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SOIL AND WATER CONSERVATION THROUGH HORTICULTURAL INTERVENSION IN HILLY AREAS

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INTRODUCTION

Land, which is the most precious heritage and the physical base of biomass production of life supporting systems, is finite. In this natural non-renewable endowment, the share of our country is fixed at about 329 million ha. It is not only inelastic but also heterogeneous in different parts and regions of the country with a definite set up, capabilities, suitability for different land resources. Conservation of land resources can promote sound land use to match with the land capabilities or suitability and to initiate correct land resources, development/suitability in the country.

A close look at the present health of the soil and water resources reveals their wanton misuse and degraded environment. About 173 million ha covering slightly half of the country are threatened by various types of degradation like salinity, alkalinity, water logging, ravenous and gullied lands, areas under ravages of shifting cultivation, desertification, etc. About 800 ha of arable land are being lost annually due to ingress of ravines. There are specific problems of land degradation due to open-cast mining operations, using good productive land for brick kilns, coastal erosion and seawater ingress, excessive erosion and land slides in the crumbling hill areas. Our forests and grass lands have been over exploited. Frequent occurrences of floods and droughts in different parts of the country are evidence of improper land use in the catchments and inadequate conservation and use of rain water. The problem of land degradation has brought us face to face with the ever increasing depletion of the productivity and the basic land stock through nutrient deficiencies on the one hand and the ever growing demand for food, fodder, fibre, fuel, land based industrial raw materials and many non-farm land uses on the other hand.

SCENARIO OF NORTHEASTERN REGION

The north eastern region comprising of states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim is endowed with wide variety of flora and fauna. Degradation of land and water resources is a serious problem in this region. The adverse biotic impact has resulted in degradation of forests and this trend has been highlighted in many recent reports. Fast paced and multi-faceted development and ever increasing population have created tremendous pressure on land to provide basic requirement essential for survival. To meet these requirements, the limited natural resources are being over-exploited resulting in widespread eco-system degradation. The northeastern region is highly susceptible to acute soil erosion problems due to its undulating topography and high intensity rainfall. The primitive cultivation practices like *jhum* and *bun* further enhances these degenerative trends and rampant deforestation, wild fires, extensive grazing, unscientific mining and quarrying, etc., are adversely affecting the overall ecological condition of the region. Control efforts have not succeeded to desired scale. The authors strongly feel for the need of review and re-orientation of the planning process and programmes particularly for conservation and maintenance of natural resources such as soil, water, plants and animals. The climatic conditions and topography in different North East states varied from plain to high altitude thereby providing congenial altitudinal variations for the production of forest, cereal crops, vegetables, tropical and sub-tropical and temperate fruits. The economy of the states mainly depends on forest wealth, horticultural crops, agriculture and animal wealth. All these four components together contribute to the

preservation of eco-system, soil conversation and healthy environment. The technical measures for conservation and development essentially are:

a) Tree planting and reforestation
b) Water harvesting
c) Terrace and other engineering structures
d) Agronomic, grassland and pastures development and other socio-economic measures for conservation and management of the soil.

It is evident that combating the degradation of our natural resources especially soil, water and vegetation and investing in their conservation for future generation will be a major practical task promoting sustainable development and nature protection. The application of modern techniques and development of new methodologies to cope with the widespread problem of soil degradation has become imperative to protect cultivable and uncultivable lands from the ravages of erosion, enhance and restore soil productivity, reverse degradative trends and restore degraded soil.

WHY SOIL AND WATER CONSERVATION

Land and water are natural resources that are essential for the existence of life and are the two variable factors for which management has become most essential. Land provides food, fuel, fodder and shelter besides supporting secondary and other economic life supporting system. However there has been a continuous depletion of land resources and the quality of land is deteriorating due to various factors like soil erosion caused mainly due to shifting cultivation, high rainfall, large scale deforestation, reckless mining activities, overgrazing, general mismanagement, etc. Such soil erosion leads to degradation of soils' physical property and loss of plant nutrients

It takes nature 600-1000 years to build 2.5 cm of top soil but get displaced in a year only due to misuse. It has been reported that 6000 million tones of productive soil are lost every year from about 80 million hectare of cultivated land alone in India. It has also been proved that soil lost from unprotected land is about 120 tonnes /ha/yr and may go as high as 300 tonnes /ha/yr. Thus, a part from depletion of fertile soil erosion results in the loss of run-off water, plant nutrients and micro flora, siltation of reservoirs and riverbeds thereby adversely affecting irrigation and power potential, causing floods in plain and valley which damage crops, animals, habitation, communication, etc. But most of them adversely affect agricultural production, forest productivity and availability of water both for irrigation and drinking besides bringing about a disturbance in the soil and water balance

PROBLEMS RELATED TO SOIL EROSION

Normal erosion is a continuous process where soil is regenerated by natural means at the same rate as it is removed. But when protective vegetation is disturbed by cultivation, grazing or burning, the natural balance is upset and soil becomes exposed to most serious causes of erosion, i.e., water and wind. Under these conditions the soil can be washed away at a faster rate than it can regenerate resulting in a net loss of soil. It causes exposure of bed rocks and silting of rivers and dams. The main cause of soil degradation in the region is as follows.

- **Shifting cultivation**

It is known as jhuming and regarded as the step in transition from food gathering or hunting to food production. This traditional practice is still predominant in this region. In this system farmers burn the cleared vegetation and cultivate plots of land in the virgin forest until the yields of the crops fall below subsistence level. At this point the farmers abandon the land to natural fallow and move to a new site. When the original area is considered to have recovered fertility, the cultivators return to

repeat the process, until once again the fertility of the land is apparently exhausted. As a result of population explosion, demand for food and fuel increased and land availability for agriculture has reduced. As a result, the jhum cycle of 10-15 years is reduced to 3-5 years. Earlier when jhum cycle was long the abandoned land got sufficient time for regeneration of forest but now due to reduced jhum cycle land does not get time for regeneration of vegetation. Indiscriminate felling of trees on the hill slopes brought an undesirable eco-imbalance. Further, the hill tops are the main source of water; deforestation of this hill top led to the elimination of water source. This, in fact, ended in the loss of top soil. Coupled with this, deforestation drastically reduced the retentive capacity of the soil. Erosion of soil in the catchment area resulted in silting of the reservoirs and streams leading to unprecedented floods. Hence, this situation needs to be tackled on top priority to keep the ecological imbalance in tact as well as to meet the fodder, food, fuel requirements, etc., in these states. The calendar of shifting cultivation system is given in Table 1.

Table 1: Soil erosion calendar of shifting cultivation system

Month	Agricultural operation	Erosion problem	Soil erosion (t/ha)	
			Min	Max
January to April	Selection of plot, forest cutting, burning and cleaning of hill slopes and sowing begins	Displacement of loose soil materials to down hills and rolling down of earthworm casting, soil erosion as above and wash due to rains.	0.0	22.4.
May	Sowing/weeding	Heavy soil wash, faint drilling at foot hills on silt deposits	0.2	61.9
June	Weeding	Heavy wash of soil aggregates	0.2	45.4
July	Weeding/harvesting begins	Heavy wash of soil aggregates, crop root exposed, farm soil visible	1.8	21.9
August	Harvesting and occasional weeding	Soil wash continues	1.0	29.6
September	Harvesting	Moss appears, soil erosion slows down	0.1	13.8
October	Harvesting	Soil erosion appreciably reduced	0.0	2.7
November	harvesting	No erosion, moss turns blackish	0.0	0.0
December	Harvesting/threshing/carry harvest back to home	No erosion	0.0	0.0
Year	Cropping with zero tillage on steep slope	Heavy soil wash	3.3	201.4

- **Unscientific land use on hill slopes**

The entire resource degradation process in the region is closely linked up with the land use system. Forestry is the most dominant land use system in the region followed by agriculture, horticulture, animal husbandry and non-agricultural uses (urbanization, commercial establishment, etc.). Evaluation of some of the land use systems practices in the region indicates that most of them are hazardous to resources and are not conducive to the aims of permanent agricultural systems with

sustainable production. Horticultural crops grown on the hill slopes without proper soil and water conservation resulted in soil erosion. The soil erosion varied with the extent of disturbances caused to the soil surface. Colocasia, tapioca, sweet potato, turmeric and ginger are the crops, which resulted in movement of soil to the foot hills during the process of harvesting (Table 2). Vegetable crops grown on the slope without proper soil and water conservation measures also resulted in this type of soil loss.

Table 2: Soil erosion on hill slopes

Sl.No.	Land use/practice	Soil loss (t/ha/yr.)	Reference
1	"Bun" system for raising tuber crops	40-50	Singh(1970)
2	Pineapple along the slope	24-62.6	Ghosh (1976)

- **Over exploitation of forest**

Exploitation of forest indiscriminately increases the soil erosion on hills and flood in down stream areas. Fuel shortage becomes acute. This again means further encroachment of forest land resulting in more denudation, environmental degradation and loss of biological components of soil and vegetation. Thus a vicious circle may crop up. Even excessive grazing by cattle may also damage forest. The best example is Cherrapunji in Meghalaya, which has been famous till recently for recoding the highest rainfall in the world. The place is suffering from acute scarcity of drinking water. With an average rainfall of over 1150 cm or more one would expect Cherrapunji to be clothed in lush green forest. But what one sees now is a desertified barren bed along the slope. Heavy deforestation for augmenting fuel/fire need and harsh climate of 1150 cm of annual rainfall distributed to whole year has come down in 4-5 months during monsoon.

- **Land degradation**

The extent of land degradation that follows use of forest areas for agriculture is largely determined by the level of management. Apart from soil loss that accompanies land clearing and early stages of plantations, there is also severe nutrient loss. The practice of jhuming or shifting cultivation in northeast region has increased the problem of land degradation. The involvement of such a large area in shifting has caused large scale deforestation, soil erosion, loss of productivity, ecological imbalance and land degradation. The growing population pressure has resulted in misuse of land resource and national options for high value plantation crops have severely affected the tropical forests. Estimates have revealed that nearly 88.3 million tonnes of soil is lost annually as a result of shifting cultivation in NEH region. The degraded land as can not be put to any productive use.

SOIL AND WATER CONSERVATION MEASURES

The water conservation is inseparable from soil conservation. It is the application of all measures necessary to conserve the whole complex of land and water resources. The maximum benefit of a variety can be derived only after maintaining a high fertility level. Therefore, soil and water conservation measures should be primary objective of research programmes. There are two approaches that have been used to reclaim degraded soils and intensify agriculture production system, i.e., engineering approaches and ecological approaches. Mechanical soil and water conservation measures are required for controlling soil erosion, retaining maximum rainfall within the slope and safe disposal of excess run off from the top to the foot hills. These structures are used in case of extreme soil degradation, where other approaches are not possible or slow. The measures useful in controlling are discussed below.

Contour bunds: Bunds are either mechanical or vegetative barrier created across the slope. The purpose is to divert the excess run-off during rain to the waterways and to retain eroded soil. These bunds on steep slopes are created by way of excavating parabolic channels (0.3 m top and 0.2 m deep)

on contours and keeping the dug out soil in form of a bund at the lower edge of the channel. These bunds require care in maintenance during first 2 years. Our experience showed that vegetative barrier alone will not serve the purpose on steep slopes. The vertical interval of these bunds may vary from 0.5 to 5 m depending on the land use, soil depth and slope of the land.

Bench terrace: Bench terraces are flat beds constructed across the hill slope; spaces between two contours are leveled by cut and fill method. In micro-watershed involving steep slopes, experiences showed that only at foot hills few benches may be constructed to produce food crops through intensive cropping. The vertical interval of such terraces should not increase more than one meter. Such measures can be adopted where the soil depth is more than 1.0 m. In case the entire hill slope is to be converted into benches, the construction should start from foot hill.

Half moon terrace: These are level circular beds having 1 to 1.5 m diameter cut into half moon shape on the hill slopes. These beds are used for planting and maintaining sapling of fruits and fodder trees in horticulture/agro-forestry land uses.

Grassed waterways: These are channels laid out preferably on natural drainage lines in the watershed. As far as possible, natural courses should be used without much disturbances for draining out the excess water. At appropriate locations, stilling basin (water pools) should be created with land use of earthen and boulder pitched bunds for temporary detention of run-off water. This structure will also serve the purpose of energy dissipation of flowing run-off water.

Water harvesting ponds: Dug out cum embankment type of water harvesting structure can be used for creating seasonal and perennial ponds at the foot of the micro-watershed for irrigation and fish farming purposes. The above soil and waster conservation measures can be created with the use of local resources. On hill slopes, soil and water conservation measures may be followed with horticulture land use system. Other steps required are:

Contour bund at 1.0 m to 5 m. vertical interval in all the land uses with common grassed waterways.
Bench terraces towards the foot hills for growing vegetable crops (Vertical interval should not increase over 1.0 m.)
Half-moons terrace (1 to 1.5 m dia.) for fruit crops.
Water storage at appropriate location for irrigation/fish purposes.

WATERSHED BASED LAND USE SYSTEM

Watershed management is the development and management of the watershed resources in such a manner so as to achieve optimum production, which can be sustained without causing deterioration in the resources base or disturbing the ecological balance.

Principles of watershed management

Our research experiences proved that with the watershed based concept, it is possible to manage the hill slopes effectively while utilizing local natural resources. A high priority within watershed management practices has to be given to water conservation and water harvesting so that the farmer is attracted to the high yield enabled by increased water availability. Land has to be developed to receive the rainwater in such a way so as to utilize the maximum for plant growth and lead the rest into storage either surface water storage or ground water storage for later use by man and animals. The daily needs of the people for food, fuel, fibre, fodder and employment have to be adequately met before any other goals of watershed management.

DEVELOPMENT OF HORTICULTURAL LAND USES

In this system mixed horticultural crops including fruit, vegetable, root crops, etc., may be grown under the best management practices to keep the soil covered. The horticultural crop residue, i.e., stubble, leaves, etc., not only reduce the soil erosion but also serve as a mulching material and add organic matter to the soil. The rotation of annual horticultural crops in between the perennial trees is

done to increase cropping intensity as well as maintain soil fertility, etc. Bunds, half moon terraces and grassed waterways are the major soil and water conservation measures required for land development. However, if vegetable crops are to be grown, then only bench terraces may be required on foot hills at a vertical interval of 0.5 to 0.75 m. The different horticultural land uses are to be formulated in the following pattern:

1. Agri-horticulture

In this system the 2/3 area (upper side) is covered under horticultural crops for which half moon terraces and contour bunds are prepared on the hill slope and 1/3 area towards down side is used for the cultivation of cereals, oil crops, etc., on the bench terraces. In this land use pattern, the following crops may be grown after the land preparation.

1) Fruit trees in half-moon terraces (triangular system of planting) on contour
2) On the contour bunds the pineapple in two rows should be planted at closer distance, which helps in soil erosion from contour area.
3) The interspaces in the contour are utilized for the cultivation of the vegetables. The legume vegetables like bean, cowpea, guar, pea and good over crop like sweet potato should be cultivated.
4) Ginger and turmeric can be grown in the interspace area in the contours.

2. Agri-horti-silvi -pastoral (model land use)

In this system the middle 1/3 area of the hills is taken for the cultivation of horticultural crops and upper 1/3 area and lower 1/3 area are being cultivated for establishment of economic forest plant's plantation with fodder and cereals, millets, etc., respectively. The middle portion is converted under contours and the fruit plants are planted in half moon terraces on the contours. The contour bund is utilized for pineapple planting. The two or three separate blocks of each fruit crop may be made so that cultural operations may become easier. The vegetables, root crops, rhizomatous crops, etc., are cultivated in the interspaces of the contour. The lower one or two contours may be used for pure vegetable cultivation.

3. Mixed horticultural land use

If the farmer is interested to grow only different horticultural crops in the land available with him the whole jhum land may be divided in the following pattern for developing mixed horticultural land use.

a) 2/3 area from top towards lower hillside is converted into contour and 3-4 fruit blocks can be developed, i.e., banana block, orange block, lemon block, papaya block. The lower 3/4 contour is utilized for the cultivation of rhizomatous crops. After that 3-4 terraces may be completely utilized for the pure vegetable cultivation. The contour bunds are utilized for the planting of pineapple.

4. Horticultural land use (with fruit crops only)

The land use under pure horticultural orcharding system has high potentiality in the region. In case more area (jhum land) is available at a place in the selected site and the owners are too interested for growing of fruit trees collectively as co-operative farming type in order to bring their large area under horticulture then pure orcharding can be done and land use pattern may be developed accordingly, keeping in view about the soil and water conservation aspects. This system of cultivating the land will be highly profitable in the long run and area will be developed as fruit growing belt. The water and soil management practices are to be followed in a systematic manner so that the soil loss can be checked to a considerable stage. The following practices (management) are to be adopted while considering this land use.

1) The fruit plants like orange, banana, etc., are to be planted either in half moon terraces or in contour bunds.

2) If the slope is below than 25.30^{o} the intercropping is to be practiced for getting the subsidiary income to the farmers and the four rows planting of pineapple after 10 rows of fruit trees across the slope will be advisable in order to check the soil erosion.
3) The legume vegetable should be considered for the cultivation as intercrop so that soil fertility may be enhanced.
4) If planting is done only in half moon terraces the chopping of weeds in interspace areas is advisable and the filler crops should be taken.

5. Horti-silvi-pastoral system

The horti-silvi-pastoral system has great potential to provide a sustainable land use system, which would maintain an acceptable level of production of fruits, vegetables, fuel wood, timber, fodder, etc., and at the same time, conserve the basic resources (mainly soil) on which production depends. This system was found economically viable and socially acceptable alternative to *jhuming* in this region.

6. Multi-tier horticultural system

1. Horti-horti three-tier system: areca nut + black pepper +ginger/ turmeric/pineapple/Assam lemon
2. Silvi-horti-three tier system: MPT + black pepper + ginger/turmeric/pineapple
3. Silvi-horti-two tier system (Parkia and pineapple or subabool and pineapple)

a) Alder based farming system of Nagaland (alder and vegetables like potato, cole crops or alder and cereals like maize, rice, etc.)
b) Alder based large cardamom system of Sikkim
c) MPT + Assam lemon

7. Multi-tier system for plantation crop

Tea plantations in the region including Sikkim and Darjeeling play major role in the economy and employment generation. It has been established that tea and coffee plantations require sparse shade and *Albegia, Dalbergia, Accasia* have been used as the major tree species for the purpose, which in general formed a two-tier system of silvi-horticulture. Recently, black pepper has been introduced in some of the plantation for making the system more profitable.

For two-tier system

- Tree spp.(*Albegia*) + tea or coffee plantation
- Tree spp. (*Dalbergia*) + tea or coffee plantation
- Tree spp. (*Acasia*) + tea or coffee plantation

For three-tier system:

- Tree spp. (*Albegia*) + black pepper + tea or coffee plantation
- Tree spp. (*Dalbergia*) + black pepper + tea or coffee plantation
- Tree spp. (*Acasia*) + black pepper + tea or coffee plantation

8. Homestead gardening

A number of horticultural crops like guava, citrus, orange, banana, peach, pear, drum stick, etc., are grown with under story crops such as tapioca, colocasia, sweet potato, cucurbits, ginger, turmeric, beans, root crops, leafy vegetables, etc., having variations in their combinations from house to house depending upon area available, site condition, climate and choice of individual family. They are mainly grown for home consumption and surplus if any sold in the local market.

Home gardening of temperate/subtropical zone

Peach, pear, plum, apple, other indigenous fruits + cole crops, radish, carrot, turnip, pea and other indigenous vegetables.

Home gardening of tropical/subtropical zone

Citrus, guava, jack fruit, mango, coconut, areca nut papaya, pine apple, low chilling peach, pear and other indigenous minor fruits + okra, solanaceous vegetables, cucurbits, tapioca, ginger, turmeric, colocasia, sweet potato, black pepper and other indigenous vegetables along with water bodies (pokhari).

Selection of crops and varieties

Suitability of crops depends upon the altitude, soil and climatic conditions. Say, as an example, Manipur state can roughly be divided into 4 land zones viz.

i) High hills: 900-2000m above MSL (apple, peach, pear, plum, apricot, potato, cabbage, cauliflower, radish, beans, etc.)

ii) Mid hills: Below 500 m (citrus, banana, pineapple, papaya, guava, ginger, turmeric, chilli, brinjal, tomato, bean, sweet potato, tapioca, colocasia, etc.)

iii) Foot hills: Bordering areas of hills (jackfruit, areca nut, black pepper etc.)

Vast areas of the hills are suitable for cultivation of tropical, sub-tropical and temperate fruits viz.

Tropical	Cashewnut, banana, papaya
Sub-tropical fruits	Pineapple, citrus, guava, banana, gooseberry, etc.
Temperate	Apple, Peach, pear and plum
Spices	Chilli, turmeric, ginger, garlic
Vegetables	Tomato, chillies, brinjal, potato, radish, pea, colocasia, okra, pumpkin, bottle gourd, cucumber, carrot, cabbage, cauliflower, knol khol, french bean, winged bean, dolichos bean.
Tuber crops	Tapioca, sweet potato
Tree vegetables	Tree bean, tree tomato and drum stick
Suitable grasses for risers	*Stylosanthes guyanansis*, *Stylosanthes hamata* and Thinnapier, NB-21.

Crop planning and production technology

The lower one-third area should be terraced and utilised for growing vegetable/spices or tuber crops. While planning crops, it should be necessary to keep in mind the requirement of farmers. Two crops round the year can be grown even under rainfed conditions. High yielding varieties of crops should be introduced. Usually the terrace risers have to be protected by growing some fodder grasses, so that apart from protecting the risers from erosion, it provides a subsidiary source of income to the farmers. Upper, the mid-one third, area should be utilized for fruit crops and the remaining upper one-third under the reserve forest (fodder or fuel trees). The plants should be planted in half moon terraces.

Other methods of efforts to check degradation

In the second half of 20th century protection efforts for forest resources and the wild life have been brought to the notice through several activities in whole country like 'Chipako Movement in UP/UA', 'Silent Valley Movement' in Kerala, 'Thingtam' in Mizoram, etc. The rich variety of vegetation in the Mawsymai sacred grove, near Cherrapunjee (or Sohra, as it is locally known), stands out as a vivid reminder of what the area was once like.

Effective traditional methods

Most of the agricultural activities in the region contribute considerably towards land and water degradation. Bench terrace cultivation in certain areas of Nagaland, Sikkim and Manipur, bamboo drip irrigation in Jowai district of Meghalaya, efficient water management system of Apatani plateau of Arunachal Pradesh, 'Zabo farming system' of Nagaland, high altitude farming of Buddhist Monpas of Kameng district of Arunachal Pradesh are examples of excellent management of biophysical resources based on local skill.

FUTURE OUTLOOK

1. Formulation of suitable combination of various land uses for optimum utilization of land, water and natural energy sources.
2. Selection of suitable fruit trees, vegetable trees, fodder and fuel trees with suitable root system desirable for binding the soil.
3. Rehabilitation of jhum lands with horticultural crops.
4. Selection of locally available fodder trees.
5. Reforestation of the degraded lands.
6. Water harvesting and development of water area by utilizing run off water have to be perfected.
7. Development of suitable technologies for watershed management to be used in mini watershed.

CONCLUSION

The deep-rooted traditional agricultural techniques cannot be washed away overnight. They can, however, be spontaneously modified to minimize the ecological ill effects. Jhum is an ancient method of cultivation wherein a patch of forestland is cut and burnt down to be cultivated. Bun is different in the sense that the slashed biomass is not burnt but ploughed in for organic content. These methods were relevant when the population pressure was less and the land was re-harnessed after 30 odd years. Today, the population pressure is such that cultivators come back to used land after three or five years. This is not sustainable, and that is why they do not get proper agricultural yield.

For sustainable farming, agri-horti-silvi-pastoral system is one of the best land-use systems with adequate advantage of soil and water conservation. It has been proved that such a system can reduce soil erosion from 42 tonne/ha to 1.5 tonne/ha, besides providing for rainwater harvesting. This water can be harnessed both for pisciculture as well as irrigation.

The commercial agriculture and the Green Revolution could not touch the NE. This was mainly due to the region's inaccessibility. Keeping this in mind, we should refocus our strategy and make it two pronged. One, augment food production through intensive high-input agriculture in the valley land and, two, convert rest of the areas into organic farming zones.

Within the next decade and a half, the NE will not only be self-sufficient but will also be food surplus. For this, rainwater needs to be harvested. That may bring in more area under settled cultivation. To usher in a revolutionary change, all NE agriculturists should protect present resources and judiciously utilise the natural ones.

Studies on alternative farming system to shifting cultivation indicate that agriculture with bench terrace and contour bunds as conservation base can provide stable alternate to switch over from shifting to permanent agriculture system provided maintenance of conservation measure is properly

done. Agro-horti system of land use with subsidiary source of income through live stock rearing provides most favourable indication in favour of adopting mixed land use system as an alternative to shifting cultivation on steep hill sides. Such a system will certainly be technologically feasible, sociologically acceptable, ecologically sound and economically viable.

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TREATMENT TECHNOLOGIES FOR WATERSHED DEVELOPMENT AND MANAGEMENT IN NORTH EAST HILL REGION

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INTRODUCTION

Land, water and vegetation are the three basic resources of the life support system. These resources are under intense pressure in the North Eastern Region due to natural and human induced factors. The ecosystem in this region tends to become fragile and precariously balanced due to rapid increase in human and bovine population, over exploitation of natural resources to meet their food, fodder and fuel requirement and unscientific management of these resources. Traditional food production system prevailing in the region, undulating terrain and high and intense rainfall, has further accelerated the resource degradation and depletion processes leading to the deterioration of the overall ecosystem. Soil erosion not only affects the on-site by way of loss of fertile soil but also off-site in form of frequent incidences of flash floods in the lower valleys and plains with consequent damage to fertile farms, water resources and irrigation systems, dams, roads and bridges and loss of life and property.

The agricultural production system in the region is mostly rainfed, mono-cropped and at subsistence level. It is estimated that 76.6 t ha^{-1} yr^{-1} of soil is lost every year due to traditional system of farming (Prasad et al., 1981). The soil erosion from hill slope (60-70%) with jhum (shifting cultivation) during first year, second year and abandoned during the 3rd year was estimated as 147, 170 and 30 t ha^{-1} yr^{-1}, respectively (Singh et al., 1995). "Bun Cultivation" is another form of food production system, which is practiced mostly in Meghalaya for cultivation of tuber crops such as potato, ginger, turmeric, etc. It was observed that from every tonne of potato produced by the system, soil loss was two tonnes (Singh and Singh, 1981). About 57.41 lakh ha area is categorized as degraded land in the region (Sehgal and Ibrol, 1994). This necessitates a long term developmental approach aimed not only at optimum utilization of natural resources but also at development of the natural resources such as land, water, vegetation and man power for restoration of ecological balance.

WATERSHED APPROACH FOR RESOURCE CONSERVATION

The scope of soil conservation is very wide and encompasses much more than physical work for erosion control. The concept of soil conservation, now-a-days has been expanded to mean protection of the soil against physical loss by erosion or against chemical deterioration. Thus, the effective conservation and management of land, water and vegetation resources aimed at obtaining optimum and sustained return from these resources without degrading them can be achieved by adopting watershed as basic unit of development. Watershed being a natural hydrological entity, it responds most effectively to various engineering, biological and cultural treatments. Monitoring of runoff and silt at the outlet of the watershed can help assess the impact of various treatments aimed at conserving soil and water, and protecting vegetation. Watershed management involves protection of land against all forms of degradation, restoration of degraded land, sediment control, pollutants control, and prevention of floods, etc. A workable size of the watershed can be decided in accordance with the aim and objective of the particular system as well as the size of the stream for which it forms a catchment. Watershed of smaller size has distinct advantage of involving a smaller number of families within a

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resource unit with a common social and economic pattern. Demarcation of watershed and subsequently sub watersheds can be done either by using topo sheet of the area available with Survey of India or by interpretation of remotely sensed imagery of the area. Prioritization of sub watershed should be done on the basis of sediment yield and pollutants concentration in the runoff from the sub watershed. The entire watershed can be treated gradually over a number of years as per the availability of financial and other resources. Numerous treatment technologies in form of engineering measures and agronomic practices are available. But identification of most suitable technologies as per the site condition and their application in correct way is most important to achieve the desired results. These technologies when adopted within the boundary of watershed, facilitates favourable interaction among various watershed factors such as physiography, land slope, soil characteristics, land use, hydrological behaviour etc, land, and water resources to produce food, fodder, fuel and fibre on sustainable basis. In present article only engineering measures suitable for the region are discussed.

ENGINEERING MEASURES

Engineering measures are also called mechanical measures. These measures are aimed at arresting the movement of eroded soil by reducing the slope length and / or slope steepness or gradient. Some of theses measures suitable for agricultural lands and their design and potential land use models are discussed.

a) Contour bund

Contour bunds are mechanical (earth made) barriers created across the slope following the line of contour. Contour bund may follow exactly the line of contour in the low rainfall areas where the objective is to conserve entire amount of rainfall in-situ. But in high rainfall areas such as this region, where in addition to the in-situ conservation of rainfall, safe disposal of runoff is also one of the objectives, the contour bunds may deviate from the line of contour in order to attain longitudinal gradient. This gradient will help guide the runoff to grassed waterways safely. Owing to the generation of large volume of runoff due to high rainfall amount and intensity, and land gradient, 0.5% longitudinal gradient to the contour bund should be provided. Such bunds are called graded bunds. The graded bunds divert the excess runoff during rains to the grassed waterways and retain eroded soil. For making of the graded bunds, first contour lines are demarcated by putting stakes on the ground. Then another line is demarcated by deviating from contour line so as to attain 0.5% grade. The graded bunds are made along this line. These bunds on steep slopes are created by way of excavating parabolic channel (0.3 m top width x 0.2 m deep) along the grade line and the dug out soil is placed in a form of bund at the downstream of the channel. The height of bund should be such that it can allow maximum 30 cm impounding of water near the bund. In the region normally 40-45 cm height is appropriate. The vertical interval between two consecutive bunds may be kept at 0.5 to 1.0 m depending on the slope, land use and soil depth. Theoretically, bunding is suitable for lands with slopes ranging from 2 to 10 % but experiences indicate that it can be adopted for land with slope upto 30%. But the height of the bunds should be raised once before commencement of the monsoon season. Other bunds being used in watershed programmes are as under:

1. **Side bunds:** These are constructed along the slope at extreme ends of the contour bunds.
2. **Lateral bunds:** The safety of contour or graded bunds from excess accumulation of runoff is very essential. This bund is constructed along the slope in between two side bunds to prevent concentration of runoff.
3. **Supplemental bunds:** If the horizontal spacing between two contour bunds is large, supplemental bunds are constructed at those places across the slope to limit the horizontal spacing.

4. **Marginal bunds:** These bunds are constructed along the margin of watersheds, streams, roads and gullies.

Crop cultivation practice is continued in the area within the two bunds; with the slow process of silt deposition within the bunds, the area between the two bunds gets leveled up and takes shape of terrace in due course of about 4-8 years time. It has been found that developing bench terraces through slow process with the help of contour bunds is very effective, as this method avoids sudden disturbance of the soil profile exposing the subsoil as happens in case of bench terracing by cut-fill method. The results of an experiment in the ICAR showed that after cultivating 3 crops, slope of land surface reduced to an average slope of 7.8% from original slope of 28.8%. Pineapple may be planted on the bunds. Pineapple planted on contour bunds yields 9300 fruits per hectare after 20 months of planting. Golden timothy grass, guinea grass, dallies grass can be planted on bund for its stabilization and fodder production (Singh et al., 1996). These bunds require care and maintenance during first two years.

b) Bench terracing

Bench terraces are flat beds constructed across the hillslopes along the contours with half cutting and half filling. They serve as barriers to break the slope length and also reduce the degree of slope thereby eliminating the all erosion hazards. On sloppy and undulating lands, agricultural practices can effectively be performed on these bench terraces. All the external nutrients supplied to the crops in form of manures and fertilizers remain in the cropped field. In micro-watersheds involving steep slopes (up to 33%) few bench terraces only at foothills may easily be constructed to produce food crops. Experiences show that, construction of dry bench terraces even up to 40 to 50% slope in NE region is feasible. The vertical interval of such terraces should not be more than 1.0 m. Such measures can be adopted where soil depth is more than 1 m. Requisite slope for risers usually 1:1 (riser to batter) slope is to be maintained for the vertical drops of the terraces. Bench terraces can also be developed with vertical stone walling and are in use by the farmers of the region. Side bunds on the outer edge of the terrace should be provided to prevent slipping down of soil and overtopping of excess runoff from the terraces. To maintain top soils in terraces, the construction should start from the foot hills.

