha) | Farm bund area (ha) | Biomass from forest | Biomass from other lands | Biomass from farm bund | Total production |
|-----------|-----------------------------|----------------------------|---------------------|---------------------|--------------------------|------------------------|------------------|
| Rishikesh | 5809                        | 9335                       | 9,588               | 13070               | 14003                    | 4794                   | 31867 (6.84)     |
| Purola    | 6560                        | 16182                      | 7727                | 14760               | 24273                    | 3864                   | 42897 (9.21)     |
| Champawat | 73557                       | 71833                      | 17656               | 165503              | 107750                   | 8828                   | 282081 (60.58)   |
| Almora    | 14873                       | 37813                      | 37154               | 33464               | 56720                    | 18577                  | 108761 (23.35)   |
| Total     | 100799                      | 135163                     | 72125               | 226797              | 202746                   | 36063                  | 465606           |

Values in parentheses refer to the percentage of total biomass generated

### **Agricultural sector**

In the agriculture sector, crop residues of paddy, wheat, maize, mustard, sugarcane, sawan, mandua and mixture of other crops cultivated on relatively smaller areas, such as pulses, oil seeds, barley, soyabeans and chilly was the major source of biomass in the study talukas. The total estimated annual biomass production from the study talukas was around 2,22,229 tons. The analysis indicated that wheat, paddy and mandua stalks were the major contributors, accounting to over 56%, while maize, mustard, sugarcane and sawan together contributed to 24% to the total production and the remaining biomass is from other crops, including oil seeds (til), pulses, barley, soyabean, vegetables and chilly, etc.

**Table 3:** Biomass production (tons/annum) from agriculture sector during 2002

| Taluka    | Wheat straw | Paddy straw | Maize straw and cobs | Mustard stalk | Sugar cane trash, leaves & tops | Sawan stalk | Mandua stalk | Others | Total production |
|-----------|-------------|-------------|----------------------|---------------|---------------------------------|-------------|--------------|--------|------------------|
| Rishikesh | 9882        | 22192       | 245                  | Nil           | 38908                           | 1019        | 1738         | 1770   | 75754 (34)       |
| Purola    | 5589        | 8583        | 77                   | 5626          | Nil                             | 1817        | Nil          | 1450   | 23142 (10.41)    |
| Champawat | 19994       | 16581       | 1820                 | 172           | Nil                             | 1756        | 13307        | 8142   | 61772 (27.80)    |
| Almora    | 6200        | 5188        | 1147                 | Nil           | Nil                             | 1204        | 15340        | 32482  | 61561 (27.70)    |
| Total     | 41665       | 52544       | 3289                 | 5798          | 38908                           | 5796        | 30385        | 43844  | 222229           |

Values in parentheses refer to the percent of total biomass production.

### **Biomass consumption pattern**

The per capita fuel wood consumption in the domestic sector of the study talukas was calculated as  $2.11 \pm 0.65$  kgs/day. It was found maximum ( $3.45 \pm 0.45$  kgs/day) during the winters and minimum ( $1.34 \pm 0.48$  kgs/day) during the summers. It was recorded that in the forestry sector, on an average about 62% of the total generated biomass is consumed. In case of agriculture residue about 63% of the total generated biomass from agriculture sector is consumed in the production sites itself, mainly in the form of fodder and fuel use, while the rest was assumed as surplus.

**Table 4:** Biomass consumption pattern in the study talukas

| Talukas   | Agriculture |               | Forest and other lands |                |
|-----------|-------------|---------------|------------------------|----------------|
|           | Generation  | Consumption   | Generation             | Consumption    |
| Rishikesh | 75754       | 40846 (53.91) | 31867                  | 25622 (80.40)  |
| Purola    | 23142       | 10820 (46.75) | 42897                  | 17855 (41.62)  |
| Champawat | 61772       | 40407 (65.41) | 282081                 | 161223 (57.15) |
| Almora    | 61561       | 48184 (78.27) | 108761                 | 86187 (79.24)  |
| Total     | 222229      | 140257 (63%)  | 465606                 | 290887 (62%)   |

Values in parentheses refer to the percentage consumption of the biomass against generation

### **Power generation potential**

It is estimated that from both the sectors, annually about 256691 tons of biomass remains as surplus, of which maximum comes from the forestry sector with over 68% in the form of twigs, dry

branches, roots and wood chips etc. Due to limited area under agriculture, biomass production as well as surplus in this sector is very low, which accounts remaining 32% to the total surplus biomass, generated mainly in the form of stalks, husk, cobs, etc.

Using the formula worked out by MNES, it was calculated that at a collection efficiency of about 75%, annually about 14.65 MW of electricity could be generated from the overall surplus biomass on sustainable basis in the study talukas.

**Table 5:** Power generation potential from surplus biomass

| Taluka    | Surplus biomass (tons) |                | Total surplus (tons) | Annual power generation potential (MW) |
|-----------|------------------------|----------------|----------------------|--|
|           | Agriculture            | Forestry       |                      |  |
| Rishikesh | 34908 (42.58)          | 6245 (3.57)    | 41553                | 2.37 (16.18)                           |
| Purola    | 12322 (15.03)          | 25042 (14.34)  | 37364                | 2.13 (14.55)                           |
| Champawat | 21365 (26.06)          | 120858 (69.17) | 142223               | 8.11 (55.40)                           |
| Almora    | 13377 (16.32)          | 22574 (12.92)  | 35951                | 2.05 (14.00)                           |
| Total     | 81972                  | 174719         | 256691               | 14.65                                  |

Values in parentheses refer percentage of the total generation

## DISCUSSION

The situation of rural electrification in the country remains to be more challenging than ever since of about 80,000 villages in the country that are yet to be electrified, about 18,000 are in remote and inaccessible areas (IEA, 2002). These villages remain difficult to be electrified in the conventional manner by extending the grid because of difficult locations such as forests, islands, deserts and hilly areas. To provide electrify to such villages, Ministry of Non-conventional Energy Sources (MNES), in its Draft Renewable Energy Policy 2000 document (MNES, 2002) has decided to use renewable energy technologies as potential alternatives to meet the energy demand in the rural areas of the country. Accordingly, Tenth Five Year Plan (2002-2007) has set a target of electrifying about 5000, out of 18000 un-electrified villages in the country by the year 2012, using mainly Solar Photovoltaics (PV), Biomass and Small Hydro Power technologies (GoI, 2001).

Though, it is stated that Uttaranchal is a power surplus state in the sense that even current levels of generation are in excess of demand, the fact remains that the rural electrification figures paint a grim picture since about 3287 villages in the state are yet to be electrified (<http://powermin.nic.in/uttaranchal.htm>). Irregular and insufficient power supply in the electrified villages worsens the situation of power in the state. Such a situation calls for promoting the renewable sources of energy in the rural areas, especially those, which are difficult to connect to the grid due to inaccessible terrain and lack of basic infrastructure. Viability of grid based village electrification decreases with increasing distance from the approach road and altitude. With its rich forest resources, Uttaranchal, therefore has huge opportunities for electrification through gasification, a comparatively cheaper, easily accessible and durable technology.

The present study has estimated a total production of about 14.65 MW of electricity from the surplus biomass in the study talukas. These results are indicative of the potential of electrifying the rural areas in the state, especially those, which are extremely tough to approach due to physical and other natural barriers. For example, the Champawat taluka in the present study has on one hand has maximum number of un-electrified villages, while on the other also has the highest potential of power generation, mainly because of relatively large extent of the forest land.

Such an attempt needs to be backed up by institutionalizing the whole process of collection of surplus biomass to the maximum extent possible and capacity building of the rural mass to use the technology to produce electricity at local level (TERI, 2003). We attempted to explore the

implementation of the findings of the present, especially to setup the collection and power generation centers within the study talukas. Based on the field surveys, discussion with various stakeholders, including villagers, officials, technical experts and industrialist, the basic amenities, their networking, transport systems and accessibility were considered few important criteria to set up such centers.

**Table 6:** Suggested centers for biomass collection and power plants in the study talukas

| Taluka    | Location for biomass collection centers          | Location for power plants setup  |
|-----------|--|----------------------------------|
| Rishikesh | Thano, Bhaniawala, Shyampur and Raiwala towns    | Rani Pokhri town                 |
| Purola    | Mori, Dhampur and Bhiyal towns                   | Purola town                      |
| Champawat | Lohaghat, Barakot, Pati towns                    | Champawat town                   |
| Almora    | Chaumu, Kande, Dhatwal Gaon and Kotyura villages | Darimi village of Lamgarha block |

Besides developing basic infrastructure, capacity building of local people and setting up of local institutions to meet the basic needs of power generation centers and distribution of powers to the villagers are other important factors, those need adequate attention in the planning phase. Capacity building on collection efficiency of biomass, technical set up and maintenance of power plants and uninterrupted supply of electricity are few important areas for capacity building programme. Regarding distribution of generated power, it could be grid, interfaced with the state grid or could supply electricity directly to the local villages and industries, etc. Another option is to decentralize the power plants of smaller capacity, which could also be set up in individual villages or cluster of non-electrified villages.

The findings of the present study reveal that despite the fact that study talukas has less agriculture area, there is enough potential of surplus biomass to generate about 14.65 MW of electricity annually. The potential can be further increased by inputs in the form of capacity building, as mentioned above and also by expanding the afforestation programmes on the wastelands and village common lands, which contribute significantly to the total geographical areas (29.12%) of the state in general and study talukas (43%) in particular. Not only this, trends between 1974 and 1994 indicate that land under area not available for cultivation is increasing in almost all the districts (Rao and Nandy, 2001). Some of the districts, recording high growth in uncultivated area included Uttarkashi, Pithoragarh, Chamoli and Pauri. The out-migration of population for employment opportunities could be considered for such a significant land use changes in the state. Such large chunks of unutilized lands can be brought under plantation programmes for promoting biomass based energy generation, which will not only help in meeting power needs of the rural areas of the state, but at the same time would also generate employment for local communities.

## ACKNOWLEDGEMENTS

Authors are thankful to the Ministry of Non-Conventional Energy Sources (MNES), Government of India for funding the project. Authors greatly acknowledge Uttaranchal Renewable Energy Development Agency (URED), Indian Institute of Science, Bangalore (IISc. Bangalore) and various other organizations who helped in data collection.

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### *Selected Abstracts*

**Agnihotri, R.K.; Sharma, Subrat; Joshi, M. and Palni, L.M.S.** 2004. **Crop diversity in home gardens of the Kumaun region of Central Himalaya, India.** *Plant Genetic Resource Newsletter*, 138: 23-28. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, Uttaranchal, India. [HOME GARDEN; IN SITU CONSERVATION; KUMAUN HIMALAYA; TRADITIONAL KNOWLEDGE]

Home gardens have been described as 'living genebanks' in which a variety of germplasm, in the form of indigenous varieties, landraces and rare species, thrives side by side and has been preserved through generations. Home gardens are found in traditional communities all over the world and are an important component of subsistence living, a cash resource and a repository for uncommon species and varieties of plants, characterized by a mixture of annual or perennial species grown in association. In the Indian Himalayan region, with the exception perhaps of northeastern parts, little attention has been paid to this aspect of the indigenous system of biodiversity management. Home gardens spread over different landforms (Tarai, Bhabar, Siwaliks and Lesser Himalaya) of the Kumaun region in the Indian Central Himalaya were sampled for species diversity, variability and composition. The process by which the home gardens in a village evolve and change was also discussed. This study revealed that small land units (home gardens) in the villages contribute significantly to maintaining the native germplasm as well as to the introduction of species from other regions. Although historically home gardens have received little appreciation, they constitute a part of the traditional resource management strategies that have evolved, and have recently been emphasized as highly productive and largely sustainable agroecosystems. The study of home gardens could be used as a tool to develop methodologies for the application of traditional knowledge in the conservation and management of biodiversity, as well as for community development.

**Arya, Swarn Lata and Yadav, R.P.** 2003. **Impact of farm diversification on income - A village study in Shiwalik foothills in Himachal Pradesh.** *Journal of soil and Water Conservation*, 2(3&4): 168-172. Central Soil and Water Conservation Research and Training Institute, Research Centre, Sector 27-A, Madhya Marg, Chandigarh, India. [CROPPING PATTERN; FARM DIVERSIFICATION; HIMACHAL PRADESH; SHIWALIK]

The present study was undertaken to examine the impact of technology transfer programme on the extent and pattern of diversification in a village situated in the foothills of Shiwalik in Solan district of Himachal Pradesh. After the introduction of irrigation facilities along with various improved production technologies, alternative land uses, farmers were encouraged to grow more number of crops to achieve higher levels of income. As a result of crop diversification, the net return per hectare increased from Rs. 7,448/- before the project period to Rs. 24,590/- after the project implementation. Herfindahl index was used to measure the extent of diversification, which revealed that 67 percent of the farmers were largely diversified after the project. The regression analysis indicated that diversification with high value crops is possible only when certain pre-conditions are met, like availability of irrigation, modern inputs, market density, and supply of institutional credit etc.

**Bhatt, H.P. and Bhatt, Sangeeta** 2004. **Environment and behavioural aspects in Garhwal Himalaya.** *Geographical Review of India*, 65(2): 199-205. H.N.B. Garhwal University, Tehri Garhwal; D.A.V. College, Dehradun, Uttaranchal. [FUEL-WOOD; GARHWAL HIMALAYA; SOIL EROSION]

The pace of depletion of forests is massive in the Himalayan region while few think of forest dwellers economically weaker and women who are worst victims of deforestation. The villagers are aware of the harm done but they feel:- They depend on forest for their occupational needs so they do not care what happens to the environment. Theoretically they agree with ecological problems created by the

over use and misuse of forests but practically it is different. Powerful people want them to stay poor so that environment can be protected. They are protecting the forests other wise situation would have been much severe than existing one.

**Bingeman, Kristin; Berkes, Fikret and Gardner, James S. 2004. Institutional responses to development pressures: Resilience of social-ecological systems in Himachal Pradesh, India. *International Journal of Sustainable Development and World Ecology*, 11(1): 99-115. Natural Resources Institute, University of Manitoba, Canada. [FOREST MANAGEMENT; RESILIENCE; SUSTAINABILITY]**

In the Kullu district, Himachal Pradesh, India, economic and urban growth, and diversification have increased pressure on forests and forest-based social-ecological systems. As in many Himalayan regions, livelihood sustainability is linked to forest systems. As in many Himalayan regions, livelihood sustainability is linked to forest resources, products and services. Recent development in the region, to which these systems may be vulnerable, brings into question environmental and livelihood sustainability. This paper examines the resilience of integrated systems of people and nature, or social-ecological systems, in the face of development pressures by evaluating a number of local and state-level institutional responses. Resilience, which describes the ability of the social-ecological systems to adapt to change by buffering shocks, improving self organization and increasing capacity for learning, is an essential quality for sustainable development. Institutional responses which positively contribute to resilience and sustainability include the work of *mahila mandals* in forest management, adoption of Joint Forest Management (JFM) policies and practices, upholding rules, strengthening local institutions, establishing firewood depots and adopting alternative energy sources. Institutional failures brought about by the lack of rule enforcement and corruption erodes resilience. The analysis of institutional responses helps to identify areas where capacity exists and areas in which capacity building is needed to produce resilient social ecological systems and therefore, sustainable development.

**Butola, J.S. and Badola, H.K. 2004. Seed germination improvement using, chemicals in *Heracleum candicans* wall, A threatened medicinal herb of Himalaya. *The Indian Forester*, 130(5): 565-572. G.B. Pant Institute of Himalayan Environment and Development, Himachal Unit, Mohal-Kullu, Himachal Pradesh. [CONSERVATION; MEDICINAL HERB; SEED GERMINATION]**

To meet mass multiplication demand in *ex-situ* cultivation of *Heracleum candicans* (Apiaceae), a threatened medicinal herb of Himalaya, presoaking treatments of plant growth regulators and other chemicals examined to achieve improved seed germination. In laboratory condition, of 15 treatments tried, GA<sub>3</sub> (250 µM), KNO<sub>3</sub> (100 mM) and NaHClO<sub>3</sub> (15, 30 and 45 minutes) significantly stimulated the seed germination over control. NaHClO<sub>3</sub> (30-min) proved significantly best treatment for achieving highest germination (81.3%) and reducing mean germination time over control. Authors recommended the use of KNO<sub>3</sub> and NaHClO<sub>3</sub> as effective and cheap stimulants to seed germination in mass multiplication and conservation programme for *H. candicans* in Himalaya.

**Chauhan, Permishwar S.; Porwal, Mahesh C.; Sharma, Lalit and Negi, Jay Dev Singh 2003. Change detecting in Sal forest in Dehradun forest division using remote sensing and Geographical Information System. *Photonirvachak*, 31(3): 211-218. Indian Institute of Remote Sensing (IIRS), Dehradun 248 001; Forest Research Institute (FRI), Dehradun 248 001, Uttaranchal, India. [GIS; MICRO-CLIMATIC CONDITION; REMOTE SENSING; SATELLITE DATA]**

The views of study site have revealed the change in vegetation cover of Sal Dense to Sal Medium and Sal Open in 6 forest Mosaics owing to biotic and abiotic condition prevailing in the specific areas. Analysis carried out using thematic map derived from aerial photograph of 1976 and satellite data of IRS 1C LISS III False Colour Composite (FCC) of March 1999 revealed the cause for change in the forest density classes. Deforestation, encroachment and agriculture have been identified as

the underlying causes, which have affected some specific locations to a marked extent. There has been a progressive and remarkable change among vegetation classes from 1976 to 1999. It is evident from forest type and density map that Sal density has significantly reduced from Sal Dense 65.61% in 1976 to Sal Dense 11.12% in the year 1999 followed by Sal Open 11.18% and Sal Medium 18.24%. The overall change has been estimated to be 42.11% of the total forested area.

**Chhetri, D.R.** 2004. **Medicinal plants used as antipyretic agents by the traditional healers of Darjeeling Himalayas.** *Indian Journal of Traditional Knowledge*, 3(3): 271-275. Panchavati Greentech Research Society, P.O. Box No. 79 Darjeeling HPO, Darjeeling 734 101, West Bengal. [ANTIPYRETIC ACTIVITY; ETHNOMEDICINE; FOLK MEDICINE; HERBAL MEDICINE; TRADITIONAL MEDICINE]

Darjeeling Himalayan region is characterized by a rich floral diversity. Since most of the hilly terrain is devoid of modern medical facilities, the people here are dependent on Traditional Medicine Systems for their health-care. During the course of the study, it was found that 37 species of plants belonging to 29 families are utilized as antipyretic agents in the different ethnic medicine practices prevalent in the region.

**Das, Tapasi and Das, A.K.** 2004. **On-farm conservation of rice diversity and farmers's knowledge of local soils: A case study in Barak Valley, North-East India.** *International Journal of Ecology and Environmental Sciences*, 29(3&4): 199-205. Department of Ecology and Environmental Science, Assam University, Silchar 788 011, Assam, India. [PADDY LANDRACES; SMALL HOLDER FARMERS; SOIL TAXONOMY; TRADITIONAL KNOWLEDGE]

On-farm conservation is a type of *in-situ* conservation of crop diversity which is best done through the maintenance of farming systems. Since farmers, on the basis of their local knowledge, shape the crop diversity, on-farm conservation also involves traditional knowledge and practical skills of the farmers. This paper describes the role of farmers in on-farm conservation of rice diversity in a village in Barak Valley, North-East India. An inventory of rice diversity was made and a total of 25 traditional cultivars were recorded from the study site. The role of farmers' knowledge of soil was also assessed. In the area which is predominantly sandy in texture, the folk soil taxonomy, which helps the farmers in the management of crop diversity, was also prevalent. Analysis of soil characteristics showed that the higher diversity of traditional cultivars was due to the heterogeneity and poor quality of the soil. This criterion was based on the assumption that the more heterogeneous the environment, the more is the varietal diversity. Thus farmers in more fragile ecosystem maintain more crop diversity to adapt to the heterogenous environment. It is important to note that small holder and marginal farmers must be encouraged to grow traditional varieties and due recognition has to be given to the traditional knowledge of these 'agroecosystem people' for managing this agrobiodiversity.

