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For Further details Contact:

Dr. K.S. Rao

Scientist –in-charge,

Environmental Information System (ENVIS) on Himalayan Ecology

Executive Editor, ENVIS Bulletin,

G.B. Pant Institute of Himalayan Environment and Development,

Kosi-Katarmal, Almora – 263 643, Uttaranchal, India

Tel : 05962-41041(O)

Fax : 05962- 31507/30100/30439/30968

E-mail: ksao1@nde.vsnl.net.in

himenvis@gbpihed.nic.in

URL : www.gepcities.com/himenvis

<http://www.gbpihed.nic.in/envis/envis.html>

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NEWS & VIEWS

AGRO-TECHNIQUES FOR PROPAGATION OF "SEABUCKTHORN" - A MULTIPURPOSE OPTION FOR FRAGILE AND MARGINAL MOUNTAIN AREAS

M.H. Shah¹, A.A. Mir² and Amarjit S. Bali³

¹ Professor and Head, Division of Agronomy,

Sher-E-Kashmir University of Agricultural Science & Technology, Shalimar, Srinagar 191 121

² Associate Director, RARS, SKUAST, Leh.(J&K)

³ Associate Professor, Division of Agronomy, SKUAST, Shalimar, Srinagar

Ladakh, a high altitude cold arid desert exhibits a great diversity in soil, climate, vegetation and topography. The climate and vegetation changes gradually and sequentially corresponding with the altitudinal transitions. The area, though characterized by rugged terrain, low annual precipitation and humidity, fluctuating temperatures and high desiccating winds, offers great potential for several medicinal and aromatic plants of very high economic value in general and "Hippophae" (Seabuckthorn) locally known as "Sarbone" or "Tserma" in particular and provides a multipurpose option for fragile and marginal mountain areas of cold arid regions of Trans-Himalayas. The Hindu-Kush Himalayan Mountains share common characteristics in terms of accelerated degradation of the environment and natural resource base, un-sustainability of the current resource use pattern and deterioration in economic conditions as the resource base continues to erode at an alarming rate. This calls for focusing on multiple, goal centered strategies for resource conservation and rehabilitation. An important component of such strategies would be choice of the species that can simultaneously satisfy the long term conservation needs as well as the short term economic needs of the people depending upon rapidly degrading mountain resources.

'Seabuckthorn' is one such species that has great potential for such situations. The total distribution of seabuckthorn in three of the main producing countries (China, Mongolia and former USSR) is approximately 8.10 (natural growth) and 3.0 (Plantation) lac hectares, respectively. This paper, discusses some of the Agro-techniques for propagation of seabuckthorn in Cold Arid Region of Ladakh in particular.

However, for generating location specific technology, there is a need to take up systematic and scientific studies for exploiting its true potential.

PLANTATION AND MANAGEMENT TECHNIQUES

Seabuckthorn, has vast potential to support high value commercial activities, meet the biomass needs of the people and perform resource conservation upgradation functions. However, level and quality can be substantially raised by adopting scientific techniques and management of seabuckthorn plantations.

TRANSFORMATION OF NATURAL SEABUCKTHORN FOREST

Natural seabuckthorn forests exist not only in China and former USSR but in the Hindu Kush-Himalayan Region in the countries such as Afghanistan, Pakistan, India, Nepal, Bhutan and Burma. Ecologically, these natural seabuckthorn forests are generally distributed along river banks and wider beaches and form mass forests. Therefore, the use and transformation of these mass seabuckthorn forests into semi cultivated forests is of a universal significance. Drawing of the Chinese experience, experiments have been conducted by the Beijing University of Forestry and results are quite inspiring.

1. MEASURES FOR TRANSFORMING NATURAL SEABUCKTHORN FORESTS

1.1 Intermediate strip cutting

This is suitable for seabuckthorn forests that are neat and have plants from young to middle age. According to design, the reserve strip should be 2 m wide and intermediate space should have width of 2 to 2.2m. In the reserve strip, other trees that are not required, male seabuckthorn trees and the dead and diseased plants should be dug out completely. But strip cutting and pruning the trees should be spaced 1m apart. In addition, each strip should contain a male-female mix in which there should be male plant as a polliniser

every 4 to 5m so as to make a male-female ratio of 1:8. In the reserve strip, if seedlings are missing, large seedlings should be planted in these empty spots. In order to avoid growing coppice shoots, the roots of the felled trees should be dug out and then hollows should be leveled.

1.2 Intermediate strip cutting and After-planting

This is suitable for agglomerate seabuckthorn forests since there are areas of seabuckthorn growth within agglomerate forests. Intermediate strip cutting and chopping can be carried out of lands with seabuckthorn forests. To carry out operations after planting in these area, the large seedlings should be planted out following the model of intermediate strip cutting. The distance between the trees and the rows should still be 1 m and ratio of male-female 1:8. Usually the size of the planting pit is about 40x40x40 cm and the height of the big seedling 2m, with a root system of 30x30x30 cm. After seedlings are planted, 25-50 percent of the crown of the tree should be pruned.

1.3 Wide Intermediate strip cutting

This is suitable for tall and old seabuckthorn forests. Curing above the root collar and improvement cutting are measures adopted. The reserve strip has a width of 4 to 8m. In this strip, most female plants are kept with the distance between the trees of 1 m. Where there are no female plants, some male plants should be reserved. In intermediate places, the seabuckthorn trees are kept above the root collar without digging out stumps. After turions grow out of the collar, they should be cut, maintaining a distance of 1m.

1.4 Cutting Above the Root Collar

This is suitable for seabuckthorn forests that are accompanied by other trees. All the trees should be cut above the root collar. The stumps of non seabuckthorn trees are dugout. Once the seabuckthorn shoots sprout out and shoots grow up to be trees that can be identified as male or female in order to maintain the proper ratio of male and female plants. Some of the plants should be weeded out and number of male plants reserved as pollinisers. Generally seabuckthorn trees bear fruit during the fourth year. This measure is specially suitable for the regeneration of old seabuckthorn forests.

1.5 Improvement cutting

This is suitable for seabuckthorn forests with neat form of middle age and accompanied by other trees. First the other trees and the male seabuckthorn trees have to be cut down and the females spaced out 1-2m apart depends on the size of the canopy and density. Second, care should be taken that the female plants are well distributed, i.e., without missing any plants after intermediate cutting. Because the original seabuckthorn forests are not altered very much and there already exist trees of fruit bearing age and these can produce high yields following their transformation.

2. ARTIFICIAL PLANTATION

Demand for seabuckthorn fruit, and especially for oil is significantly on increase and establishment of seabuckthorn plantations to meet the demand of industries is an urgent task. Therefore, experience gathered from different countries are very valuable till location specific technologies are generated. Discussed below are some points in reference to establishment of new artificial plantations.

2.1 Plantation establishment

Site selection: River banks are most suitable for setting up plantations on large scale and if plantations are to be established in arid areas, a good water supply has to be assured. On river banks, seabuckthorn can tolerate inundation because flood water contains oxygen, however, shallow kettle holes where rain and snow are easily gathered, are not suitable for their establishment. In places, where the ground water level is less than 0.5m, are also not suitable for seabuckthorn. Sandy soil and loamy rather than clayey are preferable.

2.2 Land preparation

The land should be kept in dead fallow for 1-2 years before planting. During this period, land should be ploughed deeply and harrowed. Perennial weeds with deep root systems should be destroyed by using herbicides such as ammonium 2, 4-D, Dalapon or sodium trichloroacetate. In order to ensure the fertility, composting would be an ideal treatment and if the content of the humus is more than 4 percent, the amount of organic fertilizer spread on it can be reduced by 50% of the applied manure. In the absence of organic fertilizer, green manure can be used instead. Sowing green manure crops continuously for two years can provide 100-200 tones of green organic matter. If the soil is acidic in nature, lime should be added into the soil in order to raise the efficiency of mineral fertilizer. Seabuckthorn plant is very sensitive to the increase of phosphorus in the soil and further, it does not activate the plant in anyway. Therefore, it is better to apply 100-200 kg per hectare of calcium super-phosphate to soil before ploughing it deeply.

2.3 Planting time

Seabuckthorn is one of these plants for which autumn is not a suitable planting period because of the constraining feature of the roots. Scientific studies have proven that the survival rate of the seedlings planted in autumn is much lower than those planted in spring. Overwintering is the main cause of the mortality. Seedlings planted in autumn die over the following winter. Even if seedlings are dug out in autumn, temporarily planted over winter and dug out again for planting in the field next spring. The survival rate is still low. A high survival rate is ensured only when the seedlings are dug out and immediately planted in the field during early spring before the seedlings start sprouting. A word of caution that if the time taken for temporary planting in spring or the time for transporting seedlings from the nursery to the field is too long, the survival rate decreases. The roots of the seabuckthorn are sensitive to wind and sunshine. It is good to place the roots in muddy water before planting.

2.4 Disposition of polliniser

Seabuckthorn is a typical dioecious plant. The number and disposition of pollinisers directly influence the overall production. The scientific evidence reveals that every two lines of female plants there has to be a male plant. Generally the distance within which the female plants can be pollinated is about 100m. Investigators have shown that as the distance from female to male plants (polliniser) increases (6-1m or so) the yield of the female plants decrease. For more effective pollinisers, male seedlings that have different blooming periods, a higher pollen preservation rate and tolerance of bad weather should be selected as polliniser. If both male and female plants are vegetative seedlings, the male plants will blossom at the same time. If the weather is not suitable, ripe pollen can not be spread by the wind and hence the process of pollination can not be carried out.

2.5 Irrigation

The experimental findings reveal that the minimum moisture contents permissible for specific soils are as follows:-

Clay loam	-	70%
Heavy clay	-	80%
Slightly sand oil	-	60%
Sancy loam	-	65-70%

When the moisture levels are lower, especially during the blossoming and fruit growing periods irrigation is required. The average amount of irrigation required is 500-600 m³/ha and should be soaked to a depth of about 70-80 cm.

2.6 Fertilization

Seabuckthorn needs proper nutrition but its optimum requirements are not known as yet. During spring, the seabuckthorn which has borne fruit begins to grow quickly by pumping the stored nutrients. During the first phase of the growing period, because seabuckthorn needs a good supply of nitrogen, nutrients are consumed to form roots and branches and to blossom. During the later phase of the growing period, the

branches stop growing and nutrients are consumed by the formation of the fruit and flower buds. The nutrients then flow gradually from leaves to the trunk branches and roots. During this period, the seabuckthorn plants need phosphate and potash fertilizers (Bukshenov *et al* 1985).

2.7 Form pruning

By the end of the first four years, seabuckthorn grows up to 2-2.5 m and forms its crown based on the growth of its central branch. The aim of form pruning is to make the scaffold branches take proper positions and to keep the crown compact and low in order to make it convenient for harvesting. For this purpose, the crown should be pruned regularly. Usually, the branches that overlap and those that are not in correct positions should be pruned off, and the slim and long branches should be cut short. From the fifth year, central leading branches stop growing and the plant no longer increases in height. The branches then grow out from lateral buds. Meanwhile, the seabuckthorn enters into the stage of mass bearing if the crown is dense, some branches should be pruned off. So as to let sunshine penetrate the crown. During the following spring, all diseased, withered and very low branches must be pruned. Generally, seabuckthorn begins to bear fruit in large quantities in the fourth or fifth year. The peripheral branches of the crown grow or bear alternately. In order to prevent seabuckthorn from premature senescence, pruning for rejuvenation should be carried out on three year old branches.

3. PROPAGATION

Artificial plantations are established with cultivated seedlings, cuttings, grafted seedlings and other propagated materials such as the seedlings from root turions or the plantlets produced through tissue culture. But the most important propagation methods are to cultivate seedlings from seeds and to use cuttings from hardwood/softwood trees.

3.1 Cultivating seedlings from seeds

Cultivating seedlings from seeds is a simple technology and has some definite advantages to produce a greater number of seedlings, involves lower costs than other propagation methods, and seedlings thus produced survive better and grow faster compared to cuttings. This technology involves:-

3.1.1 Pretreatment of seeds: Chinese seabuckthorn (*H. rhamoides* L., subsp. *sinensis*) seed is medium in size and one kilo of air dried seeds contains 130-140 thousand seeds. If the germination rate reaches 80-95%, one kilo of seed can produce 104-133 thousand seedlings. Before sowing, the seeds should be put into water at a temperature 60-70°C and soaked, for 2 days, when the seeds have expanded sufficiently they are taken out and dried for sowing.

3.1.2 Seed bed preparation: Seed bed should be established in a place close to the expected plantation plot with irrigation facilities. Before the seed-bed is prepared sufficient barnyard manure should be applied and land ploughed to depth of 20-25 cm. Generally, the seed bed is 10x1m. This is convenient for operation and irrigation.

3.1.3 Sowing: As the temperature of the soil (5-10 cm depth) rises to 15-20°C in spring, it is suitable for sowing. Ditch and drill seedling is commonly practiced in China. The drill furrow is 4 cm in width and 2.5 cm in depth. The drill spacing is 20-25 cm across the seeded. The seeds are sown in the drills evenly and covered with 1-2 cm of soil.

After about 12-18 days, most seedlings sprout. Then the key period follows if soil becomes dry and hard, seedlings can not sprout, should be protected from strong sunshine. Seedlings should be covered with a mulch of straw to conserve moisture, or covered with shade to protect young seedlings.

3.1.4 After care: When the seedlings sprout, 3-5 pieces of microphylla, the seedlings is not likely to die and weeding should be carried out frequently, otherwise the weeds will inhibit the growth of the seedlings. Insects living underground may also damage the young seedlings. Insecticides such as gammexane and dylox can be used to control these pests, when the growth is at 3-4 cm, dense seedlings should be thinned down and

weeds pulled out. Attention has also to be paid to drainage aspects and if the accumulated water floods over the top of the seedlings, they will die when the water recedes. To produce a seedling which is suitable for transplanting will take 6-18 months in nursery (L Ruzhi, 1990).

4. HARDWOOD CUTTING

Seabuckthorn is a dioecious, wind pollinated plant. The seedlings propagated by seeds can not maintain the fine biological characteristics and economic properties that are genetically identical to mother plants.

Among the seedlings, there are usually more male than females and it is difficult to distinguish males from females before flowering and fruiting. Cutting propagation can produce scion-rooted seedlings with the same genetic properties as those of their mother plants in a short time and these can bear fruit 1-2 years earlier than the seedlings. This is an important technology for propagating improved varieties for introducing and acclimatising new species of seabuckthorn and for building artificial plantations. The series of techniques for hardwood cutting propagation are:-

- * The adventitious roots of hardwood cuttings of seabuckthorn usually strike above the leaf scars in a scattered manner. Each cutting has 3-5 roots which grows from the epidermis of the stem. Although the cuttings root easily, the rooting is unstable and sensitive to change in environmental conditions.
- * In a cold environment adapting large and small film canopies, the hardwood cuttings can be planted at least 30-40 days before plantation in the open field. Covering with straw screens at night can increase temperature, retain moisture and protect the cutting from frost. The cutting begins to sprout roots eight days after being planted when the accumulated temperature (equals to or above 10°C in 5 cm depth of land) reaches 121.6°C. The cuttings take root in large numbers by the fifteenth till the twentieth days when the accumulated temperature reaches 315-317°C. After 30 days a complete, semi woody root system with lateral roots and nodules is formed. At this time, the seedlings of hardwood cuttings can be planted in the field.
- * Adequate aeration and water permeability in the soil are required when hard cuttings form adventitious roots. Comprehensively, considering the rooting rate and survival rate, the better rates for the medium should be sand: humic acid: the soil under seabuckthorn vegetation 5:3:1. In addition all the cuttings of different ages have the capacity to form adventitious roots. Among them, the three year old cuttings have the highest percentage of root formation.
- * The best time to take cuttings from mother trees is from Oct. to Jan. The cuttings should be stored in wet sand at low temperature in moist dark environment. Another good time to take cuttings from mother trees is middle or late March and these cuttings should be immediately planted under the canopy. Standard cuttings should be taken from the base of a 2-3 year old shoot, 10-25 cm in length and 0.8-1.5 cm in diameter.
- * Before planting, the base of the cuttings are soaked in running water for 24 hours or immersed into a container filled with water, when the base of the cuttings are given a quick dip in 300-500 ppm NAA (naphthacetic acid), rooting rate is increased. If the cuttings are immersed in 50 ppm NAA solution for 24 hrs. the same effects can also be achieved (Huo Shuhua *et al* 1989).

5. SOFT-WOOD CUTTING

Usually, soft wood cutting is an effective propagation method needing artificial mist sprays and a plastic film house with other equipment. The basic technique is summarised below.

5.1. Selection and collection of cuttings

The cuttings from small (15-20 cm length) are cut off from the mother trees, they should be immediately put into plastic film bags to prevent them from wind drying and withering. These cuttings can also be maintained in water for one week without losing their rooting capacity.

5.2 Treatment of cuttings

Each cutting must be cut into two sections of 7-10 cm length. One third of the leaves on the cuttings should be eliminated from the base of these cuttings. Then the cuttings should be placed in water to stay fresh. Before auximone treatment these cuttings are taken out of the water and bundles of 50 cuttings, bound together with a rubber band, are put into a box filled with solution of IBA (Indolebytyric acid) at a depth of 3-4 mm. The concentration of IBA solution is 50 ppm in the box. All cuttings soaked in IBA solution should be covered with a plastic film to keep the moisture in and the solution in the box should be maintained at a temperature of 20-25°C for 16 hours. The cuttings treated with auximone like IBA can strike massive adventitious roots. Before planting, these cuttings should be taken out from the IBA solution and washed in order to remove the auximone.

5.3 Cultivating softwood cuttings

This needs to be carried out in the plastic film house equipped with an artificial mist sprayer and drainage facilities. The seeded needs to be made flat and the medium of the seed bed should be of sand and humic soil mixed in a ratio of 3:1. Before cultivation, the seeded needs to be watered to keep the medium wet enough. Before inserting the cuttings, use a marker to rule small shallow furrows in the seeded (distance between furrows should be 7 cm and 3 cm between cuttings at a depth of 1.5-2 cm.

Strategy

- * Large scale plantation of seabuckthorn as part of resources conservation for fragile slopes.
- * Conservation of wild plantations into a managed system to enhance productivity by changing the ratio of male female plants and by introducing methods of easy harvesting and processing of seabuckthorn fruits.
- * Development of processing technologies for different seabuckthorn products and establishing processing units and marketing channels.
- * Generating awareness.
- * Field exposure and training.
- * Establishment of demonstration units.
- * Generation of location specific technology.
- * Involvement of people for the ultimate success.

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DEVELOPMENT INTERVENTIONS, REALIZATIONS AND PEOPLES' PERCEPTION: CASE STUDY OF A TRIBAL VILLAGE IN CENTRAL HIMALAYA

Y.S. Topal, Rekha Pant and P.K. Samal

G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643, India

The tribal population which constitute about 8.01% of the total population and signify the cultural diversity of Indian Republic, have experienced various efforts by the State after independence to improve their socio-economic condition, on a sustainable pattern. These efforts may be categorized into six major categories *viz*:

- Economic, including agriculture, forestry, animal husbandry and small scale industries,
- Educational,
- Health,
- Communication and Housing,
- Socio-cultural
- Political.

A number of studies on development of tribal communities has been carried out by researchers from various discipline. However, the term development has been defined in different manners. For Todaro (1979), 'Development is both a physical reality and a state of mind in which, society has through some combination of social, economic and institutional processes, secured the means for obtaining a better life, whatever the specific component of this better life, development in all society must have at least the following objectives:

- to increase the ability and widen the distribution of basic life sustaining goods.
- to raise the level of living, and
- to expand the range of economic and social choice to individual and nation.

According to Bottomore (1971), " in most sociological writings, the term 'development' has been used in quite a different way, first to differentiate two broad type of societies, on one side the prosperous industrial society and on other side rural society which is predominately rural, agricultural and poor, and secondly, to describe the process of industrialization and modernization". Laufer (1967), states that the term 'development' means dams and factories, roads and canals, bush clearing, universities, electrification, land improvement, secondary schools, primary schools, sanitation, research and multitudes of other activities and achievements. But again he argues that all the above development means people, the perpetration and activation of people is the cause of economic and social development. David Apter (1968), provides four characteristics in his definition of development and they are:

- Differentiation (*i.e.*, increasing specialization of their role and integration),
- Stability (*i.e.*, capacity to make decision, that solves the problems without major disruption),
- Choice (*i.e.*, increasing capacity to innovate & to be flexible), and
- Emulation (*i.e.*, imitation of foreign models, especially industrial society).

Mehta (1984), has identified the indicators of development at different level,

- Individual level: possession of material objects by the individual, families, public laboratories, construction of new houses *etc.*
- Community level: mobility of group or individual in social hierarchy, standard of living of people and increased employment opportunities,
- Societal level: economic growth, industrialization, urbanization, literacy rate, status and health status.

There may be some variations as well as contradictions among the scholars in defining the term 'Development', but the common feature which appears in almost all the writings is that the word development should not be understood as mere an economic activity and material growth. The major cause behind this may be the dominant economic concern underlying development paradigm, development planning strategies and measures of development performance (Sharma, 1986). The term 'Development' refer to the upward movement of the entire social system, which encompasses both growth and change (Pandey, 1985).

Thus the above narration reveal that the term 'development' includes various dimensions, and the process should be perceived as an involvement of reorganization and reorientation of not only the entire economic system, but the whole structural and functional social system too. Bhotia tribe which resides in the high altitude villages of UP hills are usually known as traders and pastoralist. It was observed that their agricultural practices has been largely affected by comparatively more emphasis on trade and pastoralism (Das, 1982). But in case of Tomik, it was noticed that agriculture has been the prime pursuit traditionally followed by the villagers and they had never been engaged with trade or pastoralism. In this article an attempt has been made to asses the degree of realization of development interventions (particularly IRDP, IAY, ITDP & JRY) and people's perception of development by Bhotia tribal community residing in a high altitude village - Tomik in Pithoragarh district of Central Himalaya.

THE VILLAGE

Village Tomik, which falls under the Development Block Munsyari of district Pithoragarh, is located between North longitude 30° 31' 57" and East latitude 80° 27' 24" at an altitude of 2200 msl and 20 km from road head. The village comprising of 94 households with a total population of 568, is inhabited by agriculturist sect of Bhotia tribe locally known as 'Harkotia' and the scheduled caste. The total geographical area of the village is 711.56 ha. and percentage of cultivable land is about 16.87, while the forests constitute about 26.27 % of the total reported area. The percentage of SC population to the total population is 18.49, the rest are being Bhotias. The sex ratio in the village is 803. A primary school is available within the village, while the middle school is about 3 km. and secondary school is about 20 km. away from the village. Literacy rate in the village is 42.08 % out of which 54.93 % are male and 37.50 % are female. The per capita availability of cultivated land is about 0.21 hectares and livestock is about 4.39. The main crops of the village are Wheat (*Triticum aestivum*), Paddy (*Oryza sativa*), Barley (*Hordeum vulgare*), Maize (*Zea mays*), Mandua (*Eleusine coracana*), Ramdana (*Amaranthus paniculatus*), Potato (*Solanum tuberosum*).

METHODOLOGY

The selection of village was purposive. At first, secondary data were collected from various concerned departments viz., Block Development Office, Revenue Department, Office of ITDP and Public Health Center etc., and then an indepth empirical study was carried out by a group of researchers drawn from Sociology, Geography and Anthropology, stretching over a period of one month in the village. Household schedule and Knowledge, Attitude & Perception (KAP) questionnaire were developed and made use of in the primary data collection. In addition to schedule and questionnaire, group discussions, participant observations and canvassing interviews have also been carried out simultaneously, during the collection of primary data.

FINDINGS

IRDP (Integrated Rural Development Programme)

Integrated Rural Development Programme was initiated in 1981-82 in Munsyari development block. Since inception of the program, 109 persons were benefited in Tomik under this program up to the financial year 1993-94. Under different sectors/schemes the number of beneficiaries with respect to their community is shown in table 1. Table shows that out of these 109 persons, 49 (45.0 %) received subsidized grants for sheep/goat rearing under primary sector, which is the highest frequency followed by woolen industries (24.8 %) under secondary sector.

Tomik is one of the most sustainable villages of Johar valley since it is surrounded by precious natural resources like dense forest with diverse species of fuel wood, timber and fodder trees from one side and large pastures on the other side. Per cattle availability of pasture land in Tomik was about 0.08 hectare. In this sense greater emphasis on herd rearing under primary sector seems to be well congruent to the existing resource availability and local needs. Secondary data obtained from veterinary centre at block head quarter also shows that in Gram Sabha (village council) Tomik extraction of wool per season is about 750 kg while availability of meat per month was recorded about 500 kg. Under tertiary sector, 15 persons received financial assistance for retail shops. During observations we found only 3 retail shops in the village including one attached with PDS shop.

Table 1 : Distribution of Beneficiaries by sector/scheme & community

Sector/scheme	STs	SCs	TOTAL
<i>Primary Sector</i>			
Milch animal	4 (5.2)	3 (9.4)	7 (6.4)
Sheep/goat rearing	31 (40.3)	18 (56.3)	49 (45.0)
<i>Secondary Sector</i>			
Woolen industry	27 (35.1)	-	27 (24.8)
Iron work	1 (1.3)	8 (25.0)	9 (8.3)
Carpentry	1 (1.3)	-	1 (0.9)
Tailoring unit	-	1 (3.1)	1 (0.9)
<i>Tertiary Sector</i>			
Retail shop	13 (16.8)	2 (6.2)	15 (13.7)
All sectors	77 (100)	32 (100)	109 (100)

Source: Office of the BDO, Munsyari, District Pithoragarh, (UP)

The nearest market centre (Madkote) is situated at a distance of about 20 km. from the village, which is not approachable frequently to sell the milk and milk products. However, a few villagers visits Madkote to sell their milk products hardly once or twice in a month.