Normally three types of bench terrace should be used in the region depending upon requirement of crops and availability of funds. They are as under:

1. **Level bench terraces:** Benches are almost leveled to ensure uniform depth of impounding water. This type of bench terrace is used for paddy cultivation. Therefore, they are also called table top or paddy terraces.
2. **Inwardly slopping bench terraces:** These types of bench terraces are preferred for cultivation of tuber crops such as potato, ginger, turmeric, and sweet potato, which are susceptible to water logging. Benches are made inward slopping to drain runoff as quickly as possible. The longitudinal gradient of 0.5 to 1% and inward gradient of 2.5% may be followed in the region.
3. **Puertorican or California type of terraces:** These terraces are formed by gradual conversion of land between two barriers into terrace by natural leveling process. Mechanical barriers (bunds) or vegetative barriers (grasses or shrubs) or combination of both, are laid along the contours. Due to ploughing and interculture operations soil is eroded and gets deposited at the barriers. Thus, in due course terraces are formed.

Results of experiments conducted at Byrnihat and Barapani (Meghalaya) showed that bench terrace is able to retain up to 98% of rainfall. The risers of the bench terraces should be planted with perennial grasses and fodder legumes for its stabilization and fodder yield. Legumes - *Stylosanthus guyamensis*, Shameta, thin nappier and *Seteria sphaculata* with yield potential of 19.7, 19.0, 65.05

and 80.86 tonnes of green fodder, respectively, per hectare of riser land (Verma, 1987) were found good for plantation on terrace risers.

c) Half-moon terraces

The half-moon terraces are constructed for planting and maintaining saplings of fruit and fodder trees in horticulture and agroforestry land use system. The construction of this type of terrace is made by earth cutting in half-moon shape to create circular level bed having 1 to 1.5 m diameter. The bed may also have inward slope. This type of terraces is made at an interval of planting spacing of the fruit and fodder trees. Half-moon terrace helps retain soil fertility, moisture and added fertilizers and manures for healthy growth of the plant.

d) Contour trenching

Trenches are any form of depression or micro pit or trench constructed over the land surface. In order to prevent soil erosion and to absorb rainwater in non arable lands, trenches are constructed along the contours (called contour trenches) on hillslopes above 15% with vegetative supports for forestry and horticulture land uses. Generally trenches may be dug with a cross section of 0.30 m x 0.30 m at 1 to 2 m vertical interval. For proper drainage of excessive runoff, they may be connected with longitudinal drains and drop pits. It will improve moisture status in soil, water yield in the springs, increase in fruit and wood production. For vegetative supports economic species like broom grass can be planted. They are called continuous when there is no break in length and maximum length can be 100 to 200 m long across the slope depending on the width of the field. However, when these are laid scattered with maximum length of 2 to 4 m, they are called staggered contour trench. The trenches may be trapezoidal or rectangular in cross section but flatter upstream side slopes are preferred in order to minimize the risk of scouring by incoming runoff.

e) Grassed waterways

In high rainfall area, safe disposal of runoff is very important for safety of any trace system. The main function of grassed waterways is to drain out excess runoff from the field at non-erosive velocity. It helps protect land against rill and gully erosion. A waterway is constructed according to a proper design. Turfs or sod of perennial grasses which are drought resistant, erosion resistant and submergence resistant should be developed to protect the channel section against any kind of erosion because of the concentrated flow. The velocity in the grassed waterways should be kept within the permissible limit for different types of soil and these limits are presented below (Table 1).

Table 1: Permissible velocity in grassed waterways for different soil types

Type of soil	Maximum permissible velocity (cm/sec)
Sand and silt	45
Loam, sandy loam and silt loam	60
Clay loam	65
Clay	70
Gravelly soil	100

The trapezoidal section of grassed waterways is more appropriate because it is more stable and has larger capacity as compared to other cross sections. Moreover, trapezoidal shape will assume parabolic shape in due course.

f) Diversion drains

Diversion drains are sometimes called simply diversions. They are the channels constructed across the slope for the purpose of intercepting runoff and conveying the same to a safe outlet.

Diversion drains are located above the agricultural lands at lower reaches of hill slope. Diversion drains are also constructed at the gully heads or at the upstream of bunded or terraced areas to intercept the surface runoff to avoid any damage from concentrated flow. The design criteria and maximum permissible velocity should be same as that of grassed waterways.

ECONOMICALLY VIABLE AND SUSTAINABLE FARMING SYSTEM DEVELOPED BY ICAR ON MICRO-WATERSHED BASIS

ICAR has developed economically viable and sustainable farming systems on micro-watershed basis. The above mentioned conservation measures were employed to reduce the soil and water loss from the field. Some of the promising and most suitable systems for the region are discussed below.

i) Agro-pastoral farming system

The system was developed in the area of 0.64 ha having average slope of 32.42%. The conservation measures adopted were contour bunds at higher reaches, bench terrace at lover reaches and grassed waterways in drainage channel. Top of the hillock (0.06 ha area) was kept under forest. The cost of land development under the system was around 400 man days/ha. Based on the experiences and results, two cropping systems: rice based (Rice-mustard /potato/radish, maize based cropping system (maize-groundnut/soybean/mustard) may be practiced. About 30% area was covered under bund and terrace risers. This area was utilized for fodder production. Among the perennial grasses and legumes - *Setaria sphacilata,* thin napier, guinea and stylosanthes were found suitable for plantation on terrace risers for stability of the risers and fodder production. The fodder crops should be pruned before attaining height of 50 to 60 cm to avoid any shade effects on agriculture crops in the terrace. Such system in 1 ha land can also sustain 1.25 cow or 5 pigs or 10 goats. Economics of this farming system was estimated as 1.83:1 without integration of livestock and 2.05:1 with the integration of livestock. Sediment yield from this system was found to be less than 1 t $ha^{-1}yr^{-1}$. This system can be practiced on land with more than 1m soil depth and slope upto 50%.

ii) Agri-horti-silvipastoral farming system

The system was developed in micro-watershed having an area of 1.58 ha and average slope of 41.77%. Contour bunds, bench terrace, grassed waterways and half moon terraces were the conservation measures adopted in the micro-watershed. Timber, fuel, fodder, and fruit trees were grown along with pineapple, fodder grasses, and legume crops. Labour requirement for the development of the land for this mixed land use system was estimated as 190 man days ha^{-1}. The produce from this system in 1 ha area can meet the food, fodder and fuel requirement of a tribal family consisting of 5 members. One person can maintain this system in 1 ha area through out the year except in the month of July when labour requirement exceeds 30 man days $ha^{-1}yr^{-1}$. During this month his family member can support him. The system can sustain 10 goats from the fodder obtained from risers, horticulture and silvipasture area. The system is most suitable for remote area farmers who would like to have self sufficiency in food, fodder and fuel (Singh et al., 1987). The benefit: cost ratio of the system was estimated as 2.14:1 and 1.41:1 with and without integration of the livestock component, respectively. Hydrologic evaluation of the system revealed the sediment yield of 1.22 t ha^{-1} yr^{-1}.

iii) Livestock based farming system

This system was found suitable for steep slope upto 100% and shallow soil depth. Even soil depth of 0.5 m can also sustain this system. The economic viability and sustainability of this system was established in 1.39 ha area with average slope of 32.02%. Minimum soil manipulation is required.

Contour trenches and grassed waterways can provide effective conservation of soil and water in the system. Cost of land development for such land uses may vary between 150 and 335 man days ha^{-1}. Selection of leguminous and non-leguminous annuals and perennials, shrubs and trees will depend on the type of enterprises (such as milk, beef, mutton, wool, pork and poultry production). The fodder production system has to ensure stability in fertility status of soil, availing the moisture supply towards maximum fodder production for longer period during the year and conservation of fodder for lean season. Annual legumes develop 100% canopy within 45 days of the onset of rains. Combination of cultivated varieties of perennial legumes, grasses, shrubs and trees can extend availability of green fodder up to February at low altitude thereby shortening the requirement of conserved fodder for lean season. Carrying capacity of such high land use has been estimated to be 4 to 5 livestock/unit/ha with setaria and stylo (1:1) mixture of fodder production. Livestock-based farming system has potential for substantial income from the farmyard manure and self-sufficiency in the matter of fuel through biogas plants. The benefit: cost ratio for the system was 2.08:1. Such land use is expected to retain over 90% of annual rainfall and restrict the soil loss within 2 t ha^{-1} yr^{-1}.

iv) Horticultural based land use system

This land use can be adopted in a slope not more than 100% having maximum soil depth of 1.0 meter. Contour bunds, half-moon terrace at the fruit plant location, grassed waterways and few bench terraces at the lower terraces for growing vegetables crop are essential conservation measures. Such lands are expected to retain over 90% rainfall in the slope and reduce the soil loss below 1.0 tonne ha^{-1} yr^{-1}. Land development cost will be about 108 man days ha^{-1}. Variety of horticultural crops can be grown under the system depending on the market potential. Pineapple may be planted on contour bunds across the slope. Terrace riser in the vegetable blocks should be planted with fodder legumes. Hilltop should be used for forest species to meet the fuel and fodder requirement. Yield potential of newly planted Assam lemon orchard has been found to be 11,300, 12,800 and 37,200 fruits ha^{-1} during third, fourth and fifth year after planting, respectively (Singh *et al.*, 1987). Pineapple planted on contour bunds yields 9300 fruits per hectare after 20 months of planting. During the early phase of fruit trees planting bajra x napier hybids, golden timothy grass, guinea grass, dallies grass and maize can be intercropped with orange, avocado, guava and lemon having little adverse effect on tree growth but the green forage yields 70-138, 44-82, 43-74, 45-81 and 50-55 tonnes per hectare, respectively can be obtained under these horti-pastoral systems (Singh *et al.*, 1987). Fodder rice bean and fine stylo can be produced 19-22 and 22-30 tonnes per hectare, respectively, with positive effect on the fruit tree growth.

v) Hydrological evaluation of land use systems

Studies in watershed based farming systems have shown the scope of using steep slopes for crop production. Soil and its losses from different farming systems were studied in two different locations, which are summarized in Table 2. Some of the potential farming systems such as agriculture on bench terraces, horticulture, agri-horti-silvipastoral systems, etc., have been evaluated at the experimental watersheds for their long term runoff, soil losses and so on. Land use practices in micro-watersheds with soil and water-conservation measures were found very effective in retention of rainfall; rainfall retained in situ varied between 80-100%. The surface runoff from shifting cultivation watershed remained higher in the range of 19.89 mm 54.99 mm in a year compared to other watersheds. Also as expected, the watershed treated with jhum (shifting) cultivation yielded the highest peak runoff (86.1 0 mm/hr) while the one left undisturbed with natural vegetation gave the minimum peak runoff (4.49 mm/hr). However, provision of trenches in fodder based agriculture most effectively conserved moisture and produced peak runoff 7.81 mm/hr. Maximum peak flow rate did not differ in mixed block forest, silvipastoral system and agri-horti-silvipastoral system showing the

effectiveness of suitable soil conservation and appropriate land use system on hill slopes. The contributions to stream flow in the watersheds having substantial area under natural forest is primarily by subsurface flow (base flow). The watersheds having continuous stream flow characteristics generated base flow to the extent of 70-90% of its total water yield. The highest base flow was obtained in the pine afforested undisturbed watershed, which constituted on an average 23.5% of annual rainfall.

Table 2: In-situ retention of rainfall under watershed based land use systems

Land use	Mean slope of the watershed (%)	Soil and water conservation measures	Annual rainfall retained (%)	Soil loss (t ha^{-1} yr^{-1})
Barnihat 100m msl, Sandy loam soil, 1600 mm annual rainfall				
Bamboo forest	45	-	99.55-99.98	0.04-0.52
Agriculture (S)	40	-	90.27-98.94	5.10-83.30
Agriculture (C)	42	Bench terrace	00.00-95.03	0.00 -7.70
Agriculture (C)	43	Contour bunds	80.74-99.79	0.60-68.20
Agriculture (P)	44	Contour bunds	97.08-99.66	0.88-14.28
Agri + Hort	44	Bench terrace + Contour bunds + halfmoon terrace	93.37-99.98	0.04-10.10
Umiam, 1000 m msl, Clay loam, 2554 mm annual rainfall				
Natural fallow	52	-	Trace-98.46	0.00-0.05
Agriculture (F)*	32	Contour trench + Grassed waterways	0.00-98.68	0.00-0.16
Agriculture (C)*	32	Contour bunds + Bench terrace	98.53-99.77	Trace-0.33
Agri (C)-hort-silvi pastoral	32	Contour bunds + Bench terrace + Halfmoon terrace	98.27-99.99	Trace-1.22
Horticulture	42	Halfmoon terrace + Grassed waterways	96.18-99.75	Trace-4.37
Agro-forestry	33	-do-	96.83-99.52	Trace-0.38
Forestry	38	-	92.79-98.27	Trace-7.80

F = Fodder based, C = Food crop

CONCLUSION

Food production system on hill slope without proper conservation measures is highly resource depleting and unsustainable. Proper land use in conjunction with mechanical soil conservation measures when adopted within the boundary of watershed can enhance sustainability of the production system in the region. The technologies, as mentioned above, help conserve rainfall in situ, thereby arresting soil loss and preserve soil fertility. The farming system models - agropastoral, agri-horti-silvipastoral, livestock based system and horticulture based systems developed by the ICAR for upland ecosystem through adoption of engineering measures on micro watershed basis restricted the soil loss within 2 t ha^{-1} yr^{-1}. The above mentioned farming system models can be adopted in the region on watershed basis as an alternative to jhuming.

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NATURAL HAZARDS IN AN ECOLOGICALLY FRAGILE MOUNTAIN TERRAIN : A CASE FOR THE PINDAR BASIN OF UTTARANCHAL HIMALAYA

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INTRODUCTION

The characteristics of hazards have a pulsating nature as slow acting and infrequent in source area, intense and catastrophic in other (Haque, 1997). The Pindar basin located in the center of Himalayan Mountain system, which is hazard prone and very sensitive in term of stability of landforms. Cloudbursts and landslides are the common phenomena. The history of cloudburst and consequently flashflood, landslides and landslips depicts that every year heavy rainfall occurred during the monsoon period and the entire region is affected. The major tributaries of the Pindar are worst affected due to cloudburst and landslides that occurs mostly along the course of the perennial streams and roadsides.

The entire basin is ecologically fragile, unstable and less rigid from the originating point to its confluence as it is also with the case of Himalayan Mountain System. The characteristic features of the basin, in terms of fragility, are more pronouns to discuss in the way that lowering the environmental conditions in both, highly elevated reaches and low-lying areas. The process of upliftment of mountain peaks and deepening of the river valleys is continued due to tectonic forces active throughout the basin resulting instability and disturbances in the landmasses. The natural hazards, both terrestrial (earthquakes) and atmospheric hazards (cloudburst, landslides and flush floods), can be seen everywhere. However, the impact of natural hazards increases with increasing elevation. (Swaminathan, 1991; Khoshoo, 1992; Dhar, 1993; Rajgopalan, 1993; Ramakrishnan et al., 1994; Rao, 1994; Qasim, 1995; Joshi, 1996; Valdiya, 1997).

Along with the process of development, in terms of construction of roads and dams using highly explosive measures, the rocks become more fragile and after heavy rainfall, the loosed materials of the rocks wash away and finally the process of landslides and mass movement takes place. In order to describe about the frequency and intensity of the hazards in the basin, it is observed that they are more devastating, intense and frequent. Out of these phenomena, cloudbursts followed by landslides are more prominent along with high frequencies.

The basin is tectonically more sensible and falls under the severe seismic prone region. Already, severe earthquakes have been taken place. The situation is grim in the area and there are about eight cases in the entire basin where due to landslides, many villages were devastated.

1. GEOGRAPHICAL LOCATION

The Pindar basin comprising of 1826.0 km^2 extends from 30^o N to 30^o 18'N latitude and 79^o 13' E to 80^o E longitude. It represents the eastern part of the Garhwal Himalaya with elevation ranging between 800 m to 6800 m. River Pindar originates from the 'Pindari Glacier' in district Bageshwar (32 km) and flowing an approximate 124 km with its numerous tributaries, confluences into the Alaknanda River at Karanprayag in Chamoli district. The watersheds of the Ram Ganga in the south, the Saryu in the east, the Nandakini in the north and the Alaknanda in the northwest delimit it giving it a distinct socio-geographical identity. The nature of slope is very steep ranging from 60^0 to

$90^{0.}$ Somewhere, it is more than 90^{0}. Mostly, the landslides are caused either by natural phenomenon or human-induced activities.

2. METHODOLOGY

The study is mainly based upon the collection of primary data. Case studies of two cloudburst-hit areas and various landslides zones have been done in order to facilitate an interpretation of natural hazards. Observations are done after field visits of the entire basin.

3. NATURAL HAZARDS IN THE PINDAR BASIN

As it is already mentioned that the basin is more prone to natural hazards ranging from cloudburst to landslide, rock-fall, flush flood and mass movement, case studies of cloudburst hit areas and landslides zones were done in the following manner:

3.1 Cloudburst

Cloud burst is natural calamity-a-crucial problem, not only because it depletes the natural resources of pivotal importance to the people of the region but also affects adversely in numerous ways. Like deforestation by biotic means, cloud burst is also a major factor contributing to a variety of other environmental problems, which include landslides, floods, soil erosion, loss of human and animal lives, loss of property, siltation and sedimentation, habitat destruction and some times species extinction (Sati and Maikhuri, 1992).

Cloudburst is more devastating and foremost natural phenomenon in this region. It occurs in the highly elevated regions, mostly in the water parting areas. These areas are densely covered by forests, mostly coniferous, but are more instable. Due to dense forest cover and high elevation, rainfall is more intense and occurs in violent form. Along with heavy rainfall, instability of the land and violent nature of stream flowing through the gorges, the process of landslide gets violent, often resulting to hazards and disasters. The basin receives heavy downpour during the three months of rainy season. The average rainfall is about 300 to 400 cm per year. Because, the slopes are very steep, therefore, the major streams and their tributaries flow through deep dissected valleys. Due to high slope gradient and high velocity of running water, the soil erosion is high and, simultaneously, it is cutting both the edges of the slopes. The Pindar river itself becomes violent during the rainy seasons and flows above the danger marks. Many times there are flash floods in the river due to high rainfall. These flash floods were observed first during 1772 and later on in 1992, 1995 and 2002.

Case study of cloudbursts-hit areas

The case studies of two cloudbursts hit areas in the basin are as follows:

(a) Gadanigarh Tragedy

This tragedy occurred when "Danda of Khankrakhet" received intense rainfall followed by repeated cloudburst in the north slopes (59^{o}) of alpine meadows of Khankrakhet, which is characterized by dense forest of Deodar and Surain. As a result, trees got dislocated in 55^{o} to 56^{o} slopes after formation of holes and gullies. In the confluence point of three gullies, land scar was formed at 51^{o}, which measured 40/30/10 m. Along with the formation of land scar, debris eroded by gullies were accumulated and a small lake was formed. Due to mass wasting, bedrock has been exposed at many places along the stream. During this process, a huge quantity of water along with debris accumulated in more than eleven places along the stream. The last and disastrous reservoir was formed 800 m. above the Maiduni village. The stream flows in the of gorge from the originating point and has confluenced with Khainoli stream near Gadini Bazar, where it turned violent, resulting in huge loss of property of Dadni Bazar as well as loss of cultivated land.

Gadini Bazar (near south slope of Gadini village) is situated in the left flank of Ming Gadhera, a tributary of Pindar River in the middle catchments. The market is located at 78° 23' E and 30° 5' N. Ming Gadhera is fed by the Khankrakhet (at parting of Pindar and Ramganga rivers) flowing approximately 9 km, with its major tributary Khainoli Gad inlet in the Pindar River near Ming Gadhera Market. This catchment extends between 79° 20' E to 79° 25' E and 30° 2' N to 30° 38' N.

Due to this natural calamity, the whole Gadini Bazar has collapsed, in which 18 shops, 13 water mills, one panchakki, two flour mills, 100 m canal and approximately 85 huge trees and seven bridges were included. Fourteen people lost their lives on that ill-fated night. 20 ha of cultivated land (irrigated) located on both the sides of the stream have been fully washed away.

(b) Kaiwar Gadhera Tragedy

Devastated cloudburst occurred on the 'Patihi' hills, in the northwest slope of Kaiwer Gadhera in the middle of the Pindar River (Sati, 1993). A three-meter broad gully was formed on the top of the hill, which became violent being 30-50 m broad on the middle course and caused heavy damage of property and lives.

Table 1. Comparative Study of the two cloudburst-hit areas

S. No.	Land features and nature of losses	Gadinigarh tragedy	Kaiwargadhera tragedy
1.	Name of hit area	Khankrakhet hill	Patidy hill
2.	Slope	59°	80°-85°
3.	Height	2800 m (masl)	1700 m (masl)
4.	Lat. and Long.	79° 23'E and 30° 2' N lat.	30°8'47" N lat to 79°22'56" E long
5.	Name of affected area	Gadini Bazar	Musudiyar
6.	Slope	21°	30-35°
7.	Height	1200 m (masl)	1450 m (masl)
8.	Lat. and Long.	78°23' E long and 30°5' N lat	30°8'45"N lat and 79°22'56" E long
9.	Distance between hit area and affected area	3 km downwards	1 km downwards
10.	Area of Reservoir	800m	200 m
	Losses of property and lives		
11.	Agricultural land	20 ha (irrigated)	1 ha
12.	Houses	33	14
13.	Lives	14 (people)	25 (animals)
14.	Forest type in hit area	Devdar and surain forest	Pine forest

Sources: From the survey made by the author.

The affected area is located at east facing slope, 6 km away from Narainbagar service center and extended at 30°8'46" N and 79°22'56" E at the height of 1450 m from masl occupying about 8 ha land in the both slopes of a seasonal nala (stream). The affected part is located about 1 km downwards from the cloudburst-hit area. The hit area is located on slope 80° to 85°. at 30°8'47" N and 79°22'56" E at the height of 1700 m from masl. The local people are engaged with stone mining in this area. The entire region got heavy downpour for two days and there was about 2-diameter cave got formed. Due to heavy downpour, the cave broke and a gully got formed. The distance between affected and the hit area is about 1 km, which is covered by pine trees. Due to steep slope, the frequency of erosion repeated and a gully became bigger in shape and violent. In

the downward part, which had almost gentle slope (30^o-35^o), a reservoir of water also got formed, which later broke and damaged 30-50 m land on the both slopes of the nala. Thundering also took place at the same night but its impact was negligible. There was huge debris flow along with stones of huge diameters, which swept away. Heavy loses of lives (animal) and property took place in which 12 buffaloes, 6 oxen and 7 cows died; 7 cowsheds and 2 houses were fully damaged and 3 houses were partially damaged along with crops and croplands. Table 1 shows the comparative study of the two cloudburst-hit areas.

3.2 Landslides

The landslide hazard has become a common feature in the mountain regions of the world (Singh, 1991). Its vulnerability is increasing with an alarming rate due to increasing anthropogenic activities (Singh and Pandey, 1995). The term landslide covers down slope movements of rocks and soil-debris that have become separated from the underlying stable part of the slope by a sheer zone or slip surface. The type of movement, which may include falling, sliding and flowing depends largely on the nature of geologic environment including material strength, slope configuration and pore water pressure (Smith, 1996). Jones (1992) claimed that landslides will become an increasingly disastrous hazard and will draw attention to several types of terrain where the greatest physical threat exists. Constructions of roads and engineering cuts of slopes, which according to Valdiya (1987) are about three to five meter high and four meter wide, produce sizeable volume of debris. Landslides can be seen everywhere in the basin but they are worst affected along the roadside and on the course of the perennial streams particularly of the Pindar river. Recently two major landslides, one in Narayanbagar and other in Harmony, are becoming more intensified. The table 2 provides a comparative description of these two landslides:

Table 2. Comparative studies of two landslides areas

Name of landslide areas	Narainbagar	Harmony
Length	200 m	400 m
Width	300 m	400 m
Elevation	1100 m (masl)	1120 m (masl)
Cause of slide	Left side erosion by Pindar	Headword erosion, slope failure
Consequences	1. Road block during rainy seasons even for more than a month 2. Downward movement of the area including settlements and a temple.	1. Road block during the rainy seasons even for a month 2. Mass movement of slope
Future consequences	The east portion of Kaiwar village may come under its influence	Complete failure of slope
Suitable measures	1. Diversion of road is impossible because there is no suitable site 2. River embankment is also impossible, because river flows in a narrow patch and violent in nature 3. Construction of bridge connecting Narainbagar village with the main road may help to reduce the intensity of landslide. One bridge is already constructed 4. Plantation of suitable species will definitely reduce the intensity of landslide	1. Diversion is possible but heavy investment is required 2. Slope embankment is possible but it is not only a solution 3. Construction of divergent road with taking care of all aspects related with fragility of slope in view 4. Plantation of suitable species will definitely reduce the intensity of landslide

Sources: Compiled by the author

Major landslides in the basin

The landslides in the basin are mostly found in the course of the river Pindar or along the roads. The landslides, which are found along the roads, are more problematic because of roadblocks during the rainy season. The major landslides along the Pindar river are as follows:

(a) Simli Landslide

A landslide is developing on the way to Gwaldom and Gairsain, two kilometer away from Simli service center. There is a bifurcation of road - one goes to Gairsain and other to Gwaldom. There was a small gully developed due to a small perennial stream and in a course of time it took a big shape, attenuated by expansion of roads. Now every year, particularly during the rainy seasons, landslides occur and block roads creating problem for transportation.

(b) Narainbagar Landslide

Narainbagar is a small service center located in two small pockets. One is known Tharalibagar and other is the main service center. In between the two pockets, a landslide zone occurred, which appeared after 1996 due to left side erosion by the Pindar river. There is also a perennial spring. In the recent years, violent landslides occur almost every year. The length of landslide is about 200 m and its width is about 300 m. The settlements on the head of the affected area are now on the verge of getting devastated.

(c) Harmony Landslide

It is one of the biggest landslides of the basin on the course of the Pindar river. It is about 400 m in length and 400 m in width. The slope gradient is 50^0 to 75^0 having loose soil. The landslide occurs due to headword erosion and slope failure.

Causes of landslides

The followings are the causes of landslides in this ecologically fragile mountain terrain:

1. Instability of terrain, because the process of deepening river valleys and uplifting of mountain peaks are continued.
2. Human induced activities such as construction of terraced agricultural fields, mass felling of trees for fuel, fodder, furniture and other needs and also for construction of roads.
3. Unscientific measures used for construction of roads such as blasting, cutting of fragile slope, etc.
4. Heavy downpour and repetition of cloudburst at a time and within a limited geographical area.
5. Steep slopes and high velocity of running water.
6. Overgrazing and consequently soil erosion.
7. Construction of settlement on the instable slopes.
8. Practice of quarrying.

Consequences of landslides

1. Heavy losses of lives and property.
2. Land instability.
3. Blocking of roads and transportation.
4. Severe future consequences as a form of mass wasting and sweeping away of settlements and agricultural land.

5. Stream blocking in the first stage, construction of reservoir and breaking of reservoir and consequently flash floods.

3.3 Rock fall

Rock falls can be seen along the sides of the main road in the basin. The major causes of rock fall are construction of road using explosive materials, instability of rocks, steep slope and high velocity of stream water. During rainy seasons, when heavy rainfall occurs, the soil surrounding the rocks flows along with water due to high run off; consequently, the boulders looses its stability and due to high slope gradient, they fall downwards causing heavy losses. Sometimes they fall upon the settlements, located in the valleys.

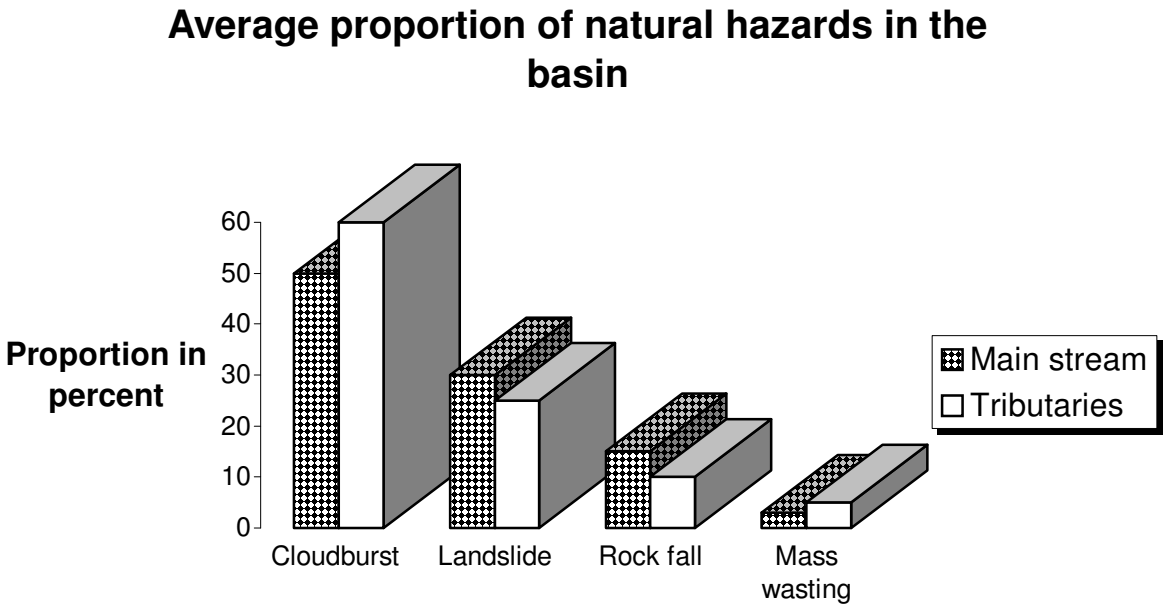
3.4 Mass movement

Mass movement, at a large scale, generally occurs due to slope failure and instability of land. The instability of the basin, which is tectonic prone, causes mass movement. Table 3 shows average proportion of natural hazards in the Pindar basin.

Table 3. Average proportion of natural hazards in the basin*

Nature of hazards	Proportion in percent	
	Main stream	Tributaries
Cloudburst	50	60
Landslide	30	25
Rock fall	15	10
Mass wasting	03	05
Draught	Nil	Nil
Avalanches	02	Nil

* These figures are estimation by the author after long experience and observation of the region



3.5 Deforestation

Deforestation is also a factor as tree roots add strength to a hill slope by vertically anchoring the soil to rock beneath and laterally reinforcing the slope across zones of instability and weakness (Swanston, 1997). Haigh, (1984) estimated that in general, excavation of one tree destroys 500 trees on the slope. Though, it is man-induced, it becomes natural and results in landslides, landslips and rock falls. This has been seen in the entire basin. This basin is rich in the natural vegetation reservoir and its diversity. The types of plants vary from subtropical to temperate along with vast alpine meadows. Out of the total vegetal cover about 75% is occupied by coniferous forest, in which pine forest dominates.

In the area, the people have two dwelling, i.e., one in the lowland and the other in the highland. During summer they migrate seasonally to the higher reaches with their domestic animals for grazing and rearing animals. These higher reaches are known as *Kharaks* (alpine grassland). Almost three to four months they remain there and during winters, they return to lowland. Almost every family has a possession on these *Kharaks*. Due to this practice, forest depletion continually takes place. Furthermore, for firewood need, the people are still dependent on the forest. There are many instances in the basin where landslide occurs due to deforestation. Over burden on the forestland due to human search for cultivated land and construction of settlements caused forest depletion in the entire basin, which gave the birth to landslides and other natural catastrophes.

3.6 Flash floods and droughts

Flash floods are common along with cloudbursts and landslides. They generally occur on the course of the streams during the rainy seasons. Sometimes, they are violent and wash away the low-lying areas. Droughts generally takes place in the valley region, but their impacts are very less.

3.7 Earthquakes

As it is discussed, the basin falls in the tectonic belt and therefore, the tremors of earthquakes have been observed many times during the past. The two recent earthquakes, e.g., Uttarakashi in 1991 and Chamoli in 1998 were worst affecting.