**Farooquee, N.A.; Majila, B.S. and Kala, C.P.** 2004. **Indigenous knowledge systems and sustainable management of natural resources in a high altitude society in Kumaun Himalayan, India.** *Journal of Human Ecology*, 16(1): 33-42. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, Uttaranchal, India. [HIGH ALTITUDE SOCIETY; INDIGENOUS KNOWLEDGE; NATURAL RESOURCE]

Considerable effort has been made to study the resource use patterns of indigenous people with a view to understanding the traditional knowledge base of different ecosystems. This study has tried to explore the linkages between the subsistence economy and utilization and conservation of natural resources in the transhumant Bhotiya society of central Himalaya. These people are also aware that the biological diversity is a crucial factor in generating the natural resources on which they depend for their survival. Hence, they have domesticated a number of wild plants and crops, and have devised their own mechanisms for indigenous cattle production. These practices of conservation of their natural resources,

has ensured their survival in extreme in hospitable environmental conditions of high altitudes. But, now their indigenous knowledge and practices are on the verge of extinction, due to the integration of their society with the main stream of other societies and market economy.

**Garbyal, S.S.; Aggarwal, K.K. and Babu, C.R.** 2004. **Impact of *Cordyceps sinensis* in the rural economy of interior villages of Dharchula sub-division of Kumaon Himalayas and its implications in the society.** *Indian Journal of Traditional Knowledge*, 3(2): 182-186. School of Biotechnology, Guru Gobind Singh Indraprastha University, Kashmere Gate, Delhi 110 006; Department of Botany, University of Delhi, Delhi 110 007. [ANTI-BIOTIC PROPERTIES; CATERPILLAR FUNGUS; MUMMIFIED INSECT; PARASITIC FUNGUS; RURAL ECONOMY; TIBETAN MEDICINE]

*Cordyceps sinensis* belonging to family Clavicipitaceae is a parasitic fungus on Lepidopteran larvae. It occurs at an altitude over 4,000 m and is known to be found in Chipla, Malpa top, Njyang top, Karschila, Budhi Galja, Chal, Baling, Bon, Dugtu, Panchachuli, Nampa and Api in Dharchula Himalayas. *Cordyceps* is known to be used for many centuries as tonic, medicine, and aphrodisiac and in religious ceremonies in China, Indonesia and upper Himalayas. Since last 4-5 years *Cordyceps* has been traded very extensively in Dharchula area of Pithoragarh District in Uttaranchal. It has had tremendous impact on the rural economy of the villages in Dharchula area. Local people have been getting about Rs. 55,000-65,000 per kg. there by improving the living conditions of many poor villagers.

**Gurmet, Padma** 2004. **"Sowa - Rigpa" : Himalayan art of healing.** *Indian Journal of Traditional Knowledge*, 3(2): 212-218. Amchi Medicine Research Unit (CCRAS), Ministry of Health and Family Welfare, Govt. of India, Leh, Ladakh, J&K, India. [AMCHI; SOWA-RIGPA; TIBETAN MEDICINE]

*Sowa-Rigpa* commonly known as Tibetan or Amchi medicine is among the oldest surviving well-documented medical traditions of the world. With the living history of more than 2500 years it has been popularly practiced in Himalayan regions throughout central Asia. In India it has been popularly practiced in Ladakh, Himachal Pradesh, Arunachal Pradesh, Sikkim, Darjeeling and now in Tibetan settlements all over India. Originated from India *Sowa-Rigpa* is based on *Jung-wa-Ina* (Panch Mahabhuta/five elements) and *Nespa-gsum* (Tri-dosh/ three humours) theories. According to these all animate and inanimate phenomena of this universe are composed of *Jung-wa-Ina* (five elements). It is on the theory of five basic elements that the science of physiology, pathology and pharmacology is established. This paper gives an introductory note on history, theory and practice of *Sowa-Rigpa* (Science of healing) in India.

**Joshi, B.K.** 2003. **Soil nutrient dynamics in different forest-ecosystem in Almora-Binsar area of Central Himalaya.** *Journal of soil and Water Conservation*, 2(3&4): 121-128. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643, Uttaranchal, India. [FOREST ECOSYSTEM; LEAF LITTER; SANCTUARY; SOIL NUTRIENTS]

Open grazing, burning and other human encroachment increasingly threaten for the forest ecosystem of the temperate hill Indian Himalaya. At present these are practiced as multiple uses, including maintaining the environmental balance of the region. The present study was conducted to assess the effect of the human encroachments in different forest ecosystems and discuss the prospects for improving their requirement by initiation of community forestry, in the context of regular deterioration in forest ecosystem. Total six types of forest were considered for the present investigation, are both natural and planted one, including herb, shrubs and tree canopy. It is observed that the woody patches with grass are affected by frequent grazing, leaf litter collection and forest fire interferences. The results revealed that the forest fire affected site along with grazing was with lowest soil moisture; organic carbon and nitrogen content and significantly varied with other sites for most of the soil characteristics. The community forestry and protected sanctuary provide a certain good quality of grasses and subsistence, covering emergency needs and many forest by products. Moreover it augment

ecological functions; carries valuable indigenous tree species, retains soil moisture and provides continuous supply of organic matter and nutrients.

**Joshi, P.K. and Gairola, Sushma** 2004. **Land cover dynamics in Garhwal Himalayas - A case study of Balkhila Sub - Watershed.** *Photonirvachak*, 32(2): 199-208. Indian Institute of Remote Sensing (NRSA), Dehradun 248 001, Uttaranchal, India. [GARHWAL HIMALAYA; LAND-COVER; NATURAL RESOURCE; WATERSHED]

The present paper focuses on land cover dynamics pattern in Balkhila sub-watershed situated in Garhwal Himalayas. This study contributes example from human shaped ecosystem in mountainous regions where fragmentation of natural resources is active. The remote sensing and GIS has been used to understand the land cover dynamics along the topography. The results report that the land cover dynamics is dependent on the aspect due to sun illumination. The altitude and slope are no more a barrier for resource extraction and the human activity zone is shifting towards higher altitudes and slopes. The changes are also defined along the road and settlements.

**Kala, C.P.** 2004. **Pastoralism, plant conservation, and conflicts on proliferation of Himalayan knotweed in high altitude protected areas of the Western Himalaya, India.** *Biodiversity and Conservation*, 13(5): 985-995. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643, Uttaranchal, India. [ALTITUDINAL GRADIENT; PASTORALISM; POLYGONUM POLYSTACHYUM; PROTECTED AREA; WESTERN HIMALAYA]

The conservation policy of banning pastoral grazing, and subsequently emerging conflicts between conservationists and pastoral communities regarding the proliferation of Himalayan knotweed (*Polygonum polystachyum*), was studied in the Valley of Flowers National Park, a high altitude protected area of the Western Himalaya, India. A total of 10 habitat types identified in the study area were sampled using quadrats along an altitudinal gradient between 3000 and 4500 m. Plant species richness decreases with altitude and also varies across habitat types. The highest density of *P. polystachyum* and its associated species, *Impatiens sulcata*, was found between 3300 and 3500 m in the disturbed habitat types, viz., bouldery areas, fragmented treeline zone, avalanche-prone areas and eroded slopes. Eradication of *P. polystachyum* from the national park of managers is not going to serve any meaningful purpose to the long-term conservation; rather it initiates soil erosion and instability, hindering the establishment of natural plant communities.

**Kalita, Bhagaban; Choudhury, M. and Ojha, S.N.** 2004. **Indigenous technical knowledge on pond construction and maintenance, fish seed transportation, and fish health management in Assam hills.** *Indian Journal of Traditional Knowledge*, 3(2): 192-197. Central Inland Fisheries Research Institute, NER Centre, Guwahati 781 006, Assam; Fisheries Information, Technology Evaluation and Transfer Division, CIFE, Mumbai. [FISH HEALTH MANAGEMENT; INDIGENOUS TECHNICAL KNOWLEDGE; INLAND FISHERIES; POND CONSTRUCTION]

Most of the inhabitants of the Hills Zone of Assam survive on their traditional knowledge base. These people are bound by traditions and are relatively untouched by modern scientific knowledge on aquaculture and allied sector. An attempt has been made in present study to document Indigenous Technical Knowledge (ITK) related to aquaculture in the Hills Zone of Assam. Data was collected after interviewing 80 fishers in one of such areas with the help of an interview schedule. In Pond construction/maintenance, seed transport and fish health management, nine ITKs were documented in this study. Under pond construction and maintenance, ITKs on traditional spillway, and protection of pond dyke were documented and under fish health management ITKs on control of dissolved oxygen deficiency, turbidity control, control of Argulus, leach control and control of Epizootic Ulcerative Disease Syndrome were documented.

**Kar, A.** 2004. **Common wild vegetables of Aka tribe of Arunachal Pradesh.** *Indian Journal of Traditional Knowledge*, 3(3): 305-313. Plant Taxonomy (Medicinal/Wild edible) Section, Defence Research Laboratory (DRDO), Post Bag No. 2, Tezpur 784 001, Assam. [AKA TRIBE; ARUNACHAL PRADESH; WILD VEGETABLES]

Arunachal Pradesh is considered as one of the biodiversity "hot spots" in the world. The Aka (Hrusso) tribe in Arunachal Pradesh utilizes many wild plants as food, fodder, medicine, etc. The present paper deals with some of the common wild vegetables used by the tribes. 25 plant species are listed here giving their scientific name, family, local name, diagnostic description, habitat, parts used and uses.

**Kaur, Ravinder; Sinha, A.K.; Rawat, J.S. and Rawat, Geeta** 2004. **Development, test and validation of a data intensive spatial decision support system (SDSS) for runoff simulation and design hydrograph generation - A case study.** *Journal of soil and Water Conservation*, 3(1&2): 51-69. Division of Environmental Sciences, Indian Agricultural Research Institute, New Delhi 110 012; Department of Geography, Kumaun University Campus, Almora, Uttaranchal, India. [MICRO-WATERSHED; RAINFALL-RUNOFF]

A data intensive Geomorphic Instantaneous Unit Hydrograph (GIUH) technique based Spatial Decision Support System (SDSS) for runoff simulation and design hydrograph generation has been developed for ungauged or inadequately gauged watersheds. The application potential of the developed SDSS for runoff simulation and design hydrograph generation for 2, 5, 10 and 25 years return periods was tested on a (gauged) second order (test) agricultural micro-watershed in Almora district of Uttaranchal state in India. The overall Root Mean Square Error (RMSE) associated with the SDSS simulated run-off rates was around 50% of simulated hydrographs were associated with well predicted total and peak runoff volumes. Besides this, 30 hydrographs had good shapes and 10 hydrographs were associated with peak runoff times synchronized with their observed values. Analysis of the effects of storm-season, size, duration and their combinations revealed that this was majorly due to the incapability of the conventional rainfall excess determining SCS-CN method to account for the within-storm moisture changes. Sensitivity analysis of the subjectively assessed SDSS input parameters on a test (summer season) storm indicated that curve number is the most sensitive input parameter and that it should be carefully parameterized for best SDSS performance.

**Khan, Kazma and Naseer, Yasmeen** 2004. **Spatial pattern of agricultural development in Dehradun district.** *Geographical Review of India*, 65(1): 66-74. Aligarh Muslim University, Aligarh, Uttar Pradesh, India. [AGRICULTURAL DEVELOPMENT; ECOLOGICAL CONDITIONS; SOCIOECONOMIC FACTORS]

The present paper aims to analyse the spatial pattern of agricultural development in Dehradun district during 1996-97. The study is based on the blockwise published data obtained from Statistical Bulletin of Dehradun district. High and medium level of agricultural development is observed in the central part of the district, where as low level of agricultural development in the northern and southern parts of the district. The central part of the district enjoys high level of agricultural development due to modernisation of agriculture and subsequent urbanisation of the region. This factor diffuses innovation to the surrounding countryside, hence high rate of development is observed.

**Khan, M.A. and Shah, M.A.** 2003. **Phosphorus load concentration in a Kashmir Himalayan game reserve - Hokersar wetland.** *Indian J. Soil Cons.*, 31(3): 243-247. Division of Environmental Sciences, S.K. University of Agricultural Sciences and Technology, Kashmir, GPO Box 726, Srinagar 190 001, Kashmir, India. [DEMOGRAPHIC TRENDS; KASHMIR HIMALAYA; PHOSPHORUS LOAD; WETLAND CONSERVATION]

The phosphorus load concentration and its compartmentalization into various components of the Hokersar wetland, and important Kashmir Himalayan game reserve, was worked out during the study period (Nov. 2000 - Oct 2001). The data are presented on the demographic trends in the catchment of the wetland and the phosphorus load as such was assessed. The high phosphorus load in the catchment (30568 kg yr<sup>-1</sup>) is reflected in the high concentration of phosphorus in the wetland water and other components. The role of low flushing rate (3.75 times yr<sup>-1</sup>) and high residence time (97.3 days) of water in the phosphorus cycling has been highlighted. The distribution pattern of this element in such ecosystems helps to understand their behaviour and proves very helpful in formulating their eco-restoration strategies.

**Khan, Y.; Sharma, R.C. and Sharma, Sanjeev** 2004. **Incidence and severity of leaf rust (*Melampsora ciliata*) of poplar in Himachal Pradesh.** *The Indian Forester*, 130(6): 673-679. Department of Mycology and Plant Pathology, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh. [AGRO-CLIMATIC CONDITION; HIMACHAL PRADESH; SEEDLING]

Among the various poplar nurseries surveyed in Himachal Pradesh, the leaf rust was first recorded in the month of April on grown up trees of *Populus* 'Lux' at Nauni. In the Nauni nursery, the disease appeared on *P. ciliata* seedlings in June. In Shilly nursery, rust was first recorded in July on *P. ciliata* and *P. xeuramericana* '65/27' seedlings. At Palampur and Bajaura nurseries, disease was first observed in August on *P. ciliata*. Disease did not appear at Nalagarh nursery where plants of 27 families of *P. deltoides* were raised. The disease index at Nauni and Shilly nurseries varied between 21.78 to 59.14 per cent and 22.85 to 72.75 per cent respectively. At Palampur and Bajaura nurseries, the disease index ranged between 12.06 to 43.46 per cent and 2.05 to 23.00 per cent, respectively. Number of rust free clones, families and *Populus* species were recorded in different location surveyed.

**Kotlia, B.S. and Rawat, K.S.** 2004. **Soft sediment deformation structures in the Garbyang palaeolake: evidence for the past shaking events in the Kumaun Tethys Himalaya.** *Current Science*, 87(3): 377-379. Department of Geology, Kumaun University, Nainital 263 002, Uttaranchal, India. [EARTHQUAKES; KUMAUN HIMALAYA; SEDIMENTS]

Soft sediment deformation structures are observed in the laminated sediments and sandy part of the 150 m thick palaeolake profile exposed along the Chhidu Nala near Garbyang village in the Tethys zone of Kumaun Himalaya. The deformed, laminated sediments and sand are separated by gravel. We observed both penecontemporaneous and post-depositional deformational patterns. The deformation may have taken place due to thixotropy and fluidization causing visco-plastic failure of the mud, and density inversion between mud and sand due to liquefaction, was probably triggered by earthquakes. This gave rise to soft sediment folds, dykes, faults, load and pseudo-nodule structures in mud, silt and sand. The study area lies in the seismically active zone of the Kumaun Himalaya.

**Kumar, Pramod; Kumar, Sudhir and Manchanda, M.L.** 2004. **Satellite stereo data for dem surfaces and derivatives.** *Photonirvachak*, 32(1): 81-90. Regional Remote Sensing Centre, 4-Kalidas Road, Dehradun 248 001, Uttaranchal, India. [DIGITAL ELEVATION MODEL; PAN DATA; SATELLITE DATA]

Various attributes can be derived from Digital Elevation Model (DEM), with are essential to analyze watershed physical characteristics. This paper discusses utility and accuracy of satellite DEM surfaces and their derivatives. Facilities available in various software packages were compared to generate DEM from satellite data and other sources. For test site at Chamba, Uttaranchal, DEMs produced from various algorithms were evaluated for accuracy of surface and its derivatives. Most of the algorithms have shown correlation coefficient of 0.99 and above but the desirable maximum error in spot height (1/5 of contour interval) is not achieved. Slope and aspect produced from various algorithms were comparable around 70-80%. Comparison of DEM surface and its derivatives were attempted for

test sites at Shimla and Nahan using IRS-1C and SPOT PAN stereo pair, respectively. Model accuracy has shown that error in height is higher than planimetry. Surface derivatives from stereo DEM for Shimla and Nahan test sites have shown an overall accuracy of 56.5% and 59.2% for slope; 49.79% and 71.21% for aspect and 74.15% for topographic level slicing, respectively. Accuracy has improved when observed class value was lowered or put-up by one unit.

**Kuniyal, J.C.; Vishvakarma, S.C.R. and Singh, G.S. 2004. Changing crop biodiversity and resource use efficiency of traditional versus introduced crops in the cold desert of the northwestern Indian Himalaya: a case of the Lahaul valley. *Biodiversity and Conservation*, 13(7): 1271-1304. G.B. Pant Institute of Himalayan Environment and Development, Himachal Unit, Mohal, Kullu 175 126, Himachal Pradesh; Department of Botany, SGPG College, Sarurpur, Meerut 250 344, U.P. India. [CASH CROPS; COLD DESERT; CROP BIODIVERSITY; CROP ROTATIONS; MONETARY EFFICIENCY; TRADITIONAL CROPS]**

This paper studies the crop biodiversity and its changing patterns across an altitudinal gradient of three highland village agroecosystems: Hinsal (2700m), Jahlma (3000m) and Khoksar (3200m). It also deals with energy (kilocalorie (physiological); kcal or Megajoules; MJ) and monetary (Indian rupee; Rs) efficiency of traditional crops versus recently introduced cash crops in the cold desert of the Lahaul valley. Newly introduced cash crops like hop, pea and potato have drastically reduced the crop biodiversity along the increasing altitudes. Of the total cropped area, 70% is occupied by these cash crops. Organic manure, mainly derived from forests and night soil, accounted for 90 and 77% of the total energy input in traditional and introduced cash crops in all the three selected villages, respectively. The energy output/input for traditional crops ranged in Hinsal from 0.6 (Kuth (*Sausurea lappa*, family Asteraceae)- a root crop of medicinal use) to 6.1 (amaranths); for the introduced cash crops it varied from 0.9 (potato) in Hinsal to 2.8 (pea) in Jahlma. In terms of energy, traditional crops are richer and more viable than the introduced cash crops. Monetary output/input of traditional crops was 0.8 (maize) to 11.8 (Kuth) and for introduced cash crops it was from 1.8 (potato) to 6.2 (hop). Overall, the average monetary efficiency of introduced crops was higher than that of traditional ones. Taking the average of the three villages, the energy and monetary output/input for the introduced cash crops was 1.4 and 3.3, respectively. However, for the purpose of food security and environmental conservation there is a need to establish a balance between traditional and introduced cash crops. This will make farming sustainable in the cold desert environment where crop growth period is limited. The Lahaul valley is landlocked and due to heavy snow deposits at Rohtang pass (3978 m), its main entry from Kullu valley remains accessible only for 5 months (July-November).

**Kushwaha, S.P.S.; Singh, I.J. and Paul, Subrato 2003. Comparison of sampling methods for inventorying the stand volume using satellite remote sensing. *Photonirvachak*, 31(4): 283-290. Indian Institute of Remote Sensing, Dehradun 248 001, Uttaranchal, India. [DENSITY; REMOTE SENSING; SATELLITE DATA]**

Remote sensing is being increasingly used for forest resource inventory as it saves time and the cost. Aerial photographs and satellite images have been effectively utilized for forest inventory all over the world. This study highlights the application of IRS LISS-III imagery for inventorying the stand volume in Lachchiwala Forest Range of Siwaliks. The satellite image was visually interpreted for forest type and density stratification. Both random as well as stratified random sampling techniques were used to see their impact on the volume estimates. Field sampling was done in the plots of 0.1 ha size. The total growing stock in all types of forests in the study area was estimated to be 1.87 mill. m<sup>3</sup>, of which Sal Forest accounted for 1.32 mill.m<sup>3</sup>, Sal Mixed Forest for 0.09 mill.m<sup>3</sup>, Mixed Sal Forest for 0.08 mill.m<sup>3</sup>, Miscellaneous Forest for 0.06 mill.m<sup>3</sup> and Forest Plantations for 0.02 mill.m<sup>3</sup>. The results were compared with an independent field-based inventory carried out by forest department. The two sampling methods were compared by ratioing of the mean of variance (gain in precision) and it was

found that the timber volume estimates using stratified random sampling technique were 15 per cent more accurate than simple random sampling. The satellite image-based inventory using stratified random sampling was found to have about 90% correspondence with the inventory done by the Forest Department.

