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Contents

ENSURING RESOURCE SUSTAINABILITY THROUGH EFFICIENT MANAGEMENT FOR ENHANCED RICE PRODUCTIVITY IN WATERSHEDS OF HIGH RAINFALL HILL ZONES OF NORTH-EASTERN HIMALAYA

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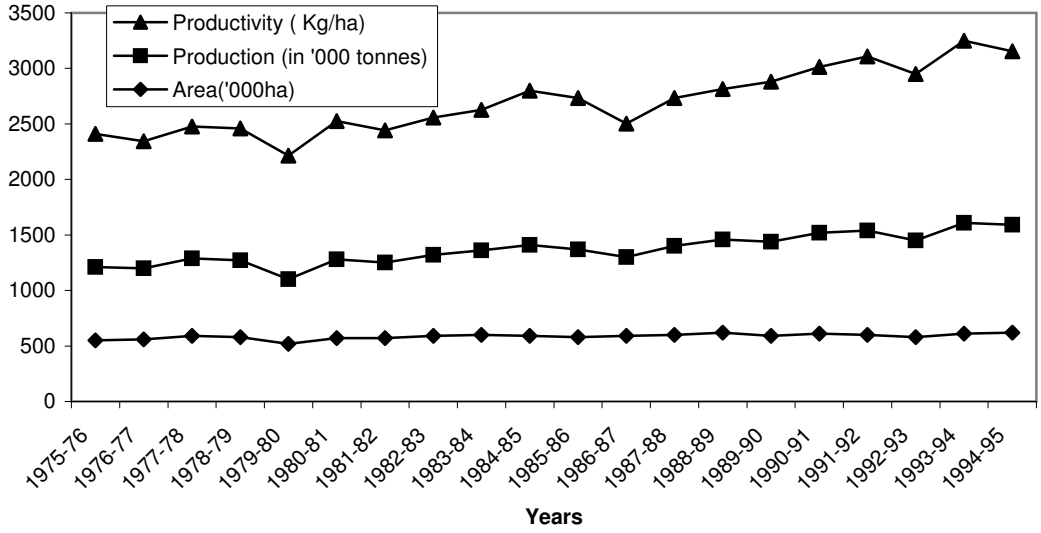
INTRODUCTION

Rice is one of the main crops of the North-Eastern Himalayan region of India. It is also a major crop of the North Eastern hilly ecosystem with an area of around one million hectare giving an average productivity of 14.5 q/ha (Anonymous, 1995). Use of improved varieties is known to contribute up to 40% of the enhanced yield and thus it plays a key role in increasing the productivity (Borthakur, 1993, Dhillon et al., 2001). Rice cultivation in the NEH region of India is exposed to different biotic and abiotic stresses including the exposure to extreme temperatures at the time of flowering and grain filling stages. The average annual rainfall of the region ranges from 2000-4000 mm and goes as high as 11000 mm in Cherrapunjee area. The production and productivity of the region are low as compared to other regions. Rice is grown in hilly upland areas in the hilly states, which are not much suitable for rice cultivation and the productivity of upland rice is much lower than that of plains. Consequently the average productivity of the region is much below the national average (Figure 1).

Figure 1. Area, production and productivity of rice in the NEH region



Edaphic and climatic factors affecting rice productivity in the North-Eastern Hill region

The topography of the region is highly rugged. In the region, the altitude varies from 500 to > 3000 m above mean sea level. The climate of the region ranges from subtropical plains to temperate

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hills with average annual rainfall varying from 1000 to 4000 mm and temperature ranges from below 0°C to above 38°C. The various soil groups are Alfisols, Entisols, Inseptisols, Moillisols and Ultisols. These factors have been listed to substantiate the claim that the region has very good potential for rice production. However, the region is lagging much behind the other advanced states as for as the production and productivity of rice are concerned. In post green revolution period after 1960s, there has been consolidated research efforts in the field of crop improvement and crop production, but the increase is minimal. The region has got rich diversity of local germplasm. Further, it is believed that the NEH region is the birthplace of rice in the world (Borthakur, 1993; Dhillon et al., 2001). But the productivity and production of the rice are low resulting into a lower per capita consumption as well. With the rapid increase in the population, it is highly essential to increase the production of this staple diet of the people to be able to self-sufficient as the potential is already there. Due to environmental and other considerations, it is not possible to expand the horizontal area under the crop. The only alternative is to boost the productivity. That can be increased by:

a) genetic manipulation and development of high yielding varieties suitable to this region (Gupta et al. 1995; Pattanayak et al., 1998; Reddy et al., 1999 and Gupta, 2001); and
b) by careful manipulation, efficient and judicious utilization and management of the resources available for rice cultivation in hills (Mishra and Gupta, 1998; Mohanty et al., 1999; Mishra and Satapathy, 2003 and Mishra et al., 2004).

Cultivation practices of rice in hilly watersheds

The rice farming situations in the North Eastern Hills are as follows:

1. Direct seeded, rain fed in upland (on steep slopes),
2. Direct seeded rain fed on level bench terraces,
3. Transplanted on wet terraces; and
4. Transplanted in valley lands.

1. Direct seeded, rain fed in upland (on steep slopes)

The patches of land are cleared in the hills and vegetation is burnt to make plots for rice cultivation on steep hill slopes. The paddy seeds are directly broad casted on steep hill slopes, which germinate with moisture availability. The crop is mainly grown as rain fed without any control on water application. Provisions, however, are made for safe removal of excess water from the fields by providing drainage channels along the slopes.

2. Direct seeded rain fed on level bench terraces

At slightly lower gradients wherever it is possible, some farmers have converted the slopes into uneven, irregular shape terraces, which may be slopy outward contrary to the requirements of high rainfall hill zones of being slopy inward with a drainage channel at the rim of the slope. In some cases the rice is cultivated on dry terraces of different shapes and sizes as rain fed crop. Where the rice is cultivated as rain fed crop on slopes, there is no careful planning and scientific design of water conveyance and drainage systems; rather the irrigation is applied from one terrace to the other except a few well developed system of rice farming in the region. Indigenous technical know how plays a very significant role in management of nutrients and crop agronomy. Without favourable growth conditions, poor inputs and heavy infestation of weeds, insects and pests attack clubbed with inefficient resources management practices, the rice productivity in the hilly watersheds has been adversely affected resulting in lower production and productivity. (Singh, 1999; Singh and Sharma, 1999).

3. Transplanted on wet terraces

In the states of Nagaland, Sikkim and Manipur the rice is cultivated on carefully designed wet terraces. The water coming from the upstream and highlands is tamed and made to stand behind the bunds. The flow of water is regulated and it is carefully carried from one terrace to the other and finally drained off in the downstream channels leading to streams or nallas. In this system of rice cultivation, there is no control on the movement of nutrients with water (Kannan et al., 1999). Zabo farming system of Nagaland and Apatanis of Arunachal Pradesh are example of a better-managed resource systems but not the well-managed system as has been claimed in the past (Singh and Sharma, 1999). Because in these systems, due to extremely high rainfall resulting into excessively high runoff with disturbances in the soil, it is likely that the soil loss will definitely take place. I have experienced this phenomenon while experimenting with lowland rice cultivation on the experimental farm of the Division of Water Management at ICAR Research Complex for NEH Region, Barapani (Meghalaya) where on a moderate gradient of 2-4%, the runoff velocity in the channels used to become so high that while trying to close a drain with mud, huge soil losses have been found to have occurred (Mishra and Gupta, 1998). With rice cultivation on steeper gradients, in high rainfall hill zone, it is therefore apt to conclude that there are unaccounted, unmonitored and unchecked huge resource wastage, which has rendered large areas poorly fertile for further intensive cultivation.

4. Transplanted in narrow valley lands

Finally, the most prevalent method of rice cultivation is the transplanted rice in valley lands in which generally the moisture regime is much higher and it is possible to grow transplanted rice in these situations. Every situation is unique in itself and the water management technology for each one is slightly different than the other (Singh, 1999; Singandhupe et al. 1999 and Verma and Srivastava, 1999). Before, going in the depth of the subject, it would be better to study the problem of resources degradation and to understand certain basic concepts and terms used in the field of water management.

Resources degradation in rice cultivation

Land and water are two major natural resources sustaining all forms of life on this earth. The North Eastern region has been bountifully bestowed with these two resources. In general the productivity of the soils is quite high due to large amount of organic matter content; however due to excessive leaching some of the nutrients are lost with high runoff requiring frequent replenishing. Water as a commodity is so widely available in the region that one seldom gets time to think for its efficient management. However, it is very essential to carefully apply and dispose the water in case of availability and excess. Because, the abundant water takes away the nutrients, which is vital to the crop production, resulting in the loss of productivity. Therefore, to understand the bottlenecks in the production, and for possible scientific research and developmental interventions using various technological options, one has to understand the basic philosophy of rice cultivation in hills and packages of practices associated thereof, following the watershed approach (Mishra et al., 2004).

The watershed approach

Management requirements

To manage the resources for their long term sustainability especially land and water, one primary need is the control over them. That means, we have to have the means to physically control the flow of water from rice fields, distribution and removal, the water can be applied to crop fields when there is a need for it (Brahmananda et al., 2000) and to stop its flow or application when there is no need; direct it to places where it is needed and remove the water from a field when its need has

been met (Brahmananda, et al., 2000; Brahmanand, et al., 2000). The above implies that good management of water will require knowledge of:

- water requirement of the crops,
- water supply conditions,
- losses in conveyance and distribution of irrigation deliveries, and
- to measure the water to apply it uniformly and efficiently.

Similarly, if the runoff can be checked, controlled and managed, the loss of top soil can be arrested. Considering the wide misunderstanding about the water and watershed management, the concept of watershed management is discussed below and a demarcation is also made between the concepts of water management and watershed management. A link is tried to be established between rice cultivation in hills in high rainfall zone and water management with watershed approach although both the subjects are quite different but interrelated.

Water management

The term water management is often found interpreted differently by different people. It is required to understand some basic concepts, in order to understand water management.

The term management is defined as *"a skilled handling of something; the executive function of planning, organizing, coordinating, directing, controlling any project or activity with responsibility for result; and judicious use of means to accomplish an end"***.** Water management for agriculture could, therefore, be interpreted to imply skilled and responsible handling of water and judicious use of it for *sustainable agricultural* production purpose. Thus, water management is a means and not the end in itself. The fundamental objective of managing agricultural water is to produce more profitably. This implies that water has an economic value, a condition that is a prerequisite to applying management concepts (Chandra, 1999; Chandra, 1999; Chandra et al, 1999 and Chandra et al., 2000).

Water management : a multidisciplinary approach

It is obvious that proper management requires application of knowledge of several disciplines. This is more or less true regardless of whether the management questions of the individual farmer, farmers, groups or the irrigation systems are considered. Knowledge of agricultural/irrigation engineering, soil science, crop science and social science including agricultural economics, rural sociology, etc. are disciplines often found closely related to the various important aspects of water management. Recently, contributions needs for management science and communication science are also being recognized (Srivastava et al.; 1999, Srivastava, 2000).

Watershed management

Watershed is a geohydrological unit draining at a common point by a system of streams. All lands everywhere are part of some or the other watershed. Essentially, a watershed is all the land and water area, which contributes runoff to a common outlet point. It is a land area that captures rainfall and conveys the overland flow and runoff to an outlet in the main flow channel. It is a topographically delineated area draining in to a single channel. A small watershed of a few hectares draining in to a small stream may form a part of a still larger watershed. All the combined watersheds may become a major river basin draining millions of square kilometres of land. The size of the watershed may vary from a few square meters to several thousand square hectares. The size becomes important, depending upon the objectives of the watershed management. For example for larger irrigation projects, watershed of thousand square kilometres may be considered. On the other hand for a small storage structure in farm (farm pond) consideration of only a few hectares of watershed suffices.

A watershed has a wide-ranging effect on the lives of the people residing in the watershed at large. Soil, water and vegetation are the main important and vital natural resources and watershed affects all of them. Judicious and efficient management of soil, water and vegetation in the watershed can ensure the sustained productivity of food, fuel, fodder, forage, fiber, fruits and small timber.

Watershed as an instrument of sustainable development

An integrated effort of land development for effective soil and water conservation with a view to "***in-situ***" utilization of rain water for crop production and animal husbandry is the basic approach for watershed management (Verma , 1998; Verma and Srivastava, 1999; Sharada and Sharma, 2001). For providing conditions for optimum utilization of land, water, plants and animal resources and for protecting the environment, it is necessary to treat the land from top to bottom or ridge to valley. Watershed management aims at minimizing risks associated with rainfed farming in hills by following the steps listed below:

- Conserving soil and water resources through mechanical and cultural practices;
- draining out excess water at a safe velocity and directing it for safe storage for its utilization in dry season;
- preventing gully formation through mechanical and vegetative means and storage of water for recharging ground water;
- utilizing land according to its capability and putting marginal lands unsuitable for arable crop production to alternate land uses;
- developing a sustainable ecosystem in harmony with the man-land-water-plant-animal complex of the watershed;
- optimizing agricultural productivity per unit area, time and available water; and
- improving the quality of life of the watershed inhabitants through infrastructure development,

Watershed approach benefits the farmer through improve soil health, better drainage and more efficient use of rain water with the possibility of excess water being stored in suitable structures for use during scarcity periods (Mishra, 1998; Kar, 1999).

Managing hilly and mountainous watershed under rice cultivation in high rainfall zone

Watershed management may be defined as *the process of formulating and carrying out a course of action involving manipulations of natural, agricultural and human resources of a watershed to provide resources that are desired by and suitable to the watershed community but under the condition that soil and water resources are not adversely affected.* Watershed management practices are thus changes in landuse, vegetative cover and other structural and non-structural changes that are made in a watershed to achieve watershed management objectives. Watershed management is an integrated and interdisciplinary approach. It generally requires land use adjustment measures, which contribute to the reduction in the soil erosion rate *vis-a-vis* agricultural production, generation of rural employment and balanced growth of the national economy. The watershed management usually involves the use by the people of the watershed area, of the watershed's natural resources especially the land water and vegetation with the active participation of institutions and organizations and in the harmony with the ecosystem.

Efficient management of resources for rice cultivation in hilly watershed: approach to be followed

Technological options for water management following watershed approach for different rice farming situations (for different land forms) can be categorized as under:

a) Rice cultivation on steep hill slopes

On the first hand as a conservationist, I will not like to advocate that the field crops should be grown on such steeper slopes as it is done in the North Eastern Hills. However, due to socio-economic limitations of the region, it is not practically feasible for planners to always adhere to the land use capability classification. Such relaxations have to be made to enable the farmers to survive. Huge investments are to be made in comprehensive planning and implementation of resources conservation and management strategies with sustainability of resources as an ultimate goal for future generations (Mishra and Gupta, 1998). Till then the rice cultivation has to be permitted despite its adverse impacts on the resources sustainability by adopting suitable conservation measures, such as contour bunding, contour cultivation, terrace cultivation, etc., which are only partially effective. The contour bunds, bench terraces or a combination of both help in retaining 70-80% of rainfall in the treated area of steeper slopes. The contour bunds should be made by drawing contour lines. Crops can be grown across the slopes either sole or in combination. Vertical intervals between contour bunds or bench terraces are kept with in 0.5 and 1 m for operational convenience. Contour bunds can be formed with local materials as an A-frame device, which functions as a contour marker. The A-frame is an indigenous substitute for expensive theodolite. Contour branches along the bunds or terraces carry the excess flow through grassed waterways in to a common pond. A higher soil moisture regime can be created by allowing maximum precipitation to infiltrate in the soil. A live hedge planted just above the bench acts as soil filter preventing soil erosion and with time makes the terraced bed less slopy. Several plant species are available for planting as live hedge. Of these lopmea, setaria, napier grass, stylosenthes or vetveria (khus) are effective as they are fast growing and some of them can be used as fodder for livestock or as fire wood. It also helps in storing some moisture (Samra et al., 1999). For still steeper slopes with soil depth not less than a meter, horticultural plantation is the most appropriate form of agricultural activity. Mulberry plantation for silk-worm rearing could be another possibility. Hill tops are to be used only for forestry purposes. Such a system allows retention of almost 90 % of rain water within the watershed area reducing the soil loss to less than one tonne/ ha/ year.

b) Rice cultivation on foot hills (dry and wet terraces)

In sub-montane tracts with light textured soils as in the foot hills of the Eastern Himalayan ranges high rates of runoff from big storms may result in to erosion losses to the tune of 20 tonnes soil/ha year or even still higher. Contour farming and bench terracing at suitable intervals supplemented with organic mulching and in-situ water harvesting in runoff reservoirs reduces the erosion losses (Chandra, 1999; Brahmananda et al., 2000). Horti-agri or horti-silvi systems on upper slopes and rice on lower slopes are recommended (Sharma et al., 1999). Provisions should be made for retaining more and more water on level bench terraces. But the plot to plot or terrace to terrace of water movement should be avoided (Brahmanand et al., 2000; Brahmanada et al., 2000). Instead the provisions should be made to safe disposal of water. Finally the water should be routed through the grasses water ways to the natural drainage way. Alternate drying and wetting system is more beneficial than the continuous submergence (Kannan and Brahmanand, 2000). In case it is not possible to keep the water level below a certain minimum level then it should be maintained at 3-5cm (Kannan et al., 1999).

c) Rice cultivation on near flat or valley lands

Elaborate arrangements should be made for drainage of excess water safely. Also, to avoid Al and Fe toxicity, necessary steps should be taken before transplanting. Dug out cum embankment type of water harvesting structures can be created at the lowest elevation for storing the rain water and

life saving irrigation can be provided in case of long rainless periods with the stored water (Srivastava et al., 1999; Srivastava , 2000).

SUMMARY AND CONCLUSION

Watershed management is an umbrella term involving a large sphere of activities for achieving the basic objectives of conservation of soil, water and vegetation for its sustained productivity. It involves the management of all the natural resources including human beings by ensuring their complete participation. Without people's participation the watershed management objectives are unachievable. Water management is a component of watershed management, be it the large scale water management (development of large irrigation projects) or small scale (management of water for crop production on farm level). The ideal situation, in which the natural balance is maintained, is "**no intervention or interference"** of any kind in the natural system from outside. It is therefore not feasible in the present situation to attain the normal or ideal natural settings. Cultivation of any form on steep hill slopes is not environmentally safe and sound yet inevitable especially in the North Eastern Hill region. Hence, we should try our level best to work to minimizing the adverse effects simultaneously ensuring the higher productivity and sustainability of the natural resources. Rice cultivation should therefore, be practiced in the hills with lots of care and with proper management. The strategy for good water management should be to use the water efficiently for growing crop ensuring that the flow of water should not hasten the process of soil erosion. Then only we shall be able to achieve the objectives of enhanced productivity of rice with long term sustainability of resources especially land and water on watershed basis.

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POTENTIAL APPLICATION OF REMOTE SENSING IN MANAGEMENT OF AGRICULTURAL RESOURCES IN NORTH EASTERN REGION

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INTRODUCTION

Agriculture resources are among the most important renewable, dynamic natural resources. Comprehensive, reliable and timely information on agricultural resources is very much necessary for a country like India whose mainstay of the economy is agriculture. Agriculture surveys are presently conducted throughout the country in order to gather information and associated statistics on crops, rangeland, livestock and other related agricultural resources. These information of data are important for the implementation of effective management decisions at local, panchayat and district levels. In fact, agricultural survey is a backbone of planning and allocation of the limited resources to different sectors of the economy.

North Eastern region of India, comprising eight states namely, Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim, has vast physiographical variations, which represent six agro-climatic zones. The major problems for agriculture in this region are undulating topography, high rainfall, natural calamities, frost, drought, occurrence of diseases and pests, etc. With increasing population pressure in whole NE region and the concomitant need for increased agricultural production (food and fiber crops as well as livestock), there is a definite need for improved management of agricultural resources. In order to accomplish this, it is first necessary to obtain reliable data on not only the types, but also the quality, quantity and location of these resources. Thus, awareness and information of remote sensing technology can play a significant role for proper planning and management of agricultural resources in this region.

REMOTE SENSING AND ITS IMPORTANCE IN AGRICULTURAL SURVEY

Remote sensing is the science and art of acquiring information (spectral, spatial, temporal) about material objects, area or phenomenon without coming into physical contact with the objects, or area, or phenomenon under investigation. Without direct contact, some means of transferring information through space must be utilized. In remote sensing, information transfer is accomplished by use of electromagnetic radiation (EMR).

In agriculture, possible applications are in the management of soil resource inventory, estimation of cropped area and production, detection of many agronomic stresses like water, nutrients, salinity, etc., scheduling of irrigation and estimation of ET apart from modeling crop growth and yield using sensing inputs. Remote sensing is quite economical, exhaustive, simple and fast. Use of remote sensing for early warning system against possible threats from natural calamities makes it more meaningful and convincing to this region.

MEASUREMENTS

Agricultural remote sensing is commonly done in the visible, near-infrared and thermal infrared portions of the spectrum; however, new applications in the microwave area are under development. The given wavelengths are employed in agricultural survey through Electromagnetic radiation by using remote sensor system.

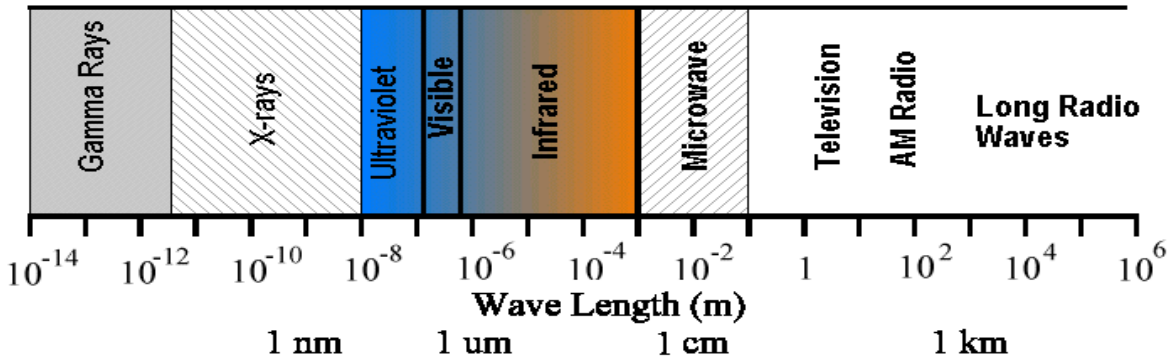

Table 1. Use of wavelength region for agricultural survey.

Area of agricultural phenomena	Wavelength employed
Plant diseases and insect infestation	0.4-0.9 mm and 6-10 mm
Natural vegetation, types of crop and fresh inventories	0.4-0.9 mm and 6-10 mm
Soil moisture content (radar)	04-0.8 mm and 3-100 mm
Study of arable and non-arable land	0.4-0.9 mm
Assessment of plant growth and rigour for forecasting crop yield	0.4-0.9 mm
Soil type and characteristics	0.4-1.0 mm
Flood control and water management	0.4-1.0 mm and 6-12mm
Surface water inventories and water quality	0.4-1.0 mm and 6-12 mm
Soil and rock type and conditions favorable for hidden mineral deposits.	0.4-1.0 mm and 7-12 mm

APPLICATIONS IN AGRICULTURE

- **Estimation of crop acreage:** An accurate and timely forecasting system of crop production is an essential element in ensuring a country's food security and proper distribution. In this, remote sensing is of paramount importance in identifying areas under cultivation. It is for this reason that the reflectance characteristics of a green leaf must be studied. Pre-harvest estimations of acreage for major crops like cotton, paddy, sorghum, soybean, sugarcane, wheat, etc. are now based on remote sensing and the methodology is now well established.
- **Pest detection**: Brown and Steckler (1995) developed a method to use digitized color-infrared photographs to classify weeds in a no-till corn field. The classified data were placed in a GIS and a decision support system was then used to determine the appropriate herbicide and amount to apply. Penuelas *et al.* (1995) used reflectance measurements to assess mite effects on apple trees. Powdery mildew has also shown to be detectable with reflectance measurements in the visible portion of the spectrum (Lorenzen and Jensen, 1989). The ability to detect and map insect damage with remotely sensed imagery implies that methods can be developed to focus pesticide applications in the areas of fields most infected, thus decreasing the damage to beneficial insects.
- **Crop stress:** Crop stress includes anything occurring in the field different than what was planned. Some of the common crop stresses that can be measured are drought, weed patches, soil erosion, nutrient deficiency and similar conditions. When trying to identify these types of stress using remote sensing, one can utilize some of the computer-aided methods or simply use visual methods to discriminate. The ratio of the red to blue to the near-IR scene reflectance can indicate plant stress before it becomes evident on the ground. A vegetation index (brightness or greenness) is a

reduction of several spectral bands into one "index" number. Emissions in the thermal IR band also can indicate plant health conditions. Other methods of detection may include change detection (subtraction of one image from an earlier image to see where the vegetation changed) and supervised or unsupervised vegetation classification (algorithms are used to select certain coloured pixels and assign to a group). Identifying crop stress due to frost damage with the aid of Landsat TM images shows promise with the development of a modified NDVI (Jurgens, 1997). Methods have been developed to utilize color-infrared images to classify weeds in no-till cornfields (Brown and Steckler, 1995) and have been established to identify water stress in plants with the difference of remotely sensed surface temperatures and the measurement of ground based air temperatures (Jackson *et al.,* 1981)

- **Water stress**: The difference between remotely sensed surface temperature and ground-based measurement of air temperature has been established as a method to detect water stress in plants (Jackson *et al*., 1981). More recently, methods to integrate spectral vegetation indices with temperature have been used to improve remotely-sensed estimates of evapotranspiration (Carlson *et al*., 1995; Moran *et al*., 1994). Moran *et al.* (1994) defined a Water Deficit Index, which uses the response of a vegetation index to account for partial canopy conditions, so that false indications of water stress due to high soil background temperatures were minimized. Spectral indices have also been used to determine "real-time" crop coefficients to improve irrigation scheduling (Bausch, 1995).
- **Soil properties or soil inventory:** Soil investigations, surveys and mapping are three types of applications using remote sensing information. They include three different approaches: the effects of soil properties on reflectance or image response, the influence of soil surface conditions on the response, and the use of imagery in mapping soil patterns. Satellite images such as Landsat Thematic Mapper (TM) data can be used in soil surveys for a broad range of applications. Soil spectral image responses are related to soil organic matter content, i.e., dark soils (higher organic matter) contrast to lighter soils (lower organic matter). The vegetation spectral response can also be used to infer various soil conditions. Yang and Anderson (1996) used these vegetation responses to define management zones within fields. The management zones are an aid to soil sampling as they define logical boundaries for obtaining samples. Remotely sensed images are also being used in "directed soil sampling" where one can map "soil management zones", which would be sampled as separate units. The management zones would become the basis for adjusting nutrient application rates using variable rate technologies
- **Predicting crop yield:** Remote sensing data are used to estimate some of the crop biometrics parameters such as Leaf Area Index (LAI) and crop cover, which in turns are parameters required to predict crop yield. Crop yield is influenced by a large number of biotic factors. The data through remote sensing gives an integrated picture of the effects of all these factors on its growth. Several approaches adopted for predicting crop yield using remote sensing data or derived parameters (Spectral Vegetation Index: SVI) have proved to be of immense use to policy makers.
- **Nutrient detection:** Using remote sensing information to detect field nutrient situations requires a thorough knowledge of what effects nutrient variations can have on the plant and on soils. Soil characteristics, such as colour, relate to organic matter content from which one can predict nitrogen (N) release to the plant. Other soil properties such as pH, texture and nutrients such as phosphorus (P) and potassium (K) are difficult to detect. Leaf greenness is related to chlorophyll content, which is directly related to plant N concentration. Discoloration such as leaf chlorosis of the margins of leaves is correlated to K deficiency while purplish leaves are correlated with P deficiency. Most of the nutrient work in remote sensing have focused on N. There have been

some encouraging results. For instance, leaf color measurements made at ground level have correlated well with corn plant N status (Blackmer *et al*., 1996).