4. VULNERABILITY POSITION OF THE PINDAR BASIN

The dangers lurking beneath the pristine and calm beauty of the basin are hardly apparent when one travels through the region. The natural disasters are in fact become common features that the people have been experiencing at a regular interval of 2-3 years. While there is the awareness of the dangers that the hazards could have in the mountains, recent trends of increased occurrence of the hazards have concerned the authorities and alarmed the villagers. The risk increases because of the increased population and unplanned settlements. It is easy to see why heavy rains cause so much destruction to life and property; the settlements are in a slope sometimes precariously perched over the only available flat land in the hills. Deforestation, as the local people understand, is linked to soil erosion and landslides but there is little they can do to prevent it.

CONCLUSION

Earthquakes, cloudbursts, landslides, flash floods, etc., are the disasters, which may not be stopped. But, the intensity of damage due to the occurrence of these phenomena can be reduced after adopting several measures. These measures are as follows:

1. It is very difficult to predict the actual occurrence of landslides. Yet there are certain signals like forecasted heavy rainfall. Seismic activity combined with landslide vulnerability can

predict the estimated time and possible consequences. The community has to be trained to recognize the signals and act upon it.

2. A warning system to relay information about landslides could be placed in the settlements to help quick evacuation.
3. Public awareness programmes for people on causes and effects of landslides, climactic conditions that lead to landslides would be an extremely effective measure to prevent damages.
4. Preparation of landslides hazard maps for locating areas prone to slides could probably be the first step for mitigation and prevention of damage in landslides. For this, information related to past landslide events – the history, topography and bedrock data and aerial photographs could help in preparing the hazard maps.
5. Other important factors to be studied are water pressure, the climatic changes, soil types, etc. This may involve relocation of settlements of certain hazardous pockets. Restrictions may also be placed on building activity on the landslide areas.
6. Certain policy level interventions may be necessary for prevention of landslides. This would involve more investment in erosion control, maintenance of agricultural and forest land.
7. It may, on the basis of observations made above, be concluded that the cloudburst has triggered debris slides along the tension cracks and caused casualties and damages on the large scale in the catchment areas should not be allowed to be obstructed and house construction activities in the interior of hills regulated.
8. Since the whole of Himalayan region is declared earthquake prone, houses should be allowed to be built only in accordance with the earthquake resistant designs recommended by the Central Building Research Institute, Roorkee.
9. A safe distance from each side of the nala, according to the situation, should be left and no cultivated fields and houses made on the said distance.
10. All landslide affected zones should be left for natural stabilization and no human activities be allowed in such landslide affected weak slopes till they are fully stabilized in due course of time.

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EFFECT OF INDOLE BUTYRIC ACID AND VARIETY ON ROOTING OF LEAFLESS CUTTING OF KIWIFRUIT UNDER ZERO-ENERGY-HUMIDITY-CHAMBER

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INTRODUCTION

The kiwifruit *(Actinidia chinensis* Planch var. Hispida) indigenous to china belongs to family Actinidiaceae. It is dull brown in colour and very rich source of Vitamin C (100-420 mg/100g). Kiwifruit is almost free from disease and pest with long shelf life. Among different cultivars under cultivation 'Hayward' is one of the most popular cultivars due to its large size, attractive shape, superior flavour and longest shelf life quality. 'Tomouri' is a good pollinizer. Though, it was introduced in Shimla in 1963, yet due to lack of technical know how, cultivation could not gain popularity and its cultivation is still in infant stage. However, keeping in view non-availability of planting material, the present investigation was undertaken for standardization of ideal IBA concentration for rooting of leafless cutting under zero-energy-humidity-chamber.

MATERIAL AND METHODS

The present investigation was carried out at the Division of Pomology, SKUAST (K), Shalimar during the year 2003-2004. Leafless cuttings of 15-20 cm long (2-3 nodes) of 8-13 mm diameter, sub-apical and basal vine were taken in February. Twenty cuttings per treatment were dipped for 5 second in 4 concentrations of IBA-0, 4000, 4500 and 5000 ppm and evaluated under randomized block design (factorial) with three replications. Treated cuttings were placed in tray containing sterilized sand media and placed in zero-energy-humidity-chamber; water was sprayed to maintain proper humidity. Observations on days taken for sprouting, survivability of cutting (%), rooted cutting (%), number of primary and secondary root/cutting, average number of root/cutting, average root length, longest root length, average diameter of longest root, number of leaves at planting, number of leaves and shoot length 30 days after planting and ultimate survival of rooted cuttings were recorded.

RESULTS AND DISCUSSION

Main effect

The days taken to sprouting, survival of cuttings, rooted cutting percentage, number of primary and secondary roots cuttings, average number of roots and average root length were significantly influenced by different levels of IBA concentrations. The cuttings treated with five thousand-ppm IBA concentration took minimum duration in sprouting (8.75 days) where as longest (9.73 days) in control (table1). Rathore (1984) had also observe the enhanced rooting in Kiwifruit with IBA application. Highest survival of cutting (95.42%) was recorded in 5000 ppm IBA treatment where as untreated cuttings recorded minimum (79.16%) (Table 1). Higher survival may be due to high humidity in the zero-energy-humidity chamber, which thus minimize it water loss from their surface. Grange and Loach (1983), Rana and Jindal (2001) also noted similar observations in kiwi fruit. Different level of IBA produced significant effect on rooting percentage. Maximum percentage of rooted cuttings (65.42) was observed with 5000 ppm IBA, while untreated cuttings noted minimum (28.3) percentage of rooting was noted in control (Table 1). IBA helps in mobilizing reserved food

material elongation of meristematic cells and differentiation of cambial initials into root primordial (Nanda, 1975). Maximum number of primary, secondary and average root number (7.68,49.0 and 75.0) (Table 1), respectively, were recorded at 5000 ppm IBA up to certain concentration (Kahlon and Singh, 1981; Rana and Jandal, 2001). Length of Longest root (9.5 cm) and diameter (0.88m) was recorded with application of 5000 ppm IBA, where as minimum (4.95cm) root length and diameter (0.30mm) were observed in control, respectively. The increase in length and diameter of root may be due to successful rooting of IBA treated cuttings. Rathore (1984) and Rana and Jindal (2001) also observed increase in root length and diameter with auxin treatment. Similarly maximum number of leaves at planting 30 DAP, shoot length 30 DAP and ultimate survivability per cent was recorded in 5000 ppm IBA treatment whereas minimum number of rooted cuttings was observed with control (table 2). These results are in agreement with those of Jawanda *et al.* 1990, Shukla and Bist (1994) and Panwar *et al.* (2001). Among the varieties, Hayward took minimum days (8.96) compared to 9.41 days in 'Tomouri' for sprouting. Maximum cutting survival, rooted cuttings (%), number of primary, secondary and average number of roots have been recorded in 'Hayward' as against Tomouri (Table 2). The difference in-rooting characters may be due to variation in genetic make-up of varieties. Rana and Jindal (2001) also observed the extent of rooting in kiwifruit cuttings, which was influenced significantly by cultivar difference.

Table 1. Effect of IBA treatment and varieties on sprouting, survival, rooting percent, number of primary, secondary and average number of roots per cutting

Treatment	Days taken to sprouting	Survival of cutting (%)	Rooted cutting (%)	No. of primary roots per cutting	No. of secondary roots per cutting	Average number of roots per cutting
Main effect of IBA (ppm)						
0 (I_1)	9.73	79.16	28.33	2.67	15.5	18.12
4000 (I_2)	8.99	83.08	47.08	3.80	21.45	25.3
4500 (I_3)	9.30	86.70	57.08	5.40	43.15	48.60
5000 (I_4)	8.74	95.42	65.42	7.68	49.0	57.0
LSD (0.05)	0.081	3.98	3.38	0.12	0.18	0.22
SE of mean difference+	0.41	1.99	1.69	0.06	0.09	0.13
Main effect of variety						
Hayward (V_1)	8.96	89.37	61.45	5.4	37.0	42.45
Tomuri (V_2)	9.41	84.8	37.5	4.38	27.5	31.9
LCD (0.05)	0.057	2.81	2.39	0.088	0.12	0.19
SE of mean difference+	0.028	1.40	1.19	0.044	0.06	0.09
Interaction effect						
I_1V_1	9.44	83.3	35.0	2.85	17.4	20.24
I_1V_2	10.02	75.0	21.7	2.5	13.5	16.0
I_2V_1	8.70	88.3	61.7	4.3	23.9	28.35
I_2V_2	9.3	88.3	32.5	3.2	19.0	22.3
I_3V_1	9.2	89.16	71.7	6.3	49.3	55.7
I_3V_2	9.3	84.16	42.5	4.5	37.0	41.53
I_4V_1	8.5	96.7	77.5	8.1	57.3	65.5
I_4V_2	8.98	24.20	53.3	7.2	40.6	47.82
LSD (0.05)	0.114	NS	4.8	0.18	0.26	0.39
SE of mean difference+	0.05		2.4	0.08	0.13	0.20

Table 2. Effect of IBA treatment and varieties on root length, diameter, growth and survivability of cuttings

Treatment	Average root lengh (cm)	Length of longest root (cm)	Average diameter of longest root (mm)	No. of leaves at planting	Shoot length at 30 days after planting	Survivability of rooted cuttings (%)
Main effect of IBA (ppm)						
0 (I_1)	2.6	4.6	0.30	4.04	4.86	56.7
4000 (I_2)	3.6	6.2	0.50	4.9	6.2	77.5
4500 (I_3)	5.1	7.6	0.80	5.6	7.4	84.2
5000 (I_4)	7.0	9.5	0.88	6.3	8.8	91.2
LSD (0.05)	0.099	0.06	0.03	0.066	0.068	4.3
SE of mean difference+	0.040	0.03	0.01	0.033	0.034	2.1
Main effect of variety						
Hayward (V_1)	5.15	7.9	0.66	3.7	8.1	81.25
Tomuri (V_2)	7.00	6.1	0.60	2.8	5.4	73.54
LCD (0.05)	0.07	0.049	0.02	0.05	0.05	3.06
SE of mean difference+	0.035	0.02	0.01	0.02	0.02	1.50
Interaction effect						
I_1V_1	3.13	5.1	0.32	2.6	5.6	60.8
I_1V_2	1.98	4.0	0.28	1.9	4.0	52.5
I_2V_1	3.87	6.9	0.56	3.7	7.3	81.7
I_2V_2	3.25	5.5	0.43	2.6	4.9	73.0
I_3V_1	5.83	8.8	0.83	4.0	9.0	87.5
I_3V_2	4.37	6.4	0.72	3.0	5.7	80.8
I_4V_1	7.76	10.5	0.93	4.5	10.45	95.0
I_4V_2	6.37	8.5	0.83	3.5	7.0	87.5
LSD (0.05)	0.14	0.085	NS	0.09	0.096	NS
SE of mean difference+	0.67	0.040		0.04	0.048	

Main effect of variety

Significantly maximum survival of cutting, rooted cutting and root number per cutting (table 1) and length of largest root, average root diameter, number. of leaves at planting time and 30DAP and survivability of rooted cutting (table 2) were recorded in Hayward as compared to Tomouri.

INTERACTION EFFECT

The IBA and variety interact significantly. In both the varieties early sprouting was recorded in cuttings treated with 5000 ppm IBA. Sprouting might be due to favorable condition in zero-energy-humidity-chamber. Interpretation of data revealed that non-significant interaction effect was observed in survival of cutting (%). Interaction effect of IBA concentration was found significant for number of primary root, secondary root, average number of root/cutting, average root length and length of longest root. However, interaction effect of IBA for average diameter of longest root and root and survivability (%) of rooted cuttings was non-significant. Maximum number of leaves number of leaf and shoot length 30 DAP were recorded when Hayward and Tomouri were treated with 5000 ppm IBA. The maximum survivability of rooted cutting may be due to better rooting of 'Hayward' with

more leaves. The variation in the rooting characters of cultivars may be due to difference in the genetic make-up of varieties.

CONCLUSION

Kiwifruit leafless cutting treated with 5000 ppm IBA concentration significantly took minimum days to sprout and maximum survival of cutting percent, rooting and number of primary and secondary and average number of roots with diameter and survivability. The cultivar and concentration interact significantly with various rooting potential. Cultivar 'Hayward' responds well at 5000 ppm IBA concentration than 'Tomouri'.

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Research Communication

Soh-phie *(Myrica species)* - An unexploited fruit of the future for Meghalaya

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About 300 edible plant species found in the North Eastern Hill Region. Some of them are really worth consuming by various ethnic groups of tribal require commercial exploitation. *Myrica* belongs to family Myricaceae locally known as Soh-phie in Khasi (Meghalaya). Over the years, the people of Meghalaya have found many uses for soh-phie besides enjoying its fresh fruit. These include home made pickle, jams and jelly. The scope for export outside the state is vast as this fruit is unique in its taste and being indigenous, Meghalaya may hold a huge monopoly on the market.

Myrica nagi Thunb. *Myrica esculenta* Buch. & Ham, *Myrica farquhariana* Wall., *Myrica sapida* Wall. is a sub-temperate evergreen tree found throughout the mid-Himalayas, starting from about 1300 m and up to 2000 m asl. It is quite common in Sibsagar (Dikho valley of Assam), Khasi and Jaintia hills of Meghalaya. The fruits are perishable in nature and their shelf life does not exceed 2-3 days. A medium to large woody, evergreen, dioecious tree, is about 12 to 15 m in height; its bark is light brown to black; the male and the female trees have almost similar appearance. Leaves are almost crowded towards the end of branches, lanceolate, ovate nearly entire or serrate and 9.2 cm long, 3.2 cm broad; lower surface of the leaf is pale green while theupper surface is dark green. Pistillate flowers are very small, sessile, solitary and bracteate; sepals and petals are either absent or not visible; inflorescence, a catkin, is about 4.2 cm long, axillary bearing about 25 flowers; only a thread-like style is visible with the unaided eye. Each staminate flower has about 12 stamens, each with a very short filament; inflorescence, a compound raceme, about 3.5 cm long. The bark is used externally as stimulant for rheumatism and in the preparation of yellow dye. Fruits are ellipsoidal or ovoid to globose in shape, succulent drupe, with a hard endocarp; the colour of fruit is initially green and later becomes reddish during ripening stage.

Uses

The tree yields a drupaceous fruit, which is one of the tastiest wild fruits of this region. This fruit tree carries a lot of commercial importance and every year its fruits worth thousands of rupees are sold in different towns of Meghalaya. The small seedy fruits of *Myrica* are very much liked by people for their taste and juiciness. The juice has a very attractive sparkling red colour. Efforts should be made to standardize a technique for its utilization. The major problem in the case of this fruit is that the harvesting period is too long and fruits from a single tree have to be harvested in many pickings. However, this is the only cost involved in case of this fruit. The fruits of this tree are very

attractive and the overall fruit quality is excellent. The local people consumed the fruit in various ways as follows

- People consume green fruit with salt as fresh and making for pickles.
- Fruit juice and pulp are used for making jam and jelly.
- The bark of this tree also has many medicinal properties and is used in different medicinal preparations.

Flowering and fruiting season

The flowering season starts from the first fortnight of October and continues till the second fortnight of December. Similarly the fruiting season starts from the last week of March and continues till the last week of June depending upon the climatic condition and species.

Physico-chemical composition of the fruit

The edible portion of the fruit is its pulp, which is 75.4 per cent of the whole fruit. The fruits of small to big size of green to pinkish colour stage were analyzed for their physico-chemical traits. The fruit weight varies from 3.63-13.57 g, fruit length from 2.16-3.24 cm, fruit diameter from 1.71-2.77 cm, juice recovery from 30.30 –39.44%, seed weight from 0.82-2.02 g and seed size from 1.06-1.85x0.79-1.37 cm. The TSS ranged from 5.7-6.2%, reducing sugar from 0.83-3.57 and total sugar from 2.18-7.68% in green and pinkish colour fruit, respectively. Whereas, acidity varies from 2.44-4.83% and ascorbic acid from 4.03-28.20 mg/100 ml juice in pink to green colour fruit, respectively (Table 1&2).

Table 1. Physico-chemical parameters of Soh-phie fruit

Species	Fruit weight (g)	Fruit size (cm)		Juice (%)	Seed/stone wt.(g)	Seed size (cm)	
		Length	Dia			Length	Dia.
Myrica sp. (Big size fruit green colour)	13.57	3.24	2.77	37.66	2.02	1.85	1.37
Myrica sp. (Small size green colour fruit)	7.10	2.57	2.22	39.44	1.44	1.65	1.15
Myrica sp. (Small size pink colour fruit)	3.63	2.16	1.71	30.30	0.82	1.06	0.79

Table 2.: Physico-chemical parameters of Soh-phie fruit

Species	T.S.S. (%)	Acidity (%)	Vit. C (mg/100ml juice/pulp)	Reducing sugar (%)	Total sugar (%)
Myrica sp. (Big size fruit green colour)	5.7	4.31	17.63	0.97	2.48
Myrica sp. (Small size green colour fruit)	6.30	4.83	28.20	0.83	2.18
Myrica sp. (Small size pink colour fruit)	6.20	2.44	4.03	3.57	7.68

Reasons for poor popularity of Soh-phie fruit crops in Meghalaya

1. Lack of awareness about the economic benefits

2. Non-availability of good quality planting materials
3. Lack of technology to reduce the gestation period and enhance the fruit production;
4. Poor marketing network
5. Lack of technology for value addition, through processing.

Most of soh-phie fruit trees grown through natural regeneration of seeds, grow slowly without any nutrition, start bearing fruits after a long period and produce fruits of inferior quality. Hence, this fruits have remained neglected without any commercial importance. However, there is further need to set up field demonstrations to provide first hand exposure to the farmers for popularizing this fruit in the field.

Steps for Improvement:

1. **Identification/selection of elite/plus tree provenances:** The elite/plus tree having high yield potential free from serious disease and pests, quality fruits with attractive colour, good fruit weight, fruit size, high TSS, pulp seed ratio, dry matter recovery and least seed size may be identified/selected through survey or selecting through arranging exhibition and selecting the best entries.
2. **Cataloguing and conservation:** The identified/selected elite trees should be catalogued with proper records of their distribution, yield and quality aspects and efforts should be made to conserve the selected trees *in -situ* for further source of multiplying the material
3. **Multiplication of planting material**

   Seed and cutting materials should be collected from selected trees to develop the elite seed and clonal orchard for establishing the nursery. The planting material of this fruit may be multiplied through seed, cuttage/graftage and tissue culture techniques.

Strategies for commercial cultivation of Soh-phie fruit

(i) Identification of progressive growers

(ii) Creating awareness among the growers with:

   a. Organizing short-term training separately for the farmers and field extension officers
   b. Preparation of a posters, covering necessary information to motivate the farmers and to impart skills for optimizing the production
   c. Setting up of field demonstrations

(iii) Providing quality-planting material for establishment of commercial orchard

(iv) Technical guidance for regulating tree size/fruiting by systematic pruning practices

(v) Working out orchard management practices

(vi) Appointment of extension officers to provide technical advisory services

CONCLUSION

Soh-phie fruit is emerging as important fruit for processing industry in Meghalaya as products of this fruit have immense potential for national and international markets. Soh-phie is used as fresh fruit as well as various processed products like pickle, jam, jelly and RTS, etc. Being the diversified uses of this fruit there is an urgent need to take up the improvement programme with collection, conservation, multiplication of quality planting material and standardization of agro-techniques.

Temperate Fruits: Gaining momentum in subtropical areas of North East

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Fruits of the following temperate plants gaining momentum in the subtropical areas of the North East and if plantation of these horticultural species is promoted further, they can play a significant role particularly in uplifting the rural economy of the region.

Pear

Pear (*Pyrus communis*) is next only to apple in importance, acreage, production and varietals variation among temperate fruits in India. It is grown in temperate and subtropical conditions because of it's wider climatic and soil adaptation tenets. The pear is native to Asia and Europe and related to apple family. It is primarily grown in Himachal Pradesh, Jammu and Kashmir, Uttaranchal, Western Uttar Pradesh, Punjab, Haryana and Delhi. Total production of pear in the world as well as in India, during the year 2002 was estimated as 16892, 188 thousand metric tones, respectively. Among the leading producing countries China alone produces 8897 thousand metric tones annually. Pears fall into two different classes – (i). the European, which is bell shaped with soft and succulent flesh, and yellow or red skin, (ii) the Asian, which are round with green yellow or green russet skin and crunchy flesh. Pear is low in calories and contains some B vitamins and minerals.

It can tolerate as low as 26^0C temperature when dormant and as high as 45^0C during growing period. Spring frost is detrimental to pear production and temperature at 3.3^0C or below kills the open blossom. The highly fertile soils rich in N are not very suitable for growing pear as the incidence of pear psylla and fire blight is more in these soils. Pear plant is commonly propagated by T- budding during April-September or tongue grafting done during December-January. In hilly areas, the trees on seedling rootstock are planted at a distance of 5m but for clonal rootstock, distance can be reduced to 3m. In plains, the planting distance of 6m and 8m is recommended for pear. The planting can be done any time from December to mid February in plains. However in hills, late fall or early spring are the common planting periods. Proper training and pruning of pear trees are essential for the development of strong framework and encouraging regular bearing. Pear trees are usually trained according to modified central leader method. Pear bears fruit on spurs of 2-year-old wood and a spur continues to bear for more than 6 years. Therefore, limbs with spurs of 6-8 years old need to be removed. In hills, 10-year-old plant requires 60-100kg FYM, 700g N, 350 g P_2O_5 and 700 g K_2O. The FYM, P and K are applied before snowfall in December. Half of N is added 3 weeks before flowering and the rest half just after fruiting. Both excessive and scanty moisture affects color, composition and quality of fruits. After harvesting in July-August, the trees should be irrigated at 20 days intervals up to the end of October; afterwards no irrigation is required up to January. Pear harvested at best desert quality are those, which are harvested between 15.6^0C-21^0C and 80-85% relative humidity.

Premature ripening begins with pink coloration near the blossom end. Consequently brown heart and softening occurs in affected fruits, which don't ripen properly. As soon as the initial symptoms appear, the fruits should be harvested and handled normally.

Peach

Peach (*Prunus persica* (L) Batch.) belongs to the family Rosaceae, sub family prunoideae with 8 basic and 16 somatic chromosome numbers. Native to china but developed in Persia, peaches are now commercially grown around the world between 25^0 and 45^0 latitude above and below the equator. The total world production of peaches during the year 2002 was 13400 thousand metric tones. It is commercially cultivated in countries like USA (1355,000 MT), France (460,00MT), Japan,

Australia (90,000MT), Italy (1708,000 MT), Spain, (1031,000 MT) China (4174,000 MT) and India (120,000MT). In India, it is being grown in the mid hill zone of Himalaya extending from Jammu and Kashmir to khasi hills of 1000-2000m above mean sea level. Low chilling peaches are grown in submountaneos region and Punjab, Haryana, Delhi and Western Uttar Pradesh. IT is also being grown to a limited scale in the hills of south India and in the northeastern region of the country. Peaches are recommended for low-cholesterol, low fat, low sodium and weight reduction or diabetic diets. Peaches are a good source of vitamin A, calcium and potassium. A medium size peach contains about 40 calories. Peaches are available from May through October with peak season in July and August

Peaches require humid climate with cold winter and dry summer. Sites, which are free from early spring frost, are more suitable as peach bloom early in the season. Peaches are highly susceptible to water logging and prefer perfect drainage. Acidic and saline soils are unfit for peach cultivation. Peach seedlings are generally used as rootstock; before sowing, seeds are stratified at 4^{o}c-10^{o}c for 10-12 weeks in moist sand. The seedlings become bud in June and if they are grown in fertile soil with full care, they become graftable in the following winter. In hills, tongue grafting during January-February and T-budding during May-June are performed. However, in plains grafting is performed during November-January and budding during April-June and September. The planting is carried out in winter season at a distance of 4 m. In tatura trellis and meadow system, peaches are planted at a distance of 5mx1m (2000 plants/ha) and 2mx1m (5000plants/ha), respectively. Modified leader and open center are usually adopted to train peach trees. In hilly areas sunlight exposure is a limiting factor where open center system of training is used. Peaches requires heavy and regular pruning because fruiting occurs laterally only on previous season's growth, which bears only once in its lifetime. The peaches has a relatively high requirement for N and K. 10 year old bearing trees require 500g N, $250P_2O_5$ and 500g k_20 along with 40kg FYM/tree. Whole quantity of FYM along with P and K are given during December-January. Half of N should be given in spring before flowering and remaining half a month later. Peaches require frequent irrigations during the fruit development; lack of irrigation results in fruit drop, reduced fruit size and quality. Peaches may be harvested in 3-4 picking at 4 days interval

Sunscald causes sever damage to the exposed trunk and main branches. Painting of exposed surface with lime past and shading by wrapping straw or hay around the trunk is quite effective in minimizing the problem. Splitting and gumming are accentuated during heavy rains after a long dry spell, generally occurs at dorsal and ventral sides mostly at pit hardening stage. The exact cause of this problem is still to be determined.

Plum

Plum (*Prunus salicina*) is an important temperate fruit, native to America, Asia and Europe. Worldwide plums are second biggest crop of stone fruits grown following peaches. The total world production of plum during the year 2002 was 9183 thousand metric tones whereas, India produced only 78 thousand metric tones. Although plum is temperate fruit but can also grow in subtropical areas. Punjab is a leading state for cultivation of subtropical plum. It is commercially grown in Himachal Pradesh, Jammu& Kashmir and Uttaranchal and also to some extent in Nilgiri hills of south India. Plum is used both as fresh and in preserved form, has good nutritional value and are excellent for pies, salad, desserts, jams, puddings and eating out of hands.

European plum requires 1000-1200 hrs below 70c during winter to break rest period, whereas Japanese plum requires only 700-1000 hrs chilling. The area with frost-free spring, having good air drainage and adequate sunshine in summer is most suited for plum cultivation. The soil should be free from hardpan, water logging and excessive salts. Tongue grafting in February is most commonly used and ideal method of propagation. Chip budding during mid February also gives good success with smooth scion-stock union. Spacing of 6m from row to row and plant to plant is recommended for plum. Planting should be done during December-January. While planting, graft-union should be kept

15-20 cm above the ground level to avoid collar rot and scion rotting. Plum trees are trained to open center system. Pruning during pre-bearing period is usually kept light and correct. Plum generally bears on spurs, which are alive up to 5-6 years. Plum requires 25-30cm annual extension growths for proper fruiting. Therefore, 25-30% thinning along with one third to half heading back of shoots is recommended. A 7-year-old plum tree requires 40kg FYM, 500gN, 250gP and 700g K. The FYM along with P and K should be applied during December-January. Half dose of N applied before flowering and remaining half N a month later. The peak water requirement period in plum is May-June, which coincides with the rapid fruit development period. Therefore, irrigation at 12 days interval in May and 8-9 day interval in June is recommended.

A fully-grown plum tree yields 60-70 kg fruits. Harvesting time varies from variety to variety in different states. Plums are available in the market from second week of may to third week of July.

Strawberry

Strawberry (*Fragaria xananassa* Duch.) is one of the most popular soft fruits and is cultivated in plains as well as in hills up to an elevation of 3000 meters in humid or dry regions. Botanically, it is an aggregate fruit, belongs to family Rosaceae and all cultivated varieties of strawberry are octaploid (2n=56). Among the fruits, strawberry gives quickest returns in shortest possible time. The fruit of strawberry is rich in vitamin B, protein and minerals like P, K, Ca and iron. It has a special demand by the fruit processing industries for the use in preserves, jams and confectioneries.

Total production of strawberry in world accounts for 3242 thousand metric tones. Europe and North America account for 50 and 30 per cent of the total production (1406 and 836 thousand metric tones), respectively. Among the European countries, France, Italy and Poland are the leading producers of the strawberries. In India it is mainly grown in Himachal Pradesh, Jammu & Kashmir, Uttaranchal and hills of Darjeeling. In the recent years, its cultivation has been extended from temperate to subtropical regions, i.e., Punjab, Haryana, Maharastra and Uttar Pradesh.

Day neutral varieties of strawberries made their cultivation possible in different times of the year and different part of the country. Day light period of 12 hrs or less and moderate temperature is important for flower bud formation. Temperature plays a critical role in the development of strawberry at a particular place. The strawberry can be grown on any type of soil provided proper moisture, organic matter and drainage is present. Water should not stagnate in the field. Since most of its roots are found in the top 15-20cm. Soil, keep this layer porous and rich in humus.

Strawberry is propagated by runner's plants. Generally one plant produces 7-10 runners/plant but under proper management it can be go up to 15 runners/plant. Runner formation can be stimulated with the application of IBA (100ppm) 10 days before flowering and also by GA_3. Soil fumigation with a mixture of methyl bromide and chloropicrin helps increased root system, reduce N-fertilizer requirement and control several weeds. September-October is ideal time of planting runners, which starts giving quality fruits in spring season. In subtropical areas like Punjab and Haryana, planting during November is promising. Runners are uprooted from nursery, made into bundles and planted in the field. The runners are usually planted at 90cm x45cm spacing. Some cultivars are planted at 60cmx25cm. Application of 50 tonnes FYM along with 80-100kg p2o5 and 50-80kg k2o at the time of bed preparation is recommended. The N (100-120kg/ha) should be applied in two-split dose, half in September- October (at the time of planting) and remaining half before blooming. GA3 (50ppm) sprayed at 4 days after flowering, maleic hydrazide (0.1-0.3%) sprayed after flowering increase yield up to 31-41%. Since strawberry is shallow rooted plant, the plant require more frequent but less amount of water in each irrigation. Irrigation should be applied in furrows between the rows. To avoid damage, plastic mulch or straw mulch must be applied in beds. Strawberry is generally harvested when half to three-fourth of skin develops colours.

Albinism is a physiological disorder in strawberry due to lack of fruit colour during ripening. Fruits remain irregular pink or even totally white and some times swollen. It is probably caused by certain climatic conditions and extremes in nutrition.

Olive

The olive (*Olea europaea* L) belongs to family oleaceae, all cultivated varieties are diploid 2n=46. Olive is subtropical fruit crop, which requires chilling for fruiting. Olive is grown for its fruit, which are extensively used for extracting olive oil. Olive oil is rich source of polyunsaturated fatty acid (PUFA) and is absolutely free from cholesterol. The consumption of olive oil has been clinically advocated to people suffering from hypertension or coronary heart diseases. More over, it is also rich in mineral like iron, calcium and phosphorus. It is also considered as a potential source of vitamin A. Besides oil, some varieties are also used for pickle preparation.

Olive is a principal crop in all countries situated in the Mediterranean region of the world. The main producers of olive include Italy, Spain, Greece, Portugal and Turkey, etc. The total production of olive and olive oil in the world during the year 2002 was estimated as 13805 thousand metric tones and 2763 thousand metric tones, respectively. Olive cultivation in India is still in its infancy stage and is restricted to the states of Jammu and Kashmir, Himachal Pradesh and Uttaranchal. Olive trees prefer a temperate and dry climate with well-defined winter but without sharp and prolonged temperature fluctuations. It requires bright illumination and its cultivation is restricted by its poor resistance to frost and excessive drought. The soil should be well drained to permit good aeration and extensive root development. Yet their maximum production has been found on calcareous silt. Olive is commercially propagated by cuttings. Leafy sub-terminal cuttings, 12-15 cm long of pencil thickness having 3-4 nodes in early summer or rainy seasons is preferred. The planting density should be 150 trees/ha when planted 8 m apart, whereas, it should be 250-300 trees/ha with a planting distance of 6-7 m. In irrigated areas January-February is ideal planting but with negligible or no irrigation facilities July-August is ideal to plant olive.

Young non-bearing trees can be pruned any time, however pruning of trees should be avoided when prolonged drought period coupled with acute water stress prevails. In bearing trees pruning should be carried out immediately after harvesting. The olive trees have certain critical periods when adequate supply of water is needed i.e. 4 weeks prior to the expected time of flowering, 2 weeks after peak blooming period, a month after fruit set stimulates development of young fruits and reduce their abscission. Application of 750g N, 500g P_2O_5 and 500 K_2O/tree are recommended for 10-year-old bearing olive trees. Poor fruit set and excessive fruit drop are typical characteristics of olive that limit productivity. NAA (30ppm) and 2,4-D were found effective in minimizing preharvest fruit drop. Olive fruits become mature between 4 and 5 months after blooming.

Except olive fly there were no serious insect, which damage the olive crop economically. Olive canker and anthracnose are serious disease of olive, which cause economical loss.