IAY (Indira Aawas Yojana)

Indira Aawas Yojana was first introduced in 1985 as a sub scheme of Rural Landless Employment Guarantee Programme (RLEGP) in Munsyari Development Block. The primary objective of IAY is to provide free accommodation to the homeless including SCs, STs, Freed Bonded Labors, and the families living below poverty line. The upper limit of per unit cost in hill areas is Rs. 15000, which include Rs. 1500 for sanitation & smokeless stove and Rs. 3500 for other basic and general facilities. However in cluster approach the amount for these basic facilities may be included with per unit construction cost of the house. Since inception of the program, three families have been provided benefit under IAY, including two SC and one ST.

ITDP (Integrated Tribal Development Project)

In June, 1967 five communities in UP namely the Jaunsari, the Bhotia, the Tharu, the Boxa and the Raji were declared as Scheduled Tribes and were concerned under Integrated Tribal Development Project initiated in the same year, with a primary objective of providing them benefits and essential infrastructural facilities for making them economically self dependent. For their economic development and to raise them above poverty line, ITDP provide them with loan with 50 % subsidy for various choice of schemes *viz.*, Milch animal, Angora rabbit, Mule, Sheep/Goat rearing, Bee keeping, Agricultural development, Vegetable/food production, Ironwork (Black smith) and Carpentry *etc.* In Tomik, 17 families have been assisted under ITDP, since 1986-87 to 1988-89, out of which ten families received loans for purchasing milch animals, five families for growing orchards and one each for carpentry and wool bank.

JRY (Jawahar Rojgar Yojana)

Jawahar Rojgar Yojana was introduced in 1989 with the primary objective of providing additional employment to unemployed and under employed youths in rural area, which are living below poverty line. The other latent aims of JRY are:

- to create sufficient employment by making the rural economic structure strong,
- to create the community and public assets, specially for Scheduled Castes and Scheduled Tribes,
- to provide them continuous and direct benefits, and
- to improve the overall quality of rural life.

Since initiation of the programme, year wise financial outlay and mandays created in Gram Sabha Tomik is shown in table 2 which shows that, since inception of the JRY in study area a total amount of rupees 4,34,253 were released up to the financial year 1993-94, through which 16,255 mandays created as an additional employment to the villagers.

Table 2 : Year wise financial outlay & mandays created under JRY

Financial Year	Total Outlay (Rs.)	Mandays
1989-90	32374	1440
1990-91	67780	2730
1991-92	67857	2465
1992-93	55582	2072
1993-94	210660	7548
Total	434253	16255

Source: Office of the BDO, Munsyari, District Pithoragarh, (UP)

Simultaneously, the village has experienced a few infrastructural facilities also. In addition, the village Panchayat building was also constructed under this scheme. One beneficiary has also established a flour mill in the village.

Other Developments

Health status of the people of any community in general and of tribal community in particular plays an important role in development. Increasing population is one of the major cause that invalidates measures to remove problems of unemployment, malnutrition, poverty, low living standard *etc.*, in tribal communities. Our primary data reveal that in village Tomik, 31 persons had undergone the sterilization, out of which only 22.6 % are male, while 77.4 % are females.

People's Perception towards development

This being the state of planned interventions and level of realization by the villagers, an effort was also made to know the perception of the villagers on the concept of development. As many as 123 persons were interviewed constituting 63 males and 60 females, whose response were as follows;

- All the respondents argued that the village should be connected by road on first priority, so that transportation will become easier, if their village is connected by road.
- 70.59 % male and 83.33 % female respondents expressed that road network is a necessary infrastructure, which would assure economic development, facilitate education and will thus help in social development.
- 29.4 % males and 37.3 % females wanted to cultivate High Yield Variety (HYV) of potato, stressing that it promises assured economic development.
- 70.6 % male and 50 % female respondents desired that, government should provide them infrastructure at first, while 5.9 % males and 16.7 % females preferred economic backup for their development. Rest of the respondents paid equal importance to both.
- Regarding the input from the government to improve farm activities, HYV seeds was found most preferred, followed by fertilizers.
- 34.8 % of respondents told that the production of cash crops, particularly potato, has the greater potentiality for the additional income generation. However, the establishment of cottage industries was preferred by 21.7 % of the respondents.

To the question that why these potential areas of income generation were not developed so far, 21.7% of respondents answered that it has been ignored by the government, while 34.8% replied that other factors like lack of awareness *etc.* hindered these areas. Rest of the respondents had no response to this question. All the respondents argued that villagers can not develop these areas without the help and encouragement from the government. Only 34.8 % of respondents were found satisfied with government introducing programmes under ITDP & JRY while 13 % and 4 % per cent of respondents were satisfied particularly with ITDP and JRY, respectively. Those who found satisfied with IRDP constitute only 49.5 % of the total beneficiaries and most of them argued that the inadequate financial assistance is the most important problem causing in poor performance of the programme.

The respondents were further asked for their suggestions to make changes in above programs. It was noticed that 30.4 % of them replied for no change while, only 4.3 % suggested to increase peoples' participation and check the corruption among the implementing machinery. But they did not have specific suggestions how to check corruption and assure peoples' participation.

CONCLUSION

In brief, the villagers of Tomik have experienced a number of programmes for rural development but the expected outcome is yet to be achieved. 109 beneficiaries received benefits in terms of different assets under IRDP while 17 families were benefited under ITDP. Some the scheme like milch animal and retail shop do not seem appropriate and potential measures of income generation in accordance with specific needs of the study village. On the other hand, a few household projects which could be more effective and gainful i.e., herd rearing and woolen industries, needs further supporting services like training programs, advance technical know-how and implements, development of cooperatives and marketing facilities *etc.*

The survey also indicated that the economy of Tomik is mainly determined by cultivation which contributes about 57 per cent to the entire economic structure of the village, though the input in agricultural activities was found too meager. Use of HYV seeds, fertilizers and pesticides which is substantially low in the village should be encouraged so that the maximum yield could be obtained. This has also reflected in the perception of the villagers. Livestock and cash crops recorded poor performance in income generation against potentiality. Non availability of infrastructure has also laid adverse impact on education which is one of the important factor encouraging socio-economic upliftment. The focus on developing transportation in term of road network by the villagers has also reflected assumed means to back up the process of further development. No doubt, the inhospitable geo-climatic condition of Tomik demands for developing such infrastructure as the very first effort, but the unanticipated consequences of these efforts should be kept in mind because the development so far in Indian Himalaya has often involved conflicts between man and nature.

ACKNOWLEDGMENT

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SEEDLING MORPHOLOGY OF SOME IMPORTANT TIMBER-YIELDING PLANTS AND ITS TAXONOMIC IMPLICATIONS

B. Saha (Das), S. Sarkar* and N. Paria¹

Department of Botany, University of Gauhati, Gopinath Bordoloi Nagar, Guwahati 781 014.

*Lecturer, Rangia College, District- Kamrup (Assam).

¹ Calcutta University, Calcutta.

Seedling morphology of five important timber-yielding plants namely *Gmelina arborea*, *Mimusops elengii*, *Polyalthia longifolia*, *Putranjiva roxburghii*, and *Terminalia arjuna* have been studied. The taxonomic implications of seedling features are discussed.

In modern era, we are losing many important plant species due to high pressure of urbanisation, industrialisation and deforestation. So the study of seedling morphology is very important to conserve these plants permanently and for easy identification. Several workers studied the seedling characters of different species of plants. Hill (1982) illustrated and discussed briefly the variations in cotyledon morphology in *Malvastrum*. Sampath Kumar (1982) stressed the use of cotyledon morphology at the generic, specific and varietal levels in the family. Kamilya and Paria (1993) studied on seedling morphology of some members of the Polygonaceae and its taxonomic implications. In this paper, the study of the morphology of seedlings of some commonly occurring timber-yielding plant species have been studied.

MATERIALS AND METHODS

In this present investigation, seedlings of different stages were collected from different natural habitats in different places of Guwahati. They were compared and identified with the help of seedlings raised from identified seeds. At least ten specimens were studied from various localities. The seedlings were dried and made into herbarium and preserved. The morphology has been described following the terminology proposed by Burger (1972), Hickey (1973) and Vogel (1980). For morphological diagnoses of seedlings, the characters of cotyledons or paracotyledons, eophylls (first few leaves) and hypocotyl were taken into consideration.

OBSERVATION

Gmelina arborea Roxb. Corom, pl.3, t-246.1818 & Fl. Ind. 3:84.1832; C.B. Clarke in Hook-P. FBI. 4:581.1885; Kanjilal *et al.* FA 3; 466. 1939; Deb, FT 2:110.1983. Fam: Verbenaceae. Local name; Gomari (Ass.) (Plate 1).

Germination epigeal, phanerocotylar. Taproot short, 1.8 - 2.9 cm. grayish white. Hypocotyl slightly curved, 1-1.3 cm. pale green, terete. Paracotyledons two, opposite, persistent up to 8-9 leaved stage, exstipulate, petiolar, Petiole \pm 1.3 cm. bases ensheathing node and some portion of internode forming a cup-like structure, tube + 1.9 cm. in length, greenish, blade fleshy, deep green, 1.8 - 2.5 cm. obovate-oblong, apex bi-lobed, base cuneate, entire, primary veins 3 - parallelly arranged, distinct, secondaries inconspicuous. Internode straight, long, terete, light green, length of first and second internodes are 6.8 & 1.8 cm respectively other shorter. First two leaves opposite, simple, petiolate, green, rhombioobovate, smooth, wavy margin, apex acuminate, base rounded, size of the

first two leaves are 5.5 x 3.8cm & 4.5 x 4.3cm respectively. Primary vein one-distinct, secondary vein 4-5 pairs, opposite or alternate, exstipulate, small, green, subsequent leaves opposite, simple stipulate other characters same as that of first two leaves.

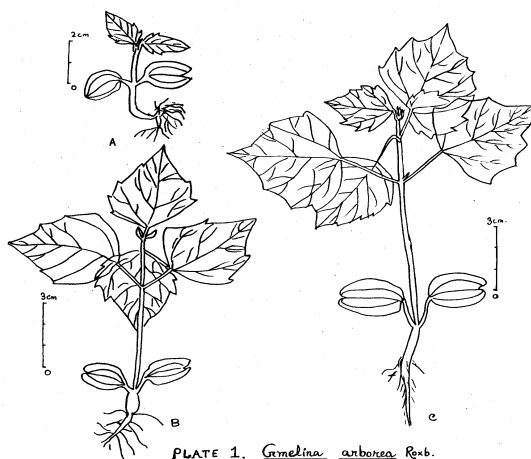


PLATE 1. *Gmelina arborea* Roxb.

Mimusops elengii L. Sp. Pl. 349. 1753; C.B. Clarke in Hook. f. FBI. 3.: 548. 1882; Kanjilal *et al.* FA 3: 197. 1939 Deb, FT. 1:430. 1981 Fam: Sapotaceae. Local name: Bakul (Ass) (Plate 2).



PLATE 2. *Mimusops elengii* L.

Germination epigeal, phanerocotylar. Tap root long, 5.5-7 cm creamy white. Hypocotyl slightly curved long 2.5-7.5 cm brown. Para-cotyledons two, opposite, persistent up to 7-8 leaved stage, exstipulate, blade smooth, green, rounded-subcordate, 2.5-2.8 cm apex and base rounded, dorsal surface smooth, ventral surface rough, entire, primary vein one, distinct, secondary vein 2-3 pairs opposite, distinct. Internodes short, 9-1.4 cm long, straight slightly curved green. First two leaves alternate, simple, oval-elliptic, glabrous, chartaceous, shining, green, entire, acuminate, acute at base, length of the 1st & 2nd leaves are 3.5 cm & 5.4 cm respectively. petiolate, petiole short, 2-7 cm primary vein one, distinct, other veins are invisible. Subsequent leaves alternate, simple green, large, other characters same as that of first two leaves.

Polyalthia longifolia (Sonn) Thw. Enum. 398, 1864, Hook. f. & Thoms. in Hook. f. FBI 1:62 1872, Kanjilal *et al.* FA 1(1):31 1934. Deb, FT. 1:87, 1981. Fam: Annonaceae, Local name : Debbaru (As) (Plate 3.)

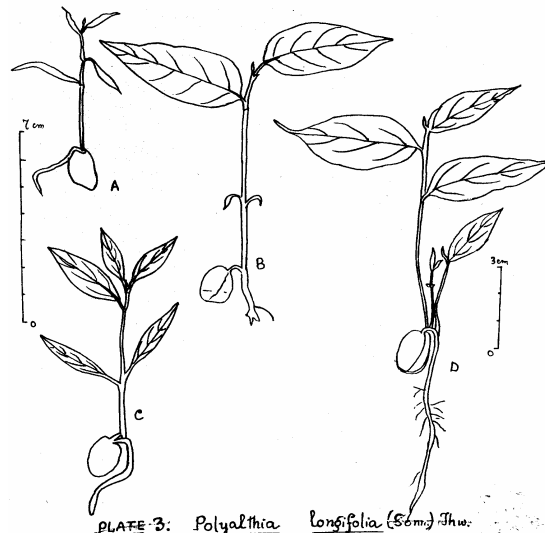


PLATE 3: *Polyalthia longifolia* (Sonn) Thw.

Germination hypogeal, phanerocotylar. Tap root long, brown, Hypocotyl curved, 1.8-2.8 cm long, grayish brown. Paracotyledones two rudimentary, 7-2.5 cm alternate or sub-opposite, lanceolate, petiolate acuminate, entire, petiole 1.5 cm greenish, acute at base, primary vein one, distinct, secondary veins invisible. Internodes long green, straight or slightly curved length of the 1st internode 2-4.5 cm 1st and 2nd internode 2.5-3.5 cm respectively, other shorter than the 1st and 2nd.

First two leaves alternate, simple, short petiolate, lanceolate, greenish, acuminate, entire or slightly wavy at margin, acute at the base, size of the first two leaves are 4.1 x 1.5cm and 5 x 1.9cm respectively, primary vein one, distinct, secondary veins 4.5 pairs alternate or sub-opposite, petiole 1.3cm subsequent leaves alternate, simple, stipulate, 2.3-3.5cm long other characters same as that of first two leaves.

Putranjiva roxburghii Wall. Tent. Fl. Nep. 61 and cat. 6814; Hook. f. FBI 5:336 1885. Kanjilal *et al.* FA. 4: 179. 1940. Fam: Euphorbiaceae. Local name: Putranjiva (Ass.) (Plate 4).

Germination epigeal, Phanerocotylar. Tap root long, 4-5cm grayish or reddish white. Hypocotyl slightly curved, long, 5.5cm upper portion pale greenish, lower portion reddish, terete. Paracotyledons two, opposite, persistent up to 8-9 leaved stage, exstipulate; petiole \pm 3cm primary vein 3, parallelly arrange, distinct, petiolar bases ensheathing node and small portion of internode forming a short cup like structure; cup 0.4-0.5cm in length greenish, blade smooth, green, cordate, 2.3-

2.5cm apex rounded, base cordate-sub-cordate; dorsal surface smooth ventral surface rough. Internode short, 1.3-1.8cm terete green other shorter than the first. First two leaves alternate, simple, petiolate, green, ovate, lanceolate, serrate, apex & base acute; length of the first two leaves are 2.8 and 3.5 cm. respectively; primary vein distinct, other veins are invisible, stipulate or exstipulate, small, green subsequent leaves alternate, simple, other characters same as that of first two leaves.

4 x 1cm respectively, slightly wavy at margin; petiole \pm .5cm primary vein one, distinct; secondary veins 5-6 pairs, distinct. Subsequent leaves alternate simple, large, petiolate, other characters same as that of first two leaves.

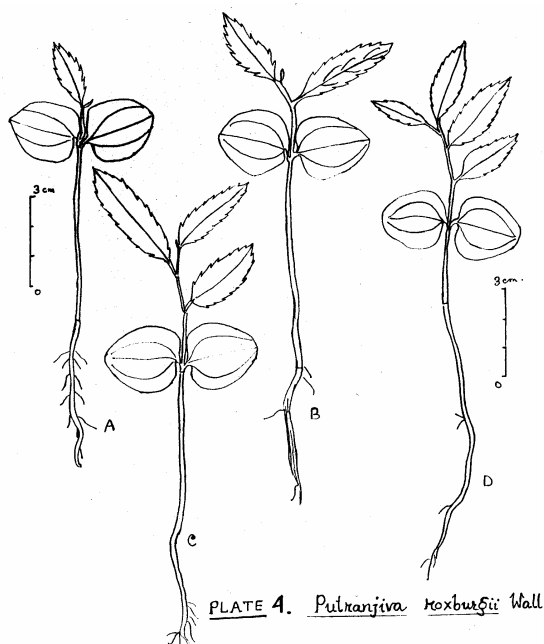


PLATE 4. *Pultraria Roxburghii* Wall

Terminalia arjuna (Roxb.) Wight & Arn. Prodr. 314. 1834; C.B. Clarke in Hook.f. FBI 2:447. 1878; Deb FT. 1:384. 1981. Fam : Combretaceae. Local name: Arjun (Ass) (Plate 5).

Germination epigeal, phanerocotylar. Tap root long, 1.5-6 cm. grayish. Hypocotyl curved, long 7-7.5cm lower portion yellowish white, upper portion light green. Paracotyledons two, large, opposite petiolate, persistent up to 8-9 leaved stage; petiole \pm 1.5cm petiolar bases ensheathing the internode to form a cup-like structure, cup \pm 5cm long; blade triangular, greenish, 2 x 3.5cm acute or rounded at apex, attenuated at base, entire, primary veins are, distinct, secondary veins 2-3 pairs, distinct. Internoded long, \pm 3cm greenish other internodes shorter, node swollen. Leaves clustered at the end of branches, first two leaves opposite, others alternate, simple, green, elliptic or elliptic-obovate, petiolate, coriaceous, puberulous, obtuse or apiculate at the apex, narrowed at the base, length of the first two leaves 2.5-3.5x7-9cm and length of the third leaf

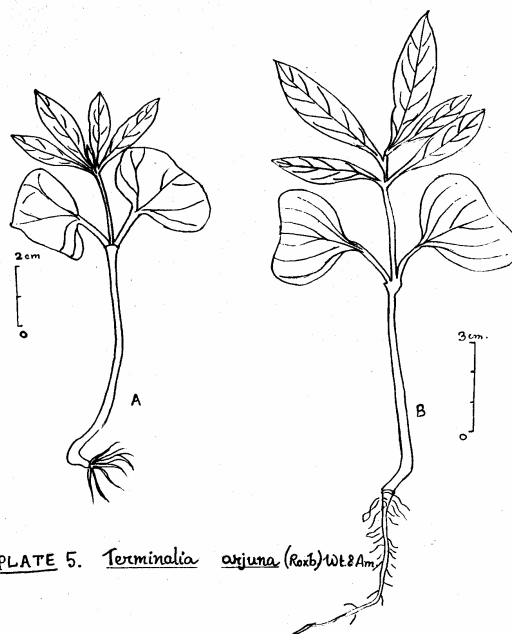


PLATE 5. *Terminalia arjuna* (Roxb) Wt & Arn.

DISCUSSION

Among the 5 plants, all species showed epigeal type of germination except *Polyalthia longifolia* which shows hypogeal type of germination. In *Polyalthia longifolia*, cotyledonary leaves are very rudimentary in comparison to others. In *Mimusops elengi*, seedling growth is very slow and it took 3 months where as *Gmelina arborea* showed very quick seedling growth. It has completed all the stages within 7 days. Hypocotyl is also very short. The area of cotyledonary leaves is large in *Terminalia arjuna*.

CONCLUSIONS

The seedling features revealed in the present study show correlation of juvenile characters with some adult characters. The data obtained in the present study help in the demarcation of families. The above mentioned five tree species of plants are very much important for timber and these timbers are very useful and utilized in different ways and also have medicinal value (Chopra, 1956; Kirtikar & Basu, 1975). With the help of seedling morphology, we can identify these plants easily and escape them from deforestation.

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परती भूमि पर बागवानी: बैज्ञानिक पद्धति

लेखक डा० वी० के० शर्मा, पब्लिशर ए० पी० एच० पब्लिशिंग कारपोरेशन ५, अंसारी रोड़, नई दिल्ली, मूल्य ५०० रू०

परती भूमि के क्षेत्रफल में हो रही उत्तरोत्तर बढ़ती भारत जैसे कृषि प्रधान देश के लिए एक अत्यन्त कठिन समस्या है। इस समस्या का निदान सम्भव है। यदि परती भूमि में आवश्यक सुधार लाकर उसे उत्पादक क्षेत्रों में परिवर्तित किया जा सके। परन्तु आवश्यक तकनीकी व जानकारी के अभाव में इस सन्दर्भ में समुचित क्रियान्वयन नहीं हो पाया है। परती भूमि पर बागवानी: बैज्ञानिक पद्धति इस दिशा में एक प्रसंसनीय कदम है, जन साधारण को हिन्दी भाषा में लिखी गई यह पुस्तक आम जन मानस को तकनीकी ज्ञान सुगमता पूर्वक पहुँचा पायेगी। पुस्तक में १५ अध्याय हैं जो कि परती भूमि की पहिचान 'अध्याय २' से लेकर उसके सुधार 'अध्याय ४' व भविष्य की योजनाओं 'अध्याय १५' तक विविध विषयों पर तथ्यात्मक जानकारी प्रदान करते हैं। अध्याय ११ में फलों की बागवानी पर दी गयी जानकारी भी लाभप्रद हो सकती है।

बिषय वस्तु की गम्भीरता को देखते हुए यह बताने में भी हिचकिचाहट नहीं होगी कि लेखक, डा० वी० के० शर्मा, ने पुस्तक में अधिकतर स्थानों पर अत्यन्त सामान्य जानकारी समाहित की है। जबकि बिषय की गहराई तक पहुँचने के लिए कुछ बिशेष जानकारियों को भी देना आवश्यक होगा। जैसे भारत के जैव भौगोलिक क्षेत्रों के अनुसार परती भूमि सुधार हेतु प्रजातियों का चयन व उनका रोपण; सुधार सम्बन्धी समस्याओं के अन्तर्गत जल आपूर्ति इत्यादि पर समुचित जानकारी। कुछ स्थानों पर लेखक द्वारा तकनीकी शब्दों के कठिन हिन्दी अनुवाद का प्रयोग पुस्तक को जन साधारण की समझ से दूर करता प्रतीत होता है। इसी प्रकार रेखाचित्रों व बिषय परक सारणियों का अभाव पुस्तक की सुगमता कम करते हैं। आशा की जानी चाहिए कि लेखक आगामी संस्करणों में इन बातों को ध्यान में रखेंगे।

कुल मिलाकर लेखक का यह प्रयास स्वागत योग्य है, परन्तु पुस्तक का मूल्य रू० ५०० इसे आम जनता की पहुँच से दूर ही रखेगा, जिससे लेखक व पुस्तक अपने उद्देश्य को पाने में असमर्थ रहेंगे।

आर० एस० रावल

AVIAN PREDATORS OF POTATO PESTS

C.K. Sharma

Sr. Scientist (Horticulture), CPRS, Modipuram, Meerut 250 110 (U.P.)

India is said to be copiously rich in avian wealth (about 1200-over 3000 species, Ali & Futehally 1967, Negi, 1993), many of them being ornamental, recreational, environmental, medicinal, food and agri-insect-pests controlling value. A great variety of climate in country enriches India with seasonal avi-fauna from other parts of world to tender service of reduction of entomeloid in agriculture.

In light of consecutive strongly felt need to reduce indiscriminate chemo-pesticides use in agriculture causing alarming health and environmental hazards, identification and study of bio-control agents other than micro-fauna (bacteria, spider, flies etc.) such as avian predator is also matter of particular significance and urgency (Ali & Futehally, 1997). Frequent call and even inaction of legislation for reducing pesticides use e.g. Scandinavian countries enacted legislation, Denmark's call for 50% cut by 1997, Sweden targeted 50% reduction within 5 years and these leads being already followed by other countries and further weightage to such activity.

An attempt to identify avi-wealth and to assess its status as predators of mainly underground pests of potato was made during September, 1996 to March, 1997. A host of battle, weevils, worms, grubs, termites, ants, aphids, hoppers, bugs, flies, caterpillars, borers, moth, loopers, crickets, thrips, snails and slugs etc., belonging to different generous, species and numbering about 80 out of over 100 potato pests reported to

damage this crop in India by gogging up both under and above ground parts or as vectors of diseases. For this purpose, a farm of about 300 hectares at Macchri under district Meerut mostly and largely monocultured with potato over about 20 years, thus creating congenial home for regional potato pests was selected. Birds visiting farm during period from field preparation to harvesting operations were closely watched and identified with the help of descriptive cum pictorial book namely, 'Common Birds' written by Salim Ali & F. Laeeq (1967) published from NBT, India, A-5, Green Park, New Delhi 110 016.