- **Vegetation change:** Images from the green and near infrared bands highlight the amount of vegetation and give an indication of plant vigor. Some companies have been providing "crop vigor" maps to farmers to assist them in seeing where vegetative growth is occurring and to determine areas within the field were vegetation is not progressing, as it should. Change detection can be accomplished by overlaying images from two flight dates and showing the vegetation change occurring between the two dates.
- **Detection of crop injury:** Hail and wind damage is a common occurrence in many parts of the country. Information about the amount of damage is useful to crop management and accuracy of insurance payments. For corn and soybeans, the greatest yield effects from hail or wind are usually related to leaf loss, stand loss, or lodging. In each case, the amount or orientation of leaves and stalks is altered and can be measured by remote sensing. Direct damage to the ears, pods or seeds is another component that is difficult to detect and measure directly. Images from non-damaged adjacent areas or before-storm condition would aid in the accuracy assessment. These images normally are colour or colour infrared. The use of color infrared film assists in the detection of damage areas. Colour infrared gives a good indication of the amount or volume of vegetation or biomass present; therefore, lower values of red reflectance reveal vegetation damage or loss.

THRUST AREA

The specific application of remote sensing techniques can be used for i) detection ii) identification iii) measurement and iv) monitoring of agricultural phenomena.

a) Applicable to crop survey

1. Crop identification
2. Crop acreage
3. Crop vigour
4. Crop density
5. Crop maturity
6. Growth rates
7. Yield forecasting
8. Actual yield
9. Soil fertility
10. Effects of fertilizes
11. Soil toxicity
12. Soil moisture
13. Water quality
14. Irrigation requirement
15. Insect infestations
16. Disease infestations
17. Water availability
18. Location of canals

b) Applicable to range survey

1. Delineation of forest types
2. Condition of range
3. Carrying capacity
4. Forage
5. Time of seasonal change
6. Location of water
7. Water quality
8. Soil fertility
9. Soil moisture
10. Insect infestations
11. Wildlife inventory

c) Applicable to livestock survey

1. Cattle population
2. Sheep population
3. Pig population
4. Poultry population
5. Age sex distribution
6. Distribution of animals
7. Animal behaviour
8. Disease identification
9. Types of farm buildings

SUMMARY

The remote sensing techniques will continue to be very important factor in the improvement of present system of acquiring agricultural data in this region. The remote sensing provides various platforms for agricultural survey in NE region. Satellite imagery has unique ability to provide the actual synoptic vies of large area at a time, which is not possible for conventional survey methods and also the process of data acquisition and analysis are very fast through GIS (Geographic Information System) as compared to the conventional methods. The different features of agriculture are acquired by characteristic, spectral reflectance, spectral signature of agriculture and associated phenomena through EMR.

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DIVERSITY OF CUCURBITACEOUS CROPS IN NORTH EASTERN REGION

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INTRODUCTION

The North Eastern region of India comprising eight states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim has vast physiographical variations, which have been represented in six agro climatic zones. The North Eastern region is one of the richest reservoirs of genetic variability and diversity of different horticultural crops, i.e., various kinds of fruits, vegetables, spices, ornamental plants and also medicinal and aromatic plants. The diversity for cucurbitaceous crops of this region has mainly been managed by local farmers, often women. Considerable diversity exists among the regional cucurbitaceous crops including variation in plant type, morphological and physiological characteristics, reactions to diseases and pests, adaptability and distribution. Apart from the nutritional value, many regional cucurbitaceous crops are used for medicinal purposes, income generating and poverty alleviation programmes in the rural areas.

Problems relating to diversity conservation and development of horticulture in the north eastern region are land tenure issues, gender and equity issues, inter-departmental coordination, smuggling of timber across the international border, shifting cultivation, inter-state border dispute, insurgency and others factors, which are responsible for horticultural diversity degradation. Adequate attention was given for systematic management of the rich diversity available in this region with the establishment of NBPGR Regional Station in Meghalaya and it gained remarkable momentum in recent years. Apart from this, the ICAR Research Complex for NEH Region (Meghalaya) with campuses through out the north-east, Central Potato Research Station (Meghalaya), Central Plantation Crops Research Institute - Regional Station (Assam), National Research Centre for Orchids (Sikkim), Botanical Survey of India (Shillong), GB Pant Institute of Himalayan Environment and Development - North-East Unit (Itanagar) and various universities in North East and their research stations have made tremendous efforts in collection, evaluation, conservation and utilization of regional germplasm for development of horticultural varieties in this region.

Keeping in view the regional demand for cucurbitaceous crops, more germplasm needs to be identified for collection particularly for high yield, quality, resistance to diseases and pests. The paper describes the diverse regional cucurbitaceous crops and their position in the traditional cropping systems of the region. It also highlights the collections, conservation, evaluation and utilization of regional horticultural species.

The North Eastern region has its own unique combination of living species, habitats and ecosystems, which together make up its diversity rich resource. While speaking strictly about plant diversity, two regions of the country are termed as hot spots. These are – Western Ghats and the North Eastern hill regions. In all living organisms the species is the single most useful unit to use in diversity assessment. Species richness and the relative abundance of different species is another criteria to measure the degree of diversity. The number of endemic species also reflects into account while assessing the richness of diversity.

In the NE region apart from cultivated cucurbits, enormous diversity occurs in semi domesticated and wild types in local pockets. Such types have been selected locally by tribal as part of their routine vegetable requirement. The most important crops genera included *Cucumis, Cucurbita, Momordica, Trichosanthes* and *Benincasa*. Many of these have not only contributed

towards diversity but also are rich gene pool for important traits. These materials along with their close wild relative serve as genetic stocks by plant breeders for development of improves vegetable varieties. With increase in the population, there is immense need to explore newer sources of vegetables and to diversify vegetable farming/cultivation to meet the present day's demand. The diversity present in cucurbitaceous crops will be very useful in screening newer sources of vegetables for present and future needs. The wild gene pool possess important traits and may be explored both by direct selection or improvement through breeding. They also constitute a priceless reservoir that contains genes conferring better adaptation to stress environment and also resistance to disease and pests.

Many of the cucurbitaceous vegetables being resilient and adaptive can be grown on the land, which is not suitable for other vegetables. They do not require a high input technology and can be raised with comparatively lower management costs. Several of them are very nutritious, remunerative and have come to rescue of people in times of crisis. Apart from the nutritional value, many regional cucurbitaceous crops are used for medicinal purposes, income generating and poverty alleviation programmes in the rural areas. The cucurbitaceous vegetables have longer storage life and some of them can be stored for years without decay.

EXPLORATION AND DISTRIBUTION

Cucurbitaceous vegetables: This large group of vegetable crops, consisting of more than 15 kinds, is grown and consumed within the region. In North East many species of cucurbits are found as vegetables and fruits. These include *Cucurbita*, *Momordica*, *Luffa, cucumis* and several lesser known cucurbitaceous crops. The cucurbits in northeastern region are grown as mixed crops with maize, ginger, French bean, amorphophallus, colocasia, cassava, chilli, etc., as well as pure crops. However, they are the main constituents in the kitchen garden of the farmers. Most of cucurbits are indigenous to northeast and few like chow-chow, *C. pepo*, etc., have been introduced, which have so acclimatized to this region that large variability is observed.

Table 1. Indigenous and exotic cucurbits in north eastern region

Exotic	Indigenous
Bottle gourd, pumpkin, snake gourd, ash gourd, chow-chow etc.	Cucumber, *Luffa* gourds, *Momordica* gourds, *Trichosanthes* gourd and tinda, etc.

Pumpkin varieties abound in number with variation in fruit size, fruit skin, flesh colour thickness, sweetness, etc. The wild species *Cucumis hardwickii*, the likely progenitor of cultivated cucumber, is found growing in natural habitants in the foothill of Himalaya and NE region particularly Meghalaya. *C. sativus* var. *sativus* is cultivated all across the North Eastern region in tropical and subtropical conditions. However, *C. sativus* var. *sikkimensis* has adapted in temperate and humid climate. Among gourds, In North Eastern region maximum variability has been recorded for bottle gourd in fruit shape and size. The Indian gene centre has rich diversity in genetic resources of ridge gourd (*L. acutangula*) and sponge gourd (*L. cylindrica*) especially in North Eastern region. In bitter gourd small as well as large sized forms are available.

Chow-Chow (*Sechium edule*), a native of tropical America, is a very popular vegetable in the region commonly called squash and grows abundantly without much care and attention. *Flemingia vestita,* known as Sohphlong, is consumed raw. It is a weak climbing/trailing type, is distributed in the humid to sub tropical regions of NE India upto 1500m (Sarma, 2001). Kakrol (*Momordica cochinchinesis*) and kartoli (*M. dioica*) are widely spread in Assam and the Garo hills of Meghalaya (Ram *et al.,* 2002).

Table 2. Diversities of cucurbits in North East India

Cultivates species	Area of concentration for diversities	Range of diversities
Cucurbita maxima	Throughout the country	Extensive
Cucurbita moschata	Hilly areas	Moderate
Cucurbita ficifolia	Meghalaya	Introduced, neutralized
Cucurbita pepo	Meghalaya, Mizoram	Limited
Coccinia grandis	Assam, West Bengal	Limited
Cucumis sativus	Throughout the country	Wide
Cucumis callosus	Foothill areas of Assam	Confined to limited pockets
Luffa acutangula	Tropical areas of Assam	Wide
Luffa cylindrica	Tropical and subtropical areas of Assam, Meghalaya, Manipur, West Bengal	Moderate
Momordica charantia	Throughout the country	Moderate
Momordica cochinchinensis	Assam, Meghalaya, Manipur, Tripura, West Bengal	Limited
Momordica dioica	Garo Hills	Rare
Trichosanthes anguina	Meghalaya, Tripura, Assam, West Bengal	Limited
Trichosanthes dioica	Tropical areas of Assam, Tripura	Limited
Cyclanthera pedata	Hills of Meghalaya, Manipur, Nagaland and Arunachal Pradesh	Moderate
Benincasa hispida	Asssam, Nagaland, Meghalaya	Wide
Lagenaria siceraria	Throughout the country	Wide
Sechium edule	High hills of Meghalaya, Manipur, Mizoram, Nagaland, Sikkim and Darjeeling of West Bengal	Moderate

Diversification of minor/underutilized cucurbitaceous vegetable in north eastern region

There are several minor/underutilized cucurbitaceous vegetables, which are grown and consumed by tribals of the region. These are mainly *Cucumis hystrix, cucumis trigonus, Luffa graveolens, Momordica macrophylla, Momordica subangulata, Trichosanthes cucumerina, Trichosanthes khasiana, Trichosanthes ovata,* and *Trichosanthes truncasa.*

GERMPLASM EVALUATION

In order to facilitate effective utilization of plant genetic resources, it is important that these are evaluated for productivity and its components, crop duration, resistance to biotic and abiotic stress and quality of produce. The germplasm material available at different centres has been evaluated and utilized for crop improvement.

Chow-Chow (*Sechium edule*) produces large starchy edible roots in addition to fruits. The tender leaves are also sold in the market and consumed by the tribal people. The National Bureau of Plant Genetic Resources, Regional Station, Shillong is the main organization involved in collection, characterization and conservation of several cucurbitaceous germplasm. Apart from this, ICAR Research Complex for NEH Region and Assam Agriculture University are also doing research work on the cucurbitaceous vegetables.

Table 3. Collection of cucurbitaceous vegetable germplasm

Cultivates species	Parts to be collected during exploration	Number	Source
Cucurbita maxima	Ripen fruit/mature seed		
Cucurbita moschata	Ripen fruit/mature seed	795	NBPGR
Cucurbita ficifolia	Ripen fruit/mature seed		
Cucurbita pepo	Ripen fruit/mature seed		
Coccinia grandis	Ripen fruit/mature seed		
Cucumis sativus	Ripen fruit/mature seed	294	NBPGR
Cucumis callosus	Ripen fruit/mature seed	156	NBPGR
Cucumis melo var momordica	Ripen fruit/mature seed	433	NBPGR
Luffa acutangula			
Luffa cylindrica			
Momordica charantia	Ripen fruit/mature seed	519	NBPGR
Momordica cochinchinensis	Mature seed/tuberous root /stem cutting/apical shoots		
Momordica dioica	Mature seed/tuberous root /stem cutting/apical shoots		
Trichosanthes anguina	Mature seed/stem cutting/root cuting	144	NBPGR
Trichosanthes dioica	Mature seed/stem cutting/root cutting		
Cyclanthera pedata			
Benincasa hispida	Mature fruit/mature seed	326	NBPGR
Lagenaria siceraria			
Sechium edule			

Table 4. Cultivated species of cucurbitaceae of regional and local importance

Scientific name	Uses	Lowland (L) /highland(H)	Annual (A)/ perennial(P)	Chromosome No.	Comments
B. hispida (Wax or white gourd)	Young and mature fruits, young leaves and buds as vegetable, seeds	L	A	24	Fruit have long term storage capacity, seed from mature fruit can be taken during collection
Cucumis anguria (West Indian gherkins)	Young fruits as vegetable, pickles	L	A	24	Extraordinary numerous fruits
Momordica dioica (biter gourd)	Fruits, shoots and leaves as vegetable	L	A	28	Seeds from mature fruit are collected
Trichosanthes dioica (pointed gourd)	Fruits as vegetable	L	A	28	

Table 5. Cultivated crop genera and their wild relatives (interspecific, intraspecific and infraspecific categories)

Crop	Genus	Cultivars (species)	Wild relatives (species)	No. of taxa available in the region
Snake gourd	*Trichosanthes*	*T. palmata* *T. multilova* *T. cordata* *T. truncata* *T. himalensis* *T. dicaelosperma* *T. dioica* *T. nervifolia* *T. cucumeriana* *T. anguina* *T. lobata* *T. integrifolia*	*T. palmata* *T. multilova* *T. cordata* *T. truncata* *T. himalensis* *T. dicaelosperma* *T. nervifolia* *T. cucumeriana* *T. lobata* *T. integrifolia*	*T. palmata* *T. wallichiana* *T. multilova* *T. cordata* *T. truncata* *T. dioica* *T. anguina*
Ash gourd	*Benincasa*	*B. hispida* *B. cerifera*	*B. cerifera*	*B. hispida* *B. cerifera*
Bittergourd	*Momordica*	*M. charantia* *M. balsamina* *M. dioica* *M. cochinchinensis* *M. denudate* *M. symbalaria*	*M. balsamina* *M. denudate* *M. symbalaria*	*M. charantia* *M. dioica* *M. cochinchinensis*
Melons	*Cucumis*	*C. trigonus* *C. prophetarum* *C. sativus* *C. sativus var. sikkimensis* *C. melo* *C. melo var. momordica* *C. melo var. utilissimus*	*C. hardwickii* *C.hirsutum* *C.metuliferus* *C. prophetarum* *C.zeyheri*	*C. sativus* *C. sativus var. sikkimensis* *C. hardwickii* *C. callosus* *C. anguina*

Trichosanthes

Trichosanthes palmata:
Leaves 3-7 inches across, usually palmately 3-7 lobed;
Flowers 1.5-2.5 inches across, male flowers in elongate racemes, female flowers on short peduncles;
Fruit 1.5-2 inches across, ellipsoid or globose, at first red with orange streaks.

T. multiloba:
Leaves 3-6 inches across, glabrous or scabrous with scattered bristly hairs on the nerves;
Flowers dioecious;
Fruit bright red with orange stripes.

T. cordata:
Leaves 6-8 inches across, entire, angled or obscurely lobed;
Flowers dioecious;
Fruit globose.

T. truncata:
Leaves 4-5.5 by 2.5-3 inches, ovate acuminate;
Flower male flowers white, female plant not seen.

T. himalensis:
Leaves 5 inches, irregular serrate;
Fruit 3-4 by 1-$1^{1}/_{4}$ inches, nearly circular in section.

T. dicaelosperma:
Leaves 4 by $3^{1}/_{2}$ inches;
Fruits pubescent with 10 paler vertical bands.

T. nervifolia:
Leaves 3 by $1^{1}/_{2}$-2 inches, membranous, not lobed;
Fruit 2-3 inches, circular in section, about twice as long as broad.

T. cucumerina:
Plant is annual and closely related to cultivated *T. anguina* (snake gourd) but differs in fruit length, shape and absence of stripes on fruit surface.
Leaves 2-4 inches diameter, usually 5-lobed about half-way down, lobes obtuse;
Flower momnoecious, male peduncles in pairs, the earlier 1 flowered the later racemed.

T. lobata: Leaves pubescent beneath and with flaccid hairs;
Fruit 2-4 by 1-2 inches, acute at both ends.

T. integrifolia: Leaves $2^{1}/_{2}$-6 inches; Fruit 2 inches diameter, red.

T. dioica: (parwal)
It is extensively cultivated in the warmer parts of the country/region. Plants are dioecious and normally grown in rainy season. Fruits are commonly used as vegetable. They are as pickled and are also used in confectionary. Several cultivated forms differing in size, shape and marking of the fruits are commonly grown.
Leaves about 3 by 2 inches, ovate-oblong, cordate;
Flower male peduncles paired but not racemed, male flowers wooly outside;
Seeds half ellipsoid, corrugate on the margins.

T. anguina: (snake gourd)
Leaves 5 lobed or angled leaves and long elongate cylindric; sometimes cultivated for the fruits, which are used as vegetable.
Fruits are characteristically long (up to 1.5 m) and often twisted with 7-8 white stripes along its length when green. The young fruits are largely used as a vegetable either boiled or in curries. Variation in the fruits, i.e., length, diameter, colour and number of stripes occurs within the species.

Momordica

In Momordica spp. total 60 species are reported world wide and out of them 7 are available in India but only four (*Momordica Balsamina, M. charantia, M .chochinchinensis, M. dioica*) are commonly available and cultivated in one or other part of north eastern region.

Uses*:* Fruits, leaves and roots of *Momordica* spp. are used as stomachic, carminative, antipurgative regulating diabetes; leaf extract is used as appetizer, astringent and in liver and spleen disorders. Roots are useful in piles and urinary disorders.

Momordica dioica: (kartoli or spine gourd)
It is also found in cultivated/semi wild form. It is dioecious, perennial in nature having tuberous roots. The green fruit is extensively used as vegetable by cooking or frying.
Leaves 1.5-4 inches long, cordate, acute more or less 3-5 lobed;
Flowers large, dioecious and yellow in colour;
Fruit 1-3 inches long, shortly beaked, densely covered with soft spines.

M. charantia: (better gourd)
It is totally domestic. Plant is monoecious, vine type and has variation in fruits shape and size.
Leaves 1-3 inches across, deeply 5-7 lobed;
Flowers monoecious and yellow in colour;
Fruit 1-5 inches long, tapering at both ends, is characterized by its tuberculate-muricate skin and sculptured seed surface; full mature unripe fruit at tender stage is used for vegetables, in pickles and curries and in salad. The fruit becomes yellow when ripes.

M. cochinchinensis: (kakrol or sweet gourd)
The plant is perennial with tuberous roots.
Leaves 4-5 inches across, usually 3 lobed;
Flowers dioecious, large, whitish;
Fruit 3-5 inches long, ovate or oblong, covered with conical points, bright red when ripes. Hard spines are found on fruit surface. The mature fruit is used as vegetable.

M. balsamina:
Leaves $1^{1}/_{2}$-3 inches diameter, palmately 3-5 lobed to about the middle;
Fruit 1-3 inches, red, usually quite smooth. Immature tender fruits are are used as vegetable or pickled

M. denudata:
Leaves 2-4 by 1-2 inches, deeply cordate, 3-5 lobed; Fruit ¾ inches long and broad.

M. cymbalaria:
Leaves 1-2 inches broad, 5-lobed; Fruit ¾ by scarcely ¼ inches, few, shortly obovoid, smooth, shining.

M. subangulata:
It is also dioecious and perennial in nature with short annual vines.

Benincasa

Benincasa hispida:
It is a tropical and subtropical fruit and has wide variability among its cultivars. The plant is monocious vine type beering large green fruits. The mature fruit becomes white and is used to prepare sweet (petha) from its mature fleshy parts.
Fruits are globose-cylindrical in shape and covered with thick epicuticular wax.

Benincasa cerifera: Leaves 4-6 inches diameter; Fruit $1\text{-}1^{1}/_{2}$ feet, cylindric, without ribs, hairy, ultimately covered with a waxy bloom.

Cucumis

Cucumis trigonus:
Leaves 1-2 inches in diameter, entire; Fruits sometimes with a few scattered hairs, often with 10 stripes.

C. prophetarus:
Leaves 1-1$^1/_2$ inches, reniform, subtriangular, much lobed; Fruit green, with paler vertical stripes.

C. melo: Leaves 3 inches diameter, petiole 2 inches; Female peduncle sometimes 2 inches; Fruit spherical ovoid elongate or contorted.
Cucumis melo var. *momordica* (snap melon or foot)
Cucumis melo var. *utilissimus* (kakari)

C. sativus: Leaves 3-5 inches diameter; Female peduncle sometimes 2 inches; Fruit commonly cylindric, 12 by 1$^1/_2$ inches.

Cucumis hardwickii:
It is closely related wild species and considered progenitor of cultivated cucumber. It is annual in nature and crossable with the cultivated types. It is resistant to green mottle virus and some nematodes.
Fruits small, oval, bitter with sparse and stiff spines on the surface
Flower monoecious
Leaves highly lobed.

PROBLEMS RELATING TO DIVERSITY CONSERVATION

- **Land tenure issues:** Land tenure systems vary widely among different North-Eastern states, which are quite different from the rest of India. The complexity in land ownership and tenurial rights makes it difficult for survey, demarcation and consolidation of land. Therefore, cadastral survey and land demarcation are completely absent in the hill areas of northeast.
- **Gender and equity issues in natural resources and diversity management:** Unequal distribution of land resources is responsible for increasing dependence on forests by certain sections of the society leading to diversity degradation. Resolving the gender and equity issues concerning natural resource management is equally important in the North-East as in the other parts of the country.
- **Over exploitation of genetic resources**
- **Deforestation and soil degradation**
- **The adverse impact of development and increase in the population**
- **Inter-departmental coordination:** There is a need for a close inter-departmental coordination for the sustainable management of horticultural resources in the region.
- **Smuggling of timber across the international border:** The illicit felling of trees and timber smuggling across the international borders has been the most important cause of horticulture areas/forest degradation in border.
- **Shifting cultivation:** Unregulated shifting cultivation by the local tribal populations has been a major threat to sustainable diversity management particularly in unclassed and community forests in the region.
- **Inter-state border dispute:** There exist a lot of inter-state border disputes among the north-eastern states. Most of these border areas are forest lands and because of boundary disputes, such lands are often declared as 'no man's land' and hence, does not come under any form of management. This leads to the degradation of diversity in such areas.
- **Insurgency:** The long insurgency problem in some states such as Assam and Tripura has considerable impact on diversity conservation.