Kiwifruit

Kiwifruits (*Actinidia deliciosa*) knows as 'China's miracle fruit and 'the horticultural wonder of New Zealand' belongs to family actinidiaceae having the somatic chromosome numbers 2n=58. A native to central China, it is being grown commercially in New Zealand, Italy, USA, China, Japan, Australia, France and Spain. With extensive research and development support its commercial cultivation in India has been extended to the mid hills of Himachal Pradesh, Jammu and Kashmir, Sikkim, Meghalaya, Arunachal Pradesh and Nilgiri Hills.

The pulp is soft and pleasantly acid and the flavor is reminiscent of strawberry and watermelon. Cut slices make an attractive garnish on plate, in fruit salad, as cereal topping and fruit cup. The fruit contains an enzyme that tenderizes meat, thus it can be rubbed into steaks before boiling. High in vitamin C, a three and one half ounce portion contains about 35 calories.

For high yield and quality fruits it requires 700-800 chilling hrs below 7^0c to break its rest period. High temperature (>35^0c) accompanied by high insulation, low humidity, sunscald and heat stress are the main problem in its cultivation. Most rapid and suitable method of multiplication is cuttings, hard wood, semi hard wood or soft wood. The cuttings of the central and basal parts are ideal. For better rooting, cutting should be treated with IBA 500ppm for 10 second before planting in moist rooting medium. Planting distance varies according to system of training. Training of kiwi vine is very important, requiring constant attention. The main aim of training is to establish and maintain a well-formed framework of main branches and fruiting arms. Generally T-bar and pergola are adopted for planting. In T-bar a spacing of 4m from row to row and 5-6 m from plant to plant, whereas, in pergola, a spacing of 6m from row to row should be maintain. January is ideal time for planting of kiwifruit. Kiwi is dioecious plant, which means male and female flower are born on different plants. A staminate plant is provided for the pollination of every six-pistilate plants. In India only two male clones - Tamuri and Allision are generally inter-planted. Kiwi plants are pollinated mainly by honeybees. The basal three to five buds of a current growth are only productive. The vines grow 4-5m each year, which will become over crowded if not pruned in summer and winter season. Girdling of young kiwi vines enhances their yield in the following year. A 3-4 mm wide strip is removed around the lateral at a height of about 1.0-1.5m. Five year old kiwi plant requires 850-900g N, 500-600g P, 800-900gK and 20kg FYM. The N should be applied in two equal doses, half to two third in January-February and the rest after fruit set in April-May. Kiwifruits having 6.2% TSS are ideal for harvesting, subsequently, they loss their firmness in two weeks at room temperature and become edible.

Pests and diseases do not cause much economical loss to kiwifruit. The cloudy, humid weather during flowering prevents petal fall, which remains adhered to the fruit, get infected with botrytis and subsequently infects the fruit.

Selected Abstracts

Arunachalam, A. and Arunachalam, K. 2005. **Community characteristics and soil biological processes during regrowth of subtropical forest ecosystems**. *Indian Journal of Forestry*, 28(1): 5-10. Restoration Ecology Laboratory, Department of Forestry, North Eastern Regional Institute of Science and Technology, Nirjuli 791109, Arunachal Pradesh. [BROAD-LEAVED FOREST; ECOSYSTEM; MICROBIAL BIOMASS; SUB-TROPICAL FOREST]

The loss of species following disturbances may reduce the resilience of ecosystems to stress. It is thus understood that diversity of plant species may affect the functional processes in a disturbed ecosystem. This paper reports on the biomass accumulation patterns in litter, roots, and microbial biomass across changing community characteristics along a successional gradient in a regrowing broadleaved forest following felling, and in a pine forest on abandoned agricultural lands in a subtropical environment of north-eastern India. The species diversity index had a linear relationship with litter, fine roots and microbial biomass accumulation in the broadleaved forest regrowths, while density and basal area of pine trees were negatively correlated to these functional processes. Over all, there were significant positive correlations among litter, fine roots and microbial biomass. These results suggest that woody vegetation characteristics could be an index to explain the biomass dynamics of the three soil biological processes that increased during community development following disturbances. Species evenness index had no relationships with the biological processes. Nevertheless, the usage of community characteristics as an index of biological processes could be ecosystem specific in general and type of successional vegetation in particular.

Bahar, Nawa 2005. **A note on the effect of pretreatment on germination behaviour of *Kydia calycina* Roxb. seed**. *Journal of Non-Timber Forest Products*, 12(1): 42-43. Forest Tree Seed Laboratory, Silviculture Division, Forest Research Institute, P.O. New Forest, Dehradun, Uttaranchal. [GERMINATION; MULTIPURPOSE TREE]

Kydia calycina Roxb. is a multipurpose tree species and its wood mainly used in toys industries. Seeds usually 3, kidney-shaped furrowed, dark brown and testa is hard. Regeneration in nature is rare due to its hard coated seed. Keeping this in view, some suitable method of pretreatment to break the dormancy of seed was evaluated. Germination was enhanced from 18.25% (untreated) to 64.0% by mechanical scarification. Although this treatment gives early, uniform and highest germination but was a laborious process and hence can not be employed on large quantity of seed. Therefore, sulphuric acid scarified seeds are recommended.

Bali, J.S. 2005. **Bio-industrial watershed management for poverty alleviation in Uttaranchal**. *Journal of soil and Water Conservation*, 4(1&2): 39-49. [BIODIVERSITY CONSERVATION; POVERTY ALLEVIATION; WATER HARVESTING; WATERSHED MANAGEMENT]

India lives in the villages, still. Increasing population, of men and animals, and degrading natural resources makes everyone's share smaller and less production. On the mountainous states like Uttaranchal, this process is more menacing. The result is migration from the poor villages to the city slums. The advancing adversity can be reversed by Bioindustrial Watershed Management. It is based upon ecological economics or eco-economics. It

means conservation, development and management of land, water and forests within the hydrological boundaries of a watershed, processing the watershed produce-plant or animal based- and marketing it in more profitable local, national and international markets. It places the ecological wealth in people's care for sustainable maximum gain, both for the present and the future generations. It address unemployment, both skilled and unskilled. Unemployment or under-employment is the real name of poverty. This concept converges all sectoral programmes of the government and the NGOs for synergic impact. People's cooperative or corporation would own the processing industry. The industry would have backward linkages with the primary producers and provide knowledge and inputs on credit. It would assure buy-back of produce at remunerative rates. It would process and sell the produce using its forward linkages with the markets. Value addition benefits would go to the primary producers. Government would have to play a major role in providing infrastructure, an enabling policy package and supporting services of R&D, capacity building and feasibility reports.

Bansal, Rupinder and Chahal, S.M.S. 2005. **A study of erythrocyte enzyme polymorphisms among people of Kullu district, Himachal Pradesh, India**. *Anthropologist*, 7(3): 229-234. Department of Human Biology, Punjabi University, Patiala 147002, India. [CASTE POPULATIONS; ENZYME POLYMORPHISMS; HIMACHAL PRADESH]

To help complete the genetic map of north Indian hill state of Himachal Pradesh, data on various polymorphic red cell enzyme systems are presented among people inhabiting its central district of Kullu. Blood samples from three main endogamous caste populations of the area viz., the Brahmin (n=114), Rajput (n=234) and Koli (n=101) were collected randomly from unrelated subjects. Haemolysates were typed for a battery of seven erythrocyte enzyme polymorphisms viz., ADA, AKI, ESD, PGM1, ACP1, GLO1 and GPI using standard electrophoretic techniques. Results showed that there were appreciable differences among the present castes in the distribution of the first three polymorphic enzymes (ADA, AK1, ESD) while no significant heterogeneity was discenrible in the next three (PGM1, ACP1, GLO1); some GPI variants have been reported for the first time from the state. The Rajput as well as the Koli groups studied here from Kullu district showed similarities with their respective counterparts inhabiting the neighbouring district of Kinnaur. This suggests possible gene flow between these two contiguous districts of Himachal Pradesh.

Bharadwaj, Garima; Sharma, Shubhangna and Nagar, Shipra 2005. **Intervention and its impact on home environment of rural male infants in**

The present study was undertaken to assess the impact of comprehensive intervention programme in relation to home environment of rural male infants in the age group of seven to twelve months. Out of the total sample of 60

Kangra district of Himachal Pradesh. *Journal of Human Ecology*, 18(3): 231-233. Department of Human Development, College of Home Science, CSKHPKV, Palampur 176062, Himachal Pradesh, India. [INFANT; INTERVENTION; SOCIO-ECONOMIC STATUS]

male infants belonging to low socio economic status families, 30 each were taken as experimental and control groups. The experimental group was provided with age appropriate intervention on the aspects of home environment. The infants in both the groups were pre tested and post tested through a modified version of Bradley and Caldwell's HOME inventory. Results showed significant impact of intervention on the home environment scores of infants belonging to experimental group.

Bhatt, Arvind; Rawal, R.S. and Dhar, Uppeandra 2005. **Germination improvement in *Swertia angustifolia*: a high value medicinal plant of Himalaya**. *Current Science*, 89(6): 1008-1012. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, Uttaranchal, India. [CONSERVATION; ENDANGERED; GIBBERELLIC ACID; *SWERTIA ANGUSTIFOLIA*]

The present communication deals with improvement in seed germination of *Swertia angustifolia* via various hormonal treatments (GA_3 IAA and KNO_3). Germination of the species under controlled conditions is found to be low (<32.0%). GA_3 is found to be the best with respect to germination (96.0%) and reducing mean germination time (7.6 days) followed by KNO_3 (81.3%; 8.4 days) and IAA (66.0%; 16.6 days). A high degree of variation with regard to the germination percentage and mean germination time in different populations and treatments is recorded. The possible reasons for such variations are discussed.

Bhattacharya, Prasanta and Bhagabati, A.K. 2005. **Potentiality of tourism development in hill districts of Assam**. *Geographical Review of India*, 67(2): 145-161. Department of Geography, Gauhati University, Guwahati. [ECOLOGICAL CONDITIONS; INFRASTRUCTURE; TOURISM DEVELOPMENT]

The hilly areas by their unique natural exposition provide diverse scope for tourism development. Their terrain, climatic condition, flora and fauna and colourful ways of life of the people atract the strangers. They also offer possibilities for various kinds of adventure-based experience. The two hill districts of Assam, viz, Karbi Anglong and North Cacher Hills represents 19.53 percent of the total geographical area and 3.75 percent of the population of the state. These hill districts are inhabited by as many as nine tribal groups with their distinctive ways of life, custom and tradition. Considering the unique nature of these two hill districts and probable socio-economic and environmental implications of tourism development, and attempt has been made to identify and assess the potential pockets of tourism activity in the area. Attempt has also been made to assess the recreational demand of the tourists visiting the state through a purposively designed resource inventory of appeal elements.

Bhattacharyya, Pratap; Tiwari, A.K. and Aggarwal, R.K. 2005. **Evaluation of land capability classification and fertility status for integrated land and water management and sustainable production in Shivalik foot hill area of Himachal Pradesh**. *Journal of soil and*

The diagnostic survey such as Land Capability Classification (LCC) and fertility mapping of a hydrological unit in Mandhala village (425 ha) of solan district in Himachal Pradesh was carried out for watershed development works. Six different land capability classes were identified. Erosion hazards were the main problem in those areas. Out of 425 ha, 86.31 ha

Water Conservation, 4(1&2): 72-79. Centre Soil and Water Conservation, Research and Training Institute. Research Centre, ICAR, Chandigarh. [LAND CAPABILITY CLASSIFICATION; SOIL CONSERVATION; WATER MANAGEMENT]

falls under choe-bed, falling under class VIII. Most of lower Mandhala falls under class II and III land having good potential to improve the productivity of land through soil, water and fertility management. Fertility status of soils under different LCC classes was done. Nutrient Index was low for N, medium for available P and K with their values of 1.08, 2.16 and 1.61, respectively. The soils pH was slightly acidic to neutral and the texture varied from sandy loam to sandy clay loam with clay content ranged from 18.8 to 26.9 per cent. Micronutrient status of Mandhala watershed was good, particularly in case of iron and manganese. So a balanced and economic fertilization as per crop requirement based on soil test values should be combined with soil conservation measures for sustainable agricultural development of the area.

Bisht, Swati and Lodhiyal, L.S. 2005. **Various aspects of soils and tree layer vegetation analysis in reserve forests of Kumaon in Central Himalaya**. *Indian Journal of Forestry*, 28(1): 37-50. Department of Forestry, Kumaun University, Nainital 263002, Uttaranchal. [A/F RATIO; RESERVE FOREST; SEEDLING]

Present study deals with the certain soil and vegetation characteristics of reserve forest occuring in the Nainital (2000-2050 m) district of Kumaon in Central Himalaya in temperte region. Vegetational analysis for tree layer was carried out by quadrat method, the forest tree composition was divided into three categories, viz. seedlings, saplings and trees. The number of tree, the density, frequency, abundance, A/F ratio, basal area and important value index (IVI) of the study sites were also reported. Total 17 tree species were present. The total density ranged from 323.2-1200 ind. ha^{-1} for seedlings, 122.6-583.3 ind. ha^{-1} for sapling and 42.9-170.1 ind. ha^{-1} for trees in all sites of reserve forest. The total average basal area of reserve forest ranged from 6.1-8.5, 21.1-33.8 and 32.7-153.8 m^2 ha^{-1} respectively for seedlings, saplings and trees. The soil texture for coarse gravel ranged from 22.0-56.2%, sand 33.9-56.7%, silt 2.7-7.1% and clay 5.9-14.2% in the reserve forest. Soil bulk density varied from 0.95-1.20 gm cm^{-3}, however the soil porosity and pH ranged from 52.8-64.2% and 5.5-6.5, respectively.

Chauhan, Amit and Singh, D.K. 2005. **Interesting plant records from Ladakh (Jammu & Kashmir)**. *Indian Journal of Forestry*, 28(1): 71-74. Botanical Survey of India, Northern Circle, 192, Kaulagarh Road, Dehradun 248195, Uttaranchal. [FLORA; FLOWERING PLANTS; LADAKH]

Eight species of flowering plants, viz., *Corydalis vaginans* Royle, *Lepidium virginicum* L., *Conyza bonariensis* (L.) Cronq., *Erigeron annuus* (L.) Pers., *Gentiana crassuloides* Bureau et Franchet, *Orobanche cernua* Loefl. var. *pseudo-clarkei* Jafri, *Chenopodium murale* L. and *Eleocharis retroflexa* (Poir) Urb. have been described as new records for the Flora of Ladakh. Of these *Gentiana crassuloides* Bureau et Franchet, *Chenopodium murale* L., *Eleocharis retroflexa* (Poir). Urb. are being recorded for the first time from the state of Jammu & Kashmir.

Chauhan, Hari 2005. **Woodcarvings from Pabbar Valley**. *Indian Journal of Traditional Knowledge*, 4(4): 380-385. Himachal State Museum, Shimla 171004, Himachal Pradesh. [PABBAR VALLEY; TRADITIONAL CRAFT; WOODCARVING]

Woodcarving was the favoured medium of artistic expression of the Indian subcontinent. Indian houses and temples were profusely adorned with it and are often inseparable from it. Woodcarving, an indigenous tradition craft finds a mention in the ancient texts such as the *Rig Veda* and *Matsya Purana*. Woodcarving craft was well developed in many states specially, Himachal Pradesh, Uttar Pradesh, Rajasthan, Gujarat, Kerala, Kashmir and Madhya Pradesh. They differed in terms of the kind of wood and the craft tradition. In the early days of kings and *nawabs*, woodcarving was essentially seen as an adjunct to architecture. Palaces, *havelis* and temples were decorated with incredibly carved doors, windows and *jalis* (lattice work). The present paper describes traditional woodcarving work adoring houses and temples of Pabbar valley of Himachal Pradesh.

Chettri, Nakul; Deb, Debes Chandra; Sharma, Eklabya and Jackson, Rodney 2005. **The relationship between Bird communities and habitat - A study along a trekking corridor in the Sikkim Himalaya**. *Mountain Ressearch and Development*, 25(3): 235-243. Natural Resource Management Programme, International Centre for Integrated Mountain Development, GPO Box 3226, Kathmandu, Nepal; Department of Zoology, North Bengal University, P.O. Raja Ramohanpur, Darjeeling, WB 734 430, India; Snow Leopard Conservancy, 18030, Comstock Ave, Sonoma CA 95476, USA. [HABITAT; HUMAN DISTURBANCE; KHANGCHENDZONGA BIOSPHERE RESERVE; PRINCIPAL COMPONENT ANALYSIS (PCA); VEGETATION]

To assess the impact of habitat disturbance on birds in the Yuksom-Dzongri trekking corridor in western Sikkim, India, the relationships between bird community attributes-including migratory groups and feeding guilds-and vegetation variables were examined. Birds were observed in 19 100-m-long transects, 3 times per season per transect, for 2 seasons from 1997 to 1998 and 1998 to 1999, in an area where forests are subject to various degrees of pressure from human disturbances. Closed conopy forests with relatively undisturbed habitat showed significant variation in habitat attributes, suggesting complexity of habitat structure. Bird species richness and diversity were significantly related to moderately disturbed habitats represented by Principal Component Analysis (PCA), where vegetation heterogeneity (vertical stratification and species composition) was greater. Analysis by migratory groups did not show an interpretable relationship with the habitats, except for the seasonal movements of migratory groups when correlated with altitudinal gradient along the corridor. However, feeding guilds showed significant relationships when correlated with different habitat types. Guilds such as insectivores showed a significant positive relationship with relatively undisturbed habitat, whereas nectarivores and granivores were associated with disturbed habitat. Such relationships have the potential to help assess bird communities and their habitat preferences. Long-term monitoring at landscape level is necessary to understand the dynamics of habitat use patterns by bird communities in relation to spatial and temporal changes.

Chhetri, D.R. 2005. **Ethnomedicinal plants of the Khangchendzonga**

The present study was carried out to survey and document the herbal drugs used by the tribal people in the

National Park, Sikkim, India. *Ethnobotany*, 17(1&2): 96-103. Panchavati Greentech Research Society, Panchvati, 11-Rockwood, Chhota Kakjhora, Post Box No. 79, Darjeeling HPO, 734101, India. [ETHNOBOTANY; ETHNOMEDICINE; KHANGCHENDZONGA]

Khangchendzonga National Park area in Sikkim, India. A report on 110 species of ethnomedicinal plants belonging to 100 genera and 70 families is presented here.

Dabral, P.P. and Jhajharia, D. 2005. **Rainfall analysis for Doimukh (Itanagar), Arunachal Pradesh**. *Journal of soil and Water Conservation*, 4(1&2): 88-92. Department of Agricultural Engineering, North Eastern Regional Institute of Science and Technology, Nirjuli, Itanagar 791109, Arunachal Pradesh. [ARUNACHAL PRADESH; MONSOON SEASON; RAINFALL DATA]

Daily rainfall data collected for Doimukh District Papum Pare, Arunachal Pradesh were analysed. Mean annual rainfall and mean annual rainy days were 3566.1 mm and 133.6, respectively. Mean seasonal rainfall of pre-monsoon (March to May), monsoon (June to October) and post-monsoon (November to February) period was 837.21 mm, 2580.4 mm and 148.3 mm, respectively. The corresponding rainy days were 35.9, 84.4 and 13.3, respectively. Minimum and Maximum value of mean monthly rainfall was in December (12.4 mm) and June (806.1 mm). Minimum and maximum number of rainy days were in December (1.6) and June (22.6). Weekly forecasting of rainfall indicated that expected rainfall is almost scarce from the month of November to February at all probability levels. Forecast weekly rainfall at 80 and 90% probability levels may be used for low land and upland crop planning of the region respectively.

Das, Sandip[1]; Gupta, V.K. [1] and Gupta, I.D.[2] 2005. **Codal provisions of seismic hazard in northeast India**. *Current Science*, 89(12): 2004-2008. [1]Department of Civil Engineering, Indian Institute of Technology, Kanpur 208016, India; [2]Central Water and Power Research Station, Pune 411024, India. [CODAL PROVISIONS; NORTH EAST INDIA; UNIFORM HAZARD CONTOURS]

Seismic hazard maps have been prepared for Northeast India in the form of uniform hazard contours for pseudo-spectral acceleration at stiff sites. These maps are for the horizontal component of ground motion and for different values of exposure time, confidence level and natural period. A comparison with the codal provisions given by the Bureau of Indian Standards code (IS 1893 (Part 1): 2002) shows that the pseudospectral accelerations specified in the code for Northeast India are broadly consistent with the hazard level corresponding to 10% probability of exceedance and 50 years service life, and that the present practice of specifying seismic hazard through peak ground acceleration and a fixed spectral shape may be inappropriate for structures in most areas of the region.

Deb, Panna and Sundriyal, R.C. 2005. **Status review of Namdapha National Park, India: Need for strengthening community-conservation linkages**. *Indian Journal of Forestry*, 28(1): 85-96. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, Uttaranchal.

The North East India is among the most significant global hotspot of biodiversity, and state of Arunachal Pradesh covers 32% of total area of the region. In comparison to the other neighbouring states and countries, large areas of the State of Arunachal Pradesh are under intact forest cover that provides unique opportunity to conserve biodiversity within the protected areas. This paper analyses the status of biodiversity and management of

[BIODIVERSITY; BUFFER ZONE; CONSERVATION; NAMDAPHA NATIONAL PARK; PROTECTED AREA]

Namdapha National Park, which is also a Tiger Project and is under the active consideration of Biosphere Reserve status. The park falls among the select relict rainforest patches of high global significance, and has been identified as an epicenter of high endemism and biodiversity with over 1119 plant 1399 faunal species in an area of 1985 km^2 (elevation variation 200-4570 m above sea level). It also provides unique habitats to four Wild Cats (Tiger, Leopard, Snow Leopard and Clouded Leopard) and only Ape (Hollock Gibbon) in India, thus conservation of this Park has larger implications not only for India but for whole of the South-east Asian countries. There has been communities living around the Park, a few settlements within the Park area are of major concern for the conservation of biodiversity. Besides, grazing, hunting, and NTFPs collections, particularly in the fringe areas, are other major threats to the biodiversity of the Park. The management suffers due to lack of proper infrastructure, enough manpower and trained personnel, which has been a major constraint in recent times. The paper highlights the need of strengthening community conservation linkages by educating people and addressing the issues of settlement, NTFP collection and hunting involving local communities in the management of Park around its buffer zone in addition to building capacity of Park management staff. Preparing comprehensive eco-development programmes for different areas and communities in and around the park is an important issue to address long-term management of the area.

Dey, S.K. 2005. **A preliminary estimation of carbon stock sequestrated through rubber *(Hevea brasiliensis)* plantation in North Eastern region of India**. *The Indian Forester*, 131(11): 1429-1436. Rubber Research Institute of India, Regional Research Station, Agartala, India. [GREEN-HOUSES; ROOT BIOMASS; RUBBER PLANTATION]

Global concern on increasing levels of greenhouse gases specifically carbon dioxide in the atmosphere, has led to the search for various mitigation options. In this context, carbon sequestration through managed rubber plantation is gaining importance. Rubber plantation has been expanding in the North East (NE) region and covers an area of 51,510 hectare. In this study, the carbon stock of rubber plantation in the NE region has been estimated and results indicate that an average carbon store in rubber plantation is around 136 tonnes/ha, out of which 92.7 t C/ha is contributed by soil and 2.40 t C/ha addition through litter fall and undergrowth vegetation. About seven million tonnes of carbon is store in the rubber plantations of this region. On completion of projected area of 4,50,000 ha., the carbon store would be around nine times higher than the present value. This study reflects the immense ecological value that rubber plantations provide, by storing carbon despite low productivity in these marginal lands.

Dhawan, Seema[1] and Mishra, S.C.[2] 2005. **Influence of felling season and moon phase on natural resistance of bamboos against termite**. *The Indian Forester*, 131(11): 1486-1492. [1]Lecturer, D.W.T. (P.G.) College, Dehradun; [2]Scientist F (Retd.), Entomology Division, F.R.I. Dehradun, Uttaranchal. [BAMBOO; BIODEGRADATION; HARVESTING]

Bamboos form an integral part of rural and urban life style. It has over 1500 uses and tremendous versatility in many aspects of daily life. In ground contact it has only one to two years' service life as it is usually affected by termites. Knowing the rising cost of repairs a study of natural termite resistance of bamboo becomes very relevant and important. The three bamboo species studied were *B polymorpha, B. aundinacea* and *D. stricuts* for their natural resistance abgainst termite *M. beesoni* Snyder under laboratory conditions. These were found significantly different in their natural resistance and *D. strictus* is found as the most resistant species and *B. arundinacea* is the least among the species studied. Season has the great influence on the durability of bamboo species. The bamboos harvested during winter months were more resistant to termite attack than harvested during summer. Effect of the Moon phase is found significant on termite resistance. The bamboos felled during dark phase were comparatively more resistant than felled in moon phase. These findings could be effectively used for harvesting of bamboos and selection of suitable species along with the season. However, more studies are required to confirm the tests.

Dhingra, Rajni; Manhas, Sarika and Thakur, Nirmala 2005. **Establishing connectivity of emotional quotient (E.Q.), spiritual quotient (S.Q.) with social adjustment: A study of Kashmiri migrant women**. *Journal of Human Ecology*, 18(4): 313-317. P.G. Department of Home Science, University of Jammu, Jammu 180004, Jammu and Kashmir, India. [EMOTIONAL QUOTIENT; KASHMIRI MIGRANT; SOCIAL ADJUSTMENT; SPIRITUAL QUOTIENT]

The present study assesses the emotional quotient (E.Q.), spiritual quotient (S.Q.) and social adjustment of Kashmiri migrant women. Further, it explores the relationship that exists between these variables. The sample comprised of 50 migrant women (25 each classified as socially well adjusted and maladjusted respectively) in the age group of 35-45 years, residing in Muthi camp at Jammu. The tools used for data collection included interview schedule, participant observation, Social Ajustment Inventory, Spiritual Quotient Scale and Emotional Quotient Scale. The results showed that majority (86%) of the women had moderate S.Q. and (58%) had moderate E.Q. There existed a significant positive correlation between E.Q. and S.Q. Social adjustment was positively and significantly correlated with E.Q. (for the entire and maladjusted group). This indicates that women scoring high on social adjustment had low E.Q. and vice versa. Social adjustment on the other hand shared a significant negative correlation with S.Q.(for entire sample and maladjusted women). This shows that higher the social adjustment higher the S.Q. of the sample women.

Dutt, Som and Verma, K.S.* 2005. **Effect of collection time, pre-sowing treatments and sowing time on the**

Sandal *(Santalum album* L.) is valuable for its fragrant heartwood and is one of the commercial tree species of India. It flowers and fruits twice in a year during March-

germinability of Sandal *(Santalum album* L.) seeds under nursery conditions. *Journal of Non-Timber Forest Products*, 12(4): 205-208. Doon (P.G.) College of Agriculture Science and Technology, Selakui, Dehradun, Uttaranchal; *Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. [ENVIRONMENTAL CONDITION; HIMACHAL PRADESH; MICRO-CLIMATIC CONDITION]

April and September-October. Fruits are single seeded. Studies pertaining to the effect of collection time, pre-sowing treatment and sowing time on the germinability of its seeds revealed that September-October collected seeds performed better than March-April collected seeds. Maximum germination percentage (48.50%) and germination energy (35.00%) was registered under T_4 (depleting of mesocarp) treatment for September-October collected seeds sown in April. Where as minimum germination percentage (6.00%) and germination energy (4.00%) was recorded under T_6 (control) treatment for March-April collected seeds when sown in the month of June. Minimum time taken for germination (23.75 days) was recorded under T_4 (depleting of mesocarp) treatment for September-October collected seeds when sown in April and maximum time taken for germination (60 days) was registered under T_6 (control) treatment for March-April collected seeds when sown in the month of June.

Dutt, Vaishnu and Gupta, B. 2005. **Interaction between trees and ground flora in different aged chirpine stands of sub-tropical region in India: I. density of herbage and Lai**. *Indian Journal of Forestry*, 28(1): 28-36. Department of Silviculture and Agroforestry, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173230, Himachal Pradesh. [CHIRPINE-GRASSLAND; DENSITY; GERMINATION; LEAF AREA INDEX]

The present study was conducted to investigate the structural differences in herbage vegetation under different aged chirpine trees at four locations, viz., Barog, Deothi, Dharampur and Tatul of Solan Forest Division of Himachal Pradesh, India. Each location had three sites representing different ages of chirpine stand, viz., sapling, pole and tree besides an open grassland. Monthly plant sampling in each site revealed ten grass species, two sedges, two legumes and two non-legumes in total. Total density and LAI of herbage was found to increase from July to August/ September, thereafter, decreased up to November. Amongst the different species, in general, *Themeda anathera; Panicum maximum; Chrysopogon montanus* and *Pollinia argentea* were the major contributors to the density of herbage vegetation. Total density of herbage was higher in open grassland as compared to the three chirpine inhabited sites at all the locations. Further, LAI of herbage under chirpine sites was less as compared to LAI of herbage in open grassland during different samplings. LAI of herbage hand significant relationship with density variations.

Gupta, P.K. and Bhagat, Pushplata 2005. **Littoral macrozoobenthos of a subtropical Himalayan Lake (Lake Naukuchiyatal)**. *International Journal of Ecology and Environmental Sciences*, 31(4): 321-330. Laboratory of Limnology, Department of Zoology, D.S.B. Campus, Kumaun University, Nainital 263002, Uttaranchal. [BIOMASS; COMMUNITY

The macrozoobenthic community of Lake Naukuchiyatal, which has gradually turned eutrophic during the past 30 years, was investigated for the period January, 2000 to December, 2001. Among the 21 species collected during the study, Diptera were numerically most significant whereas in terms of biomass the gastropods dominated the community. Numerically, the most important taxa were: *Chironomus plumosus, Glossiphonia weberi, Mesostoma* sp., *Tubifex tubifex* and *Dugesia* sp.

ABUNDANCE; DIVERSITY INDEX; SUBTROPICAL LAKES]

Gravimetrically, the most dominant species included *Lymnaea acuminata, Chironomus plumosus, G. weberi, Barbronia weberi* and *Gyraulus convexiusculus*. The community abundance was characterized by a single peak, which coincided with the phytoplankton peak. Both the community abundance and biomass revealed that the macrobenthic fauna was unaffected by eutrophication.

Gupta, Vikram 2005. **Application of lichenometry to slided materials in the Higher Himalayan landslide zone**. *Current Science*, 89(6): 1032-1036. Wadia Institute of Himalayan Geology, Dehradun 248001, India. [LANDSLIDE; LICHENOMETRY; PAWARI LANDSLIDE ZONE]

The lichen-based study involving the measurement of percent cover of lichens on slided materials in the Pawari landslide zone located in the Higher Himalaya is described. This has been correlated with the indicators showing movement of deposits and activity of the slide. It is well documented that in a slided mass, boulders containing more lichen cover are stable in the present climatic scenario or have moved least compared to the ones showing lesser lichen cover. Slopes covered with more or less fresh rock boulders and pebbles in the slide zone indicate an active part within the slided mass. This study can be used as an indirected method to assess the differential movement of slope within the slide mass.

Hasnat, Syed Miftahul and Thapliyal, Ramesh Chandra 2005. **Enhancement of seed germination in hard coated seeds of *Cassia fistula* L**. *Journal of Non-Timber Forest Products*, 12(4): 229-230. Forest Seed Technology Laboratory, Silviculture Division, Forest Research Institute, Dehradun 248 006, Uttaranchal. [NON-TIMBER FOREST; SEED GERMINATION]

Cassia fistula L. is an important source of timber and non-timber and non-timber forest produce. The seeds of this species suffer from seed coat imposed dormancy and require pre-treatment to enhance germination. This study was undertaken to identify better pre-treatment for enhancement of germination in hard coated seeds of *Cassia fistula*. The seeds were subjected to different pre-treatment, viz., control, manual scarification, soaking in gibberlic acid, in cold water, hot water, and acid scarification for varying periods. Among different pre-treatments manual scarification and acid scarification were found to be the best pre-treatments in terms of germination percentage and mean germination time. However, untreated seeds showed eleven per cent germination.