Attempt made resulted in identification of 17 avi-predators useful in reduction of regional potato pests (Table 1). They were noticed to pick-up insects during all field operations even from standing crops but particularly during irrigation and soil disturbance at mechanical harvesting, interculture and field preparation operations. They were seen picking up grubs, caterpillars, worms, beetles and other insects. Most active avi-predators were Myna *Acridotheres tristis*, Housecrow *Corvus splendens*, Black Drongro *Dicrurus adsimilis*, Redwattled lapwing *Vanellus indicus* large pied wagtail *Motacilla caspica & maderaspatensis*, Cattle Egret *Bulbulcus ibis* and Pied Myna *Sturnus contra*. Most close followers of plough to capture insects were seen to be cattle egret followed by common myna redwattled lapwing, house crow and sometimes black drongo. In absence of cattle egret, common Myna turned to be prime follower of plough. Most close air followers of plough were common myna followed by house crow and rarely cattle egret. Number of common myna was seen also to exceed over all avi-visitors followed by house crow, black drongo and cattle egret. Most active ones were seen to assembling large flocks during morning hours (7-8 A.M.) at ploughing, harvesting and intercultural operations. Number reduced after 11-12 p.m. first by cattle egret and then by house crow. Common myna, large pied wagtail, black drongo, redwattled lapwing and some other small birds (plover *etc.*) continued to tender service of insect-capturing till day light of different months of the period.

House crow, black dronge, sometimes common myna were seen to be in habit of snatching insect picked by other avi-fauna and chasing away them for the same. Black drongo, and sometimes common myna when in large flockes dared to chase away even house (row. Black drongo was seen sitting on large soil clodes or other perches and then hurriedly flying to spot of insect available. This mode of insect collection was too seen in small blue king fisher and chers *Gyps bengalensis & indicus* or Saras cranes *Grus antigone* gliding down sometimes to field from nearby tall trees or sky blue jay were observed to be great scarer of all birds seen. Although these birds were noticed to be present but it appeared that they did not feel small insects sufficient for them. They hence used to fly away after small half in the field. Small birds like large pied wagtail and some plovers *etc.*, were seen short, long flying or running all over field to capture insects.

Table 1. Avian predator of potato pests.

Scientific & common name of Avi-predator	Vernacular name & Notes	Mode of haunting observed
1. Tree pipet (<i>Anthus trivialis</i>)	Rugel or charchari, Tseep-Tseep	Enters quietly under plant and picks up insects
2. Common Myna* (<i>Aeridotheres tritris</i>)	Desi Mayna, Keek-Kee-Keek Kok-Kok-Kok, Churr-Churr	Follow plough closely, attend ploughed and irrigated field in flocks to pick fleeing insects from ground and air.
3. Common Yora (<i>Aegithina tiphida</i>)	Shoubeggi, musical whistling & long drawn sibilant cheu-cheu	Moving about in pairs through hopping among plants to capture the insects.
4. The Small Blue King Fisher (<i>Alcedo atthis</i>)	Chotta Kilkila or Sharatan, Sharp Chichee-chichee	Flying closely over standing water in the field, drop into water to pickup insect, dashing off to nearby perch for eating the insects.
5. Stone curlew or Goggle-eyed plover (<i>Burhinus oedienemus</i>)	Karwanak or Barsiri Pick, pick...pick-wick, pick, wick	Attending ploughed and unploughed field in pair or flocks to catch insects, worms etc.
6. Cattle Egret* (<i>Bubuleus ibis</i>)	Surkhia or Gaj Bagla	Very closely following plough gregariously to catch insects from turning soil, seen haunting in waterfield.
7. House crow* (<i>Corvus splendens</i>)	Desi Kowa, Kaun-Kaun in various tones	Following plough behind and overhead, attending ploughed, fellow and waterfield, chasing away other birds, snatching for getting insects, eating at spot or taking away, entering water only on seeing insects.
8. Indian roller or Blue Jay (<i>Coracias benghalensis</i>)	Nilkanth or Sabzak	Swooping down from nearby lookout perch to watered field for picking up insects, flying around or back to same or other perch.
9. Little ringed plover (<i>Charadrius duhioi</i>)	Zirrea or Merwa	Running around whole damp field in loose flocks and stopping suddenly to pick the insects.
10. Black Drongo* (<i>Decrurus adsimilis</i>)	Bujanga or Katwal	Follow plough distantly and attending ploughed, unploughed, irrigated, unirrigated field, heap of potato haulm & other farm garbage to catch insect from air, casing away other birds including crow to get morsel.
11. Saras crane (<i>Grus antiqone</i>)	Saras	Landing on ploughed field in pair, bending neck to pick up insects.
12. Adjutant Stork (<i>Leptoptila dubious & Javanicus</i>)	Harigila, Garua or Dthink	Gliding down heavily on ploughed or unploughed field, entering watered field for eating away insects.
13. Malabar whistling (<i>Myiophoneus horsfieldii</i>)	Kastura	Coming alone to both ploughing and watered field to catch insects.
14. Large pied wagtail* (<i>Myiophoneus caspica Moderaspatensis</i>)	Kee-Kee	Running and flying all over watered, ploughing and unploughed field to catch the insect.
15. Pied Myna* (<i>Sturnus contra</i>)	Ablak or Sirioli	Follow plough and watered field to catch insects.
16. The Redwattled lapwing* (<i>Venellus indicus</i>)	Titeeri Did-ye-do-it or Pity-to-do-it	Follow plough, attend unploughed and watered field in small parties to pick-up insects.
17. The common sandpiper (<i>Tringa hypoleucos</i>)	Tee-tee-tee or Wheet Wheet	Single bird running about watered field to catch insects.

[Reference Book: Ali, S and Fatehally, L. 1967. Common Birds, NBT India, A-5 Green Park, New Delhi 1100016]

* Most actives avian predators of pests.

Common myna, cattle egret, redwattled lapwing, tree pipit, large pied wagtails, common sandpiper, some rare visitors like herons, saras cranes and other egrets were noted to be most active water wandering insect catchers while remaining to be outside watchers and entered water of irrigated field when felt necessary. Some of them like Indian roller & black drongo *etc.*, were recorded to pick up insects from standing water without entering on their feet. Barring redwattled lapwing and cattle egret, all birds under study were also recorded to capture insects from piles of potato haulms and other garbages on farm.

None of the birds under watch was found to eat any part of potato plant although several of them reported to be herbi-cum-insectivorous or herbi-cum-carnivorous. Exception was house crow that was noticed flying away with cut or rotten potato sometimes, attempting to eat recalcitrantly but leaving half eaten. Recorded birds appeared to be completely safe predators of regional above and especially underground pests in potato without any damage from them to the crop, possibly in other root, rhizomatous, tuber crops and sugarcane.

Strictly insectivorous of them in all horticultural and agronomical crops while herbi-cum-insectivorous ones strictly up to field operations, but not after sowing, are also safe avian reducer of entomoload. Several birds like vulcher, owl, *etc.*, are reported to be alive reducer of rodents.

Only harms excepted from avi-insectivorous are spread of diseases especially viral ones and death of some useful lives like earthworm *etc.*, and predators of insects (some spider & dragon flies *etc.*). The exact value of avi-insectivorous in reducing under ground pests under field conditions is always difficult to determine due to one or other reasons. But a difference in presence of kind/number of pests between a square disturbed and non-disturbed plot exposed to bird visit may generate some idea. Not already existing sporadic shallow study in Indian agri-literatures but a comprehensive scientific investigation led by a team of agri-entomologists (insect identification *etc.*), ornithologist (bird identification *etc.*) and botanist (vegetation identification *etc.*) may lead to efficient workable avian based technology of reducing entomo-strains, protection against damage done by herbi-cum-insectivorous birds and even exploitation of herbi-cum-insectivorous birds without their damage in agriculture.

Suggestions: Read as below harvesting efficient services of reducing agri-entomo-strains on agricultural farm by avi-fauna.

- Permanent water source.
- Boundary plantation of vegetation of non-food value to man but of food, resting nesting value to avi-insect-predator on mixed farm of root, tuber including potato, rhizomatous, bulbous selected plantation crops (coconut, rubber, tea *etc.*), cut flowers and sugarcane crops. Need research to identify such vegetation.
- Boundary plantation of vegetation of non-human-food value but of nesting and resting value to strictly insects and carnivorous birds on farm crops susceptible to bird damage. Research needs to identify such vegetation.
- Cultivation of bird amaze free crops like coconut, most cut flower crops, bel and colosassia *etc.*, to force birds to feed upon insects.
- Frequent deep required soil disturbance, irrigation and exposure of field of avi-insect-predators for acting upon.
- Identification of regional/climate/crop specific avi-insect-predators in addition to general types coming to all crops, Reason being, not all birds visit same crop, region climate and season.
- Restricted use of chemo-insecticides lethal or repelling avian insectivorous from visiting field itself.
- Development of non-toxic spray enabling plants to repel avi-cum herbivorous but attracting insectivorous birds.
- Minusing genes responsible for herbivoracity from insect cum herbivorous birds (House crow, poultry birds, ducks *etc.*) and induction of genes liable for easy to tame, strong identification of residence to return same, response to human inviting call from white pigeon into them, or incorporation of genes responsible for strong insectivoracity from strictly insectivorous birds into white pigeon through advanced biotechniques may lead to development of bird stocks of enhanced insect controlling or multipurpose value. Attempts to breed out or breed in desirable or undesirable characters will be more useful in birds with

capacity to escape from predator or capacity by immediate flying away. Capacity to escape from catching lacks in weak fliers (poultry bird or ducks *etc.*). Idea appears to be funny, But in light of recent advancement of bio-technology does not seem to be so funny. Synthesized birds for this purpose should be strong insectivorous nature, free from herbivoracity, able to identify residence to return same, able to respond human inviting call and escaping from catching, able to forage within restricted area, need not to be caged always. These all qualities do exist in white pigeon which has also good value in Tripura and tamed for the same but lacks strongly in insectivoracity. Needless to mention that wide variability in these characters does axise among birds belonging to same species, genera, family, class for this purpose.

Some Common Himalayan Birds

EXISTING NAME*	NEW NAME**	SCIENTIFIC NAME
Mountain Quail, Himalayan or Indian Mountain Quail	Himalayan Quail	<i>Ophrysia superciliosa</i>
Impeyan Pheasant, Monal Pheasant, Himalayan Monal	Himalayan/Impeyan Monal	<i>Lophophorus impejanus</i>
Darjeeling Pied Woodpecker	Darjeeling Woodpecker	<i>Dendrocopos darjellensis</i>
Himalayan Pied Woodpecker	Himalayan Woodpecker	<i>Dendrocopos himalayensis</i>
Himalayan Goldenbacked Threetoed Woodpecker, Himalayan Goldenback	Himalayan Flameback	<i>Dinopium shorii</i>
Himalayan Great Slaty Woodpecker	Great Slaty Woodpecker	<i>Mulleripicus pulverulentus</i>
Great Pied Kingfisher, Himalayan Pied Kingfisher	Crested Kingfisher	<i>Megaceryle lugubris</i>
Himalayan Cuckoo	Oriental Cuckoo	<i>Cuculus saturatus</i>
Indomalayan Swiftlet, Black-nest Swiftlet	Black-nest Swiftlet	<i>Collocalia maxima</i>
Darkbacked Swift, Khasi Hill Swift	Dark-rumped Swift	<i>Apus acuticauda</i>
Tawny Wood Owl	Tawny Owl	<i>Strix aluco</i>
Himalayan Greyheaded Fishing Eagle, Lesser Fishing Eagle, Lesser Greyheaded Fishing Eagle	Lesser Fish-Eagle	<i>Ichthyophaga humilis</i>
Himalayan Griffon Vulture	Himalayan Griffon	<i>Gyps himalayensis</i>
Redbreasted Falconet	Collared Falconet	<i>Microhierax caerulescens</i>
Jay	Eurasian Jay	<i>Garrulus glandarius</i>
Himalayan Tree Pie	Gray Treepie	<i>Dendrocitta formosae</i>
Magpie, Whiterumped Magpie	Black-billed Magpie	<i>Pica pica</i>
Nutcracker, Eurasian Nutcracker	Spotted Nutcracker	<i>Nucifraga caryocatactes</i>
Kashmir Red-breasted Flycatcher	Kashmir Flycatcher	<i>Ficedula subrubra</i>
Himalayan Rubythroat	White-tailed Rubythroat	<i>Luscinia pectoralis</i>
Himalayan Tree Creeper	Bar-tailed Tree-Creeper	<i>Certhia himalayana</i>
Altai Accentor	Rufous-streaked Accentor	<i>Prunella himalayana</i>
Sikkim Tree Creeper	Brown-throated Tree-Creeper	<i>Certhia discolor</i>
Crossbill, Common Crossbill	Red Crossbill	<i>Loxia curvirostra</i>
Goldcrest	Common Goldcrest	<i>Rugulus regulus</i>
Manipur Streaked Laughing Thrush	Striped Laughingthrush	<i>Garrulax virgatus</i>
Himalayan Greenfinch	Yellow-breasted Greenfinch	<i>Carduelis spinoides</i>
Goldfinch, Eurasian Goldfinch	European Goldfinch	<i>Carduelis carduelis</i>

* Names used in the subcontinent;

** Names from Pittie & Robertson 1993, Ripley *et al.* (in press), and a few cases from Inskipp *et al.* 1996

[Source: ENVIS Newsletter: Avian Ecology and Inland Wetlands, Vol.2 No.4, ENVIS Centre, Bombay Natural History Society, Salim Ali Chowk, Shaheed Bhagat Singh Road, Mumbai 400 023]

A NOTE ON LENTIC WATER BODIES IN TRIPURA WITH REFERENCE TO SESSILE ROTIFERS

S. Banik, Saumen Chakraborti and Manjuri Chakraborti
Fisheries & Limnology Research Unit, Department of Life Sciences, Tripura University,
Agartala 799 004, Tripura

The present study has been carried out in nine ponds of Tripura (West district, latitude 23°50'15" N and longitude 91°15'45" E; South district, latitude 30°15'00" N and longitude 91°27'00" E; North district, latitude 24°28'00" N and longitude 92°15'00" E), which have been used as Carp rearing freshwater ecosystems. The present data is the observations of August 1994 to July 1996.

These waterbodies supported a number plant species such as *Eichhornia crassipes*, *Salvinia* sp., *Lemna minor*, *Trapa bispinosa*, *Nymphaea* sp., *Utricularia vulgaris*, *Myriophyllum tuberculatum*, etc., which serve as substrata for the sessile rotifer fauna.

As many as 29 species of sessile rotifers were identified from the littoral water region. The most common occurrence of those species were *Ptygura melicerta* (EHRENBERG), *Collotheca ornata* (EHRENBERG), *C. tenuilobata* (ANDERSON), *C. trilobata* (COLLINS), *C. mutabilis* (HUDSON), *P. tacita* (EDMONDSON), *Lacinularia flosculosa* (MULLER), *L. elliptica* (SHEPHARD), *Sinantherina semibullata* (THORPE), *S. procera* (THORPE) and *S. spinosa* (THORPE).

Their mode of reproduction has been found to be correlated with certain physical as well as chemical parameters of freshwater. A temperature of 18-30°C and higher amount of dissolved oxygen (6-10 ppm) are found to be helpful for their parthenogenic reproduction ($P < 0.01$). However, very high temperature (30.73°-34.1°C), shorter photoperiod (6 hrs), higher transparency (50-77cm) and poor content of dissolved oxygen (2.3 ppm) ($P < 0.001$) are correlated with their sexual mode of reproduction. At this stage they showed production of relatively large sized resting eggs, the glycogen content of which was found to be rich. The parthenogenic eggs produced by them are quantitatively more but the amount of glycogen in those amictic eggs are relatively very less. Under laboratory experiment, it was understood that besides physico-chemical parameters of freshwater, some other parameters (such as over population, predators, lower food abundance) also play key role behind sexual reproduction in the sessile rotifers. The hatching of amictic and resting eggs exhibited strong correlation with the suitable limnological conditions such as greater photoperiod, lower concentration of dissolved organic matter, higher phosphate value etc. The physico-chemical parameters of the studied water bodies are presented in table, pooling all the data together into mean value, in order to understand the limnological feature very clearly.

Table: Physico-chemical conditions of the studied ponds during August 1994 to July 1996.

Parameters	Range	Mean
Water temperature (°C)	117.03-34.1	22.03
Transparency (cm)	5.06-77.0	19.01
pH	6.02- 6.9	6.41
Bi-carbonate (ppm)	46.19-108.1	73.33
Dissolved oxygen (ppm)	4.00-14.00	6.79
Free carbondioxide (ppm)	1.10-4.60	2.31
Dissolved organic matter (ppm)	0.86-13.00	4.67
Chlorinity (ppm)	25.00-40.00	30.00
Salinity (ppt)	0.07-0.10	0.07
Silicate (ppt)	0.80-13.76	6.12
Phosphate-P (ppm)	0.02-0.34	0.23
Nitrate-N (ppm)	0.09-0.39	0.26
Calcium (ppm)	1.20-30.04	12.01
Magnesium (ppm)	2.02-10.00	4.10

Summary of Completed/Ongoing Projects

COMMERCIAL RESOURCES OF *CINNAMOMUM* SPECIES IN EASTERN HIMALAYAN REGION OF INDIA : SURVEY, IDENTIFICATION AND CONSERVATION FOR SUSTAINABLE USE

Subhan C. Nath

Regional Research Laboratory, Jorhat 785 006, Assam

- * A total of 27 morphologically and chemically different taxa of the genus *Cinnamomum* associating, spice and medicinal use of rural and aboriginal people in Eastern Himalayan region of India including its North-East part has been brought to light.
- * These 27 taxa of *Cinnamomum* growing in Eastern Himalayan region of India comprise 13 species and 20 infraspecific categories against the 11 taxa of species categories reported previously from the region, while one species *Viz. C. sulphuratum* is revealed to be a new record to the flora of the region. However, the remaining taxon *Viz. Cinnamomum* sp. (RRLJ 1805) is revealed to be a separate species other than the known ones from the region. Necessary process is on to confirm its naming.
- * The 20 infraspecific categories of *Cinnamomum* revealed in this investigation comprise 17 phenotypic variants and 16 chemotypes. Amongst the phenotypic variants, 11 taxa (three for *C. bejolghota*, two each for *C. camphora*, *C. sulphuratum* and *C. verum*) are indicative of varietal rank while five taxa (three for *C. tamala* and two for *C. verum*) are of cultivar ranks. Amongst the chemotype, four taxa belong to *C. sulphuratum*, three taxa each to *C. bejolghota* and *C. Verum* and two taxa each to *C. camphora*, *C. parthenoxylon* and *C. tamala*.
- * Six species *Viz. C. verum*, *C. cassia*, *C. iners*, *C. sulphuratum*, *C. pauciflorum* and *C. bejolghota* (RRLJ 1600 & RRLJ 1847) are known in the region as "Dulchini" (Cinnamon) and their bark used as cinnamon spice of commerce, while four species, *Viz. C. tamala*, *C. impressinervium*, *C. bejolghota* (RRLJ 1603) including the unidentified one (RRLJ 1805) are known as "Tejpat" and used their leaves as tejpat spice of commerce, besides being the uses amongst some of them as folklore medicine. Interestingly, a taxon of *C. bejolghota* namely the RRLJ 1603 is known either in the name of "Dulchini" or "Tejpat" according to the uses of its bark as "Dulchini" and leaves as "Tejpat" by the people. Likewise *C. camphora* and *C. parthenoxylon* are known in the region as "Karpur" and their leaves are being used for culinary purposes, while *C. glaucacens* and *C. glanduliferum* and known as "Gondsoroi".
- * A taxa of *Cinnamomum* mainly the RRLJ 1254 which was although identified as *C. tamala* variant, on the basis of herbarium discussion at CNH, Howrah, has been found to be indicative of *C. sulphuratum* in this investigation, as regards its morphology and chemical characters.
- * A simple and easier peeling technique for isolation of epidermis for *Cinnamomum* spp. has been developed and standardised.
- * A controversial nomenclature of a type of stomata occurring in *Cinnamomum* spp. Which has been describing so far till our work either as sunken or anomocytic or as paracytic has been solved detecting and characterizing its actual nature as sunken type (Baruah & Nath, foliar epidermal characters in Twelve species of *Cinnamomum* Schaeffer (Lauraceae) from Northeastern India, Phytomorphology, 1997, In press).
- * There is a positive correlation found between the size of leaves and their eugenol contents in essential oils, in case of the variants studied for *C. tamala*. Smaller in leaf size of variants, higher is the eugenol content in their oils. As eugenol is the main active ingredients responsible for quality of "Tejpat" spice, hence the *C. tamala* variants possessing smaller leaves could be considered as superior strain/cultivar/variety.
- * Of the 27 taxa screened for essential oils and aroma chemicals, 26 taxa comprising 13 species reveal positive indication.
- * Methodologies for seed propagation of *C. tamala*, *C. impressinervium* & *C. sulphuratum* and stem cutting propagation of *C. pauciflorum* & *C. verum* have been standardised.

- * About 100 seedlings, each for *C.tamala*, *C.impressinervium* and *C.sulphuratum* raised as a result of propagation studies have been transplanted into the Experimental R & D Plots.
- * About 200 voucher specimens representing a total of 27 *Cinnamomum* taxa surveyed, collected & characterized have been processed as herbarium specimens and preserved at the Herbarium of RRL, Jorhat.
- * About 2 acres of land has been developed as Experimental Botanic Garden (Herbal Garden) at RRL Jorhat introducing & maintaining the live plant germplasms of a total of 18 *Cinnamomum* resources comprising 12 species collected from different parts of the region.
- * A taxonomic key to the taxa based on morphological (including micro) and chemical characters has been formulated.

STUDY OF ALLELOPATHIC EFFECT ON FIELD CROPS BY SOCIAL AND AGRO-FORESTRY TREES IN GARHWAL HIMALAYA

M.S.M. Rawat and Geeta Pant

Department of Chemistry, HNB Garhwal University, Srinagar (Garhwal)

Fields survey in *Prunus cornuta*, *P. armeniaca*, *P. jacquemontii*, *P. amygdalus*, *Buxus wallichiana*, *Cassia fistula* and *Fraxinus micrantha* growing areas of Garhwal Himalaya were conducted with reference to the germination and growth of some companion crops at various sites of different soil fertility. Retardation in germination, growth and yield were noted in nearly all test crop plants, particularly on those sites where the percentage of soil organic matter was low. It was also observed that the magnitude of interference gradually decreases as the distance from the tree increases.

The extracts of the bark of *Prunus cornuta* in petroleum ether, ethanol, ethyl acetate and water were prepared and the residues after dilution were tested for their allelopathic effect on the germination and growth of *Raphanus sativus*. Significant inhibitory effect were observed with all the solvent extracts. Prunasin (a cyanogenic compound) and melilotoside methyl ether isolated from ethanol extract also remarkably inhibited the germination and growth of radish.

Aqueous and organic solvent extracts of the aerial parts of *Prunus armeniaca* were made and their residues were tested after proper dilution for their phytotoxic effect on germination and growth of test crop. Residues of light petroleum and ethyl acetate extracts showed maximum inhibition in growth and germination of test species. The isolated compounds were identified with the help of spectroscopic techniques and also bioassayed. B-sitosterol, 2, 6-dihydroxy-4-methoxyacetophenone and kaempferol were isolated from petroleum extract whereas aromadendrin, quercetin, B-sitosterol-B-D-glucoside, pleoside and tannins (four proanthocyanidins-A type) were characterized from ethyl acetate extract. Of these, proanthocyanidins showed maximum inhibition whereas quercetin, aromadendrin, kaempferol and genin of pleoside inhibited to lesser extent.

In the bioassay studies with light petroleum, ethyl acetate and alcohol extracts of the root and bark of *Prunus jacquemontii*, the ethyl acetate extract have shown more inhibition to the germination and growth of *Raphanus sativus*. Pavetannin and 13'-hydroxymahuannin from the ethyl acetate extract were more inhibitory than B-sitosterol and its glucoside. The aqueous and ethyl acetate extracts of the root were more inhibitory than the bark.

Aqueous and organic solvent extracts of the aerial parts of *Prunus amygdalus* were made and their residues were tested after proper dilution for their phytotoxic effect on germination and growth of *Triticum aestivum* and *Eleusine coracana* by conducting bioassay experiments. Residues of light petroleum and ethyl acetate showed maximum inhibition in the growth and germination of *Triticum aestivum*, whereas *Eleusine coracana* was found as a tolerant species in the test towards all residues. The compounds were isolated from the residues of light petroleum and ethyl acetate extracts and identified with the help of spectroscopic techniques and co-chromatography with the authentic samples. The isolated compounds were also subjected to bioassay. Persicogenin-3'-glucoside was found more inhibitory for the growth and germination of test species followed by naringenin and aromadendrin.

The phytotoxicity of aqueous and organic extracts of leaves and stem bark of *Buxus sempervirens* syn. *wallichiana* was examined in the laboratory using local varieties of wheat (*Triticum aestivum*), lentil (*Lens culinaris*), mustard (*Brassica campestris*), radish (*Raphanus sativus*), finger millet (*Eleusine coracana*), barnyard millet (*Echinochloa frumentacea*), kidney beans (*Macrotyloma uniflorum*) and black gram (*Phaseolus mungo*).

The germination and seedling growth (root length and shoot length) of all crops were inhibited by aqueous and organic solvent extracts of leaves and bark. Among summer crops finger millet was found to be most susceptible crop whereas, black gram was more resistant crop. Five percent aqueous extract of both leaves and stem bark completely inhibited the germination of finger millet. Among winter crops lentil was found most inhibited sp. while radish was least affected sp. The phytotoxicity was found to be concentration dependent in increasing order of 1.25% < 2.5% < 3.75% < 5.0%. Chloroform extract of both leaves and stem bark was found more toxic than other organic solvent extracts.