CONSERVATION OF DIVERSITY

Although there are not many agencies/organizations working exclusively for diversity conservation in the north-east *per se*, the activities taken up by many organizations including non-governmental and traditional institutions, government departments and scientific institutions have direct or indirect implications for diversity conservation.

- **State Government Agencies:** Many state agencies are now involved in such diversity conservation activities and establishment of germplasm banks for horticultural crops.
- **Research Organizations:** Many state and central government research organizations including universities of the region are engaged in research, inventory and conservation of diversity in the region. Such organizations are Botanical Survey of India, Shillong; GB Pant Institute of Himalayan Environment and Development, North-East Unit, Itanagar; Indian Council of Agricultural Research for North-Eastern Hill Region, Barapani, Shillong with campuses through out the north-east; State Forest Research Institute, Itanagar, NBPGR, Shillong; North-Eastern Hill University, Shillong; Nagaland University, Kohima; Mizoram University, Aizawl; Arunachal University, Itanagar; Tripura University, Agartala; Assam University, Silchar; Tezpur University, Tezpur; Gauhati University, Guwahati; Assam Agricultural University, Jorhat; Regional Research Laboratory, Jorhat; Dibrugarh University, Dibrugarh.
- **Non-Governmental Organizations:** Many non-governmental organizations are now working for the conservation of diversity in the north-east.
- **International Agencies:** International donor agencies in Meghalaya, Manipur, Assam and Nagaland have been playing crucial role in conserving the diversity through their respective projects.
- **International and National Policies and Conventions:** Many of the international treaties and national policies have significant impact on the conservation of diversity in the north-east.
- **Shifting Cultivators:** The shifting cultivators and other traditional farming communities of north-east have played a key role in conserving the rich horticultural crops germplasm of the region. In spite of the availability of many hybrid and high yielding varieties, these farmers have been cultivating the traditional varieties for generations.

GAPS IN DIVERSITY CONSERVATION

The depletion of diversity and inadequacy in actions to conserve the diversity of the region may be attributed to several factors, which range from inadequate knowledge about diversity and its components to adoption of wrong and inappropriate policies by the concerned stakeholders.

1. Gaps in knowledge and information

- Information on urban diversity is scanty
- Species inventory in inaccessible areas of Arunachal Pradesh, Nagaland, Karbi Anglong and North Cachar hills of Assam, and parts of Mizoram and Manipur is yet to be made.
- Information on genetic diversity is extremely poor

2. Gaps in vision: Most of the programmes and activities being undertaken by the state governments are shortsighted. Long-term planning based on sustainable development strategies and integration of diversity conservation issues with development planning are the needs of the hour.

- **Monoculture plantations:** In order to increase the revenue generation, the State Horticulture Departments pursue the policy of raising plantations of commercially important species by clearing and burning the natural diversity areas.

- **Introduction of high yielding varieties/hybrids of crops:** The horticulture departments are introducing various high yielding varieties/hybrids of cucurbitaceous crops. This is associated with increasing use of inorganic fertilizers and chemicals for plant protection. Such policies not only ignore the indigenous species and varieties but also have adverse effects on existing flora and fauna.

3. Gaps in policies and legal structure

- The wrong conservation policies with focus on economically important species have been harmful to diversity. Such policies as adopted in Tripura, Mizoram, Nagaland and Meghalaya have not only decreased the species diversity in natural/rehabilitated forests but have also resulted in accelerated soil erosion and loss of soil moisture.
- The policy of rehabilitation of *jhumias* through rubber plantation as has been done in Tripura may prove to be a disaster for other floral species in such areas.
- The policy of promoting high yielding varieties and assessment of progress and success on the basis of consumption of fertilizer and plant protection chemicals has led to ignoring the indigenous varieties. The government subsidy and credit policy is instrumental in adopting these schemes.
- Through the Public Distribution System only HYV are distributed. There is a need to include distribution of indigenous varieties too.
- The planners have not considered the role and value of diversity in preparing developmental plans.
- Most of the problems are related to increase in population. The rate of population growth in the northeast is unusually high. This causes tremendous strain on the natural resources and adoption of certain policies that are not very friendly to conserve diversity. No population policy has been adopted for future planning.
- Education policy does not include teaching on diversity conservation. The school curriculum should be able to mould the young minds in favour of diversity conservation.
- No policy as such is operational to create awareness among masses for diversity.

4. Gaps in institutional and human capacity

- The number of trained taxonomists in the region is grossly inadequate. This is one of the most important bottlenecks for completing the inventorization of diversity.
- Not all persons concerned with management of genetic resources understand the concept of diversity in proper perspective. Many of them suffer from biased attitudes. So it is imperative that those who plan, decide and implement the developmental programmes are adequately trained and educated in favour of diversity conservation.
- There are a number of institutions, departments, colleges, universities, NGOs, local community groups that follow certain programmes having bearing on genetic resources. While framing their programmes, these agencies are motivated to pursue their own goals in watertight compartments without considering their impact on other programmes or existing resources. There is no institution, which can make them sit together and discuss the programmes in a holistic manner.

5 Gaps in diversity related research and development

- Regeneration and cultural practices for many species need to be researched and standardized for their cultivation. Threatened species need immediate action for ensuring their continued existence.

- Identification and classification of threatened species need to be done.
- Richness of diversity of horticultural crop species is yet to be fully inventorized and documented.
- There is a serious gap between research and field needs. The established formal institutions like university departments, departmental research stations and others rarely consult the farmers and local communities about their problems while pursuing research. Need-based research needs to be encouraged.

CONCLUSION

In the NE region considerable diversity exists among the regional cucurbitaceous species including variation in plant type, morphological and physiological characteristics, reactions to diseases and pests, adaptability and distribution. Apart from the nutritional value, many regional cucurbitaceous crops are used for medicinal purposes, income generating and poverty alleviation programmes in the rural areas.

Problems relating to diversity conservation and development of horticulture in north eastern region are land tenure issues, gender and equity issues, inter-departmental coordination, smuggling of timber across the international border, shifting cultivation, inter-state border, insurgency etc., which are responsible for horticulture diversity degradation. Keeping in view the regional demand for horticultural crops more germplasm needs to be identified for collection particularly for high yield, quality, resistance to diseases and pests, tolerance to frost and acidity.

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BIODIVERSITY CONSERVATION ISSUES IN SIKKIM – II. HIGH ALTITUDE MULTI-PURPOSE ANIMAL SPECIES, THE YAK (*BOS MUTUS GRUNNIENS*)

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The Eastern Himalaya of India, revealing a great deal of diversity in flora and fauna, constitutes one of the richest regions on earth. High rainfall along with humid cold climate and other influencing factors such as altitude, manifest tremendous differentiation of ecosystems and provide refuge to a variety of unique life forms. On the western end of the Indian side of the Eastern Himalaya lies Sikkim, one of the smallest states of India. With a total area of 7096 km^2, of which 2656 km^2 (36.3%) is under forest (Anonymous, 1994), Sikkim is located between North 27^0 03' 47" to 28^0 07' 34" latitude and East 88^0 03' 40" to 88^0 57' 19" longitude. With almost no flat land, this entirely mountainous state has altitude range of 300 to 8598 m above mean sea level (amsl). Mt. Khangchendzonga (8598 m), on the north-east border of the state, is India's highest and world's third highest peak. Administratively, the state is divided into four districts and the majority populace comprise four ethnic groups of *Bhutia*(*s*), *Lepcha*(*s*), Nepalese and *Limbu*(*s*). Spread across a mere 114km north to south and 64km east to west, the state has an extraordinary range of climate, from hot subtropics to freezing cold alpine zone and beyond the Greater Himalaya, the Tibetan plateau. The relatively well-protected forest vegetation varies from the tropical pine forests, tropical broad-leaved forests, subtropical forests, temperate broad-leaved and coniferous forests to sub-alpine scrubs, alpine meadows and swamps-generally related to the high mountain flora of the North Temperate Zone. Some of the unique and endangered animals like Snow Leopard (*Uncia uncia*), Clouded Leopard (*Neofelis nebulosa*), Red Panda (*Ailurus fulgens*), Musk Deer (*Moschus moschiferus*), Great Tibetan Sheep (*Ovis ammon hodgsonii*), Tibetan Antelope or Chiru (*Pantholops hodgsonii*), Tibetan Fox (*Vulpes ferrilatus*), Wild Ass (*Equus kiang polydon*), Shapi or Eastern Himalayn Tahr (*Hemitragus jemlahicus schaferi*) and Yak (*Bos mutus grunniens*) are among the 150 odd mammals that enrich the state. As many as 690 species of butterflies have been reported from Sikkim Himalaya (Haribal, 1992).

The state of Sikkim serves as the catchment for the mighty river Teesta, of which Rangeet and numerous other rivers and rivulets are the tributaries. All the diversity in life forms and landscape make Sikkim a paradise for people of different walks of life. Proximity to the Bay of Bengal ensures that Sikkim remains the most humid region in the entire Himalaya. The rainfall ranges from 2000 – 5000mm. Monsoon brings heavy rain throughout the state from June to September. Subtropical climate prevails in the lower hills and valleys and with rise in altitude, the climate gradually changes to temperate and the alpine zone faces extremely harsh climate of low temperature, constant wind with heavy snowfall and scant rain.

Ecosystem types

Sikkim's geographical position (tri-junction of the eastern Himalaya, central Himalaya and Tibet), high annual rainfall of 2000-5000mm, wide variation in altitude (300 to 8586m amsl) and topography, high constant relative humidity (70% and above throughout the year) and favourable

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temperature regimes make it one of the richest "hotspot" of biological diversity in the country. The forest types showed similarity with increase in altitude and varied from the typical tropical sal forests to temperate that climaxed to the alpine/arctic type at the highest elevation beyond the timberline (>4500m).

Tropical forests (up to 900 m amsl): Mainly comprise tropical moist deciduous to semi-evergreen elements with sal (*Shorea robusta*) as the dominant species. They occur along Teesta and Rangeet valleys at low altitudes. Along the riverbanks *Saccharum* sp., *Oroxylum indicum* and *Meizotropis buteiformis* are the common species.

Subtropical forests (900 – 1500 m amsl): These mixed forests consist *Adina cordifolia*, *Alangium chinense*, *Bischofia javanica*, *Callicarpa arborea*, *Castanopsis indica*, *Eurya cerasifolia*, *Franxinus floribunda*, *Ficus* sp., *Gynocardia odorata*, *Helicia nilagirica*, *Macaranga denticulata*, *Magnolia hodgsonii*, *Michelia velutina*, *Mangifera sylvatica*, *Saurauia nepalensis*, *Schima wallichii*, *Vernonia volkameriaefolia*. Predominant shrubs include *Buddleja asiatica*, *Clerodendrum*, *Embelia floribunda*, *Mussaenda roxburghii*, *Melastoma malabathricum* and *Vitex negundo* and others. Climbers like *Piper* sp., *Smilax* sp., *Tetrastigma* sp., *Cissus* sp., *Pothos* sp., *Rhaphidophora* sp. are common in this zone. Ferns and fern allies with many orchid species enrich the epiphytic flora of this region. *Mus* sp. and *Pandanus* sp. form dense patches in humid and exposed areas. Tree fern *Cyathea* sp. is randomly found in moist shady places. Exotic weeds like *Eupatorium* sp. and *Mikania micrantha* have naturalized in considerable parts of this region.

Temperate forests (1500 – 3500 m amsl): Such forests are differentiated as broad-leaved temperate forests and coniferous forests. Main constituents of broad-leaved forests in Sikkim are *Alnus nepalensis*, *Acer campbellii*, *Betula utilis*, *Engelhardtia spicata*, *Exbucklandia populnea*, *Ilex dipyrean*, *Juglans regia*, *Populus ciliata*, *Prunus nepalensis*, *Malus sikkimensis*, *Quercus lineata*, *Q. lanata*, *Q. lamellosa*, *Q. ixyodon*, *Q. glauca*, *Lithocarpus pachyphyla*, *L. elegans* and others. Shrubby vegetation, which is dense and diverse predominantly comprise *Berberis umbellata*, *B. wallichiana*, *Elaeagnus umbellata*, *Gaultheria fragrantissima*, *Piptanthus nepalensis*, *Prinsepia utilis*, *Rhododendron* sp., *Hippophae salicifolia*, *Maddenia himalacia*, *Rubus macilentus*, *Viburnum erubescens*, *Zanthoxylum oxyphyllum* and so on.

Alpine vegetation (3500 – 5000 m amsl): The lower altitudes of this zone are dominated by trees of *Abies densa*, *Tsuga* sp., *Picea morindoides*, *Salix* sp., *Larix grifithii*, *Juniperus* sp., *Betula* sp., *Sorbus* sp. and shrubby species of *Rhododendron*(*s*), *Berberis*, *Aconitum* sp., *Cotoneaster* sp., *Diapensia* sp., *Euonymus* sp., *Panax* sp., *Gaultheria* sp, *Salix* sp., *Thalictrum* sp., *Anaphalis* sp., and *Vaccinium* sp. While the prostrating *Rhododendron anthopogon*, *R. lepidotum* and *R. setosum* form dense tussocks in the upper parts of the alpine zone. In the higher elevations of alpine zone, the vegetation is typical alpine moor land type where tree growth is completely arrested and the stunted bushy and cushionoid growth forms are a revelation.

In the existing land use of Sikkim, agriculture comprised some 11% of the total geographic area and 16% under alpine pasture, gaucharan and khasmal forests (Anonymous 1994). Wide ranging crops are cultivated on well-established terraces up to 2000 m elevations. Thereafter, there is a drastic reduction in the crops' variation. Irrespective of the agro-ecological zone, farm animals are an integral component (Table 1). Alpine pastures constitute the majority of the grazing or fodder gathering areas in the state (Table 2) where the rate of natural regeneration is slower than at the lower elevation forests. There is a quantitative difference in the quantum of animal fodder availability at the alpine zone where a small population of domesticated animals is in competition with the wild goats/goat-

antelopes. The temporal changes in the livestock census revealed that highest number of animals were recorded in 1988 and declined in 1997 (Table 3) except the cattle population that increased among the large animals whereas yak numbers decreased in 1997. The fall in the strength of yaks led to a corresponding rise in the horses and ponies population. At the higher elevations (3000 to 5000 m amsl) one comes across herds of grazing animals shepherded by one or a group of men. The biggest and most prominent among them are the yaks. There are two species, one the original, wild yak and the other, semi-domesticated yak locally known as *dzo* (vernacular, *Bhutia*) It may be necessary to mention about the ancestor or the descendents of the yak before proper perspectives of the animal are highlighted. It seems that a close relative of the yak is aurochs (Sub-genus *Paephagus*) as per the Grzimek's Encyclopeadia - Mammals - IV. However, there are strong opinions of the Tibetans that the animal was inherited from wild species similar to yak but much bigger in size known as "Dong". The species had the same morphological and anatomical construction.

Table 1. Agro-ecosystems of Sikkim

Area	Climate (Altitude m)	Ecological adaptation	Crops Agriculture and horticulture
Lower hills	Tropical (300 – 900 m)	Wet and dry agriculture, sedentary farming, horticulture, livestock	Rice, maize millet, wheat, pulses, oilseeds, vegetables, potato, guava, lime, lemon, mango, ginger, mandarin
Mid hill	Sub-tropical (900 – 1800 m)	Wet and dry agriculture, livestock, horticulture and minor forest produce	Rice, maize, millet, wheat, pulses, oilseeds, vegetables, potato, mandarin, plum, peach, pear, large cardamom
High hills	Temperate (1800 – 2700 m)	Dry agriculture, *Bhutia* transhumance	Maize, barley, vegetables, potato, apple, plum, peach, peas
High hills	Sub-alpine (2700 – 4000 m) Alpine (4000 – 5000 m)	Yak herding, horticulture, pastoral economy (wool, cheese, butter, hides, and potato are commercial commodities)	Mainly used for rangelands, seed potato and vegetables
Very high hills	Alpine (> 5000 m)	Yaks, sheep, horses/ponies based transhumance. Crops grown include potato, cabbage, leafy mustard (*Brassica juncea* var. *regusa*), and radish.	Mainly used for rangelands, seed potato and vegetables

Table 2. Area under gorucharan, khasmal and alpine pastures in Sikkim (ha)

District	Alpine pasture	Khasmal	Gaucharan	Total	Percentage
North	90861	21607	1200	113668	73
South	3022	9778	1082	13892	9
West	6487	9189	1086	16762	11
East	6	10500	902	11408	7
Total	100386	51074	4270	115730	100

Source: Anonymous, 1994

Table 3. Temporal changes in the livestock population of Sikkim

Livestock	Livestock census		
	1977	1988	1997
Cattle	157546	183385	195327
Buffaloes	5438	3088	1970
Sheep	16104	10933	5023
Pigs	18596	31207	26975
Goats	88986	98210	82938
Horses and ponies	1186	1409	5436
Poultry	220927	256841	221406
Yaks	3995	5354	4781
Rabbits	------	------	357
Total	512778	590427	544213

Source: Anonymous, 1998

Wild Yak

The wild yak is much bigger in size than the domesticated yak. It is massive, shaggy and well - built, structured with a big head and broad face. It has long coarse hairs at the flanks and busy tuft between its horns and a great mane upon its neck. The male measures at HRL up to c.325 cm and BH is over c.200cm. It weighs between 1200 - 1500kg (Grzimek's Encyclopeadia 1000kg). Yaks have 14 pairs of ribs unlike other oxen that have 13 pairs. Their long legs have strong enlarged hoofs and pseudo-claws, which serve as support when the animal wanders on the high mountains. It has a bushy tail covered with long hair from the base and ends in tassel. The coat on head withers and back is rather short but densely mated. It inhabits the North Tibet desert steppes, which have no tree and bushes and are located around 5000 m amsl. In the month of June they shed their winter coats in large patches. Yaks have excellent sense of smell but average eyesight. The famous Russian explorer - Prezewalski, who found that the wild yaks generate strong grunting during mating but they are silent during rest of the period, gave the scientific name for yaks, the name *mutus*, the `Mute'. The gestation period is of nine month and they give birth every second year because their young ones are dependent on them for one year. Distribution of wild yak extended from Glacier point to north-east Siberia and reached south to headwaters of the Hwang Ho and Yalung rivers in Chinese province of Tsonghai. But then, gradually its distribution was narrowed down by the well-armed, rapacious, highland nomads from Tibet or Mongolian pastoral tribes from the north. Today, Yaks are reported from North Tibet to the Karakoram in the west, inward along the south slopes of the Altyn Tahg over the Kuenlum Mountains to Manshan Mountains.

Domesticated Yak

Distribution and characteristics

The Tibetans of western Kuenlum Mountains or East Pamir had probably first domesticated the yak in the first millennium B.C. The domesticated yak (*Bos mutus grunniens*) is much smaller than its wild ancestor. They are found in different colours viz., brown, yellow, grey in addition to the black and white colours. Their coat resembles the wild one, although in most cases they have even larger stomach mane. Their horn is weaker while even hornless are not too rare at a ratio 1:100. The domesticated yak is widely distributed than their origin form. It occurs in the west approximately as per Buchra, in the south to Bhutan and Nepal where the animals were kept in the pasture farming in the east and north up to the interior of the Mongolia and to the mountain chains south of Lake Baikal. Because of its frequent grunting sound compared to wild relative they are called `Grunting Ox'. The oestrous is irregular and domestic yak female have calves every year. The food consumption of domestic yak is

less than wild yak and is insensitive to cool temperature; hence it is the best-suited domestic animal in Asia at elevations above 2000m amsl.

The yaks in Sikkim were originally inherited from Bhutan, Chumbi valley and Nepal, which are presently found at Lachung valley in North, Nathu la, Kupup, Gnathang, Thegu in East and Yuksom-Dzongri in West Sikkim. The quality of yak bred from Bhutan heritage is better and has high adaptation significance. The yaks found in Lachen valley, Thanggu and Muguthang valley originated from Tibet. However, the ancestor of yaks of Bhutan and Nepal were also from Tibet but in the process of evolutional history they have developed certain intrinsic characteristic for the existing environment. Every alternate year an offspring per animal was born through inbreeding. Breeding season extended from July to September and the newborn weaned till they could graze (Avasthe, 1996).

Utility value

Yaks of Sikkim are multi-purpose animals that can be used completely! It shared a special relationship and performed a pivotal role in the life of the residents. Observations revealed that yak is a semi-domesticated animal that requires minimum traditional maintenance. Yak produces milk (maximum 1 kg per animal), meat (200-300 kg per animal), fur, dung manure, hides and the like. The yak milk has high nutritious value with fat content of 7-8%. A kilogram (kg) of its milk yields 0.25kg "*churpi*" (butter) from a "*dhongmo*" by the traditional process that involves the entire family. Lesser amount of ghee (clarified butter) is generated. This "*churpi*" and its smoke-dried form are relished and are in great demand. Meat is also smoke-dried and preserved for winters. Yaks shed their hair once a year, which is converted into blankets, tent, bags, ropes, slings, mats and shoes, etc. The fine wool of the yak is used for under garments, which is very soft, gentle and of highly priced wool. The furs from other different parts of the animal are used as: belly fur for making tents, moulted fur for tents and ropes, tail is used as such during prayers, and decorative items are manufactured from its fur, which are dyed in natural dyes obtained from plants growing in the local surroundings. Horns and heads form house decorative pieces (trophies) and chopped horns are used for salt and medicine. Yak skin is tanned before use for purposes such as storage of ghee. The dung of yak can be used as fuel energy like the cattle dung in the plain areas. The yaks can also be cross-bred with cattle and the progeny has great market as it has proved to be very strong and good natured animal for ploughing, used in caravan, riding, etc. If properly trained, yak is found to be the most reliable mode of transport and travel. Prices of yak ranges from Rs. 4000-8000 per yak in the local sales. All the yak products are marketed at Gangtok. Residents of Muguthang (c. 4545m) conjectured that blood of yak was man's last food in times of heightened desire to survive!

Conservation concerns

A famished yak could reportedly survive for almost 20 days in acute winter! The 1994-95, 1995-96 and 1997-98 winters experienced some of the heaviest snowfalls in recent times that resulted in the death of almost 20-25 per cent of the yak population of Sikkim. Grazing in open pastures was the normal feeding procedure among yaks, sheep and horses. Grazing in the open pastures was controlled; community meetings decided that for one-month animals would graze on one pasture and then would move to next in following months. Food shortage during winter was the major cause for natural deaths here (Bhutia, P., 1996 *Pers. Commun.*). Additionally, yaks were diagnosed to suffer from foot and mouth disease (FMD), tempanitis, common diarrhoea, respiratory problem, poisoning, ringworm and fungal infections. Internal parasites such as flukes, tapeworms' and external parasites like lice and ticks and faulty/mal-nutrition were common. Although the Department of Livestock and Veterinary Services, Government of Sikkim had put in appreciative efforts to reach FMD vaccinations and medicines to this difficult area with good efficacy, the actual problem management still needs

more attention. The male offsprings of all cross-bred are said to be sterile. Inbreeding has caused a fall in the standards of the yaks in Sikkim that can be related to quality and quantity of their products. This is the major concern as the residents are heavily dependent on the yaks. It has great potential for milk and meat production, thus their decline will trigger erosion of this significant species the "undisputed ship of the high altitudes of Sikkim". Designing urgent *ex situ* and *in situ* conservation measures for *vis-à-vis* the future of this majestic animal of the high altitudes is the call of the hour. Measures such as Establishment of a High Altitude Yak Breeding and Improvement Centre, creation of winter fodder centres at identified locations and winter yak monitoring and rescue teams if embarked upon by the State Government will promote the cause of the yak in Sikkim.

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Research communication

SURVEY OF SOCIO-ECONOMIC PROFILE OF FARMERS AND ANIMAL FEED RESOURCES IN THE MOUNTAINS OF HIMACHAL PRADESH

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INTRODUCTION

Livestock plays an important role in mountain farming systems and Himachal Pradesh is one of the important livestock rearing states in India. In this state, mixed agricultural production system is practiced by the farmers with both crop and livestock husbandry as the important components. Animal husbandry plays an important role in the economy of Himachal Pradesh where land holdings are small and fragmented with wide variations in topography and agro-climatic conditions. Availability of nutritious fodder is the biggest constraint in animal husbandry in this state. Except for rainy season, (July to September), there is scarcity of fodder throughout the year. Natural grasslands play an important role in supplying fodder to the animals. But, due to heavy grazing pressure, the productivity in these grasslands is very poor; also there is infestation of obnoxious weeds like Lantana, Parthenium, Ageratum, Eupatorium, etc. In hilly and mountain regions, the demand of feeds and fodder for livestock is much higher than their availability. The available fodder is not only insufficient but also poor in nutritive value. As a result, the productivity of the animals is very low. Whatever fodder resources are available, their availability is also seasonal. By and large, there is shortage of fodder from November to June. The present investigation was undertaken to study the general profile of the farmers and animal feeding practices in the mountains of Himachal Pradesh.