Hore, D.K. 2005. **Issues and strategies related to the management of Nokrek Biosphere Reserve in Meghalaya, India**. *International Journal of Ecology and Environmental Sciences*, 31(4): 353-359. NBPGR Regional Station, Umroi Road, Barapani, Meghalaya 793103, India. [BIOLOGICAL RESOURCES; BIOSPHERE RESERVE; DEVELOPMENT]

Nokrek is one of the important biosphere reserves of India, which was earlier designated as *Citrus* Gene Sanctuary. Despite its designation as biosphere reserve, there has been no scientific study of the area. This paper attempts to document the flora and fauna of this unique ecosystem rich in genetic resources. This will be helpful for framing conservation strategies. Emphasising the importance of this reserve, recommendations are made for further scientific studies and social development within the reserve.

Indrayan, A.K.; Sharma, Sudeep; Durgapal, Deepak; Kumar, Neeraj and

Study of Different medicinally valued seeds of *Nelumbo nucifera, Embelia ribes, Eugenia jambolana* and leaves of

Kumar, Manoj 2005. **Determination of nutritive value and analysis of mineral elements for some medicinally valued plants from Uttaranchal**. *Current Science*, 89(7): 1252-1255. Natural Products Laboratory, Department of Chemistry, Gurukul Kangri University, Haridwar 249404, India. [*ARTOCARPUS HETEROPHYLLUS; EUGENIA JAMBOLANA*; MINERAL ELEMENTS; NUTRITIVE VALUE]

Artocarpus heterophyllus showed Cr, K, Ca, Cu, Zn and Mn to be sufficient in seeds of *N. nucifera* which also have good nutritive value and are quite rich in carbohydrates accompanied by enough protein, but are low in fat. *E. ribes* seeds have been a higher nutritive value with high carbohydrates, enough mineral elements but low position. Rich in Mg and moderate in protein, the *E. jambolana* seeds have a moderate nutritive value. *A. heterophyllus* leaves are not rich in desired mineral elements except Na, and have a low nutrition value. However, on a dry matter basis they too have a high nutritive value and are used as fodder for livestock.

Jain, Alka[1]; Roshnibala, S.[1]; Rajshree, K.[2]; Sharma, H. Nandiram[3]; Kanjilal, P.B[4]. and Singh, H. Birkumar[1] 2005. **Matting ruch *(Schoenoplectus lacustris* (Linn.) Palla): Status, utility, threat, cultivation and conservation options in Manipur**. *Current Science*, 89(6): 1018-1022. [1]Regional Research Laboratory, Sub-station (CSIR), Lamphelpat 795004, India; [2]C.I. College, Bishenpur 795126, India; [3]D.M. College of Post Graduate Science, Imphal 795001, India; [4]Regional Research Laboratory (CSIR), Jorhat 785006, India. [ECONOMY; HANDICRAFT ITEMS; MATTING RUSH; WETLAND CONSERVATION]

Nestled in small valley among the hills of the eastern Himalayas with nature's pristine glory, Manipur's mythological concept of creation is revealed in her famous handicrafts items. Matting/water rush or club ruch *(Schoenoplectus lacustris* (Linn.) Palla, syn. *Scirpus lacustris* Linn., and aquatic terete herb belonging to the family Cyperaceae, locally called `Kouna in Manipuri, is closely associated with the tradition of the Meitei community of Manipur and is used in making a variety of handicrafts items ranging from ladies' bag to chappal, hat, floor mat, cushion, chair, etc. This aquatic plant is generally cultivated in the wetlands of Manipur valley, *c*. 800 msl, and is a good source of income. The plant is harvested thrice a year (May-June, September-October and December-January) and can be continued up to 15 years. The productivity of the rush is about 14.4×10^5 tillers/ha/yr, which weight 43,200 kg in fresh weight. A farmer having a cultivable land of 1 ha can earn an annual income of Rs 252,000. Currently, around 1200 ha of land in Manipur is under Kouna cultivation, which generates a sum of more than Rs 30 crores annually. It has been estimated that more than Rs 250 crores can be generated from matting rush, if cultivated in other potential areas of the state.

Jain, S.K. and Goel, A.K. 2005. **Some Indian plants in Tibetan traditional medicine -I**. *Ethnobotany*, 17(1&2): 127-136. Institute of Ethnobotany, Mall Avenue Colony, Lucknow 226001, India. [AMCHI; ETHNOMEDICINE; TIBET; TIBETAN MEDICINE]

The Tibetan System of Medicine is very ancient and well known. For various political, logistic and other reasons, recent studies on Tibetan medicine have been done primarily outside Tibet. About 100 species predominantly used in Tibetan medicine also occur in India. A comparative study 35 such plants show that many medicinal uses for which plants are employed in Tibetan medicine do not seem to be well known in Indian system of medicine or even ethnomedicine in India. The paper provides brief information on medicinal uses in Tibetan system and also Indian medicine. Studies on judicious exploitation of such plants in India are suggested.

Joshi, P.K.; Rawat, G.S.[1]; Padaliya, H. and Roy, P.S. 2005. **Land use/land cover identification in an alpine and arid region (Nubra Valley, Ladakh) using satellite remote sensing**. *Journal of the Indian Society of Remote Sensing*, 33(3): 371-380. Indian Institute of Remote Sensing (NRSA), Dehradun 248001; [1]Wildlife Institute of India, Dehradun 248001, India. [LAND-USE; MEDICINAL PLANT; NUBRA VALLEY; REMOTE SENSING; SATELLITE DATA]

The remote sensing technology has been widely used for mapping the vegetation types in the tropical landscapes. However, in the temperate and alpine arid regions of India very few studies have been conducted using this technique. In the mountainous temperate arid conditions the vegetation is largely confined to marsh meadows, stream courses, river valley and moist pockets close to snowfields. The ground truth collections in these zones are physically challenging due to tough terrain and restricted mobility. The detailed mapping of vegetation and other land use classes in these areas is therefore, extremely difficult. This paper describes the use of IRS-1D LISS III sensor for deciphering land cover details Nubra Valley, northern portion of Ladakh Autonomous Hill Council, Jammu & Kashmir (India). This analysis essentially emphasizes in bringing out various vegetation classes (specially *Hippophae rhamnoides* and other medicinal plant communities) along the narrow river valleys.

Kala, Chandra Prakash 2006. **Plant community composition and species diversity in the alpine meadows of Uttaranchal Himalayas**. *The Indian Forester*, 132(2): 156-164. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, Uttaranchal. [LIVESTOCK GRAZING; NATIONAL PARK; SPECIES DIVERSITY; VALLEY OF FLOWERS]

The alpine meadows of the Uttaranchal Himalayas are well known for rich floral and faunal diversity. In order to study the alpine meadows of Uttaranchal Himalayas, the Valley of Flowers National Park (VOF; protected from livestock grazing) and the Khiron Valley (seasonally grazed by livestock) were selected. This paper reports plant community composition and species diversity in the VOF and Khiron Valley using stratified random quadrats of 0.25 m^2. TWINSPAN was used for identifying the plant communities and Shannon Wiener Index (H') was used for species diversity. The central valley portion in the VOF that falls between 3,300-3,700m elevations obtained 9 plant communities whereas the Khiron Valley, located at similar elevation, obtained only 7 plant communities. In VOF, species diversity was higher (H'=2.93) than the Khiron Valley (H'=2.77). Plant species diversity decreased with elevation in both protected and unprotected alpine meadows. The results are discussed along with the management implications.

Kant, Shashi and Dutt, Harish Chander 2005. **Dye-yielding plants of Neeru catchment in Doda, Jammu & Kashmir, India**. *Ethnobotany*, 17(1&2): 197-199. Department of Botany, University of Jammu, Jammu 180006, India. [GADDI; NATURAL DYES; NEERU CATCHMENT]

An ethnobotanical survey was conducted in Neeru catchment in the vicinity of lesser Himalayas. It has been noticed that some local tribals, viz., Gaddies, Shippies, and a few other professionals like weavers and shoe-makers, use plant parts for dyeing hand-woven threads and hides, respectively. A list of nine plant species which are used for such purposes has been furnished along with relevant details.

Kumar, Dinesh; Srivastava, S.K.; Negi, S.S. and Kumar, Pradeep 2006. **Development of technique for rapid extraction of seeds from cones of *Pinus roxburghii* Sarg. under controlled conditions**. *The Indian Forester*, 132(2): 197-204. Silviculture Division, Forest Research Institute, Dehradun, Uttaranchal. [EXTRACTION METHOD; *PINUS ROXBURGHII*; SEED GERMINATION]

The conventional practice of extracting seeds from cones of *P. roxburghii* consists in drying of cones in the sun. This process takes about three weeks. A new technique has been developed which achieves seed extraction in four days. The new techniques involves soaking of cones in water for 10 minutes followed by drying at 60°C for 11:50 hours and then shaking for few seconds every day. The technique did not show any adverse effect on seed germination. Further studies are in progress to adapt this technique so as to eliminate the need of kilns for practical application in forest nurseries.

Kumar, Rajesh; Satapathy, K.K.; Mishra, A.K. and Pal, P.P. 2005. **Identification of livestock based problems and its prioritization through PRA technique in the watershed area**. *Indian J. Soil Cons.*, 33(2): 162-165. ICAR Research Complex for NEH Region, Umiam, Meghalaya, India. [LIVESTOCK PRA TECHNIQUE; WATERSHED]

A study was conducted through application of PRA techniques to assess the problems related to livestock rearing faced by the farmers in a watershed area. Results revealed that the high cost of piglet and feed (98.43 and 95.31 R.B.Q. value) were the most severe problems stated by the key informants. Farmers ranked the non-availability of fingerlings as the least severe problem. Further, the research team also discussed the livestock problems with the farmers. It was found that the most severe problem was the high cost of feed followed by high cost of piglets. The farmers ranked the least severe problem as lack of knowledge about hygienic livestock management. The magnitude value was worked out and they revealed the severe problems, perceived by the key informants were most the servere.

Kumar, Rajneesh and Sharma, K.R. 2005. **Standardization of borehole method of oleoresin tapping in Blue Pine *(Pinus wallichiana* A.B. Jackson)**. *Journal of Non-Timber Forest Products*, 12(4): 177-181. Department of Forest Products and Utilization, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173230, Himachal Pradesh. [BLUE PINE; ENVIRONMENTAL CONDITION; HIMACHAL PRADESH]

The present investigations in Blue Pine *(Pinus wallichiana* A.B. Jackson) were carried out to study the effect of borehole diameter and depth and concentrations of chemical stimulants on oleoresin yield. The experiment was carried out in Jelly UPF-167, Unprotected forest of Mashobra range of Shimla Forest Division of the Himachal Pradesh. The trees having diameter between 30-35 cm were selected for the study. The significant differences were observed for all the morphological parameters (height, needle length, needle thickness and grain angle) except that for the diameter of selected trees. Maximum oleoresin yield was obtained from 3.125 cm borehole diameter with 17.5 cm depth and minimum from borehole of 1.25 cm diameter with 10 cm depth. Higher oleoresin yield was obtained when 10 per cent ethephon + 20 per cent sulphuric acid (mixture) was sprayed into boreholes, whereas the lowest yield was recorded in control.

Maikhuri, R.K.; Rao, K.S.[1]; Kandari, L.S.; Chauhan, Kusum; Nautiyal, S.[2]; Purohit, Aditya; Semwal, R.L.[3] and

Nanda Devi Biosphere Reserve (NDBR) established on 18 January 1988 under UNESCO's Man and Biosphere (MAB) programme with an area of 5860.69 km^2 is one of

Saxena, K.G.* 2004. **Conservation policy and social conflicts in protected areas of the Indian Himalaya and options for conflict resolution: A case study from Nanda Devi Biosphere Reserve**. *International Journal of Ecology and Environmental Sciences*, 31(1): 21-28. G.B. Pant Institute of Himalayan Environment and Development, Garhwal Unit, Srinagar-Garhwal 246 174, Uttaranchal; *School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110 067; [1]CISMHE, University of Delhi, South Campus, New Delhi 110 021; [2]Centre for Spatial Science, University of Tokyo, Tokyo, Japan; [3]World Wild Fund for Nature - India, 172 B Lodhi Estate, New Delhi 110003, India. [BIOSPHERE RESERVE MANAGEMENT; MANAGEMENT AUTHORITY - PEOPLE CONFLICTS]

the reserves where people inhabiting in the buffer zone villages feel that they have been deprived of the traditional uses of natural resources from the reserve. Ignoring the dependence of the local people for their subsistence needs has created conflicts between protected area managers and local people. The priority interventions recommended based on long-term scientific, participatory and action research approaches includes plantation of fodder and medicinal plant species in degraded forest lands, cessation of exploitation of the local people by the middlemen traders, enhancement in use of local knowledge of the biodiversity for the economic benefits, incentives for cultivation of crops with comparative advantages and lesser risks of damage by wildlife. Rejuvenation of the traditional practices, such as, involvement of the whole village community in decision-making, could be the viable options for resolving conflicts between people and protected area management authorities.

Majila, B.S.; Joshi, G.C.* and Kala, C.P. 2005. **Patterns in litter fall and litter decomposition along an altitudinal gradient in the Binsar Wildlife Sanctuary, Central Himalaya**. *International Journal of Sustainable Development and World Ecology*, 12(2): 205-212. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, Uttaranchal; *Department of Botany, Kumaun University Campus, Almora, Uttaranchal. [ALTITUDINAL GRADIENT; BINSAR WILDLIFE SANCTUARY; LITTER DECOMPOSITION]

Patterns in litter fall and litter decomposition were studied along an altitudinal gradient in the Binsar Wildlife Sanctuary of central Himalay. The study area was stratified into three broad altitudinal zones: Lower (1600-1900 m), mid (1900-2100 m), and higher (2100-2400 m), based on the occurrence of major forest types (e.g. chir pine, chir oak and oak). Three plots of 100 x 100 m were selected in each altitudinal zone and the amount of litter was measured by placing five litter traps of 1 x 1 m randomly on the forest floor at each site. Litter decomposition was studied using the nylon bags technique. The results reveal that production of litter decreases with elevation in the Binsar Wildlife Sanctuary. At lower elevations, the litter is primarily composed of chir pine needles and woody litter, and is highest in June and lowest in January. There was a similar trend in litter production at mid elevations, whereas at higher elevations, the maximum litter fall was recorded in May. There are variations in decomposition rates, and the most rapid dry weight loss begins with the onset of the rainy season and continues into the post-monsoon period up to November. The rate of decomposition in the study area is lower than in other central Himalayan forests due to the location, which forms a transition zone between temperate and sub-tropical forest.

Majumdar, Paromita 2005. **Urban development in Jammu and Kashmir**.

The process of urbanization and rise in the city population have intensified the aggravation of urban problems

Geographical Review of India, 67(1): 55-69. Institute of Social Science, New Delhi. [INFRASTRUCTURE; SUSTAINABLE DEVELOPMENT; URBAN DEVELOPMENT]

throughout the country. It has become more pronounced, due to inadequate infrastructure and transportation facilities, high values of land under services, partial success of the metropolitan planning efforts and so on. Therefore it is necessary to work out a stringent policy to optimize the size of urban population. It is more so for a state like Jammu and Kashmir, where the sustainable living environment is increasingly being pressurized by the rapid population growth, with little appreciation and support to indigenous efforts to tackle the problem of urban development effectively. The present paper aims to analyse the status of urban development in Jammu and Kashmir in the context of planning for formulating a state urban policy for sustainable development.

Mehrotra, Arushi 2005. **Studies of diseases of some medicinal plants**. *Journal of Non-Timber Forest Products*, 12(1): 44-56. Department of Botany, University of Allahabad, Allahabad, U.P. [DISEASE SURVEY; LEAF BLIGHT; LEAF SPOT; MEDICINAL PLANT]

Studies on diseases of medicinal plants were conducted in nurseries and herbal gardens in and around Dehradun and Rishikesh. In all 29 diseases were recorded on 17 medicinal plants of which 23 were new diseases hitherto unrecorded in the country. Out of 23 new diseases, 9 diseases namely *Rhizoctonia* leaf web blight of *Rauvolfia canescens* and *Artemisia* sp., *Myrothecium* fruit rot of *Withania somnifera, Sclerotium* leaf blight of *Gloriosa superba* and *Spilanthes oleracea, Pseudocercospora* leaf spotting and blight of *Gloriosa superba, Colletotrichum* leaf spot of *Tylophora indica, Pseudocercospora* leaf spot of *T. indica* and *Rhizoctonia* basal rot of *Solanum khasianum* were recorded from New Forest Nursery, Dehradun; 7 diseases namely *Rhizoctonia* aerial blight of *Stevia rebaudiana, Fusarium* wilt of *S. rebaudiana, Macrophomina* charcoal rot of *Rosmarinus officinalis, Rhizoctonia* leaf blight of *R. officinalis, Andrographis paniculata* and *Mentha piperata* and *Sclerotium* leaf spot of *Embelia ribes* occurred in the nursery at Muni-ki-Reti, Rishikesh; *Rhizoctonia* leaf web blight of *Withania somnifera* was encountered in the herbal garden at Jolly Grant and the remaining 6 new diseases namely *Phoma* leaf spot of *Clitoria ternata, Rhizoctonia* leaf web blight of *C. ternata, Alternaria* leaf blight of *C. ternata, Botrytis* leaf blight of *C. ternata, Phytophthora* leaf blight of *Plumbago zeylanica* and *Fusarium* canker of *Tephrosia purpurea* were recorded from the herbal garden at Vasant Vihar, Dehradun. An account of diseases is given.

Mehta, Harsh and Tyagi, P.C. 2005. **Genetic efficiency and analysis of finger millet genotypes for production and conservation of soil moisture**. *Indian J. Soil Cons.*, 33(2): 144-147. Central Soil and Water Conservation Research and

Eleven finger millet genotypes were tested for production and conservation of resources under finger millet-lentil cropping sequence during *karif* 2000 and 2001. The genetic correlations among different component traits were derived to identify suitable selection indices. Pooled analysis for two years indicated that the cultivar VR-708

Training Institute, Dehradun 248195, Uttaranchal, India. [CROPPING SYSTEM; FINGER MILLET; RESIDUAL SOIL MOISTURE; SHORT DURATION VARIETIES]

was the earliest to mature in 76 days and left on an average 15% residual soil moisture in comparison to local cultivars, which matured in 108 days leaving behind only 8% residual soil moisture. The residual soil moisture can be conserved with such short duration high yielding varieties with suitable agronomic interventions. This will facilitate in increasing the cropping intensity in regions which are predominantly monocropping, growing traditional crops under rainfed conditions. Number of productive tillers, grains per spike, biological yield and early flowering are suggested as parameters to develop such short duration high yielding varieties.

Naithani, H.B. 2006. **Occurrence and flowering of a bamboo *dendrocalamus latiflorus* munro, in Nagaland, India**. *The Indian Forester*, 132(3): 358-364. Consultant, Botany Division, Forest Research Institute, Dehradun, Uttaranchal. [BAMBOO; FLOWERING PLANTS; GERMINATION; HOUSEHOLD]

The origin of bamboo *Dendrocalamus latiflorus* Munro is unknown. However, it is cultivated in China, India, Taiwan, Myanmar, Hong Kong, Indonesia and Philippines. The prospects of this bamboo are very promising, especially for edible shoots production and export. It is now being reported for the first time from India. In Nagaland this bamboo is commonly planted almost all the districts, and about 60% of culms were with purplish flowers.

Naithani, H.B.[1]; Deorani, S.C.[2] and Yaden, T.A.[3] 2005. ***Populus gamblei* Dode- A tree new to Nagaland, India**. *The Indian Forester*, 131(9): 1212-1216. [1]Scientist (Retd.), Systematic Botany, Botany Division, Forest Research Institute, Dehradun, Uttaranchal; [2]Principal Secretary, Environment and Ecology, Government of Nagaland, Kohima, Nagaland; [3]Wildlife Warden, Nagaland Forest Department, Dimapur, Nagaland. [DARJEELING HILLS; NAGALAND; *POPULUS GAMBLEI*]

Populus gamblei Dude a southern-most Poplar tree in the Northern Hemisphere, endemic to India from Darjeeling hills, North Bengal, Arunachal Pradesh and Sikkim, has now been reported from wild for the first time from Nagaland. A tree of about 15 m high and girth of 3.2 m has also been measured in Nagaland. About 40 small or medium sized trees were also located in the area. Twenty four hours dip treatment of branch cutting in aqueous solution of 200 hours ppm concentration of Indole Acetic gives 70% rooting. It is used by local people of Nagaland for construction temporary huts in shifting cultivated areas. In Kalimpong hills, West Bengal it is locally called '*Sungrikong*' (Lepcha) and '*Pipalpati*' or '*pilpile*' (Nepalese).

Nautiyal, P. 2005. **Taxonomic richness in the fish fauna of the Himalaya, Central Highlands and Western Ghats (Indian Subcontinent)**. *International Journal of Ecology and Environmental Sciences*, 31(2): 73-92. Department of Zoology, H.N.B. Garhwal University, Srinagar 246174, Uttaranchal, India. [HIGHLANDS; SIMILARITY INDEX; SPECIES: FAMILY RATIO]

A survey of published literature on fish distribution in India reveals the occurrence on 363 native species from 122 genera, 36 families and 11 orders in the highlands of India, Nepal and Bhutan. The Himalayan region harbours the largest number of species (266), genera (107), families (32) and orders (11). In Western Ghats (WG), 155 species, 62 genera, 24 families and 10 orders occur compared with 95 species from 55 genera, 22 families and 8 orders in the Central Highlands (CH). Species: family ratio is lower in CH (4.3) than in WG (6.5) and the Himalaya (8.3) indicating greater diversity at family rather than species level. Further, a sizeable number of species occur within one family, the Cyprinidae,

suggesting recent richness with respect to species, especially in the Himalaya. Only 41 species were common to the three highlands. A large number of species are restricted in distribution (164 in Himalaya, 77 in WG and 8 in CH).

Negi, Y.K. [1]; Garg, S.K.[2] and Kumar, J.[1] 2005. **Cold-tolerant fluorescent *Pseudomonas* isolates from Garhwal Himalayas as potential plant growth promoting and biocontrol agents in pea**. *Current Science*, 89(12): 2151-2155. [1]G.B. Pant University of Agriculture and Technology, Hill Campus, Ranichauri 249199, India; [2]R.M.L. Awadh University, Faizabad 224001, India. [BIOCONTROL AGENTS; PLANT GROWTH PROMOTION; *PSEUDOMONAS FLUORESCENS*]

Four rhizospheric strains of *Pseudomonas fluorescens* (Pf), viz. Pf-102, Pf-103, Pf-110 and Pf-173 were antagonistic against *Fusarium solani* f. sp. *pisi* (causal agent of root rot in pea). In liquid culture assay, Pfs could inhibit the growth of *F. solani* f. sp. *pisi* by 60-100%, suggesting that their secondary metabolites were sufficient to antagonize the target pathogen. Mode of inhibition of *F. solani* f. sp. *pisi* by Pf-102 and Pf-103 was fungistatic, while Pf-110 and Pf-173 were lytic in their action. Plant growth promotion and *in vivo* antagonism assays against the target pathogen revealed that a consortium of four test strains was the best. also individually, strains Pf-110 and Pf-173, capable of solubilizing inorganic phosphate and producing siderophore, were consistently better than the others. These activities are relevant to ecological fitness of the producer strains under the framework of organic farming underway in Uttaranchal.

Pande, D.K. 2005. **Data warehouse techniques in traditional knowledge systems**. *Indian Journal of Traditional Knowledge*, 4(4): 358-366. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, Uttaranchal. [DATA WAREHOUSE TECHNIQUES; TRADITIONAL KNOWLEDGE SYSTEMS]

Traditional knowledge is the knowledge that has been passed from one generation to the next through the oral or written traditions, Elders, being the most knowledge persons are very important in the society. The elders are the people, who have gained the knowledge over their lifetime and are needed to teach the younger generations. The relationship of the indigenous people to the land and its resources is tantamount to their survival. No matter where they live and whatever beliefs they have, they all view land as the basis of their survival. Attempts are being made to document and preserve Oral Traditional Knowledge and Traditional Cultural Expressions. Looking into the quantum of the information, it is difficult to document and retrive the information. To make this a reality, an urgent need to fabricate a Data Warehouse (DW) on Traditional Knowledge System (TKS) has been emphasised.

Parveen; Bisht, Prabha; Sharma, V.K. and Mandal, A.K. 2005. ***In vitro* propagation throught epicotyl explants of *oroxylum indicum* Vent**. *Journal of Non-Timber Forest Products*, 12(3): 123-126. Division of Genetic and Tree Propagation, Forest Research Institute, P.O. I.P.E., Kaulagarh Road, Dehradun,

Results of studies on micro-propagation of *Orxylum indicum* Vent., using epicotyl nodal segments of *in vitro* grown seedlings are reported. Multiple bud break in axillary shoots was achieved in MS medium supplemented with IAA 0.1mg/1+ BA 1.0 mg/1. MS Medium supplemented with 0.1 mg/1 IAA + BA 5.0 mg/1 produced maximum number of shoots with large amount of callus. Maximum shoot multiplication was

Uttaranchal. [GERMINATION; SEEDLING]

achieved in MS medium supplemented with IAA 0.1mg/1+ BA 0.5 mg/1 + Adenine sulphate 50 mg/1 with maximum shoot length. 40% rooting of *in vitro* grown shoots was observed in 1/2 MS medium supplemented with IBA 1.0 mg/1. Plantlets were successfully hardened in *in vitro*.

Punam; Singh, Balbir; Sharma, Shivesh and Atul 2006. **Effect of micro site variations on the phenological studies of Himalayan shrubs-*Woodfordia, Carissa, Prinsepia* and *Debregeasia***. *The Indian Forester*, 132(2): 211-220. Department of Agroforestry and Environment, CSK Himachal Pradesh Agricultural University, Palampur, H.P.[FLOWERING PLANTS; GERMINATION; VEGETATIVE GROWTH]

A phenological study was carried out to know the effect of micro-zonal variation on the different phenophases like flowering, fruiting, seed maturation and seed dispersal etc. of four important multipurpose shrubs of Himachal Himalayas i.e., *Woodfordia, Carissa, Prinsepia* and *Debregeasia* species. Flowering phase was enhanced in *Woodfordia* and *Debregeasia* species at certain sites due to minute temperature variations.

Qaisar, K.N. and Mishra, V.K. 2005. **Nursery and field performance of *Acacia catechu* willd. seedlings raised in different type and size of containers**. *Journal of Non-Timber Forest Products*, 12(2): 91-95. Department of Silviculture and Agroforestry, University of Horticulture and Forestry, Nauni, Solan, H.P. [COLLAR DIAMETER; ROOT BIOMASS; SEEDLING]

Nursery performance of *Acacia catechu* seedlings raised in different type and size of containers, viz. side perforated polybag (1350 cc), bottom perforated polybag (1350 cc), root trainer 110 cc, root trainer 150 cc and root trainer 250 cc was assessed. Container type and size significantly influenced the growth of the seedling. Side perforated polybag raised seedlings gained maximum height, while root trainer 250 cc closely followed by bottom perforated polybag grown seedlings exhibited maximum collar diameter. The number of leaves and leaf area was registered highest in bottom perforated polybag seedlings. Side perforated polybag resulted in seedlings with maximum root length. The 110 cc, 150 cc and 250 cc root trainer and bottom perforated polybags resulted in seedling with higher number of primary, secondary+tertiary roots. The bottom perforated polybags also registered highest values for root dry matter and total seedling dry matter content. The bottom perforated polybag and root trainer raised seedling depicted better values of seedling quality parameter, viz. sturdiness, root/shoot ratio, ratio of fibrous to total root biomass and Dickson quality index, which indicated the overall quality of seedlings. The six month out planting studies clearly showed higher survival of bottom perforated polybag and 250 cc root trainer seedlings, whereas the root trainer 250 cc seedlings surpassed bottom perforated seedlings in terms of seedling height in field whereas side perforated polybag seedlings exhibited lowest value of height increment. However, the longer field trials are needed to ascertain the superiority of bottom perforated and root trainer raised seedlings.

Raina, A.K. and Jha, M.N. 2005. **Inter-relationship between geology, soil and vegetation in Raipur range of Mussoorie Forest Division, Uttaranchal**. *The Indian Forester*, 131(9): 1201-1211. Forest Soil and Land Reclamation Division, Forest Research Institute, Dehradun, Uttaranchal. [ORGANIC MATTERS; SOIL FERTILITY; SOIL MORPHOLOGY]

The relationship between geology soil and vegetation have been evaluated in Raipur range of Mussoorie Forest Division (Uttaranchal). The findings of the study show that floristic composition and soils have some relationship with parent material. It has been observed that Mollisols occur on dolomitic limestones (Dwara) or on limestones interbedded with shales (Ladpur, Raipur, Rajpur and parts of Ringalgarh) whereas Inceptisols occur on quartzites (Manipur and parts of Sripur) and on phyllite, slate and limestone (Ringalgarh). The study further indicated on the basis of soil and mineralogical data that *Quercus leucotrichophora* and *Pinus roxburghii* forest thrive well on Inceptisols whereas *Shorea robusta, Dalbergia sissoo* and scrub forests grow well on Mollisols. Relief and age acting on geology of Raipur range of Mussoorie forest division govern the existing soil formation whereas altitude and climate besides other soil forming factors impact geology and give rise to natural vegetation. Climate and aspect of a particular site have given rise to the various pedogenic processes and floristic composition. It was, however, inferred on the basis of soil as well as mineralogical data that geology, vegetation and soil are in stable relationship with each other and such studies should also be carried out in different ranges for a comprehensive knowledge of these inter-relationships.

Randhawa, S.S.[1]; Sood, R.K.[1]; Rathore, B.P.[2] and Kulkarni, A.V.[2] 2005. **Moraine-dammed lakes study in the Chenab and Satluj river basins using IRS data**. *Journal of the Indian Society of Remote Sensing*, 33(2): 285-290. [1]Himachal Pradesh Remote Sensing Cell, Shimla 171009; [2]Space Application Center, Ahmedabad 380015. [IRS DATA; SATELLITE IMAGES; SATLUJ RIVER BASIN]

Moraine-dammed lakes are normally formed near glacier terminus. These lakes can burst due to excessive melting and can cause floods in the valleys. Many such floods have been reported in the Himalayas and other parts of the World. In this paper, an inventory of these lakes in Satluj and the Chenab basins has been reported. During the investigation, 22 lakes in the Satluj and 31 lakes in the Chenab basin were mapped. In the Chenab basin, two lakes are of very large size, their areal extent is 105 and 55 ha, located in toposheet number 52 H11 and 52H02, respectively. These lakes were selected for detail monitoring. The lake near the Geepang glacier, is located in toposheet number 52H 02 and its area was 27 ha in 1976. Using the satellite data, areal extent of the lake was monitored. The lake area was almost doubled to 55 ha in 2001. This suggested that, lake size is constantly increasing and it can cause outbrust flood. The maximum possible depth of lake was estimated by taking the average difference of maximum and minimum height of moraine dam from the Survey of India toposheet. By considering the average depth, the volume of the lake water and the instantaneous discharge of 350 m^3/sec were estimated. This is large discharge for a small stream like

the Geepang Gath and it can damage many civilian and defense establishments. Therefore, further detail field investigations of this lake are needed to assess threat potential and to develop strategy to avoid this flash flood.

Rawat, Kirti; Tyagi, Monika; Nautiyal, S. and Kumar, Pankaj 2006. **Variability studies of different seed sources of *Pinus wallichiana* with special reference to seed and germination characteristics**. *The Indian Forester*, 132(3): 373-380. Plant Physiology, Botany Division, Forest Research Institute, Dehradun, Uttaranchal. [CONSERVATION; GERMINATION; PINUS WALLICHIANA]

Genetic parameters for five seed traits (length, width, thickness, weight, and volume) and percentage germination were studied in twenty seed sources of *Pinus wallichiana*, mostly from the states of Uttaranchal and Himachal Pradesh in two successive years 2002 and 2003. Value for variability and expected genetic gain were calculated for all individual characters. Seed weight and volume exhibited high genetic variability, heritability and genetic gain. Almost all the seed characteristics were found to be highly heritable at 5% level of significance. Heritability values were maximum for seed weight and minimum for seed length. Hence, heavy and large seeds have to be chosen for the good results. A correlation study showed that seed length, width, thickness, weight and volume were positively correlated with each other. Seed thickness had the highest direct effect on seed width. Germination characteristics were also found positively correlated with each other.