**Lal, H.; Samra, J.S. and Arora, Y.K. 2003. Kinnow mandarin in Doon Valley: 2. Effect of irrigation and mulching on water use, soil temperature, weed population and nutrient losses. *Indian J. Soil Cons.*, 31(3): 281-286. Central Soil and Water Conservation Research and Training Institute, Dehradun 248 195, Uttaranchal, India. [IRRIGATION; ORGANIC MULCHES; WATER USE EFFICIENCY; WEED FLORA]**

A study was conducted on organic mulches and irrigation to assess the performance of Kinnow mandarin in Doon Valley during 1999 to 2001 in a split plot design with four replications. The treatments comprised of three frequencies of irrigation based on CPF viz. 80, 160 and 240 mm and control as main plot and two organic mulches viz. sal (*Shorea robusta*) and Lantana (*Lantana camara*) dry leaves @ 1 kg m<sup>-2</sup> and control as sub-plot. Kinnow plants irrigated at 80 mm CPE encouraged population and dry weight increase of weed and nutrient removal by weed but it also improved water use and seasonal water requirement, and produced 79.30 and 13 per cent more fruits than non-irrigated and irrigated plants at 240 and 160 mm CPE, respectively. Similarly, mulch of sal leaves minimised water use and water requirement, population and dry weight of weeds, nutrient removal by weed, improved weed control efficiency, regulated soil temperature and produced 16.6 and 8.0 per cent more fruits than control and *Lantana* mulch, respectively.

**Maikhuri, R.K.; Rao, K.S. and Saxena, K.G. 2004. Bioprospecting of wild edibles for rural development in the Central Himalayan mountains of India. *Mountain Research and Development*, 24(2): 110-113. Garhwal Unit, G.B. Pant Institute of Himalayan Environment and Development, P.O. Box 92, Srinagar, Garhwal 246 174, Uttaranchal, India. [CENTRAL HIMALAYA; DIVERSITY; ECONOMIC DEVELOPMENT; WILD EDIBLE PLANT]**

Despite abundant wild edible plant resources with immense potential for economic development, Uttaranchal, a newly created hill state situated in the Central Indian Himalaya, remains underdeveloped, owing primarily to inaccessibility and poor infrastructure. Development initiative show little concern for mountain perspectives. Yet the region is rich in resources and underutilized plant species with potential food value, about which there is little knowledge. For the present study, 13 potentially exploitable wild fruit species and 1 semidomesticated species with good potential for exploitation were selected; 6-*Aegle marmelos* (bael or Bengal quince), *Berberis asiatica* (barberry), *Hippophae rhamnoides* (sea buckthorn), *Myrica nagi* (box myrtle), *Rubus ellipticus* (yellow Himalayan raspberry), and *Prunus armeniaca* (apricot)- were examined closely in terms of economic potential. A variety of value-added edible products such as jam, jelly, juice, and squash were made to generate income from these wild fruits, particularly for poor rural people. This was demonstrated locally to encourage people to engage in small-scale village-level cottage industries.

**Mishra, Rajan Kumar and Mandi, Swati Sen 2004. Molecular profiling and development of DNA marker associated with drought tolerance in tea clones growing in Darjeeling. *Current Science*, 87(1): 60-66. Seed and Molecular Biology Laboratory, Department of Botany, Bose Institute, 93/1 Acharya Prafulla Chandra Road, Kolkata 700 009, India. [DIVERSITY; GERMPLASM; TEA CLONES]**

Amplified Fragment Length Polymorphism (AFLP) fingerprints were developed for 29 Darjeeling-grown tea clones. AFLP diversity estimates based on Jaccard's coefficient allowed separation of the 29 clones into three clusters. Genetic relatedness between the clones was found to be at 70% level. Random Amplified Polymorphic DNA (RAPD) analysis of DNA of ten short-listed (on the basis of field

performance for drought tolerance) clones using 11 primers, revealed 180 PCR products of which 131 were polymorphic bands. Activity of drought-specific superoxide dismutase (SOD) and ascorbate peroxidase (APX) isozymes was found to be appreciably high in RR17/144, CP1, TV26 and AV2. Regression analysis using peak areas (from scans of stained activity-gel preparation) of Cu-Zn SOD and APX II as dependent variable and RAPD band scores as independent variable revealed that OPAH02 primed DNA band at 1400 bp was associated with high activity of the drought tolerance-specific isozymes. Using Fisher's exact test (*F*-tes), this association was found to be at 99.9% confidence level.

**Monika; Shubhangna and Raj 2004. Factors affecting infant feeding practices among women of Baijnath block of Himachal Pradesh.** *Journal of Human Ecology*, 16(1): 29-32. College of Home Science, CSK HPKV, Palampur 176 062, Himachal Pradesh, India. [BREASTFEEDING; FEEDING PRACTICES; PRE-LACTEAL FEEDING; WEANING]

Feeding practices refer generally to meet nutritional and immunological needs of the baby at different stages of child growth. A study of feeding practices was carried out on a sample of 100 infants in the age group of 5 months to 2 years. The results have revealed that factors like income level and caste of the family, had direct bearing on these practices. Caste was found to have direct impact on foods avoided during lactation and post-natal practices. Use of commercial foods and pre-lacteal feeding given to infants was greatly influenced by the income of the family. Top feeding practices were also having significant association with monthly family income. Health status of lactating mothers, malnourishment and environmental insanitation in the area of child care directly affected the feeding practices in Baijnath block of Himachal Pradesh.

**Nandy, S.; Joshi, P.K. and Das, K.K. 2003. Forest canopy density stratification using biophysical modeling.** *Photonirvachak*, 31(4): 291-297. Indian Institute of Remote Sensing (NRSA), Dehradun 248 001, Uttaranchal, India. [ECOLOGICAL CONDITIONS; FOREST MANAGEMENT; REMOTE SENSING]

Forest canopy density is an important parameter to assess the ecological conditions *viz.*, light penetration through canopy, undergrowth, surface reflectance, rainfall interception, etc. in a forest landscape. The rate of change in the cover and density has increased due to human need for fuel and fodder. Hence, quick, repetitive and accurate information about forest density is required at the local, regional state and national levels for sustainable forest management. Satellite remote sensing has the potential to provide information on the forest canopy closure. The present study aims at forest canopy density mapping using satellite remote sensing data using three techniques: visual interpretation (VI), object oriented image segmentation (OOIS) and biophysical modeling (BM). On comparing the techniques, the BM has been found to be the better density mapping technique than other two in terms of accuracy, efficiency and high correlation with ground estimates.

**Pande, Veena; Palni, Uma Tewari and Singh, S.P. 2004. Species diversity of ectomycorrhizal fungi associated with temperate forest of Western Himalaya: a preliminary assessment.** *Current Science*, 86(12): 1619-1623. Department of Botany, Kuamaun University, Nainital 263 002, Uttaranchal, India. [CONIFER FORESTS; DIVERSITY; FUNGI; WESTERN HIMALAYA]

An attempt has been made to give an assessment of the species diversity of epigeous ectomycorrhizal fungi of the temperate forests of Western Himalaya, based on studies carried out in the region. The main hosts were oaks (primarily *Quercus leucotrichophora* and *Q. floribunda*), Pines (*Pinus roxburghii* and *P. wallichiana*) and deodar (*Cedrus deodara*). The species richness of ectomycorrhizal fungi was 43 in oak forests and 55 in conifer forests, which is close to midpoint values on the range derived from the literature for similar forest types. The major genera in terms of species were *Amanita* (15 sp.), *Russula* (13 sp.), *Boletus* (12 sp.), *Lactarius* (9 sp.), *Hygrophorus* (4 sp.) and *Cortinarius* (4 sp.). Some of these genera showed clear-cut host specificity - *Amanita* was primarily associated with

conifers and *Russula* and *Boletus* with oaks. All these forests with the dominance of ectomycorrhizal hosts, had low tree species diversity.

**Pant, B.R.** 2003. **Housing and sanitation pattern in Himalayan Villages.** *Geographical Review of India*, 65(4): 403-407. Government P.G. College, Rudrapur, Uttaranchal, India. [ENVIRONMENTAL CONDITION; SANITATION PATTERN; UTTARANCHAL HIMALAYA]

The present investigation is an attempt to examine the living and sanitation conditions of the people in Himalayan villages. To accomplish it, 136 sample households of 14 sample villages located in different geophysical division of the Himalayas were surveyed during 1999-2000. The study reveals that the housing conditions from the viewpoint of both quality and size have not attained desirable level. Only 73.5 per cent households have *Pucca* houses and majority of the houses were of small size. The sanitary situation was far from satisfactory. About 85.3 and 88.2 per cent households have no bathroom and latrine facilities respectively. A majority of households (84.6 per cent) disposed off refuse and waste water in the open space. Hence, there is an urgent need for proper management of housing, water supply and sanitation in the villages.

**Pant, Pushpa** 2003. **Tourism in Nainital : A Geographical Study.** *Geographical Review of India*, 65(2): 189-193. Kumaun University, Nainital, Uttaranchal, India. [LESSER HIMALAYA]

The purpose of this paper is to discuss various problems related to infrastructural and recreational amenities as observed by the tourists in Nainital, which is an important lake resort of Northern India lying in Southern Lesser Himalayas.

**Purohit, A.N.** 2003. **Plant form and functional behaviour along the altitudinal gradient in mountains.** *Journal of Plant Biology*, 30(2): 199-209. Hemvati Nandan Bahuguna University, Srinagar Garhwal, India. [FUNCTIONAL BEHAVIOUR; HIGH ALTITUDE PLANTS; PLANT FORM]

Morpho-physiological syndrome of high altitude plant species includes: (a) stunted growth, (b) slow but steady growth and differentiation of different plant parts, (c) thick leaves with larger length and width of mesophyll cells and more palisade layers, (d) lower specific leaf water content and absolute leaf water content, (e) high root/shoot weight ratio, (f) high chlorophyll *alb* ratio, and (g) low reflectivity of leaf surfaces. Since these species are from harsh conditions, these are considered to be the storehouses of several secondary metabolites of pharmaceutical importance. When exposed to identical environments, comparison of high and low-altitude species reveals that high-altitude species have higher flexibility in their morphological and physiological characters as compared to low-land species. All these characters of high-altitude plants are of biotechnological importance, especially in changing world climate scenario.

**Pyasi, S.K. and Singh, J.K.** 2003. **Runoff prediction by memory based system approach models for a Himalayan catchment.** *Indian J. Soil Cons.*, 31(3): 215-222. Department of Agricultural Engineering, Birsa Agricultural University, Kanke, Ranchi 834 006, Jharkhand, India. [HIMALAYAN CATCHMENT; RAINFALL; RUNOFF; UTTARANCHAL]

Rainfall and runoff sequence on a daily basis can be regarded as input and output for the catchment fluvial system. Memory based linear and non-linear models were found adequate to model the daily rainfall-runoff process of a Himalayan catchment. The values of multiple determination coefficients ( $R^2$ ) were found to be 79 per cent and 89 per cent respectively for linear and non-linear models. The antecedent runoff index (AQI) has been found significantly affecting the present event in both the models. The past three successive events prior to the event under consideration have been found affecting the current event by 44.84 per cent, 32.13 per cent and 23.03 per cent respectively. This study differs from the earlier studies made by several researchers in the sense that the varying weightage has

been assigned to different preceding event expected to effect the output of the present event. Thus the impact of memory parameters on output confirms the strong dependence in the outputs of study area.

**Ram, Jeet; Kumar, Arvind and Bhatt, Jitendra** 2004. **Plant diversity in six forest types of Uttaranchal, Central Himalaya, India.** *Current Science*, 86(7): 975-978. Department of Forestry, Kumaun University, Nainital 263 002, Uttaranchal, India. [BROADLEAF FORESTS; ENVIRONMENTAL CONDITION; PLANT DIVERSITY]

*Quercus* spp. (oaks) and *Pinus roxburghii* Sarg. (chirpine are the major forest-forming tree species in the Central Himalayan region. *P. roxburghii* forest is generally pure with low total species richness of shrubs and herbs, while mixed-broadleaved forest has high total species richness in *P. roxburghii* mixed-broadleaved forest and low species richness in *Quercus semecarpifolia* Sm. forest. *Quercus leucotrichophora* A. Camus forest has high tree diversity, while shrub and herb diversity is highest in *Cupressus - Quercus* mixed forest. Anthropogenic disturbances are changing the species richness and diversity, which influence the soil and environmental conditions. Thus, the conservation and management of these forests will be important for the sustainability of human and land in the region.

**Rather, G.M.** 2004. **Level of Mal nutrition in pre school children of four rural communities in Bandipora and gurez tehsils (J&K state).** *Geographical Review of India*, 66(1): 28-39. University of Kashmir, Srinagar, Jammu & Kashmir, India. [AGRO-CLIMATIC CONDITION; MAL NUTRITION; SOCIO-ECONOMY]

Variation in the availability of nutrients in diet and departure of the same from standard requirement had badly affected the health of pre-school children of four rural communities viz Kashmiri, Hanjis, Dards and Gujar of Bandipora and Gurez tehsils of J&K state. Eighty percent of the sample pre-school children were identified under various levels of malnutrition. Severe degree of malnutrition has been computed at a very low weight by applying statistical techniques like mean, standard deviation and percentile methods. Even average weight was less by three and half kg than the weight recommended by I.C.M.R. About sixty nine percent of pre-school children were found suffering from deficiency diseases like scurvy (20.15 percent) nightblindness (19.38 percent) beriberi (18.60 percent) and pellagra (10.85 percent). The percent paper attempts to analyse not the geographical distribution and assessment of magnitude of malnutrition but also ecological causes that are directly or indirectly responsible for the problem of health of pre-school of the area.

**Rawat, P.S.; Punj, Nidhi and Chand, Fakir** 2004. **Seasonal distribution and infection intensity of ectomycorrhizae in *Pinus roxburghii* forest.** *The Indian Forester*, 130(4): 405-415. Forest Pathology Division, Forest Research Institute, Dehradun, Uttaranchal, India. [CHIRPINE; MICROCLIMATE; SOIL MOISTURE]

A study was conducted to assess seasonal distribution and infection intensity of ectomycorrhizae in Chir pine (*Pinus roxburghii* Sarget.). Maximum number of mycorrhizal roots were observed to be highest during monsoon season (July, August and September). Dead mycorrhizal roots were noticed to be maximum during summer. Percent occurrence and death rate of mycorrhizal were observed maximum in the month of October. No specific patterns of increase and decrease of mantle thickness during various months were noted while the mantle thickness was found maximum in the month of October. The intensity of hartignet penetration was recorded maximum in the month of June and lowest in August. Overall, eight different types of mantle were observed in Chir pine forest positively significant correlation was estimated between available phosphorus and live mycorrhiza ( $P < 0.001$ ) and organic carbon and live mycorrhizae ( $P < 0.05$ ).

**Sarkar, S.; Kanungo, D.P. and Chauhan, P.K.S.** 2004. **Landslide disaster of 24 September 2003 in Uttarkashi.** *Current Science*, 87(2): 134-137. Central Building Research Institute, Roorkee 247 667, Uttaranchal, India. [FOOTHILL; LANDSLIDE; MAIN CENTRAL THRUST; SEISMIC ZONE]

A landslide disaster occurred in Uttarkashi on 24 September 2003 which has affected a part of the town. The paper highlights the probable causes of the slide, degree of instability in the Varunavat hill and risk assessment. According to an earlier assessment some instability was persisting in the Varunavat Parvat which triggered the slide after a heavy rainfall. The earlier landslide scars and cracks present prior to the slide contributed to the instability in the hill. The potential zone of risk in the foothill had been assessed and suggestions were made to administrative authorities to minimize loss of life and property.

**Sharma, Ajay and Verma, T.D.** 2004. **Biology of *Locastra muscosalis* walker (Lepidoptera: pyralidae) A defoliating pest of *Pistacia integerrima* stew ex. brandis.** *The Indian Forester*, 130(5): 573-578. Department of Entomology and Apiculture, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni-Solan, Himachal Pradesh, India. [COCOON; MEDICINAL VALUE]

*Pistacia integerrima* is a tree of great economic importance because of its ornamental and medicinal values and as its wood is used for making furniture. The defoliation caused in this tree hampers the production of the leaf galls formed on this tree which are capable of curing various diseases. Out of different defoliators, *Locastra muscosalis* is the most important one which takes heavy toll of the foliage. This pest is reported for the first time on this tree. It is gregarious pest which live on the tree by making webs and is capable of defoliating the whole tree. The eggs are laid in the last week of June. 1st, 2nd and 3rd instar larvae are gregarious in behaviour, but in the 4th and 5th instar the larvae change to solitary behaviour. Larvae hibernate inside the silken cocoon from September onwards upto next June when pupation take place inside the cocoons made for hibernation. The black coloured adults with greenish tinge emerge in last week of June. Its detailed biology is being reported.

**Sharma, Sandeep; Negi, P.S.; Thakur, K.S. and Kumar, Surinder** 2004. **Study on germination and longevity in seeds of *Hippophae tibetana* schltr.** *The Indian Forester*, 130(6): 647-654. Himalayan Forest Research Institute, Conifer Campus, Panthaghati, Shimla, Himachal Pradesh, India. [HIGH ALTITUDE; MEDICINAL SHRUB; SEED GERMINATION; TIBETAN SEABUCKTHORN]

Tibetan Seabuckthorn (*Hippophae tibetana*) is an important multipurpose medicinal shrub of higher Himalayan regions. A study was conducted on germination and longevity in seeds of this species when stored under ambient conditions. The ripened berries were collected from Sangla Valley in Himachal Pradesh and were immediately depulped, air dried and stored in plastic container under ambient conditions in the seed laboratory of HFRI, Shimla. Seeds were sown in petridishes in seed germination after giving various pre-sowing treatments twice during the study period i.e. after six months of storage and after one year of storage. The results thus obtained show that the seeds of *Hippophae tibetana* collected from Sangla Valley did not possess any kind of dormancy. Therefore no pre-sowing treatment is recommended before sowing seeds of this species as control also registered upto 98.5 to 99% seed germination i.e. after six months of storage and one year of storage respectively. The seeds of Tibetan Seabuckthorn retained viability even after one year under ambient conditions during study period hence possesses excellent storability. Total germination period in seeds reduced substantially from 8-10 days (six month stored) to 5-6 days (one year stored) under various pre-sowing treatments as the length of seed storage period increased. This suggested that after-ripening take place in the seeds of this species during storage.

**Sharma, Subrat** 2004. **Trade of *Cordyceps sinensis* from high altitude of the Indian Himalaya: Conservation and biotechnological priorities.** *Current Science*, 86(12): 1614-1619. G.B. Pant Institute

of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, Uttaranchal, India. [CENTRAL HIMALAYA; CONSERVATION; HIGH ALTITUDE]

*Cordyceps sinensis*, a parasitic fungus in the alpine regions, is highly valued in the traditional medicinal system of China, Nepal and India. The cost of 1 kg of wild collected fungus in the market varies from 30,000 to 60,000 Nepali Rupees in Nepal, and about Rs 1 lakh in India. This study explores the collection, trade route, market price at various stages of trade, and linkages in the region. Market price, trade and channels of *Cordyceps* collection are not transparent in the Indian subcontinent. Collection from wild habitats is a new income-generation opportunity in the remote locations of the Central Himalayan region. Among the stakeholders, conservation and sustainable harvest is the issue of debate. There is need for scientific exploration and research on biological screening of the Indian strains of this fungus, status in natural habitats, and artificial cultivation to harvest timely the prospects. Highlighting this species as a Chinese herb and its substances as anti-aging, pro-sexual, anti-cancer and immune boosting, now *Cordyceps* and its products are present in the market of the Western countries as over-the-counter medicine/tonic; however, the primary source is Tibet. For the past few years, there has been large-scale harvesting of the wild material from Nepal and India. This study highlights the importance of the fungus as medicine, a case study of collection and trade in the Central Himalayan region, and research needs in the Indian context.