Effect of organic and aqueous extracts of stem bark, leaves and pods of *Cassia fistula* on seed germination and seedling growth of *Triticum aestivum* was examined. The different concentrations of extracts i.e 2.5%, 5% and 10% of stem bark, leaves and pods significantly inhibited the seed germination and seedling growth of *Triticum aestivum*. The inhibition was noticed as concentration dependent. Bioassay with different solvents extracts showed that the ethyl acetate extract of stem bark, leaves and pods were more inhibitory than other extracts. The ethyl acetate extract yielded epiafzelechin, epicatechin, 1,8-dihydroxy-3-methyl anthraquinone (chrysophenol), 1,8-dihydroxy-3-methyl-6-methoxy-acetophenone (physcion), kaemferol and dihydroxykaempferol. The chemical studies revealed that the tannins and anthraquinone have shown maximum inhibition in germination, plumule and radicle growth of *Triticum aestivum*.

Aqueous leaves extracts of *Fraxinus micrantha* and coumarin compound (fraxetin) isolated from the leaves of the plant were tested for their allelopathic effects on germination and growth of *Brassica campestris*, *Eleusine coracana*, *Raphanus sativus* and *Triticum aestivum*, *Brassica campestris* and *Triticum aestivum* were found to be most susceptible to phytotoxic responses of aqueous extracts of *Fraxinus micrantha* and found to be concentration dependent. Coumarin compound (fraxetin) was found more toxic to all tested crops than the aqueous extracts. Bioassay of bark of *Fraxinus micrantha* with different solvents extracts showed that the butanol extract was more inhibitory than other extracts. The isolated compounds from butanol extract, (+)-1-hydroxypinoresinol and aglycone of fraxin (fraxetin) showed more inhibitory effect on the germination and growth of *Triticum aestivum* seedlings.

STUDIES ON THE ECO-BIOLOGY OF SELECTED TRIBUTARIES OF RIVER GANGA BETWEEN DEVPYAYAG & RISHIKESH

B.D. Joshi

***Head, Department of Zoology & Environmental Sciences
Dean, Faculty of Life Sciences, Gurukula Kangri University, Haridwar***

The present research work has been conducted under the project entitled "Studies on the ecobiology of selected tributaries of river Ganga between Devprayag and Rishikesh," during three years (1994-97) tenure of the project, sanctioned to us by the G.B. Pant Institute of Himalayan Environment and Development, Kosi, Almora. For this study, the water samples were collected from the six selected stations, which included three from tributaries (Goolar gad, Huanl west gad and Huanl east gad) and three sites from river Ganga (one each at Devprayag, Rishikesh and Shyampur). This Final Technical report of the Project includes 18 grand tables and 43 text figures/histograms/graphs. The following points can be summarised, out of this report :-

- * The air temperature was found low at tributaries as compared to river Ganga, this is mainly due to less time of its exposure to sunlight, as the rivulet sites and runway area is usually deep valleyed and shaded under forest canopy.
- * The water temperature was higher in tributaries as compared to river Ganga. This may be due to shallow water table of these rivulets (gads), and less sandy beaches around, as compared to the main river, besides

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the fact that the main river contains hundred times more water mainly arising from the melting of the glaciers, i.e. the main river is snowfed while the contributing rivulets are of spring origin.

- * In the tributaries the water shows greater periods of transparency than the main river, which is turbid not only during rains but during summers also when the snow melts at higher altitudes and brings a lot of eroded soil mass alongwith.
- * The current velocity was found to be directly proportional to the flood level and also with the gradients of the stretch. In tributaries velocity increases during monsoon and in river Ganga increases May onward, but was usually lowered during winters, on account of lesser water.
- * The turbidity was highest during monsoon period and lowest in winter. Turbidity was high in river Ganga in comparison to tributaries. For the selected sites of river Ganga, Shyampur station showed maximum turbidity, due to township sewage and factory drains of I.D.P.L..
- * The conductivity was always high during winter up to monsoon. The Huanl east gad and river Ganga at Shyampur showed high values of conductivity.
- * The total, dissolved and suspended solids were maximum in river Ganga as compared to tributaries.
- * pH was always observed neutral to alkaline in all six stations. High values were recorded during winter and low during monsoon months.
- * Bicarbonates were in higher amount in river Ganga as compared to tributaries. Among tributaries Huanl east gad showed maximum concentration.
- * The carbonate values were below the detection limit during July to September in Goolar, Huanl west and Huanl east gad, while in river Ganga, the values were very low in July-August. The higher values were noticed during winter.
- * Dissolved oxygen concentration was observed high in winter and low during monsoon. The high concentration was recorded in tributaries as compared to river Ganga.
- * High value of F-CO₂ was observed during monsoon months and low during winter months, at all six stations.
- * High value of BOD and COD were noted for river Ganga, as compared to the three tributaries. The COD vale was usually higher in all stations than the BOD.
- * The contents of calcium and magnesium were higher during winter months and lower during monsoon months, at all sampling stations.
- * The lower value of iron was observed in rainy season in river Ganga, while in tributaries no definite pattern of variation were found. Maximum values were recorded during winter months.
- * In tributaries high concentration of sodium and potassium was observed at Huanl east gad and Shyampur station in river Ganga. Lower values were recorded during winter and higher during monsoon months.
- * The higher values of phosphate were observed during June and July in all tributaries, but in the months of July and August in river Ganga. The lowest values of sodium was noted during winter months.
- * Higher phosphate contents in river Ganga were observed at Shyampur stations, and lowest at Devprayag stations. In tributaries Huanl east gad showed high concentration, as compared to others.
- * The nitrate contents were maximum during July in all tributaries, and round the monsoon period in river Ganga. The lowest values were observed during winter months.
- * The maximum chloride contents were observed during rainy season and minimum during winter months. In tributaries no definite pattern of variation were observed during the investigation period.
- * The DOM values were high at Shyampur in river Ganga and Huanl east gad as compared to others. High values were observed during rainy seasons and low during winter months.
- * The high density of benthic fauna was noticed at river Ganga at Shyampur station, as compared in the three tributaries. Among the benthic fauna, *Ephemeropterans* and *Tricopterans* constitute the maximum number, while *Dipterans* and *Crustaceans* contribute the minimum number at all sampling stations. The concentration of benthic fauna decreased during monsoon months.
- * Among the planktons, the Bacillariophyceae and Chlorophyceae constituted the minimum biomass at all sampling stations. Zooplanktons were high in river Ganga at Rishikesh and Shyampur stations.
- * The maximum productivity in terms of GPP and NPP was recorded at Goolar gad in comparison to others. Lowest productivity was observed at Devprayag for river Ganga, during monsoon.

- * The three tributaries of river Ganga harbors 44 species of freshwater teleost.
- * Among the diseases helminthic infections contributed, highest instances of parasitization. A total of about 207 fishes showing disease, is rather a higher proportions.

LANDSLIDES OF SIKKIM AS A FUNCTION OF THEIR AGE

C.B. Sunwar

Sikkim Government College, Tadong, Sikkim

Sites of study were selected in the East District of Sikkim, viz. Dhanukey, Pacheykhani and Buduney all differing in the termination of their activities by a margin of 10 years. Soil from these landslides were collected by random sampling and was treated for separation of clay fraction, fulvic acid fraction and humic acid fraction. Clay fraction contained mainly chlorite, Illite and Kaolinite. Humic acid fraction was treated with Sephadex and predominant fraction was found to lie in the molecular weight range of 5000-10000.

Chlorite and Kaolinite, available in pure form in the market, were treated to obtain their Na-form in colloidal form of $< 2 \mu\text{m}$ size with the following contents: Na-chlorite = 1.450g / 100ml and Na-kaolinite = 1.648g / 100ml. Na-kaolinite was treated with tetraethylthionine (TET) and Na-chlorite was treated with diquat and paraquat to produce complexes with the following contents:

Na-kaolinite-TET 1,225g / 100ml

Na-chlorite-diquat 1.814g / 100ml

Na-chlorite-paraquat 0.882g / 100ml

These were then treated with various organic and inorganic actions to study their capacity. The results are summarised below:

Exchanger	Inorganic ions	Organic ions
Na-kaolinite-TET	i. $\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{NH}_4^+ < \text{Rb}^+ < \text{Cs}^+$ ii. $\text{Mg}^{2+} < \text{Ca}^{2+} < \text{Sr}^{2+} < \text{Ba}^{2+}$ iii. $\text{Co}(\text{NH}_3)_6^{3+} < \text{Co}(\text{en})_3^{3+} < \text{Co}(\text{pn})_3^{3+}$	i. $\text{TMA}^+ < \text{TEA}^+ < \text{TPA}^+ < \text{TBA}^+$ ii. $\text{EDA}^{2+} < \text{PrDA}^{2+} < \text{BuDA}^{2+}$ iii. $\text{DTMA}^+ < \text{DDTMA}^+ < \text{DDP}^+ < \text{TDTMA}^+ < \text{CTMA}^+ < \text{CP}^+$
Na-chlorite-diquat	i. $\text{Li}^+ < \text{Na}^+ < \text{H}^+ < \text{K}^+ < \text{NH}_4^+ < \text{Rb}^+ < \text{Cs}^+$ ii. $\text{Mg}^{2+} < \text{Ca}^{2+} < \text{Sr}^{2+} < \text{Ba}^{2+}$	i. $\text{TBuA}^+ < \text{TPrA}^+ < \text{TEA}^+ < \text{TMA}^+$ ii. $\text{DTA}^+ < \text{DDTA}^+ < \text{CTA}^+ < \text{CP}^+$ iii. $\text{EDA}^{2+} < \text{PrDA}^{2+} < \text{BuDA}^{2+}$
Na-chlorite-paraquat	i. $\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{NH}_4^+ < \text{Rb}^+ < \text{Cs}^+$ ii. $\text{Mg}^{2+} < \text{Ca}^{2+} < \text{Sr}^{2+} < \text{Ba}^{2+}$	As above

The process of adsorption of TET onto Na-kaolinite was found to be exothermic.

Water-intake capacity and toluene-intake capacity of the clays of the landslide areas decreased and increased respectively with the introduction of organic molecules in the order of increasing molecular weight.

The extent of binding of metals by humic and fulvic acids followed the order $\text{Pb}^{2+} > \text{Cu}^{2+} > \text{Cd}^{2+} > \text{Ca}^{2+}$ whereas the proton releasing tendency due to the interaction of these ions with humic acid followed the other $\text{Cu}^{2+} > \text{Pb}^{2+} > \text{Cd}^{2+} > \text{Ca}^{2+}$.

Follow-up Actions:

1. Analysis of landslides all over Sikkim in terms of their clay-mineralogical composition to be done.
2. Treatment of active landslides with large-sized organic cations to examine the effect of their hydrophobic character in lessening the water-absorbing capacity of soil to be studied.
3. The viscosity of landslide clay-minerals under high pressure to be studied to further get an insight into the mechanism of landslide occurrence.

MASS PROPAGATION OF *DENDROCALAMUS HAMILTONII* AND *D. HOOKERI* USING SINGLE NODE CUTTING

Anil Sood

Division of Biotechnology, IHBT (CSIR), Palampur 176 061, H.P.

- * There has been an increase in the incidence of flowering in *D. hamiltonii* in these regions.
- * In some cases, a few culms show rejuvenation despite sporadic flowering where the flowering culms get shrivelled up.
- * A functional protocol for *D. hamiltonii* using nodal explants has been developed and tested for application in micropropagation and field transfer.
- * Elimination of shakers for multiple shoot and root induction has been a major accomplishment for reducing the overall cost of production.
- * Protocol is dependent on the rhythmic pattern of seasonal fluctuations and good rates of 'in vitro' proliferation are achieved only during the corresponding favourable seasons *ex vitro*.
- * Callusing and somatic embryogenesis in both the bamboos has resulted in accomplishing greater rates of plant production.
- * A suitable potting mix and poly-tunnels with fogging systems were designed and erected for ensuring acclimatization of bamboos.
- * Tissue culture raised plants of *D. hamiltonii* show faster growth in the fields as compared to the seedlings.

Selected Abstracts

Compiled by S.N. Nandy, D.S. Negi and S.K. Sinha

G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643, India

Agnihotri, S.K. 1997. **Naga hills district in the 19th century.** *Indian Journal of Public Administration*, XLII(2):222-231. Chairman, Administration Reforms and Chairman, Board of Revenue, Government of Meghalaya, Shillong. [ADMINISTRATION; AHOM; BOUNDARY; NAGA HILLS; TRIBES]

With a historical perspective, the author discusses, citing documentary evidence from archives, the dynamics of carving out of the Naga Hills District in the Nineteenth Century.

Ahmad, Mukhtar; Dayal, Rameshwar; Mishra, R.K. and Dobhal, P.C. 1997. **Antifeedant potency of some plants produce against defoliating pest of poplar, *Clostera cupreata*.** *Indian Forester*, 123(9):821-826. Forest Research Institute, Dehradun, India. [ALCOHOL; EUCALYPTUS TERETICORNIS; POPLAR; URSOLIC ACID]

Natural forest products have long been known to possess insecticidal, insect growth regulating and antifeedant properties. During present studies extractives of some forest produce including acetone and alcohol extracts of bark and roots of *Dalbergia stipulacea*, leaves of *Eucalyptus* hybrid and *Adina cordifolia*, ursolic acid and bryonolic acid were evaluated as insect antifeedant against poplar defoliator *Clostera cupreata* (Lepidoptera : Notodontidae). Ursolic acid (separated from *Eucalyptus* hybrid leaves extract) has shown maximum antifeedant activity and gave over 92 per cent protection of poplar leaves from its pest. It was followed by alcohol and acetone extracts of *Eucalyptus* hybrid leaves, bryonolic acid, acetone extract of *D. stipulacea* bark, alcohol extract of *A. cordifolia* leaves etc. Solvents play important role in extracting active ingredient of specific nature as acetone extracts of *D. stipulacea* were found more effective than their alcohol extracts while solvents (acetone and alcohol) did not show any antifeedant activity on their own.

Airi, S.; Rawal, R.S.; Dhar, U. and Purohit, Aditya N. 1997. **Population studies on *Podophyllum hexandrum* Royle - a dwindling, medicinal plant of the Himalaya.** *Plant Genetic Resource Newsletter*, 110:29-34. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India; High Altitude Plant Physiology Research Centre, Srinagar 246174, Garhwal, India. [BIOMASS; HIMALAYAN MAYAPPLE; SOIL ACIDITY; SUB-ALPINE]

The diversity of the genus *Podophyllum* and its distribution in the Himalayan region are presented. Himalayan mayapple (*Podophyllum hexandrum* Royle) is described in detail. The existing status of the species, habitat relationships and growth performance in the natural habitat were studied and analyzed in selected sites of Kumaun Himalaya. Several morphological and environmental features were identified which have bearing on below-ground biomass (the utilizable part). The species performs best in specific habitats (*Quercus-Abies* forest floor), at relatively low altitudes and in acidic soils. The utilizable part exhibited significant relationships with plant height ($P<0.05$), stem diameter ($P<0.001$) and leaf area ($P<0.001$) and negatively correlates with increasing altitude and soil pH.

Bag, Niladri; Palni, L.M.S. and Nandi, S.K. 1997. **Mass propagation of tea using tissue culture methods.** *Physiology and Molecular Biology of Plants*, 3:99-103. Division of Environmental Physiology and Biotechnology, G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643 U.P., India. [COMMERCIAL PLANTATION; EMBRYO FORMATION; GERMINATION; TEA CLONES; TISSUE CULTURE]

Cotyledons (from immature seeds) of tea [*Camellia sinensis* L. (O.Kuntze)] were cultured on full strength Murashige and Skoog's (MS) medium supplemented with 5.0 μ M 6-benzylaminopurine (BAP)

and 1.0 μM $\hat{\text{A}}$ -naphthalene acetic acid (NAA). Somatic embryo formation and *in vitro* germination occurred within a period of 120 days, giving rise to many plantlets. This was accelerated by doubling the concentration of BAP (10 μM), and by the addition of 0.5 μM gibberellic acid (GA_3) along with 1.0 μM NAA to the medium. In addition to this "direct" embryo formation, the same could also be obtained "indirectly", through a callus phase. An interesting feature of regeneration via somatic embryogenesis and also through shoot-bud induction is the gradual and asynchronous production without the loss of regeneration potential over long periods of culture. About 125 microshoots per 100 mg of initial tissue could be obtained in 6 subcultures. Furthermore, shoot multiplication using nodal explants has also been improved. Shoot doubling time was found to be about 6 weeks, and 60% rooting success has been achieved. Two distinct types of root formation were observed in *in vitro* raised "rootless" plants, with NAA or indole-3-butyric acid (IBA) treatments given separately. NAA treated shoots produced 2-14 unbranched roots whereas IBA promoted only 1-4 branched roots. The rooted plants were subsequently transferred to the community pots. The high frequency regeneration obtained in the present investigation can be useful for mass multiplication of desirable clones.

Berkes, Fikret; Davidson-Hunt, Iain and Davidson-Hunt, Kerril 1998. Diversity of common property resource use and diversity of social interests in the western Indian Himalaya. *Mountain Research and Development*, 18(1):19-33. Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada; Department of Anthropology, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada; The Taiga Institute for Land, Culture and Economy, 120 Second Street South, Kenora, Ontario P9N 1E9, Canada. [DIVERSITY; FIRE-WOOD; FODDER; FRAMEWORK; SOCIO-ECONOMIC]

Resources of mountain environments are often held and used as commons. This paper examines the use of mountain commons in two villages in the Manali area, Kullu valley, Himachal Pradesh, India, where the land settlement of 1886 provided the local people with well defined resource rights and allowed a degree of local control. Each village had a resource area which included a series of zones from agricultural land at about 2,000 m to the highest pastures at about 4,000 m. Within this area, ten categories of land use were identified: three kinds of private property agricultural land; four kinds of common-property grazing land; and three kinds of forest land, two of which had elements of common-property. Diversity of land use was due to a diversity of interests based on gender, caste, and ethnicity. Village-based social institutions. *mahila mandals* and members, allowed these diverse interests a voice in resource management.

Bhandari, B.S.; Mehta, J.P.; Nautiyal, B.P. and Tiwari, S.C. 1997. Structure of a Chir Pine (*Pinus roxburghii* Sarg.) community along an altitudinal gradient in Garhwal Himalaya. *International Journal of Ecology and Environmental Sciences*, 23(1):67-74. Department of Botany, Post Box 86, H.N.B. Garhwal University, Srinagar-Garhwal, India. [CHIR-PINE COMMUNITY; DIVERSITY; DOMINANCE; VEGETATION ANALYSIS]

Present study reports vegetational analysis of a forest dominated by *Pinus roxburghii* at different slopes. Competition was observed in shrub layer between *Berberis aristata* and *Rhus parviflora*, *Rubus ellipticus* and *Pyrus pashia*, and *Pyrus pashia* and *Berberis aristata*. Community diversity, beta-diversity and concentration of dominance ranged from 1.31 to 2.87; 2.0 to 2.96; and 0.09 to 0.207, respectively. Community diversity was highest (2.87) on the upper slope and was directly related to the number of shrub species. The concentration of dominance followed the opposite trend of diversity index at all the slopes.

Bhatt, B.P.; Chauhan, D.S. and Todaria, N.P. 1997. Crop growth soil under some social forestry plantation in Garhwal Himalaya. *Indian Journal of Forestry*, 20(2):198-200. Department of Forestry, P.O. Box-59, HNB Garhwal University, Srinagar Garhwal 246174, U.P. [EUCALYPTUS TERETICORNIS; FODDER; NUTRIENTS; SOIL EROSION]

Mean aerial dry matter yield of some major food crops- *Glycine max*, *Eleusine coracana*, *Hordeum vulgare* and *Zea mays* was recorded by growing them in soils influenced by some tree crop- *Alnus nepalensis*, *Pinus roxburghii*, *Prunus cerasoides* and *Sapindus mukorossi*. The dry matter accumulation of all the tested food crops increased significantly ($P < 0.05$) under the soils of the tree crops, whereas, the soil from outside of the plantation (control) responded with poor yield of the crops. *A. nepalensis* and *S. mukorossi* have the best potential to enhance the yield of the agricultural crops, on the other hand, soils of *P. roxburghii* yielded poorly and *P. cerasoides* soils ranked in between these two. Although, yield of *G. max* (leguminous C₃ crop) was not influenced very much by these soils, however, dry matter production of rest of the crops, depended very much on these soil influences (treatments).

Bisht, B.S. and Tiwari, P.C. 1997. **Occupational pattern and trend of rural out-migration: a study of Gomti watershed in U.P. Himalaya.** *Journal of Rural Development*, 16(2):329-339. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India; Senior Lecturer, D.S.B. Campus, Kumaun University, Nainital 263002. [CENSUS; EMPLOYMENT; INFRASTRUCTURE; MIGRATION; OCCUPATIONAL PATTERN]

In the U.P. Himalaya large scale out-migration creates many problems for implementation of developmental programme in both urban and rural areas. Due to very limited life supporting activities *i.e.*, low agricultural production, lack of industrial development and other activities, it is necessary for the working population of the hill region to migrate to other parts of the country for seeking livelihood. This paper highlights the trend of migration from the Central Himalayan region. The related factors that have been analysed are education, road connectivity and market/service centres scenario

Bist, Prabha; Kapoor, M.L.; Sharma, S.K. and Chauhan, J.M.S. 1997. **In Vitro clonal propagation of juvenile *Eucalyptus* hybrid (*E. Camaldulensis* Dehn. x *E. Tereticornis* SM.).** *Indian Journal of Forestry*, 20(1):. Division of Genetics & Tree Propagation, Forest Research Institute, Dehradun, U.P. [EUCALYPTUS TERETICORNIS; POLYTHENE; SEEDLING]

Nodal segments taken from aseptically raised seedlings of FRI-5 (*E. camaldulensis* Dehn. X *E. tereticornis* Sm.) were cultured on MS medium supplemented with different concentrations of BAP and NAA. The most effective BAP and NAA level for the induction of multiple shoot formation was BAP (1.0 mg/l)+NAA (1.0 mg/l). Elongation of shoots was achieved on 1/2 MS medium without any plant growth regulators. Rooting was achieved on 1/2 MS+IBA (1.0 mg/l). Plantlets so raised successfully transferred to pots and plantlets have attained a height of 60cm within two months. Plantlets can be developed successfully using this three step method described here.

Chakravarty-Kaul, Minoti 1998. **Transhumance and customary pastoral rights in Himachal Pradesh: claiming the high pastures for gaddis.** *Mountain Research and Development*, 18(1):5-17. Lady Shri Ram College, Lajpat Nagar, New Delhi 110024, India. [ALPINE PASTURE; NOMAD; PASTORAL INSTITUTION; TRANSHUMANCE]

Herding in Himalayan alpine pastures is as "old as the hills." As such practices could not have been sustained unless the pastures, in both the Himalaya and the plains of northern India, had been sustained, the claims of the Gaddi shepherds to both horizontal and vertical access to pastoral resources in the mountain commons are founded upon long-standing customary use. These practices were sustained by institutions of transhumance, a response to ecological demands whose design rested on constant and mutual adjustment between herding and cultivation, in both mountains and plains, to insure against specific seasonal risks and enhance preparedness against general uncertainty at different elevations. Such collective behavior was possible because of the complementary demands of the herders in the mountains and the cultivators in the valleys and plains. The gains from such practices for both groups induced each to uphold its own responsibilities. In the ecological balance in the environment was sustained. Since the nineteenth century, alterations in the political economy of the northern plains have changed the character of risk and shifted the nature of uncertainty. Dams, plantation forests, and canals have changed the plains and upset the ecological balance of their relations with the Himalaya. Increase in numbers of both humans

and animals has also altered the ecological balance on the commons. The customary institutions which had regulated herding and agricultural practices in the mountains have been eroded. This paper maps the nature of customary usage on the pastoral commons; examines the relations between these institutions and human and natural ecology; assesses the change in the nature of risk and uncertainty consequent to statutory and development interventions by the State; and advocates policy directions.

Chandra, S. and Dhyani, P.P. 1997. **Diurnal and monthly variation in leaf temperature, water vapor transfer and energy exchange in the leaves of *Ficus glomerata* during summer.** *Physiology and Molecular Biology of Plants*, 3:135-143. High Altitude Plant Physiology Research Center, H.N.B. Garhwal University, P.O. Box-14, Srinagar Garhwal 246174, India; G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [ENERGY EXCHANGE; FICUS GLOMERATA; LEAF TEMPERATURE; RADIATION; SEASONAL VARIATIONS]

Studies on diurnal and monthly variations in leaf temperature, water vapor transfer and energy balance per unit leaf area in the seedlings of *Ficus glomerata* revealed that it is slightly under temperature plant in which most of the energy absorbed by the leaves was lost in form of re-radiation, transpiration and conduction across two leaf surface which may be considered on of the causes of lower leaf temperature than the temperature of surrounding air and convection and conduction energy. As the conventional energy is inversely proportional to heat transfer resistance, the negative conventional energy (*i.e.* gain of energy by convection of heat) of this plant indicates that this species would be able to survive in considerably high air temperature and therefore would reduce the heat load of the surrounding air by cooling down the atmosphere around it. Therefore, the species could survive much better if planted on sites of mountains.