Rawat, P.S. and Punj, Nidhi 2006. **Ectomycorrhizal status and soil characteristics of deodar forest in central Himalayan region of Nainital hills**. *The Indian Forester*, 132(3): 365-372. Research & Coordination Section, Forest Research Institute, Dehradun, Uttaranchal. [DEODAR FOREST; ORGANIC MATTERS; SOIL MOISTURE]

Seasonal distribution of ectomycorrhizae in Deodar *(Cedrus deodara)* forest of Nainital hill of Central Himalayas has been asessed in relation to their soil characteristics. The occurrence of mycorrhizae in per 100g of soil was recorded to be highest in the month August and lowest in January. The per cent occurrence and attrition rate (live/dead) of ectomycorrhizae were also reported to be maximum in the month of August and minimum in January. Although no specific trend of increase and decrease in mantle thickness and Hartignet penetration was observed, however the mantle thickness and Hartignet penetration were reported to be maximum in the months of November and May respectively. Linear regression between ectomycorrhizal count and some of the soil characteristics have shown positively significant correlation ($p<0.001$) between available P and live mycorrhizae. Negatively non-significant correlation was found between soil pH and total mycorrhizae. Moreover, positively significant correlation was observed between soil N and C:N with live mycorrhizae ($p<0.01$) and that of $P<0.01$ between soil moisture and live ectomycorrhizae.

Rawat, R.S. 2005. **Threat status of some banned medicinal plant species of Western Himalayas**. *Journal of Non-Timber Forest Products*, 12(3): 113-118. Ecology and Biodiversity Conservation

Literature on Western Himalayan banned medicinal plant for export has been reviewed and based on these, about 19 potential medicinal plant species are described in this paper with sequence of their recent botanical names, threat status and distribution.

Division, Himalayan Forest Research Institute, Shimla 171 009, Himachal Pradesh. [CONSERVATION; DIVERSITY; MEDICINAL PLANT]

Rout, Jayashree[1]; Kar, Ashish[2] and Upreti, D.K.[3] 2005. **Traditional remedy for kidney stones from a high altitude lichen: *Cladonia rangiferina* (L.) Wigg (Reindeer moss) of Eastern Himalaya**. *Ethnobotany*, 17(1&2): 164-166. [1]Department of Ecology & Environmental Sciences, Assam University, Silchar; [2]Defence Research Laboratory, DRDO, P.B No. 2, Tezpur, Assam; [3]Lichenology Laboratory, National Botanical Research Institute, Lucknow, India. [*CLADONIA*; KIDNEY STONES]

The present paper describes the ethnomedicinal use (removal of kidney stones) of a common lichen, *Cladonia rangiferina*, found growing in the alpine regions of West Kameng district of Eastern Himalaya. The information provided here is based on personal interview with a herbalist from Monpa tribe.

Samal, P.K.; Palni, L.M.S.[*] and Dhyani, P.P. 2005. **Status and trends in research and development projects in the mountains: A situational analysis in the Indian Himalaya**. *International Journal of Sustainable Development and World Ecology*, 12(4): 479-488. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, Uttaranchal; [*]State Biotechnology Programme, Government of Uttaranchal, Biotech Bhawan, Haldi, Pantnagar, Uttaranchal. [INDIAN HIMALAYA; MOUNTAIN ECOSYSTEMS; RESEARCH AND DEVELOPMENT; TRENDS]

The mountains hold the key to global ecological and social stability by virtue of being centres of biological and cultural diversity and the storehouse for water and other resources. However, they are becoming unable to sustain the demands of the changing life style of the growing number of inhabitants as well as the population in the plains and, therefore, the resources are depleting rapidly. Inadequacy of research and development (R&D) projects undertaken in mountain ecosystems is, perhaps, a major factor that has not enabled us to evolve and introduce suitable interventions to replenish and restore the health of the degraded mountains. In this article, taking the Indian Himalayan region as a case study, an effort has been made to understand the adequacy and appropriateness of R&D projects in mountain ecosystems by analysing the research and development projects implemented in this region from 1985-86 to 1998-99. The analysis revealed inadequacy in the number and budgets of R&D projects implemented in this mountain ecosystem as a whole as well as in specific subject areas; the number of R&D projects implemented during this period was only 5.28% of the total projects, with a fund allocation of 4.45% of the total R&D budget of India, which appears to be inadequate considering the geophysical and bio-social importance of the Himalaya. The finding suggests that national funding agencies of mountain nations need to increase the number of R&D projects in mountain regions as a priority, with the intention of developing scientific packages capable of restoring the degraded ecosystem of the mountains and ensuring their sustainable development.

Sanjeev; Gera, Mohit and Sankhayan, P.L. 2005. **Phytosociological analysis of arnigad micro-watershed in Mussoorie hills of Garhwal Himalayas**. *The Indian Forester*, 132(1): 19-30. Resource Survey and Management Division, Forest Research Institute, Dehradun, Uttaranchal. [DEGRADED LANDS; FLORISTIC DIVERSITY; GARHWAL HIMALAYA; MICRO-WATERSHED]

The present study was carried out in Arnigad micro-watershed covering an area of 13.43 km^2 in Mussoorie hills of Garhwal Himalayan region. For the purpose of characterizing the species composition, vegetation structure and floristic diversity by land use categories, the entire watershed was delineated into four land uses, viz., forest, scrub forest, degraded and agricultural lands. In all, 64 species belonging to 63 genera and 56 families were found to be growing in the micro-watershed. The vegetation analysis showed that *Quercus leucotrichophora, Acacia catechu, Eucalyptus* spp. and *Juglans regia* were found to be dominant in forest, scrub forest, degraded and agriculture lands respectively for the tree stratum. Similarly *Berberis aristata* and *Lantana camara* were observed to be dominant in the shrub communities of forest and scrub forests respectively. *Lantana camara* was also found to be dominant in the shrub communities of degraded land. Results of the diversity index, concentration of dominance and equability on the three land uses, viz., forest, scrub forest and degraded land indicated that maximum diversity was observed in forest with respect to tree stratum followed by scrub forest and degraded lands, whereas in case of shrub and herb strata, scrub forest showed the maximum diversity. The maximum values on dominance were recorded for all the three strata of vegetation on degraded land indicating the presence of single or few species. The vegetation recorded on scrub forest was found to be more equitable compared to vegetation on forest and degraded land.

Sankhyan, H.P. and Sehgal, R.N. 2005. **Effect of micro-nutrient application on the growth of Seabuckthorn seedlings in the cold desert of Himachal Pradesh**. *Journal of Non-Timber Forest Products*, 12(3): 157-160. Department of Tree Improvement and Genetic Resources, College of Forestry, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173 230, Himachal Pradesh. [COLD DESERT; COLLAR DIAMETER; MICRO-NUTRIENT; SEEDLING]

An experiment was laid in polythene bags to study the effect of micronutrient (Zn, Cu, Mn, B, Mo, separately as well as in combination) application on the growth of Seabuckthorn *(Hippophae rhamnoides* L.) seedlings. All the treatments were given to the soil before sowing of seeds. A basal dose of N, P_2O_5 and K_2O at the rate of 120:60:60 kg/ha, respectively, was also applied. An assessment of the effect of treatments collectively on seedling parameters has revealed that treatments T_6 (5 ppm B) and T_5 (20 ppm Mn) are the best for obtaining vigorous and healthy seedlings of seabuckthorn. The soils of cold deserts are deficient in zinc and are likely to respond to its application, thus application of 10 ppm zinc to soil will also be beneficial because this treatment improved some seedling parameters too. B, Mn and Zn should receive special attention of foresters and scientists in order to raise healthy planting stock for greening the cold deserts.

Sekar, K. Chandra and Srivastava, S.K. 2005. **New reports on aphrodisiac plants from Pin Valley National Park, Himachal Pradesh**. *Ethnobotany*, 17(1&2): 189-190. Botanical Survey of India (NC), 192, Kaulagarh Road, Dehradun 248195, Uttaranchal, India; Royal Botanic Gardens, Richmond, Surrey, Kew (United Kingdom). [APHRODISIAC; PIN VALLEY NATIONAL PARK; TRIBALS]

Information about four plants used as aphrodisiacs by the tribals of Pin Valley National Park, Lahaul-Spiti in Himachal Pradesh is provided along with their mode of preparation and dosage.

Sharma, N.K. 2005. **Spatial analysis of disturbance gradient in a forested landscape of an Indian Central Himalayan watershed**. *The Indian Forester*, 131(11): 1474-1482. Regional Remote Sensing Service Centre, Dehradun, Uttaranchal. [BROADLEAF FORESTS; LANDSCAPE; REMOTE SENSING; WATERSHED]

In the present study disturbance gradient of Kalsa watershed was analyzed using Remote Sensing and Geographical Information System. A total of ten landuse and vegetation classes were mapped for the area using IRS-1D LISS III data. Disturbance Index map was derived by using fragmentation, patchiness, porosity, interspersion, juxtaposition and biotic zoning (distance from habitation and roads) as input. The disturbance gradient was mapped into four discrete classes' viz., very low, low, medium and high disturbance using geospatial modelling in GIS domain. Disturbance gradient has been compared with all the forest types in the study area.

Sharma, Neeru and Vaid, Sumati 2005. **Role of parents in the social development of Adolescents: A comparison of low and middle socio-economic status**. *Journal of Human Ecology*, 18(2): 109-115. P.G. Department of Home Science, University of Jammu, Jammu 180006, Jammu and Kashmir. [DEVELOPMENT NICHE; EMOTIONAL MATURITY; SELF ACTUALIZATION]

The present research is an exploratory attempt to study the "Role of parents in the social development of adolescents: A comparison of low and middle socio-economic status". The sample consisted of 100 adolescents and their parents. Random sampling technique was employed to select the middle socio-economic ground and snowball sampling technique was used to select low socio-economic status. Three scales were used-Measure of Approving Parent (MAP) for parents, and Emotional Maturity Scale (EMS) and Self Actualization Inventory (SEAI) for adolescent children. Statistical analysis shows that the majority of parents show a moderate degree of approval towards their children. Most of the adolescents of both the group were emotionally unstable and had attained moderate self-actualization. Data was also analyzed through coefficient of correlation and it was found that parental approval does not correlate highly with emotional maturity or self-actualization.

Sharma, P.K. and Lal, B. 2005. **Ethnobotanical notes on some medicinal and aromatic plants of Himachal Pradesh**. *Indian Journal of Traditional Knowledge*, 4(4): 424-428.

Himachal Pradesh, which forms a part of the western Himalaya, is a repository of medicinal and aromatic plants and the traditional knowledge associated with these plants. Utilization of plant resources in their day-to-day life has been an age old practice of the people inhabiting

CKS Himachal Pradesh Krishi Vishwavidyalaya, Palampur 176061, Himachal Pradesh; Biodiversity Division, Institute of Himalayan Bioresource Technology, Palampur 176061, Himachal Pradesh. [AROMATIC PLANTS; ETHNOBOTANY; MEDICINAL PLANTS]

this hilly state. The people living in remote and tribal areas still depend on household remedies for healthcare. The present paper provides information on the indigenous therapeutic application and other traditional uses of 9 plant species that are used by the natives of Himachal Pradesh. Information provided includes scientific name, family name (in bracket), vernacular names, distribution, and ethnobotanical use clubbed with the common uses as recorded from the relevant literature.

Sharma, P.K.[1]; Chauhan, N.S.[2] and Lal, B.[3] 2005. **Studies on plant associated indigenous knowledge among the *Malanis* of Kullu district, Himachal Pradesh**. *Indian Journal of Traditional Knowledge*, 4(4): 403-408. [1]Department of Agroforestry and Environment, COA, CSKHPKV, Palampur 176062, Himachal Pradesh; [2]Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173230, Himachal Pradesh; [3]Biodiversity Division, Institute of Himalayan Bioresource Technology, P.O. Box 6, Palampur 176061, Himachal Pradesh. [ETHNOBOTANY; PARVATI VALLEY; TRADITIONAL KNOWLEDGE; TRIBES]

The *Malani* is an ethnic community inhabiting a remote village generally called as Republic of Malana, located in Parvati valley of Kullu district, Himachal Pradesh. The adjoining are of Malana is inhabited by *Gujjars ,Gaddis*, and other rural communities. Since ages, these people have been utilizing their ambient plant resources for food, fodder, fibre, medicine, fuel, and other purposes. During ethnobotanical surveys conducted in 2000-2002 among the *Malanis* and other inhabitants of Parvati valley, first hand information on 35 plant species was recorded. The uses in details are described in the present communication.

Sharma, Rajesh and Bhalaik, R.R. 2005. **Genetic analysis of cone and seed characters among seed sources of deodar *(Cedrus deodara* (Roxb.) G.Don)**. *Indian Journal of Forestry*, 28(1): 17-21. Himalayan Forest Research Institute, Panthaghati, Shimla 171009, Himachal Pradesh. [CONE DIAMETER; GENETIC ANALYSIS; SEEDLING]

The materials used in this study were obtained from 19 seed sources selected from different geographical areas under the species in the state of Himachal Pradesh. These 19 seed sources were evaluated for variability studies in cone and seed characters. Significant differences (p=0.05) were observed among provenances for cone length, cone diameter and seed weight indicating that a significant amount of genetic variation exists among provenances for these traits. Wide ranges in the means were exhibited for cone weight (79.4-314.40g), No. of seed (124-230), seed weight (1.5-15.5 g) and No. of scale (120-215). In all cases the standard error were lower than their respective means. All characters were found to have positive and highly significant genetic correlation except cone length and seed weight (0.39). In all the cases genotypes correlations were larger than the phenotypic correlations. The heritability estimates were high for all traits except seed weight (16.26%). The highest values were obtained for cone weight 66.43% followed by cone length 56.73% and cone diameter 53.04%. Cone weight, which recorded highest estimate of heritabiltiy also recorded highly significant genetic correlation with all traits. Although

heritability estimates in broad sense may give useful indication about the relative value of selection in the materials, heritability along with genetic gain is more useful than the heritability alone in predicting the resultant effect for selecting the best genotypes for a given trait.

Sharma, Rajesh; Kumar, Surinder and Thakur, K.S. 2006. **Genetic improvement of chir pine *(Pinus roxburghii* Sargent.) in India - A review**. *The Indian Forester*, 132(3): 314-328. Himalayan Forest Research Institute, Conifer Campus, Shimla, Himachal Pradesh. [CHIRPINE; COLLAR DIAMETER; SEED GERMINATION]

Pinus roxburghii Sargent (Chir pine) is the most important pine among the six indigenous pines of India. The genetic variation in Chir pine both among and within populations with regard to quantitative and qualitative aspects of inheritance, morphological, physiological, biochemical characters and gene marker studies have been studied in the past, but in isolation. The article reviews the results of various studies on different aspects of tree improvement of the species, specifically highlighting the work on isozyme analysis of the provenances and plus tree to narrow down the population/provenance differences and their categorization based on genetic diversity, differentiation and genetic distances.

Singh, S.K. and Rai, J.P.N. 2005. **Impact of biotic disturbances on vegetation and litter accumulation in alpine meadows of Nanda Devi Biosphere Reserve**. *The Indian Forester*, 131(9): 1178-1186. Department of Environmental Sciences, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttaranchal. [AGROECOSYSTEM; BIOTIC PRESSURE; BUFFER ZONE; NANDA DEVI BIOSPHERE RESERVE]

The present investigation reports on the phytosociological attributes of plant species encountered changes in litter accumulation in alpine meadows exposed to a gradient of biotic pressures in buffer zone of Nanda Devi Biospher Reserve. *Danthonia cachemyriana* showed maximum IVI in the moderately disturbed site whilst *Kobressia duthiea* in the intensively disturbed site. Maximum litter accumulation was recorded in the moderately disturbed site in October whilst minimum in the intensively disturbed site during August. On contrary to the undisturbed meadow, in the intensively disturbed meadow total litter production was contributed minimum by the grasses-more palatable plants.

Singh, S.P.; Tewari, Ashish and Jina, B.S. 2005. **Carbon sequestration in forests of Central Himalaya: Considerations for soil carbon storage and carbon trade**. *International Journal of Ecology and Environmental Sciences*, 31(1): 45-48. Department of Botany, Kumaun University, Nainital 263002, Uttaranchal. [CARBON TRADE; COMMUNITY FORESTS; VAN PANCHAYATS]

The increase in concentration of carbon dioxide and other greenhouse gases in the atmosphere has been projected to causes observable climatic changes because of increase in global temperature, changing rainfall pattern and melting if ice and glaciers in the polar regions. The Kyoto Protocol pertaining to development of carbon sinks, emphasises upon afforestation and reforestation, while increasing carbon storage through conservation of the existing forests has been neglected. This paper discusses (i) the possible role of community forests (occupying 7000km^2) of Uttaranchal in C-sequestration/trade and (ii) problems of estimating C-sequestration in below ground components of forests, particularly pertaining to uncertainty about the longevity of fine roots and the fate of deep soil carbon.

Singh, Sarnam[1]; Singh, T.P.[2] and Srivastava, Gaurav[1] 2005. **Vegetation cover type mapping in Mouling National Park in Arunachal Pradesh, eastern Himalayas - An integrated geospatial approach**. *Journal of the Indian Society of Remote Sensing*, 33(4): 547-563. [1]Forestry and Ecology Division, Indian Institute of Remote Sensing, 4 Kalidas Road, Dehradun 248001; [2]NRDMS Centre, Kumaun University Campus, Nainital 263002, Uttaranchal, India. [BROAD-LEAVED FOREST; DIGITAL ELEVATION MODEL; GEOSPATIAL APPROACH; MOULING NATIONAL PARK; SATELLITE DATA]

Improving image classification and its techniques have been of interest while handling satellite data especially in hilly regions with evergreen forests particularly with indistinct ecotones. In the present study an attempt has been made to classify evergreen forests/vegetation in Mouling National Park of Arunachal Pradesh in Eastern Himalayas using conventional unsupervised classification algorithms in conjunction with DEM. The study area represents climax vegetation and can be broadly classified into tropical, subtropical, temperature and sub-alpine forests. Vegetation pattern in the study area is influenced strongly by altitude, slope, aspect and other climatic forests. The forests are mature, undisturbed and intermixed with close canopy. Rugged terrain and elevation also affect the reflectance. Because of these discrimination among the various forest/vegetation types is restrained on satellite data. Therefore, satellite data in optical region have limitations in pattern recognition due to similarity in spectral response caused by several forests. Since vegetation is controlled by elevation among other factors, digital elevation model (DEM) was integrated with the LISS III multiband data. The overall accuracy improved from 40.81 to 83.67%. Maximum-forested area (252.80 km^2) in national park is covered by sub-tropical evergreen forest followed by temperate broad-leaved forest (147.09 km^2). This is probably first attempt where detailed survey of remote and inhospitable areas of Semang sub-watershed, in and around western part of Mouling Peak and adjacent areas above Bomdo-Egum and Ramsingh from eastern and southern side have been accessed for detailed ground truth collection for vegetation mapping (on 1:50,000 scale) and characterization. The occurence of temperate conifer forests and Rhododendron Scrub in this region is reported here for the first time. The approach of DEM integrated with satellite data can be useful for vegetation and land cover mapping in rugged terrains like in Himalayas.

Singh, Virendra; Nayyar, H.[*]; Gupta, R.K. and Uppal, Rajesh[**] 2005. **Germination behaviour of different biotypes of Seabuckthorn *(Hippophae* L.)**. *Journal of Non-Timber Forest Products*, 12(4): 209-213. Hill Agriculture and Extension Centre, CSK Himachal Pradesh Agricultural University, Bajaura, Kullu 175 125, Himachal Pradesh; [*]College of Basic Sciences, CSK H.P. Agricultural University Palampur;

The germination behaviour of seeds of 11 natural population of *Hippophae rhamnoides* and 1 each of *H. salicifolia* and *H. tibetana* growing in cold desert and high altitude region of Himalayan State of Himachal Pradesh, was studied. The seeds of Seabuckthorn growing in arid region of Spiti showed better germination rate (98-100%) than those of semi-arid region of Lahaul (21-97%). Among the species, *H. tibetana* showed a maximum rate of seed germination (100%) followed by *H. rhamnoides* (21.0-100.0%) and *H. salicifolia* (37.0%). After 14 days, biotype of *H. tibetana* attained the

[**]Department of Agroforestry and Environment, CSK Himachal Pradesh Agricultural University, Palampur 176062, H.P. [COLD DESERT; LAHAUL-SPITI; SEED GERMINATION]

maximum length of 8.71 cm, significantly higher than those of *H.rhamnoides* (4.3-6.5 cm) and *H. salicifolia (3.7 cm).* Seedling of all the biotypes had longer shoots than roots, with the exception of H. tibetana). Seeds with brown colour, oval, ovate and oblong shapes showed better growth than the cylindrical, elliptical, with the exception of *H. tibetana*. In general, seeds of medium to large size had better growth than the small seeds.

Singh, Virendra[1]; Gupta, R.K.[1]; Uppal, Rajesh[2]; Singh, B.[3] and Lata, Swarn[2] 2005. **Morpho-biochemical variations in the seeds of different biotypes of Seabuckthorn *(Hippophae* L.)**. *Journal of Non-Timber Forest Products*, 12(1): 25-29. [1]CSK H.P. Agricultural University, Hill Agriculture Research and Extention Centre, Bajaura, Kullu, H.P.; [2]CSK H.P. Agricultural University, Palampur, H.P.; [3]IVRI, Regional Centre, Palampur, H.P. [LAHAUL-SPITI; SEABUCKTHORN; SOIL EROSION]

The present study was carried out on the morphological and biochemical variations in the seeds of 13 biotypes of Seabuckthorn, growing in the District Lahaul-Spiti (2600-4100 m asl), a dry temperate Himalayan region of Himachal Pradesh. The colour of the seeds of 11 biotypes of *Hippophae rhamnoides* ssp. *turkestanica,* the most dominant and widely distributed species of Seabuckthorn, varied from light to medium and dark brown, whereas it was medium to dark brown in *H. salicifolia* and dull white in *H. tibetana*. There was a lot of variation in the shape of the seeds. Weight of the 100 seeds varied from a maximum of 1.331 g in *H. tibetana* to 1.142 g in *H. salicifolia* and 1.103-0.718 g in the biotypes of *H. rhamnoides*. Crude protein (CP) content varied from 32.1-19.2% in the biotypes of *H. rhamnoides* and 25.5% and 20.3% in the seeds of *H. tibetana* and *H. salicifolia*, respectively. The total oil content was highest in the seeds of *H. tibetana* (16.9%), followed by the biotypes of *H. rhamnoides* (8.8-14.6%) and *H. salicifolia* (9.4%). There was no definite pattern of different characteristics of the seeds of Seabuckthorn in relation to the altitude of the region.

Sinha, B.L.[1] and Rastogi, R.A.[2] 2005. **Discrete linear input-out model for a Himalayan watershed in Uttaranchal**. *Journal of soil and Water Conservation*, 4(1&2): 1-7. [1]ACICRP for Dry Land Agriculture, R.B.S. College, Bichpuri, Agra, U.P.; [2]Department of SWCF, GBPUA&T, Pantnagar, Uttaranchal. [WATERSHED; DISCRETE; HYDROGRAPHS; RAINFALL; RUNOFF]

A discrete linear input-output model for Chaukhutia (452.25 km^2) watershed of Ramganga river was developed for estimating direct runoff hydrographs on storm basis. The parameters of the model were determined by least square method using rainfall and runoff data of the watershed for storm events of calibration set. The performance and adequacy of the model was tested by comparing the computed direct runoff hydrographs with the observed runoff hydrographs. The model was calibrated for twenty-four storm events and verified for four storm events. The average value of the integral square error, absolute ralative error in estimated peak and relative squared error of the model were 0.07, 4.15 per cent, and 0.012 for calibration events; and 0.08, 5.90 per cent and 0.028, respectively, for prediction events. The computed direct runoff hydrographs by model were in close agreement with the observed direct runoff hydrographs.

Talatam, Satyanarayana[1]; Raina, J.N.[2]; Karthikeyan, K.[1] and Coumar, M.Yassanda[1] 2005. **Nutritional status of apple orchard soils and plants of Himachal Pradesh part I: Macronutrients**. *Journal of soil and Water Conservation*, 4(1&2): 50-55. [1]Ph.D. Scholars, Division of Soil Science and Agricultural Chemistry, IARI, New Delhi 110012; [2]Sr. Scientist, Department of Soil Science and Water Management, Dr. YSPUH&F, Nauni-Solan, H.P. [AGRO-CLIMATIC CONDITION; NUTRITIONAL STATUS; ORCHARD SOIL]

A nutritional survey of 144 apple orchards in Shimla, Kullu, Mandi, Chamba, Sirmour and Kinnaur districts of Himachal Pradesh was carried out to determine the NPK status of plants and soil. Soil (0-20 and 20-40 cm depths) analysis revealed low to medium N levels and medium to high P and K levels. Soil pH varied between 4.28 and 7.54 and the soil EC values were lower than 0.8 dS M^{-1}. All the samples had high organic carbon content. Leaf analysis revealed low to sufficient levels of N, P and K. The results of the present study may be useful to the apple growers for appropriate fertilizer management in apple orchards ensuring higher yields of quality fruits.

Tripathi, S.P. 2005. **Status of joint forest management in Nagaland**. *The Indian Forester*, 131(9): 1158-1170. Silviculture and JFM Division, Tropical Forest Research Institute, Jabalpur, Madhya Pradesh. [BIODIVERSITY; ECO-DEVELOPMENT; JOINT FOREST MANAGEMENT]

The paper gives an account about the status of Joint Forest management (JFM) in the State of Nagaland. The land holding pattern in the state is totally different from the other states. In the states, most of the land belongs to people. The involvement of people has played an important role in protection and conservation of forests. Through JFM programme people are also getting involved in biodiversity conservation. The Samanvit Gram Vanikaran Smriddhi Yojna (SGVSY) and National Afforestation Programme (NAP) implemented by Forest Development Agencies (FDAs) have given momentum to JFM programme in the state which leads to increase in dense forest cover. The JFM programme is very successful in the state.

Uniyal, Kamla 2005. **Smoky stem blight of chir pine- A new rocord**. *The Indian Forester*, 131(11): 1483-1485. Forest Pathology Division, Forest Research Institute, Dehradun, Uttaranchal. [DISEASE INDEX; FUNGICIDE]

Macrophomina pheseolina was first time recorded causing smoky blight of Chir pine. About 90% plants were found infected with one disease. Three fungicides viz., Dithane M-45, Tagcop and Bavistin in four concentration viz., 0.2, 0.1, 0.02 and 0.01% were evaluated for control of disease. Bavistin was found effective at all concentration followed by Tagcop which was effective in three concentration. Dithane M-45 was found less effective.

Upadhaya, K.; Pandey, H.N.; Law, P.S. and Tripathi, R.S. 2005. **Dynamics of fine and coarse roots and nitrogen mineralization in a humid subtropical forest ecosystem of northeast India**. *Biology and Fertility of Soils*, 41(3): 144-152. Department of Botany, School of Life Science, North Eastern Hill University, Shillong 793 022, India.

The present study was carried out of understand whether fine root growth and N mineralization are synchronized in such a manner that helps to conserve N in the humid subtropical forest ecosystem, and to assess whether or not these processes are influenced by human disturbance. The study was conducted in two pairs of undisturbed and disturbed stands of subtropical humid forest in the Jaintia hill district of Meghalaya, northeast India. The amount of fine root (540-754 g m^{-2}) and coarse root (307-387 g m^{-2})

[BIOMASS; NITROGEN MINERALIZATION; SUBTROPICAL HUMID FOREST]

mass in the protected stands was higher than those recorded (fine root 422-466 g m^{-2}, coarse root 247-305 g m^{-2}) in the unprotected stands. The local annual root production was also higher in the protected stands (1,102-1,242 g m^{-2}) than the unprotected stands (890-940 g m^{-2}). The mean concentration of NH^{+}_{4}-N and NO^{-}_{3}-N was higher in the protected stands than in the unprotected stands. The inorganic-N (NH^{+}_{4}-N and NO^{-}_{3}-N) concentration was markedly high during the dry period and low during the wet period in all tha stands. Inorganic-N concentration, nitrification and N mineralization rates were significantly *(P<0.01)* higher in the surface (0-10 cm) than the subsurface (10-20 cm) layer. The low and high N mineralization rates observed during the dry and wet periods, respectively, coincided with the lean and peak periods of fine root mass. Disturbance in the forests caused a reduction in fine root mass as well as in N mineralization.

Varte, R.Th 2005. **Opportunity for natural selection: The Vaiphei of Manipur, India**. *Anthropologist*, 7(4): 299-300. Anthropologist Survey of India, North East Regional Centre, Mawblei-B, Madanrting, Shillong - 21, Meghalaya, India. [MANIPUR; NATURAL SELECTION; VAIPHEI]

An attempt has been made to deal with the opportunity for natural selection among the Vaiphei of Churachandpur, Manipur based on the differential fertility and mortality from 38 ever pregnant aged of 45+ years. Observed that, the I value is 0.344 and low contribution of mortality component in the population.

Verma, R.K.; Kapoor, S.K.; Rawat, R.S.; Subramani, S.P. and Kumar, Surinder 2005. **Analysis of plant diversity in degraded and plantation forests in Kunihar Forest Division of Himachal Pradesh**. *Indian Journal of Forestry*, 28(1): 11-16. Himalayan Forest Research Institute, Conifer Campus, Panthaghati, Shimla, Himachal Pradesh. [BIODIVERSITY; PLANT DIVERSITY; SOIL FERTILITY]

Plant species diversity of plantation forest and degraded forest in Surajpur block (Barotiwala) of Kuthar Forest Range in Kunihar Forest Division of Himachal Pradesh was studied in October, 2002. The number of herbs and grasses species under plantation forest and degraded forest was 31 m^{-2} and 25 m^{-2}, respectively. On the basis of importance value index (IVI), *Justicia simplex* and *Andropogon* sp. were observed to be the dominant herbs under plantation forest and degraded forest, respectively. In general, distribution of most of plant species was contiguous. Index of dominance was lower and index of diversity was higher for shrubs and herbs species under plantation forest than that of degraded forest. Index of diversity for herbs was 4.40 in plantation forest and 3.70 in degraded forest. The index of dissimilarity for herbs between plantation forest and degraded forest was high indicating remarkable degree of dissimilarity in herbs species. However, there was plenty of similarity between plantation forest and degraded forest as far as shrubs species under them was concerned. The soil under plantation forest has better fertility status in comparison to degraded forest.

Yadava, P.S. and Devi, Sarjubala A. 2005. **Effect of slash and burning on N-Mineralisation in the *Dipterocarpus* forest of Manipur, NE India**. *International Journal of Ecology and Environmental Sciences*, 31(1): 53-60. Department of Life Sciences, Manipur University, Imphal 795003, Manipur. [AMMONIFICATION; INORGANIC N; NITRIFICATION; ORGANIC C]

The effect of slash and burning - the traditional form of agriculture on plant available nitrogen and rate of N-mineralisation in the *Dipterocarpus* forests soil of Manipur have been studied. The rate of ammonification, nitrification and N-mineralisation varied from 0.16 to 6.90 μg g^{-1} soil, 0.65 to 3.21 μg g^{-1} soil and 0.82 to 9.54 μg g^{-1} soil in the slash and burnt site and 0.94 to 5.30 μg g^{-1} soil, 0.47 to 2.71 μg g^{-1} soil and 1.41 to 7.75 μg g^{-1} soil respectively in the protected forest site in different months throughout the year. The rate of ammonification, nitrification and N-mineralization were found to be higher in the slash and burnt site as compared to the protected forest site which may be due to the addition of organic C and total N during the operation of slash and burnt treatment. Significant positive correlation were recorded between the rate of ammonification, nitrification and N-mineralisation with soil moisture, total soil organic C and total soil N.

Forthcoming events

Indo US Workshop on Disaster Management: Issues and Challenges. 27-29 September 2006, Srinagar (Kashmir) India. Contact : Dr. Imtiyaz Ali, Professor & Head, Department of Community Medicine, Sher-I-Kashmir Institute of Medical Sciences, Soura (Kashmir), Jammu & Kashmir - 190011.