**Singh, Dhan and Vasistha, H.B.** 2004. **Rehabilitation of mined degraded lands in the Himalayas through silvi-pastoral models.** *The Indian Forester*, 130(4): 398-404. Forest Ecology and Environment Division, Forest Research Institute, Dehradun, India. [ORGANIC MATTERS; SILVI-PASTORAL; SOIL MOISTURE]

The impact of silvi-pastoral measures on water conservation particularly on soil moisture, water holding capacity and infiltration rate were studied in limestone mined rehabilitation areas at lambidhar near Mussoorie, Garhwal Himalaya. Appreciable changes have been recorded for these parameters after 7 years of rehabilitation. A significant increase was recorded in soil moisture percentage, from 6.63 in unrehabilitated control site to 26.55 in rehabilitated site. Similar trend was also observed in water holding capacity, which has increased from 18.33% (in control site) to 32.26% (in rehabilitated site). A significant reduction in infiltration rate was observed from 27.0 cm/hr in control site to 15.22 cm/hr in rehabilitation site. The pronounced impact on these hydrological parameters may be attributed to the combined effect of grasses, shrubs and trees used in silvi-pastoral measures.

**Singh, H. Birkumar; Puni, L.; Jain, Alka; Singh, R.S. and Rao, P.G.** 2004. **Status, utility, threats and conservation options for rattan resources in Manipur.** *Current Science*, 87(1): 90-94. Regional Research Laboratory, Manipur Substation (Council of Scientific and Industrial Research), Lamphelpat 795 004, India; Department of Forests, Government of Manipur, Sanjenthong 795 001; Regional Research Laboratory (Council of Scientific and Industrial Research), Jorhat 785 006, Assam, India. [CONSERVATION; NORTH EAST INDIA; SOCIO-ECONOMY]

Manipur, one of the eight states of northeastern India, harbours more than 13 species of rattans under three genera as against 51 species under five genera from the rest of India and 600 species under 13 genera from the world as a whole. Rattans are mainly used for construction, craft, fencing, rituals, rope, food, medicine, etc. In Manipur, about  $15 \times 10^4$  and  $293 \times 10^4$  running metres of canes were extracted officially during 2000-01 and 1992-93 respectively. The revenue generated from rattans and bamboos was 6.2% (out of which 0.6% was from rattans) of total minor forest products during 1999-2000. During 2000-01, a revenue of Rs 13,000 was generated from rattans against Rs 740,000 during 1992-93. The extraction pressure was 6.8 running metre of cane per  $\text{km}^2$  during 2000-01 as against 131 running metre of cane per  $\text{km}^2$  during 1992-93. Continuous and unscientific extraction rattans from the vast natural habitat, threatens their survival in Manipur. Cultivation of rattans in Manipur and by and large in the whole of northeastern India, is a challenge that needs to be attending to urgently.

**Singh, Inderjit and Garg, R.K.** 2004. **Finger dermatoglyphics: A study of the rajputs of Himachal Pradesh.** *Anthropologist*, 6(2): 155-156. Department of Forensic Science, Punjabi University, Patiala 147 002, Punjab, India. [CASTS; FINGER DERMATOGLYPHICS; POPULATION VARIATION]

In the present investigation of dermatoglyphic characteristics of fingerprints of 100 unrelated Rajput (50 males and 50 females) of Sundli and Jubbal area of Shimla District, Himachal Pradesh have been analyzed. The results for the present study were observed to fall within the ranges as reported for the population groups reported from North India, particularly.

**Singh, Ombir; Singh, Jasbir and Bhuyan, T.C.** 2004. **Establishment of seed production area of khasi pine (*Pinus kesiya*) in Meghalaya through improved technique.** *The Indian Forester*, 130(6): 691-698. Rain Forest Research Institute, Jorhat, Assam, India. [BUFFER ZONE; MEGHALAYA; SEED PRODUCTION]

The establishment of Seed Production Areas (SPA) is considered as the first step in any tree improvement program and ensures production of good quality seeds at moderate cost. An improved method of establishment of SPA has been introduced in the State of Meghalaya to establish Khasi pine (*Pinus kesiya*) seed production area. Detailed methodology of SPA establishment and genetic gain achieved has been described in this article. The population retained in this SPA is improved by 32.88, 39.37, 52.51 and 67 per cent, respectively, for index value, height, clear bole height and girth at breast height. The new improved method found good, user friendly and takes care of shortcomings of the earlier procedures.

**Singh, Virendra and Kumar, Shashi** 2004. **Seed quality as affected by mid cone diameter in *Pinus roxburghii* sargent.** *The Indian Forester*, 130(7): 757-761. College of Forestry and Hill Agriculture, Hill Campus, Ranichauri, Tehri Garhwal, Uttaranchal, India. [CHIRPINE; DIAMETER; GERMINATION]

The present investigation was undertaken to find out the effect of mid cone diameter classes on seed quality in Chir pine. The cones were grouped into small (5-<6 cm), medium (6-<7 cm) and large (7-<8 cm) cone diameter classes. The large cones showed superiority in germination per cent, germination value, germination capacity, germination energy and germination speed over other cone diameter classes. Also, there existed a positive and highly significant correlation between cone diameter and different seed parameters. Therefore, large cones (in diameter) should be given preference for quality seed collection.

**Singh, Virendra and Singh, R.K.** 2004. **Morpho-biochemical variations in seabuckthorn (*Hippophae* L.) populations growing in Lahaul Valley, dry temperate Himalayas.** *The Indian Forester*, 130(6): 663-672. CSK HP Agriculture University, Mountain Agriculture Research and Extension Centre, Kukumseri, Lahaul-Spiti, Himachal Pradesh, India. [HIGH ALTITUDE; HIMACHAL HIMALAYA; SEABUCKTHORN]

The present study was carried out on survey of resources and morphological and biochemical variations in the natural populations of Seabuckthorn (*Hippophae* L.) growing in Lahaul valley (2,600-3,200 m asl) of District Lahaul-Spiti, a dry temperate region of Himachal Himalayas. There is about 400-500 ha land area under Seabuckthorn in Lahaul. Plant size varied from 101-271 cm in *H. rhamnoides* to 400-700 cm in *H. salicifolia*. Weight of 100 fruits varied from 11.6-19.5g in *H. rhamnoides*, to 30.7g in *H. salicifolia*. Weight of 100 seeds also varied from 0.64-1.26g in *H. rhamnoides*, to 1.03g in *H. salicifolia*. Colour of fruits were red to redish-orange and yellowish-orange in *H. rhamnoides* and yellow in *H. salicifolia*. Shape of the seeds in *H. rhamnoides* was oval to ovate, elongate, round elliptical, whereas it was ovate in *H. salicifolia*. Total oil content in the fresh ripe fruits of *H. rhamnoides* varied from 2.9-4.6%, which were significantly ( $P < 0.05$ ) higher than *H. salicifolia*

(2%). Total protein content varied from 2.1-3.4% in *H. rhamnoides*, which was also significantly ( $P < 0.05$ ) higher than *H. salicifolia* (1.2%). Further surveys are required for the selection of some promising forms of *H. rhamnoides* in other regions of Himalayas.

**Sinha, B.L. and Rastogi, R.A.** 2003. **Impulse response function for Chakhutia watershed in Ramganga catchment, Uttaranchal.** *Journal of soil and Water Conservation*, 2(3&4): 129-135. AICRP for Dry Land Agriculture, R.B.S. College, Bichpuri, Agra, U.P.; Department of Soil and Water Conservation Engineering, G.B. Pant University of Agriculture and Technology 263 145, Uttaranchal, India. [HYDROGRAPHS; IMPULSE RESPONSE FUNCTION; RUNOFF; WATERSHED]

The mathematical formulation was developed for the impulse response function of chakhutia watershed of Ramganga river based on discrete linear input-output model to predict peak runoff rates and the temporal distribution of direct runoff of storm basis. The z-transformation and inverse z-transformation were used to develop the impulse response function. The performance and adequacy of the impulse response function was tested by comparing the computed direct runoff hydrographs with the observed runoff hydrographs. The average values of absolute relative error in estimated peak and relative mean absolute deviation were found to be 4.2771 per cent and 0.0315 respectively. These low average values indicate that the developed impulse response function generates closely comparable direct runoff hydrographs. The average value of coefficient of efficiency was found to be 0.9778, which indicates a very high degree of association between computed and observed direct runoff hydrographs.

**Solanki, G.S. and Chutia, Chutia** 2004. **Ethno zoological and socio-cultural aspects of monpas of Arunachal Pradesh.** *Journal of Human Ecology*, 15(4): 251-254. Department of Applied Science (Forestry), North Eastern Regional Institute of Science and Technology, Nirjuli 791 109, Itanagar, Arunachal Pradesh, India. [ETHNO ZOOLOGY; MAGICO RELIGIOUS; MONPA; SOCIO CULTURE]

Arunachal Pradesh is, a trical state, inhabited by 26 major tribes and 105 sub-tribes. Monpa is one of the major tribe inhabiting mainly in Tawang and West Kameng Districts of Arunachal Pradesh. Monpas has unique socio-cultural entity and claim themselves Indo-Bhutan and Indo-Tibet in origin. In spite of their ritual concepts in Buddhist culture use of animals as food and therapeutic use is not uncommon. Present communi-cation deals with the diversity of use pattern of wild fauna as food item, therapeutic and medicinal purpose and in socio-cultural practices.

**Sundriyal, Manju and Sundriyal, R.C.** 2004. **Wild edible plants fo the Sikkim Himalaya: marketing, value addition and implications for management.** *Economic Botany*, 58(2): 300-315. G.B. Pant Institute of Himalayan Environment and Development, North East Unit, Vivek Vihar, Itanagar 791113, Arunachal Pradesh, India. [CONSERVATION; EDIBLE PLANTS; MARKETING; SIKKIM HIMALAYA]

This paper presents data on marketing, value addition and management concerns of the wild edible plants of the Sikkim Himalaya. At least 23 weekly markets, locally called 'Hats', have been identified in the state, and three markets, viz. Gangtok, Namchi and Singtam, were studied in detail, for one year, with reference to the availability, quantity sold and retailers involved with the marketing of wild edible species. A total for 44 wild edible species have been recorded to be sold annually in the three markets. Among all the species, *Spondias axillaris* was sold in highest quantity and more retailers were involved in its business than for any other wild edible plant. Other important species were *Machilus edulis*, *Diplazium esculentum*, *Eleagnus latifolia*, *Dendrocalamus hamiltonii*, *Agaricus* and *Baccaurea sapida*. The rural economics of wild edible plants is estimated to be some 140 tons per annum, and the prices for various species have increased over the years. At Gangtok, prices increased 3 to 6 times from 1981 to 1996-1997. Analysis of the field data showed that the wild edible plants were an important source of income to the plant dwellers and subsistence for farm families. Value addition was done to a

few wild edible species, and cost-benefit analysis showed that the income from the fruit could be increased by at least 3-5 times after making pickles, squash and jam. It was recorded that plant dwellers have open access for the collection of these plant resources, which often leads to their over exploitation, and the local state government at present lacks policies and strategies for protecting and promoting wild edible plants in any of its programs. It is suggested that suitable conservation practices and policies need to be formulated to conserve these plants in the wild habitats within the state.

**Sundriyal, Manju and Sundriyal, R.C. 2004. Wild edible plants of the Sikkim Himalaya: Nutritive values of selected species. *Economic Botany*, 58(2): 286-299. G.B. Pant Institute of Himalayan Environment and Development, North East Unit, Vivek Vihar, Itanagar 791113, Arunachal Pradesh, India. [MICRONUTRIENTS; NUTRITIVE VALUE; PROXIMATE ANALYSIS; SIKKIM HIMALAYA; WILD EDIBLE PLANT]**

Wild edible plants form an important constituent of traditional diets in the Himalaya. In the Sikkim Himalaya a total of 190 species have been screened as edible species out of which nearly 47 species come to the market. The present paper deals with nutritive values of 27 most commonly consumed wild edible plants in the Sikkim Himalaya. Of 27 plant species that were analyzed for the nutritive values, 22 were edible for their fruits and five for leaves/shoots. Among different plant parts, generally higher nutrient concentration was recorded for leaves, followed by new shoots and fruits. For different species the crude fiber content ranged between 2.15-39.90%, and the total soluble salts between 4.66-21.00%, and the vitamin C content from 6-286 mg/100g. The fat content was determined high in the fruits of *Castanopsis hystrix*, *Machilus edulis*, and *Cinnamomum* species, while the protein content was highest in *Hippophae rhamnoides*, *Cucumis melo*, and *Eleagnus latifolia*. The total carbohydrate content ranged from 32-88% in the fruits of various wild edibles, the reducing sugar from 1.25-12.42%, total sugar from 2.10-25.09%, the lignin content varied from 9.05-39.51%, the hemicellulose between 25.63-55.71% and cellulose content varied from 9.57-33.19% in different species. Among the various macronutrients estimated in the plant samples of different wild edible species, nitrogen was present in highest quantity, followed by potassium, calcium, magnesium, phosphorus, and sodium. Micronutrients, such as iron, zinc, magnesium, and copper contents were analyzed in different plant parts of various wild edible species. The iron content was higher in leaves and new shoots. The nutritive values of certain wild edible species determined in this study are comparable with various commercial fruits. It is suggested that a few wild edible species need to be grown for commercial cultivation and adopted in the traditional agroforestry systems, which will lead to reduced pressure on them in natural forest stands as well as producing economic benefits for poor farmers.

**Thakur, Navdeep; Savitri and Bhalla, Tek Chand 2004. Characterization of some traditional fermented foods and beverages of Himachal Pradesh. *Indian Journal of Traditional Knowledge*, 3(3): 325-335. Department of Biotechnology, Himachal Pradesh University, Summerhill, Shimla 171 005, Himachal Pradesh, India. [FERMENTED BEVERAGES; FERMENTED FOOD; TRADITIONAL BEVERAGES; TRIBALS]**

Traditional fermented foods and beverages are very popular in the tribal and rural areas of Himachal Pradesh. A number of fermented foods and beverages were identified and the traditional fermentation processes were studied. Some of the popular fermented foods and beverages were analysed for their microbiological characteristics. The Fermented Products that are unique to the tribal and rural belts of Himachal are *Bhaturu*, *Siddu*, *Chilra*, *Manna*, *Marchu*, *Bagpinni*, *Seera*, *Dosha*, *Sepubari*, *Sura*, *Chhang*, *Lugri*, *Daru*, *Angoori* and *Behmi*. Besides source of nutrition, these fermented foods e.g. *Bhaturu*, constitute staple food in larger part of rural areas of Kullu, Kangra, Mandi and Lahaul & Spiti districts of the state while others are consumed during local festivals, marriages and special occasions. Traditional starter cultures like '*Phab*' (dehydrated yeast formulation), '*Treh*' (previously fermented

wheat flour slurry) and 'Malera' (previously fermented wheat flour dough) are the inocula used in preparing fermented products. Microbiological studies revealed that species of *Saccharomyces cerevisiae* is a dominant microorganism in fermentation along with species of *Candida*, *Leuconostoc* and *Lactobacillus*. The ethanol content of some of the fermented beverages was also analysed.

**Thakur, P.S. and Sehgal, Sandeep** 2004. **Influence of conopy management on the performance of multipurpose tree species.** *The Indian Forester*, 130(6): 639-646. Department of Silviculture and Agroforestry, University of Horticulture and Forestry, Solan, Himachal Pradesh, India. [CANOPY; COLLAR DIAMETER; MULTIPURPOSE TREE; SOIL MOISTURE]

Tree canopy management imposed on 5 year old, 4 tree species have significantly affected number of shoots stump<sup>-1</sup>, number of nodes, collar diameter and vigour in fuel and fodder tree species (*Grewia iptiva*, *Celtis australis*, *Bauhinia variegata* and *Morus alba* M-5). *Grewia* produced the highest number of shoots followed by *Morus*. Collar diameter increased with increasing cutting height up to 2.0 m in *Grewia* and *Morus*, but declined in *Celtis* and *Bauhinia*. Coppiced and pollarded trees of all the species recorded significant monthly variations in transpiration rate with *Bauhinia* registering the highest rate followed by *Morus* > *Celtis* > *Grewia*. Cutting heights did not affect soil moisture utilization. Out of 4 tree species, *Bauhinia* utilized the maximum soil moisture content. Canopies of all the 4 tree species maintained lower beneath canopy temperature by 0.15°C to 1.97°C than the open control (without trees).

**Thakur, V.C.** 2004. **Active tectonics of Himalayan frontal thrust and seismic hazard to ganga plain.** *Current Science*, 86(11): 1554-1560. Wadia Institute of Himalayan Geology, Dehradun, Uttaranchal, India. [EARTHQUAKES; LESSER HIMALAYA; MAIN BOUNDARY THRUST; SEISMIC HAZARD]

We review the existing work on one of the principle thrust, namely that of Himalayan Frontal Thrust (HFT), caused by the collision between Indian and Asian plates. HFT is the only structure that has observed most of the N-S shortening across the Himalaya. We have carried out an excavation of a 55 m long trench across a scarp (Black Mango Fault) that has displaced the HFT at Kala Amb, Himachal Pradesh. The exposed trench-wall has revealed four low angle thrusts. Analysis of the trench-wall stratigraphy, structure and <sup>14</sup>C dating has revealed evidence of two large surface-rupture earthquakes. We have also caried out field study of piedmont zone between Fatehpur and Roorkee. The active deformation observed along the HFT zone suggests increased seismic hazard to the adjoining the Ganga-Yamuna plain, The seismic zonation of India (2001) needs revision in view of geological conditions and past historical seismicity; specifically, we believe that the region between HFT and MBT should be included under zone V category. Multidisciplinary and integrated studies have to be initiated, on a priority basis, covering the central seismic gap region, Uttaranchal.

**Tripathi, O.P.; Pandey, H.N. and Tripathi, R.S.** 2004. **Distribution, community characteristics and tree population structure of subtropical pine forest of Meghalaya, Northeast India.** *International Journal of Ecology and Environmental Sciences*, 29(3&4): 207-214. Department of Botany, School of Life Sciences, North-Eastern Hill University, Shillong 793 022, Meghalaya, India. [PINE REGENERATION; SPECIES RICHNESS; SUBTROPICAL PINE FORSEST; TREE POPULATION STRUCTURE]

The subtropical pine forests of Meghalaya occur in about 1,694 sq km areas between 800-2000m asl on well-drained acidic soils, low in total Kjeldahl nitrogen and available phosphorus. The forest canopy is almost exclusively composed of pine trees with a few scattered broad-leaved tree species. Altogether 174 species belonging to 139 genera and 77 families were recorded from the three stands located at 1050m (low-elevation), 1460 m (mid-elevation) and 1900m (high-elevation) altitudes. These could be grouped into tree (>15 cm cbh), shrubs/tree sapling (5-15 cm cbh) and herbaceous (<5

cm cbh) life-forms. The species richness, diversity and evenness indices of the three life forms were maximum in the high-elevation stand and minimum in the low-elevation stand. However, the dominance of pine showed a reverse trend. Within its distributional limit, species diversity in the stand was positively correlated ( $r = 0.93$ ,  $P = 0.001$ ) with annual rainfall and negatively ( $r = -0.93$ ,  $P = 0.001$ ) related to the temperature difference between mean monthly minimum and maximum values. On the contrary, the dominance of pine was positively correlated ( $r = 0.89$ ,  $P = 0.001$ ) with the variation in mean monthly minimum and maximum temperatures but negatively correlated ( $r = -0.89$ ,  $P = 0.001$ ) with mean annual rainfall of the area. The tree density varied between 810 and 1050 stem  $ha^{-1}$  and their basal cover ranged from 28.9 to 37.4  $m^2 ha^{-1}$  in the three stands. Out of these, about 52-75% individuals had a girth of  $>55$  cm cbh in all the three stands. The density of young trees (15-35 cm cbh) was very low (1-2%) in the mid and high-elevation stands suggesting prevalence of unfavourable condition for their survival at these altitudes. The high ratios of seedling of sapling density, and sapling to adult tree density in the low elevation stand showed that the regeneration potential of pine in this stand was better although young trees were absent owing to their extraction for firewood purposes. The absence of pine seedlings and saplings in the mid-elevation stand indicated its poor regeneration, which may be due to annual surface fire and cattle trampling. The regeneration of pine was also poor in the high-elevation stand due to the absence of saplings. The competition of pine seedlings and saplings with the dense ground flora for light seems to be the major cause of poor regeneration in this stand.