MATERIAL AND METHODS

A proforma was developed for collection of useful information regarding general profile of the farmers in Chamba district of Himachal Pradesh. The same proforma was also used to collect information on land holding, knowledge level, livestock composition, feed and fodder produced and preservation measures, existing feeding practices, breeding, health, modern scientific practices adopted and other related issues. A detailed survey was conducted using this proforma in four villages of Chamba district viz. Kiani, Bhrore, Sarol and Mangla in 2003. Face to face interview was conducted among randomly selected 100 farmers from these villages. Selection of the respondents was conducted by using a stratified random sampling technique. Accordingly, the respondents were classified into agriculturists and other with respect to their occupational status. The other occupation status included business and Government service. Farm families in the selected villages were categorized into five categories on the basis of size of landholding: (a) Families having no land, classiried as landless (b) Families having equal to or less than 0.5 ha, classified as marginal (c) Families having more than 0.5 ha but equal to or less than 2 ha, classified as small (d) Families having more than 2 ha but equal to or less than 4.0 ha, classified as medium and (e) Families having more than 4 ha, classified as large.

RESULTS AND DISCUSSION

General profile of the farmers: Table 1 shows the general profile of the farmers in the selected villages. It was found that majority of the farmers were landholders and the percentage of landless,

marginal, small, medium and large farmers were 6.0, 16.0, 31.0, 30.0 and 17.0, respectively. The educational standard of the heads of the families showed that 31% of the heads of the families were illiterate. Out of the remaining 69%, 14% had primary level education, 45% had matric standard and 10% had their education above high school. An attempt was made to classify the sample farmers into those having agriculture, animal husbandry or other occupation as main or subsidiary. Agriculture was the main occupation among two-third of the farmers and the rest one-third have other occupations like business and services. Only a very small number of farmers has taken animal husbandry as the main occupation.

Table 1: General profile of selected farmers

	Type of farmers	No. of households studied in the villages				% of households studied in the villages				% of total households
		1	2	3	4	1	2	3	4	
1	Age of head of farmers family									
	Young(20-35years)	4	10	3	8	16.00	40.00	12.00	32.00	25.00
	Middle(36-50year)	9	10	6	11	36.00	40.00	24.00	44.00	36.00
	Old(51 and above)	12	5	16	6	48.00	20.00	64.00	24.00	39.00
2	Education									
	Illiterate	6	8	6	11	24.00	32.00	24.00	44.00	31.00
	Up to primary	0	4	10	0	0.00	16.00	40.00	0.00	14.00
	High school	17	8	70	13	68.00	32.00	28.00	52.00	45.00
	Above high school	2	5	2	1	8.00	20.00	8.00	4.00	10.00
3	Type of family									
	Nuclear	9	13	17	6	36.00	52.00	68.00	24.00	45.00
	Joint	16	12	8	19	64.00	48.00	32.00	76.00	55.00
4	Family members/Household									
	1-5	3	7	8	2	12.00	28.00	32.00	8.00	20.00
	6-10	17	12	15	15	68.00	48.00	60.00	60.00	59.00
	11-15	5	4	2	8	20.00	16.00	8.00	32.00	19.00
	16-20	0	2	0	0	0.00	8.00	0.00	0	2.00
5	Main occupation of the heads of the family									
	Farming	13	18	22	17	52.00	72.00	88.00	68.00	70.00
	Service	12	6	3	8	48.00	24.00	12.00	32.00	29.00
	Business	0	1	0	0	0.00	4.00	0.00	0.00	1.00

Table 2: Type of land holding

Type of Land holding	No. of farmers				Percentage				% of total households
	1	2	3	4	1	2	3	4	
Large	3	5	5	4	12.00	20.00	20.00	16.00	17.00
Medium	8	7	8	7	32.00	28.00	32.00	28.00	30.00
Small	8	9	7	7	32.00	36.00	28.00	28.00	31.00
Marginal	3	3	5	5	12.00	12.00	20.00	20.00	16.00
Landless	3	1	0	2	12.00	4.00	0	8.00	6.00

Table 3: Village-wise livestock

Village		Cow	Bullock	Buffalo	Sheep and goat	Equines
1	Mean	3.28	1.08	0	1.00	0.28
	No.	82	27	0	25	7
	%	92.00	56.00	0	16.00	8.00
2	Mean	2.04	1.32	0	0.28	0
	No.	51	33	0	7	0
	%	100.00	68.00	0.00	8.00	0
3	Mean	3.80	1.20	0	2.4	0
	No.	95	30	0	60	0
	%	100.00	60.00	0	44.00	0
4	Mean	3.96	1.52	0.68	1.88	0
	No.	99	38	17	47	0
	%	100.00	72.00	12.00	32.00	0

Table 4: Role of women labour(%) for upkeep of animals

	Large	Medium	Small	Marginal	Landless
1 Fodder collection	0	32.14	44.84	46.66	100.00
2 Feeding	13.33	44.64	62.10	64.44	100.00
3 Watering	0	42.86	41.14	26.67	100.00
4 Cleaning	6.67	57.74	67.33	53.33	66.67
5 Milking	24.22	57.74	62.10	75.57	100.00
Mean	8.89	47.02	55.50	53.33	93.33

Table 5: Village wise and land holding wise average number of fodder trees owned by the farmers

Land holding	Village 1	Village 2	Village 3	Village 4	Mean
Large	7.67	6.4	12.00	8.21	8.57
Medium	15.50	8.86	13.88	12.24	12.62
Small	13.20	9.69	15.86	9.33	12.07
Marginal	18.56	11.67	18.20	16.08	16.13
Mean	13.80	9.08	14.92	11.47	12.32

Animal resources:

Animal rearing in Chamba is dominated by cattle, sheep and goats. Buffaloes are almost absent. 98% of the farmers had cattle and 4% had ponies either sole or in combination with cattle. 91% of the farmers reared cattle of small herd size (1-5) and 6.0% had a medium herd size (6-10). None of the fermers was having large cattle herd size. Only few farmers were having migratory flocks of sheep and goats. Veterinary services are available from the veterinary dispensaries of Himachal state Government to all the farmers. The vaccination facilities for foot and mouth disease were being provided free of cost by the state government and most of the farmers were having access to these facilities. However, many farmers complained about the non-availability of veterinary medicines in these dispensaries. Bullocks played an important role in performing agricultural operations. Ponies were used for transport purposes. The pony keepers were almost landless labourers and they earned their livelihood by using these animals for transportation of construction material and other goods. The farmers were having both crossbred and indigenous cattle. The crossbred cattle outnumbered the

indigenous cattle because of the implementation of Intensive Livestock Improvement Project (ILIP). At present emphasis is being laid on crossbreeding of *desi* cows with jersey. The implementation of these cattle improvement programmes led to gradual replacement of local cattle with graded-up and crossbreeds with variable jersey inheritance. The farmers mostly used cow dung as manure; few of them also used it as fuel.

Feed resources and feeding practices:

The availability of green fodder is the most important single factor responsible for the success of animal husbandry. With the intensification of livestock development, the importance of fodder production is fully recognized. Quantitative and qualitative insufficiency of feed and fodder is one of the main reasons for poor yield of milk and other animal products in hilly areas. The various feed and fodder resources, their time of use and quantity offered per adult animal recorded in villages under study were as below:

Table 6: Available feed resources and their time of use

Feed resources	Time of use	Quantity/adult animal (kg)
Grass from grassland	July to Oct/Nov	10 - 15
Maize stover	Nov to March	8 - 15
Wheat straw	June – July and Nov to Feb	2 - 5
Hay	Nov to June	4 - 9
Weeds from wheat crop	March to May	8 - 12
Tree leaves	Nov to Feb	3 - 10
Concentrate feed	Working and lactating animals	0 - 1
Shortage of feed	Nov to June	-

Availability of fodder round the year is one of the key factors for success of dairy farming. During the monsoon period, the growth of natural grasses is appreciable and plenty of greens are available. There is no shortage of fodder in the months of July, August, September and October. When the monsoon season is over, the grass from grassland is harvested in dry condition and stored as hay. By this time, the herbage is over-mature and its feeding quality is no better than straw. Other feed-stuffs stored for animal feeding are maize stover, wheat straw and paddy straw. Storage of hay and straw in the forks of trees was widespread to keep the material out of reach of stray cattle. House top storage is also very common on small holdings. These stored feed-stuffs are fed to the animals during period of scarcity, i.e., from November to June. Thus, in study area, the bulk of the feed constitutes crop residues, i.e., cereal straws and stovers. The two main drawbacks of the poor quality cereal straws and stovers are the low *ad libitum* consumption and poor utilization by ruminants, both of which are influenced by several factors; one of them being their low N content. The nitrogen present in such poor quality roughages is considered to be of little biological value and is undoubtedly inadequate to meet even the growth requirements of the enormous microbial population upon which the ruminant host animal is so much dependent.

None of the farmers was found using the practice of silage making. Concentrate feed was fed only to lactating cows and working bullocks. Mineral mixture was given to animals by 8% of the farmers only. The quantities of the dry matter, digestible crude protein and total digestible nutrients offered to the animals were estimated and compared with the animal requirements of these nutrients in accordance with Morrison feeding standard. 92% of the animals received sufficient or more than sufficient amount of dry matter to meet their requirements, whereas 8% of the animals were underfed as far as dry matter requirements were concerned. Coarse roughages, viz. maize stover, wheat straw and dry grass formed the bulk of animal feeding during study period in the area. 62% of the animals

did not receive any green fodder. Tree leaves formed the major source of green fodder in the study area. The important tree species used for feeding were *Bauhinia variegata, Grewia optiva, Bambusa arundinacea, Melia azedarach, Acacia catechu, Pyrus, Robinia pseudoacacia, Morus alba, Quercus leucotrichophora, Ficus species*, and *Celtris australis*. 6% of the animals were supplied with concentrate feed. Mustard cake, linseed cake and barley were produced by the farmers themselves, whereas, Mayur and P- mark brand names of cattle feeds were purchased from the market. The chemical composition of various feeds and fodder collected from chamba is given in table 2/3. 80% of the animals were offered sufficient digestible crude protein to meet their requirements. By and large the total quantity of D.C.P offered to these animals was much less than the required amount. The deficiency of this nutrient was caused by the absence of leguminous fodder and concentrate feeds in the ration of these animals. The percentage of animal receiving less T.D.N was 32 but the availability of TDN to animals was questionable as most of the dry matter was supplied through coarse roughages. By and large, the nutritional status of animal feeding was not satisfactory.

The study concluded that the feeding schedule of the animals was highly unbalanced and the animals were exposed to malnutrition, which was responsible for their short stature and the milk production of the animals in the region was extremely low. The survey further revealed that crop residues (wheat straw, paddy straw and maize stover) constituted the major feed resources for the livestock population in the study area. The productivity of grazing lands has decreased considerably due to overgrazing resulting disturbance in the ecological balance. Poor nutrition caused serious problems in livestock resulting in poor productivity, infertility, abortion and high morbidity and mortality. There is, therefore, an urgent need to improve the quality of locally available feed resources in the hills to provide better nutrition for the livestock.

Selected Abstracts

Adhikari, B.S.; Babu, M.M.; Saklani, P.L. and Rawat, G.S. 2005. **Distribution, use pattern and potential for conservation of medicinal climbers in Uttaranchal state**. *The Indian Forester*, 131(7): 901-916. Herbarium Section, Department of Habitat Ecology, Wildlife Institute of India, Dehradun, Uttaranchal. [CONSERVATION; ECO-CLIMATIC REGIONS; PROTECTED AREA]

This paper provides information on the distribution and use pattern of medicinal climbers in Uttaranchal State, India. A list of 88 medicinal climbers, found in Uttaranchal has been appended based on extensive literature survey. Their altitudinal distribution and part used in various ailments has been analyzed. Fabaceae, Vitaceae and Cucurbitaceae are the largest families, and have more than 10 species of medicinal climbers. The medicinal climbers in different ecological regions found in sub-tropical, warm temperate, cool-temperate, sub-alpine and alpine are 83,44,7,3 and 1, respectively. Including all the species the major parts used in various ailments are in the following order: Leaves and roots (44 species each) > fruits (17 species) > seed (15 species). Maximum climbers are used in dysentery, diarrhoea, fever, wounds, digestive complaints, skin diseases, rheumatism, bronchitis and asthama. The first region i.e., sub-tropical region is the most important zone for *in-situ* and *ex-situ* conservation of medicinal climbers, as most of them grow in this region. The paper will help in the formulation of strategies for promotion and cultivation of medicinal climbers in Uttaranchal State.

Agarwal, Manisha; Gupta, Sangeeta and Painuly, Veena 2005. **Xylotomic study of the family Sapindaceae: Microstructure, systematics and ecological trends**. *The Indian Forester*, 131(8): 1024-1040. Wood Anatomy Discipline, Forest Research Institute, Dehradun. [ANATOMICAL STUDY; VESSEL SIZE; WOOD SAMPLES]

The present study provides detailed wood anatomical features of the family Sapindaceae. The wood anatomy of 18 species belonging to 14 genera of Sapindaceae native to or commonly cultivated in India is described in detail and a species wood anatomical key is given. The wood anatomical features collected are as per the feature list given by International Association of Wood Anatomists. Based on constant characters, a species identification key has been developed for the separation of the taxa at the species level. Photomicrographs showing diagnostic features have been given. Based on wood microstructure inter-tribe and sub familial studies were described. Relationship between wood element dimensions and their ecology has also been established.

Akimpou, G.; Rongmei, K. and Yadava, P.S. 2005. **Traditional dye yielding plants of Manipur, North East India**. *Indian Journal of Traditional Knowledge*, 4(1): 33-38. Department of Life Sciences, Manipur University, Imphal 795 003, Manipur. [DYE YIELDING PLANTS; MANIPUR; NATURAL DYES; TRADITIONAL DYES]

Manipur is one of the richest states in plant biodiversity in the North Eastern states of India. Different ethnic groups, residing in Manipur before the introduction of the chemical dyes into the state, used the dyes extracted from the plants. The survey was undertaken during 2002-2003 in different parts of Manipur. Eighteen traditional dye yielding plants belonging to sixteen families have been reported, which different ethnic communities of Manipur use for dyeing the cloth and other items.

Bajpai, R.K. and Narayan, P.K. 2005. **Natural analogue study of Resubelpara Group of thermal springs at Garo Hills, Meghalaya for demonstration of safe geological disposal of nuclear waste**. *Current Science*, 88(6): 986-989. Back End Technology Development Division, Bhabha Atomic

Research Centre, Mumbai 400 085, India. [GARO HILLS; GRANITIC ROCKS; MEGHALAYA; NUCLEAR WASTE]

A group of thermal springs (with temperatures up to 50°C) occuring around Resubelpara locality near Sarangkhol, East Garo Hills district, Meghalaya has been studied to elucidate the geological analogy of various geochemical, thermal and geological features around them with those expected around disposed nuclear waste over packs in granitic rocks in the depth range of 400-500 m in a geological repository. Discrete uraninite occuring in granites and high radon content have been considered to be analogous with a part of radio active waste. High mobility of uranium is noticed under combinations of favourable groundwater chemistry (high concentration of carbonates and phosphates) and potential geological pathways. It is found that hot groundwater in granites is capable of transporting uranium into the biosphere when provided with suitable structural conduits like deep-seated faults. While in the areas of granites devoid of potential pathways, no significant transport of uranium is observed, the study demonstrates the capability of good host rock coupled with suitable geological set-up in providing long-term safe disposal of nuclear wastes. This is also an attempt to use natural analogue in India to demonstrate safely of nuclear waste disposal.

Baskar, Sushmitha; Baskar, R.; Mauclaire, L. and McKenzie, J.A. 2005. **Role of microbial community in stalactite formation, Sahastradhara caves, Dehradun, India**. *Current Science*, 88(8): 1305-1308. Geological Institute, ETH-Zentrum, 8092 Zurich, Switzerland. [BIOMINERALIZATION; MICROBIAL COMMUNITY; STALACTITE FORMATION]

Speleothems found in three caves in Sahastradhara, Dehradun, India were studied to understand if geomicrobiological processes were involved in mineral formation. Mineralogical studies (XRD and SEM-EDAX) of the stalactite samples revealed that calcite is the dominant mineral. An abundant microbial community (9×10^5 cells, g sed^{-1}) was detected by direct microscopic observation after DAPI staining. Application of fluorescence *in situ* hybridization techniques (FISH), based on the presence of rRNA, demonstrates the presence of a large number of active microbial cells (around 55% of the total cell number). The microbial community is dominated by Eubacteria, mainly sulphate-reducing bacteria (representing 10% of the total microbial community), but Archaea are also present. A significant fraction of these cells are active, indicating the high probability of their participation in biomineralization processes involved in the stalactite formation. This conclusion is at variance with the established classical model for stalactite formation based entirely on inorganic processes associated with carbonate solubility.

Bhardwaj, Sujata[1] and Gakhar, S.K[2]. 2005. **Ethnomedicinal plants used by the tribals of Mizoram to cure cuts & wounds**. *Indian Journal of Traditional Knowledge*, 4(1): 75-80. [1]Bhaskracharya College of Applied Sciences, Sector-2, Dwarka, New Delhi 110 045; [2]Department of Biosciences, Maharshi Dayanand University, Rohtak 124 001, Haryana, India. [ETHNOBOTANY; ETHNOMEDICINE; MIZORAM]

Results of ethnobotanical studies carried out in the state of Mizoram are presented. The usage of wild plants by the native people for the cure of cuts and wounds is described. The use of 17 species, bolonging to 14 families together with their local names and other uses have been enumerated. The plants not only contain antiseptic value but also have regenerative and healing properties. Sticking property of paste of bark was also observed in *Laki* tree. In addition, blood-clotting properties of some plants has also been reported.

Chakrapani, G.J. and Veizer, Jan 2005. **Dissolved inorganic carbon isotopic compositions in the Upstream Ganga river in the Himalayas**. *Current Science*, 89(3): 553-556. Department of Earth

Sciences, Indian Institute of Technology, Roorkee 247667; Institut fur Geologie, Ruhr Universitat, 44780, Bochum, Germany. [DISSOLVED INORGANIC CARBON; GANGA; WATER SAMPLE]

Dissolved inorganic carbon (DIC) is a major component of river waters and is derived from atmospheric CO_2, from reactions for silicate and carbonate rock weathering and biological activities such as photosynthesis and respiration. To distinguish the sources of HCO_3^- in river waters, it is essential to estimate the amount of CO_2 consumed from the atmosphere during rock weathering and to understand the biogeochemical cycling of carbon. One of the more reliable method adopted to understand the different sources of DIC in rivers, is the measurements of carbon isotopes in DIC, since the fractionation factors between the different carbonate species in dissolved river water and gaseous CO_2 are well established. The present study is aimed at understanding the source of DIC in the Alaknanda and Bhagirathi rivers in the Himalayas by measurements of $^{\delta 13}C_{DIC}$ in water samples. From the measurements made on these rivers in India through the present study, we find that the river waters have highly depleted $^{\delta 13}C_{DIC}$, which indicates the importance of carbonate rock weathering and bacterial respiration as the major processes for dissolved inorganic carbon.

Chhetri, D.R.; Basnet, Deewa; Chiu, Po Fong; Kalikotay, Sujata; Chhetri, Gagan and Parajuli, Sippy 2005. **Current status of ethnomedicinal plants in the Darjeeling Himalaya**. *Current Science*, 89(2): 264-268. Panchvati Greentech Research Society, Post Box No. 79, Darjeeling-H.P.O., Darjeeling 714101; Department of Botany, Darjeeling Government College, Darjeeling 734101, India. [DARJEELING HIMALAYA; ETHNOMEDICINE; FOLK MEDICINE; HERBAL DRUG; TRADITIONAL MEDICINE]

Darjeeling Himalayan region is characterized by a rich diversity of ethnomedicinal plants as well as a rich heritage of traditional medicine practices. The present study has revealed that 281 species of plants belonging to 108 different families are used in the fold-medicine of this region. Among the enumerated plants, about 58% shows hitherto unreported uses. However, 14% of the medicinal plants of this region is under different categories of threat. Therefore, domestication of important medicinal plants of this region is of utmost necessity.

Dhaulakhandi, Manoj and Rajwar, G.S. 2005. **Litter dynamics of two oak species (*Quercus Leucotrichophora* and *Q. Floribunda*) in Garhwal Himalaya**. *The Indian Forester*, 131(6): 829-834. Department of Botany, Government P.G. College, Rishikesh, Uttaranchal. [ABIOTIC FACTORS; FOREST ECOSYSTEM; GARHWAL HIMALAYA]

Quercus leucotrichophora and *Q. floribunda* were two important tree species of the montane zone of Garhwal Himalaya. Total litter production of *Quercus leucotrichophora* (site I) forest was estimated as 663.9 ± 56.8 gm^{-2} yr^{-1} and *Q. floribunda* (site II) forest as 564.1 ± 27.74 gm^{-2} yr^{-1}. Leaf fall contribution to the total litter fall was 530.0 ± 50.1 on site I and 446.0 ± 25.7 gm^{-2} yr^{-1} on site II. The litter decomposition rate on both the sites was maximum in August. Total litter decomposition after a period of 13 months on site I was 75.1 and on site II 66.6%. Decomposition constant (K') values for these species were 0.75 and 0.67 respectively.

Dimri, A.P.[1]; Mohanty, U.C.[2] and Rathore, L.S[3]. 2005. **Minimum temperature forecast at Manali, India**. *Current Science*, 88(6): 927-934. [1]Research and Development Centre, Snow and Avalanche Study Establishment, Him Parisar, Sector 37A, Chandigarh 160 023, India; [2]Centre for Atmospheric Sciences, Indian Institute of Technology, Hauz Khas, New Delhi 110 016; [3]National Center for Medium Range Weather Forecasting, Mausam Bhawan Complex, Lodhi Road, New Delhi 110 003, India. [ENVIRONMENTAL PREDICTION; PERFECT PROGNOSTIC METHOD; WEATHER FORECASTING]

Northern India is comprised of complex Himalayan mountain ranges having different altitude and orientation. Knowledge of minimum temperature in this region during winter months is very useful for assessing human comfort and natural hazards. In the present study, Perfect Prognostic Method (PPM) is used for forecasting minimum surface temperature at one of the stations, Manali, in Pir Panjal range of Himalayas. Firstly, a statistical dynamical model is developed for assessing next day's temperature category, i.e. $\leq 0^{o}$C or $>0^{o}$C. Once the category is known, then temperature forecast model is developed for that category. Statistical dynamical models are developed for winter season, December, January, February and March (DJFM) using multivariate regression analysis. model is developed with data of DJFM for 12 years (1984-96) and tested with data of DJFM for the year 1996-97. Analysis data from National Center for Environmental Prediction (NCEP), US, station surface and upper air data of three stations of India Meteorological Department (IMD), India and surface data at Manali are used. Four experiments are carried out with four different sets of predictors of evaluate performance of the models with independent data sets. They are: (i) NCEP reanalysis data, (ii) operational analyses from the National Center for Medium Range Weather Forecasting ((NCMRWF) in India, (iii) day 1 forecast with a T80 global spectral model at NCMRWF and (iv) forecasts from the regional mesoscale model MM5 day 1 forecast. A comparison of skill is drawn among these four set of experiments. It is found that best prediction for temperature category is made with an accuracy of 71.2% with MM5 day 1 forecast as predictors in temperature category forecast model. Further, temperature forecast model for $\leq 0^{o}$C category selects only station data and shows skill of 62.1% with independent data, whereas, model for $>0^{o}$C category selected predictor from numerical analysis also. Here MM5 day 1 forecaste makes best prediction with 90.0% skill.

Dutta, B.K. and Dutta, P.K. 2005. **Potential of ethnobotanical studies in North East India: An overview**. *Indian Journal of Traditional Knowledge*, 4(1): 7-14. Microbial & Agricultural Ecology and Biodiversity Conservation Laboratory, Department of Ecology & Environmental Sciences, Assam University, Silchar 788 011, Assam. [BIODIVERSITY; CONSERVATION; ETHNOBOTANY; MEDICINAL PLANTS; NORTH EAST INDIA; TRIBES]

North East India has a valuable heritage of herbal remedies. Its rural people and tribals living in remote/forest areas still depend to a great extent on the indigenous systems of medicine/cultivation. So far studies in this regard have been reported from a very limited number of the tribes of North East region, viz. Ler, Mikir, Karbis, Miris, Khasi and Jaintai, Garo, Monpas, Nishi, Apatani, Reangs, etc. A wide range of plants with ethnobotanical value against some very important diseases have been reported but much larger numbers of folk medicines have remained endemic to certain tribal pockets in North East India. Therefore, further detailed studies on the ethnobotanical aspects in the region may provide meaningful ways for the promotion of traditional herbal medicinal plants/land races of crop plants for the benefit of mankind at large. In the present papar, the work that has been reported and the potentials of the ethnobotanical studies with particular reference to biodiversity conservation of the important medicinal/crop plants in the North Eastern region have been highlighted and discussed.