National Conference on Technology for Disaster Mitigation. 29-30 September 2006, Hamirpur (Himachal Pradesh) India. Contact : Dr. Umesh Sharma, Organizing Secretary, Department of Civil Engineering, National Institute of Technology, Hamirpur 177 005 (H..P.) (Email : umesh@recham.ernet.in)

Workshop on "Himalayan Earthquakes: A freshe appraisal" (HIMEQ-2006). 07-08 October 2006, Dehradun (Uttaranchal) India. Cotact : Convener, HIMEQ-2006, Wadia Institute of Himalayan Geology, 33 GMS Road, Dehradun 248001, Uttaranchal (Email: himeq_2006@wihg.res.in)

International Seminar of Forests, Forest Products and Services : Research development and challenges ahead. 1-3 November 2006, Srinagar (Garhwal). India. Contact : Dr. D.S. Chauhan/Dr. B.P. Chamola, Organizing Secretary, Department of Forestry, P.O. Box 59, HNB Garhwal University, Srinagar (Garhwal) 246 174, Uttaranchal (Email: forestseminar@rediffmail.com)

13th Symposium on Earthquake Engineering (13SEE-06). 18-20 December 2006, Roorkee (Uttaranchal), India. Contact : Dr. M.L. Sharma, Organizing Secretary, Department of Earthquake Engineering, Indian Institute of Technology, Roorkee 247 667 (Email : 13see@iitr.ernet.in).

National Conference on Digital Library 2006. 29-31 October 2006, Dehradun (Uttaranchal), India. Contact : Dr. A.K. Suman, Organizing Secretary, IGNFA, P.O. New Forests, Dehradun 248006.

News & Views

(Compiled from the published news clippings on Himalayan Ecology)

World Bank loan for watershed projects

THE TRIBUNE : January 20, 2006

The Himachal Pradesh government and the World Bank signed an agreement to enable the hill state to draw $60 million for watershed development projects in the mid-Himalayan region. The primary objective of the proposed project is to reverse the process of degradation of natural resource base and improve the productive potential of natural resources and the income of rural households in the project area. The Gram Panchayat Watershed Development Plans (GPWDP) have been prepared in an informed, participatory, and transparent process that they may be implemented with adequate technical backstopping and the project performance can be adequately monitored and evaluated.

Tehri dam has killed two rivers, says Bahuguna

THE HINDU : January 23, 2006

The Tehri hydel power project had spelt doom to two rivers - the Ganga and the Bhagirathi, apart from wreaking havoc on the livelihoods of river-dependant villages, alleged environmental activist Sunderlal Bahuguna. According to the leader of legendary Chipko movement, 'Despite of our protest for 15 years, the dam was allowed to come up by submerging over 22 villages along with 42 km^2 of land holdings and over 1 lakh rendered destitute. Now, there is a plan to let the dam waters go beyond Haridwar upto Delhi. As Delhi had already killed the Yamuna, it makes for three dead rivers'. The Save Himalayas movement led by him was now advocating tree planting on the hill slopes to check soil erosion, as the siltation caused by the dam was very high. This would not only enable village communities to benefit from tree produce, but also to conserve water.

Diverting Sutlej could spell disaster : environmentalists

TIMES OF INDIA : January 24, 2006

As Himachal Pradesh plans to tap its huge hydropower potential, environmentalists warn that diverting Sutlej, one of the fastest flowing rivers in the country, through tunnels could spell disaster in the event of an earthquake in the fragile Himalayan terrain. The state is planning 42 large and small projects to tap its hydropower potential of about 11,000 mw, which is more than a third of that of the entire country. If these projects were to be taken up, in about a decade's time the river could end up being diverted underground into various tunnels running over 150 km. While the government is excited about tapping the power potential and the huge revenue that will flow into the hill state's coffers, the greens disagree. They foresee disaster in the event of a major earthquake.

Move on cash valuation of forests opposed

THE ASSAM TRIBUNE : February 01, 2006

The Environment and indigenous people's groups of the North East (NE) region have questioned the locus stand of the move to determine the cash value of the forest resources. They are of the opinion that the entire process to calculate the cash value of the forests is originated and dominated by those who are accustomed to putting a price on the priceless. Some of these groups also made arguments before the expert committee constituted by the Institute of Economic Growth (IEG) in pursuance of the Supreme Court of India directive in IA No 566 in Writ Petition (Civil) 202 of 1995. This Committee is an independent body authorized to determine the net present value (NPV) of the forests in the country and is also mandated to formulate its own procedure and methods for the purpose. These groups also expressed their concerns for the women in rural

and backward area keeping in view that individualization and commercialization move. Levying NPV would simply eliminate the role of the women and would thus affect their interests. In case the NPV comes into existence, industries would continue with the deforestation spree by merely paying such values. Besides, the industries would also resort to trading in the forest items to augment their profits. But all these would have heavy adverse impacts on the civilization of the NE people, argued these NE organizations. Some of them also resented the moves made by the State Governments in the region to bring an end to the practice of *Jhum* cultivation without providing any alternative to it for the people engaged in such farming.

Himalayan yew faces extinction

DAILY EXCELSIOR : February 12, 2006

Indian Himalayan Forests have a rich availability and diversity of biological resources, especially, the medicinal and aromatic plants (MAPS). This is perhaps largely due to extreme climatic and edaphic conditions conducive to the growth, development and diversity of these plants, which constitute raw material for pharmaceutical industries. Infact higher plants have served human kind as source of medicinal agents since its creation. The Himalayan yew/common yew, technically known as *Taxus baccata* Linn. (locally known as postol) of family *Taxaceae* is a slow growing evergreen tree 12-30m height, densely branched having long outspread or ascending shoots with needles of 1-3cm. length, flat, shining above and light green below with single median view having recurved margin, crown ovate or more globose. Since the extensive and reckless collection of taxus bark and leaves for the synthesis of taxol, all along the length and breadth in Himalayas and other regions have put it into the 2000 IUCN Red list of threatened species. It is therefore imperative that the threatened, fragile and over exploited Taxus species be preserved to the greatest extent possible for the future generations.

Rs 365-cr watershed project launched

THE TRIBUNE : February 20, 2006

The Himachal Pradesh's Chief Minister has launched the Rs 365 crore mid-Himalayan watershed development project at Parohi village in Kothipura of Bilaspur district. The Himachal Government had succeeded in winning the first-ever repeater Mid-Himalayan Watershed Development Project which would bring about economic rehabilitation in the rural area, especially the 545 identified *Gram Panchayat* of 42 blocks of the state. According to the Minister, the State happened to be an agricultural state, whose 90% population inhabited in the rural area and their livelihood depends upon agriculture-related activities. He also said the endeavor of the state government had been to provide better living conditions and improved economy.

The losing paradise

THE ASSAM TRIBUNE : February 20, 2006

Manipur, the beautiful little Shangrila, is famous for the Loktak lake, the largest fresh water lake in the Northeast - a veritable miniature inland sea and the Keibul Lamjao National Park, the only floating National Park in the world, formed by run-off soil particles in the lake and getting bound by the roots of various species of aquatic plants and grasses. These floating mats locally called phumdi remain afloat due to its low specific gravity. But today, the lake is seriously threatened on account of damaging land use practices in its catchments, overexploitation of resources by a burgeoning population and its growing demand for land and food and also faulty and unsustainable economic development. Since the lake is included under Ramsar Convention as a wetland

of international importance, many conservation works are going on to protect this amazing lake, but most of them are not so effective. The lake's ecological character is deteriorating gradually due to lack of maintenance and management skills. Only a concerted effort on the part of official agencies, professionals, NGOs and the local communities themselves on this delicately balanced, biologically rich wetland ecosystem, can save the lake from its demise.

Tibetans vow not to use animal skins

Vibhor Mohan for THE TRIBUNE : March 17, 2006

Hundreds of Tibetans vowed not to use skins of endangered wildlife species and donated scores of '*Chubas*' (traditional Tibetan over coats) as part of a special campaign to save wildlife. Tibetans had been traditionally using tiger and snow leopard skin on their clothing but it was now the need of the hour to save these endangered species from extinction. There has been a sudden eruption of environmental activism ever since the Dalai Lama made a strong appeal to Tibetans. The initiative has been taken by the Tesi Environmental Awareness Movement (TEAM), an environmental NGO based at Dharamshala of Himachal Pradesh.

Development taking toll on forests

Subhas Sharma for THE TRIBUNE : March 18, 2006

The adverse environmental impact of tourism and hydroelectric projects in Kulu-Manali in the north-western Himalayas has reached an alarming situation. More than 10,000 green trees have been cut during the past two years and about 30,000 are awaiting the axe of the so-called, development in this district. The Rs 2,000-crore project of the Rohtang tunnel would require felling of 684 fully grown and 350 small trees, just to make an approach road to the south portal of the tunnel, besides 20,000 trees would be cut to complete the 2051-MW Parbati hydroelectric project in the Manikaran and Sainj valleys of the district. A study carried out by the Himachal Unit of G.B. Pant Institute of Himalayan Environment and Development, reflected that the environmental situation arising at Kulu and Manali due to increasing pressure of tourism and deforestation has registered dangerous proportions of polluted air, water and an increase in suspended particulate matter (SPM). The study further reveals that the indiscriminate throwing of municipal solid waste into rivers is a common practice in this district which results in polluting of the river water. According to Shri Kishan Lal, an eminent environmentalist, the pace of destruction of forests due to the pressure caused by tourism, hydroelectric projects, construction of hotels and other developmental activities would convert this part of the Himalayas into a "desert" if not checked.

Unscientific mining on : Meghalaya PCB

THE ASSAM TRIBUNE : March 20, 2006

Mining activities in mineral-rich Meghalaya were being done in an unscientific and unplanned manner without any measure for reclamation of mined areas, the Meghalaya State Pollution Control Board has said. The main minerals are coal and limestone found in almost its entire southern belt of the state. Mining activities are mostly in private hands and such activities were causing severe water pollution and environmental degradation in the mining areas. As per information from the Directorate of Industries, the report said, there were about 3,800 industrial units or establishments in the state. Most of these were tiny units, non-polluting in nature, with some medium and small-scale cement plants, lime calcination plants, ingot manufacturing and steel rolling mills etc. However, a few of these were polluting and one of them was cement plant under large-scale industrial sector falling in the categories of highly polluting

industries. While issuing consents, conditions were being imposed with regard to the effluent and the emission standards to which industries have to comply with. Conditions were also stipulated for setting up effluent treatment plants and/or installing of air pollution control systems whenever found necessary.

Upper Siang project likely to be relocated on Chinese concerns

THE HINDU BUSINESS LINE : March 24, 2006

The 11,000-MW `Upper Siang' hydroelectric project in Arunachal Pradesh, which would have been the country's largest power project and the world's third largest - could be shifted to an alternative site, 49 km downstream of the original site mainly due to environmental concerns raised by China. The Chinese administration has raised objections to the National Hydroelectric Power Corporation (NHPC) project since the reservoir, if executed at the original location, would have led to submergence of territory in Tibet across the Arunachal border during the construction stage. According to the Government official, the project is likely to be re-christened as `Intermediate Siang' on account of its new location and a decision on the revised project size would be taken once a fresh feasibility report is completed. Investigations have been taken up for the preparation of the feasibility report for the project at the new site, the official said, adding that the new production capacity of the project can be established only once the report is completed.

Global warming swells Tibetan lakes

D Radhakrishnan for THE SENTINEL : April 15, 2006

The pasture near the lake is flooded from time to time; in winter, it is often covered with ice according to the residents of Lhasa. In many lake areas, water springs out of formerly dry places, roads are flooded, and alkali is found no more in what used to be alkaline lakes. Many herders have also witnessed similar situations. The Remote Sensing Application Research Centre of the Tibet Autonomous Region conducted site surveys of five lakes in the prefecture and analyzed changes in the sizes of the lakes over the past two decades with remote sensing mapping. The study found rises in rainfall as well as in air and ground temperatures in lake areas but declines in water evaporation, exposure to sunlight, and thickness of snow and frozen earth which might cause the lakes to swell. The average water level in Naigri Puencog and two other inland lakes rose by 12.6 meters in the recent two decades, flooding an average 40.8 km^2 of pasture, cropland and roads. Despite the damages to the pastures and roads, many people say the local climate is milder than before as it gets warmer and rains more often.

Development projects not wildlife-friendly

THE HINDU : April 21, 2006

Environmentalists claimed that the development projects in Uttaranchal are not wildlife friendly and are especially causing harm to elephant population of the State. Raising concern about an elephantine problem as 90 elephants have been killed in the last five years, which was nearly 20% of the State's pachyderm population, according to Himalayan Chipko Foundation. After the formation of Uttaranchal state in November 2000 there had been a spurt in development activities in the State, dams, roads, bridges, transmission lines, canals were being constructed. Further, there was a proposal to build a four-lane highway from Dehradun to Tanakpur through Rajaji, Chilla and Corbett national park, posing danger to the wildlife and ecology of the area. Though development activities could not be stopped, however, such projects must have adequate planning to make them wildlife and eco-friendly, the wildlife activists believed.

Call to preserve Himalayan eco-system

THE HINDU : April 24, 2006

After reports that global warming, higher pollution levels and deforestation would lead to "death" of major Himalayan rivers, particularly the Ganga, and cause irreparable damage to the Himalayan eco-system, those closely associated with the region including mountaineers, glaciologists, climatologists and ecologists have urged the Union Government to take immediate measures for conservation of the fragile eco-system of the region. Demanding immediate revival of the Planning Commission's Himalayan Region Task Force, the experts have asked the Union Government to undertake the conservation of the Himalayas as a Central project with active involvement of all the Himalayan States. Cooperation of the countries located astride the Himalayas and those sharing common borders should also be taken for evolving a joint strategy for management of the Himalayas, they opined. Experts have also stressed the need for setting up a monitoring network along the Indian Himalayan Arc for collection of scientific data on climate change impacts, pollutant transport, cryosphere (the frozen water part of the earth system), high altitude limnology, medical and physiological sciences, high altitude fauna and vegetation, and assessment of environmental impacts for improved territorial use by setting up pyramid laboratory observatories in the Himalayan glaciers.

Autonomous wildlife authority on cards

THE TRIBUNE : April 27, 2006

The Himachal Pradesh state government is considering to setup an autonomous authority for the management of four major protected wildlife areas in the state. The State Forest Minister said the Great Himalayan Conservation Authority; the proposed organization would be responsible for the management of the Pin Valley National Park, the Rupi Bhaba Wildlife Sanctuary and the Kanawar Wildlife Sanctuary apart from managing the Great Himalayan National Park. He said the authority would have a flexible administrative procedure and governing board structure to help ensure continuity of funding across financial years and eliminate bureaucratic delays.

Tripura tribals face eviction

THE HINDU : May 20, 2006

The land dispute between the Revenue and Forest Departments of Tripura poses an eviction threat to 60,000 forest dwellers, at a time when Parliament is all set to pass the Scheduled Tribes (Recognition of Forest Right) Bill. The families lost their right on the trees and timbers produced on the lands allotted to them by the Revenue Department, with the forest administration issuing a fresh ban order. The Revenue Department had allotted the land to the displaced, mostly tribals, about two decades ago. But now the forest official alleged that the Revenue Department cannot allot any forest land without the permission of the Forest Department and the dwellers are viewed as encroachers.

Biological diversity of North East

Moon Moon Sharma for THE ASSAM TRIBUNE : May 22, 2006

An appeal was shouted to strengthen people's commitment and action for the conversation of biological diversity in the North-East on the eve of the International Day of Biological Diversity. The North East in India is a geographically distinct region and is well known for its unique bio-diversity. As an extension of the Himalayan range, the region is marked with hills, mountains, valleys, a range of elevations, platforms as well as depressions. It is one of the ten bio-geographical zones of the country. Sixty four per cent of total geographical area of the region is covered with various types of forests, especially, moist deciduous and alpine forests. Though the region embodies 7-8% of the total geographical area of the country it contributes about 26% to

total forests cover of the nation. It is one of the major orchid habitats as nearly 50% of the total available 1300 species in the country are found in this region. The region is not only rich in floral wealth and endemic species of plants, but also habitat of many faunas including one horned rhino, greater adjutant stork, Gangetic river dolphin, vulture and many other mammals. Greater adjutant stork or Bortokola or Hargila is a very important globally endangered bird that is now on the verge of extinction.

Sanctuaries at Naina Devi, Norgu may be scrapped

Rakesh Lohumi for THE TRIBUNE : May 22, 2006

The Naina Devi and the Norgu sanctuary are among the four protected wildlife areas proposed to be scrapped under the rationalization exercise carried out by the Forest Department of Himachal Pradesh. Besides, boundaries of 15 other protected areas are proposed to be redrawn by excluding inhabited and cultivated areas and including those important for wildlife conservation. Spread over an area of 278 km^2, the Norgu sanctuary in Chuhar valley of Mandi district is the biggest protected area proposed to be de-notified. Naina Devi sanctuary (123 km^2) in Bilaspur is also significant, while the Darlaghat (6.5 km^2) and Sili (2 km^2) are indeed small. The department maintains that these sanctuaries will not serve the purpose of providing a safe habitat for wildlife because of "too much human interference" or "very small area". The Norgu and Naina Devi sanctuaries are dotted with human habitations, which is not conducive to proper management of protected areas as there is much biotic interference. However, environmentalists are not in favour of tinkering with protected areas frequently as it affects wildlife.

Attack of the wild worries Uttaranchal

Swati R Sharma for THE STATESMAN : May 23, 2006

It's not the fear of criminals or natural disasters but wild animal attacks that is the biggest worry for people of this hill state. In the last five years, more than 150 people have been killed by wild animals as the forest department remained a mute spectator. People of the state, especially those living on the fringes of forests, are facing the constant threat of animal attacks. Wild animals, especially leopards, tigers, elephants and the blue bull damage crops, and houses and also attacks animals and humans. According to records of the forest department, in the last five years, ex-gratia has been given to the next of kin of 131 people killed in wild animal attacks. Besides this, 5,459 cattle have been killed by wild animals and 3,558 incidents of animals going on rampage and damage to crops have been recorded. There have also been instances of humans being killed by wild animals in reserve forest areas or in national parks, in which cases there is no provision for compensation under the Wildlife Protection Act of 1972. It is not only the people who suffer loss; many wild animals also lose their lives. In order to save their crops from the onslaught of the wild animals, villagers either poison them or electrocute them.

Hindi Section

पिंडर नदी : बहुआयामी परियोजना तैयार

दैनिक जागरण : जनवरी 16, 2006

पहाड़ की नदियां भले ही मैदान के लोगों की प्यास बुझा रही हों। लेकिन इनके अपने ही आंचल में स्थित बागेश्वर, अल्मोड़ा, पिथौरागढ़, चमोली व नैनीताल जिलों के कई इलाके आज भी बूंद–बूंद पानी को तरस रहे हैं। हालांकि यहां की समस्या से निबटने के लिए विभागीय पटल पर पिंडर नहर परियोजना प्रस्तावित है, लेकिन सेवानिवृत विशेषज्ञों की एक पांच सदस्यीय टीम ने प्रभावित इलाकों का खुद सर्वे करके पिंडर पर ही एक बहुआयामी सर्पाकार परियोजना का प्रारूप तैयार किया है। इसे मुख्यमंत्री नारायण दत्त तिवारी को सौंपा जा चुका है। स्पेशल सिक्योरिटी ब्यूरो के सेवानिवृत्त अभियंता पर्वतारोही जगदीश चंद्र ढौढियाल, सेवानिवृत्त मेजर हीरा सिंह गढ़िया, बनारस हिंदू विश्वविद्यालय के सिविल इंजीनियरिंग विभाग के सेवानिवृत्त विभागाध्यक्ष व जल संसाधन आयोग के विशेषज्ञ डा0 के0 एस0 कार्की, पंतनगर विश्वविद्यालय के पूर्व रसायन विभागाध्यक्ष डा0 एस0 जी0 एस0 खन्ना व कुमाऊं विश्वविद्यालय के पूर्व कुलपति डा0 के0 सी0 जोशी की टीम द्वारा सर्वे के आधार पर तैयार की गई इस बहुआयामी परियोजना में कहा गया है कि गढ़वाल मंडल के उत्तरी क्षेत्र में पानी की कोई कमी नहीं है, लेकिन दक्षिण में छोटे पहाड़ हैं और वे हिमाच्छादित भी नहीं है। यही कारण है कि बागेश्वर शहर को छोड़कर आसपास व अल्मोड़ा क्षेत्र में पानी का अकाल है। प्रारूप के अनुसार ग्लेशियरों से निकली पिंडर नदी से एक मुख्य नहर बागेश्वर–चमोली जिलों की सीमा ग्वालदम की ओर निकाली जाएगी। यहां से दो नहरें निकलेंगी, जिनमें से एक नहर पिंडर घाटी के दक्षिण में बसे चमोली जिले के गॉवों में जलापूर्ति करती हुई गैरसैंण क्षेत्र तक पहुंचेगी। दूसरी नहर अल्मोड़ा–चौखुटिया–गेवाड़ की रामगंगा घाटी के पूर्वी भाग में ऊपरी क्षेत्रों में बसे गांव को पानी देगी। इससे कौसानी, वरंगला, लखनाड़ी व लोद को पानी मिलेगा। पिंडर का यह जल कौसानी से लमगड़ा व बिन्सर की तरफ काटा जायेगा, जो गिरेछीना पहुंचेगा। अल्मोड़ा व लोधिया पहुंचने वाला पिंडर का यह पानी कोसी नदी के उत्तरी ढाल के ग्रामों में होता हुआ दक्षिणी ढाल पर बनी पाइप लाइन के जरिये हल्द्वानी पहुंचाया जायेगा, जिससे तेजी से विकसित हो रहे इस नगर की पेयजल समस्या दूर हो सकेगी।

विदेशों में भी महकेंगे सूबे के जैविक उत्पाद

अमर उजाला : जनवरी 19, 2006

उत्तरांचल के जैविक उत्पाद निकट भविष्य में विश्व के खाद्य बाजारों में भी महकेंगे। केंद्रीय कृषि एवं प्रसंस्कृत खाद्य उत्पाद निर्यात विकास एजेंसी (एपीडा) राज्य के जैविक उत्पादों के लिए वैश्विक बाजार का रास्ता खोलने के लिए आगे आई है। सूबे की जैविक विकास परिषद को राज्य के विशिष्ट उत्पादों तथा उनके उत्पादक क्षेत्र को चिन्हित करने को कहा गया है। जैविक कृषि क्षेत्र में उल्लेखनीय प्रदर्शन की वजह से उत्तरांचल एपीडा की प्राथमिकता सूची में शामिल है। अंतर्राष्ट्रीय स्तर पर संभावना खुलना राज्य की कृषि अर्थव्यवस्था के स्वास्थ्य के लिए 'च्यवनप्राश' माना जा रहा है। जैविक विकास परिषद की कार्यक्रम प्रबन्धक के अनुसार इससे जहां उत्तरांचल को विश्व मानचित्र पर पहचान मिलेगी, वहीं काश्तकारों को उनकी मेहनत का भरपूर मेहनताना मिलने लगेगा। राज्य की स्थानीय फसल 'मडुवा' को भी विश्व खाद्य कार्यक्रम में शामिल किया जा चुका है। देश के कृषि उत्पाद तथा प्रसंस्कृत खाद्य पदार्थों के लिए विदेशी बाजारों में जगह बनाने मे एपीडा की महत्वपूर्ण भूमिका है। वर्तमान में प्रदेश में 3000 हैक्टेयर भूमि पर प्रमाणित तथा 13,000 हैक्टेयर भूमि पर अप्रमाणित प्रजातियों की खेती हो रही है। करीब 1200 गांव अब तक जैविक ग्राम का दर्जा हासिल कर चुके हैं। एपीडा के प्रस्ताव के मुताबिक जनपदवार जैविक प्रजातियों को चिन्हित किया जा रहा है। हालांकि अभी राज्य के उत्पाद देशी बाजार में तो प्रचलित होने लगे हैं, लेकिन एपीडा की सहायता से इस कारोबार को अधिक बड़ा दायरा मिल जाएगा।

वनों को बचाने के लिए कवायद तेज

अमर उजाला : जनवरी 31, 2006

भारतीय वन अनुसंधान संस्थान ने वनों के संवर्धन के लिए ठोस प्रयास करने की पहल की है। इसके तहत देशभर के फारेस्टर, वैज्ञानिक और गैर सरकारी संस्थाएं दून में जुटेंगी और वनों की रक्षा के लिए उपाय सुझाने के साथ ही उनके संवर्धन की योजना भी तैयार करेंगी। वनों को बचाने के लिए 1918 में वन संवर्धन सम्मेलन की शुरूआत की गई थी। जहां वैज्ञानिक, वन अधिकारी और समाज सेवी संस्थाएं एक ही मंच पर पहुंचकर वन संवर्धन की योजनाएं तैयार करते थे। यह क्रम 1967 तक जारी रहा, लेकिन फिर इस पर ब्रेक लग गया। जबकि वनों के प्रतिशत में कमी का दौर जारी रहा। 38 वर्ष बाद एक बार फिर से एफआरआई ने इस दिशा में पहल की है। संस्थान के निदेशक के अनुसार संस्थान के शताब्दी वर्ष में दून में एक से तीन फरवरी तक 12वें वन संवर्धन सम्मेलन का आयोजन किया जाएगा। सम्मेलन में सेल्वीकल्चर के जरिए वन उत्पादकता बढ़ाने के उपायों, संयुक्त वन प्रबंध– पीएफएम में वन संवर्धन एवं प्रबंध विषय पर चर्चा होगी। साथ ही वन अग्नि, ईधन काष्ठ, चारा, चराई, औषधीय पादपों एवं अन्य अकाष्ठ वन उपज, एलकेटीएस, जैव ईधन के लिए वनों का प्रबंध और रोपण प्रौद्योगिकी पर विचार विमर्श होगा।

ग्लेशियरों के खिसकने से प्रभावित हुई शीतकालीन वर्षा

दैनिक जागरण : फरवरी 21, 2006

इस वर्ष शीतकालीन वर्षा व हिमपात नहीं होने से पूरे पर्यावरण व जन जीवन में विपरीत प्रभाव पड़ने की आशंका है। शीतकालीन वर्षा नहीं होने के पीछे वैज्ञानिक ग्लेशियरों का पीछे खिसकना प्रमुख कारण मान रहे हैं। वैज्ञानिक शोधों से पता चलता है कि उत्तरांचल, हिमाचल व कश्मीर में शीतकालीन वर्षा मानसून के ग्लेशियरों में टकराने के बाद होती है। इस वर्ष उत्तरांचल में इसका सर्वाधिक प्रभाव पड़ा है। शोधों के मुताबिक लद्दाख स्थित झीलों में जल स्तर लगातार घट रहा है जो भविष्य के लिए चिंता जनक है। प्रसिद्व भू–वैज्ञानिक प्रोफेसर कोटलिया ने ग्लेशियरों में किये गये शोधों के बाद बताया कि हिमालयी ग्लेशियर विगत 7 हजार वर्षों से निरन्तर पीछे खिसक रहे हैं। लद्दाख सहित उत्तरांचल में शीतकालीन मानसून ग्लेशियरों में नहीं टकराने से वर्षा व हिमपात में अत्यधिक कमी आई है और इन दोनों क्षेत्रों में जल संकट गहराता जायेगा तथा इससे तापमान में वृद्वि होगी और गर्मियों में ग्लेशियर अधिक मात्रा में पिघलेंगे। ग्लेशियर अपने स्थान से 200 मीटर पीछे खिसक चुके हैं इसका प्रभाव जहां वर्षा में पड़ा है वहीं लद्दाख के 75 किमी व्यास की सोकर व 60 किमी व्यास की सोमुरारी झीलों पर पड़ा है। यह झील ग्लेशियरों पर निर्भर हैं। दोनों झीलों में 100 मीटर जल का स्तर घटा है। उत्तरांचल व लद्दाख में जनवरी से अब तक मात्र 1 मिमी वर्षा हुई है जबकि बीते वर्षों में 4 से 5 मिमी शीतकालीन वर्षा हुई। ग्लेशियरों का प्रभाव सर्वाधिक लद्दाख व उत्तरांचल में पड़ने जा रहा है। लद्दाख की यह जीवनदायिनी झील 50 से 100 वर्षों के बीच सूख जायेंगी जबकि उत्तरांचल में पानी का संकट काफी बढ़ जायेगा।

पहाड़ के जंगलों में उगाया जाएगा मणिपुरी बांज

अमर उजाला : अप्रैल 28, 2006

उत्तरांचल के पहाड़ों में तेजी से सूख रहे पानी के स्त्रोतों की चिंता अब राज्य सरकार को भी सताने लगी है। यही कारण है कि वन महकमे ने इस साल पौधरोपण कार्यक्रम में चौड़ी पत्ती वाले मणिपुरी बांज के पौध रोपने की तैयारी की है। राज्य के नौ पहाड़ी जिलों में 17 लाख पौधे रोपने का लक्ष्य रखा गया है। रूद्रप्रयाग की एक संस्था वन विभाग को मणिपुरी बांज के पौधे उपलब्ध कराएगी। इस साल सूखे के चलते कई जगह पानी के स्त्रोत सूखने लगे हैं। राज्य सरकार ने स्त्रोतों को बचाए रखने के लिए ठोस रणनीति तय करने के लिए वन विभाग को जिम्मेदारी सौंपी है। विभाग ने कई पर्वतीय राज्यों में पानी के स्त्रोत बचाए रखने में सहयोगी पेड़–पौधों का अध्ययन किया। जंगलात के सूत्रों ने बताया कि पानी के स्त्रोतों को बचाए रखने के लिए मणिपुरी बांज की प्रजाति सबसे महत्वपूर्ण है। इसके साथ ही स्थानीय बांज, कचनार, भीमल के पौधे भी लाभदायक हो सकते हैं। वन विभाग ने अब मणिपुरी बांज की नर्सरी तैयार कर रही

रूद्रप्रयाग की संस्था एप्रोप्रिएट टैक्नोलांजी इंडिया से संपर्क साधा है। यह संस्था पहले चरण में 16 लाख 84 हजार पौधे उपलब्ध कराने के लिए तैयार हो गई है। वन विभाग अब बरसात में मणिपुरी बांज रोपने संबंधी कार्ययोजना बनाने लगा है। इसके लिए पानी के स्त्रोत वाले स्थलों का चयन हो रहा है।

जैव विविधता संरक्षण के साथ रोजगार भी

अमर उजाला : मई 2, 2006

जैव विविधता के संरक्षण के साथ ही स्थानीय लोगों को रोजगार से जोड़ने की कवायद शुरू कर दी गई है। अस्कोट मस्क डीयर वाइल्ड लाइफ सेंक्च्युरी के लैंडस्केप से इसकी शुरूआत की गई है। वर्ल्ड बैंक ने योजना पर सहमति जताते हुए इसे बायोडाइवर्सिटी कंजरवेशन थ्रू रूरल लाइवलिहुड इम्प्रूवमेंट प्रोग्राम के अंतर्गत लाने को कहा है। साथ ही इसके क्रियान्वयन के लिए चार करोड़ रूपये भी उपलब्ध कराए हैं। स्थानीय लोगों के पास रोजगार के विकल्प नहीं होने की वजह से जंगलों पर निर्भरता बढ़ती जा रही है। इस कारण जैव विविधता को खतरा पैदा हो गया है। ऐसा नहीं है कि इससे उत्तरांचल को ही जूझना पड़ रहा हो, बल्कि कई अन्य देशों में यह समस्या सिर उठा रही है। योजना की खासियत यह है कि इसके लिए प्रोजेक्ट नहीं बनाया गया है। बल्कि स्थानीय लोगों के सुझाव के आधार पर सामुदायिक विकास और रोजगार का खाका तैयार किया जाएगा। वनों के साथ ही वन्यजीवों और वनस्पतियों की रक्षा में गांववासियों की भूमिका तय की जाएगी। इससे वन्यजीवों की मौत पर भी लगाम लगने की संभावना है।