**Umdor, M. 2004. Indigenous practice on protection of *Areca catechu* Linn. seedling- A case study in Meghalaya.** *Indian Journal of Traditional Knowledge*, 3(3): 253-256. Department of Botany, Sankardev College, Bishnupur, Shillong 793 013, Meghalaya, India. [ARECA NUT SEEDLINGS; INDIGENOUS PRACTICES; KHASI WARS; PEST CONTROL; RED PALM WEEVIL]

The present study was conducted in the southern part of East Khasi Hills District of Meghalaya dominated by tribe Khasi Wars where maximum land is under Areca nut plantation. Areca nut seedling are seriously damaged by the grubs of a red palm weevil which kill the whole seedling. However, the Wars farmers with their traditional wisdom easily detect the infested seedlings and with their indigenous practices of "*checking the grubs in nuts*" locally known as "*peit ksain kwai*" control the damage of the young plants. Khasi Wars farmers' knowledge for identifying and protecting Areca nuts damage in the young stage developed by indigenous initiative, inherited over generations, is very effective and still in practice.

**Uniyal, A.K.; Bagwari, H.K. and Todaria, N.P. 2004. Rehabilitation of abandoned and denuded lands in Garhwal Himalaya afforestation techniques - A case study.** *Indian J. Soil Cons.*, 31(3): 269-275. Department of Forestry, P.O. Box - 59, H.N.B. Garhwal University, Srinagar (Garhwal) 246 174, Uttaranchal, India. [ABANDONED LAND; AFFORESTATION; AGRO-FORESTRY; MPTS; REHABILITATION]

Rehabilitation of abandoned and denuded land by improving upon indigenous traditional knowledge, some agroforestry demonstration models were developed at different sites in the Garhwal Himalayas. Through improved planting techniques, the performance of some multipurpose tree species (MPTs) in terms of survival and growth was recorded. Organic matter of soil increased by 4<sup>th</sup> year of plantation. It was concluded that at the sub-tropical sites (Chauras and Mayali), where most of the planted species were common, *D. sissoo*, *G. Optiva*, *T. belerica* and *A. lebbek* were most suited along with other (*L. leucocephala* & *M. alba* at Chauras; and *C. australis* and *P. cerasoides* - at Mayali) for restoration of abandoned agriculture and degraded lands, while at Budhna site *Alnus nepalensis*, *Quercus leucotrichophora*, *Juglans regia* and *Populus ciliata* were promising. All these MPTs fulfil local needs of fodder, firewood and timber without influencing the production of traditional food crops. Soil organic matter in the surface layer (0-7.5 cm) showed significant improvement all the three locations.

**Uniyal, V.P.** 2004. **Butterflies of Nanda Devi National Park - A world heritage site.** *The Indian Forester*, 130(7): 800-804. Wildlife Institute of India, Dehradun, Uttaranchal, India. [BIODIVERSITY; BIOSPHERE RESERVE; NATIONAL PARK]

Nanda Devi National Park, declared as such in 1982, was further made a Biosphere Reserve in January 1988. Realising its biological diversity and several rare and endangered endemic floral and faunal species, it was declared a world heritage site by the United Nations in Dec. 1988. This research supports many plant and faunal species. The author has documented 35 butterfly species belonging to 25 genera and four families, as a result of his study between in 2001, in this Park, as part of the Garhwal Rifles Regimental Centre Landsdowne expedition in this region.

**Yadav, Ram R.; Singh, Jayendra; Dubey, Bhasha and Chaturvedi, Rajesh** 2004. **Varying strength of relationship between temperature and growth of high-level fir at marginal ecosystems in western Himalaya, India.** *Current Science*, 86(8): 1152-1156. Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow 226 007. [ECOSYSTEM; HIGH ALTITUDE; MICROCLIMATE]

Ring-width chronologies (AD 1794-1998, 1644-1999, 1672-2000, and 1739-2002) of *Abies spectabilis* from four distantly located tree-line sites in western Himalaya were developed. The existence of good correlation among the site chronologies shows the influence of common forcing factor that could be climate, largely temperature. Correlation of May and mean April-May temperatures with chronologies show weakened relationship towards the later part of the 20th century.

### *New Discovery*

#### **NCF-led expedition discovers new species of primate!**

Recent surveys undertaken by the Nature Conservation Foundation (NCF), Mysore along with its partners, the Wildlife Conservation Society (WCS), New York, the International Snow Leopard Trust (ISLT), Seattle and the National Institute of Advanced Studies (NIAS), Bangalore have resulted in the discovery of a primate, the Arunachal macaque (*Macaca munzala*), that is new to science. A team comprising Dr. Anindya Sinha (NIAS/NCF/WCS), Dr. Aparajita Datta (NCF/WCS), Dr. M.D. Madhusudan (NCF/WCS) and Dr. Charudutt Mishra (NCF/ISLT) made this discovery a full 101 years after the last species of macaque, the Pagai macaque, was described in 1903. This exciting find is the latest in a series of biological discoveries that NCF has made in northeast India over the last 5 years.

### *Forthcoming Events*

National Seminar on Tourism and Himalayan Bio-diversity (NSTHB). 04-05 March 2005, Uttarkashi, India. Contact : Dr. Harshvanti Bisht, Convener – NSTHB 2005, Government Post Graduate College, Uttarkashi – 249 193, Uttaranchal, India. (E-mail: [nanda\\_devi@rediffmail.com](mailto:nanda_devi@rediffmail.com), [harsh\\_bisht@rediffmail.com](mailto:harsh_bisht@rediffmail.com))

International Seminar on Ecotourism Planning and Development in Protected Areas. 28 February-03 March 2005, Srinagar (Garhwal), India. Contact : Prof. S.C. Bagri, Dean & Director, Mountain Tourism and Hospitality Studies, HNB Garhwal University, Srinagar, Garhwal, Uttaranchal – 246 174. (E-mail : [bagri\\_sc@hotmail.com](mailto:bagri_sc@hotmail.com))

### *Workshop*

#### **Analysis of contemporary issues related to carrying capacity of pastoralism in higher Himalaya**

To generate information on the key issues relating to carrying capacity of pastoralism in the Central Himalayan region, a two days workshop was held at GBPIHED on 7-8 December 2004. Major themes of the workshop include conservation and management issues in alpine pastures; rangeland management and wildlife; sociological and economic issues; and impact of recent changes and developments. The specific objectives of the workshop were:

- To review the state of present knowledge on the management of livestock vis-a-vis availability of grazing resources in the alpine pastures.
- To understand the critical issues related to the carrying capacity of pastoralism.
- To identify gaps for further research with regard to changing socio-economic conditions of the pastoral communities, and impact of education and integration to global market economy.

## News & Views

### **Number of leopards goes up in Himachal**

The leopard population in Himachal Pradesh has registered an almost 20% increase with their number going up from 650 to 783, according to the latest census of the wildlife department. The census was undertaken simultaneously in the 37 territorial units, 3 wildlife divisions and 2 national parks on June 16 to avoid duplication. Apart from the census figure, there are 24 leopards in various zoos in the state. Snow leopards have registered a marginal increase from 32 to 35 in the Great Himalayan National Park and Pin Valley as per the preliminary analysis of the census. The highest concentration of leopards is in Mandi among all districts of the state, where the number touched 222.

THE HINDU : 19 July 2004

### **Bamboo project to create jobs in Uttaranchal**

A Rs. 265 crore project of bamboo plantation and industry will generate employment opportunities on a large scale to the people of Uttaranchal. Recently an MoU was signed between Uttaranchal Forest Department and Uttaranchal Forest Development Corporation on one hand and Eland International, a Delhi-based company on the other hand. The plantation work will be done on 1,50,000 acres of *Van Panchayat* land. The company will provide planting material to village *Panchayats*, motivate people to grow bamboo and establish bamboo-based units in Uttaranchal. Training will also be given to villagers by the company through a society in making bamboo handicrafts.

TIMES OF INDIA : 25 July 2004

### **A treasure house of healing herbs**

Sikkim is not only a repository of magnificent natural beauty, rich cultural tradition and dense forests, but it is also a treasure house of rare medicinal plants that are found only in parts of Uttaranchal. The state is recognized as one of the rare biodiversity spots having over 424 species of medicinal plants/herbs. Efforts are on to make inventories and documents recording all the medicinal plants found in this Himalayan state. The state government initiation in setting up of the State Medicinal Plants Board and proposal of setting up of a medicinal plants research institute are among the activities to develop these rare resources of the state.

TIMES OF INDIA : 15 August 2004

### **Project to study Pong dam flora, fauna**

To undertake economic evaluation of flora and fauna of the Pong dam wetlands, the Himachal State Council for Science Technology and Environment has sanctioned a project to the Bombay Natural History Society (BNHS). The Pong dam wetland in Kangra district is one of the largest man-made wetlands in northern India which attracts migratory birds from the trans-Himalayan zone. The reservoir is very important from the fish biodiversity point of view as it supports 20 freshwater fish species, including game fish like mahseer. The aim of the project is to document the monetary value of biodiversity for the stakeholders and to study the magnitude of exploration of living resources.

*Vishal Gulati* for THE TRIBUNE : 21 August 2004

### **Govt moots project to relive Corbett memories**

In the memory of famous hunter and writer Jim Corbett, who spent many decades of his life in Kumaun, a mega Corbett Country project will come up in Uttaranchal according to the Chief Minister of the State. The project includes features related to the life and time of the legendary figure as Corbett Museum, Wildlife Trails, Corbett Treks, etc. The 512 crore rupees project is being

looked at as a landmark in the development of tourism in Uttaranchal and this tourism destination spread over 802 acres in Hempur near Corbett Tiger Reserve.

TIMES OF INDIA : 26 August 2004

### **Morarka push for organic farming in Shimla**

The MR Morarka Rural Foundation has signed a memorandum of understanding with Shimla's district Rural Development Agency and another local organization called Sameti to promote organic agriculture in Himachal Pradesh. The Foundation has already begun conducting field surveys in nine selected blocks to identify ten village clusters suitable for launching the organic farming programme. The Foundation will arrange for expert personnel and conduct training programmes for the state's field functionaries and members of the block technical teams in organic farming. Besides these, arrangements will be made for the procurement, processing and direct marketing of the organic farm produce in the domestic as well as export market.

*Surinder Sud* for BUSINESS STANDARD : 1 October 2004

### **Over Rs. 1.35 crore envisages to boost horticulture in Udhampur**

To boost horticulture production an outlay of over 1.35 crore has been envisaged under centrally sponsored Technology Mission (MM-II) programme during the year 2004-05 with a target of covering 450 ha of land in Udhampur district of Jammu & Kashmir. This will ensure plantation of 48 thousand fruit plants of different species and will generate employment avenues for one lakh people connected with his scheme. Under this programme, 1800 metric tons of fruit production is expected to be achieved in the next 10 years.

KASHMIR TIMES : 4 October 2004

### **Steps to raise livestock productivity**

The Himachal Pradesh Government has taken a number of steps to increase productivity of livestock in the hill state through state Livestock Development Board to upgrade milk cattle through cross-breeding. The Government of India has approved grant-in-aid amounting to Rs. 12.75 crore to the state for three years. Apart from this, the District Rural Development Agency is working towards boosting dairy activities. It is implementing dairy development in Mandi, Hamirpur, Kangra and Chamba districts at a cost of Rs. 28.25 crore.

*Rakesh Lohumi* for THE TRIBUNE : 6 October 2004

### **Himachal nests 36 pc bird species**

The lushgreen valleys and snow-capped mountains of Himachal Pradesh nest 36% of country's species of aves. Of the 1,228 species of birds hata have been reported in India, 447 have been recorded in the state alone. The state has the largest population of chir pheasants in the world. Western tragopan, an endangered species is confined to the western Himalayas. The state, a storehouse of biodiversity supports 3,120 species of flowering plants, including 187 medicinal plants, besides 5,721 species of fauna, which is about 7% of the total animal life recorded in the country. However, only 100 species of vertebrate and invertebrate fauna are observed regularly.

THE TRIBUNE : 7 October 2004

### **Gujjars, Bakerwals ignore anti-polio drive**

Despite the funds pouring in for polio awareness campaign, specifically for the rural areas, a section of Jammu & Kashmir is still not benefiting from the efforts of the health department. The Gujjar and Bakerwal tribe of the state is one such lot that is not reluctant in taking polio drops but also a victim of misconceptions. Most of them resist bringing their children to the vaccine booths, fearing that these drops would lead to impotency in their children. Apart from that their 'religious' constraints

also discourage them intake these drops. However, officials in the health department claim that they are under the process of convincing the rural section and also achieved some success in the state.

KASHMIR TIMES : 10 October 2004

### **IBRD-aided watershed project in Uttaranchal**

For the development and maintenance of natural resources, to meet the basic needs of local inhabitants such as water, food and fuel and for their economic uplift, watershed development projects have been given more importance in the state. The state Chief Minister launched the World Bank aided Uttaranchal Decentralised Watershed Development project, which will be implemented through *Gram Panchayats* and cover 19 development blocks of 10 districts. About Rs. 405 crore would be spent for over 1200 villages generating direct and indirect employment in the region.

BUSINESS LINE : 15 October 2004

### **Cancer cases on the rise in NE**

The number of cancer patients has been on the rise in the north eastern region, particularly in Manipur over past few years, according to the latest survey conducted by the Regional Institute of Medical Sciences (RIMS), Imphal. The RIMS run by the North Eastern Council for the six beneficiary states – Manipur, Nagaland, Mizoram, Meghalaya, Tripura and Arunachal Pradesh, has been conducting research works in cancer. Types of cancer commonly suffered by men are lung cancer, nasopharynx and lymphoma, while a large number of women are affected by womb and breast cancer. The RIMS reveals that men are more prone to the disease. Excessive smokings, consumption of alcohol, use of tobacco and carcinogen products are the main cause of cancer among them.

THE ASSAM TRIBUNE : 17 October 2004

### **Malnutrition high in Meghalaya: study**

A study which was undertaken under the 'Mission 2007 initiative for hunger-free India' by the MS Swaminathan Research Foundation said about 33.87% of the Meghalaya population lived below poverty line. About 37.9% of the children below 3 years being moderately underweight and 11.3% severely underweight along with a very high infant mortality rate (39 per 1000) in the state was recorded. Due to lack of potable water, diarrhoeal diseases posed a major problem to the populace. Land degradation and lack of vegetative cover could be the main reason for drinking water problems; the study said suggesting measures like thick forest cover to help pure and plentiful water.

THE TIMES OF INDIA : 8 November 2004

### **Uranium mining project in West Khasi hills hangs fire**

The hopes of Uranium Corporation of India Limited (UCIL) for gaining the "official" support of local landowners in West Khasi hills for the long pending Rs 800 crore mining project was dashed by the forceful protest by the local unit of Khasi Student Union (KSU) demanding government clarification on the decline in health due to uranium mining. However, some local miners along with leaders and landowners said that there was no health hazard as claimed by the anti-mining lobby such as the KSU among others. The resolution to support the project could not be passed at the meeting due to the vociferous opposition by the KSU. In contrast, 20 villages in the area have decided to submit a memorandum separately to the Chief Minister indicating their support for the project, which can be taken as a step forward for the UCIL.

THE PIONEER : 11 November 2004

### **Himalayan component to be kept aside**

Contrary to the broad outlines drawn by the task force on rivers' interlinking project during the NDA regime, identifying 31 links for preparing feasibility reports, the UPA Government has

informed the Supreme Court that it will initially keep aside the Himalayan rivers and focus on the peninsular component in the south. Out of the 31 links identified by the task force, 14 relate to the Himalayan component and the remaining 17 to peninsular rivers. Political observers feel the controversial nature of the Himalayan component could be the main reason for not touching it at the moment.

*S.S. Negi* for THE TRIBUNE : 15 November 2004

### **73 pc Gujjars below poverty line: TRCF survey**

67% population of nomad Gujjars in the state of Jammu & Kashmir alone is living below poverty line, claimed in a survey conducted by Tribunal Research and Cultural Foundation (TRCF), a primary organization working for the cause of Indian tribes. The survey says the Gujjars of Himalayan ranges are without sufficient food, fodder for their animals and lack of basic facilities like proper shelter, health, drinking water, education, etc. Moreover, 71% of nomads are not aware of schemes operating by the state and central governments for their upliftment, according to the survey.

KASHMIR TIMES : 24 November 2004

### **Dal lake gets a new lease of life**

In a major attempt to save the world famous Dal Lake from extinction, purification of the lake would be carried out with hi-tech sewage treatment plants. The shrinking of the lake has caused concern among the residents. As per the plan, series of sewage treatment plants at the cost of Rs. 500 crores would be constructed along the lake and it was revealed that the Central Government had decided to provide 100% financial assistance to the same. A rehabilitation plan has also been worked out which, in the long run, is expected to help in the save Dal mission. Out of the 6000 families living in the Dal, 1200 families have already been shifted.

THE HINDU : 27 November 2004

### **Mizoram leads the way in bamboo industry**

Mizoram is preceded by no other states in India in bamboo projects, according to the Chief Minister of the state and newly set up bamboo board making industry at Sairang is also first of its kind in India. The other neighbouring states like Meghalaya and Tripura have huge annual income from bamboo produce mostly handicrafts. The state bamboo project is board-making, which will be a total substitute to timber and the State Government has allotted Rs. 1,600 lakh for bamboo processing project. The Minister also claimed the total bamboo resources in the north-east, which has the largest bamboo resource in India, are concentrated in Mizoram as the state has around 25 lakh metric tonnes of bamboo. However, the problem in bamboo industry in the state is transportation, as most of the bamboos grow in deep forest, which are in-accessible.

THE SENTINEL : 27 November 2004

### **Arunachal's pilot malaria project to serve as model for NE**

Most of the states in the north-east and other parts of the country have decided to adopt the modus operandi of the Arunachal Pradesh pilot malaria project as a 'role model' to control the dreaded disease in their states. The malaria control scheme which was completed in Lower Dibang Valley and Changlang districts of the state was highly appreciated. According to sources, the Arunachal Pradesh is one of the seven states, which would get substantial input during 2005-2009 under the intensive malaria control project.

THE SENTINEL : December 10, 2004

### **Sikkim keen to be No 1 in eco-tourism**

The Government of Sikkim has chalked out an ambitious plan to develop its infrastructure in its bid to become the country's numero uno eco-tourism destination. Endowed with rich natural flora

and fauna, Sikkim is re-dited with having nearly 4,000 species of flowering plants, 300 species of ferns and allies. Besides the state is gifted with more mountains per square km than any other area on the globe and the five glorious peaks, including world's third highest the Kunchanjungha peak. It offered various facilities for eco-tourism, pilgrim tourism and adventure tourism including trekking and river rafting which proved popular in the river Teesta rumbling down the Himalayas.

THE SENTINEL : 13 December 2004

### **Himalayas not environment friendly: Study**

Historic Himalayan ice dams created huge lakes and caused mammoth floods in India, a new research says and suggests the Himalayas is not environment friendly. Ice dams across the deepest gorge on the Himalayas created some of the highest-elevation lakes in history. The most recent of these lakes, in the Himalayan Mountains of Tibet, broke through its ice barrier somewhere between 600 and 900 AD, causing massive torrents of water to pour into India. Geological evidence points to the existence of at least three lakes, and probably four, at various times in history when glacial ice from the Himalayas blocked the flow of the Tsangpo River in Tibet, according to University of Washington geologist David Montgomery, a Professor of Earth and Space Sciences. A group of researchers led by Prof. Montgomery found evidence of the resulting lakes in ledges carved into the sides of the Tsangpo gorge and also presented the evidence of repeated damming and flooding of the gorge.