Garbyal, S.S.; Aggarwal, K.K. and Babu, C.R[1]. 2005. **Return of biodiversity in Darma valley, Dharchula Himalayas, Uttaranchal, North India following fortuitous changes in traditional lifestyle of the local inhabitants**. *Current Science*, 88(5): 722-725. School of Biotechnology, Guru Gobind Singh Indraprastha University, Kashmere Gate, Delhi 110 006, India; [1]Department of Botany, University of Delhi, Delhi 110 007, India. [BIODIVERSITY; DARMA VALLEY; UTTARANCHAL]

Darma Valley situated in 30^{0} North and 80^{0} East, in Kumaon region of Uttaranchal state in India, at an altitude between 7000 and 14000 feet has 12 villages with population less than 1000. Traditionally, the main occupation of the villagers in the region has been trading, sheep rearing and

cultivation of Fagopyrum esculentum and potatoes. The valley has always been very rich in biodiversity. Many plant species, some of which are rare and threatened, had been under severe pressure in the past due to over-extraction, large livestock population and extensive cultivation. Lifestyles of the people in the area changed in 1970s due to increased level of literacy and awarenes resulting in increased downward migration. Only about 25% of the earlier population lives in the villages now. The sheep population also came down drastically by as much as 90% in some places. Only about 25% of the fields are now cultivated. Thus the species got opportunities to flourish and many rare herbs and shrubs like *Aconitum heterophyllum, Bergenia ciliata, Cordyceps sinensis, Dactylorhiza hatagirea, Hippophae tibetana, Picrorhiza kurroa, Swertia ciliata, Taraxacum,* etc. are now found growing in abundance in the abandoned fields and meadows. The biotic factors in Darma valley appear to be in balance. Now one can see biodiversity having returned to its glory in Darma Valley.

Garbyal, S.S.; Aggarwal, K.K. and Babu, C.R[1]. 2005. **Traditionally used medicinal plants in Dharchula Himalayas of Pithoragarh district, Uttaranchal**. *Indian Journal of Traditional Knowledge*, 4(2): 199-207. School of Biotechnology, Guru Gobind Singh Indraprastha University, Kashmiri Gate, Delhi 110006; [1]Department of Botany, University of Delhi, Delhi 110007. [ECONOMIC UPLIFTMENT; ECONOMICS; ENDANGERED PLANTS; ETHNOMEDICINE; MEDICINAL PLANTS; MEDICINAL PLANTS TRADE; SUSTAINABLE USE; TRADITIONAL MEDICINE]

An attempt has been made to evaluate the traditionally used medicinal plants found in Dharchula areas of Kumaun Himalayas in Pithoragarh district, Uttaranchal, North India. The reported plant species are also highly valued in the Indian, Tibetan and Chinese Systems of Medicine. Based on interactions with the locals and traders and considering the potentials of some species for developing new drugs, the value of the species of medicinal importance occurring in the area has been worked out. The value is high enough for taking appropriate measures to conserve these valuable species and use them sustainable for the economic upliftment of the region.

Goyal, V.C.[1]; Jain, Sanjay[1] and Pareek, Navneet[2] 2005. **Water logging and drainage assessment in Ravi-Tawi irrigation command (J&K) using remote sensing approach**. *Journal of the Indian Society of Remote Sensing*, 32(3): 7-15. [1]National Institute of Hydrology, Roorkee 247 667, Uttaranchal; [2]Sher-e-Kashmir University of Agricultural Science & Technology, Jammu 181 102, India. [REMOTE SENSING; SATELLITE IMAGERY; SPATIAL PATTERN]

Water logging is one of the major land degradation processes that restricts the economic and efficient utilization of soil and land resources in commond areas. Since independence, various irrigation schemes, for providing water for agriculture and drinking have been taken up by Central and State agencies in India. In most of these schemes very little efforts have been made for proper drainage. Obstruction of natural drainage by way of construction of roads, railways, aerodrome, various structures, etc., causes the ponding of monsoon runoff on the upstream of the structures. Periodic monitoring of command areas helps in analysing the extent of water logging, and should help in taking suitable remedial measures. Remote sensing and GIS are powerful tools, which could be effectively used to study the dynamic behaviour of waterlogged areas. In this study, waterlogged and salt-affected areas have been estimated in the command area of Ravi-Tawi Irrigation Complex in Jammu region. About 14% of the total commond area is water logged/salt-affected. Being a new project, this area is likely to grow in future when the project runs with its installed capacity, and as the distributaries expand in the command area. Plausible causes of water logging have been discussed, and remedial measures suggested for reclaiming operations.

Gupta, Sangeeta and Singh, Magan 2005. **Wood microstructure, ultrastructure and systematic study of indian *Terminalia***. *The Indian Forester*, 131(8): 995-1011. Wood Anatomy Discipline, Botany Division, Forest Research Institute, Dehradun. [ANATOMICAL STUDY; NTFP; WOOD SAMPLES]

The genus *Terminalia* L. is of great forestry and economic importance, as it includes a number of valuable timbers, gum and tannin yielding species. It comprises of 250 species distributed throughout the tropical and sub-tropical regions of the world. In india, the genus is represented by 18 species. In this paper a detailed microscopic wood anatomical survey of the 15 species of this genus is presented based on the standard list of features given by International association of Wood Anatomists (IAWA). Numeric key based on IAWA features and species identification key has been developed based on the study. Photomicrographs have been added of microstructure and ultra structure features as seen under Scanning Electron Microscope (SEM). Remarks on systematic positions of species have been presented specially with regards to *T. tomentosa* and *T. chebula* group.

Gupta, Vishal 2005. ***Jhum* cultivation practices of the Bangnis (Nishis) of Arunachal Pradesh**. *Indian Journal of Traditional Knowledge*, 4(1): 47-56. Divisional Forest Officer, Seppa Forest Division, Seppa 790 102, Arunachal Pradesh, India. [ARUNACHAL PRADESH; BANGNI TRIBE; JHUM CULTIVATION; NISHIS TRIBE; RICE BEER]

Jhum (slash and burn cultivation) is an age-old system of agriculture among the indigenous groups in the humid tropics. The Jhumias make use of the local ecological and environmental conditions to their advantage. The natural indicators, their magico-religious beliefs, and analogy & faith condition their decision-making. Worships, rituals, myths and folktales also govern their land and resource use. The entire gamut of their socio-cultural life is thus woven around Jhum that is not merely and `Agricultural Activity', but a Cultural Practice' and a `Way of Life'. The paper attemts at understanding the complex relation of how the socio-cultural life of Bangni jhumias of East Kameng to Jhum. The traditional calendar of Jhum activity is presented and is followed by tracing the origin, settlement history and land stewardship of the tribe that closely relates to origin of this practice. The socio-cultural beliefs, magico-religious practices, festivities and rituals associated with Jhum are described, to give a view of their traditional system of agriculture and land management.

Hatwar, H.R.; Yadav, B.P. and Rama Rao, Y.V. 2005. **Prediction of western disturbances and associated weather over Western Himalayas**. *Current Science*, 88(6): 913-920. India Meteorological Department, Lodi Road, New Delhi 110 003, India. [RAINFALL FORECASTS; SATELLITE DATA; STREM LINE ANALYSIS; SYNOPTIC ANALYSIS; SYNOPTIC OBSERVATIONS]

Two cases of intense western disturbances which affected the northwest India have been investigated using the India Meteorological Department's operational limited area analysis and forecast system. The model results are compared with the synoptic observations, which have been enriched by additional stations installed under the national project 'Parwat'. The analysis shows that the 24-hour model forecasts are in good agreement with the observations both in respect of western disturbance's movement and intensification. Even the numerical model could predict the spatial distribution of precipitation with a high success rate and was found to be very useful in providing numerical guidance in day-to-day operational short range forecasts.

Jamir, N.S. and Lal, P. 2005. **Ethnozoological practices among Naga tribes**. *Indian Journal of Traditional Knowledge*, 4(1): 100-104. Nagaland University, Headquarter: Lumami Mokokchung 798 601, Nagaland, India. [ETHNO ZOOLOGY; NAGA TRIBES; NAGALAND; TRADITIONAL KNOWLEDGE]

The present paper describes the traditional method of treating various kinds of ailments using different vertebrates and invertebrates and/or their products by different Naga tribes. Since different Naga tribes have their own distinct language and vernacular of a particular animal differs from one tribe to other. Efforts have been made to identify different animals of medicinal value used by Naga tribes and decode their names in common English language along with their lcoal and zoologicl names as far as possible. A list of twentysix animal species and their products, nature of ailments and mode of treatments has been presented. Efforts have been to make known the animal based remedial measures practiced by and large by the Naga tribes. Though traditional in nature, most of the treatments have been reported to provide miraculous healing in various kinds of ailments.

Kalita, Bhagaban[1]; Dutta, Amalesh[1] and Choudhury, M[2]. 2005. **Fish attractant: An indigenous device to prevent escapement of fishes**. *Indian Journal of Traditional Knowledge*, 4(1): 91-93. [1]Department of Zoology, Gauhati University, Guwahati 781 014, Assam; [2]Central Inland Fisheries Research Institute, NER Centre, Guwahati, Assam, India. [ASSAM; FISH ATTRACTANT; JUBULEE; OIL CAKE; RICE BEER; RICE BRAN]

Studies on fish attractant especially in fresh water fish are very scanty. Tribal people, who practice fish attractant against the escapement of fish during inundation of ponds during flood, mainly inhabit the Karbi-Anglong district of Assam. This fish attractant is made from locally available ingredients such as rice bran, oil cake, Jubulee, etc. The practice is quite popular among the fishers in Karbi-Anglong. On verification of the efficacy of this indegenous method, it was observed that as many as 70% of fishes remain in the pond after flood.

Kanwar, Promila and Yadav, Dinesh 2005. **Indigenous animal healthcare practices of Kangra district, Himachal Pradesh**. *Indian Journal of Traditional Knowledge*, 4(2): 164-168. Department of Home Science Extension Education, College of Home Science, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur 176062, H.P., India. [ANIMAL HEALTH CARE; ETHNOMEDICINE; INDIGENOUS HEALTH CARE; KANGRA VALLEY]

Indigenous technical knowledge in animal healthcare practices was documented in the Kangra district of Himachal Pradesh by using participatory rural appraisal technique (PRA). Among the documented indigenous practices, food and mouth disease, diarrhoea, tympany, cold, fever, skin diseases, conjunctivities, wound and eaten placenta were primarily treated with medicinal plants along with other materials available with the farmers. In the opinion of the experts, these practices could be recommended as they have some scientific rationale. However, practices applied for hemorrhagic septicemia, indigestion, tail necrosis, dislocation of joints and horn fracture, were doubtful for recommendations.

Kharkwal, Geeta; Mehrotra, Poonam and Pangtey, Yashpal Singh 2005. **Comparative studies on species richness, diversity and composition of oak forests in Nainital district, Uttaranchal**. *Current Science*, 89(4): 668-672. Department of Botany, Kumaun University, Nainital 263 002, India. [COMPOSITION; DIVERSITY; OAK FOREST; SPECIES RICHNESS]

Species richness, diversity and composition of herb species in oak forests, viz. Banj oak *(Quercus leucotrichophora*) A. Camus, Tilonj oak *(Quercus floribunda*) Rehder and Kharsu oak *(Quercus semecarpifolia*) Smith were evaluated. The total number of species, genera and families observed for Kharsu oak forest was higher than Banj and Tilonj oak forests. Only a few species were dominant in all study sites. Asteraceae and Lamiaceae were found to be the dominant families in all the forest types. Regarding ecological structure and composition, the study revealed that Banj and Tilonj oak forests were less complex in comparison to Kharsu oak forest.

Khumbongmayum, Ashalata Devi[1]; Khan, M.L.[1] and Tripathi, R.S[2]. 2005. **Survival and growth of seedling of a few tree species in the four sacred groves of Manipur, Northeast India**. *Current Science*, 88(11): 1781-1788. [1]Department of Forestry, North Eastern Regional Institute of Science and Technology, Nirjuli 791 109, India; [2]Department of Botany, North-Eastern Hill University, Shillong 793 022, India. [ENVIRONMENTAL CONDITION; MICRO-CLIMATIC CONDITION; SACRED GROVE; SEEDLING; SOIL MOISTURE]

Vegetation in the sacred groves is protected and conserved because of religious beliefs and cultural practices of local people. Regeneration of species in the groves is largely influenced by micro-climatic conditions. Differences in growth response of nine tree species in terms of relative growth rate for height (RGRH) and relative total leaf area (RGRA) were studied in the gaps and understorey of the four selected sacred groves of Manipur, Northeast India. Seedling survival, RGRH and RGRA were higher in the gaps than in the understorey. This clearly indicates that tree species differ in their response to light environment and the growth of seedlings was influenced by canopy openness. Seedling mortality was greater during February and lower during June, which is a wet month in Manipur. RGRH and RGRA revealed interaction of season and attained the higher relative growth rates during the wet and moist season (summer season) and lower rates during the cool and dry period (winter season), while temporal changes are caused by physiological parameters. Progressive increase in growth rates during the wet season may by attributed to the increased availability of nutrients due to rapid decomposition of litter on the forest floor and also to higher moisture content of the soil during the summer season experiencing rainfall. Peak seedling growth during the rainy season in all the species could be attributed of favourable temperature and soil moisture conditions. Results of the study indicate better growth and survival of species in the gaps than the understorey. Variation in height growth and leaf area of the seedlings of different species may be partly responsible for the differences in growth behaviour and species-specific attributes for efficient utilization of resources under a given set of environmental conditions.

Khumbongmayum, Ashalata Devi[1]; Khan, M.L.[1] and Tripathi, R.S[2]. 2005. **Ethnomedicinal plants in the sacred groves of Manipur**. *Indian Journal of Traditional Knowledge*, 4(1): 21-32. [1]Department of Forestry, North-Eastern Regional Institute of Science & Technology, Nirjuli 791 109, Itanagar, Arunachal Pradesh; [2]Department of Botany, North-Eastern Hill University, Shillong 793 022, Meghalaya. [CONSERVATION; ETHNOBOTANY; ETHNOMEDICINE; MEDICINAL PLANTS; SACRED GROVE]

Ethnobotanical studies carried out in the four sacred groves of Manipur revealed therapeutic applications of 120 plant species representing 106 genera and 57 families. Tree species contributed the maximum having 42% while herbs recorded 33% of the total medicinal plants. These plants are used for a wide range of common ailments like skin disorders, ulcer, rheumation, bronchitis, etc. Majority of the preparations are taken orally in the form of juice extracted from the freshly collected plant parts. Leaves are the major plant parts used for the preparation of medicine by the medicine-men *(Maibas*). Most of the plant parts are harvested from the wild. It has been observed that the species that are scarce locally in the forest due to various development activities, deforestation, over-exploitation, etc. are abundant in the `sacred groves'. Information on medicinal claims was collected from the elderly people residing in the vicinity of sacred groves and also from the traditional healers called *`Maibas'*. The study describes details of botanical identity, family, local name, parts of the plant used, therapeutic uses, and mode of application of the drug.

Kulkarni, Anil V.[1]; Rathore, B.P.[1]; Mahajan, Suresh[2] and Mathur, P[3]. 2005. **Alarming retreat of Parbati glacier, Beas basin, Himachal Pradesh**. *Current Science*, 88(11): 1844-1850. [1]Marine and Water Resources Group, Space Application Centre (ISRO), Ahmedabad 380 015; [2]Central Department

of Hydrology and Meteorology, Tribhuvan University, Keerthipur, Kathmandu, Nepal; [3]Snow and Avalanche Study Establishment, Him Parisar, Sector 37-A, Chandigarh 160 030, India. [CLIMATIC VARIATION; GLOBAL POSITIONING SYSTEM; SATELLITE DATA; SATELLITE IMAGES]

The Himalayas has one of the largest concentrations of glaciers outside the Polar regions. Various reports suggest that a significant number of mountain glaciers are shrinking due to climatic variations. In this communication, unusual retreat of the Parbati glacier in the Parbati river basin, Kullu district, Himachal Pradesh is reported. This is one of the largest glaciers in the valley. Satellite data of 1990, 1998, 2000 and 2001 are used in the investigation. The study has shown that the glacier had retreated 578 m between 1990 and 2001, almost 52 m per year. This rate of retreat was confirmed by field observations of glacier terminus in October 2003. Position of glacier snout was estimated by comparing its relative position with other features in field and in satellite images. In addition, position of the snout was also estimated using Global Positioning System. Compared to other glaciers in the Himalayas, this glacier is retreating at a high rate. This is possibly because the glacier is located in the lower altitude range. About 90% of the glacier is located in the altitude range lower than 5200 m; this is almost equal to the average altitude of the snow line at the end of the ablation season. The specific mass balance of the glacier is estimated using Accumulation Area Ratio method for a year 2001 as - 86 cm. The amount of retreat along with maximum length was predicted as 1461 m between 2001 and 2022, more then the present rate of retreat. This suggests that the Parbati glacier will continue to retreat at an unusual rate and it will profoundly affect the availability of water in the basin.

Kumar, Rajneesh; Sharma, Kulwant Rai and Gupta, Lalit Mohan 2005. **Variation in physico-chemical characteristics of wood of candidate plus trees of Shisham *(Dalbergia sissoo* Roxb.)**. *The Indian Forester*, 131(8): 1012-1023. Department of Forest Products and Utilization, Dr. Y.S. Parmar University of Horticulture & Forestry, Nauni-Solan, Himachal Pradesh. [DALBERGIA SISSOO; DIAMETER; DIVERSITY]

The present studies were conducted on variation in physico-chemical characteristics of wood of candidate plus trees (CPTs) of Sissoo *(Dalbergia sissoo*). Among different CPTs of Dalbergia sissoo, significant differences were noticed for all the characters except for holocellulose contents. The maximum height and diameter were recorded in Khajjian-1 whereas, the minimum height was observed in Dhaulakuan-1 and diameter in Dhartatoh-3. The maximum bark percentage was noticed in Dhartatoh-1 and minimum in Raja ka Bagh-1. The maximum sapwood percentage and minimum heartwood percentage was found in Dhaulakuan-1, while the maximum heartwood percentage was noticed in Khajjian-1. Physico-chemical properties of sapwood viz., specific gravity, fibre length, cold water solubility, hot water solubility, alcohol-benzene solubility, lignin content and holocellulose content ranged between 0.5138-0.6306, 0.93-1.22 mm, 2.25% (1.50) - 6.75% (2.60), 3.50% (1.87) - 9.15% (3.02), 1.01% (1.00) - 7.56% (2.75), 23.90 - 30.50% and 66.00 - 76.55%, respectively. Physico-chemical properties of heartwood of *Dalbergia sissoo* CPTs viz., specific gravity, cold water solubility, hot water solubility, alcohol-benzene solubility, lignin content and holocellulose content ranged between 0.5275 - 0.6905, 5.25% (2.29) -10.15% (3.19), 9.15% (3.02) - 11.55% (3.40), 6.82% (2.61) - 10.82% (3.29), 30.50 - 39.70% and 62.00 - 70.00%, respectively.

Kuniyal, C.P.; Rawat, Y.S.; Oinam, S.S.; Kuniyal, J.C. and Vishvakarma, Subhash C.R. 2005. ***Kuth (Saussurea lappa*) cultivation in the cold desert environment of the Lahaul valley, northwestern Himalaya, India: arising threats and need to revive socio-economic values**. *Biodiversity and Conservation*, 14(5): 1035-1045. G.B. Pant Institute of Himalayan Environment and Development, Himachal Unit, Mohal-Kullu 175126, Himachal Pradesh. [COLD DESERT; ENDANGERED MEDICINAL PLANT; INTEGRATED APPROACH; SAUSSUREA LAPPA]

Surveys were conducted in the cold desert environment of the Lahaul valley in the northwestern Himalaya for assessing the past and present status of *Kuth (Sausurea lappa*) cultivation. The findings reveal that this age-old practice now is in bottleneck. Main factors responsible for this setback to the species were the lengthy cultivation cycle, small land holdings, and even fluctuating and relatively low market prices. owing to these constraints farmers have now started replacing cultivation of this threatened herb with pea *(Pisum sativum* L.), potato *(Solanum tuberosum* L.) and hop *(Humulus lupulus* L.). These crops obtained popularity due to comparatively more economic returns as well as their easy adaptability to the short growth season of the cold desert environment. *Kuth* cultivation in this region is among the interesting examples of domesticating wild medicinal herb by some innovative farmers during the 1920s. However, in the recent past farmers have been less interested to continue this practice due to its larger cultivation cycle, more profits with cash crops like pea and potato, and permit formalities at the time of export from the valley. In addition to being the oldest cash crop in the cold desert environment. *Kuth* is an endangered medicinal herb that has to be conserved on a priority basis. This study attempts to find out potential measures such as regular revision of market rates, development of existing uncultivable land under medicinal plant cultivation and strengthening the marketing network through establishment of federations of farmers at village level to revive cultivation of this important species.

Lal, H.; Saroj, P.L.; Sharma, N.K.; Dadhwal, K.S.; Shrimali, S.S. and Arora, Y.K. 2005. **Mango based agri-horti system on degraded lands in Doon Valley**. *Indian J. Soil Cons.,* 33(1): 67-72. Central Soil and Water Conservation Research and Training Institute, Dehradun 248195, Uttaranchal, India. [AGRI-HORTI SYSTEM; DEGRADED LANDS; ECONOMICS; MANGO; NUTRIENTS SUPPLEMENTATION]

A field experiment was conducted for seven years (1995-2001) to study the performance of mango cv. Mallika based Agri-Horti systems on degraded gravelly riverbed lands in Doon Valley. Okra-toria cropping system gave maximum gross income of Rs. 26015 ha^{-1} $year^{-1}$ and superseded by 298.5, 142.9,73.1, 66.9, 26.6 and 24.3 per cent more over without intercrop, clusterbean-toria, pigeonpea, sesame-toria, blackgram-toria and cowpea-toria cropping systems, respectively. Okra-toria cropping system proved more beneficial with highest net profit of Rs. 7423 ha^{-1} $year^{-1}$ and maximum bebefit: cost ratio of 1.40 followed by cowpea-toria (Rs. 4285 ha^{-1} $year^{-1}$ with B:C ratio of 1.26), blackgram-toria (Rs.4086 ha^{-1} $year^{-1}$ with B:C ratio of 1.25), pigeonpea (Rs. 1803 ha^{-1} $year^{-1}$ with B:C ratio of 1.14), sesame-toria (Rs. 1222 ha^{-1} $year^{-1}$ with B:C ratio of 1.09), and without intercrop (Rs.-764 ha^{-1} $year^{-1}$ wit B:C ratio of 0.90). Pigeonpea supplemented highest amount of nitrogen, phosphorus, potassium, calcium and magnesium through their residue followed by cowpea, okra, blackgram, sesame and toria. The plant growth characters, fruit yield and quality parameters of mango not influenced were adversely due to presence of any intercrop.

Nath, P.C.; Arunachalam, A.; Khan, M.L.; Arunachalam, K. and Barbhuiya, A.R. 2005. **Vegetation analysis and tree population structure of tropical wet evergreen forests in and around Namdapha National Park, northeast India**. *Biodiversity and Conservation*, 14(9): 2109-2136. Restoration Ecology Laboratory, Department of Forestry, North Eastern Regional Institute of Science and Technology, Nirjuli 791109, Arunachal Pradesh. [NAMDAPHA NATIONAL PARK; NORTH EAST INDIA; SPECIES RICHNESS; TREE POPULATION STRUCTURE; TROPICAL WET EVERGREEN FOREST]

Species composition, diversity and tree population structure were studied in three stands of the tropical wet evergreen forest in and around Namdapha National Park, Arunachal Pradesh, India. Three study stands exposed to different intensities of disturbances were identified, viz., undisturbed (2.4 ha) in the core zone of the park, moderately disturbed (2.1 ha) in the periphery of the park and highly disturbed

(2.7 ha) outside the park area. In total 200 plant species belonging to 73 families were recorded in three stands. Tree density and basal area showed a declining trend with the increase in disturbance intensity. The densities of tree saplings and seedlings were lower in the disturbed stands than in the undisturbed stand. Species like *Altingia excelsa, Olea dioica, Terminalia chebula, Mesua ferrea* and *Shorea assamica* in the undisturbed stand and *Albizia procera* alone in the moderately disturbed stand contributed more than 50% of the total tree density in respective stands. The undisturbed stand contained young tree population. In the highly disturbed stand, the tree density was scarce, but had uncut trees of higher girth class (>210 cm GBH). Low shrub density was recorded in both disturbed stand due to frequent human disturbances; the broken canopy and direct sunlight enhanced the abundance of herbs in these stands. With a species rarity (species having <2 individuals) of ca. 50%, the tropical wet evergreen forests of the Namdapha National Park and its adjacent areas warrant more protection from human intervention and also eco-development to meet the livelihood requirements of the local inhabitants in the peripheral areas of the Namdapha National Park in order to reduce the anthropogenic pressure on the natural resources of the park.

Negi, Chandra Singh 2005. **Socio-cultural and ethnobotanical value of a sacred forest, *Thal Ke Dhar*, central Himalaya**. *Indian Journal of Traditional Knowledge*, 4(2): 190-198. Department of Zoology, Government Postgraduate College, Pithoragarh 262502, Uttaranchal. [CONSERVATION; ETHNOBOTANY; ETHNOMEDICINE; SACRED FOREST; SACRED GROVE; SACRED PLANTS; TABOOS]

The sacred groves/forests have in the recent years drawn the attention of the environmentalists due to their undisturbed conditions, which enable them to be repository of gene pools. Apart from environmental significance the sacred groves are also indicative of the phenomenon of ethnoenvironmental management. It is a social institution which permits management of biotic resources through people's participation. Unfortunately the social significance of the sacred groves has not been studied in depth and the environmental aspects are inevitably over emphasized. The present study deals with the traditional beliefs and social institutions surrounding the sacred forest - *Thal Ke Dhar* and makes an attempt to bring out the inherent environmental principles behind the conservation practices. In addition, the forest was assessed for its ethnobotanical value to the local herbalists and traditional folk medicine practitioners. Pragmatic approaches combining conservation and sustainable uses are considered as are traditional values that have preserved the sacred groves in the past. Integration of traditional values and protection mechanisms into the newly emerging cultural and religious contexts has been emphasized.