Das, A.K. 1997. **Less-Known uses of plants among the adis of Arunachal Pradesh.** *Ethnobotany*, 9:90-93. Coordinator, Arunachal University, P.G. Centre, Department of Botany, Jawaharlal Nehru College, Pasighat 791 103, Arunachal Pradesh, India. [ADIS; ARUNACHAL PRADESH; ETHNOBOTANY; FERN-ALLIES]

Adis constitute one of the important tribal groups of Arunachal Pradesh. The paper deals with the ethnobotany of one of the least-known and economically less important groups of plants, viz., ferns and fern-allies. Ferns are put into such diverse uses as rituals, beverage making, medicine, vegetables, famine food, etc. While giving a detailed list of such plants, brief descriptions of various uses and local name(s) and collection numbers are mentioned for ready reference.

Dayal, Rameshwar 1997. **Chemical investigation of medicinal plants.** *Indian Forester*, 123(3):249-255. Chemistry Division, Forest Research Institute, Dehradun, India. [ANTICANCER; MEDICINAL PLANT; PHYTOCHEMICAL; TISSUE CULTURE]

Since his existence on this planet man has had to depend on Nature for sustenance and survival. Medicinal plants have been used by him to keep himself healthy. According to the studies on ethnomedicine and folk medicine about 2000 species are newly identified as drug yielding plants and are well known for their use in about 4000 drug industries of various Indian systems of medicine. Phytochemical examination of a number of them has been carried out and active ingredients, isolated, identified are being currently used as drugs. Chemical examination of hitherto unexplored medicinal plants will help in discovering new drugs.

Dhar, U.; Rawal, R.S. and Samant, S.S. 1997. **Structural diversity and representativeness of forest vegetation in a protected area of Kumaun Himalaya, India: implications for conservation.** *Biodiversity and Conservation*, 6:1045-1062. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [COMPOSITION CHANGE; CONSERVATION; HIMALAYAN FORESTS; NATIVE; NON-NATIVE; POPULATION STRUCTURE]

Forest vegetation of a protected area (Askot wildlife sanctuary) in Kumaun (west Himalaya) was analysed for structure, composition and representativeness. A high percentage of non-natives was noticed

in herbaceous flora of all representative forest types. Floristic representativeness in all growth forms (tree, shrub and herbs) increased significantly (tree, $p < 0.05$; shrub and herbs, $p < 0.01$) with altitude. The population structures of trees suggest, (i) expansion of riverine and *Pinus roxburghii* forests; (ii) compositional changes in *Quercus leucotrichophora* and *Quercus lanuginosa* forests, largely owing to preferred extraction demand of inhabitants; and (iii) infrequent regeneration and declining population of *Quercus semecarpifolia* and *Abies pindrow* forests. The possible pathways of non-native introduction in the study area were examined. Considering the existing status of forest vegetation and future trends, proliferation of non-native species in most forest types was discussed. It is suggested that the compositional changes *vis-a-vis* proliferation of non-native species need priority attention while initiating conservation activities in the reserve.

Dhiman, R.C.; Thapliyal, R.C. and Singh, Jagdish 1997. One year field performance of three genetically controlled poplar clones with locally produced ETPs. Indian Journal of Forestry, 20(4):398-400. Forest Research Institute, P.O. New Forest, Dehradun. [AGRO-FORESTRY; GERMPLASM; POPLAR CLONES]

One year field performance of three identified poplar clones, *i.e.*, *Populus deltoides* G-3, G-48 and *P.x euromericana* is compared with one locally grown unidentified clone. Results indicate significant superiority of identified clones over unidentified locally grown clone in their height and diameter growth. Non-significant growth differences between the three identified clones were also observed.

Dimri, B.M.; Jha, M.N. and Gupta, M.K. 1997. Status of soil nitrogen at different altitudes in Garhwal Himalaya. Van Vigyan, 35(2):77-84. Division of Forest Soil & Land Reclamation, Forest Research Institute, Dehradun 248006. [ALTITUDE; FOREST SPECIES; GARHWAL HIMALAYA; SEASON; SOIL NITROGEN]

A study was conducted in Mungersanti range of Yamuna Forest Division of Garhwal Himalaya to determine the status of soil nitrogen in spring and autumn seasons at different altitudes. Soil supported by different forest species in the Himalayan region showed substantial variation in the soil nitrogen contents. Soils at higher altitude have higher nitrogen content which decreases with lowering altitude. It is thus clear that nitrogen content in soils increased with increasing altitudes. This is due to accumulation of litter and its snow and decomposition as affected by micro-climatic conditions. Soil nitrogen concentrations in autumn season were higher as compared to spring season at all altitudes. Soil nitrogen content showed significant negative correlation with depth in different seasons and altitudes.

Dobriyal, R.M.; Singh, G.S.; Rao, K.S. and Saxena, K.G. 1997. Medicinal plant resources in Chhakinal watershed in the northwestern Himalaya. Journal of Herbs, Species & Medicinal Plants, 5(1):15-27. Dabur Research Foundation, Gaziabad, India; G.B. Pant Institute of Himalayan Environment and Development, Kosi, Almora 263643, India; School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110067, India. [CONSERVATION; ECONOMICS; MEDICINAL PLANT; TRADITIONAL MEDICINE]

Traditional knowledge, uses, monetary costs, and benefits associated with medicinal plants were analyzed in the Chhakinal watershed of northwestern Himalaya. Of 29 plant species used in folk medicine, only 3 species, *Juglans regia*, *Picrorrhiza kurroa* and *Morchella esculenta* were noted to have market value. The medicinal value of four species, *Dioscorca deltoidea*, *Podophyllum hexandrum*, *Valeriana jatamansi* and *Jurinea macrocephala* were unknown to local people, but sold for cash income. Use of medicinal plants in the traditional health care system of the area varied, depending upon the species and ailment. A total of 11 species were used for disorders related to digestive system, six species were used for skin infections and three species were used for joint or muscular pain. The medicinal plants grew in government owned forests and other uncultivated lands as constituents of natural vegetation. Alpine vegetation had the greatest number of medicinal plant species, while forests had the greatest density of medicinal plants. Medicinal plants contributed 1.29 percent of annual cash income of an average household in the watershed.

Duffield, C.; Gardner, J.S.; Berkes, F. and Singh, R.B. 1998. **Local knowledge in the assessment of resource sustainability: case studies in Himachal Pradesh, India, and British Columbia, Canada.** *Mountain Research and Development*, 18(1):35-49. Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2; Department of Geography, University of Delhi, India. [CONSERVATION; SOCIOECONOMY; SUSTAINABILITY; WATERSHED]

The knowledge of local resource users and managers about the biophysical, socioeconomic, and cultural-historical elements of their immediate environment plays a significant role in determining the long-term sustainability of those resources. This paper reports on the results of two case studies from high mountain areas, one in the Upper Beas river watershed of the Indian Himalaya, and the other in the Arrow Lakes area of the Canadian Cordillera. Specifically, this paper describes sustainability indicators which were enumerated by local people in two differing cultural-historical, but environmentally similar, contexts. These indicators may be reflective of local, indigenous knowledge about the environment and therefore may be of significance in impact assessment and monitoring environmental change. Results from the Upper Beas watershed reveal a highly discriminated set of indicators which may be grouped as: forest cover indicators; forest-linked indicators; forest management indicators; agricultural livelihood indicators; and socioeconomic indicators. Local people demonstrated a very precise knowledge of the state of the biophysical resources of their village use areas. Specific indicators identified include; forest cover area (decreasing), forest species diversity (some species such as deodar decreasing), forest tree density (decreasing), consistency of water flow (decreasing) and frequency of avalanches and slides (increasing). These are all indicators which can be measured and verified independently of local knowledge. All suggest declining sustainability,. Residents in the Arrow Lakes area demonstrated much less precise knowledge of biophysical indicators of sustainability. They enumerated a set of indicators which emphasized institutional arrangements for forest and resource management. For example, few respondents identified the extent of forest cover as important whereas the majority identified forest/land use rules in place as being important indicators of sustainability. In both case studies, people mentioned a number of socioeconomic factors as being important indicators of sustainability.

Dutt, Bhupender; Kaushal, A.N. and Sharma, K.R. 1997. **Compatibility studies on some low commercial value lignocellulosic materials for wood Cement composites.** *Indian Journal of Forestry*, 20(3):296-299. Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173 230, H.P. [EUCALYPTUS TERETICORNIS; LIGNOCELLULOSIC; PINUS ROXBURGHII; POPULUS DELTOIDES]

The compatibility of seven low cost lignocellulosic materials with cement was examined by monitoring hydration parameters of temperature and time required to reach maximum temperature. Out of these saw dust of *Eucalyptus tereticornis* was found to be highly compatible, whereas whole woods of *Eucalyptus tereticornis* and *Populus deltoides* as well as saw dust of *Populus deltoides* and pruned material of *Malus domestica* was found to be moderately compatible *Pinus roxburghii* (needles) and *Parthenium hysterophorus* were found non-compatible.

Dutt, Bhupender; Ravishankar and Sharma, A.K. 1997. **Effect of combined treatment of chromium fixation and acetylation on some broad-leaved species.** *Indian Journal of Forestry*, 20(2):174-177. Department of Forest Products, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.) 173 230, India. [ACETYLATION; BROAD-LEAVED; CHROMIC ACID; DELTOIDES]

Combined treatment effect of the chromic acid and acetylation was studied on dimensional stability, Chromium leaching, water absorption and extractive leaching in *Populus deltoides* Bartr., *Celtis australis* Linn. and *Bombax ceiba* Linn. In acetylation followed by chromic acid application lower values of chromium pick up and the higher amount of hexavalent chromium leaching was observed. Chromic acid treatment followed by acetylation showed best results. No hexavalent chromium leaching was observed in this case. The water repellent effectiveness (WRE) values after 136 hrs., immersion in water was 41.04%, 51.44% and 44.95% in *P. deltoides*, *C. australis* and *B. ceiba*, respectively. The

corresponding reduction in water absorptivity (RWA) values was 29.68%, 32.82% and 30.94%, respectively. This treatment also reduced extractive leaching.

Farooq, S. and Pathak, G.K. 1997. **A herbal preparation for cough care.** *Indian Journal of Forestry*, 20(4):406-412. 57, Lytton Road, Dehradun 248 001; Vikas Loke Lane, 5 Sahastradhara Road, Dehradun 248 001, U.P. [COUGH CARE; ENZYME; HERBAL; SIALIC ACID]

K. Preparation (A herbal preparation for cough care certainly checks the effect of flyash influenced enzyme increase in GOT (Glutamic Oxaloacetic Transaminase), GPT (Glutamic Pyruvic Acid Transaminase) and Ca-Mg-ATPase (Calcium-Magnesium-ATPase) activities at the end of one week. There was no significant alteration of Protein, Carbohydrate and Sialic Acid contents of liver and lung tissues of rats after the treatment by *K. Preparation* and was also found effective against the effects of flyash to the rat serum parameters.

Gangoo, S.A.; Mughal, A.H. and Makaya, A.S. 1997. **Fertilizer response by two species of poplars on initial growth parameters.** *Indian Forester*, 123(3):240-244. Division of Forestry, S.K. University of Agricultural Science and Technology, Srinagar (J&K). [BIOMASS; COLLAR DIAMETER; POPLAR; ROOT-SHOOT RATIO]

The paper presents a study on the growth behavior of two poplar species namely *Populus deltoides* and *Populus nigra* by giving different doses of fertilizer. The results indicate that N₁₅₀ P₁₂₀ M₂₀ is the best dose for *Populus deltoides* and N₁₅₀ P₁₂₀ M₁₀ is the best dose for *Populus nigra* for obtaining optimum height. Individually phosphorus and Nitrogen increases the height and diameter of both the species but there is no effect of fertilizer on root-shoot ratio and number of roots/plant in both the species.

Ghosh, S.; Sen, K.K.; Rana, U.; Rao, K.S. and Saxena, K.G. 1997. **GIS application to natural resource management and development planning in a rural area - Pranmati watershed, Garhwal Himalayas, India.** In: *MENRIS Case Study Series No.5.* (July 1997 ed.) International Centre for Integrated Mountain Development, Kathmandu. 26 pages. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India [DATABASE; GIS; NATURAL RESOURCE; PLANNING; REMOTE SENSING]

Govil, Kailash C. and Verma, Anjali 1997. **Conceptual framework - A product of mental plan of the research design.** *Indian Forester*, 123(9):806-810. Winrock International, Dehradun, U.P. [CONCEPTUAL FRAMEWORK; DATA COLLECTION; MENTAL PLAN]

Development of conceptual framework of a research design can be compared to a mental process which regulates human efforts to achieve useful results. It can be treated as a network of efforts/steps, in which every step or effort is related to the other step/effort, either directly or indirectly. This framework, therefore, defines each efforts, gives the causal relationship, direction and appropriateness to the research efforts. While addressing the conceptual framework the researcher should understand the different steps/efforts which are of methods and procedures to be followed, means of data collection and observation, method of analysis and how inferences should be drawn. The researcher must also exercise back and forth to ensure compatibility between various efforts/steps of the conceptual framework. The selective arrangement, placement and linkages of the efforts within the context and boundary of the conceptual framework is very crucial to the research design and any lapse or fault at any step may lead to unreliable and irrelevant results. However, the boundaries and structure of the conceptual framework do not have a rigid format but are quite flexible. In order to make the research reliable and credible, the researcher has to build a proper structure, context and define the boundary of conceptual framework.

Gupta, S.C. 1997. **Joint forest management heralds a novel approach in Kullu.** *Indian Forester*, 123(6):512-518. Conservator of Forests, Kullu, Himachal Pradesh. [DEODAR; FODDER; FOREST MANAGEMENT; FUEL-WOOD; GRASSLANDS]

The JFM was started in Kullu during September, 1994. The staff took an initiative and the JFM Support Team through various participatory training workshops sensitised the field staff as well as local people to bring about an attitudinal change. Nine VFDCs have been formed and six micro plans prepared during last two and half years. The JFM approach has been successful inspite of many apprehensions expressed in the beginning.

Jamir, N.S. 1997. **Ethnobiology of Naga tribe in Nagaland: I-medicinal herbs.** *Ethnobotany*, 9:101-104. Department of Botany, Nagaland University, H.Q. Lumami Camp, Mokokchung, Nagaland 798 601, India. [BIODIVERSITY; CONSERVATION; ETHNOMEDICINE; NAGALAND]

The State of Nagaland is situated in the north eastern region of India, which is inhabited by 14 major tribes. The state is perhaps endowed with the richest flora and fauna in the country. This biodiversity in the state is being utilised by these tribal people for their existence and livelihood, including multipurpose uses as herbal medicine. *Panax pseudo-ginseng* is used as tonic and to dissolve tumours. *Viscum articulata* is used for rheumatism, *Clerodendrum colebrookianum* for reducing high blood pressure, *Bambusa tulda* for abortion, *Laggera alata* for stomach ulcer and tumour, and so on. The author stresses the crying need for survey and conservation of these valuable plants, because many of them are on the verge of extinction due to rampant deforestation and denotation of land.

Jamwal, Mamta and Kaul, B.L. 1997. **Cytomorphological studies in colchicine induced autotetraploids of *Apium graveolens* var. *Dulce*.** *Indian Journal of Forestry*, 20(3):269-274. Department of Botanical Sciences, Regional Research Laboratory, Jammu, J&K. [POLYPLOIDY; SEEDLING; STOMATAL; TETRAPLOIDS]

Autotetraploids of *Apium graveolens* were produced following seedling treatment with aq. colchicine solution. Seed treatment for the given duration was found to be totally ineffective. The tetraploids exhibited delayed flowering and initial slow growth with reduction in plant height. There was improvement in the size of stomata and pollen diameter, while decrease was observed in stomatal frequency per microscopic field, number of branches and pollen stainability. Although bivalents were more common, varying number of quadrivalents, trivalents and univalents were also observed. There was decrease in the seed yield of tetraploids which is the deleterious effect of polyploidy.

Joshi, D.N. and Rawat, G.S. 1997. **Need for conservation and propagation of alpine and sub-alpine medicinal plants of north-west Himalayas.** *Indian Forester*, 123(9):811-814. Non-Wood Forest Products Division, Forest Research Institute, Dehradun, India. [CONSERVATION; MEDICINAL PLANT; PHARMACEUTICAL; SUB-ALPINE]

The alpine and sub-alpine areas of North-West Himalayas provides a matchless wealth of highly priced medicinal, aromatic plants and are known as a natural reservoir of these herbs. In alpine pasture and meadows (bugyals) due to continuous loss of forest land, uncontrolled grazing and irregular exploitation of medicinal herbs by commercial enterprises have resulted in depletion of valuable medicinal plants used since ancient times. There are many medicinal plants which have become rare in several tracts while a few others have fallen in the list of endangered species. Therefore it has been felt that there is an urgent need for conservation, *ex-situ* and *in-situ* cultivation of these valuable and threatened species by establishing high altitude nurseries in their natural habitat, so that regular supply to pharmaceutical industries and users could be maintained and above all this valuable flora of the alpine/sub-alpine areas of North-West Himalayas could be conserved.

Kalia, Shamila; Kaushal, B.R. and Pant, N.C. 1997. **Damage potential of the weevil *Dicranognathus Nebulosus redtenbacher* (Coleoptera: attellabidae) in the Kumaun region.** *Indian Journal of Forestry*, 20(4):319-323. T.F.R.I.; P.O.R.F.R.C.; Mandla Road, Jabalpur (M.P.) 482021; Reader, Department of Zoology, Kumaun University, Nainital 263 002 (U.P.). [DICRANOGNATHUS NEBULOSUS; FIRE-WOOD; FODDER]

Dicranognathus nebulosus Redtenbacher (Coleopter:Attelabidae) is a major pest of *Quercus leucotrichophora* in the Kumaun Himalayas. The percentage damage caused by this insect was studied in the laboratory and in the field for two years. The average percentage infestation was 51.6% in the first year and 50.3% in the second year respectively. Only a very small percentage of the weevils survive to continue the cycle because the environmental factors of resistance were high in the field.

Kanwar, Kamlesh; Khosla, P.K.; Rana, Rajesh K. and Pamposh 1997. Micropropagation of thornless/nearly thornless *Robinia Pseudoacacia*L. - An analysis of production cost. *Indian Journal of Forestry*, 20(3):248-250. Department of Silvi & Agroforestry, UHF, Nauni, Solan; Directorate of Extension, UHF, Nauni, Solan; Regional Centre, NAEB, UHF, Nauni, Solan; Department of Tree Improvement, UHF, Nauni, Solan (H.P.). [FODDER; FUEL-WOOD; HONEY BEE; TISSUE CULTURE]

*Robinia pseudoacacia*L. commonly known as black locust; being very promising for soil conservation, excellent fodder, good quality fuel-wood, propagation through suckers, honey bee flora and atmospheric nitrogen fixation, is extensively desired by the farmers. However the presence of spiny stipules on the branches, makes its lopping difficult and lower palatability of the fodder considerably. Detailed cost of propagation thornless/nearly thornless *Robinia* (from natural selection) through tissue culture method and measures to lower this production cost are discussed.

Kaushal, R.; Bhandari, A.R.; Sharma, J.C. and Tripathi, D. 1997. Soil fertility status under natural Deodar (*Cedrus Deodara*) forest ecosystem of North-West Himalayas. *Indian Journal of Forestry*, 20(2):105-111. Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173 230, H.P. [BIOMASS; DEODAR; MICRO-NUTRIENT; SOIL FERTILITY]

Some soil profiles developed under temperate zone of Himalayan forest ecosystem, representing Typic Hapludolls and Typic Udorthents were studied for physico-chemical properties (pH, organic carbon, EC, CEC and CaCO₃) and available macro and micro-nutrient status. The soils are normal in reaction, high in organic carbon (OC), available P and K, low to medium in available N, medium to high in SO₄ -S, high in available of Na, Ca, Mg, Fe and Mn contents and low to medium in Zn and Cu supply. Available N and K showed significant and positive relationship with OC, CEC and negative with sand. Available P was significantly and positively correlated with EC, OC, CEC and negative with Ca CO₃. SO₄ -S exhibited significant and positive relationship with EC, OC and negative with CaCO₃. DTPA extractable micro-nutrient actions (Zn, Cu, Fe and Mn) showed significant and positive relationship with OC, EC, CEC and negative with pH, CaCO₃ and sand. On the basis of fertility status of soils the locations could be arranged in descending order : Kalpa > Kilba > Shongtong > Thangi > Moorang > Ribba.

Kaushik, Purshotam and Dhiman, Anil Kumar 1997. Some vedic medicinal plants. *Advances in Plant Sciences*, 9(II):1-12. Botany Department, Gurukul Kangri Vishwavidyalaya, Haridwar 249 404, India. [ATHRAVA VEDA; FOLK MEDICINE; MEDICINAL USES; VEDAS]

This paper gives the use of plants particularly for their medicinal potential since antiquity, recorded in the vedas which comprise the oldest literature of the world where the information has been presented in the form of hymns. The vedic information was modified and adopted by Sanskrit scholars that resulted the compilation of the *Samhitas*, the *Brahman granths* and the *Nighantus*.

Kharel, Fanindra R. 1997. Agricultural crop and livestock depredation by wildlife in Langtang National Park, Nepal. *Mountain Research and Development*, 17(2):127-134. Planning Officer, Ministry of Forest and Soil Conservation, P.O. Box 3987, Singha Durbar Complex, Kathmandu, Nepal. [CROP DEPREDATION; LIVELIHOOD; LIVESTOCK; NEPAL; WILDLIFE]

A national park model that neglects the subsistence needs of the local people and denies them benefits from the park and lead to resentment and conflict. About 35,000 people living in and around Langtang National are dependent mainly on agriculture for their livelihood. Agricultural crop and livestock depredation by wildlife results in disputes between the park authorities and the local people.

Potential solutions discussed here emphasize the need for the Langtang National Park administration to accept responsibility for the protection of crops and livestock from park wildlife.

Kumar, Anil; Nagar, P.K.; Gupta, Akshey K. and Palni, L.M.S. 1997. **Studies of dormancy in *in vitro* produced cormlets and *in vivo* produced cormels and changes in the levels of IAA and carbohydrates during storage of cormels in *Gladiolus*.** *Physiology and Molecular Biology of Plants*, 3:117-122. Division of Biotechnology, Institute of Himalayan Bioresource Technology (CSIR), Palampur, Kangra 176061, India; G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [ALDEBARAN; DORMANCY INDEX; ENZYME; GLADIOLUS CORMELS; HORMONES]

Cormlets of *Gladiolus* produced under *in vitro* conditions in PGR free MS medium containing 0.232 M sucrose were found to be dormant. The level of dormancy in these cormlets was comparable to that of conventionally *i.e.*, field produced cormels. Incorporation of NAA (>10.0 µM) to the medium inhibited the development of dormancy. Conventionally raised cormels, at the time of harvest exhibited strong dormancy, and a dormancy index (DI) of more than 6 was recorded, the value of which decreased rapidly during storage at room temperature. Endogenous free IAA was detected in cormels only after 75 days of storage (with concomitant release of dormancy) and the levels increased subsequently. The starch content was high in cormels at the time of harvest and started to decline after 30 days of storage, while total soluble sugars and reducing sugars were found to increase. These changes appear to be correlated with the release of dormancy in *gladiolus* cormels.

Kumar, Anjani and Kumar, Abha S. 1997. **Micropropagation of *Duabanga Grandiflora*.** *Indian Journal of Forestry*, 20(2):129-131. Department of Botany, North-Eastern Hill University, Shillong 793 014, India. [BENZYLADENINE; BIOMASS; COTYLEDONERY; MICROSHOOTS; SEED GERMINATION]

Multiple shoots were obtained by culturing cotyledonery nodes of *in vitro* germinated seeds of *Duabanga grandiflora* on Murashige and Skoog's (MS) medium supplemented with benzyladenine at range of concentrations (0.5 - 5.0 mg/l). Nodal segments obtained from *in vitro* proliferated shoots gave rise to multiple shoots on the same medium containing 2.0 mg/l benzyladenine. Subcultures resulted in rapid shoot multiplication at an average rate of 6 fold per subculture. Isolated microshoots rooted on MS medium containing 0.1 mg/l each of 3-Indole butyric acid and 1-Naphthalene acetic acid. The regenerates were successfully transferred to pots containing soil under glass house conditions.

Lalramnghinglova, J.H. and Jha, L.K. 1997. **Ethnomedicine from Mizoram - North East India.** *Ethnobotany*, 9:105-111. Department of Forestry, North-Eastern Hill University, Mizoram Campus, Aizwal 796 012, India. [ETHNIC COMMUNITIES; ETHNOMEDICINAL PLANTS; ETHNOMEDICINE; MIZORAM; NORTH EAST INDIA]

A brief account is given of recent field studies carried out in Mizoram-North-East India. Ethnomedicine comprises mineral products, medicinal plants, including veterinary plants used in combination for the treatment of bone-setting, bleeding, cancer, etc., and combinations of plants and animals which are used traditionally by different ethnic communities, *viz.*, *Chakma, Mizo, Mara, Lai, Bru, Bawm and Pang*.