HINDUSTAN TIMES : 16 December 2004

### **Kashmir's wetlands may vanish in 10 years**

Kashmir's wetlands, temporary home to lakhs of migratory birds, are shrinking rapidly. The Wildlife Protection Department maintains that the wetlands are presently host to over 5 lakh migratory waterfowls from Siberia, Central Asia, China, North Europe and the Indian sub-continent. Rampant encroachment and lack of funds for the de-weeding and de-silting is the main cause of rapid shrinking of these wetlands. Environmentalists warn that if immediate measures are not taken to arrest the problem, Valley's wetlands will vanish in 10 years.

HINDUSTAN TIMES : 19 December 2004

### **JK signs MoU with UNDP for earthquake reduction**

The Government of Jammu & Kashmir have signed Memorandum of Understanding (MoU) with the United Nations Development Programme (UNDP) country office for implementation of the Urban Earthquake Vulnerability Reduction (UEVR) programme in the cities of Jammu and Srinagar of the state. This programme is a part of the Government of India – UNDP, Disaster Risk Management (DRM) programme, and is a national initiative taken by the Ministry of Home Affairs with UNDP support to reduce the vulnerabilities of communities in 169 most hazardous prone districts in 17 states of India. The programme would demonstrate a suitable model for mainstreaming of earthquake risk management initiatives at all levels so as to help reduce seismic risk in the most earthquake prone urban areas.

KASHMIR TIMES : 26 December 2004

### **Uttaranchal farmers court aromatic plants**

In a diversifying move farmers in the Selaquie area of Dehradun have changed to cultivating aromatic plants in the face of growing demand from the multi-billion cosmetic industry. From lemon grass to citronella, aromatic crops perennial in nature are now being grown in small pieces of lands as they require less water and the yield is much better. Moreover, animals do not eat them due to their strong smell. Help came in the form of the Rs 1 crore pilot project launched by the Uttaranchal Government with collaboration from a French NGO called Agrisud and Rajiv Gandhi Foundation.

BUSINESS STANDARD : 27 December 2004

## Hindi Section

### **छोटा कैलाश में भी तेजी से पीछे जा रहे हैं ग्लेशियर**

छोटा कैलाश को जाने वाले ट्रेकरों की संख्या लगातार बढ़ती ही जा रही है। धार्मिक यात्रियों के अलावा भारी संख्या में अकुशल ट्रेकर भी इस रूट में जा रहे हैं। मौज मस्ती को जाने वाले यह लोग काफी प्रदूषण फैलाते हैं। बढ़ते प्रदूषण व जंगलों के कटान के कारण यहां के ग्लेशियर तेजी से पीछे की ओर जा रहे हैं। छोटा कैलाश की यात्रा कर चुके प्रो० शेखर पाठक बताते हैं कि इस रूट में जाने वाले अकुशल ट्रेकरों के कारण प्रदूषण तो फैल ही रहा है साथ ही जंगलों पर भी दबाव पड़ रहा है। प्रदूषण व जंगलों के कटान के कारण ग्लेशियर भी प्रभावित हो रहे हैं। इन पर 'ग्लोबल वार्मिंग' का भी असर पड़ा है। इसी कारण ये तेजी से पीछे की ओर जा रहे हैं। प्रसिद्ध छायाकार अनूप साह बताते हैं कि ट्रेकर व धार्मिक यात्री खाद्य सामग्री और पालीथीन रास्ते में जगह-जगह फेंक देते हैं। जंगलों में पड़ रहे दबाव को रोकने के लिए यात्रियों को रूट में गैस सिलिंडर उपलब्ध कराने चाहिए। इसके अलावा रूट में कूड़ा इकट्ठा करने के लिए उचित स्थल बनाये जाएं। स्थानीय नागरिकों को जागरूक कर ही रूट को प्रदूषण से मुक्त किया जा सकता है।

अमर उजाला : जुलाई 30, 2004

### **अब केदारनाथ पर छाये खतरे के बादल**

आस्था के सर्वोच्च शिखरों में से एक केदारनाथ धाम पर कभी भी चौराबाड़ी ग्लेशियर बम की तरह फटकर कहर बरपा सकते हैं। मंदिर के ठीक पीछे स्थित करीब 6 किलोमीटर लंबे इस ग्लेशियर से हिमस्खलन लगातार सक्रिय हो रहे हैं। जबकि मौसम के गर्म होने से चौराबाड़ी के इर्द-गिर्द बर्फीली झीलों की संख्या अप्रत्याशित रूप से बढ़ गई है। चूंकि ये झीलें ग्लेशियर के पीठ पर सवार हैं। इसलिए अगर पानी का बोझ बढ़ा तो झीलें फट पड़ेंगी और मौका ताड़कर यमुनोत्री और बदरीनाथ से भीषण तबाही केदारनाथ धाम में मचाने निकल पड़ेंगी। चौराबाड़ी ग्लेशियर का सर्वेक्षण पूरा कर हाल ही में केदारनाथ से लौटे हिमालय भू-विज्ञान संस्थान के विशेषज्ञों की गोपनीय रिपोर्ट पर गौर करें तो हालात बहुत अच्छे नहीं हैं। रिपोर्ट के मुताबिक केदारनाथ मंदिर से महज दो किलोमीटर दूरी पर स्थित चौराबाड़ी ग्लेशियर के मुरैन पर बर्फीली झीलों की संख्या चिंताजनक रूप से बढ़ रही है। जिन झीलों की संख्या वर्ष 2003 में सिर्फ तीन थी वर्ष 2004 में वह बढ़कर सोलह हो गई है। दुखद यह है कि मौसम के गर्म होने से पिघल रहे चौराबाड़ी ग्लेशियर के कारण झीलों के आयतन में जबरदस्त बढ़ोत्तरी हो रही है। आयतन में वृद्धि के चलते झीलों के पानी के भार से इनके फटने की संभावनाएं बढ़ गई हैं। जानकारों का कहना है कि जब तक ग्लेशियर में इन झीलों को रोकने की झमता है या झीलें छोटी हैं तब तक तो ठीक है लेकिन तापमान बढ़ने से ग्लेशियर में दरारें पड़ी या एक झील दूसरे से मिल गई तो हालात बेकाबू हो जाएंगे। चौराबाड़ी ग्लेशियर की बिगड़ती स्थिति केदारनाथ मंदिर के लिए इसलिए भी खतरनाक मानी जा रही है क्योंकि यह ग्लेशियर मंदिर के ठीक पीछे स्थित है। अगर हिमस्खलन हुआ तो वह केदारनाथ मंदिर को दाएं और बाएं से हिट करेगा जबकि ग्लेशियर की झील फटने की स्थिति में पानी की यह नदी मंदिर को पीछे से चोट पहुंचाएगी। यही नहीं जहां मंदिर है उसके पीछे के पड़ाव की झुकाव करीब 60 डिग्री के कोण पर हैं। एवंलाच की दृष्टि से 60 डिग्री कोण को काफी खतरनाक माना जाता है। और चूंकि सर्दियों में यहां आठ से दस फीट तक बर्फ गिरती है और मंदिर के बगल के पहाड़ वर्ष भर बर्फ से पटे रहते हैं इसलिए यह 60 डिग्री का स्लोप सर्दियों में और भी खतरनाक है।

दैनिक जागरण : अगस्त 1, 2004

### **एक और बड़े बांध की तैयारी**

टिहरी हाइड्रो-डैवलपमेंट कारपोरेशन (टीएचडीसी) किशाऊ में जल विद्युत की एक और बड़ी परियोजना लेकर आ रहा है। 600 मेगावाट की इस परियोजना में 4,000 करोड़ रुपये से अधिक की लागत आएगी। विभागीय सूत्रों के अनुसार इस परियोजना से बनने वाली बिजली का बंटवारा उत्तरांचल और हिमाचल प्रदेश के बीच होना है। लेकिन पानी के बंटवारे में उत्तरांचल, उत्तर प्रदेश, हरियाणा, पंजाब, दिल्ली, राजस्थान और हिमाचल प्रदेश का हिस्सा है। एक हजार मेगावाट के टिहरी बांध की परियोजना के बाद यह टीएचडीसी को प्रदेश में मिलने वाली दूसरी बड़ी परियोजना होगी। इस परियोजना के डूब क्षेत्र में कुल 17 गांव आते हैं। जिससे तकरीबन साढ़े पांच हजार लोगों का पुनर्वास करना होगा। किशाऊ बांध देहरादून से लगभग सौ किमी की दूरी पर उत्तरांचल और हिमाचल प्रदेश की सीमा पर स्थित यमुना की प्रमुख सहायक नदी टोंस पर बनने वाली एक बहुदेशीय परियोजना है। 236 मीटर ऊंचाई एवं 680 मीटर लंबाई के सालिड ग्रेविटी बांध एवं 600 मेगावाट के सतही विद्युत गृह का निर्माण कर एक बड़ा जलाशय बनाया जाएगा। यमुना और टोंस नदी के संगम स्थल डाकपत्थर से 45 किमी अपस्ट्रीम पर स्थित इस परियोजना के सांभरखेड़ा स्थल पर अधिकांश भूवैज्ञानिक सर्वेक्षण, हाइड्रोलॉजी, पर्यावरण एवं इकोलॉजी, भूकंपीय अध्ययन, वृक्षारोपण और पुनर्वास से संबंधित

पक्षों पर अध्ययन किए जा चुके हैं। भूवैज्ञानिक एवं भूकंपीय विषमताओं के सापेक्ष आर्च ग्रेविटी बांध के विकल्प स्वरूप अर्थ एवं राकफिल बांध प्रस्तावित कर विस्तृत परियोजना रिपोर्ट 1978 में केंद्रीय जल आयोग एवं केंद्रीय विद्युत प्राधिकरण को प्रेषित कर परीक्षित कराई गई थी। विभागीय सूत्रों के अनुसार अंतरराज्यीय समझौतों के बाद शीघ्र ही इसके लिए सहमति पत्र तैयार किया जाना है।

अमर उजाला : अगस्त 8, 2004

### बाघ की खाल के बदले मिलती है शाहतूश

बाघ और तेंदुए की हत्या खाल के लिए नहीं बल्कि इनके अंगों के लिए की जाती है। चीन में इन अंगों से कीमती दवा बनाई जा रही है। ऐसा अनुमान है कि इन्हीं अंगों के बदले शाहतूश यहां लाया जाता है। वन्यजीवों के अंगों की तस्करी में लगे लोगों का मुख्य मकसद तेंदुए और बाघ की हत्या कर उनके अंगों को किसी भी तरह चीन तक पहुंचाना है। इसके लिए उत्तरांचल के नेपाल से लगे क्षेत्र को सुरक्षित माना जाता है। पहले बाघ और तेंदुए का शिकार खाल प्राप्त करने के लिए ही किया जाता था। 1992 के बाद इन वन्यजीवों की हत्या इनके अंगों को प्राप्त के लिए की जाने लगी। बताया गया है कि चीन में बाघ और तेंदुए की हड्डि की अत्यधिक मांग है। इनका उपयोग चीन में बनने वाली पारंपरिक दवा में किया जाता है। बाघ की हड्डियों को शराब बनाने में भी प्रयोग में लाया जाता है। इससे गठिया रोग दूर होता है। इसके अलावा फोड़ों का इलाज करने, मांसपेशियों की ऐंठन दूर करने, टाइफाइड, बुखार, मलेरिया, हाइड्रोफीबिया जैसी बीमारी के इलाज के लिए भी इन हड्डियों का उपयोग किया जाता है। चीन में बाघ और तेंदुए की चर्बी, मांस, अंडकोष, पेट, नेत्रगोलक, नाक, दांत, पंजे, मूछ, मल, खून को भी दवा के लिए प्रयोग में लाया जाता है। बाघ के अंगों की तस्करी करने वाला अंतर्राष्ट्रीय गिरोह है। यह गिरोह नेपाल, तिब्बत मार्ग का सहारा लेता है। भारतीय क्षेत्र से बाघ और तेंदुए के अंग ले जाए जाते हैं। तिब्बत में ही वन्यजीवों के अंगों की अदला बदली तिब्बत में मिलने वाले शाहतूस से की जाती है।

अमर उजाला : अगस्त 19, 2004

### बारह साल में सूख जाएगी कोसी

अल्मोड़ा नगर तथा आसपास के सैकड़ों गांवों की प्यास बुझाने वाली नदी कोसी दस बारह सालों में पूरी तरह सूख जाएगी। अल्मोड़ा के लिए यह खतरे की घंटी है। बारह साल में पानी चार गुना कम होने से कोसी की चार सहायक नदियां पहले ही सूख चुकी हैं। वैज्ञानिकों ने कोसी को बचाने के लिए बरसात का पानी इकट्ठा करने पर जोर दिया है। कोसी हिमालय से निकलने वाली नदी नहीं है और पूरी तरह जल स्रोतों और सहायक नदियों पर निर्भर है। करीब 15-20 सालों में आबादी बढ़ने के साथ इस नदी का जल स्तर लगातार घट रहा है। कुमाऊं विश्वविद्यालय अल्मोड़ा परिसर में भूगोल विभाग के उपाचार्य तथा नेचुरल रिसोर्स डाटा मैनेजमेंट सिस्टम सेंटर के परियोजना निदेशक डा0 जे0एस0 बिष्ट ने बताया कि इस साल मई में इस नदी में पानी का प्रवाह 195 लीटर प्रति सेकेंड रिकार्ड किया गया जबकि 12 साल पहले 790 लीटर प्रति सेकेंड था। नदी में पानी 50 लीटर प्रति सेकेंड प्रतिवर्ष की दर से कम हो रहा है जो खतरनाक है। डा0 बिष्ट के मुताबिक सर्वे आफ इंडिया के रिकार्ड में सदाबाहिनी नदी के रूप में दर्ज कोसी की सहायक मैलोनगाड़, सुमारीगाड़, साईनाला और नानिकोसी नदियां अब सूख कर मौसमी नदियों का रूप ले चुकी हैं। कोसी को सदानेरी बनाए रखने के लिए डा0 बिष्ट ने एक योजना बनाकर दी है। इस योजना पर अभी से अमल हो जाए तो कोसी में पानी की कमी नहीं रहेगी। नदी में कोसी कस्बे से ऊपर की तरफ कौसानी तक 323 गांवों से पानी आता है। यह सभी गांव कौसानी, सोमेश्वर, बिंसर, शीतलाखेत तथा कसारदेवी इलाके के अंतर्गत आते हैं। इन सभी इलाकों और कोसी की सहायक नदियों के इर्द-गिर्द पहाड़ की ढलान में पांच मीटर चौड़े और पांच मीटर गहरे खनकी (टैंक) बनाए जाने चाहिए। उन्होंने मौसमी नदियों के आसपास पत्थर व लकड़ी के छोटे-छोटे पोखर तथा चैक डैम बनाने और इस समूचे क्षेत्र में चौड़ी पत्ती वाले पेड़ लगाने का सुझाव दिया है। कोसी कस्बे के नीचे फड़का में छोटा बांध बनाने की भी बात रखी है, ताकि गर्मियों में इससे पानी की आपूर्ति की जा सके।

अमर उजाला : अगस्त 23, 2004

### सेब उत्पादन में 20 वर्षों का रिकार्ड टूटा

उत्तरांचल में सेब की पैदावार के लिए इस वर्ष मौसम अनुकूल रहा। वर्षा व नमी ने पूरा साथ दिया। जिसके चलते यहां सेब उत्पादन में 20 वर्षों का रिकार्ड टूट गया है। राज्य भर में तकरीबन 3 लाख 38 हजार मैट्रिक टन सेब पैदा होने का अनुमान है। असामान्य व असमय वर्षा, पानी की समय पर कमी और ओलों की मार जैसी समस्याओं के चलते पिछले दो दशकों में उत्तरांचल में सेब उत्पादन में कमी आती रही, जबकि हिमाचल व जम्मू कश्मीर के सेब धूम मचाते रहे। गत वर्ष लगभग 38 हजार मीट्रिक टन सेब पैदा हुआ। हालांकि इस बीच सेब बागानों के क्षेत्रफल में खास बढ़ोत्तरी नहीं हुई, किन्तु किसानों ने सेब की नई नस्लों को अपनाया। उत्तरांचल में जल्दी पकने वाली चौबटिया प्रिंस,

अर्ली सनवरी, गोल्डन व ग्रीन स्वीट से लेकर खैनी, पिनौनी, मैकन्टौस, किंग डेविट, रैड डैलिसस व अन्य डैलीसस प्रजातियों से लेकर शीतकाल के पहले तक तैयार होने वाली राइमर, वर्किंगम व पिक्स जैसी प्रजातियों का सेब इस बार अच्छी तादात में पैदा हुआ। राज्य में सबसे अधिक सेब उत्तरकाशी में पैदा होता है। उद्यान एवं खाद्य प्रसंस्करण निदेशालय से लगे सर्वाधिक पुराने व मशहूर चौबटिया गार्डन में लगभग 56 प्रजातियां मौजूद हैं। शीघ्र व मध्यकाल में पकने वाली प्रजातियों से अभी तक लगभग तीन सौ किंवा सेब प्राप्त हो चुका है।

अमर उजाला : अगस्त 27, 2004

### मानव विकास को हिमालय की सुरक्षा जरूरी

मानव सभ्यता के विकास के लिए पर्यावरण की सुरक्षा को सबसे महत्वपूर्ण जरूरत बताते हुए काशी हिंदू विश्वविद्यालय के पर्यावरण विशेषज्ञ प्रो० जे० एस० सिंह ने कहा कि हिमालय क्षेत्र की पर्यावरण सुरक्षा आज सबसे बड़ी चुनौती है। उन्होंने प्राकृतिक जल स्रोतों की सुरक्षा पर विशेष बल दिया। गोविन्द बल्लभ पंत हिमालय पर्यावरण एवं विकास संस्थान, कटारमल में आयोजित दसवें पंडित गोविन्द बल्लभ पंत स्मृति व्याख्यानमाला को संबोधित करते हुए मुख्य वक्ता के रूप में श्री सिंह ने कहा कि पर्यावरण की सुरक्षा के लिए जंगलों से लगे गांवों की आर्थिक सुरक्षा का ध्यान देना होगा। पर्यावरण से सम्बंधित जो भी कार्यक्रम चलाये जायें, उसका सीधा लाभ जनता को मिले। उन्होंने कहा कि उत्तरांचल में अधिकांश क्षेत्र वनों से आच्छादित हैं इन वनों के विकास के साथ-साथ यहां पर उपलब्ध संसाधनों पर छोटे-छोटे व्यवसाय से लोगों को जोड़ना होगा। व्याख्यानमाला में प्रदेश के मुख्य सचिव डा० आर० एस० टोलिया ने कहा कि प्रदेश के आर्थिक एजेंडे में पर्यावरण को सम्मिलित किया गया है। उन्होंने कहा कि 12वें वित्त आयोग में भी पर्यावरण सम्बंधी गंभीर विषयों को समाविष्ट कर अधिक महत्व दिया गया है। ग्लेशियरों के बारे में भी हम सभी को गंभीरता से सोचना होगा व वनों की सुरक्षा की ओर विशेष ध्यान देने की जरूरत है। केन्द्रीय पर्यावरण तथा वन सचिव डा० प्रदीप्तो घोष ने कहा कि पर्यावरण संस्थान को पारिस्थितिकीय और सामाजिक बदलावों के अंतर्सम्बंध की समझ बढ़ाते हुए जल संसाधन, हिमनद एवं वनों के संरक्षण पर प्राथमिकता से काम करना होगा।