Pant, R.K.[1,4]; Phadtare, N.R.[1]; Chamyal, L.S.[2] and Juyal, Navin[3] 2005. **Quaternary deposits in Ladakh and Karakoram Himalaya: A treasure trove of the palaeoclimatic records**. *Current Science*, 88(11): 1789-1798. [1]Wadia Institute of Himalayan Geology, 33 General Mahadeo Singh Road, Dehradun 248 001, India; [2]Department of Geology, MS University of Baroda, Vadodara 390 002; [3]Physical Research Laboratory, Navrangpura, Ahmedabad 380 009, India; [4]Present Address: G-1001,Sarjan Towers, Gurulul Road, Memnagar, Ahmedabad 380 052, India. [CLIMATE CHANGE; FLUVIO-LACUSTRINE ENVIRONMENTS; GEOMORPHIC FEATURE; LADAKH; SEISMICITY]

Preliminary observations on the Quaternary deposits of Ladakh and Karakoram Himalaya and their palaeoclimatic significance are highlighted in this article. Based on the geomorphology and sedimentary field evidences, a tentative scenario of landscape evolution and climate is proposed. Our observations suggest that the Quarternary landscape was evolved due to the interation of climate and seismicity. The earliest event was dominated by regional glacial activity that was followed by humid fluvio-lacustrine environments. This phase was succeeded by a renewed phase of glacial activity, though restricted to higher altitudes due to moisture-starved condition. Following this the region experienced

marginal improvement in aridity that continued till Present. The landform diversity and Quaternary deposits provide an opportunity to undertake a multidisciplinary approach for reconstructing the history of Quaternary climate and seismicity in the region.

Paul, Ashish; Khan, M.L.; Arunachalam, A. and Arunachalam, K. 2005. **Biodiversity and conservation of rhododendrons in Arunachal Pradesh in the Indo-Burma biodiversity hotspot**. *Current Science*, 89(4): 623-634. Department of Forestry, North-Eastern Regional Institute of Science and Technology, Nirjuli 791109, India. [ANTHROPOGENIC THREATS; ARUNACHAL PRADESH; BIODIVERSITY; CONSERVATION; RHODODENDRON]

India is one of the 12 mega diversity countries in the world having two hotspots- the Western Ghats and the Eastern Himalayas, based on species rarity and endemism. Arunachal Pradesh in the Eastern Himalaya is among the 200 globally important ecoregions. The state harbours nearly 50% of the total flowering plant species in India. Rhododendrons form the dominating species all along the cool temperate, subalpine and alpine zones in the Arunachal Himalaya. Rhododendron is one of the largest genus of the Ericaceae family, occurring in the higher altitudes having ecological significance and economic importance in addition to its graceful flowers. About 98% of the Indian species is found in the Himalayan region, among which 85% is found in the Arunachal Himalaya. It has aesthetic, sacred, aromatic, medicinal and fuelwood values. Due to human interference the natural populations of rhododendrons in the Arunachal Himalaya are gradually diminishing. Major threats to rhododendrons in western Arunachal Pradesh are deforestation and unsustainable extraction of firewood by the local people. Rhododendrons which are classified as rare, endangered and threatened may be wiped out in near future from the biota, if proper management and conservation initiatives are not taken up. Various *in situ* as well as *ex situ* measures like establishment of arboretums, sanctuaries, parks and reserve forests, protected areas through community management, botanical gardens and in vitro research procedures are prescribed to conserve this species for posterity. Moreover, awareness and participation of and by the people is warranted for successful conservation.

Prasanthkumar, M.G.; Skornickova, J.; Sabu, M. and Jayasree, S. 2005. **Conservation priority and phytogeographical significance of *Rhynchanthus longiflorus* Hook. f. (Zingiberaceae): A rare, endangered species from Mizo Hills, NE India**. *Current Science*, 88(6): 977-980. Department of Botany, University of Calicut, Calicut 673 635, India. [BIO-CLIMATIC CONDITION; CONSERVATION; FRAGMENTED FORESTS; MIZO HILLS]

A rare and endangered species of *Rhynchanthus* Hook. f., *R. longiflorus* is collected and described from Mizo hills, N.E. India. The hitherto undescribed fruit is described. Phytogeographical significance and conservation measures are also mentioned.

Purohit, V.K.; Palni, L.M.S.*; Rikhari, H.C. and Nandi, S.K. 2005. **Rooting of air layered shoots of *Quercus glauca* Thunb. and subsequent performance of such plants and seedlings under different microclimatic conditions**. *The Indian Forester*, 131(6): 786-796. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, Uttaranchal; *Presently at : State Biotechnology Programme, Govt. of Uttaranchal, P.O. Haldi, Pantnagar (U.S. Nagar). [MICRO-CLIMATIC CONDITION; SEED GERMINATION; STEM CUTTING]

The rooting ability of air layered shoots of *Quercus glauca*, a difficult to root species, and subsequent performance of well rooted shoots under different microclimatic conditions have been examined. Different concentrations of auxins (IBA, NAA and IAA), Shuttedex and Bavistin (Carbendazim 50%) were used to induce rooting in shoots during rainy season. A relatively lower concentration of IBA (100 ppm) resulted in maximum (73.3%) rooting of air layered shoots, whereas

highest number of roots per air layered shoot were formed when the same concentration of NAA was used. The survival of rooted shoots (plants) thus obtained was 100% inside a mist chamber, following transfer to soil. The increment in height and leaf number after one year was found to be maximum for plants kept inside a polyhouse, followed by those kept in a polypit. However, the lowest values for these two parameters were observed for plant kept in the open and under a chhappar (thatch), respectively. On the other hand maximum and minimum height increment for seed raised plants was observed when the seedling were grown inside a polypit and in the open, respectively. Although the relative growth rate of both seedlings and air-layered plants was found to significantly differ under different microclimatic conditions, the same was not statistically different for the plants raised by these two methods, indicating that the performance of air layered plants and seedlings in comparable.

Rai, S.C. 2005. **Apatani paddy-cum-fish cultivation: An indigenous hill farming system of North East India**. *Indian Journal of Traditional Knowledge*, 4(1): 65-71. G.B. Pant Institute of Himalayan Environment and Development, North East Unit, Vivek Vihar, Itanagar 791 113, Arunachal Pradesh. [AGROECOSYSTEM; INDIGENOUS KNOWLEDGE; JHUM CULTIVATION; LAND MANAGEMENT; WET-RICE CULTIVATION]

The tribal communities of North East India have paddy-cum-fish farming along with shifting cultivation *(Jhum*). Paddy-cum-fish cultivation is practiced mainly by Apatani, a progressive agricultural community of Arunachal Pradesh. The Apatani version of paddy cultivation is one of the most advanced cultivation practices. The main advantage from the practice is that, the land gives sustained yield year after year, unlike the *Jhum* system, that is under cropping only once in a few years of fallow interval, depending upon the *Jhum* cycle. The economic and energy efficiency of this agro-ecosystem is exceptionally high and rice is exported after meeting local needs. Rain fed cultivation of millet and mixed cropping contributes toward meeting the diverse needs of the people. Mithun, Swine and poultry husbandry are an important link with agro-ecosystems. Therefore, an understanding of this agro-ecosystem function becomes significant and it offers opportunities for redevelopment with additional scientific inputs.

Rashid, Shaik A. 2005. **The geochemistry of Mesoproterozoic clastic sedimentary rocks from the Rautgara Formation, Kumaun Lesser Himalaya: Implications for provenance, mineralogical control and weathering**. *Current Science*, 88(11): 1832-1836. Department of Geology, Aligarh Muslim University, Aligarh 202 002, India. [GEOCHEMICAL ANALYSES; LESSER HIMALAYA; RARE EARTH ELEMENTS; SEDIMENTARY ROCKS]

The Mesoproterozoic clastic sedimentary rocks, comprising pelites and quartzites from the Rautgara Formation, Kumaun Lesser Himalaya, have been analysed for major and trace elements, including Rare Earth Elements (REEs) to evaluate their provenance and weathering history. The pelitic rocks are characterized by moderate SiO_2 and AI_2O_3 contents and show consistent REE patterns with LREE (light REE)-enriched and HREE (heavy REE)-depleted patterns (La_N/Yb_N=7.4-10.3). The total REE abundances of Rautgara pelites are high (up to 266 ppm) with large negative Eu-anomalies (Eu/Eu^*=0.57-0.64). Except high SiO_2 contents, the other major and trace element concentrations are significantly low in the associated quartzites. Although the quartzites contain low REE abundances (up to 41 ppm), their pattern, including negative Eu anomalies, are akin to pelites, suggesting that both the rock types be derived from similar source. The Chemical Index of Alteration and A-CN-K parameters indicate that moderate chemical weathering has taken place in the source region of the Rautgara rocks. The linear correlation co-efficients between AI_2O_3, K_2O, TiO_2 and total REE reveal that the accessory minerals (mainly Ti-bearing phases) have hosted the REEs. The striking similarities between the REE patterns of Rautgara pelites and BGC of Aravalli and Bundelkhand granitoids, which are consistent with

the palaeocurrent studies of the area, indicate that the granitoid rocks from these regions have supplied detritus to the Lesser Himalayan Rautgara sedimentary basin.

Rawat, R.S. 2005. **Studies on interrelationship of woody vegetation density and soil characteristics along an altitudinal gradient in a montane forest of Garhwal Himalayas**. *The Indian Forester*, 131(8): 990-994. Department of Botany, H.N.B. Garhwal University, Srinagar, Uttaranchal; Present Address: Himalayan Forest Research Institute, Conifer Campus, Shimla, H.P. [BROAD-LEAVED FOREST; COLLAR DIAMETER; GARHWAL HIMALAYA]

In the present study density of woody vegetation and soil characteristics were studied along an altitudinal gradient from 1,700 to 2,100 m above msl in a mountain flank of Garhwal Himalaya. Maximum total tree density (density of tree, sapling and seedling) was recorded for the upper slope followed by middle and lower slopes respectively; whereas in case of shrub maximum density was recorded for lower slope followed by middle and upper slope respectively. Results of soil pH, organic carbon and potassium were found to be statistically significant at 5 per cent level of significance; where organic carbon and potassium were positively correlated and soil pH showed negative correlation with the altitudinal gradient. However, phosphorus content showed non-significant correlation.

Sahoo, K.N.; Datta, G.K.; Pandit, S.K.; Biswas, T.K. and Debnath, P.K. 2005. **A life saving medicine made by a vanishing species**. *Indian Journal of Traditional Knowledge*, 4(2): 132-138. J.B. Roy State Ayurvedic Medical College & Hospital, Kolkata 700 004, West Bengal, India. [ANTISNAKE VENOM; APHRODISIAC ACTIVITY; AYURVEDA; IMMUNOMODULATOR; KASTURI; MUSK; RASAYANA DRUG; SEX STIMULANT]

Kasturi (musk) obtained from *Kasturi mriga* (musk deer), was chiefly used as a *Rasayana* (immunomodulator) as well as *Vajikarana* (aphrodisiac) by the ancient physicians of Ayurveda. It was once considered as last resort of emergency medicine. Some experimental studies on its stimulant and antisnake venom properties are reported to be promising. Detailed discussion on *Kasturi* has been made in the review.

Sankhyan, H.P.; Sehgal, R.N. and Bhrot, N.P. 2005. **Standardization of presowing treatments for different Seabuckthorn species in cold deserts of Himachal Pradesh**. *The Indian Forester*, 131(7): 931-938. Department of Tree Improvement and Genetic Resources, College of Forestry, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. [COLD DESERT; COLLAR DIAMETER; SEABUCKTHORN; SEED GERMINATION]

Seabuckthorn is a wonderful plant for the afforestation and ecological rejuvenation of the cold desert areas of Himalayas where plantations of poplars, willows and robinia have not given very encouraging results. It has the potential to economically transform these harsh and marginal areas plagued by low productivity. Keeping in view, almost complete lack of information in India on regeneration through seed the present investigation was carried out to standardize various presowing treatments in two species of Seabuckthorn in the cold desert of Himachal Pradesh. Different presowing treatments were hot water (80^{o}C for 10 minutes), conc. H_2SO_4 (20 minutes), cold water for 2,4 and 6 days, cow dung heap for 2 days and control. In case of *Hippophae rhamnoides*, the best presowing treatment was found to be cold water soaking for 6 days which resulted in the highest germination per cent (93.33), per cent survival (73.33), growth index (69.78) and SVI (8502.36). However, for *H. salicifolia* soaking treatment in hot water at 80^{o}C for 10 minutes was found to be the best and resulted in the highest germination per cent (76.66), per cent survival (60.00) shoot length (45.6 cm), root length (70.9 cm), growth index (39.90) and SVI (8930.89) and ranked first.

Sekar, K. Chandra and Srivastava, S.K. 2005. **Traditional uses of plants in curing jaundice in Pin Valley National Park, Himachal Pradesh**. *Indian Journal of Traditional Knowledge*, 4(3): 314-316. Botanical Survey of India (NC), 192 Kaulagarh Road, Dehradun 248195, Uttaranchal. [JAUNDICE; PIN VALLEY NATIONAL PARK; TRADITIONAL USES]

The paper provides traditional uses of few plant species in curring jaundice by the local community residing in and around Pin Valley National Park, Lahaul & Spiti in Himachal Pradesh. Their uses along with the dosages and combination with other plants are provided.

Seth, M.K.; Thakur, Madhu and Kapoor, Ira 2005. **Circumferential and radial variation in ring width in west Himalayan fir *(Abies pindrow* Royle)**. *The Indian Forester*, 131(8): 1091-1100. Department of Bio-Sciences, Himachal Pradesh University, Shimla, H.P. [HIMALAYAN FIR; RADIAL PATTERN; RING WIDTH]

In west Himalayan fir *(Abies pindrow* Royle) ring width does not differ significantly among eight cardinal directions. It is negatively and significantly correlated with age. Mean ring width value of juvenile wood is significantly and positively correlated with the mean ring width value of intermediate as well as mature wood. The ring width of individual juvenile wood rings (1-10 from pith) is not correlated with the mean ring width value of mature wood. Based on the results of present investigations it is suggested that any random raidal direction can be used to compare ring width values among straight tree of West Himalayan Fir. A random sample of five juvenile wood rings and four mature wood rings are required to compare the ring width values amongst trees for juvenile wood and mature wood respectively in *Abies pindrow* Royle.

Sharma, A.R.; Singh, Ratan and Dhyani, S.K. 2005. **Conservation tillage and mulching for optimizing productivity in maize- wheat cropping system in the outer western Himalayan region - a review**. *Indian J. Soil Cons.,*, 33(1): 35-43. Central Soil and Water Conservation Research and Training Institute, Dehradun 248 195, Uttaranchal, India. [ALLEY CROPPING; EROSION LOSSES; LIVE MULCHING; PRODUCTIVITY; RESIDUAL MOISTURE; TILLAGE]

Maize and wheat are the most important crops grown in sequence largely under rainfed conditions, with low inputs and traditional practices in the outer western Himalayan region. Deficiency of moisture and nutrients is primarily responsible for low productivity of these crops. The conventional practices for alleviating these stresses such as summer ploughing, use of organics, intercropping with legumes, mulching, *haloding* (interculturing), earthing-up and ploughing immediately after harvesting of maize are gradually being discontinued by the farmers due to various emerging problems. This article reviews the effects of tillage and mulching on moisture conservation and nutrient use in the maize-wheat cropping system. Field studies at different locations of this region have shown the beneficial effects of resource conserving technologies for improving productivity of maize and following wheat. The results have suggested that the conventional repetitive tillage operations including deep ploughing can be dispensed with, and equally good or even higher yield can be obtained with minimum or zero tillage along with mulching or residue management practices over a period due to improved soil environment. Live mulching with weeds, annual legumes or pruned biomass of perennial legumes in alley cropping systems are beneficial for efficient conservation of soil, moisture and nutrients for higher productivity in maize-wheat cropping system. There is a need for adopting diversified farming systems approach for improving productivity of crops as well as other enterprises for greater livelihood security of the farming community in this region.

Sharma, Ajay 2005. **Management of *Locastra muscosalis* walker (Lepidoptera : Pyralidae) using certain synthetic insecticides and physical methods**. *The Indian Forester*, 131(7): 939-942.

Department of Entomology and Apiculture, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, H.P. [EGG MASSES; INSECTICIDES; LARVAL POPULATION]

The efficacy of three synthetic insecticides and three neem products was evaluated in the field for the control of *Locastra muscosalis* Walker (Lepidoptera : Pyralidae) affecting *Pistacia integerrima* Stew ex. Brandis trees growing in the campus of Dr. Y.S. Parmar University of Horticulture and Forestry Nauni, Solan (H.P.). Along with these insecticides, a physical practice of removing the egg masses was also evaluated as a control method. Removal of egg masses was found to be the most successful method in controlling this pest. Amont the various chemicals used Endosulfan 35EC (1.5ml/lt) was found to be the most effective followed by Monocrotophos 36SL (2.5ml/lt) and Chlorpyriphos 20EC (2.5ml/lt). The neem products used to control the pest were found to show negligible effect in controlling the pest population when compared with the synthetic insecticides.

Sharma, Bindia and Maheshwari, Snehlata 2005. **Traditional medical practices of Gaddi tribes in Kangra district, Himachal Pradesh**. *Indian Journal of Traditional Knowledge*, 4(2): 169-172. Department of Home Science Extension Education, College of Home Science, Maharana Pratap University of Agriculture and Technology Udaipur 313001, Rajasthan, India. [DIARRHOEA; ETHNOMEDICINE; GADDI TRIBES; KANGRA TRADITIONAL MEDICAL PRACTICES; PINWORM]

The tribal people of Himachal Pradesh living close to forests and facing unfavourable climatic conditions have rich traditional knowledge, which was documented and tested on scientific scale and mostly recommended for further research. Traditional practices followed by the Gaddi tribes in Kangra district of Himachal Pradesh to cure pinworm and diarohoeal problems among infants have been discussed.

Sharma, H. Manoranjan[1]; Devi, A. Radhapyari[1] and Sharma, B. Manihar[2] 2005. **Vegetable dyes used by the Meitei community of Manipur**. *Indian Journal of Traditional Knowledge*, 4(1): 39-46. [1]Department of Botany, Thoubal College, Thoubal 795 138, Manipur; [2]Ecology Research Laboratory, Department of Life Sciences, Manipur University, Canchipur 795 003, Manipur, India. [ETHNOBOTANY; MANIPUR; MEITEI COMMUNITY; VEGETABLE DYES]

The paper describes 34 plant species, belonging to 30 families, used in the extraction of dyes by the Meitei community of Manipur. The plant parts used in the extraction of dyes along with the method of extraction and their uses have also been described in detail. Besides these dye-yielding plants, another 19 plant species belonging to 14 families, used as dye mordants have also been included. The people of the state still use these dyes for dyeing of their handloom products, which are famous all over the world.

Singh, H. Birkumar and Singh, Th Brojendro 2005. **Plants used for making traditional rosaries in Manipur**. *Indian Journal of Traditional Knowledge*, 4(1): 15-20. Regional Research Laboratory, Substation (CSIR), Lamphelpat 795 004, Manipur, India; Oriental College, Takyelpat 795 001, Manipur. [ETHNOBOTANY; MANIPUR; MEDICINAL PLANTS; MEITEI TRIBE; ROSARY PLANTS; TRADITIONAL ROSARIES]

The uses of rosaries made from various plant parts of the Meitei community in Manipur are the symbol of tradition and culture and are used as ornaments or related to health and/or religious practices. Out of the 20 plants, reported to be used for rosaries, 18 plants belonging to 15 families, are used to cure 29 diseases or complicacies such as fever, gout, urinary disorder, rheumatism, tuberculosis, heart diseases, liver complaint, bronchitis, etc. Some of the rosaries are also sold in the local markets and fetch good price. There is scope for promotion of traditional rosaries as cottage industry in the state.

Singh, Pratap[1]; Haritashya, U.K.[2]; Ramasastri, K.S[1]. and Kumar, Naresh[1] 2005. **Prevailing weather conditions during summer seasons around Gangotri Glacier**. *Current Science*, 88(5): 753-760. [1]National Institute of Hydrology, Roorkee 247 667, India; [2]Department of Earth Sciences, Indian Institute of Technology, Roorkee 247 667, India. [CRYSTALLINE ZONE; GANGOTRI GLACIER; HIGH ALTITUTE HIMALAYAN; MELTING SEASON]

Meteorological data collected near the snout of the Gangotri Glacier suggest that the study area receives less rainfall. The average seasonal rainfall is observed to be about 260 mm. The rainfall distribution does not show any monsoon impact. Amount of seasonal rainfall is highly variable (131.4-368.8 mm) from year to year, but, in general, August had the maximum rainfall. Average daily maximum and minimum temperatures were 14.7 and 4.1°C repectively, whereas average mean temperature was 9.4°C. July was recorded as the warmest month. During daytime, wind speed was four times higher than that at night-time. The average daytime and night-time winds were 12.6 and 3.0 km/h respectively. Mean seasonal evaporation was 640.8 mm, which is high with respect to the high altitude. Average relative humidity and daily sunshine duration were also high throughout the melting season.

Singh, S.P.; Bargali, Kiran; Joshi, Asha and Chaudhry, Smita 2005. **Nitrogen resorption in leaves of tree and shrub seedlings in response to increasing soil fertility**. *Current Science*, 89(2): 389-396. Department of Botany, Kumaun University, Nainital 263002, Uttaranchal, India. [NITROGEN AVAILABILITY; NITROGEN RESORPTION; NUTRIENTS; SOIL FERTILITY]

In the present study an attempt was made to examine the relationship between availability of nitrogen in soil and the resorption of nitrogen before leaf fall. For this, common tree *(Quercus leucotrichophora, Pinus roxburghii, Cupressus torulosa, Alnus nepalensis* and *Populus ciliata*) and shrub species *(Desmodium elegans* and *Crataegus crenulata*) of Central Himalayan forests varying in leaf lifespan and other characters were selected. Seedlings of these species were raised from current year seed crop and grown at various levels of nitrogen availability. The species differed with regard to nitrogen level up to which their biomass increased with increasing nitrogen availability. In each species, the proportional resorption of nitrogen decreased continuously with increasing nutrient level. The nutrient use efficiency also decreased with increasing nutrient level in each species. These results suggest that as the availability of a limiting nutrient increases, the mechanisms used by plants to conserve that nutrient may become less efficient.

Singh, Surendra Pratap; Sah, Pankaj; Tyagi, Vidit and Jina, Bhupendra Singh 2005. **Species diversity contributes to productivity- Evidence from natural grassland communities of the Himalaya**. *Current Science*, 89(3): 548-552. Department of Botany, Kumaun University, Nainital 263002, Uttaranchal, India. [BIODIVERSITY; ECOSYSTEM; GRASSLAND]

The impact of species diversity on ecosystem functioning has generated considerable research and tremendous debate in view of the accelarated depletion of biodiversity worldwide. A number of recently conducted experiments based on synthetic assemblages of plant species indicated that ecosystem productivity declines with loss of species. The problem with acceptability of this hypothesis is that in spite of best efforts, conditions created in the experiments fall short of natural conditions. The present study, which was carried out in alpine grasslands of Himalaya, is from natural ecosystems to lend support to the above hypothesis. It emphasizes that with the depletion of biodiversity, we are going to lose some of the life-supporting ecosystem services.

Singh, V.N.[1] and Mittal, Abha[2] 2005. **Synthetic accelerograms for two Himalayan earthquakes using convolution**. *Current Science*, 88(8): 1289-1297. [1]Department of Earth Sciences, Indian Institute of Technology, Roorkee 247 667; [2]Central Building Research Institute, Roorkee 247 667, India.

[HIMALAYAN EARTHQUAKES; MAIN BOUNDARY THRUST; MAIN CENTRAL THRUST; SEISMIC ZONE]

In the present communication, computation of synthetic accelerograms is based on convolution. The spectrum of ground motion expected at a recoding site is first computed from a knowledge of source parameters and medium properties. This spectrum is then inverse Fourier transformed to yield the desired synthetic accelerogram. This method has been successfully used by Boore, and has been further extended in the present communication. The suitability of the method is demonstrated successfully by modelling the accelerograms for two Himalayan earthquakes namely, the 1991 Uttarkashi earthquake and the 1999 Chamoli earthquake and compared with the observed accelerograms.

Singh, Virendra and Chauhan, N.S. 2005. **Traditional practices of herbal medicines in the Lahaul valleys, Himachal Himalayas**. *Indian Journal of Traditional Knowledge*, 4(2): 208-220. CSK Himachal Pradesh Agricultural University, Hill Agriculture Research and Extension Centre, Bajaura 175125, Kullu, Himachal Pradesh; Department of Forest Products, Dr Y.S. Parmar University of Horticulture and Forestry, Nauni 173230, Solan, Himachal Pradesh. [HERBAL MEDICINE; LAHAUL VALLEY; TRADITIONAL PRACTICES]

Observations on the traditional practices of herbal medicines were recorded in the villages of Lahaul, a semi-arid region of district Lahaul-Spiti, a dry temperate region of Himachal Himalayas. The information was recorded for the habitat, plant characteristics, plant part used of 43 plant species, belonging to 25 families and diseases treated in the Lahaul Valley.