Lalwani, Mahesh and Thomas, Eugene D. 1997. **Incedence of poverty in Meghalaya villages.** *Journal of Rural Development*, 16(3):401-414. Department of Economics, North Eastern Hill University, Shillong 793014. [HEAD COUNT RATIO; INCOME LEVEL; POVERTY GAP RATIO; POVERTY INCIDENCE; SEN'S INDEX]

Sharp inter-district variation in poverty incidence is found within the state of Meghalaya. And in each district, such a variation presents shocking proportions at block and village levels giving clear signals to planners that in matters of fund allocation and related logistics, poverty eradication programme must not use state totals. District and block totals would serve the purpose better. About the poverty incidence in the state, there are no official estimates either from the state of Central Government. So this study is

modest exercise in this direction. Based on 4701 households selected from fifty villages across all the districts in the state, this study having cost and time limitations surely may be found lacking the econometric vigour but its simplicity and modesty in presenting crude poverty estimates, through ratios and percentages does make it worst looking at by the people who shape the destiny of this country. Out of fifty sample villages, as many as 20 villages had a poor's Head Count Ration (HCR) exceeding or equivalent to 75 per cent. Another 10 sample villages registered an HCR of the poor varying between 50 per cent and 74 per cent. Of the remaining twenty village, only five villages registered a low HCR of less than or equal to 15 per cent.

Lata, Sneh 1997. Indigenous knowledge about *Grewia optiva* in Indo-Nepal Himalaya. *Ethnobotany*, 9:112-116. Institute of Ethnobiology, C/o. National Botanical Research Institute, Lucknow 226 001, India. [GREWIA OPTIVA; INDIGENOUS USES; INDO-NEPAL HIMALAYA]

Grewia optiva Drumm. ex Burret (Tiliaceae), an important multipurpose tree of Indo-Nepal Himalaya, is used for fodder, fibre, fuel, fruits, medicine and various other purposes. The present study was aimed at recording indigenous knowledge about this plant in Indo-Nepal Himalaya. Uses were recorded in field, from literature and also from herbarium specimens. During field work, some new uses were noted.

Mahajan, N.; Kalia, M. and Kataria, S.R. 1997. Food consumption by rural population of selected areas of Mandi district of Himachal Pradesh (India). *Journal of Rural Development*, 16(1):167-171. Food Science and Nutrition, College of Home Science, Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh. [FOOD HABITS; FOOD INTAKE; NUTRITION; RDA]

The study was conducted on one hundred and fifty subjects selected from rural areas of Mandi district of Himachal Pradesh (India). The food consumption survey was carried out to assess the mean food intake by different age groups of the selected population. It was found that consumption of pulses and milk and milk products was the same in male and female children, whereas the consumption of remaining foods was more in females than in males. Intake of pulses, fats and oils only met the recommended dietary allowances (RDA). The adolescents consumed more of vegetables and milk when compared with RDA. In case of adults, intake of cereals, pulses, fats, and oils, sugar and jaggery was adequate whereas consumption of vegetables was above RDA. In the aged persons, the overall intake of all the food groups was adequate.

Maikhuri, R.K.; Nautiyal, S.; Rao, K.S. and Saxena, K.G. 1998. Medicinal plant cultivation and biosphere reserve management: A case study from the Nanda Devi Biosphere Reserve, Himalaya. *Current Science*, 74(2):157-163. G.B. Pant Institute of Himalayan Environment and Development, Garhwal Unit, P.O.Box 92, Srinagar (Garhwal) 246 174, India; G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643, India; School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110 067, India. [AGROECONOMY; BUFFER ZONE; FLORAL BIOLOGY; MEDICINAL PLANT]

Conservation-induced natural resource management options are of significance for effective management of biosphere reserves where people reserve conflicts are the prime attention of management plans. Nanda Devi Biosphere Reserve (NDBR) in Garhwal Himalaya is one such area where existing conflicts drew researchers' attention on management of natural resources. The cultivation of medicinal plants existing in this area has become a major activity with conservation-oriented land use changes. We describe here the agronomic practice and uses of eight medicinal and aromatic plants cultivated in the NDBR buffer zone villages of Garhwal Himalaya. The efficiency of resource use and economic returns indicate how such low-volume, high value crops which were suggested for this region have not only the potential for economic betterment of people of this area but also help the cause of conservation in this biosphere reserve.

Maikhuri, R.K.; Semwal, R.L.; Rao, K.S. and Saxena, K.G. 1997. Agroforestry for rehabilitation of degraded community lands: a case study in the Garhwal Himalaya, India. *International Tree Crops Journal*, 9:89-99. G.B. Pant Institute of Himalayan Environment & Development, Garhwal Unit, Post Box 92, Srinagar (Garhwal) 246174, India; G.B. Pant Institute of Himalayan Environment & Development, Kosi-Katarmal, Almora 263643, India; School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110067, India. [IRRIGATION; PARTICIPATORY RESEARCH; RAINFED SYSTEM; WATER HARVESTING]

An agroforestry approach for rehabilitation of degraded village community lands was developed and tested in a mid-altitude village (1200 m amsl.) in the Garhwal Himalaya. Components of the rehabilitation project were based on informal discussions with villagers. The approach involved creation of supplemental irrigation capacity through water-harvesting tank technology and planting of native multipurpose trees, and economically important crops preferred by the local communities. Involvement of the whole village community in the decision making process was identified as a potential mechanism of securing local participation. Supplemental irrigation improved survival and growth of tree species, and also crop yield. The increase in survival of trees ranged from 39% in *Albizia lebbek* to 164% in *Boehmeria rugulosa*. Growth response to irrigation was most prominent in *Grewia oppositifolia*, in terms of height, and in *B. rugulosa*, in terms of diameter at collar height. Irrigation enabled higher crop yields with substantially lower organic manure and seed inputs compared to the rainfed, or non-irrigated system. Monetary output:input ratio of crop component in irrigated system was recovered over a period of three years. It is concluded that agroforestry systems, based on traditional knowledge system with water management as an integral component, would be more effective for rehabilitation of degraded community lands than afforestation in the Himalaya.

Maikhuri, R.K.; Semwal, R.L.; Rao, K.S. and Saxena, K.G. 1997. Rehabilitation of degraded community lands for sustainable development in Himalaya: a case study in Garhwal Himalaya, India. *International Journal of Sustainable Development and World Ecology*, 4:192-203. G.B. Pant Institute of Himalayan Environment & Development, Garhwal Unit, Post Box 92, Srinagar (Garhwal) 246174, India; G.B. Pant Institute of Himalayan Environment & Development, Kosi-Katarmal, Almora 263643, India; School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110067, India. [AGRO-FORESTRY; COMMUNITY LANDS; LOCAL PARTICIPATION; PEOPLE'S PERCEPTION; SUSTAINABLE DEVELOPMENT; TRADITIONAL KNOWLEDGE; WATER HARVESTING]

An approach to the rehabilitation of degraded lands built on people's perceptions and traditional knowledge was developed, implemented on a small scale (6 ha plot), and evaluated in terms of economic and ecological costs and benefits over a period of 5 years in a mid-altitude (1200m) village of Garhwal Himalaya. Rehabilitation comprised establishment of water harvesting tanks, organic management of soil, agroforestry (native multipurpose trees+traditional crops), and decision making by the whole village community. Costs and benefits under irrigated and unirrigated conditions were compared. The total cost of establishing the irrigated agroforestry system was 1.23 fold that of the unirrigated one, whereas the total benefit was 2.09 fold. The average standing above-ground biomass of the 4-year-old plantation in the irrigated agroforestry system was 11.69 t/ha compared to 8.34 t/ha in the unirrigated system. Improvement in soil properties was more pronounced in the irrigated system than in the unirrigated one. Nutrient input, an input derived largely from forest biomass, in the unirrigated system was nearly 3 times higher than that in the irrigated system. It is concluded that, considering the local and national/regional/global interests in an integrated manner, agroforestry incorporating water management would be a more effective option for rehabilitating degraded community lands than the afforestation currently being attempted by the government in the mid-altitudes of Indian Himalaya.

Manibabu, Mayanglambam 1997. Marriage type and marital distance among the Phayeng (Manipur). *Man in India*, 77(4):387-390. Oriental College, Imphal 795001 (Manipur). [EXOGENY;

MARRIAGE TYPE; MEAN MARRIAGE DISTANCE; POPULATION GENETICS; VILLAGE ENDOGAMY]

Marriage type, incidence of village endogamy/exogamy and distribution of marriage distance of the Phayeng population is reported; and the mean marital distance recorded is 3.56 ± 0.46 km. The population under study has a high rate of village endogamy and consanguineous marriage, which may probably be due to the mate availability, social pattern, geographical distributional pattern of different *loi/chakpa* group. The MMD of consanguineous and affinal types of marriage show very high significant difference. The population reveals positively skewed and leptokurtic marriage distribution.

Mehrotra, M.D. 1997. **Diseases of *Paulownia* and their management.** *Indian Forester*, 123(1):66-72. Forest Pathology Division, Forest Research Institute, Dehradun, India. [AGRO-FORESTRY; DAMPING-OFF; PAULOWNIA; PLANTATION; SEEDLING]

Diseases of *Paulownia*, an exotic to India, have been studied in the nursery and young plantations and management of the potentially destructive diseases has been worked out. In all seven fungal diseases and one bacterial disease have been recorded on *P. fortunei*. They are damping-off caused by *Rhizoctonia solani*, root and basal rot by *Rusarium* sp. and *R. solani*, leaf spotting and blight by *Corynespora cassiicola*, *Cercospora* sp. and *Pseudocercospora* sp. and leaf blight by *R. solani* and *Phytophthora nicotianae*. Of the above diseases root and basal rot, *Pseudocercospora* and *Corynespora* leaf spotting and blight and leaf blight by *Phytophthora nicotianae* and *R. solani* are the diseases hitherto unknown and are reported for the first time. Root and basal rot, which is highly destructive and is responsible for routing the plantation at New Forest, has been successfully controlled through cultural practices involving mound planting or planting on raised strips and soil amendment by mixing sand with soil (1:1). Root/shoot cuttings if planted in February-March ensures the young crop free from root and basal rot as the tissues become sufficiently mature by the time monsoon rains set in. Similarly, potting mixture with soil and sand (2:1) and 2 per cent well decomposed FYM is recommended to minimise the disease. A bacterial disease caused by a rod-shaped bacterium is the first record of the disease on *P. fortunei*, *Cladosporium cladosporioides* plastering the lower leaf surface and a sooty mold growing on the upper leaf surface are recorded. On *P. tomentosa* the diseases have been studied in the nursery only. Five fungal diseases recorded on this species are damping-off caused by *Fusarium* sp. and *Rhizoctonia solani*, leaf spotting and blight by *Cercospora* sp. *Pseudocercospora* sp. and *Corynespora cassiicola* and leaf blight by *P. nicotianae*. Both *Paulownia* species show high susceptibility to *Meloidogyne*, the root knot nematode. Use of deoiled neem cake @ 15 g/per pot is recommended to overcome the nematode problem in the nursery.

Mishra, Charudutt 1997. **Livestock depredation by large carnivores in the Indian trans-Himalaya: conflict perceptions and conservation prospects.** *Environmental Conservation*, 24(4):338-343. Centre for Ecological Research & Conservation, 3076/5, IV Cross Gokulam Park, Mysore 570 002, India. [CANIS LUPUS; CONFLICT; LIVESTOCK; SNOW LEOPARD; WOLF]

Livestock depredation by the snow leopard, *Uncia uncia*, and the wolf, *Canis lupus*, has resulted in a human-wildlife conflict that hinders the conservation of these globally-threatened species throughout their range. This paper analyses the alleged economic loss due to livestock depredation by these carnivores, and the retaliatory responses of an agro-pastoral community around Kibber Wildlife Sanctuary in the Indian trans-Himalaya. The three villages studies (80 house-holds) attributed a total of 189 livestock deaths (18% of the livestock holding) over a period of 18 months to wild predators, and this would amount to a loss per house-hold equipment to half the average annual per capita income. The financial compensation received by the villagers from the Government amounted to 3% of the perceived annual loss. Recent intensification of the conflict seems related to a 37.7% increase in livestock holding in the last decade. Villagers have been killing the wolf, though apparently not the snow leopard. A self-financed compensation scheme, and modification of existing livestock pens are suggested as area-specific short-term measures to reduce the conflict. The need to address the problem of increasing livestock holding in the long run is emphasized.

Mishra, Harendra Nath 1997. **A case study on Eucal-Pole columns.** *Indian Journal of Forestry*, 20(2):168-173. Timber Engineering (DFPR), Forest Research Institute (ICFRE), Dehradun. [BAMBOOS; EUCAL-POLES; EUCALYPTUS TERETICORNIS]

Results of different use patterns of *Eucalyptus* poles as column in very ordinary condition subjected to alternate rains and sun rays and frequent growth of debris and vegetations on the adjacent area of construction have been presented. Poles seasoned under shade developed surface cracks before use. Hot bitumen was applied on the lower portion by brushing only. Inner part remained untreated. Deeper cracks developed on the poles due to alternate effects of wetting and drying. Results of providing c.c. layer around the lower part including the embedded portion of columns and installation of some new poles over the raised round dwarf c.c. pillars also been discussed in this paper.

Mishra, V.K. and Chauhan, Sanjeev K. 1997. **Response of N and P fertilizers on *Ulmus villosa* seedlings morphological indices and fertilizer response function.** *Indian Journal of Forestry*, 20(1):74-77. Department of Silviculture and Agroforestry, University of Horticulture & Forestry, Nauni 173 230, H.P. [BIOMASS; FODDER; MORPHOLOGICAL TRACES; SEEDLING]

Effect of four levels of nitrogen (0,40,80 and 120 kg/ha.) and three levels of phosphorus (0,30 and 60 kg/ha.) was studied on *Ulmus villosa* in the nursery. The growth and biomass attributes were recorded and the indices were worked out from the recorded data. The N and P fertilizer application contributed significantly to the morphological indices. The fertilizer response functions have also been developed. The maximum predicted outplanting survival was worked out at a combination of 122.43 kg N plus 65.91 kg P₂O₅/ha. during 1991 and 111.45 kg N plus 60.77 kg P₂O₅/ha. during 1992.

Nandi, S.K.; Rikhari, H.C.; Nadeem, M. and Palni, L.M.S. 1997. **Clonal propagation of *Taxus baccata* L. - a Himalayan asset under threat.** *Physiology and Molecular Biology of Plants*, 3:15-24. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [CANOPY LOSS; LEAF AREA INDEX; SEASONAL VARIATIONS; TAXUS BACCATA; VEGETATIVE PROPAGATION]

A survey has been conducted to estimate the canopy loss of *Taxus baccata* L. (family Taxaceae) trees growing in the Jageshwar area of Central Himalaya. Observations from 763 trees covering an area of 9.54 ha, and calculations based on C-2000 computer programme (Licor) indicate 57.4% canopy removal. In order to compensate for the damage, a simple technique for rapid and clonal (vegetative) multiplication of this species has been developed using cuttings from young shoots (1st year's growth). To determine the most appropriate time for raising maximum number of plants, a systematic study of the seasonal effect (*i.e.* monsoon, autumn, winter and spring), if any on adventitious rooting by using two auxins (IBA and NAA), phenolic compounds (phloroglucinol, gentisic acid and coumarin), a combination of auxins and phenolics, and a systemic fungicide Bavistin has been carried out. During the monsoon (July), high rooting success (>70%) was observed with 0.25 mM IBA, 0.25 mM NAA and 0.05% Bavistin. Coumarin, gentisic acid and the combined treatment of auxins and phenolics failed to promote rooting. Cuttings collected and planted in autumn (October), had low survival rate in most treatments (including control) but more success in rooting (25-40%) was observed with IBA (0.25 and 1.25 mM), 0.25 mM NAA and 0.05% Bavistin. In winter (January), neither callusing nor rooting were observed in control treatments. However, significant increases in callusing (25-100%) and rooting (20-70%) were detected following treatment with IBA (0.25 and 1.25 mM), NAA (0.25 mM), IBA + NAA, phlorostimulatory effect on adventitious rooting by these chemicals during winter was found to be similar to that of the monsoon season although to a lesser extent. All cuttings collected and planted during spring (April) did not survive. Thus, the seasonal effect on chemical induction of rooting stem cuttings declined in the order: monsoon>winter>autumn. The survival of monsoon grown 10-month-old cutting-raised plants in polyhouse, was found to be 71% and 63% following 5 and 14 months, respectively, after transfer to field in its natural habitat. It is hoped that these findings will pave the way for augmenting the reportedly very

poor natural regeneration through "seed", and for conservation of this species which is being excessively collected from the Himalayan forests for the highly priced anticancerous drug, taxol.

Nautiyal, B.P.; Pandey, Nirmala and Bhatt, A.B. 1997. **Analysis of vegetation pattern in an alpine zone in northwest Himalaya: a case study of Garhwal Himalaya with reference to diversity and distribution patterns.** *International Journal of Ecology and Environmental Sciences*, 23(1):49-65. Department of Botany, H.N.B. Garhwal University, Srinagar (Garhwal) 246174, U.P., India. [ALPINE; DISTRIBUTION PATTERN; DIVERSITY; GARHWAL HIMALAYA; OAK FOREST; VEGETATION PATTERN]

The vegetation pattern of a Himalayan alpine zone in Panwalikantha at 3800 m above sea level was worked out. A total of 135 species has been reported which included the herbaceous plants viz., grasses, sedges and forbs and dwarf kharsu (*Quercus semicarpifolia*). Normally the plants have a short life span, however a few species persist throughout the growth period (May-October). The vegetation enters senescence in October onwards. Studies made in 5 stands varying in slope, aspect and grazing pressure revealed that *Danthonia cachemyriana* and *Poa annua* were the dominant grasses while *Trachydium roylei* and *Geum elatum* were the dominant forbs in one or the other stand. Grasses were abundant on west facing steep slopes while forbs preferred the levelled land of east facing meadows. The grasses and sedges together had optimum density during August. The species distribution among the stands was 74.4-100% contagious and 14.3-28.6% random. Stand III and V had lowest similarity indices which was almost uniform among other stands. The stands having the species with a short life-span displayed more diversity for a month or two while the stands with majority of long life-span species exhibited optimum diversity in totality. The community organisation is discussed in view of dominance diversity curves.

Negi, A.K.; Bhatt, B.P.; Todaria, N.P. and Saklani, Atul 1997. **The effects of colonialism on forests and the local people in the Garhwal Himalaya, India.** *Mountain Research and Development*, 17(2):159-168. Department of Forestry, H.N.B. Garhwal University, Srinagar (Garhwal) U.P. 246174, India; Department of History, H.N.B. Garhwal University, Srinagar (Garhwal) U.P. 246174, India. [COLONIAL INTERVENTION; ENVIRONMENTAL DEGRADATION; FOREST MANAGEMENT; REVENUE COLLECTION]

The present condition of forests in the Garhwal Himalaya results from traditional use by local inhabitants and from government legislation. This paper discusses the impact of human activities on the forest and land resources of the region over the past 200 years. During British occupation (1815-1947) the region was divided into two parts - British Garhwal, controlled by the British government in India, and Tehri State, governed by a native king. The systems of management were similar in each area, although the Forest Department was better organized in British Garhwal. The major cause of deforestation were traditional practices such as the clearing of forest for agriculture and settlement. This cleared land was exempt from government revenue collection for many years and this was one reason why small scattered villages were established in distant forests by local people. Land settlement first took place in British Garhwal and occurred much later in Tehri State. Land resources, including forest, were the major source of revenue and State intervention in forest use resulted in unrest among Himalayan peasants. This dependence on forests for revenue increased significantly after Independence, with consequent degradation and new social tensions.

Negi, K.S. and Muneem, K.C. 1997. **Adzukibean (*Vigna Angularis*(Willd.)) Ohwi & Ohashi - A new crop for Uttarakhand Himalaya.** *Indian Journal of Forestry*, 20(2):144-146. National Bureau of Plant Genetic Resource, Regional Station, Bhowali 263 132, Niglat, Distt. Nainital, U.P. [ADZUKIBEAN; CROP DIVERSITY; GERMPLASM; KHARIF]

Adzukibean has recently been introduced in the Uttar Pradesh Himalaya through the Co-ordinated Research Project on Under-utilized and Under-exploited plants. Because of its dwarfness, early maturing and relatively high degree of resistance to certain storage pests, it may prove popular to other legume crops with the farmers of Uttarakhand Himalaya. Sixty accessions of adzukibean built up from

Himachal Pradesh (H.P.), Uttar Pradesh Himalaya (U.P.) and 6 countries abroad, were evaluated during *Kharif* seasons of 1989 - 1994. Some of the promising accessions have been identified for different agro botanical traits. These accessions may be tried in the farmers field for its acceptance as a grain legume.

Pandey, Anita and Palni, L.M.S. 1997. Himalayan trees: fungal diseases and control strategies. In: *Recent Researches in Ecology, Environment and Pollution*. Vol. X. (Eds: Sati, S.C.; Saxena, J. and Dubey, R.C.) Today and Tomorrow's Printers & Publishers, New Delhi, 283-293. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643 [FUNGAL DISEASES; HEART ROTS; INSECTS; MYCORRHIZAL FUNGI; ROOT ROTS]

Several fungal pathogens are known to cause diseases from nursery to field stages in forests of the Himalaya. The article describes the damping off of conifers in nurseries, root diseases caused by both soil and root inhabiting fungi, and heart rots, and possible control measures such as the use of chemicals, biocontrol agents, ectomycorrhizal fungi and plant growth promoting rhizobacteria

Pandey, Anita; Sharma, Eklabya and Palni, L.M.S. 1998. Influence of bacterial inoculation on maize in upland farming systems of the Sikkim Himalaya. *Soil Biol. Biochem.*, 30(3):379-384. G.B. Pant Institute of Himalayan Environment and Development, Kosi, Almora, U.P. 263 643, India; G.B. Pant Institute of Himalayan Environment and Development, Tadong, Gangtok, Sikkim 737 102, India. [BACTERIA; BIOMASS; CROP RESIDUE; MICROBIAL ANALYSIS]

A field experiment using three strains of *Azotobacter chroococcum* and two of *Azospirillum brasilense* was carried out at two elevations in Mamlay Watershed, Sikkim, India. A local maize variety was used as the test crop. The treatments (applied by seed inoculation) resulted in statistically significant improved plant performance at the subtropical location where yield enhancement of 1.15-fold over control was recorded with one of the bacteria. *Azotobacter chroococcum* W5 (originally a wheat isolate) gave the best performance. Observations recorded for various microbial communities indicated stimulation of some of the native, beneficial groups of microorganisms. During the middle of growing period there was a 2-5-fold increase in the population of actinomycetes, and a group of bacteria able to grow on N-free medium. This suggests that the observed effects of seed inoculation on plant growth may in part be due to the stimulation of already existing plant growth-promoting rhizobacteria in and around roots. Bacterial inoculation also resulted in significantly higher values for nitrogen and phosphorus content of plant components. Seed inoculation did not result in improvement of plant performance at the temperate location. This was probably due to the inability of the introduced bacteria to establish or survive at lower temperatures.

Pandey, Gopa 1997. Joint forest management : Perceptions of new incumbents in Indian forest service. *Indian Forester*, 123(6):527-535. Indira Gandhi National Forest Academy, Dehradun, U.P. [COMMUNITY PARTICIPATION; FOREST MANAGEMENT; SOCIO-ECONOMIC; THEMATIC TRAINING]

The training pattern of IFS officers recruited by the UPSC is frequently moderated to address the emerging professional needs. Professional training of Indian Forest Service officers at Indira Gandhi National Forest Academy at Dehradun has also been tailored to suit the upcoming socio-economic dimensions of forestry profession in India. A survey of IFS probationers from four batches of Indian Forest Service officer including the first batch which has undergone the latest pattern of on-the-job training sandwiched between Professional and Advance Phases has been conducted to interpret their assumptions and perceptions on the issues of Joint Forest Management in India. Though their exposure to the process is very limited, yet the new generation has expressed some key issues from its objectivity to the problem which needs to be addressed. Most of them have revealed optimistic thoughts about the process and accept JFM as one of the options of regulating forestry in India.

Panikkar, Sambhu V. and Subramanyan, V. 1997. Landslide hazard analysis of the area around Dehradun and Mussoorie, Uttar Pradesh. *Current Science*, 73(12):1117-1123. Department of Earth

Sciences, Indian Institute of Technology, Pawai, Mumbai 400 076, India. [BANJ; CROSS TABULATION; GEOMORPHOLOGY; LAND USE TRANSFORMATION]

Landslides are a common natural hazard in mountainous terrain like the Himalaya. In the present study, an area of 445 sq. km around Dehradun and Mussoorie in Uttar Pradesh has been considered for landslide hazard analysis on a geomorphological basis. The analysis involves classification of the terrain into homogeneous units (terrain mapping subunits) based on relevant geomorphic parameters, and consequently the geomorphic processes including occurrence of landslides. The hazard in these units is evaluated on the basis of field settings. Decision rules for the allotment of a hazard score to a unit have also been framed. The data on geomorphological complexes, lithology, drainage density, relief and landslide distribution were used in a geographical information system (GIS) for the analysis. A final landslide hazard map with four classes - very high, low and very low has been prepared. Such a map proves extremely useful as a first generation map for planning detailed surveys in the high hazard areas. The effect of human interference on the environment, particularly depletion of the forest cover has been studied. The landuse/land cover data for a period of 60 years were analysed in a GIS to study the changes in the forest cover. The forested areas account only for 9% of the landslide occurrence. About 60% of the landslides are in non-forested areas that were forested in 1930.