दैनिक जागरण : सितम्बर 11, 2004

### उत्तरांचल में चुनौती बन सकता है पानी

पानी आने वाले समय में उत्तरांचल में चुनौती बनकर उभर सकता है। यह खुलासा केंद्रीय जल संसाधन मंत्रालय की रिपोर्ट में किया गया है। रिपोर्ट में इस पहाड़ी प्रदेश के मैदानी क्षेत्रों के लगातार गिरते भू जल स्तर पर चिंता व्यक्त की गई है। हांलाकि प्रदेश सरकार ने जल समस्या से निपटने के लिए ग्राउंड वाटर सेल के गठन की योजना बनाई है और इसके क्रियान्वयन के लिए लगभग साढ़े चार करोड़ का प्रस्ताव केंद्र सरकार को भेजने की तैयारी कर ली है। हरिद्वार, कोटद्वार व ऊधमसिंह नगर जैसे मैदानी इलाकों में लगातार गिरते भू-जल स्तर को लेकर अब नीति नियंताओं के माथे पर चिंता की लकीरें उभरने लगी हैं। केंद्रीय जल संसाधन मंत्रालय द्वारा आयोजित राज्यों की बैठक में इस रिपोर्ट का खुलासा होने के बाद ग्राउंड वाटर सेल के गठन पर कार्य शुरू हो गया है। सिंचाई विभाग ने जल स्तर में गिरावट का पता लगाने के लिए सर्वेक्षण कर प्रबंधन की योजना तैयार कर ली है ताकि वर्तमान ग्राउंड वाटर लेबल को कायम रखा जाए और भविष्य के खतरे से निपटने के लिए कारगर हल तलाशा जा सके। विगत दो व तीन अगस्त को राज्यों की बैठक में केंद्रीय जल संसाधन मंत्री प्रियरंजन दास मुंशी ने समस्या की गंभीरता के मद्देनजर ग्राउंड वाटर प्रोजेक्ट प्रस्तुत करने के निर्देश दिए थे। भू-जल स्तर गिरने का मुख्य कारण माइनिंग आफ वाटर यानी जल स्रोतों का अनावश्यक दोहन माना गया था। मैदानी क्षेत्रों में फिलहाल इस समस्या से निपटने के लिए न तो कारगर उपाय ही तलाश जा सके हैं और न ही समुचित संसाधनों का उपयोग हो पाया है।

दैनिक जागरण : सितम्बर 12, 2004

### वैज्ञानिक लाभदायी पेड़ों की प्रजाति विकसित करें

प्रख्यात पर्यावरणविद् सुंदर लाल बहुगुणा ने पानी के संकट के प्रति सचेत करते हुए वैज्ञानिकों का आह्वान किया कि वे वैज्ञानिक तरीके से लाभदायी पेड़ों की खेती विकसित करें। श्री बहुगुणा यहां पर्यावरण संस्थान में आयोजित 'हिमालयी क्षेत्र में खिसकते ग्लेशियर: पर्यावरण एवं सामाजिक प्रभाव' विषयक गोष्ठी को संबोधित कर रहे थे। गोष्ठी के अध्यक्ष एवं पर्यावरण व वन मंत्रालय के सचिव डा० प्रदीप्तो घोष ने दूरगामी प्रभावों को ध्यान में रखकर योजनाएं क्रियान्वित करने पर बल दिया। श्री बहुगुणा ने भविष्य में होने वाले पानी के संकट में अपनी चिन्ता से अवगत कराते हुए कहा कि हमें पानी कम से कम खर्च करना चाहिए। औद्योगिक इकाइयों को पानी का विकल्प ढूंढना होगा और कम खर्च हेतु कड़ा कानून बनाना चाहिए। पहाड़ों में पेड़ों की खेती की जानी चाहिए, जिससे पानी का खर्च कम होगा। डा० प्रदीप्तो घोष ने कहा कि हिमालय के ग्लेशियरों को सिर्फ अध्ययनों तक ही सीमित नहीं रखना चाहिए, बल्कि भविष्य में होने वाले दूरगामी प्रभावों को ध्यान में रखते हुए अभी से अपनी योजनाओं को क्रियान्वित करना चाहिए। एस्ट्रोफिजिक्स

संस्थान बंगलौर में प्रोफेसर विनोद कुमार गौड़ ने गोष्ठी में हिमालय के ग्लेशियरों का विस्तृत वैज्ञानिक व्याख्यान प्रस्तुत किया एवं जोर देते हुए कहा कि गोविन्द बल्लभ पंत हिमालय पर्यावरण एवं विकास संस्थान को ग्लेशियर अध्ययन की नोडल एजेंसी बनाकर क्षेत्र का अध्ययन किया जाय।

दैनिक जागरण : सितम्बर 12, 2004

### आपदा से निपटने में घंटे नहीं, मिनट लगेंगे

प्रदेश का दूरदराज का अतिदुर्गम क्षेत्र प्राकृतिक आपदा की चपेट में आ जाए, तो सूचना मिलने के बाद बचाव व राहत की प्रभावी रणनीति बनाने में कितना वक्त लगेगा? दिन और घंटे नहीं, बल्कि चंद्र मिनट। भले ही आज यह भरोसे की बात न लगे, लेकिन सरकार ने प्रदेश के गांव-गांव की डिजिटल मैपिंग की जो कवायद शुरू की है, उसने इसकी काफी हद तक उम्मीद जगायी है। आपदा प्रबंधन एवं न्यूनीकरण केंद्र (डीएमएमसी), प्रदेश का जो डिजिटल मानचित्र तैयार कर रहा है, उसमें राज्य के कोने-कोने की भौगोलिक, सामाजिक, आपदा संवेदनशीलता की जानकारी तो है ही, वहां मौजूद अस्पताल, खाद्यान्न भंडार, उपलब्ध मानव शक्ति का भी बारीकी से ब्योरा दिया जा रहा है। डीएमएमसी के अधिशासी निदेशक डा० आर०के० पाण्डे का कहना है कि कम्प्यूटरीकृत मानचित्र में वृहद जानकारियों का समावेश होने की वजह से चंद्र सेकेंड में प्रभावित क्षेत्र की पूरी तस्वीर सामने होगी। प्रभावित इलाके की भौगोलिक तथा तत्काल उपलब्ध संसाधनों के आधार पर बचाव व राहत कार्य को त्वरित गति से शुरू करना मुमकिन हो जाएगा। डीएमएमसी अब तक उत्तरकाशी तथा अल्मोड़ा का मानचित्रिकरण कर चुका है। आपदा प्रबंधन को फुर्तीला बनाने के लिए डीएमएमसी के वैज्ञानिक लंबे समय से सिर खपा रहे थे। अधिशासी निदेशक डा० पाण्डे ने कहा कि यह बात नहीं है कि प्रदेश के संसाधनों के बावत जानकारियां नहीं हैं। आपदा मानचित्र के वक्त आवश्यक हर विभाग तथा उसके संसाधनों की उपलब्धता को एक ही स्थान पर समाहित कर दिया गया है। इसमें हर गांव की भौगोलिक स्थिति की जानकारी है। वहां पहुंचने का मार्ग, उपलब्ध सरकारी संसाधन, वहां तैनात कर्मचारी, निजी प्रतिष्ठान (केमिस्ट, ट्रांसपोर्ट, जनरल स्टोर आदि) की सूचीबद्ध सारणी बनाई गई है। अत्याधुनिक तकनीकी का इस्तेमाल करते हुए एक-एक बिंदु का अक्षांश तथा देशांतर में स्थिति भी दी जा रही है।

अमर उजाला : सितम्बर 15, 2004

### पर्यटन को गांवों में ले जाएंगे हिमालयी सूबे

हिमालयी राज्यों में पर्यटन को पांच सितारा शहरी कल्चर से निकालकर गांवों में ले जाने के लिए एक राय कायम होने लगी है। प्रकृति प्रेमी सैलानियों को रिज्ञाने के लिए पर्वतीय अंचल में साझा नेटवर्क तथा मार्केटिंग की रणनीति बनाने को हिमाचल प्रदेश, सिक्किम तथा लद्दाख ने उत्तरांचल के हाथ से हाथ मिलाया है। कोशिश यह है कि शहरों तक सिमटे पर्यटन का दायरा विकसित कर दूरदराज अंचलों तक फैलाया जाए। पर्यटन के क्षेत्र में संभावनाओं के मद्देनजर केंद्रीय ग्रामीण पर्यटन योजना शुरू कर केंद्र सरकार भी अपनी गंभीरता जाहिर कर चुकी है। उत्तरांचल के विभिन्न वन प्रभागों के गंगी (टिहरी), अगोड़ा (उत्तरकाशी), कोटी (चकराता), सारी (केदारनाथ वन्यजीव), पवलगढ़ (रामनगर), बूंगा (पिथौरागढ़), मिलम (बागेश्वर), कनोल (टोंस), आठ गांव इस योजना में शामिल हैं। गौरतलब है कि उत्तरांचल में पर्यटन में स्थानीय समुदाय की भागीदारी का इतिहास नया नहीं है। राज्य गठन के बाद से कार्बेट नेशनल पार्क के बकराकोट, छोटी हल्द्वानी तथा क्यारी, गंगोत्री राष्ट्रीय पार्क के हर्षिल, मुखवा, धराली, जसपुर तथा दथारी गांव में ग्रामीण पर्यटन की शुरुआत की जा चुकी है। नंदा देवी बायोस्फीयर के लाता, तोलमा, रैणी तथा भ्यूंडार गांवों में ग्रामीण पर्यटन की गतिविधियों से जुड़े हुए हैं।

अमर उजाला : दिसम्बर 11, 2004

### गोमुख में आवाजाही नियंत्रित होगी

देश के तीसरे विशाल गंगोत्री राष्ट्रीय उद्यान को नियोजित ढंग से विकसित करने तथा पर्यावरणीय दृष्टि से बेहद संवेदनशील माने जा रहे गोमुख क्षेत्र में पर्यटकों की आवाजाही नियंत्रित करने के लिए वन विभाग ने ठोस योजना तैयार करने की कवायद शुरू कर दी है। राज्य के वन एवं पर्यावरण मंत्री नवप्रभात ने पार्क का दौरा करने के बाद विभागीय अधिकारियों को योजना तैयार करने के निर्देश दिए हैं। गंगोत्री राष्ट्रीय उद्यान संभवतया देश का ऐसा पहला स्थान है जहां कि भोजवासा-गोमुख क्षेत्र जाने वाले पर्यटकों को बरड़ मृगों के झुंड देखने का शत-प्रतिशत अवसर मिलता है। झुंडों में रहने वाले बरड़ मृग यहां हजारों की संख्या में मौजूद हैं और ये बेखौफ राहगीरों के पास से होकर कुलांचं मारते हुए निकल जाते हैं। गंगोत्री राष्ट्रीय उद्यान की इस विशेषता से यहां पर्यावरणीय संकट भी बढ़ने लगा है। गंगोत्री राष्ट्रीय उद्यान में बड़े पैमाने पर अवैध शिकार के प्रमाण मिलने पर चौकन्ने वन विभाग ने अब गंगोत्री में रेंज कार्यालय खोलकर तथा पेट्रोलिंग की व्यवस्था कर स्थिति पर नजर रखने का निर्णय लिया है। उच्च हिमालयी क्षेत्र के इस पार्क की सीमा में आने वाले गोमुख क्षेत्र में बेतरतीब ढंग से पर्यटकों की आवाजाही तथा टनों कूड़ा-कचरा बिखेरने

से चिंतित वन विभाग यहां पर्यटकों की आवाजाही को नियंत्रित करने की योजना तैयार करने में जुटा है। इसके अलावा विभाग आवेदन करके परमिट हासिल करने तथा विदेशी पर्यटकों के लिए शुल्क पर पार्क में प्रवेश की व्यवस्था पर भी विचार किया जा रहा है। गंगोत्री में वाहनों की आवाजाही से बढ़ते प्रदूषण से निजात पाने के लिए कुछ किमी पीछे ही पार्किंग स्थल विकसित करने की योजना है ताकि वाहनों को सीधे गंगोत्री जाने से रोका जा सके।

अमर उजाला : दिसम्बर 11, 2004

### देवभूमि की भूगर्भीय हलचल खतरे का संकेत दे रही है

देवभूमि की धरती के भीतर भी कुदरत शांत नहीं है। पिछले 17 महीने में 15 बार ऐसे मौके आ चुके हैं, जब धरती के भीतर हलचल हो चुकी है। हालांकि इन सभी भूकंपों की तीव्रता रिक्टर पैमाने पर 3 से 4.5 तक ही आंकी गई है। 1999 से लेकर अब तक उत्तरांचल के विभिन्न इलाकों में भूकंप के छोटे-छोटे करीब 2400 झटके महसूस किए गए। आपदा प्रबंधन एवं न्यूनीकरण केंद्र के आंकड़े गवाह हैं कि इस पूरे साल सूबे में धरती शांत नहीं बैठी है। धरती के भीतर लगातार हलचल जारी है, जो भूकंप के झटकों के रूप में सामने आ रही है। दक्षिण एशिया में हुई तबाही ने 'हाई सैस्मिक जोन' वाले हिमालयी क्षेत्र को समय रहते किसी भी आपदा से निपटने के लिए सतर्क कर ही दिया है। कुमाऊं विश्वविद्यालय का भूगर्भ विज्ञान विभाग 'साइस्मिक नेटवर्क इन कुमाऊं हिमालया' नामक परियोजना के माध्यम से पिछले कई वर्षों से हिमालयी क्षेत्र में हुई भूगर्भीय हलचलों पर अध्ययन कर रहा है। उत्तरांचल में विभिन्न क्षेत्रों में पिछले वर्षों के दौरान आए भूकंप के छोटे-बड़े झटके परियोजना के तहत स्थापित नैनीताल की बिड़ला स्थित पहाड़ी में बने केंद्र में दर्ज हैं। इस केंद्र के वैज्ञानिकों के मुताबिक इंडियन प्लेट, यूरेशियन प्लेट के नीचे की ओर पांच सेमी0 प्रति वर्ष की रफ्तार से सरक रही है। इस प्रक्रिया के दौरान एकत्र होने वाली ऊर्जा जब पृथ्वी से बाहर निकलती है तब भूगर्भीय हलचल होती है और भूकंप के झटके आते हैं। कुमाऊं विश्वविद्यालय नैनीताल के भूगर्भ विज्ञान विभाग के विभागाध्यक्ष प्रो0 चारु पंत ने बताया कि भूकंप के खतरे की दृष्टि से उत्तरांचल जोन -4 में आता है। उन्होंने बताया कि बताया कि पृथ्वी के भीतर साइनोतिबेटैन प्लेट और इंडियन प्लेट टकराने से इस हिमालय क्षेत्र में भूकंप के झटके आते हैं। सुमात्रा द्वीप में भूकंप का केंद्र समुद्र के भीतर होने की वजह से उतना अधिक असर नहीं पड़ा, जितना कि इसके किसी महाद्वीप के केंद्र में होने पर पड़ता। रिक्टर पैमाने पर 8.9 तीव्रता का जलजला करीब 21 लाख वर्ग किलोमीटर क्षेत्र को थराने को काफी है। और उत्तरांचल का भौगोलिक दायरा महज 53 हजार 484 वर्ग किलोमीटर तक ही है। हिमालयी क्षेत्र में इंडियन एवं यूरेशियन (तिब्बतन) प्लेट के बीच चल रहे टकराव की वजह से चिंतित विशेषज्ञों को डर है कि यदि भविष्य में इस क्षेत्र में कभी ऐसा हुआ तो फिर भगवान ही मालिक है। विडंबना यह है कि इतना सब होने के बाद भी न तो सरकार और न ही जनता हिमालयी क्षेत्र की भूकंपीय संवेदनशीलता के प्रति गंभीर है और न ही आपदा से पूर्व बचाव के लिए जागरूक है।

अमर उजाला : दिसम्बर 28, 2004

## धान की पारम्परिक प्रजातियों के संरक्षण में हिमालयी कृषकों की भूमिका

रजनीश कुमार अग्निहोत्री

गोविन्द बल्लभ पंत हिमालय पर्यावरण एवं विकास संस्थान  
कोसी-कटारमल, अल्मोड़ा 263 643, उत्तरांचल

किसी क्षेत्र के जैव विविधता संसाधन उस क्षेत्र के विकास के लिए एक महत्वपूर्ण घटक का काम करते हैं। इनके महत्व की तुलना प्रायः पानी एवं मिट्टी से की जाती है जो कि खेत के प्रबन्धन के लिए अत्यावश्यक घटक हैं। पारम्परिक जीन बैंक ने कृषि के विकास एवं सुधार में पूरे संसार में महत्वपूर्ण भूमिका निभाई है। इन्हीं पारम्परिक जीन बैंक से नई प्रजातियां बनायी गई हैं जो कि जैविक एवं अजैविक तनाव से लड़ती हैं और महत्वपूर्ण सस्य गुण पैदा कर पारम्परिक प्रजातियों की विविधता, खाद्य संरक्षण और सतत कृषि के विकास में एक महत्वपूर्ण भूमिका निभाती हैं। यद्यपि आधुनिक कृषिकरण और अधिक उपज वाली किस्मों/संकर बीजों (Hybrid seeds) ने पैदावार में वृद्धि के साथ एकल कृषि को बढ़ावा दिया है पर पुरानी प्रजातियों को विलुप्तता के कगार पर भी पहुँचा दिया है।

हिमालय, फसल विविधता के प्रमुख बिन्दु (Hot Spot) के रूप में जाना जाता है (खुशू 1992)। पुरानी प्रजातियों (Primitive cultivar or landraces) समय के साथ-साथ, कीट-पतंगों के आक्रमण तथा कठिन वातावरणीय दशाओं के चलते विलुप्त सी होती जा रही हैं। आजकल यह फसलें विभिन्न नामों से जानी जाती हैं जैसे – कम उपभोग वाली फसलें, कम जमीन में पैदा होने वाली फसलें, गरीब आदमियों की फसलें। इन पारम्परिक हिमालयी फसलों के कृषि शोध में ध्यान न देने का मुख्य कारण शायद राष्ट्रीय आमदनी में कम योगदान तथा पहाड़ों पर कम जमीन का होना है। भारतीय हिमालय के लगभग 20 प्रतिशत भाग में खेती की जाती है जो कि राष्ट्रीय औसत (46%) से बहुत कम है, फिर भी भारतीय हिमालय में रहने वाले 51 मिलियन लोगों के जीवन यापन के लिए यह एक महत्वपूर्ण साधन है (गंगवार एवं रामाकृष्णन, 1990)। हिमालय पर्वत बड़ी संख्या में पारम्परिक फसलों (Landraces) की खान है जिनकी आर्थिक एवं पारस्थितिक क्षमता का पूर्ण रूप से दोहन अभी भी बाकी है।

धान विश्व की आधे से भी अधिक जनसंख्या के लिए एक महत्वपूर्ण अनाज है यह एशिया के कई भागों में अनाज की श्रेणी में उत्पादकता में पहले स्थान पर है। भारत में कम आमदनी वाले लोगों के प्रतिदिन के भोजन का महत्वपूर्ण भाग है (विशेषतः पूर्वोत्तर भाग में)। आज-कल केवल सुदूर गांवों में (सड़क से दूरी पर) धान के फसल की कुछ पारम्परिक प्रजातियाँ उगायी जाती हैं।

उपरोक्त संदर्भ को ध्यान में रखते हुए इस अध्ययन में कुमाऊँ हिमालय के विभिन्न क्षेत्रों (तराई, भाबर, शिवालिक एवं निम्न हिमालय) में कृषकों द्वारा प्रयुक्त खेती के विभिन्न प्रकार एवम् उगायी जाने वाली पारम्परिक फसलों खासकर धान की फसल के अंदर पायी जाने वाली विविधता का एक विस्तृत अन्वेषण किया गया। पहाड़ों पर प्रायः सड़कें, नई तकनीकी के उपयोग की जानकारी एवं संपर्क का प्रतिनिधित्व करती हैं इसलिए निम्न हिमालयी क्षेत्रों में गाँवों की सड़क की दूरी के हिसाब से इनको पुनः तीन भागों में बांटा गया (1) गाँव जो बिल्कुल सड़क पर हैं (2) गाँव जो सड़क से 1 किमी० की दूरी पर हैं (3) जो सड़क से 1 किमी० से भी अधिक दूरी पर स्थित हैं। इस अध्ययन से यह निष्कर्ष निकला की तराई में कृषि में प्रयुक्त होने वाले आधुनिक यंत्रों एवं ढुलाई के साधन तथा पानी प्रचुर मात्रा में उपलब्ध होने की वजह से वहाँ के किसान केवल अधिक उपज वाली किस्मों (संकर प्रजातियाँ) को ही प्रयोग में लाते हैं। इन आधुनिक किस्मों के प्रयोग ने पुरानी प्रजातियों को पूरी तरह हटा दिया है। भाबर में भी लगभग वही देखने को मिला। शिवालिक हिमालयी क्षेत्रों में दोनों प्रकार की किस्मों (पारम्परिक एवं आधुनिक प्रजातियों) का प्रयोग होता है (सारणी 1)।