Sinha, B.L. [1]; Rastogi, R.A.; Saxena, V.K. and Kumar, D. 2005. **A discrete linear rainfall-runoff model for Chaukhutia watershed**. *Indian J. Soil Cons.,*, 33(1): 13-17. [1]ACICRP for Dry Land Agriculture, R.B.S. College, Bichpuri, Agra, U.P.; Department of Soil & Water Conservation Engineering, College of Technology, G.B. Pant University of Agriculture and Technology, Pantnagar 263195, Udham Singh Nagar, Uttaranchal. [CHAUKHUTIA WATERSHED; HYDROGRAPHS; RAINFALL; RUNOFF]

A discrete linear rainfall-runoff model for Chaukhutia watershed to Ramganga river was developed for estimating direct runoff hydrographs on storm basis. The parameters of the model were determined by using least square method. The model was calibrated for twenty four storm events and verified for four storm events. The computed direct runoff hydrographs by model were in close agreement with the observed direct runoff hydrographs. The average value of the integral square error and coefficient of efficiency were found to be 0.0568 and 0.9778, respectively. The regression equations were also established relating computed and observed peak runoff rates with effective rainfall.

Tag, Hui[1]; Das, A.K[2]. and Kalita, Pallabi[3] 2005. **Plants used by the Hill Miri tribe of Arunachal Pradesh in ethnofisheries**. *Indian Journal of Traditional Knowledge*, 4(1): 57-64. [1]Department of Botany, Arunachal Pradesh University, Itanagar 791 112, Arunachal Pradesh; [2]Department of Botany, Arunachal Pradesh University, Rono Hills, Itanagar 791 112; [3]Department of Zoology, Arunachal Pradesh University, Rono Hills, Itanagar 791 112, Arunachal Pradesh, India. [ETHNOBIOLOGY; ETHNOFISHERIES; ETHNOMEDICINE; FISH POISON; HILL MIRI TRIBE]

The state of Arunachal Pradesh is known for its rich bioresources and ethnocultural diversity. Ethnobiological survey was conducted during 2001-2003 in Hill Miri dominated districts of Arunachal Pradesh, which reveals their hidden Indigenous Knowledge System. Fishing and hunting is one of the major economic activities of this hilly tribe apart from *Jhum* cultivation. They derive their fish protein diet requirement directly from the wild sources. Two major rivers and number of its tributaries form ideal site for fisheries activity. A total of 21 plants significant for ethnofisheries have been listed. Twelve

plants are used as ethnotoxic (Fish Poison) and rest 9 species are used in different ethnofisheries techniques and gears.

Thakur, A.K.; Sharma, Sarita and Srivastava, D.K. 2005. **Plant regeneration and genetic transformation studies in petiole tissue of Himalayan poplar *(Populus ciliata* Wall.)**. *Current Science*, 89(4): 664-667. Department of Biochemistry, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan 173 230, India. [β-GLUCURONIDASE; DIRECT ORGANOGENESIS; GENETIC TRANSFORMATION; PLANT REGENERATION; *POPULUS CILIATA*]

Plant generation and genetic transformation techniques have been developed in petiole tissue of Himalayan poplar *(Populus ciliata*). High frequency shoot regeneration via direct organogenesis was obtained on MS medium supplemented with 1.50 mg/1 Kn and 0.10 mg/1 IAA using petiole explant. High percentage root regeneration in *in vitro* developed shoots was obtained on MS medium supplemented with 0.10 mg/1 IAA. Himalayan poplar plantlets were able to regenerate within two months. Genetic transformation studies were caried out using disarmed *Agrobacterium tumefaciens* strain LBA 4404 containing *gus* gene *(β*-glucuronidase) in binary vector pBI 121 along with *npt-II* (neomycin phosphotransferase-II) gene. After cocultivation, the transformed cells were selected on the selective medium containing 50 mg/1 kanamycin. Successful genetic transformation in the transformed calluses from petiole explant was confirmed by β-glucuronidase enzyme assay.

Tripathy, Nihar R. and Srivastava, H.B. 2005. **Mesoscopie ductile shear zones from the Main Central Thrust zone of Bhagirathi Valley, Garhwal Higher Himalaya**. *Current Science*, 88(5): 815-821. Department of Geology, Banaras Hindu University, Varanasi 221 005, India. [BHAGIRATHI VALLEY; GARHWAL HIMALAYA; MAIN CENTRAL THRUST]

Mesoscopic ductile shear zones are well developed in the crystalline rocks of the Main Central Thurst (MCT) zone of Bhagirathi valley. Ductile and brittle-ductile shear zones are dominantly observed and exhibit both sinistral and dextral sense of sear. Detailed analysis reveals that NE-striking sinistral and NW-striking dextral shear zones form a conjugate pair. The bisectors of preferred orientations of these two sets of shear zones indicate that they developed in response to NNE-SSW horizontal compression synchronous to the translation of the MCT, which took place during the northward movement of the Indian plate. Strain analysis reveals that the mesoscopic ductile shear zones developed in response to very high strain, in a narrow zone, which even deformed the internal fabrics of the rocks. The study of quartz *c*-axis fabrics in mesoscopic shears zones demonstrates that a single girdle pattern of quartz developed at the shear zone boundary and became prominent in the centre of the shear zone with increase in shear strain.

Uniyal, Bhagwati and Shiva, Vandana 2005. **Traditional knowledge on medicinal plants among rural women of the Garhwal Himalaya, Uttaranchal**. *Indian Journal of Traditional Knowledge*, 4(3): 259-266. Type IV/11 (Residential Complex) Wildlife Institute of India, Post Box No. 18, Chandrabani, Dehradun 248001; Navdanya,105 Rajpur Road, Dehradun 248001, Uttaranchal. [ETHNOMEDICINE; GARHWAL HIMALAYA; MEDICINAL PLANTS; TRADITIONAL KNOWLEDGE]

The present paper deals with traditional knowledge of medicinal plants among rural women of Garhwal. Seventy women of 11 villages were interviewed on the basis of their traditional knowledge on the various uses of medicinal plants found in the adjoining forest and agricultural areas. A total of 113 medicinal plant species were recorded during the intensive surveys and discussions held with the rural women.

Uniyal, Sanjay Kumar[1,2]; Awasthi, Anjali[1] and Rawat, G.S[1]. 2005. **Biomass availability and forage quality of *Eurotia ceratoides* Mey in the rangelands of Changthang, eastern Ladakh**. *Current Science*, 89(1): 201-205. [1]Wildlife Institute of India, P.O. Box 18, Chandrabani, Dehradun 248 001, India; [2]Institute of Himalayan Bioresource Technology, P.B. No. 6, Palampur 176 061, India. [BIOMASS; ECOSYSTEM; FORAGE QUALITY; NUTRIENT QUALITY]

Rangeland condition can be assessed based on the biomass availability and nutrient quality of major forage plants. While conducting ecological studies on the rangelands of Changthang, eastern Ladakh, we assessed the above-ground biomass and nutrient quality of *Eurotia ceratoides* May (Chenopodiaceae), a common shrub in the area, following standard methods. Its density, cover and biomass were highest in the lower slope and sandy plains, while it was completely absent in the marsh meadows. Nutritive quality of *Eurotia* was found to be significantly *(P<0.005*) higher compared to other dominant species. As expected, a seasonal variation in nutrients was found. Crude protein content decreased from 21% in summer to 12% in winter, whereas anti-quality factors increased during winter. Patterns and processes of *Eurotia* degradation and its implications for the management of rangelands are discussed.

Upadhaya, K.; Pandey, H.N.; Law, P.S. and Tripathi, R.S. 2004. **Diversity and population characteristics of woody species in subtropical humid forests exposed to cultural disturbances in Meghalaya, Northeast, India**. *Tropical Ecology*, 45(2): 303-314. Department of Botany, North-Eastern Hill University, Shillong 793022. [NORTH EAST INDIA; SACRED GROVE; SPECIES RICHNESS; SUBTROPICAL HUMID FOREST; TREE DIVERSITY; TREE POPULATION STRUCTURE]

The study was carried out to assess the impact of anthropogenic disturbances of mild intensity on diversity and phytosociological attributes of tree species in two subtropical forest stands, represented by Ialong and Raliang sacred groves in Jaintia hills of Meghalaya, northeast India. A total of 159 woody species (≥5 cm dbh) of 107 genera was identified in the two groves spreading over an area of 2 ha. The richness of woody species in 0.5 ha study plots increased from 80-82 in the protected stands to 92-93 in the disturbed stands of the two groves. In case of Ialong sacred groves, their density decreased from 1476 stems ha^{-1} in the protected stand to 1340 stems ha^{-1} in the disturbed stand whereas, in the Raliang sacred grove, it increased from 938 stems ha^{-1} in the protected stand to 1308 stems ha^{-1} in the disturbed stand. The basal area was higher in the undisturbed stands (57 to 71 m^2ha^{-1}) than the disturbed stands (36 to 49 m^2h^{-1}) in both the groves. Its distribution in different dbh classes resulted in a J-shaped curve in all but one stand. On the contrary, distribution of both species richness as well as their density in different dbh classes yielded a reverse J-shaped curve. Results revealed that the disturbance of mild intensity, to which these forests were exposed, enhanced species richness without altering tree population structure of the community.

Upadhaya, K.; Pandey, H.N.; Law, P.S. and Tripathi, R.S. 2005. **Plants of ethnobotanical importance in the sacred groves of Jaintia hills of Meghalaya**. *The Indian Forester*, 131(6): 819-828. Department of Botany, North Eastern Hill University, Shillong, Meghalaya. [BIODIVERSITY; FLORISTIC DIVERSITY; JAINTIA HILLS; RESERVE FOREST; SACRED GROVE]

Sacred groves are patches of virgin forests, protected by the indigenous people as a part of their culture and religious beliefs. The paper records 69 species of ethnobotanical importance used by the Jaintia tribe living around Ialong and Raliang sacred groves in the Jaintia Hills of Meghalaya.

Upadhyay, Rajeev[1]; Awatar, Ram[2]; Kar, R.K.[2] and Sinha, A.K[3]. 2005. **First record of Middle-Late Jurassic palynomorphs from the Lamayuru Complex, Indus Suture Zone, Ladakh, India**. *Current Science*, 88(6): 980-986. [1]Department of Geology, Kumaun University, Nainital 263 002; [2]Birbal Sahni

Institute of Palaeobotany, 53 University Road, Lucknow 226 007; [3]Apartment B-602, GH-19, Sector-56, Gurgaon, India. [INDUS SUTURE ZONE; LADAKH; ROCK FORMATION]

We report here Middle-Late Jurassic palynomorphs bearing sediments from the Lamayuru Complex, exposed along the Indus-Tsangpo Suture Zone in Ladakh. Apart from addition of new data towards understanding the geodynamics of the India-Asia collision zone, this will be helpful in understanding the formation of the slope-deep marine passive margin turbidites basin along the Indus Suture Zone, its palaeogeography and the processes of sedimentation and tectonics during subduction of the Indian plate beneath the Asian plate. The presently recorded Middle-Late Jurassic palynomorphs from the Lamayuru Complex also help to further strengthen our viewpoint that the Permian and Mesozoic palynomorphs bearing sediments were reworked from the Zanskar-Lamayuru Complex Tethyan realm and transported through the Lamayuru Complex to the Nindam basin during ongoing geodynamic processes operative within the India-Asia trench-forearc subduction complex between Cretaceous-Palaeocene time span.

Verma, M.P. and Rastogi, R.A[1]**.** 2005. **Liner reservoir model of Chaukhutia watershed**. *Indian J. Soil Cons.,*, 33(1): 18-21. KVK Gorakhpur, Uttar Pradesh; [1]C/o Sri H.P. Verma, 1099/2, D-Block, Indira Nagar, Lucknow 226016, U.P. India. [CLARK IUH; LINEAR RESERVOIR ROUTING]

The rainfall runoff process is non-linear and hydrodynamic with spatially distributed input and outputs. The complexity of rainfall runoff process and the absence of data with which to describe in detail the character of heterogeneous watersheds and of spatially distributed inputs, simulation of the rainfall process is generally based on concept of conceptual models. Such model contains parameters that must be estimated and models vary in range of runoff situations. Due to complexity of the hydrologic process the conceptual or time area histogram model was applied on Chaukhutia watershed for the development of hydrographs through routing the series of linear reservoir model. The coefficient of efficiency of the model was found to be very high (0.8370) which shows that the model adaptable for the watershed DRH development.

Yadav, R.P.; Aggarwal, R.K.; Bhattacharyya, P. and Bansal, R.C. 2005. **Infiltration characteristics of different aspects and topographical locations of hilly watershed in Shivalik - lower Himalayan region in India**. *Indian J. Soil Cons.,*, 33(1): 44-48. Central Soil and Water Conservation Research and Training Institute, Research Center, Sector-27A, Madhya Marg, Chandigarh 160 019, India. [ASPECTS; INFILTRATION RATE; TOPOGRAPHY; WATERSHED]

Infiltration characteristics in different aspects and topographic landscape in a 20 ha hilly watershed in Shivalik-lower Himalayan region in India were studied to investigate the long-term effect of soil and water conservation measures. Litter deposition, soil texture, organic carbon and clay content of soils were also measured to know the correlation between these soil properties with infiltration. Steady state infiltration rates gradually decreased from upper to lower reaches. Very slow to slow steady state infiltration rates (0.11 and 0.14 cm hi^{-1}, respectively) were observed in lower reaches of east and north facing slopes. Cumulative infiltration were also low (0.61 to 5.2cm) in east and north facing slopes than that of west and south facing slopes (2.43 to 24.68 cm). Significant negative exponential correlation was found between litter deposition and infiltration rate.

Forthcoming Events

International workshop on geology and natural hazards of the eastern Himalaya syntaxis, Indo-Burmese arc, and adjoining region. 9-11 February 2006, Itanagar (Arunachal Pradesh), India. Contact : Dr. C.S. Dubey/Dr. B.K. Sharma, Room No. 207 & 208, Department of Geology, University of Delhi, Delhi 110 007, India (Email: csdubey@gmail.com)

International training course on small hydropower development. 14-25 February 2006, Roorkee (Uttaranchal) India. Contact : Head, Alternate Hydroenergy Centre, Indian Institute of Technology Roorkee, Roorkee 247 667 (Email : ahec@iitr.ernet.in, ahec@vsnl.com)

All India seminar on air pollution and health impacts. 23-24 February 2006, Institution of Engineers (India), Roorkee (Uttaranchal). Contact : Dr. B.R. Gurjar, Organising Secretary (AISAPHI), Dept. of Civil Engineering, IIT Roorkee 247 667 (Email: bholafce@iitr.ernet.in, brgurjar@yahoo.com).

Brain storming session on ecosystem services and ecological economics : Himalayan mountain context. 24-25 February 2006. Almora (Uttaranchal), India. Contact : Dr. G.C.S. Negi, G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643 (Email : gcsnegi@gbpihed.nic.in)

Workshop on intellectual property rights : Himalayan context. 26-27 February 2006, Almora (Uttaranchal), India. Contact : Dr. S.K. Nandi/Dr. S.C.R. Vishvakarma, G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643 (Email : shyamal_nandi@rediffmail.com / ihedhima@yahoo.co.in)

4th World Congress on mountain ungulates. 12-15 September 2006. Dehradun (Uttaranchal), India. Contact : Dr A.J.T John Singh , Wildlife Institute of India, Dehradun (Email: hrwepa.munnar@tatatea.co.in)

NEWS & VIEWS

Sikkim govt plans 3,639 mw of hydro-electricity by '09-10

In terms of sheer hydro potential, Sikkim might be the proverbial diamond in the rough but the Sikkim government has a plan to iniciate of new projects this year to create 3,639 mw capacity by 2009-10. The power genereted, besides feeding the state, will be supplied into the national grid. Sikkim will harness nearly 15% of this hydropower for free. In the proposed joint sector hydro projects, the Sikkim government will hold 26%, while private partners will hold 74% stake. Some projects will also be executed by National Hydro Power Corporation on the 'build own operate' model. Recently a MoU was lnked between the Sikkim government and a five-member consortium of private hydro undit developers to set up the 1,200 mw Teesta Hydro-Stage III.

ECONOMIC TIMES : Augest 01, 2005

Forest eviction drive continues in Karbi Anglong

The Forest Department of West Division, Karbi Anglong district carried out a successful eviction drive in areas like Alaideo and Tolaram basti between Manglimukh and Missibailum under Dhansiri Reserve Forest located along the Assam-Nagaland border. According to Forest Department sources, at least 21 families belonging to Dimasa community were evicted from the forest area, while more than 200 hactares of forest land was evacuated from the clutches of the encroachers. The eviction drives are going on to clear the forest areas in Karbi Anglong district at the directives of the Supreme Court and all the divisions of the forest department had already evicted encroachers from many reserve forests of the district.

THE SENTINEL : August 03, 2005

NEPED embarks on sustainable devp in Nagaland

NEPED, the Nagaland Empowerment of People through Economic Development, is a project funded by Indo-Canada Environment Facility (IECF) to introduce micro hydel plants for harnessing extensive potential of streams and rivulets to boost mainly agri and allied activities in Nagaland. Continuing its efforts to ensure a sustainable development since 1995-96, NEPED has now introduced hydrogers, a device to generate electricity in a cost effective way from small streams and rivulets in remote villages to complement economic activities, mainly for increase of production and productivity in agri and allied sector. NEPED's first two phases focused on two different areas of intervention – tree plantation in jhum fields and micro credit to take up income generating activities by the villagers. With lessons leant from implementation of two phases of NEPED, which basically reveolved around the concept on agro-forestry through people's perticipation, the project now embarks upon bigger issues of sustainable development in the hill state beyond intallation of hydrogers.

THE SENTINEL : August 08, 2005

Upside down : Drought in Cherrapunjee

The world's wettest place is going through a crisis of having received just a few spells of short showers this year. Locally know as Sohra, the city normally receive over 20,000 mm of rainfall annually and sometimes up to 1,500 mm in a single day. This unusual pattern of rainfall can be attributed to the monsoon trough moving southwards from its normal postion over the Cherrapunjee-Assam-Bihar belt and this shift has caused more rain in the Orissa-Maharashtra belt, admits Met

official. Throughout the North-East, there has been less rainfall. According to Met officials Assam and Meghalaya received 29% less than average, while Arunachal Pradesh received 22% less.

THE TIMES OF INDIA : August 13, 2005

Health herbs on Uttaranchal hills

Government wants to see the growth of Kalihari, an important medicinal plant found in parts of Uttaranchal in commercial basis which contains colchicin, considered to be an important harb. For this purpose, the government has clubbed kalihari in the 26 eclusive clubs of medicinal plants for which it has given permission for commercial exploitation o a larger scale. In a new government order, Gopeshwar based Herbal Research Medicinal Institute has been made the nodal agency to register all those farmers, who had been growing medicinal plants in their fields. Further a total of 26 species of medicinal and aromatic plants (MAPs) have been identified to be entitled for a 50% subsidy. In this regard, the economics of cultivation of these 26 species has been prepared, which would be distributed to farmers.

BUSINESS STANDARD : August 17, 2005

First-ever pheasant census reveals 71,290 in Himachal

In the first-ever census of pheasants in the country, Himachal Pradesh has counted 71,290 pheasants including the endangered ones, as being habitat of the State. The wildlife wing of the Himachal Forest Department conducted the survey in May this year of 7 types of pheasants namely, the Red Jungle Fowl, Khaleej Pheasants, Koklass, Western Tragopan, Himalayan Monal, Indian Peafowl and Cheet Pheasants. Of these, the last 4 are endangered and are protected under Schedule-I of the Wildlife Act. Western Tragopan is also on the Red Data Book of the International Union of Conservation of Nature (IUCN). The Census would help the Department in making plans for conservation of some of the endangered species of birds.

INDIAN EXPRESS : August 17, 2005

1248 water bodies in J&K, Ladakh has the most

There are 1,248 water bodies/lakes exist in the state as rported by a study conducted by the Department of Environment and Remote Sesing, Jammu & Kashmir. A major share of these water bodies (about 637) are in Ladakh division, followed by Kashmir (about 500) and Jammu (about 111) division. These lakes are categorised as vally lakes, forest/alpine lakes, glacier lakes depending on the altitudinal variation. However, most of these water bodies having area of less than 20 ha, but 9 water bodies are spread over an area of above 1,000 hectare. Crystal movements due to faulting and folding are said to be the prime factors along with the earthquakes, which are responsible for the formation of the lakes according to the study.

KASHMIR TIMES : August 26, 2005

Mizoram to harvest all bamboos

The Mizoram Government has chalked out an array of measures to harvest all the bamboo trees in the forest before the full fledged flowering occurs. The flowering of the big grass, which is expected by next year, is a unique phenomenon that occurs every 50 years across the north-eastern region and Mizoram in particular. According to the Chief Minister of the state, the Muli bamboo (*Melocanna baccifera*) has grown over an area of more than 6,400 km^2, which is one third of the total area. However, a group of environmentalists in Mizoram have already raised concern over the

government's bamboo policy, and its plans to harvest all bamboo trees before the flowering. They fared of ecological disaster in the region as the large scale harvesting of bamboo could leave the land fellow for many years to come, leaving farmers without fertile soil.

THE SENTINEL : August 26, 2005

Pachyderm movement in Garo Hills being monitored

With a view to preserving the traditional routes of elephants in the densely forested South Garo Hills district and prevent encroachment by humans on their habitat, Samrakshan Trust – an environmental NGO has taken up the strenous work of monitoring their aeas of movement. It is expected that such monitoring, in the long run, will be resulting in man and animal living side by side without any form of conflict. As a pilot activity, this exercise is presently being undertaken in five A'kings, namely, Amapangre, Alokpang, Halwa Atong, Gongrot and Panda. The Trust intends to eventually expand its scope to all 33 A'kings that constitute hthe Balpakram Baghmara Community Conservation Landscape (BBCCL).

THE ASSAM TRIBUNE : August 29, 2005

Uttaranchal and J&K govts to promote trout fishing

Sensing a big export market for the trout, the Uttaranchal government has signed an agreement with NABARD to exploit the fishery potential in new areas in the state. Napcons, a consultancy service of NABARD will prepare a detailed project report on the trout and other fish after conducting a survey in the state. The government is currently produding fingerlings of the trout at its three fish farms in the Uttarkashi and Chamoli districts. With the market rate of trouts hovering around Rs 500 per kg., the government has also asked the revenue and forest departments to stop the illegal fishing of the trout, which is generally found at an altitude above 4,000 feet and between temperature 5 and 10^{o} Celcius. The Jammu & Kashmir government is also planning to boost trout fish farming in the state, particularly in Jammu, a move it hopes would generate additional employment. The State Fishery Department has distributed nearly 5,00,000 fingerlings of various varieties of trout in districts of Kashmir division.

BUSINESS STANDARD : September 01, 2005

Uttaranchal to focus on tourism infrastructure

The Government of Uttaranchal will spend around Rs 100 core every year for the next 3 years on the creation of tourism infrastructure in the State. In addition, private sector investment to the tune of Rs 3,000 crore in the State's tourism sector over the next 3 to 5 years has been envisaged. Of this proposed corpus, an investment amount of Rs 1,200 crore is already in the pipeline, according to the Principal Secretary of tourism, sports and youth welfare of the State. A master plan prepared by the State Government focuses on circuit tourism and destination tourism. Different circuits and stand-alone destinations would be promoted as tourist hot-spots in this regard. Towards this end, the Uttaranchal Tourism Development Board was working on coordination and synergy of the operations of the Kumaun Mandal Vikas Nigam (KMVN) and Garhwal Mandal Vikas Nigam (GMVN) , the two tourism corporations of the State. Meanwhile, in 2004-05, the State attracted 1.4 crore tourists and revenue generated from trourism has been pegged at about Rs 3,000 crore in the last year with an expectation of annual growth of around 20% in the State's tourism sector.

BUSINESS LINE : September 06, 2005

Macrophytes pose challenge to Dal, Wullar : ecologist

Presence of Azolla sp. is for the first time reported to be found in the waters of Dal and Wullar lake of Jammu & Kashmir. With its profused growth and due to its great potential of nitrogen fixation in these lakes, Azolla sp. has eaten up the vitals of other free floating species. Thus, posing a great chanllange to the lake environment in general and ecologist in particular. A study analyzing the diversity of macrophytic vegetation in various fresh water bodies; Dal, Wullar, Manasbal, Ahansar and Nilnag lake; conducted by the Centre of Research for Development, University of Kashmir, Srinagar revealed this. The survey deals with the macrophytic composition of various fresh water bodies of Kashmir Himalaya. These fresh water bodies are not only situated within different geographical coordinates but also under varying degrees of anthropogenic impacts, the study-report pointed out. Aquatic habitats of Kashmir support a rich and varied nature of macrophytic flora. The study informed that the macrophytes comprise a dominant group of plants especially in shallow lentic systems, lakes and wetlands, that determine the functioning of these ecosystems. Moreover, changing human activities in and around the freshwater bodies have not only changed their physical and chemical milieu but their overall biological setup has also been largely altered puts forth the study.