Pant, K.S.; Sehgal, R.N. and Sharma, S.S. 1997. **Flora biology and breeding system in *Grewia optiva* drummond.** *Indian Journal of Forestry*, 20(4):309-313. Department of Tree Improvement, University of Horticulture and Forestry, Solan (H.P.) 173 230, India. [BREEDING BEHAVIOUR; FLORAL BIOLOGY; GREWIA OPTIVA; SEXUAL HYBRIDIZATION]

The study on the breeding system of *Grewia optiva* has been carried out to observe the different aspects of floral biology and to test for the presence or absence of self-incompatibility. Compatibilities were inferred on the basis of difference in fruit-set between self and cross-pollinated flowers together with the examination of pollen on the stigmas. The species is predominantly cross-pollinated.

Pant, Rekha; Rawat, D.S. and Samal, P.K. 1997. **The changing scenario of polyandry culture: a case study in central Himalaya.** *Man in India*, 77(4):345-353. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [INFRASTRUCTURE FACILITIES; MARRIAGE TYPE; POLYANDRY; TRADITIONAL CULTURE]

Polyandry constitutes a specific cultural pattern in the Himalayan region and especially in Jaunsar Bawar locality it becomes the peoples characteristic feature in day-to-day life and philosophy. But during the recent period due to the implementation of various developmental activities and traditional culture centering round polyandry is in a rapid process of change. The study pin-points this changing situation through the investigation into the system of polyandry occurring at Matiyawa village in Jaunsar Bawar.

Purohit, Indu; Prasad, P. and Nautiyal, A.R. 1997. **Nodulation and seedling growth in some nitrogen fixing tree species.** *Indian Journal of Forestry*, 20(3):239-241. High Altitude Plant Physiology Research Centre, H.N.B. Garhwal University, Srinagar Garhwal 246 174, U.P. [NITROGEN FIXING; SEEDLING; TREE SPECIES]

Seedlings of five NFT species growing in Himalayan region were assessed for their nodulation behaviour at nursery level. Nodulation in terms of nodule number was highest in *Dalbergia sericea* and *Dalbergia sissoo* but quantitatively *Albizia stipulata* had the highest nodule weight per plant. On the basis of nodule nitrogen, although *A. stipulata* had highest nitrogen turnover per plant, the rhizobial strain associated with *D. sericea* seems to be highly efficient than other species.

Ram, Nirmal and Jana, M.M. 1997. **Effect of sloping surfaces on infiltration under natural sal forest at the foot hills of Darjeeling Himalaya.** *Van Vigyan*, 35(3&4):159-164. Environment Research Station, Institute of Forest Productivity (ICFRE), P.O. Sukna, Dist. Darjeeling (W.B.); Department of

Geography, North Bengal University, Dist. Darjeeling (W.B.). [BIOTIC INTERFERENCE; BULK DENSITY; INFILTRATION; NATURAL SAL FOREST; POROSITY; SLOPE]

Infiltration study under natural sal forest in the foot-hill of Darjeeling Himalaya reveals that as the slope of forest floor increases the bulk density of the soil also increases and thereby porosity of the soil decreases. Root biomass in the soil also decreases with the increase in the slope of forest floor. Thus this phenomena has affected the water intake. Initially (within 5 minutes) intake of water (cm/hr.) under 0-1^o slope was observed 14.48 per cent more than 2-4^o slope. It was also observed that intake of water at constant stage under 0-1^o slope was 2.20 cm/hr. whereas under 2-4^o slope, it was 0.86 cm/hr. The area faces extensive biotic interferences in such process. Forest surfaces with higher slopes suffer a lot hydrologically and ecologically than normal forest slope. Management of forest floor has been suggested for improving productivity.

Rao, K.S. and Saxena, K.G. 1997. Hydropower for sustainable development of remote villages in Himalaya - a case study on problems and prospects. In: *Hydro Centenary 1997. First International Conference on Renewable Energy - Small Hydro* Vol. 2. (Eds: Varma, C.V.J. and Rao, A.R.G.) Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 129-136. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India; School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110067 [HOUSEHOLD INDUSTRY; HYDRO ELECTRICITY; MYCROHYDEL; SUSTAINABLE DEVELOPMENT]

Hydropower potential for development is well known. As this system is more environmentally friendly, exploiting the opportunities wherever they exist is important both for national and regional contexts. The conventional approaches for development projects and specially for hydropower projects are haunted by both public opposition and avoidable cost escalations. Looking over the local requirements and potentials stand alone mini-microhydel systems combined with facility for value addition for local produce was designed and demonstrated by the Institute in Pranmati watershed of Chamoli District in Uttar Pradesh. A 20KW system was installed with simplified turbine and control systems at Pai village to provide hydro energy both for domestic needs and household industry development. Contrary to conventional approach the system installed by this model is being operated by the local villagers including women after initial training. Our aim of reducing the burden of forests for fuelwood extraction is achieved as some of the households started to use the hydroelectricity for both cooking and heating. Without including the monetary value of the environmental benefits accrued, the cost of project is expected to be recovered within 10 to 15 years after deducting the depreciation and maintenance costs.

Rastogi, Alind 1997. Negotiations : a challenging task in Joint Forest Management. *Indian Forester*, 123(6):542-545. Indian Council of Forestry Research and Education, Dehradun, U.P. [FOREST MANAGEMENT; FUEL-WOOD; NATURAL RESOURCE]

The negotiation skills with the forests can play a positive role in shaping the institutionalization of Joint Forest Management (JFM) in India. The zeal challenge lies in the pace of transformation of organizational mandate into the institutionalized process of participatory management. The present day ecological conflicts have their roots in economic compulsions, sociological stresses, technological intensification, changing consumption patterns, scarce land availability and contending resource users. Making trade-offs between competing goals is thus a necessary skill for the natural resource managers. The paper also discusses the quantity, quality and pace of negotiations in the process of JFM.

Rawal, R.S. and Dhar, U. 1997. Sensitivity of timberline flora in Kumaun Himalaya, India: conservation. *Arctic and Alpine Research*, 29(1):112-121. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [ALPINE REGION; CONSERVATION; MEDICINAL PLANT; NATIVE TAXA; SPECIAL SCALE; TIMBERLINE ZONE]

The paper focuses on the diversity in the timberline flora in a part of Kumaun (west Himalaya). Of the 465 species recorded, >64% were native Himalayan taxa. Scrophulariaceae (78%), Ranunculaceae (70%), Asteraceae (69%), Rosaceae (68%), and Saxifragaceae (63%) were the dominant families showing

high percentage of native taxa. Although flora mainly contained perennial growth forms (86%), the representation of annuals (14%) was more compared to the subalpine/alpine regions of the other mountain systems in the world. All the Himalayan endemic and near endemic taxa (55% of native taxa) in the timberline flora were analyzed of their susceptibility to endangerment. The analysis provided a rapid approach to rank the potentially endangered taxa for conservation action at both local (timberline zone of Kumaun) and regional (Himalaya) spatial scales. Analysis revealed that 34 taxa need top priority at local level while 13 deserve priority attention at Himalayan scale. Three taxa (*Cypripedium himalaicum*, *Aconitum balfourii*, and *Caragana gerardiana*) were, however, identified to be common to both local and Himalayan scale. The frequency of different priority classes in identified habitat types was also analyzed to identify the habitats deserving attention for conservation initiatives.

Rawat, D.S. and Sharma, Subrat 1997. The development of a road network and its impact on the growth of infrastructure: a study of Almora District in the Central Himalaya. *Mountain Research and Development*, 17(2):117-126. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [CENSUS; HEALTH-CARE; INFRASTRUCTURE; ROAD NETWORK; TELECOMMUNICATION]

The introduction and extension of basic facilities in a rural landscape was analyzed in relationship to the development of a road network in a high-altitude, remote location in the Indian Central Himalaya. In general, the infrastructure was concentrated along a road or within a distance of two kilometers, and declined with increasing distance from the road. However, the distribution of primary education units and postal services was not affected by road development but the impact of a road was clearly visible. The major human and animal health-care facilities were concentrated at a few easily accessible points, and the location of other facilities was determined by distance from the road. Drinking water supplied by government agencies and an electricity network were initially introduced along the road network and then extended whereas telecommunication facilities (telephone and telegraph) and financial institutions were established only along the road. A road network is the most felt need for socioeconomic development in remote and inaccessible mountains area that are cut off from mainstream development.

Rawat, D.S.; Joshi, M.; Sharma, S.; Rikhari, H.C. and Palni, L.M.S. 1997. Sustainable development and management of rural ecosystem in the Central Himalaya: a case study from Haigad watershed. *International Journal of Sustainable Development and World Ecology*, 4:214-225. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [PEOPLE'S PARTICIPATION; PLANNING; RURAL DEVELOPMENT; SUSTAINABLE DEVELOPMENT; WATERSHED]

Ecologically fragile landscapes of the Himalaya, particularly rainfed areas, have been experiencing increased degradation of land and water, and loss of biodiversity. This study emphasizes the utility of micro-level planning of area-specific land use for environmental management in the most populated mountain belt (between 1000-2400 m asl), commonly referred as the 'problem zone' in the Central Himalayan region. Assessment of existing land-use practices, environmental problems, and evaluation of physical and cultural infrastructures were the foundation of the envisaged developmental model and action plan. Based on the primary information, and constant interaction between the scientists and farmers, an eco-friendly alternative model for sustainable and optimal utilization of land has been developed and demonstrated. The people's participation was considered an essential tool for successful implementation of the action plan. Consequently, subsequent actions hand field work were carried out by villagers themselves with the encouragement and guidance of experts. People's perception about the entire programme has been demonstrated on their land. The basic ethos has been the supplementation of the traditional knowledge base, not its replacement.

Saini, B.C.; Misra, K.K. and Singh, R.V. 1997. Effects of pruning intensity on the canopy dynamics of gutel (*Trewia nudiflora* L.) in an agroforestry system. *Indian Journal of Forestry*, 20(2):112-115.

College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar 263 145. [AGRO-FORESTRY; CANOPY; GERMINATION; SEEDLING]

The effect of pruning intensity on the canopy dynamics of gutel (*Trewia nudiflora* L.) in an agroforestry system was studied under *Tarai* conditions of U.P. during the year 1990-91. Heavy pruning was found effective in regulating the leaf-fall and canopy development. This tree species tolerates heavy pruning and was found most suitable in sequencing its phenophases in relation to wheat intercrop in an agroforestry system.

Samant, S.S. and Dhar, U. 1997. Diversity, endemism and economic potential of wild edible plants of Indian Himalaya. *International Journal of Sustainable Development and World Ecology*, 4:179-191. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [DIVERSITY; ENDEMISM; NATIVE COMMUNITIES; POTENTIAL]

The rich plant diversity of Indian Himalaya is utilized by the native communities in various forms as medicine, edible/food, fodder, fuel, timber, agricultural tools, etc. Among these, wild edible plants from an important source as a supplement/substitute food in times of scarcity for native communities. Because land holdings are small and subsistence agriculture prevails, the natives gather many wild plants for food. This paper presents an inventory of wild edible plants of Indian Himalaya used by local communities. Over 675 wild plant species, representing 384 genera and 149 families, are used as food/edible and their various parts are either consumed raw, roasted, boiled, fired, cooked or in the form of oil, spice, seasoning material, jams, pickles, etc. The species were analysed for diversity in different phytogeographical provinces, altitudinal distribution, endemism, origin and potentials. West Himalaya shows the highest diversity (50.96%) of edible plants and East Himalaya the maximum number of endemics (18 taxa) and wild relatives of economic plants (39 taxa). Mass scale propagation, dissemination of information packages to local inhabitants to ensure that wild edibles remain as a resource for income generation, and strategies for conservation and management are recommended.

Sen, K.K.; Rao, K.S. and Saxena, K.G. 1997. Soil erosion due to settled upland farming in the Himalaya: a case study in Pranmati watershed. *International Journal of Sustainable Development and World Ecology*, 4:65-74. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India; School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110067, India. [CROP ZONE; HIGH ALTITUDE; SOIL LOSS; SUSTAINABLE AGRICULTURE; TERRACE SLOPE]

A common concept is that upland agriculture undertaken by local communities is a major factor causing large-scale soil erosion and other environmental problems in the Himalaya. Attempts to measure soil loss from farm field are limited. This study was undertaken to measure the rate of soil loss from fields sown with crops during the rainy season and to examine the factors determining the erosion rates in the Pranmati watershed which is characterised by settled organic farming on terraced slopes. About 43% of the total agricultural land in the watershed was on low sloping terraces (<2°), 32% on medium sloping terraces (2-6+°) and 25% on highly sloping terraces (6-10+°). Potato was the most dominant crop, occupying 50.2% of the total cropped area, followed by *Amaranthus paniculatus* (22.6%), *Eleusine coracana* (11.2%), *Echinochloa frumentacea* (10%) and *Oryza sativa* (6%). Soil loss from different crop covers was in the range of 0.300-0.658 t/ha/yr on low sloping terraces, 1-7 t/ha/yr on medium sloping terraces, and 6.037-64.39 t/ha/yr on highly sloping terraces. Comparison of different crops revealed the highest soil loss was from potato fields, a cash crop in the watershed. Potato cultivation on highly sloping terraces accounted for 72.6% of the total soil loss from agricultural fields. The area under this crop is rapidly increasing because of increasing emphasis on a monetary economy. Organic manure input in potato fields (28.5 t/ha) was much higher as compared to traditional crops (7.8-15.5 t/ha). Byproducts of potato do not have any fodder value, while the traditional crops do have useful fodder byproducts. The increase in area under potato also implies more intensive pressure on the forests. The threat of soil erosion causing unsustainability of upland agriculture seems to be due more to the cultivation of potato than to

traditional subsistence crops. Factors related to erosion and land-use policy aspects are discussed in the paper.

Shah, N.C. 1997. **Ethnobotany of *Cannabis sativa* in Kumaun region, India.** *Ethnobotany*, 9:117-121. MS-78, Sector 'D', Aliganj, Lucknow 226 024, India. [ATTAR; CANNABIS; CONDIMENT; ETHNOBOTANY; FOODGRAIN]

Cannabis sativa L., one of the most important plants found wild and under cultivation in the Kumaun region of India, is used for various purposes. Seeds are used as condiment, foodgrain and source of oil, stem for making hempen cloth, cordage, torch-wood, and fuel ignite, and resin (*attar*) from the dried floral leaves and inflorescence as an intoxicant. The plant is also used in a bonfire festival by the Kumaunis. The introduction of *Cannabis* from its centre of origin into the Kumaun region is discussed.

Sharma, Arvind K. 1997. **District councils in the north-east.** *Indian Journal of Public Administration*, XLIII(3):783-793. Professor of Public Administration, Indian Institute of Public Administration, New Delhi. [AUTONOMOUS COUNCIL; CONSTITUTION; DISTRICT COUNCIL; MOVEMENT; TRIBES]

Covering comprehensively the background of politics in north-eastern tribal areas since the British days, recommendations of Bardoloi Committee and provisions made in the Sixth Schedule of our constitution, the author traces constitution of District Councils in the North-East. He, then, analytically discusses working of these councils.

Sharma, Jitendra 1997. **Joint Forest Management - Some fundamentals reviewed.** *Indian Forester*, 123(6):536-541. Deputy Conservator of Forests, Directorate of Research, ICFRE, Dehradun, U.P. [BIOMASS; BIOTIC PRESSURE; COMMUNITIES; FODDER; FOREST MANAGEMENT]

This paper looks at ecological and social objectives that could be achieved through implementation of JFM programmes. It also examines the likelihood of changing needs and responses of the local communities in different types of possible socio-economic scenarios in which participative forestry programmes will have to operate in future. Need for research in various important policy related areas for JFM programmes as well as areas of potential conflict are also highlighted.

Sharma, O.P.; Dawra, R.K.; Datta, A.K. and Kanwar, S.S. 1997. **Biodegradation of lantadene A, the pentacyclic triterpenoid hepatotoxin by *Pseudomonas pickettii*.** *Letters in Applied Microbiology*, 24:229-232. Biochemistry Laboratory, Indian Veterinary Research Institute, Regional Station; Division of Biotechnology, CSIR Complex and Department of Microbiology, Himachal Pradesh Agricultural University, Palampur, India. [BACTERIA; BIODEGRADATION; FERMENTATION; MICROBIAL PROTEIN]

A bacterial strain capable of biodegradation of lantadene A (22 β -angeloyloxy-3-oxoolean-12-en-28-oic acid) has been isolated from soil using lantadene A as the sole carbon source. The organism is rod shaped, Gram negative, motile and has been identified as *Pseudomonas pickettii*. This is the first of the biodegradation of a pentacyclic triterpenoid.

Sharma, Subrat and Rikhari, H.C. 1997. **Forest fire in the central Himalaya: climate and recovery of trees.** *International Journal of Biometeorology*, 40:63-70. G.B. Pant Institute of Himalayan Environment and Development, Kosi, Almora 263 643, U.P. [CENTRAL HIMALAYA; CLIMATE; FIRE-WOOD; RECOVERY; SPROUT]

A forest fire event is influenced by climatic conditions and is supported by accumulation of fuel on forest floor. After forest fire, photosynthetically active solar radiation was reduced due to accumulation of ash and dust particles in atmosphere. Post-fire impacts on *Quercus leucotrichophora*, *Rhododendron arboreum* and *Lyonia ovalifolia* in a broadleaf forest were analysed after a wild fire. Bark depth damage was greatest for *L. ovalifolia* and least for *Q. leucotrichophora*. Regeneration of saplings was observed for all the tree species through sprouting. Epicormic recovery was observed for the trees of all the species.

Young trees of *Q.leucotrichophora* (<40 cm circumference at breast height) were susceptible to fire as evident by the lack of sprouting. Under-canopy tree species have a high potential for recovery as evident by greater length and diameter of shoots and numbers of buds and leaves per shoot than canopy species, Leaf area, leaf moisture and specific leaf area were greater in the deciduous species, with few exceptions, than in evergreen species.

Sharma, Vinita and Thakur, M.L. 1997. **Contribution to the pollinating insect fauna of *Ammi Majus* Linn. in Doon Valley.** *Indian Journal of Forestry*, 20(4):386-389. Division of Forest Entomology, Forest Research Institute, Dehradun, U.P. [FAUNA; HONEY BEE; MEDICINAL HERB; TAXONOMIC STATUS]

Eighteen species belonging to 11 families and three orders are recorded on *Ammi majus* Linn., of these, 9 species belong to Hymenoptera, 7 to Diptera and two to Coleoptera. Relative abundance of different insect pollinators of this medicinal herb indicate that *Apis florea* Fabr. is the most abundant insect species, followed by *Apis cerana* Fabr. and *Apis dorsata* Fabr., which occupy second and third position respectively. *Syrphus serarius* Wild. is the least abundant. A few non-pollinating insects are also reported from this herb for the first time.

Shrivastava, M.B. 1997. **Management of spruce (*Picea Smithiana*) and Silver fir (*Abies Pindrow*) forests in Western Himalayas.** *Indian Journal of Forestry*, 20(2):116-128. Department of Forestry, PNG University of Technology, Lae (Papua New Guinea). [BROAD-LEAVED; CONIFERS; SEEDLING; SILVER FIR; SPRUCE]

The paper describes the management of Spruce (*Picea smithiana*) and silver fir (*Abies pindrow*) forest of Western Himalaya. The study covered an area of 2,551.50 ha. The forests were stock mapped and total enumeration carried out. The growth data were collected from sample trees and plots and local volume tables prepared. Growing stock and annual increments were assessed (average volume 327.37 m³/ha; average number of trees 324.2/ha; average annual increment 7.09 m³/ha). Forests are to be managed under Selection System with 60 cm exploitable diameter and 15 years felling cycle. The yield is to be regulated by the number of selection trees recruited from lower diameter class to exploitable diameter class during the felling cycle and expressed in percentage. Provision for the removal of over-mature trees is made to avoid decay. Annual prescribed yield for Deodar, Kail and Spruce/Silver fir is fixed at 36, 18 and 900 number of selection trees which are 35%, 35% and 30% of the total number of selection trees and 32%, 15% and 45% of the annual volume increments of the species respectively. Managed under selection system, the forests will achieve normally in due course to provide sustained yield in perpetuity.

Shrivastava, M.B. 1997. **Procedure to determine breast height and crown diameters of felled and lost trees.** *Indian Journal of Forestry*, 20(4):346-351. Department of Forestry, PNG University of Technology, Lae (Papua New Guinea). [CANOPY DIAMETER; CROWN DIAMETER; REGRATION ANALYSES; SILVICULTURE]

With the help of regression and correlation analyses, it is possible to make relatively accurate predictions of crown and breast height diameter of trees from stumps. The paper describes such methods in a case study of Spruce (*Picea smithiana*) forests in Western Himalayas in India. The results will serve as a tool to unearth the oversize markings and excessive fallings of trees and act as an aid in thinning of evenaged crop. The results are valid only for the stands and areas under study. Therefore, it is obligatory develop prediction equations on local or regional levels.

Singh, Charan and Singh, Arun P. 1997. **Life-history, feeding and reproductive potential of *Colasposoma Semicostatum* Jack (Coleoptera: Chrysomelidae) on *Impatiens Thomsoni* hooker, a weed under coniferous forests in the Western Himalayas.** *Indian Journal of Forestry*, 20(3):293-295. Himalayan Forest Research Institute (ICFRE), Shimla 171001.[FEEDING POTENTIAL; HOST PLANTS; LEAF AREA; WEED DENSITY]

Experiments were conducted on the life history, feeding and reproductive potential of *Colasposoma semicostatum* on *Impatiens thomsoni* a weed in Deodar forests and alternate host plants of this beetle were also found. The life-span (from hatching till death of adult) was found to be 58.98 days. A female laid 200-250 eggs. The maximum feeding activity was recorded for the adult stage, i.e., 37.56 cm. The results showed that 595.42 insects can control of this weed in their life span, i.e., from first instar larvae till the death of adult. Only one alternate host plant of *C. semicostatum*, i.e., *Populus ciliata* was recorded out of 20 species.

Singh, Charan; Kumar, Vinay and Pacholi, R.K. 1997. **Growth performance of *Arundo Donax* (Reed Grass) under difficult site conditions of Doon Valley for erosion control.** *Indian Forester*, 123(1):73-76. Division of Plant Sciences, Central Soil & Water Conservation Research and Training Institute, Dehradun, U.P.; International Development Research Centre, (IDRC), ICFRE Dehradun, U.P.; Social Forestry Division, Forest Research Institute, Dehradun, U.P. [BIOMASS; DOON VALLEY; REED GRASS; SOIL CONSERVATION]

Growth parameters and biomass production of *Arundo donax* under different difficult site conditions of Doon Valley, have been given in this paper. Among four different sites as Hill slopes of mine spoiled area (Site-A), old bouldery river bed lands (Site-B), Nala site (Site-C) and Above gabion structures (Site-D), Site-B was found most suitable for growth of the Reed grass and produces maximum biomass of 1.17 kg/m² with highest plant growth. Site-D has poorest growth performance and minimum biomass yield of 0.7 kg/m².

Singh, Dhan; Vasistha, H.B. and Goel, Ruchi 1997. **Potential species for revegetation of limestone mined land with special reference to Garhwal Himalaya.** *Van Vigyan*, 35(3&4):128-131. IDRC Project, Indian Council of Forestry Research & Education, Dehradun 248006. [POTENTIAL SPECIES; RECLAMATION; SOCIO-ECONOMIC STATUS]

Limestone is single most important mineral which has been extensively mined in all temperate regions of Himalaya resulting in ecological degradation and environmental imbalance. The reclamation of these areas is a difficult task because all the plant species may not grow and survive due to lack of good soil nutrients and other physico-chemical characteristics. Some species have the potential to grow in such inhospitable conditions in temperate region. This study aims at to identify and select such potential species for mined area which are also beneficial for the upliftment in socio-economic status of the rural hill people through fuel and fodder production.

Singh, G.S. and Ram, S.C. 1997. **Prospects of sustainable development of Kullu valley in north-western Himalaya.** *Journal of Rural Development*, 16(2):359-368. G.B. Pant Institute of Himalayan Environment and Development, Himachal Unit, Shimla, Kullu 175126 (H.P.). [LAND USE PATTERN; SOCIO-ECONOMIC; SUSTAINABLE DEVELOPMENT; TRADITIONAL SYSTEM]

Local and village level institutions culturally play an episodic and catalytic role in management of common resources which are traditionally governed by village committee in the area since generation. Indigenous knowledge pertaining to the traditional land use system is not only highly efficient from ecological point of view but also subsidised the system in terms of incorporating animal products and forest resources. Before 1960s the agriculture operations were merely based on their traditional system with the use of organic manure based local crops. But, recently after introducing the cash crops in the area the demand for high use of non-renewable resources (inorganic fertilizers and pesticides) has increased tremendously. Thus, land use pattern has changed from traditional subsistence farming to cash fetching high yielding variety of crops, vegetables and gaities of fruit bearing trees which subsequently has left the system in the "transition phase". Change in the land use has change the socio-economic profile of the people. Newly designed sustainable development approach, however, is based systems which are inherited since generations. Integrated training of farmers in collaboration with scientific communities and planners would narrow down the gaps incurred in the age old techniques and technologies. The five tier model could help in rejuvenating the crop's diversity and upgradation the economy of the marginal farmers.