निम्न हिमालयी क्षेत्रों के विभिन्न गाँवों में यह देखने को मिला कि जो गाँव सड़क पर या उसके निकट हैं अथवा सड़क से एक किमी० की दूरी पर स्थित हैं वहाँ धान की 8 से 12 तक पारम्परिक प्रजातियाँ पायी जाती हैं परन्तु जैसे ही सड़क से दूरी 4 किमी० से अधिक हुई चौंका देने वाले परिणाम सामने आए। इन गाँवों में 20 से भी अधिक पारम्परिक प्रजातियाँ प्राप्त हुईं।

उपरोक्त परिणाम यह दर्शाते हैं कि तराई क्षेत्र में तकनीकी जानकारी तथा कृषि की आधुनिकता के चलते कृषि का विकास अन्य क्षेत्रों की अपेक्षा अधिक हुआ है। इसका कारण है उन्नत प्रजातियों और संकर बीजों का प्रयोग। परन्तु इनके प्रयोग ने मूल प्रजातियों एवं क्षेत्रीय किस्मों को खेती से प्रतिस्थापित कर दिया है। आजकल तराई क्षेत्रों में प्रयुक्त होने वाली सारी प्रजातियाँ उच्च उत्पादकता (High yielding variety) वाली होती हैं। लगभग यही सत्यता भाबर के

लिए भी है। लेकिन निम्न हिमालयी क्षेत्रों में एक भी आधुनिक या संकर प्रजाति नहीं मिली। सारी की सारी प्रजातियां पारम्परिक ही थीं इससे एक यह भी बात स्पष्ट होती है कि जैसे-जैसे सड़क से गांव की दूरी बढ़ती है वैसे-वैसे पारम्परिक प्रजातियों की संख्या भी बढ़ती जाती हैं।

इन सभी अध्ययनों से यह निष्कर्ष निकलता है कि हिमालयी कृषक अभी भी फसली विविधता में विश्वास रखते हैं और उनको संजोये हुए है। इसलिए हिमालयी कृषक हमारी पारम्परिक प्रजातियों के संरक्षण के लिए (जो कि आजकल विलुप्त सी होती जा रही हैं) बधाई के पात्र हैं। इस योगदान के लिए हिमालयी कृषकों की जितनी भी प्रशंसा की जाए कम होगी।

#### सारणी 1. कुमाऊं हिमालय के विभिन्न क्षेत्रों में पारम्परिक एवं आधुनिक प्रजातियों

| ग्राम/क्षेत्र       | धान की प्रजातियाँ |        |
|---------------------|-------------------|--------|
|                     | पारम्परिक         | आधुनिक |
| <b>तराई</b>         |                   |        |
| झोपड़पट्टी          | —                 | 3      |
| मटकोटा              | —                 | 5      |
| बरहनी               | —                 | 5      |
| बाजपुर              | —                 | 4      |
| <b>भाबर</b>         |                   |        |
| कमोला               | —                 | 3      |
| <b>शिवालिक</b>      |                   |        |
| मंगोली              | 2                 | 1      |
| <b>निम्न हिमालय</b> |                   |        |
| पिंगलो              | 11                | —      |
| सिरकोट              | 8                 | —      |
| छतियानी             | 21                | —      |
| लस्करखेत            | 5                 | —      |
| ज्यूना इस्टेट       | 8                 | —      |
| व्हील कुलवान        | 11                | —      |

#### संदर्भ

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## फूलों की घाटी: एक प्रस्तावित विश्व धरोहर

चन्द्र प्रकाश काला 'हीरामणि'

गोविन्द बल्लभ पंत हिमालय पर्यावरण एवं विकास संस्थान  
कोसी-कटारमल, अल्मोड़ा 263 643, उत्तरांचल

हिमालयी सरोकारों की प्रमुख मासिक पत्रिका 'युगवाणी' के 2004 के अगस्त और सितम्बर अंकों के मुख पृष्ठों पर 'फूलों की घाटी' का मनोहारी दृश्य और 'हेमकुण्ड' में ब्रह्मकमलों से आभूषित, पारम्परिक परिधानों से सुसज्जित पहाड़ की महिलाओं को देखकर मुझे अपने पिछले एक दशक की यादें तरो ताजा हो गईं। मैं सर्वप्रथम अप्रैल, 1993 में अपने शोध के सम्बन्ध में इन रमणीक स्थलों के भ्रमणार्थ निकला था। अप्रैल माह में बर्फ इतनी अधिक थी कि मुझे फूलों की घाटी जाने वाले रास्ते के अंतिम पड़ाव 'घाघरिया' से वापस लौटना पड़ा था।

मई, 1993 के उत्तरार्ध में, मैं पुनः 'फूलों की घाटी' के सर्वेक्षण हेतु निकला और अक्टूबर तक घाघरिया में अपना डेरा डाले रखा। चूंकि घाघरिया में मंहगाई बहुत ज्यादा थी तथा लम्बे समय तक आवासीय व्यवस्था का उपलब्ध होना भी एक बड़ी समस्या थी। अतएव मैंने कैनवास के दो तम्बू घाघरिया में लगा दिए और एक छोटा तम्बू मैं इधर-उधर सर्वेक्षण के दौरान अपने साथ रखता था। मेरा यह क्रम 1993 से 1997 तक लगातार चलता रहा। इस दौरान मैंने 'फूलों की घाटी' एवं 'हेमकुण्ड' से सम्बन्धित बहुत सारी जानकारियां प्राप्त कीं। 'फूलों की घाटी' वस्तुतः एक बुग्याल है जो 1930 के दशक से पहले भ्यूदार घाटी का ऊपरी हिस्सा कहलाता था। तब इस घाटी का एक नाम न होकर अलग-अलग भागों के अलग-अलग नाम होते थे। 'फूलों की घाटी' का प्रवेश द्वार 'पैरा' तथा इसके प्रारम्भिक भाग को 'वामनी धार' कहा जाता था। लोक मान्यताओं के अनुसार वामनी धार में किसी ब्राह्मण का निवास हुआ करता था। घाटी के मध्य के भागों को कुण्डलियां सैण, द्रूनागेर, विषतोली, स्यूँचाँद एवं घोड़ाडुन्गी के नामों से जाना जाता था तथा अंतिम भाग को भ्यूँदार खाल कहा जाता था। इन नामों का एक सार्थक पहलू यह था कि कुण्डलियां सैण में बैठकर ब्राह्मण पालसियों के बच्चों की जन्मकुण्डली बनाता था। द्रूनागेर में संजीवनी बूटी जैसी लाभदायक औषधियों का भण्डार होता था। विषतोली में विषैले पौधे, यथा मीठा (एकोनाइट्स) अत्यधिक मात्रा में होता था। स्यूँचाँद में कस्तूरी मृग बहुतायत में पाये जाते थे। स्थानीय भाषा में स्यूँ, कस्तूरी मृग के बच्चों को कहा जाता है। घोड़ाडुन्गी में पालसियों के घोड़े एवं खच्चर चुगान के लिए छोड़ दिये जाते थे एवं भ्यूदारखाल इस घाटी का अंतिम छोर होता था। यह सम्पूर्ण घाटी गढ़वाल में भेड़ बकरियों के चुगान के लिए सर्वोत्तम चरागाह माना जाता था।

सन् 1931 में एक अंग्रेज पर्वतारोही फ्रैंक स्माइथ, जब अपने दल के सदस्यों के साथ, जिनमें होल्डब्रस्थ जो कि एक वनस्पति शास्त्री था, कामेट के सफल आरोहण से वापस आ रहे थे, संयोगवश अत्यधिक धुन्ध के कारण रास्ता भटक जाने से वह इस घाटी में पहुँच गये। इस घाटी की अनुपम छटा एवं फूलों की महक स्माइथ को पुनः 1937 में यहाँ खींच लायी। इस दौरान स्माइथ ने यहाँ कुछ महीने रहकर एक किताब लिखी जिसका शीर्षक था 'द वैली ऑफ फ्लावर्स'। यह किताब 1938 में प्रकाशित हुई। पुस्तक में घाटी एवं यहाँ के फूलों का सजीव चित्रण होने के कारण इस घाटी को विश्व स्तर पर पहचान मिली। इसी पुस्तक से प्रेरित होकर 'एडिनवरा बॉटैनिकल गार्डन' से एक महिला, मार्ग्रेट लैग (Margrett Legge) 1939 में यहाँ के फूलों के अध्ययनार्थ यहाँ पहुँची लेकिन एक पहाड़ी से फिसलने के कारण उसकी यहीं मृत्यु हो गयी। उसकी याद में उसकी बहन ने एक समाधि कुण्डलिया सैण नामक स्थान पर बना रखी है जो आज भी देखी जा सकती है। लेकिन वर्षों से समाधि का पत्थर टूटा हुआ है जो आज भी टुकड़ों में वहीं पर रखा हुआ है।

1930 के दशक में ही हिमालय का भू-सर्वेक्षण करते हुए एक सरदार जी लोकपाल नामक सरोवर पर पहुँचे जो घाघरिया से 6 किमी० की दूरी पर स्थित है। सरोवर के आसपास का विहंगम दृश्य एवं सरोवर को सात छोटी-छोटी पहाड़ियों से घिरा देखकर उन्होंने अनुमान लगाया कि गुरु गोविन्द सिंह जी ने अपने पूर्व जन्म में इसी स्थल पर तपस्या की होगी जैसा कि गुरुजी ने अपनी पुस्तक में इसका जिक्र किया है। 'हेमकुण्ड सोवत है वहाँ, सप्त श्रृंग है जहाँ'। चूंकि सरोवर बर्फ से बना हुआ था इसलिए उन्होंने इसे 'हेमकुण्ड' का नाम दिया, जो कि स्थानीय लोगों द्वारा लोकपाल के नाम से अति पवित्र एवं पूज्यनीय माना जाता था। कालान्तर में इस सरोवर के किनारे एक भव्य गुरुद्वारे का निर्माण किया गया। सरोवर की समुद्रतल से ऊँचाई 4300 मी० है अतएव: रात्रि विश्राम एवं तीर्थ यात्रियों की सुविधा के लिए गुरुद्वारा प्रबन्धक कमेटी ने रास्ते में दो और गुरुद्वारों का निर्माण किया एक 1800 मी० की ऊँचाई पर गोविन्दघाट में और दूसरा 3000 मी० पर घाघरिया में।

यह संयोग मात्र ही है कि 1982 में जब 'फूलों की घाटी' को राष्ट्रीय पार्क घोषित किया गया तो इसी दशक में हेमकुण्ड में भी तीर्थ यात्रियों का सैलाब उमड़ने लगा। तत्पश्चात् एक ओर फूलों की घाटी जहाँ संरक्षण की नीतियों के

तहत विवादों में घिरने लगी वहीं दूसरी तरफ हेमकुण्ड में तीर्थ यात्रियों की बढ़ती हुई आबादी के कारण स्थानीय लोगों एवं पर्यटकों में भी विवाद पनपने लगे।

मेरा इस घाटी में रहने का मुख्य उद्देश्य 'फूलों की घाटी' का समुचित अध्ययन करना था। अपने अध्ययन के दौरान मैंने घाटी में 500 किस्म की फूलों की प्रजातियाँ लिपिबद्ध की जो कि मौसमी फूल थे। अपने अध्ययन से मुझे पता चला कि यह सारे फूल घाटी में एक साथ नहीं खिलते बल्कि प्रत्येक पुष्पीय पादप का अपना-अपना जीवन काल निर्धारित होता है। जैसे-जैसे पहाड़ों की चोटियों से बर्फ खिसकनी शुरू होती है वैसे ही बर्फ के पिघलने के साथ ही साथ प्रिमुला (Primula) एवं मार्स मैरी गोल्ड (Marsh Merry Gold) उगने एवं फूल देना प्रारम्भ कर देते हैं। इन फूलों का जीवनकाल बहुत छोटा होता है तथा यह पौधे 15 दिन के अन्तराल में अपना जीवन चक्र पूरा कर लेते हैं। तत्पश्चात् अन्य प्रजातियों के पुष्पीय पादप इन पौधों को विस्थापित कर देते हैं जिनमें लिली (Lily), फ्रीटीलेरीया (Fritillaria), एनीमोन्स (Anemons), आदि प्रमुख रूप से शामिल हैं। इन पौधों को भी तीसरे समूह के पौधों द्वारा विस्थापित कर दिया जाता है और यह क्रम सितम्बर तक चलता रहता है।

एक बार गॉव के एक नवयुवक ने मुझसे आकर घाटी में उगने वाले कुछ फूलों के नाम जानने की इच्छा व्यक्त की जिससे वह इसे अपने रोजगार का साधन बना सके। प्रतिवर्ष सैकड़ों देशी एवं विदेशी सैलानी घाटी की सैर करने आते रहते हैं। मैं उस युवक को अगले रोज घाटी में ले गया और उसको तकरीबन 35-40 फूलों की प्रजातियों के नाम बताए जिनको उसने अपनी डायरी में विधिवत दर्ज कर लिया। सौभाग्यवश 15-20 दिन बाद उक्त युवक को विदेशी पर्यटकों का एक जत्था मिल गया जिनको गाइड की आवश्यकता थी। जब वह युवक उन विदेशी पर्यटकों का गाइड बन कर घाटी में पहुँचा तो पर्यटकों ने उससे फूलों के नाम जानने चाहे। लेकिन वह एक भी फूल का नाम नहीं बता पाया। पर्यटकों के बार-बार पूछने एवं उलाहना देने पर युवक ने कहा कि जिन फूलों को मैं जानता हूँ वह तो अब घाटी में हैं ही नहीं। दरअसल जिन फूलों के नाम उसको बताए गए थे उनका जीवन काल समाप्त हो गया था और उन सभी जगहों पर दूसरी प्रजाति के पुष्प आच्छादित थे। ऐसा नहीं है कि घाटी में फूलों की प्रजातियाँ कम हो रही हैं बल्कि इन मौसमी फूलों के बारे में सही जानकारी उपलब्ध न होने के कारण पर्यटक दिग्भ्रमित हो जाते हैं। इसी तरह नीचे की घाटियों में फूलों की प्रजातियों का जीवन काल ऊँचाई वाली जगहों से अधिक होता है क्योंकि बर्फ पहले नीचे पिघलती है और सर्दियाँ ऊपर से नीचे को शुरू होती है इसीलिए उच्च भू-भागों एवं पहाड़ियों पर फूलों का जीवन काल भी घटता जाता है।

फूलों की विभिन्न प्रजातियों के अतिरिक्त फूलों की घाटी में विभिन्न दुर्लभ जाति के पशु-पक्षी भी निवास करते हैं। कस्तूरी मृग, भरड़, थार, हिमालयी तेंदुआ एवं हिमालयी काला भालू भी घाटी में निवास करते हैं। मोनाल जैसा खूबसूरत पक्षी भी इस घाटी की रमणीकता को बनाये हुए है। घाटी में यदा-कदा बर्फीली लोमड़ी भी घूमती हुई देखी जा सकती है। भोजपत्र के विशाल जंगल एवं बुरांश प्रजाति के पौधे भी घाटी को मोहक बनाये रखते हैं। यदा-कदा ग्लेशियरों के टूटने की भयंकर आवाज इसके शान्त वातावरण को डरावना बना देती है। इसके अतिरिक्त यह घाटी विभिन्न किस्म की दुर्लभ जड़ी-बूटियों का भंडार है। जिनमें हत्थाजड़ी, कुटकी, वड़मूला, अतीस, महामैदा, सालममित्री, चोरु, जटामासी, लालजड़ी, वनककड़ी एवं थुनेर मुख्य हैं।

'फूलों की घाटी' के बुग्यालों की अन्य हिमालयी बुग्यालों जैसे गढ़वाल के खीरों, चिनाव, एवं राज खरकों के बुग्यालों तथा हिमाचल के प्रसिद्ध 'ग्रेट हिमालयन राष्ट्रीय उद्यान' के बुग्यालों से तुलना करने पर मुझे ज्ञात हुआ कि 'फूलों की घाटी' में फूलों एवं अन्य बुग्याली पादपों की विविधता अन्य बुग्यालों से कहीं अधिक है। दुर्भाग्यवश आये दिन बिना अनुसंधान एवं अध्ययन के 'फूलों की घाटी' पर विभिन्न विवाद खड़े कर दिए जाते हैं। 1982 के बाद पालीगोनम नामक पौधे को लेकर उठा विवाद आज भी बदस्तूर जारी है और विभिन्न दस्तावेजों में यह अंकित किया जा रहा है कि उपरोक्त पौधा 'फूलों की घाटी' में फूलों की प्रजातियों को नष्ट कर रहा है। और इसकी प्रमुख वजह है भेड़-बकरियों के चुगान पर प्रतिबन्ध लगाना। मैंने स्वयं कुछ लोगों को यहाँ तक कहते हुए सुना है कि पालीगोनम (Polygonum polystachyum) के बीजों को कोई विदेशी पर्यटक घाटी में आकर बिखेर गया जिससे यहाँ के फूल खत्म हो जायें। लेकिन वस्तुतः यह सब मनगढ़ंत बातें हैं और वास्तविकता से इनका दूर-दूर तक कोई सरोकार नहीं है।

पालीगोनम की उपस्थिति के बारे में फ्रैंक स्माइथ ने भी 1938 में अपनी पुस्तक 'द वैली ऑफ प्लावर्स' के पेज न0 78 में लिखा है कि 'गढ़वाल हिमालय में जहाँ कहीं भी भेड़-बकरियाँ अत्यधिक चुगान करती हैं वहाँ की जमीन पर पालीगोनम एवं इम्पेसियन्स अत्यधिक फैल जाता है। और 'फूलों की घाटी' के विभिन्न स्थलों पर भी यह दोनों प्रजातियाँ काफी मात्रा में उपलब्ध हैं।' पश्चिमी हिमालय के बुग्यालों में अपने अध्ययन के दौरान मैंने पाया कि 3000 से 3500 मी0 की ऊँचाई वाले भू-भाग पालीगोनम के मुख्य वास स्थल होने के कारण इस पौधे की अधिकता संजोये हुए रहते हैं। लेकिन इस ऊँचाई पर भी जहाँ कहीं मृदा का कटान ज्यादा होता है वहीं पालीगोनम उगता है। पालीगोनम मिट्टी के

कटान को अपनी मूसलादार जड़ों के कारण रोकने में समर्थ होता है और इस तरह से पारिस्थितिकी तंत्र का एक बहुउपयोगी हिस्सा है। हिमालय में तीव्र ढलान एवं निरन्तर होती अत्यधिक वर्षा से जहाँ मिट्टी बहकर मैदानों में चली जाती है वहीं पालीगोनम जैसी पादप प्रजातियाँ इस मिट्टी का एक सीमा तक क्षरण होने से रोकने में मदद करती हैं।

अपने एक दशक के 'फूलों की घाटी' पर किए गए शोध कार्यों का ब्यौरा मैंने अपनी पुस्तक 'द वैली आफ फ्लावर्स : मिथ एण्ड रियैलिटी' (The Valley of Flowers : Myth and Reality) में विस्तार से दिया है। जो इसी वर्ष जून माह में 'इण्टरनेशनल बुक डिस्ट्रीब्यूटर्स, देहरादून' से प्रकाशित हुई है। अपने अनुभवों के आधार पर मेरा मानना है कि मानव को प्रकृति-प्रदन्त इस अमूल्य तोहफे के उचित रख-रखाव के साथ ही साथ इसे समझने की नितान्त आवश्यकता है। सौभाग्यवश 2004 में भारत सरकार ने 'फूलों की घाटी' को विश्व धरोहर स्थलों में शामिल करने की पहल की है तथा इससे सम्बन्धित दस्तावेज IUCN को भेज दिए गए हैं इसी संदर्भ में IUCN की एक टीम घाटी का अध्ययन कर रही है और 2005 के मध्य तक अपनी रिपोर्ट UNESCO को सौंप देगी। 'फूलों की घाटी' को एक बार यदि विश्व धरोहर स्थलों में शामिल कर दिया जाता है तो यह इस घाटी को विश्वस्तर पर अधिक पहचान दिलाने एवं इसकी सुंदरता को बनाए रखने में एक कारगर सकारात्मक पहल होगी।

**नोट:** इस लेख में व्यक्त विचार लेखक के अपने हैं। सम्पादक/संस्थान का उनसे सहमत होना आवश्यक नहीं।