उत्तरांचल सहित 26 राज्यों में सिकुड़े जंगल

दैनिक जागरण : मई 2, 2006

देश में घटते घने जंगलों के कारण बढ़ते पर्यावरण असंतुलन ने पर्यावरण विदों की चिंता बढ़ा दी है। वन बहुल प्रदेश उत्तरांचल सहित 26 राज्यों के घने जंगल सिकुड़ रहे हैं। भारतीय वन सर्वेक्षण के आंकड़ों पर आधारित केंन्द्रीय पर्यावरण एवं वन मंत्रालय की वार्षिक रिपोर्ट (2005–2006) में बताया गया है कि देश में घने वन 290564 वर्ग किलोमीटर में हैं। जबकि भारतीय वन सर्वेक्षण की रिपोर्ट (2001) के मुताबिक वर्ष 2001 तक 416809 वर्ग किलोमीटर में घना जंगल था। इस प्रकार 26245 वर्ग किमी घना जंगल घटा है। राष्ट्रीय वन नीति में पर्यावरण संतुलन के लिए अनिवार्य तौर पर एक–तिहाई (33 फीसदी) भू–भाग पर वृक्षावरण होना स्वीकार किया है। जबकि देश के 20.64 फीसदी भू–भाग पर (678333 वर्ग किलोमीटर) ही जंगल है, जिसमें 287769 वर्ग किलोमीटर (8.76 फीसदी) पर खुला जंगल है। घने वन में 40 फीसदी से अधिक व खुले वन में 10 फीसदी से अधिक वृक्षावरण होने का मानक है। राष्ट्रीय वन नीति के अनुसार, देश के पर्वतीय जिलों में दो–तिहाई (66 फीसदी) वन भूमि होना अनिवार्य है, जबकि यहां पर 38.34 फीसदी पर ही वन है उत्तरांचल के सभी 13 जिलों सहित देश के कुल 123 पर्वतीय जिलों में भी घना वन घटा है। वर्ष 2001 की रिपोर्ट में पर्वतीय जिलों में 175771 वर्ग किलोमीटर में जंगल था, जो सिकुड़ कर 167969 वर्ग किलोमीटर हो गया है। भारतीय वन सर्वेक्षण के अनुसार दिल्ली, चंडीगढ़, छत्तीसगढ़, मणिपुर, मेघालय, नागालैंड, उड़ीसा, त्रिपुरा तथा दमन एवं दीव को छोड़कर अन्य 26 राज्यों में घना जंगल घटा है।

कैपिटल एक्शन प्लान की तैयारी

अमर उजाला : मई 11, 2006

वातावरण में सामान्य तौर पर धूल कण की मात्रा करीब 100 माइक्रोग्राम प्रति क्यूबिक मीटर होनी चाहिए, जबकि प्रदूषण नियंत्रण विभाग के आंकड़ों के अनुसार राजधानी की फिजां में यह 383 माइक्रोग्राम प्रति क्यूबिक मीटर है। सरकार ने कड़े कदम उठाते हुए कैपिटल एक्शन प्लान तैयार किया है। खासतौर पर राजधानी दून में बढ़ते पर्यावरण प्रदूषण पर लगाम कसने की कोशिश की जा रही है। राज्य बनने के समय कुल वाहनों में दुपहिया गाड़ियों की संख्या करीब 32 प्रतिशत थी, जो अब बढ़कर 68 फीसदी हो गई है। यानि, पांच वर्षों में दुपहिया गाड़ियों की कुल संख्या में 47 फीसदी की बढ़ोत्तरी हुई है। यही नहीं, तिपहिया वाहनों में यह बढ़ोत्तरी 55 प्रतिशत, जबकि लाइट मोटर

व्हीकल्स में वृद्वि 23 प्रतिशत हुई है। इससे चिंतित प्रदूषण नियंत्रण विभाग ने अब स्टेट एक्शन प्लान की तैयारी शुरू कर दी है। फिलहाल विभाग की ओर से राज्य बनने के बाद से अब तक के आंकड़ों का पुलिंदा तैयार किया जा रहा है, जिसकी समीक्षा के आधार पर योजना को अंतिम रूप दिया जाएगा। राजधानी दून के लिए विशेष तौर पर किए जाने वाले प्रावधान प्रदूषण के लेवल को नीचे लाने में सहायक होंगे। इसके तहत विभिन्न स्थानों पर प्रदूषण की माप की जाएगी और जिम्मेदार तत्व पर नियंत्रण किया जाएगा। इसके लिए पूरे प्रदेश में एक साथ कड़े मानक लागू किए जाएंगे।

अल्मोड़ा में दूर होगी पानी की कमी

दैनिक जागरण : जून 13, 2006

कोसी नदी पर सालों से लंबित बरसीमी बांध परियोजना के धरातल पर उतरने के दिन नजदीक आने लगे हैं। सिंचाई विभाग की रिपोर्ट के आधार पर केन्द्र सरकार ने भू–वैज्ञानिकों से सर्वे कराया है। इसकी रिपोर्ट में भू–सर्वेक्षण व टोपोग्रॉफिकल सर्वेक्षण कराने की जरूरत बतायी गयी है। सिंचाई विभाग ने इसके लिए शासन से 98 लाख रूपये की मांग की है। बांध के बनने से अल्मोड़ा में जहां पानी की किल्लत खत्म होगी, वहीं उत्पादन का भी लाभ मिलेगा। जल निगम द्वारा भी एक सर्वे कराया गया है जिसमें जलनिगम ने बताया कि 90 साल की आयु के हिसाब से बांध के लिए 36 एमएलडी पानी की आवश्यकता पड़ेगी। इसको संचय करने के लिए 40 से 60 मीटर ऊंचा बांध बनना जरूरी है। सिंचाई खंड के अधिकारियों ने बताया कि विभाग ने इंजीनियरों से विद्युत उत्पादन के लिए भी प्रारम्भिक सर्वे करा लिया है, जिसके अनुसार प्रस्तावित बांध से चार मेगावाट विद्युत का उत्पादन हो सकता है। इससे अल्मोड़ा के साथ–साथ नैनीताल को भी बिजली की आपूर्ति की जा सकती है।

पर्वतीय कृषि प्रबन्धन में धान की पारम्परिक प्रजातियों (लैण्डरेसेज) का योगदान

रजनीश कुमार अग्निहोत्री
गोविन्द बल्लभ पंत हिमालय पर्यावरण एवं विकास संस्थान
कोसी–कटारमल, अल्मोड़ा – 263643, उत्तरांचल

पारम्परिक प्रजातियों की विविधता खाद्य संरक्षण और सतत् कृषि के विकास में एक महत्वपूर्ण भूमिका निभाती है। जैसा कि देखने में आया है कि एकल खेती में फसलों के फेल होने का खतरा रहता है। विभिन्न पारम्परिक प्रजातियॉ फसलों के फेल होने के इस खतरे को कम करती हैं। एक निश्चित सीमा क्षेत्र में इनका पकने का समय फसल–चक्र को भी प्रभावित करता है। विभिन्न प्रजातियां सूक्ष्म जलवायु और मृदा क्षमता के हिसाब से लम्बे समय से विकसित होती आ रही हैं।

धान की पारम्परिक प्रजातियां सिंचित एवं असिंचित दो भागों में विभाजित हैं। सिंचित क्षेत्रों के गर्म क्षेत्रों में (घाटी में) कन्टोलिया नामक प्रजाति तथा ठंडी जगहों (ऊंचाई में) पर थापाचीनी की खेती की जाती है। इन दोनों प्रजातियों में भी कन्टोलिया की खेती लोग अधिक करते है क्योकि इनकी जड़ें ज्यादा मजबूत होती हैं तथा इनमें मिट्टी पकड़ने की क्षमता अधिक होती है जो कि तेज हवाओं (ऑधियों) के समय पौधों को मजबूती प्रदान करती है। असिंचित क्षेत्र (Rainfed Cropfield) धान की विभिन्न प्रजातियों के गढ़ माने जाते हैं। कुमाऊॅ हिमालय के विभिन्न क्षेत्रो (तराई, भावर, शिवालिक एवं निम्न हिमालय) में किसानों द्वारा खेती में प्रयुक्त धान की विभिन्न प्रकार की प्रजातियों के एक विस्तृत अन्वेषण में सिंचित क्षेत्रों की अपेक्षा असिंचित क्षेत्रों में, 80 से 90 प्रतिशत तक अधिक पारम्परिक प्रजातियां पायी गयीं (सारिणी–1)। इससे यह स्पष्ट है कि हिमालयी किसान अब भी फसलों की विविधता को संरक्षित किये हुए हैं जो कि कृषि प्रबन्धन में बहुत बड़ा योगदान करती हैं।

किसी प्रजाति की उपयोगिता किसी भी प्रकार की हो सकती है। उदाहरणार्थ यदि एक किसान पाता है कि उसके खेत में झरूआ पौधे (अगले वर्ष अपने आप पहले से गिरे हुए बीजों से उगने वाले पौधे) आ गये हैं तो वह अगले वर्ष ऐसी धान की प्रजाति को लगाता है जो कि बाह्यरूप (तने के रंग की भिन्नता) से झरूआ पौधों से अलग हो। जैसे कि जिस खेत में झरूआ उगे हों उसमे काले रंग की कॉव–कॉव नामक पारम्परिक प्रजाति लगाई जाती है, जिससे निराई करते समय झरूआ पौधों को आसानी से अलग किया जा सकता है। इस प्रकार यह फसल एवं खरपतवार प्रबंधन में बहुॅत ही प्रभावशाली हैं। इसी प्रकार अन्य पुरानी प्रजातियों के भी विभिन्न लाभ हैं। जैसे कि डानबासमती प्रजाति में झूॅस (दाने के ऊपर बालनुमा संरचना) होने के कारण इसे जानवर विशेषकर बंदर नहीं खाते। अतः इस प्रजाति को लोग गॉव के आस पास के खेतों में बंदर आदि जानवरों से बचाने के लिए लगाते हैं। देहरादूनी बासमती की मीठी खुशबू होने के कारण लोग इसे विशेष आयोजनों पर पकाते हैं। इसी प्रकार स्याऊ धान प्रजाति केवल खाने के लिए ही नहीं उगायी जाती अपितु इसका धार्मिक एवं औषधीय महत्व भी है। इसके पके हुए चावलों का उपयोग महिलाओं के मासिक चक्र को नियंत्रित करने तथा बच्चों की पेचिस के उपचार में किया जाता है।

श्रम प्रबंधन में भी इन पारम्परिक प्रजातियों की महती भूमिका होती है क्योकि ये प्रजातियां फसल जीवन–चक्र के हिसाब से अलग–अलग समय पर पक कर तैयार होती हैं। कुछ पहले तैयार हो जाती हैं तथा कुछ बाद में। हिमालयी क्षेत्रों सें नौकरी की तलाश में पुरूषों के शहरी क्षेत्रों की ओर पलायन के कारण, ग्रामीण अंचलों में परिवार के सदस्यों की संख्या कम ही रहती है। ग्रामीण क्षेत्रों में आर्थिक स्थिति भी बहुत अच्छी न होने के कारण बहुत से परिवार बाहरी श्रमिक भी कृषि कार्यों में नहीं लगा सकते हैं। इस समस्या के समाधान के लिए ऐसे स्थानों पर पारम्परिक प्रजातियों की मिश्रित खेती की जाती है जिससें भिन्न–भिन्न प्रजातियों के पकने का समय भिन्न–भिन्न होता है और कृषि कार्य उपलब्ध मानव बल द्वारा ही सम्पन्न कर लिया जाता है। इन्ही प्रजातियों में एक प्रजाति तिलॉसी है जो कि पकने में अन्य प्रजातियों से 10–12 दिन कम लेती है। अतः किसान पहले इसको काटता है उसके बाद अन्य प्रजातियों को काटने के लिए उसको पर्याप्त समय मिल जाता है।

इसी प्रकार धान की एक पारम्परिक प्रजाति खुड़िनानधानी है जो कि बासमती चावल की तरह ही स्वादिष्ट एवं खुशबूदार होती है। पहाड़ के सुदूर गॉवों में शादी–ब्याह के अवसर पर इसके चावल को पुलाव के

रूप में पकाते हैं। सैलाणी प्रजाति बहुत ही पतली एवं चमकदार होती है। जिन किसानों को व्यापार (बेचने) के लिए धान बोना होता है वे सभावती को प्राथमिकता देते हैं क्योकि इसके दाने लम्बे एवं मोटे होते हैं। इसी प्रकार सस्यी उत्पादन (Agronomic yield) के लिए सौरजु बावन एवं ताईचीन प्रजातियों की खेती की जाती है। वैसे तो ये बौनी प्रजातियां होती हैं और अन्य पारम्परिक प्रजातियों की तुलना में इनसे चारा (Fodder) कम मात्रा में प्राप्त होता है परंतु इनसे उत्पादन अधिक मिलता है। इन पारम्परिक प्रजातियों का उपयोग उपरोक्त प्रबंधन के अतिरिक्त सूखा, बाढ़, तथा कीट–पतंगों के कारण जबं पूरी की पूरी फसल नष्ट हो जाती है उस समय एक अतिरिक्त भण्डार (Buffer) के रूप में किया जाता है। (कोठारी, 1997)

सारिणी –1. कुमाऊ हिमालय के विभिन्न क्षेत्रों में उत्पादित धान की पारम्परिक प्रजातियां

क्र0स0	स्थानीय नाम	स्थान (ग्राम)	ऊंचाई (m amsl)	भौगोलिक अवस्थान	
				देशान्तर	अक्षान्तर
1.	अंजनी	पारकोटी	1400–1500	79°35'21"E	29°58'18"N
2.	बऊरान	छतियानी	1400–1600	79°35'24"E	29°59'04"N
3.	बऊरीया	पिंग्लू	1160–1300	79°33'41"E	29°57'10"N
4.	बिन्दुधान	छतियानी	1400–1600	79°32'24"E	29°59'04"N
5.	छटुली	छतियानी	1400–1600	79°32'24"E	29°59'04"N
6.	छोटिया	छतियानी	1400–1600	79°32'24"E	29°59'04"N
7.	दलबदल	हैगाड़	1160–2338	79°33'08"E	29°58'04"N
8.	डानबासमती	पिंग्लू	1160–1300	79°33'41"E	29°57'10"N
9.	देहरादूनी बासमती	छतियानी	1400–1600	79°32'24"E	29°59'04"N
10.	दुधीकपकोटी	धारमल्ला	1500–1650	79°35'45"E	29°58'56"N
11.	डुटियाव	छतियानी	1400–1650	79°32'24"E	29°59'04"N
12.	झूंगिया	हाविल	1600–1700	79°33'58"E	29°59'18"N
13.	कालादूर	ब्रहमसेरा	1500–1650	79°35'04"E	29°55'02"N
14.	कन्टोलिया*	हैगाड़	1160–2368	79°33'08"E	29°58'04"N
15.	कॉवकॉव	लस्करखेत	1300–1700	79°35'55"E	29°57'56"N
16.	खुड़िनानधानी	छतियानी	1400–1600	79°32'24"E	29°59'04"N
17.	कुरणीधान	कुलवान	2150–2200	79°33'07"E	29°59'18"N
18.	लालधान	पारकोटी	1400–1500	79°35'21"E	29°58'18"N
19.	नानधानी	रतिसेरा	1600–1750	79°35'33"E	29°55'26"N
20.	नौली	छतियानी	1400–1600	79°32'24"E	29°59'04"N
21.	पतोली	लस्करखेत	1300–1700	79°35'55"E	29°57'56"N
22.	सभावती	छतियानी	1400–1600	79°32'24"E	29°59'04"N
23.	सैलाणी	लस्करखेत	1300–1700	79°35'55"E	29°57'56"N
24.	सन्तोली	पिंग्लू	1160–1300	79°33'41"E	29°57'10"N
25.	सौंजी	पारकोटी	1400–1500	79°35'21"E	29°58'18"N
26	सौरजु बावन	सिरकोट	1600–1675	79°34'45"E	29°58'04"N
27.	स्याऊधान	ज्वानास्टेट	1300–2100	79°32'36"E	29°58'59"N
28.	ताईचीन	रिमोली	1500–1600	79°33'59"E	29°58'10"N
29.	थापचीनी*	हैगाड़	1160–2368	79°33'08"E	29°58'04"N
30.	तिलांसी	कुलवान	2150–2200	79°33'07"E	29°59'18"N

(श्रोतः अग्निहोत्री et.al., 2003) *Irrigated – सिंचित

विविध फसलों की खेती (Multiple cropping) पर छपे साहित्यों ने विकासशील संसार में एक भविष्य के रूप में दस्तक दी है। यह बातें खासकर वैज्ञानिकों, उच्च प्रशासकों के लिए महत्वपूर्ण हैं जो कि विभिन्न शोध तथा प्रसार संस्थाओं में व्यक्तिगत एवं संसाधनों का आवंटन करते हैं जो कि किसानों तक पहुँचता है (बीटस,1982)। अब हमें इन प्रजातियों की जैविक वास्तविकता की खोज करनी है जिससे कि ये राष्ट्रीय एवं अंतर्राष्ट्रीय मुद्दे (Agenda) पर प्रभाव डाल सकें। कृषकों की आवश्यकता तथा बाजार की क्षमता को ध्यान में रखकर क्षेत्रीय तथा जिला स्तरीय विकासशील योजनाओं को बनाने के लिए प्रेरित करना चाहिए।

संदर्भः

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नर्सरी मालिकों द्वारा आयुर्वेद का प्रचार – एक सामाजिक दायित्व

युद्धवीर कुमार भून

''वृक्ष एवं पर्यावरण मित्र'' 35 ए/2, मियांवाली कालोनी, गुड़गांव – 122001

हम भारतीय आयुर्वेद को ''जीवन का विज्ञान'' के रूप में जानते हैं और आज आयुर्वेद सारे विश्व में सबसे पुरातन, वैज्ञानिक एवं पूर्ण स्वास्थ्य प्रदान करने वाली पद्धति के रूप में माना जा रहा है। यह हमारा विज्ञान उतना ही पुराना है जितना इस पृथ्वी पर मानव का इतिहास। आज आयुर्वेद का वैश्वीकरण हो रहा है। आयुर्वेद पद्धति पौधों पर आधारित है और आज विश्व के विकसित देशों के लोग भी अपने स्वास्थ्य की देखरेख जड़ी–बूटियों द्वारा ही करना चाहते हैं। WHO द्वारा संचालित ''सबको स्वास्थ्य – 2000 तक'' कार्यक्रम के असफल होने का मूल कारण है आधुनिक स्वास्थ्य पद्धति ऐलोपैथी। क्योंकि आधुनिक स्वास्थ्य पद्धति सभी को स्वास्थ्य प्रदान नहीं कर सकती, विशेषतः विश्व के गरीब देशों में। यह आधुनिक स्वास्थ्य पद्धति बहुत महंगी है और केवल समाज के उच्च वर्ग के लोगों के लिए है। आज जो दवा किसी बीमारी के लिए सुझाई जाती है, बाजार में उतारे जाने के कुछ वर्षो पश्चात् ही उसको यह कह कर वापस ले लिया जाता है की इसके स्वास्थ्य पर दुष्प्रभाव है। इस आधुनिक प्रद्धति में एक रोग ठीक होता है तो दूसरा रोग शरीर में इनके Side effect के कारण पैदा हो जाता है। हर तीसरा अमेरिकी इन आधुनिक दवाईयों के प्रयोग से परेशान है। क्योटा विश्वविद्यालय में 2000 में आयोजित एक महासम्मेलन में यही निष्कर्ष निकला कि यदि विश्व में सभी को स्वास्थ्य प्रदान करना है तो वह केवल पारम्पारिक पद्धति द्वारा ही प्रदान किया जा सकता हैं। विश्व की 85 प्रतिशत जनसंख्या अपने स्वास्थ्य की देखरेख इन्हीं Traditional System of Medicine के द्वारा ही करती है।

चीन ने अपने देश में अपनी ही पुरातन पद्धति Chinese System of Medicine (जो कि पूर्णतः जड़ी–बूटी आधारित है और उतनी ही पुरानी है जितना कि हमारा आयुर्वेद) को लोकप्रिय बनाया और अब सारे विश्व में इसकी मांग बढ़ रही है। चीन में प्रत्येक वह डाक्टर जो पंचवर्षीय पाठ्यक्रम MBBS का अध्ययन करता है उसको एक वर्ष Chinese System of Medicine भी पढ़ना पड़ता है और डाक्टर बनने पर ग्रामीण क्षेत्रों में नौकरी के दौरान बीमारी का इलाज करते समय 60 प्रतिशत दवाईयां Chinese System की लिखनी होती हैं और यदि शहरी क्षेत्रों में हो तो 40 प्रतिशत दवाईयॉ Chinese System की लिखनी होती हैं। यही नहीं वो सभी सैलानी जो चीन की प्रसिद्ध दीवार देखने आते हैं उनको Chinese System of Medicine की उपलब्धियों के बारे में भी पूरी जानकारी देते हैं। इसी कारण आज विश्व के सभी देशों में यह पद्धति फैल रही है। यही नहीं

भारत सरकार CSIR की अनेक प्रयोगशालाओं ;जिसमें विज्ञान एवं प्रौद्योगिकि के सभी विषय होते हैं में जितनी धन राशि लगाती है चीन सरकार उतनी ही धन राशि केवल Chinese System of Medicine के अनुसंधान एवं विकास पर खर्च करती है। इसी कारण आज चीन हमसे 20 वर्ष आगे है। परन्तु हमारा आयुर्वेद भी उतना ही महत्वपूर्ण है। अंतर मात्र इतना है कि हमने इसको अपने तक ही सीमित रखा। विश्व में इसको नहीं पहुंचाया। इसमें उस स्तर का अनुसंधान एवं विकास कार्य नहीं किया जितना कि अन्तर्राष्ट्रीय स्तर पर होना चाहिए था। चीनियों ने अपनी पद्धति को पूर्ण वैज्ञानिक ढंग से विकसित किया है। पिछले कुछ वर्षो से भारत सरकार भी आयुर्वेद संबंधी अनुसंधान एवं विकास कार्यों की ओर काफी प्रयत्नशील हो रही है, क्योंकि विश्व की मंडियों में हमें भी अपना स्थान बनाना है।

चाइनीज दवा जिनसंग एक जड़ी–बूटी है तथा गहन अनुसंधान के पश्चात् ही आज सारे विश्व में उसकी अत्यधिक मांग है। परन्तु हमारी अपनी जड़ी–बूटी अश्वगंधा जो कि दवाई के रूप में जिनसंग के मुकाबले कहीं अधिक प्रभावशाली एवं सस्ती और उगाने में भी आसान है, उसको हम विश्व तक नहीं ले जा सके क्योंकि उस पर उतना उच्च स्तरीय वैज्ञानिक अनुसंधान नहीं हो पाया जितना कि जिनसंग पर हुआ। सन् 2002 में विश्व की मंडियों में जड़ी–बूटियों का सालाना व्यापार रू0 66000 करोड़ का आंका गया। जो कि प्रति वर्ष 10–15 प्रतिशत की दर से बढ़ रहा हैं। चीन वालों ने पहले से ही इसके बड़े हिस्से पर अच्छे ढंग से अपनी पकड़ बनाई हुई है। भारतीयों की इस व्यापार में भागीदारी मात्र एक प्रतिशत है। इतने बड़े जड़ी–बूटी बाजार पर पकड़ बनाने के लिए भारत सरकार ने 2002 में National Medicinal Plants Board (NMPB) की स्थापना की और अब लगभग सभी प्रान्तों में State Medicinal Plants Boards काम कर रहे हैं। अक्टूबर 2004 तक NMPB द्वारा 11,000 हेक्टेयर भूमि पर 30% subsidy द्वारा औषधीय पौधों की Contractractual farming कराई जा रही है। इसमें 32 मुख्य पौधे हैं जिनकी अत्यधिक मांग है। इतना ही क्षेत्र *In-situ* conservation के तहत कृषि विश्वविद्यालयों, वन विभागों, NGOs, धार्मिक संस्थानों में Herbal Gardens के रूप में है ताकि लोगों में इन औषधीय पौधों की खेती करने के प्रति जागरूकता पैदा की जा सकें। परन्तु अभी यह आंकना बाकी है कि सन् 2002 से शुरू यह NMPB की आकांक्षा भरी परियोजना जिसमें कई हजार करोड़ रू0 (सार्वजनिक सम्पति) के रूप में खर्च हुए हैं, उसके कितने अच्छे परिणाम आते हैं। अच्छा होगा यदि State Medicinal Plants Board के सदस्य सचिव इस लेख को पढ़ने के बाद एक लेख लिखें कि उनके क्षेत्रों में कितने किसानों ने वास्तविकता में इस 30% subsidy का पूर्ण निष्ठा के साथ उपयोग किया, क्योंकि CEO, NMPB ने अभी तक हमारे पत्र का कोई जवाब नहीं दिया है।

जब विश्व की मंडियों में इन सभी औषधीय पौधों की मांग बढ़ रही है। किंतु हमें पहले अपने ही देश में आंतरिक मंडी की मांग की भरपाई करनी होगी। इसकी अपने ही देश में आंतरिक मांग बढ़ानी होगी। 80–90 प्रतिशत स्वदेशी और विदेशी मंडियों की मांग की भरपाई केवल जंगलों में प्राकृतिक रूप से उगने वाली जड़ी–बूटियों से होती है। हालांकि उनके दोहन पर रोक है। परन्तु वह तो कागजों पर है। अरावली के पहाड़ों से ना जाने कितने ट्रक भर कर अडूसा, पसर, कटेहरी का दोहन हो रहा है? परन्तु क्या कोई ठेकेदार इन औषधीय पौधों के बीज इन जंगलों में विखेरने पर कुछ खर्चा करता है। हम अपने स्वार्थ के लिए प्रकृति का दोहन कर रहे हैं। खारी बावली दिल्ली में बैठे बड़े–बड़े लक्ष्मी उपासक व्यापारी इन्हीं जंगलों से उखाड़ी गई जड़ी–बूटियों द्वारा लखपति/करोड़पति बन गए। कितनों ने जंगलों में जाकर पौधे/वृक्षारोपण किया है? कितनों ने सर्पगंधा के बीज/अश्वगंधा के बीज बिखेरने पर लाभ का कुछ अंश खर्च किया है? हम सभी को जागरूक होना होगा। जंगलों का प्रहरी बनकर अपनी प्राकृतिक सम्पदा का रक्षक बनना होगा। जल्दी ही यह नियम आने वाला है कि जो भी कोई कुछ भी जड़ी–बूटी बेचने बाजार में आएगा तो उसको यह प्रमाण पत्र देना होगा कि उसने यह जड़ी–बूटी जंगल से नहीं उखाड़ी अपितु फलां फलां खेत पर उगाकर लाई गई है। एक और लाभ जो इन उगाए गए औषधीय पौधों का है कि जब इन्हें जंगल से लाते हैं तो अलग अलग स्थानों से इकट्ठा करने के कारण इनमें Active Ingredient की मात्रा अलग अलग होती है। अन्तर्राष्ट्रीय बाजार में उन्नत प्रकार के माल की ही मांग है।

आयुर्वेद को लोगों तक ले जाने में नर्सरी वालों को एक सामाजिक दायित्व निभाना होगा। नर्सरी मालिक कुछ औषधीय पौधे जैसे अश्वगंधा, शतावरी, सफेद मूसली, तुलसी, मरवाह, दमाबेल, कालमेद्य, मुलहठी, अदरक, हल्दी, पत्थरचटा, पत्थरचूर, सर्पगंधा, निम्बूघास, सदाहरी, स्टीविया, पसरकटेहरी, आदि के पौधे पोलीथीन

बैग में तैयार करके उचित मूल्य पर उपलब्ध कराएं। ऐसा नहीं कि टी.वी. के माध्यम से आयुर्वेद का प्रचार करने वाले स्वामी रामदेव जी ने जब अश्वगंधा के पत्तों के रस का उपयोग मोटापा कम करने में बताया तो, दिल्ली की नर्सरी वालो ने अश्वगंधा के पौधों की कीमत 25 रू0 तक कर दी।

अभी तक नर्सरी वाले केवल सजावटी पौधों का ही व्यापार करते आए हैं। औषधीय पौधों की उपलब्धता पर उनका कभी ध्यान नहीं गया। बदलती स्थितियों में जब इन पौधों को घर–घर पहुंचाना है तो नर्सरी वालों की इसमें एक महत्वपूर्ण भूमिका और सामाजिक दायित्व हो सकता है। साथ में आर्थिक लाभ तो जुड़ा ही है।

इन पौधों को घर के पिछवाड़े सहवाटिका में लगाकर Primary Health Care का अंग बनाया जा सकता है ताकि बीमारी आने ही ना पाये। यदि जनमानस इन जड़ी–बूटियों का सेवन जारी रखे तो आजकल स्वास्थ्य ठीक रखने के लिए किये जाने वाले खर्च से बचा जा सकता है। कालमेद्य खून साफ करने की अति उत्तम दवा है। यदि चार पत्ते मौसम बदलते समय खाएं तो बच्चों व बड़ों में होने वाला ज्वर, फ्लू और वायरल बुखार आदि से बचा जा सकता है। पुदीने और धनियां के पत्तों के साथ मरवाह के पत्तों की चटनी पेट के रोगों से मुक्त रखती है। नींबू घास के पत्तों की चाय से शरीर में रोग क्षमता बढ़ती है। इस तरह कई तरह के नुख्से हैं। तुलसी के पत्तों का प्रतिदिन प्रयोग शरीर को रोग मुक्त रखता है। नर्सरी वाले ना केवल इन साधारण एवं महत्वपूर्ण औषधीय पौधों को उपलब्ध करा सकते हैं बल्कि दुर्लभ और लुप्त हो रही पौध प्रजातियों को सुरक्षित रखने में भी सहायक हो सकते हैं। हमारे भारतीय वैज्ञानिकों द्वारा विकसित औषधीय पौधों की उन्नत किस्मों के बीज, प्लांटिंग मैटीरियल जैसे कन्द, कंटिंग आदि का गुणनसंवर्धन कर इनको उपलब्ध करा सकते हैं। Central Institute for Medicinal and Aromatic Plants, Lukhnow से (तुलसी सीम आयु, मरवाह सीम सोमया, खस, नीबू घास, पामारोजा, सदाबहार, भूमि आंवला की उन्नत किस्मों के लिए) Regional Reseach Lab. Canal Raod, Jammu (खस, नीबू घास, जावा घास, पामारोजा और तुलसी की अनेक किस्मों के लिए) Haryana Agricultural University (मुलेहठी) National Research Centre in Med. and Aronatic Plants, Borivar, Gujarat, National Institute for Pharmaceuitical Education and Research, Mohali (PB) से (ऐसपैरेगस एडसकेनडीन, ब्राहमी, मण्डकपर्णी, दमाबेल, अगनीमंथ) अच्छी व उन्नत किस्मों को प्राप्त कर अपने अपने क्षेत्रों में Multiply कर पौधों को उपलब्ध कराया जा सकता है। अधिक मात्रा में भी उत्पादन कर किसानों को भी दिया जा सकता है। आने वाले समय में Quality Plant Material की अधिक मांग होगी और सभी को तैयार रहना होगा। Director, CIMAP (डा0 खनूजा) ने अक्टूबर में CIMAP Lucknow द्वारा आयोजित NIM (National Interactive Meet 2004) में यह घोषणा की थी कि संस्थान शीघ्र ही कुछ चुनी हुई Seed Companies को संस्थान द्वारा विकसित औषधीय पौधों के बीजों का Multiplication के लिए Licence भी देगी ताकि यह Accredited Centres वैज्ञानियों के देखरेख में पूर्ण गुणवत्ता वाले औषधीय पौधों के बीज पैदा कर किसानों को दे सकें। जिस प्रकार सब्जियों, दलहन और अनाज के बीजों पर Seed Act लागू है उसी प्रकार इन कम्पनियों पर भी Seed Act लागू होगा। तभी गुणवता कायम होगी। भारत फिर से विश्व गुरू बन सकेगा। चीन की तरह हम भी 21वीं सदी में औषधीय पौधों के विश्व स्तरीय व्यापार में अपनी पकड़ बना पाएंगे। ईमानदार निष्ठावान व्यक्तियों की आवश्यकता है। वैसे तो कुछ युवा वैज्ञानिक नौकरी छोड़कर इस व्यवसाय में आ रहे हैं परन्तु किसानों को चौकन्ना बनना होगा। किसानों के ही समूह बनाने होंगे जो Marketing भी देख सकें। महाराष्ट्र की तरह सहकारिता का सहारा लेना होगा। जन–मानस को यदि जड़ी–बूटियों का प्रयोग दिनचर्या में बता दिया जाय तो देश में ही एक बहुत बड़ा Internal Market खड़ा किया जा सकता है।

संदर्भ

1. प्राथमिक स्वास्थ्य में उपयोगी 51 औषधीय पौधे – जीवनय संस्थान लखनऊ
2. आयुर्वेद का प्राण, वनौषधी ज्ञान – शांती कुन्ज, हरिद्वार
3. औषधीयॉ – शान्ति कुंज, हरिद्वार
4. गमलों में स्वास्थ्य – शान्ति कुंज, हरिद्वार