Singh, G.S.; Rao, K.S. and Saxena, K.G. 1997. Energy and economic efficiency of mountain farming system: a case study in the nor-western Himalaya. *Journal of Sustainable Agriculture*, 9(2/3):25-49. G.B. Pant Institute of Himalayan Environment and Development, Kosi, Almora 263 643, India; School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110067. [AGRI-HORTICULTURE; AGROECOSYSTEM; CROP DIVERSITY; ECONOMIC EFFICIENCY; TERRACED SLOPES]

The state of Himachal Pradesh in the north-western Indian Himalaya is distinguished for integration of profit-oriented horticulture and use of modern yield-increasing inputs in the traditional, subsistence-economy-centered agriculture in the recent past. Farming systems in the two neighboring villages of the state were analysed. The average land holding was 0.84 ha split into two distant plots, one in the upland and the other in the valley. A high level of crop diversity (14 rainy season crops and 3 winter season crops) was maintained by rotation of crops in time and space on small fields, together with coexistence of mixed and monocropping practices. Upland, terraced agroecosystems were none diversified, as well as efficient in terms of energy and monetary rates of return, than the valley agroecosystems. Potatoes showed the highest energy and monetary output:input ratio. Mixed cropping was not as dominant as monocropping. Following the introduction of apples in the croplands, rates of return declined after 5 years of tree growth until 15 years, and subsequently increased. Both energy and monetary output:input ratios of a 25-year-old apple plantation, where crops were not grown at all, were much higher than those of agroecosystems. Policies of encouraging use of inorganic fertilizers, high-yielding varieties of wheat, and apple cultivation followed land-use intensification in upland rainfed farming, reduction in crop diversity, and more intensive use of and pressure on forests, along with substantial cash income to the farmers. Implications of policy-induced changes in traditional farming are discussed.

Singh, Pratap; Jain, S.K. and Kumar, Naresh 1997. Estimation of snow and glacier-melt contribution to the Chenab river, western Himalaya. *Mountain Research and Development*, 17(1):49-56. National Institute of Hydrology, Roorkee (U.P.) 247667, India. [GLACIER-MELT; ISOHYETAL PATTERN; LANDSAT DATA; SEASONAL DISTRIBUTION]

The contribution of snow and glacier-melt runoff to Himalayan rivers is significant and an estimation of the amount is necessary for the development, planning, and management of water resources. In this study, the average contribution of snow and glacier-melt runoff in the annual streamflow of the Chenab River at Akhnour was estimated using a water balance approach. For a period of 10 years (October 1982-September 1992) the total water budget of the basin was assessed; rainfall data of 25 well-distributed stations were used to compute total rainfall input to the basin, and total volume of flow was computed using discharge data at the Akhnour gauging site. Evapotranspiration losses only from the snow-free area were taken into account, considering that evaporation from rain falling on the snow-covered area, and from the snow-covered area itself, is negligible. The snow-covered area in the basin was determined using satellite imagery. It is observed that, on average, about 70% of the area of the basin is covered with snow in March/April and this is reduced to about 24% in September/October. The average snow and glacier runoff contribution to the annual flow of the Chenab River at Akhnour is estimated to be about 49 percent.

Singh, R.D. and Bhatnagar, V.K. 1997. Differences in Soil and Leaf litter nutrient status under *Pinus*, *Cedrus* and *Quercus*. *Indian Journal of Forestry*, 20(2):147-149. Vivekananda Parvatiya Krishi Anusandhan Shala (Indian Council of Agricultural Research), Almora, U.P. [BIOMASS; DEODAR; NUTRIENTS; SOIL FERTILITY]

A study was conducted to examine the difference in nutrient status of the soils receiving litters from pine (*Pinus roxburghii* Sarg.), deodar (*Cedrus deodara* Roxb.) and oak (*Quercus incana* Linn.) growing naturally in a small area. The total annual leaf fall accumulations in the pine, deodar and oak were 6076, 3223 and 4934 kg ha⁻¹, respectively. The total macronutrient (N,P and K) made available to the soil

by pine, deodar and oak leaf litter amounted 53.46, 62.85 and 88.32 kg ha⁻¹, respectively. The value of available nutrients in soil was in the order oak > deodar > pine.

Singh, R.P.; Negi, D.V. and Chand, Prakash 1997. Ecological studies on *Rosa webbiana* wall. EX royle in cold desert areas of Spiti valley in Himachal Pradesh. *Indian Forester*, 123(9):827-830. Conifers Research Centre, Shimla, Himachal Pradesh. [BIOMASS; COLD DESERT; COLLAR DIAMETER; SEED GERMINATION]

The present study was conducted in the cold desert areas of Spiti valley in the State of Himachal Pradesh. *Rosa webbiana*, seeds should be treated with concentrated sulphuric acid for 20 minutes duration to enhance its germination. It can be propagated by stem cutting and root suckers. Stem and branches contribute maximum to the total biomass followed by root and leaves in that order. Approximately twenty shoots sprout from single root stock and form a colony over barren slopes which checks the erosion. Total biomass on dry weight basis was 5.42 kg/plant and energy ranged from 3.1 to 4.2 K.cal/g dry weight. An average bush accumulates 20615 K.cal of energy per plant.

Tyagi, D. 1997. Looking at polyandry - a dying or dead social institution in India ? *Man in India*, 77(4):329-343. Anthropological Survey of India, 27 Jawaharlal Nehru Road, Calcutta 700016, India. [LEGITIMACY; PLURAL MARRIAGE; POLYANDRY; SOCIAL INSTITUTION]

The institution of polyandry has a long history in India. Having its origin in the remote past polyandry flourished through ages; it witnessed change with the alteration of cultural perspectives, and gradually it started diminishing due to some obvious reasons. Polyandry has its own appeal to which it has been discussed by large number of social scientists from diversified angles. In the present paper the author has put forward a systematic review of the various observations made by the different authorities. Various factors relating to the emergence of polyandry and the related causes have been pin-pointed here. The study highlights that once flourishing social institution like polyandry is now in a state of disappearance.

Upadhyaya, V.P.; Singh, R.P. and Rana, B.S. 1997. Soil respiration in disturbed forest ecosystems of Central Himalaya. *Indian Forester*, 123(1):77-82. Department of Forestry, Kumaun University, Nainital, U.P. [CENTRAL HIMALAYA; FODDER; FOREST ECOSYSTEM; SOIL RESPIRATION]

An *in-situ* soil respiration study was conducted in landslide damaged and undamaged pine and oak forests of Central Himalaya to evaluate the seasonal differences in CO₂ evolution in different components of the soil system. Higher respiration rates were observed in rainy season (September) across all sites followed by summer and low in winter season. Soil respiration on 8 and 30 year old damaged sites was 86 and 20% less than the undamaged site, respectively. Across all sites increase in soil respiration was positively related to age of site. Litter removal reduced total respiration by 18%. Bulk density, soil N concentration and air temperature explained 90, 78 and 80% variability in total respiration. The respiration rates of Central Himalayan forests roughly equal the respiration rates of tropical rain forests.

Vasistha, H.B.; Soni, P. and Kumar, Om 1997. *Wendlandia Exserta* - A promising tree species for restoration of mined degraded habitats. *Indian Journal of Forestry*, 20(2):178-180. Division of Ecology and Environment, Forest Research Institute, Dehradun. [BIOMASS; GREEN FODDER; NUTRIENTS]

The study was undertaken to evaluate the growth characters and root binding capacity of *Wendlandia exserta* on mined spoil and nursery soil conditions. The results show that this plant species significant difference in height, diameter, shoot biomass and root biomass, root volume, tap root length, number of laterals, and binding capacity being higher in mine spoil grown plants. Whereas leaf area, leaf biomass depth of rooting zone showed a non-significant difference in the two strata.

News & Views

Compiled by S.N. Nandy, D.S. Negi and S.K. Sinha

G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643, India

Watershed management in Himalaya urge

The delegates of the seminar organised by Himalayan Institute of Action Research and Development stressed on an integrated scientific framework must be evolved for planning management of the fragile ecological resources of the Himalayan region, with a focus on watershed management. Environment and resource mapping, hydrological parameters of watersheds, application of remote sensing techniques and geographical information system measurement of biotic interference and ecotop therapy/ecotop surgery were discussed in the seminar. The watershed management approach aims at creating a self-supporting system essential for sustainability of the hill region's economy.

THE BUSINESS LINE: March 6, 1998

Threat to Manipur wetlands

The wetlands of Manipur valley are playing an important role in the environmental management of the state. The ecology of the lakes of Manipur have badly deteriorated, due to accelerating rate of siltation, eutrophication and pollution. Some of the lakes like Tokyelpat, Lamphelpat and Utrapat have dried up. The volume of water in the Loktak lake has reduced to half from 600 million cubic metres in 1970 due to heavy siltation rate raising the bottom of the lake during last two decades. Uncontrolled cutting of wood for timber fuel and other forest products has led to heavy destruction of forest in the catchment areas of the wetlands. Deforestation caused accelerated soil erosion and siltation of the lakes and river, filling up the wetlands gradually. Besides the nutrients brought from the catchment with the runoff, huge amount of domestic sewage and municipal sewage along with the toxic organochlorine pesticides like DDT cause pollution. With the drying of these wetlands the whole environment of the state are in serious threat.

THE ASSAM TRIBUNE: March 8, 1998

Scheme to augment power

Kinnaur, the beautiful valley of apple orchards is now diversifying the field of power in a big way. The Himachal Pradesh State Electricity Board (HPSEB) and other power agencies are busy exploiting the present power potential in the hill district. The Sanjay Vidyut Pariyojna Bhaba is supplying power to Himachal and other adjoining states. A private company has started its first venture on Baspa Stage-II 300MW hydro-power project. Besides these, the dam site of the Nathpa Jhakri project having a capacity of 1500MW is being constructed as a joint venture of the Himachal Government and Nathpa Jhakri Power Corporation is also falls in Kinnaur district. It is estimated that a huge power potential of 3000MW remains to be exploited in the district.

THE TRIBUNE: March 24, 1998

Development vs displacement: a struggle simmers at the border

Part of Gurez Valley, in north Kashmir along the line of control, an ancient tribe is fighting the lone battle against a dam which is considered crucial for the development of the region. In the remote corner of India the valley is the homeland of 25,000 Dard Shin tribes will be submerged once the proposed dam of the Kishen Ganga is built. The land acquisition notices for the Rs.2000 crore 330MW hydro-electric project have already been sent. Dawar, the capital of Gurez and hub of all socio-cultural activity in the area will be drowned and the displacement will not only endanger a language and a particular ethnic community but also their homeland along with the significant archaeological treasure. The government, however, insists that the project is vital for the development of the region and displacement a small price to pay for it and the displaced population will be adequately take care of.

THE INDIAN EXPRESS: March 26, 1998

4.5 cr for wasteland development

Under the integrated wasteland development project, Rs. 4.5 crore had been sanctioned by the central government for Sirmaur in Himachal Pradesh. 15 watersheds would be selected and developed and when completed it would develop 12,500 hectares of wasteland by soil erosion measures, large scale plantation, development of grass lands. The project also envisages employment opportunities for unemployment youths.

THE TRIBUNE: April 2, 1998

Call to preserve natural resources

The conveyor of 'Gene-Campaign' held at Shillong urged the people to preserve the patent rights of their natural resources of the region. The north-eastern region is one of the twelve regions of the world having vast biodiversity potential. The campaign's sustained position continues to be against patents and privatisation in this field in this field. The bio-technology, is one of the modern technology where we can be highly competitive and should not allow ourselves to be tied up by patent laws. For the first time since independence, India is in a position to be not just the consumer of a new technology but one of its important produces, admits conveyor.

THE ASSAM TRIBUNE: April 6, 1998

Centre to aid J&K's revival package for tourism sector

The centre government will give full support to the special packages being worked out with leading financial institutions by the Jammu & Kashmir government for revival of the militancy-torn state economy. Leading financial institutions like IFCI, IDBI and many banks will be participating in implementing these packages. The package aims direct finance at subsidised interest rate to entrepreneurs for different categories of tourism activities in the state including that for guest houses, motorboats, travel and excursion and tourist transport. Apart from the financial incentives, the state government is also working on a agenda for strengthening of other related sectors like telecommunication which the state government feel are vital factors upon which hinges the success of reviving of tourism industry in the valley.

THE FINANCIAL EXPRESS: April 7, 1998

Timber mafia going strong

The police seized large quantities of timber in a dozen other cases during last three months in Mandi district of Himachal Pradesh. In the wake of tight vigilance being maintained by the police and the forest department, timber smugglers have currently switched over to new modes of transport like maruti vans and is alleged that politicians are at the back of the forest mafia and provide protection to the forest offenders. The latest official count of 1997 reveals a disturbing decline of forest cover of 5,500 km² compared to the count of 1995 just within two years and this fast shrinking rate is a great concern over country's forest cover.

THE TRIBUNE: April 7, 1998

Bleak future for watershed development scheme

The report reveals a bleak future for watershed development projects continuing in the sub-Himalayan Uttar Pradesh. The Himalayan Watershed Management Project, initiated by the World Bank in 1982, in the valley of two tributaries, Nayaar and Panaar was abandoned in less than a decade amidst criticism about lapses in the implementation and monitoring. The European Economic Community (EEC), with highly acclaimed approach of participatory rural appraisal, besides involving village communities in the decision making and implementation of the project, remained at the mercy of its donors, only to undergo erratic expansions and contractions until its final stages. The status of Watershed Management Directorate established in a forest clearing at Dehradun is still not clear. Efforts to award it a permanent status have not borne fruit, amidst pulls and pressures between the donor agency and successive

representatives of the government. However, in a meeting between EEC officials and *Uttaranchal Vikas Vibhag*, the EEC asked to bear the burden of employee's wages. But the devaluation of the rupees and wage hikes making things all the more difficult for a cash-strapped treasury.

THE STATESMAN: April 8, 1998

Panel to review management of Loktak lake

An understanding was reached between India and Canada under the India-Canada Environment Facility (ICEF) on February to launch a major project for the sustainable development and water resource management of the Loktak lake based on a project proposal conceived by the Loktak Development Authority (LDA) and Wetlands International South Asia (WISA) to save it from deterioration as a result of the Loktak Hydroelectric power project. The Ministry of Environment & Forests (MoEF) has reconstituted a high level technical advisory committee on lakes to oversee matters of development and management of these natural water bodies. The committee comprising members from MoEF, LDA, Planning Commission, Manipur University and World Wildlife Fund of India and has seriously considered an overall review of the present management of Loktak lake, the largest fresh water lake in the north-eastern region by different agencies.

THE ASSAM TRIBUNE: April 9, 1998

Red mites pose threat to apple crop in Himachal

Red spider mites have posed a serious threat to the apple crop in Himachal Pradesh, which is the backbone of the state economy in terms of revenue. According to experts of Dr Y.S. Parmar University of Horticulture and Forestry the premature defoliation observed in an endemic form in some apple growing areas of Chamba resulted in reduced photosynthetic activity effecting apple production. Experts point out that an invasion by European red mite took place first in Mandi and Kullu district then it spread to Chamba and Shimla and over 62% of total apple orchards has been reported to be infected with the mite.

THE FINANCIAL EXPRESS: April 13, 1998

Govt in fix over resuming mining

The Himachal Government is ready to lift the ban on mining, which is a livelihood for thousands of people in the surrounding area of Khaniyara in Kangra district. The main hurdle in permitting mining in the area is the Supreme Court order that no non-forest activity would be carried out on forest land without approval of the Central government. In view of this, permission has to be sought from the Centre, as some of the ecologically fragile area of Khaniyara has been indicated as forest land in the revenue records, though the forest department agreed that the area is unculturable waste and does not strictly come under this category. The permits for short-term mining would be issued to all those who had applied, after getting the permission only, though some mining lessees admit illegal mining is going on at a number of places and there is no point to maintaining ban on it.

THE TRIBUNE: April 15, 1998

A project to predict earthquakes

'Peninsular shield of India' could no longer be considered seismically inactive and the United Nations expert committee, after the 1993 Latur quake, had strongly recommended regular monitoring of the region, and suggested dense Geographical Positioning System (GPS) & vertical control methods to monitor seismotectonic activities. Based on this Dehradun based Survey of India (Department of Science & Technology) will launch a World Bank funded plan to geodetically monitor the peninsular shield using GPS to predict earthquakes apart from monitoring Crystal movements in the subcontinent on a regular basis. Today GPS is the most widely used technique to generate inputs for the earthquake prediction process and also finds extensive application in fields as varied as navigation, surveying, mapping, remote sensing and developmental activities.

THE HINDU: April 21, 1998

Bill to prevent foreign states from patenting Darjeeling tea

After *Basmati* and turmeric issues patenting Darjeeling tea is a major issue in international community. The Indian tea industry is demanding a patent for the premium tea on the grounds that Sri Lankan producers and exporters are selling tea grown in the island nation as 'Darjeeling tea'. In view of this the government is preparing a draft bill to treat Darjeeling tea as a geographic indicator to prevent other countries from patenting it or claiming to sell the premium tea variety. According to the official, the industry and trade policy divisions of the Centre are preparing the Bill for enactment which would make India the only country of origin of Darjeeling tea besides being the geographic indicator.

THE STATESMAN: April 24, 1998

Darjeeling tea planters resort to organic farming

Organic farming in tea is fast gaining ground in the hills and as many as 11 gardens in Darjeeling have gone fully bio-organic. Apart from clinching better export deals in the European market, such kind of farming has helped in the retention of top soil and kept it alive with micro-organisms. With exports of organic tea on the rise, most growers are contemplating a conversion of the tea growing area for organic cultivation. Most organic planters admitted that the trend in productivity has shown an increase in tea estates that gone for conversion and that is why many gardens are switching over to bio-organic farming.

THE FINANCIAL EXPRESS: April 27, 1998

Devastating quake forecast in Assam before 2010

The probability of an earthquake in Assam of a magnitude greater than 8 on the Richter Scale at any time before the year 2010, according to a renowned environmental scientist, Prof. S.K. Sarmah of Gauhati University. Prof. Sarmah said these, together with computed return periods for high magnitude earthquake of the region and historical seismicity tended to indicate the probability of occurrence of a high magnitude earthquake in the western part of the north-east at any time in the next few years and any delay in the occurrence of the quake will only increase its magnitude. In order to reduce loss of lives and properties due to this earthquake, it is necessary to adopt some precautionary measure without delay and people should be made aware of the dangers soon.

THE HINDU: April 27, 1998

J&K Govt plans to restore Dal lake to former glory

The Jammu & Kashmir Government has chalked out a comprehensive programme for restoration of the famous Dal lake situated at an altitude of 1,580m above sea level in the eastern part of Srinagar, to its original shape and avert its possible extinction. The lake has shrunk from 48 km² in 1947 to nearly 15 km² due to unchecked encroachments and pollution. Under the restoration programme a modern machine manufactured in collaboration with the Dutch costing about Rs. 3.5 crore would be put in use for de-silting under supervision of scientists, limnologists and engineers.

THE STATESMAN: April 28, 1998

Pest attack

Deodar defoliator (*Ectropis deodarae*), a forest pest has affected about one lakh cedar trees in Naganalli and Mihani ranges of Theog forest division of Shimla district, Himachal Pradesh. The pest feeds no other tree species except on deodar and it is a valuable tree growing between 1800 to 2600 m above seal level in the north-west Himalaya comprising an estimated area of 2,03,263 ha in Himachal Pradesh, Jammu & Kashmir and hills of Uttar Pradesh. The scientists fears that the attack may become epidemic cause large scale destruction, if appropriate action is not taken immediately.

DOWN TO EARTH: April 30, 1998

‘Crack’ in Tehri dam causes alarm

Though the official of Tehri Hydro Development Corporation denied the report of either sinking or cracking any part of the site, but the reports have triggered a debate on whether the phenomenon is only of a local nature or related to seismic activity in the Garhwal region. The region has experienced frequent tremors since time immemorial and frequent tectonic activity along the outer Himalayan belt, made of fragile rocks along with frequent rainfall have often triggered fluvial action and slope failures, according to experts. However, former Director-General of Geological Survey of India denies any seismic activity causing the crack, might have appeared due to some constructional lacunae. Those opposing the construction, argue that the quake hit Uttarkashi district in October 1991 also effected the adjoining Tehri district, where the mega dam is being constructed, is a seismically very active area.

THE TIMES OF INDIA: April 30, 1998

Development plans fail to help Tripura tribal

Tribals of Tripura are flooded with too many development projects but many of these projects fall through as they are unsuitable for them. Certain schemes introduced in the area were not acceptable to the tribals, according to the Director of Tribal Research Directorate (TRD). Some times projects are pushed through without training the tribals in their use, for instance solar energy in some remote tribal villages. He admits that the government departments do not consult the TRD on the suitability of a scheme before launching it, often lack of education also makes tribals less receptive to development programmes.

THE TIMES OF INDIA: May 6, 1998

J&K govt aims to revive sericulture

The Jammu and Kashmir government has embarked upon a multipronged strategy to revive sericulture using traditional method of cultivation in a bid to double cocoon production in the state this year. According to the official sources, the sericulture development department is distributing silk worm seeds to farmers and expects three lakh kg cocoon production and 335 incubation centres have been set up in the valley.

THE BUSINESS STANDARD: May 9, 1998

Limestone mining continues unabated in Doon valley

In spite of Supreme Court order banning all mining activities, contractors are continuing limestone mining in the Doon valley in Uttar Pradesh even though their lease hold period had expired as long back as 1984. The mining areas are located in the thick forests in the Tehri Garhwal district within the Doon valley, which were saved from destruction by the apex court through several orders, from indiscriminate limestone mining in 1983 on a public interest petition by an NGO. After the apex court order of December 1996 in the tree felling case, the status of the 9.85 hectares of civil land was that of forest land as the entire mining area was having natural growth of forest tree and undergrowth, the District Magistrate order to allow mining and export mining material from this land was indefensible and no way justifiable.

THE BUSINESS AND POLITICAL OBSERVER: May 11, 1998

Tourism, ecology must go hand in hand

The concept of eco-tourism in the Himalayan regions is required urgently as it will go a long way in preserving the natural beauty of these mountains which attract thousand of tourists from the world over and help support these mountain economies. All developmental activity related to making available better tourist amenities must also be eco-friendly, according to Mr Umesh Dwivedi, editor of *Himalayan Paryavaran* - an environment magazine. Eco-tourism is ecologically and socially responsible nature based tourism that fosters environmental appreciation and understanding.

THE PIONEER: May 14, 1998

Scientists find scarcity of honeybees cause for fruit loss in Himachal

Scientists at the Dr Y.S. Parmar University of Horticulture and Forestry have found that the lack of an adequate number of bee colonies in the hill state of Himachal Pradesh is one reason for the poor apple crop. The horticulture experts feel that many orchards do not bear enough fruit because of population of bees is too small, which plays a significant contribution in apple pollination. There are all about 10,000 to 12,000 bee colonies including private bee-keepers which is just 8% of the total requirement of the state. According to their recommendations, apple yields can be considerably increased by pollination by honeybees and at least two bee colonies are required for each hectare of orchard, which can be met by government intervention and additional involvement by the private sector.

THE FINANCIAL EXPRESS: May 18, 1998

Jhum cultivation causes soil degradation in Nagaland

According to official sources about 44 lakh tones of fertile top soil is lost every year from areas where Jhum (shifting) cultivation is practiced in Nagaland. It has been estimated that 70% of the total top soil degradation and water resources deterioration was due to it. According to the Director of Soil Conservation, 'contour bunding' across the hill slopes of jhum fields is the most suitable technique and with jhum cycle having been reduced to 4-5 years from the earlier 8-10 years earth contour bunds were proposed to be constructed during the Ninth Plan in the State. The tangible progress has been made in weaning away farmers from jhum cultivation by adopting watershed techniques under the State plan and Centrally-sponsored schemes, claimed by the director and one project each would be taken up in all the 52 rural development blocks of the state during the Ninth Plan.

THE HINDU: May 19, 1998

Tehri - the cracks are showing

The Tehri Hydro Dam Corporation (THDC) officials have refuted the existence of any cracks or damage to the structure near the control gate shaft through which the stored water of the reservoir would flow towards the turbines. The officials also denied any sinking of the mountain in face portion. They claim that they are only removing the loose overburden mass to reach a firm foundation before starting the actual construction of the main structure. The author presents a detailed discussion on environmental and ecological factors related to the dam with a long term view. The Tehri dam project is a prime example of large technological intervention in nature and unthinking adherence to a plan based on old ideas. The region has very shaky foundation and the dam is located in a highly seismic zone. The Ganga tear fault, also known as the inner ridge of Delhi-Haridwar is pushing the Garhwal region to north-east at a rate of 2 to 3 cm every year causing prone to earthquakes. The enormous amount of water (storage capacity 2615 million m³) in 42.5 km² reservoir will enhance the intensity of any earthquake that might take place and cause collapse of the dam. The new Tehri township where those ousted from the dam site are going shifted is also of doubtful stability as cracks had developed and there was sinking of roads even before the quake. On the dam site the gate number 3 lies in a relatively unstable shear zone of the hills and due to the unstable slope formed by the slumped mass the top surface of the shaft no. 3 has sunk, causing cracks. Further damage to the structure is not ruled out with the onset of rains.

Sitesh Bhatia for THE STATESMAN: May 25, 1998

Need to properly manage water resources

Arunachal Pradesh could be one of the richest state of the country if its water resources were properly managed, said the Chief Minister, Gegong Apang while inaugurating a workshop on water resource management at Itanagar. He also said that the state could supply 50% of the county's hydel power requirements with proper management of its vast water resources. Expressing concern over the faulty national planning, Sri Apang said the planners failed to realize the need for proper management of water resources in the north-eastern region and Arunachal Pradesh in particular.

THE ASSAM TRIBUNE: May 28, 1998