KASHMIR TIMES : September 06, 2005

World Bank all set to rescue forests in Himachal Pradesh

The World Bank could soon bail out Himachal Pradesh's shrinking forests by funding an ambitious Rs 370 crore preservation project. Shrinking forests is causing concern among several quarters in the hill state and has begun to affect the ecologically fragile green cover in the mid hills resulting notably in water scarcity and soil erosion. The project will be implemented in 7 years and the money will be spent in the ecologically fragile mid-hills varying from 1800 to 5000 feet in 10 districts, involving 400 panchayats, acccording to the World Bank officials. The primary focus of the project will be on the conservation of water resources which is fast shrinking in the mid-hills of the state. Afforestation, water harvesting, building check dams will also be carried out with the help of locals and other agencies.

BUSINESS STANDARD : September 16, 2005

Chescor firming up proposals for Uttaranchal eco-tourism project

A major $200 million eco-tourism project in Uttaranchal is in the process of being finalised by the Chescor Capital, an international investment firm. The firm has been involved in developing and financing many projects in West Asia and India and now aims for setting a new trend in eco-tourism in India. The project will be developed as a pure eco-tourism venture with a very low density and green relaxing space, golf course and orchards. Around 800 acres of land have been alloted for the project on the outskirs of the Corbett National Park in the State. The project will be a destination resort with a host of facilities with the entertainment focus on nature. It would also serve as a hub destination for other tourist spots in the State.

BUSINESS LINE : September 21, 2005

Hindi Section

धरती की कोख में भी छिपा है बिजली का भंडार

जल, वायु, तापीय प्रक्रियाओं के बाद अब बारी है धरती के भीतर दहकती तपिश की मदद से बिजली पैदा करने की। भू–वैज्ञानिकों ने सरकार को राज्य में मौजूद साठ से भी ज्यादा गरम पानी के स्त्रोत चिह्नित कर जियोथर्मल इनर्जी उत्पादन की नई संभावनाओं का रास्ता खोला है। हिमाचल, हरियाणा तथा महाराष्ट्र में बखूबी चल रहे इस प्रयोग के उत्तरांचल में भी कामयाबी हासिल करने की उम्मीद है। भारतीय भू–वैज्ञानिक सर्वेक्षण विभाग (जीएसआई) के निदेशक का कहना है कि गरम पानी के स्रोतों के निकलने वाली भाप से पावर टरबाईन को सहज ही चलाया जा सकता है। यहीं नहीं पावर प्रोजेक्ट के साथ ही यदि इन इलाकों में पर्यटन के लिहाज से हॉट वाटर पार्क विकसित कर दिए जाएं तो विदेशी सैलानियों को भी आकर्षित किया जा सकता है। उत्तरांचल के भूगर्भीय संरचना के सर्वेक्षण के दौरान जीएसआई के विशेषज्ञों ने गरम पानी (हॉट वाटर स्प्रिंग) के नए स्रोतों की खोज की। अधिकाशंत यह स्रोत उच्च पर्वतीय इलाकों में हैं, जहां से भारतीय भू–प्लेट की मुख्य दरारें होकर गुजर रही हैं।

अमर उजाला : जुलाई 2, 2005

दहशत के साये में हिमालय

भूस्खलन व बाढ़ की दृष्टि से कुमांऊ अति संवेदनशील है। राष्ट्रीय सुदूर संवेदन हैदराबाद की रिपोर्ट के अनुसार संपूर्ण उत्तरांचल के 1200 गांवों को भूस्खलन से भंयकर खतरा है। खासकर पिथौरागढ़–मालपा मार्ग पर 13 आबादी क्षेत्र भूस्खलन की दृष्टि से बेहद संवेदनशील हैं। इसके अलावा इस मार्ग पर 150 गांव भी बेहद संवेदनशील हैं। यही नहीं काली और शारदा नदियों की घाटियां भी आपदा दृष्टि से संवेदनशील हैं। रिपोर्ट के मुताबिक मिलम, पिंडारी और कफनी जैसे ग्लेशियरों के वैज्ञानिक अध्ययन से पाया गया है कि हिमालय की आंतरिक हलचलों और भूमंडलीय तापमान बढ़ने की विश्वव्यापी घटना से ये ग्लेशियर सर्वाधिक प्रभावित हैं और कभी भी बड़े विनाश का कारण बन सकते हैं।

अमर उजाला : जुलाई 7, 2005

भूकंप से पड़ी छोटी दरारें भी नहीं छिपेंगी

गढ़वाल और कुमाऊं क्षेत्र के पहाड़ों में भूकंप से दरक गए छोटे से छोटे निशान को खोजने के लिए सिंथेटिक अपरचर रडार (एसआर) का इस्तेमाल किया जाएगा। देश में पहली बार प्रयुक्त हो रही इस तकनीक से पर्वतीय व मैदानी इलाकों में जमीन के अंदर–बाहर के बदलावों तथा वहां की भूकंप–भूस्खलन की दृष्टि से खतरों का आकलन किया जा सकेगा। आईआईटी के वैज्ञानिक एक माह में इस तकनीक का प्रयोग शुरू कर देंगे। भूकंप के कारण अन्य क्षेत्रों की स्थिति कैसी है इसका पता लगाने की जिम्मेदारी डिपार्टमेंट ऑफ साइंस एंड टेक्नालॉजी (डीएसटी) ने आईआईटी के भूकंप विभाग को सौंपी है।

अमर उजाला : जुलाई 14, 2005

उत्तरांचल में बाघ व हाथी घटे

उत्तरांचल में वन्यजीवों की गणना के नतीजे घोषित कर दिए गए हैं। ताजा आंकड़ों के अनुसार प्रदेश में जहां बाघ, हाथी, पाड़ा व हिमालयन भालू की संख्या घटी है, वहीं गुलदार, कस्तूरी मृग, सांभर, चीतल, काकड़, भरल, थार, घुरल, नीलगाय, भूरा भालू व सिराऊ की संख्या में बढ़ोत्तरी हुई है। राज्य में पहली बार बारहसिंघा, मगरमच्छ, घड़ियाल, स्लोथ बियर व जंगली सुअर की गणना की गई है। उत्तरांचल में बाघों की संख्या में मामूली कमी आई है, जबकि हाथियों की संख्या घटकर 1510 रह गई है। जिन वन्यप्राणियों की संख्या में इजाफा हुआ है, उसमें गुलदार की संख्या बढ़कर 2105 हो गई है। कस्तूरी मृग की संख्या में मामूली बढ़त हुई है और अब इसकी संख्या 279 दर्ज की गई है। वर्ष 2005 की गणना में उत्तरांचल के पांच वन्यजीवों को

पहली बार शामिल किया गया। इन प्राणियों की गणना में उत्तरांचल में बारहसिंघा की संख्या 34, मगरमच्छ की संख्या 16, घड़ियाल की संख्या 8, स्लोथ वियर की संख्या 240 तथा जंगली सुअर की संख्या 32613 दर्ज की गई है।

दैनिक जागरण : जुलाई 29, 2005

थुनेर ने खोला नए खजाने का दरवाजा

उत्तरांचल में पाई जाने वाली थुनेर (टैक्सस बक्काटा) से निकलने वाले टैक्सोल की कीमत लाख और करोड़ में नहीं बल्कि इससे भी कहीं ज्यादा है। अंतर्राष्ट्रीय बाजार में एक किलो टैक्सोल की कीमत 1.80 अरब रूपये है। इस टैक्सोल का इस्तेमाल कैंसर की दवा बनाने में होता है। बायोफ्यूल जेट्रोफा तथा बांस के बाद अब थुनेर ने भी राज्य के लिए एक नए खजाने के दरवाजा खोल दिये हैं। थुनेर के उपयोग तथा मूल्य के मद्देनजर प्रदेश सरकार थुनेर के व्यावसायिक कृषिकरण की कवायद में जुट गई हैं। वर्तमान में अल्मोड़ा सिविल सोयम वन प्रभाग में थुनेर पर वृहद् स्तर पर काम चल रहा है। शासन का इरादा काश्तकारों को थुनेर के व्यावसायिक कृषिकरण के प्रति प्रोत्साहित करने का है। आयुर्वेदिक दवाईयां बनाने वाली विख्यात डाबर कंपनी के साथ इसके विपणन का समझौता भी हो गया है। गौरतलब है कि साढ़े तीन हजार से पांच हजार फीट की ऊंचाई पर पाया जाने वाला थुनेर खासकर कैंसर की बीमारी के लिए काफी उपयोगी माना गया है। उत्तरांचल में अल्मोडा में कपकोट, जागेश्वर तथा गढ़वाल मंडल में थुनेर पांच हजार फीट तक की ऊंचाई पर बहुतायत में होता है। अल्मोड़ा सिविल सोयम वन प्रभाग में इस पर बड़े पैमाने पर काम शुरू किया गया, जो कि काफी सफल साबित हो रहा है।

अमर उजाला : अक्टूबर 4, 2005

टिहरी झील से बदलेगा मौसम का मिजाज

टिहरी में बन रही विशाल झील देश के मौसम को एक नया रूप देने जा रही है। झील से स्थानीय स्तर पर मौसम में क्रांतिकारी बदलाव के साथ ही देश के विभिन्न हिस्सों में खासे परिवर्तन नजर आएंगे। दिल्ली व उत्तर प्रदेश में मौसम का बदला रूप ज्यादा प्रभाव दिखाएगा। स्थानीय स्तर पर झील के आसपास कई किलोमीटर तक का वातावरण ड्राई से वेट हो जाएगा। घाटी कोहरे में छिप जाएगी। बारिश बढ़ेगी और हिमालय की सर्द हवाओं से ठंडक कम हो जाएगी। झील पूरी तरह से भरने के बाद मौसम अपना रंग दिखाना शुरू कर देगा। लगभग 42 किलामीटर में फैली झील अगले वर्ष के उत्तरार्द्ध तक पानी से भर जाएगी और इसके साथ ही विशाल जलाशय मौसम पर अपना प्रभाव दिखाना शुरू कर देगा। मौसम विभाग के निदेशक के अनुसार झील का पानी सर्द हवाओं को मॉडरेट कर देगा। जिससे झील के आसपास के वातावरण में नमी अधिक होगी। पहाड़ी क्षेत्र में चलने वाली हवाएं पानी के संपर्क में आकर नमी को सोख लेंगी और हवाओं की ठंड़क कम हो जाएगी। गर्मी के दौरान यही प्रक्रिया बदल जाएगी और झील की नमी के संपर्क में आते ही हवा ठंडी हो जाएगी। इसके अलावा झील के पानी से घाटी कोहरे में छिप जाएगी। लोकल क्लाइमेट सिस्टम के साथ ही आसपास के क्षेत्र में बनने वाला साइक्लोनिक सर्कुलेशन झील की नमी के संपर्क में आकर मजबूत हो जाएगा जिससे बारिश की संभावना बढ़ेगी। पर्यावरणविद् सुंदरलाल बहुगुणा का भी यही मानना है। उन्होंने कहा कि झील में पानी भरने के बाद कोहरा इतना अधिक पड़ेगा कि लोग सुबह की धूप से वंचित हो जाएंगे।

दैनिक जागरण : दिसम्बर 21, 2005

नन्दा देवी संरक्षित जैवमंडल क्षेत्र में परिवेश पर्यटन को प्रोत्साहन : मतभेद सुधार, जैव–विविधता संरक्षण एवं सामाजिक और आर्थिक विकास के लिए सुदृढ़ मार्ग

आर0 के0 मैखुरी, रितेश जोशी, ललित कुमार एवं दीपक ध्यानी
गोविन्द बल्लभ पन्त हिमालय पर्यावरण एवं विकास संस्थान,
गढ़वाल इकाई, श्रीनगर गढ़वाल उत्तरांचल

परिचय

अपनी समृद्ध पर्यटन परम्परा एवं क्षमता से परिपूर्ण भारतीय हिमालय वर्तमान में सम्पूर्ण विश्व में अंतर्राष्ट्रीय पर्यटन के क्षेत्र में ख्याति प्राप्त किये हुए है। धार्मिक, परम्परागत, साहसिक, पर्वतारोहण, खोज अभियान के अलावा विदेशी व स्वदेशी पर्यटक इस हिमालय क्षेत्र में अनोखे रहस्योद्घाटन में लगे हैं जो इस बात को बल देता है कि पर्यटन का कुछ भाग संरक्षित क्षेत्रों की तरफ भी निरन्तर फैलता जा रहा है। जहाँ एक तरफ पर्यटन उद्योग, जो अपने आप में एक बढ़ता हुआ पारिस्थितिक प्रभाव हिमालयी संरक्षित क्षेत्रों में रखता है वहीं दूसरी तरफ अनियंत्रित निरन्तर बढ़ते हुए पर्यटकों की संख्या खतरे की तरफ आगाह कर रही है एवं सम्भावनाओं पर भी प्रश्नचिन्ह लगा रही है। पर्यटन उद्योग के अन्तर्गत पर्यावरण संरक्षण एवं सामूहिक विकास के मापदण्डों में भी विवाद भी देखा गया है और इसमें व्यापक बदलाव भी हो रहे हैं।

हिमालय संरक्षित क्षेत्र आधारित श्रृंखला 3 जैवमण्डल, 18 राष्ट्रीय उद्यान, 71 वन्यजीव अभ्यारण्य से मिलकर बनती है जो कि भारतीय हिमालय का 9.2 भाग है। संरक्षित क्षेत्र स्तर हेतु जारी वैधानिक प्रपत्र भी छोटे संसाधनों के इस्तेमाल एवं पर्यटन और साथ ही स्थानीय समुदाय के सामाजिक एवं सांस्कृतिक तन्त्र को भी प्रभावित करता है जो कि जन समुदाय–संरक्षित क्षेत्र के मध्य प्रबन्धन सम्बन्धी विवाद उत्पन्न करता है। इस तरह के विवाद जैव–विविधता संरक्षण, संरक्षण नियोजन एवं प्रबन्ध हेतु रीतिगत नीति में बदलाव के लिए विषम परिस्थिति उत्पन्न करते हैं।

नन्दादेवी संरक्षित क्षेत्र का संक्षिप्त इतिहास

मध्य हिमालय में स्थित नन्दा देवी जैवमण्डल क्षेत्र (विश्व धरोहर स्थल) अपने आप में एक अनोखा विश्व धरोहर स्थल है, जो 5860.69 वर्ग कि0मी0 में फैला है और समृद्ध पारिस्थितिक तन्त्र, सांस्कृतिक विविधता, जैव–विविधता लिए हुए है इसमें प्रमुख रूप से दो आन्तरिक क्षेत्र आते हैं। नन्दा देवी राष्ट्रीय उद्यान (624.62 वर्ग कि0मी0) और विश्व प्रसिद्ध फूलों की घाटी राष्ट्रीय उद्यान (87.50 वर्ग कि0मी0)। शेष क्षेत्र (5148.57 वर्ग कि0मी0) जैव मण्डल के बाहरी क्षेत्र का निर्माण करता है जिसमें 47 गांव शामिल हैं। उक्त क्षेत्र उत्तरांचल राज्य के चमोली, बागेश्वर, पिथौरागढ़ जनपद के अन्तर्गत आते हैं।

नन्दादेवी जैव–मण्डल क्षेत्र में लगभग 400 प्रजातियों के पेड़, 570 प्रजातियों की पादप जड़ी–बूटियां, 86 प्रकार के स्तनधारी, 534 प्रकार के पक्षी 54 प्रकार के सरीसृप व अभयचर मौजूद हैं। जिनमें अधिकतर कम अथवा विलुप्तीकरण श्रेणी के अन्तर्गत आते हैं। यहां विद्यमान सामाजिक–सांस्कृतिक परिवेश अपने आप में विशिष्ट है एवं यहां रहने वाले लोग प्रमुख रूप से दो समुदायों से सम्बन्ध रखते हैं पहला इण्डो–मंगोलियन (भोटिया जनजाति) व दूसरा इण्डो–आर्यन (सामान्य जनसमुदाय) ये समुदाय प्रमुख रूप से कृषि एवं पशुपालन को अपनाते हैं साथ ही छोटे–छोटे ऊन आधारित उद्योग भी इनके जीवन–यापन का प्रमुख अंग होते हैं।

नन्दादेवी जैवमण्डल क्षेत्र में जन्मे अपवाद की रूपरेखा एवं परिवेश पर्यटन के माध्यम से उसका समाधान

वर्ष 1982 में नन्दा देवी राष्ट्रीय उद्यान एवं 1988 में संयुक्त राष्ट्र शैक्षिक, वैज्ञानिक एवं सांस्कृतिक संगठन (यूनेस्को) के मानव व जैवमंडल कार्यक्रम (MAB) कार्यक्रम के तहत स्थापित किये गये जैवमंडल आरक्षित क्षेत्र ने जहाँ एक तरफ स्थानीय समुदायों के हक–हकूकों को छीना (बॉक्स 1), वहीं दूसरी ओर उसने स्थानीय जनसमुदाय को प्राकृतिक संसाधनों के इस्तेमाल के कोई और विकल्प प्रदान नहीं किये। नंदादेवी जैवमंडल आरक्षित क्षेत्र के अंदरूनी क्षेत्र को पर्यटकों के आवागमन हेतु भी पूर्ण रूप से बन्द कर दिया गया। आरक्षित क्षेत्र के अंदरूनी क्षेत्र में लगे पर्यटन प्रतिबन्ध एवं हक–हकूकों पर लगे प्रतिबन्ध ने स्थानीय जनसमुदाय को अपने विभिन्न संसाधनों से विमुख किया। प्रमुख तथ्य यह था कि समस्त ग्रामवासियों को उनके अधिकारों के

हनन के बारे में कोई सूचना नहीं दी गयी, सम्भावित वैकल्पिक लाभों से अवगत नहीं कराया गया और उनको प्राकृतिक संसाधनों के इस्तेमाल से वंचित रखा गया। आरक्षित प्रबन्धन नीति ने स्थानीय जन–समुदायों के सतत् रहन–सहन की अपेक्षा वैधानिक संरक्षण पर जोर दिया एवं जिस कारणवश स्थानीय जनसमुदाय एवं आरक्षित प्रबन्धकों के मध्य विवाद ने जन्म लिया।

बॉक्स 1. स्थानीय समुदायों एवं सम्बन्धित सरकारी संगठनों के मध्य जन्मे अपवाद के प्रमुख कारक

- ❖ अंदरूनी क्षेत्र में पशु चराने पर प्रतिबंध।
- ❖ गैर–काष्ठीय वन उपज के एकत्रीकरण पर प्रतिबन्ध।
- ❖ नंदादेवी जैवमंडल आरक्षित क्षेत्र के अंदरूनी क्षेत्र में स्थित एवं अन्य पर्वतों पर खोज अभियानों व पर्वतारोहण पर प्रतिबन्ध।
- ❖ ग्राम वन पंचायत वनों के अधिकारों पर प्रतिबंध।
- ❖ पालतू पशुओं को वन्य–जीवों के द्वारा मारा जाना।
- ❖ वन्य जीवों के द्वारा फसलों, फलों एवं मधुमक्खियों के छत्तों की क्षति।
- ❖ सेना के प्रशिक्षण गोलीबारी क्षेत्र में आकस्मिक पालतू पशुओं की क्षति।

आवश्यकता है तो सिर्फ इस तथ्य की कि सरकार को कार्बेट, राजाजी एवं फूलों की घाटी राष्ट्रीय पार्क को दृष्टिगत रखते हुए नंदादेवी बॉयोस्फेयर रिजर्वे क्षेत्र में भी विभिन्न स्थानों में पर्यटक आवागमन अथवा भ्रमण का प्रवाह बढ़ाना होगा, जो संरक्षित क्षेत्र एवं स्थानीय जनसमुदाय के मध्य विवाद का एक प्रमुख कारण भी बना है। इन सभी तथ्यों को ध्यान में रखते हुए आज एक ठोस कार्य योजना के तहत जैव–विविधता संरक्षण, स्थानीय जनसमुदायों को वैकल्पिक जीवन–यापन के अवसर प्रदान करना आदि की नितान्त आवश्यकता है। जिसके माध्यम से क्षेत्र विशेष की दोनों समस्यायें–आरक्षित क्षेत्र–जनसमुदाय मतभेद एवं जैव विविधता क्षरण का संरक्षण किया जा सके। इसलिए नंदादेवी जैवमंडल आरक्षित क्षेत्र के बाहरी क्षेत्रों में परिवेश पर्यटन को बढ़ावा देना सकारात्मक प्रयास होगा। परिवेश पर्यटन संरक्षित क्षेत्र के संरक्षण एवं जैवमंडल आरक्षित क्षेत्र के संरक्षण हेतु निम्न कारणों से उपयोगी हो सकता है। प्राकृतिक आवासों एवं जैव विविधता के संरक्षण एवं प्रबंधन हेतु आर्थिकी को बढ़ावा, स्थानीय समुदायों द्वारा उत्पादित वस्तुओं को स्थानीय स्तर पर विस्तृतीकरण को बढ़ावा व आय को प्रोत्साहन। उक्त सभी बिन्दु इसीलिए संरक्षित क्षेत्रों के संरक्षण में सहायता प्रदान कर सकेंगें एवं जिसके माध्यम से हम क्षेत्र विशेष के जनसमुदायों के मध्य संरक्षण मानकों को रखकर उन्हें जागरूक कर पाने में सफल होंगे। परिवेश पर्यटनों के उद्देश्यों एवं ध्येय को समक्ष रखते हुए निम्न गतिविधियां परिवेश पर्यटन के नियमों को परिपूर्ण कर सकती हैं (बॉक्स 2)

बॉक्स 2. परिवेश पर्यटन की प्रमुख नियमावलियाँ

- ✓ प्राकृतिक स्थानों पर यातायात को प्रोत्साहन
- ✓ स्थानीय जनसमुदायों को सहयोग, आर्थिक लाभ एवं सशक्तिकरण प्रदान करना।
- ✓ जैव विविधता संरक्षण, पर्यावरण प्रबंधन हेतु सहभागिता।
- ✓ पर्यावरण जागरूकता का निर्माण।
- ✓ पर्यावरण एवं स्थानीय जनसमुदायों के नकारात्मक प्रभावों को कम करना।
- ✓ स्थानीय परम्परा एवं संस्कृति को आदर प्रदान करना।

परिवेश पर्यटन को प्रोत्साहन प्रदान करने हेतु प्रयास

(1) प्राकृतिक संसाधनों के प्रबंधन, संरक्षण, शिक्षा, जंगली उत्पादों के मूल्य संशोधन को प्रोत्साहन एवं स्थानीय खाद्य वस्तुओं और गृह–पर्यटन आदि को प्रोत्साहन प्रदान करने हेतु इस अध्ययन के अंतर्गत स्थानीय जनसमुदाय, टूर–प्रबंधकों आदि को स्थानीय आर्थिकी सुधार प्रशिक्षण प्रदान करने के प्रयास किये जाएं।

(2) परिवेश पर्यटन को प्रोत्साहन प्रदान करने हेतु स्थानीय जनसमुदायों, स्थानीय यात्रा–प्रबंधकों, गाइडों एवं यात्रा–संचालकों के विचारों को दृष्टिगत रखते हुए नंदादेवी जैवमंडल आरक्षित क्षेत्र के बाहरी क्षेत्र एवं निकटवर्ती क्षेत्रों में परिवेश पर्यटन सम्बन्धित यात्रा हेतु सम्भावित स्थानों एवं पर्यटन मार्गों की पहचान, और चयन करना।

(3) समुदायों की क्षमताओं द्वारा उनके अपने ही संसाधनों एवं प्रयासों के प्रबंधन हेतु विभिन्न पहलुओं का उपयोग।

(4) स्थानीय जनसमुदायों, आगंतुकों एवं यात्रा संचालकों हेतु दिशा–निर्देशों का निर्माण।

(5) सामाजिक एवं आर्थिक विकास एवं संरक्षण उद्देश्यों को एक साथ रखते हुए परिवेश पर्यटन हेतु सम्भावित प्रयासों के लिए एक कार्ययोजना का निर्माण।

परिवेश–पर्यटन प्रोत्साहन हेतु संभावित स्थान एवं यात्रा मार्ग

स्थानीय जनसमुदायों की आर्थिकी पर पड़ रहे बुरे प्रभावों को दृष्टिगत रखते हुए आज पर्वतारोहण से सम्बन्धित नंदादेवी बॉयोस्फेयर रिजर्व के कुछ क्षेत्रों को खोले जाने की नितान्त आवश्यकता के साथ ही संवेदनशील नंदादेवी बॉयोस्फेयर रिजर्व के सम्बन्ध में पर्यटकों को जागरूक करने की भी आवश्यकता है, तभी नन्दा देवी को उसके प्राकृतिक सौन्दर्य, हरे मखमली बुग्यालों, सघन वन क्षेत्रों एवं बर्फ से आच्छादित पर्वतों को दृष्टिगत रखते हुए हम नंदादेवी बॉयोस्फेयर रिजर्व बफर जोन में परिवेश–पर्यटन दर्शन पर कामयाबी हासिल कर पायेंगे। नंदादेवी बॉयोस्फेयर रिजर्व के बफर जोन में बर्फ से आच्छादित – हनुमान (6041 मी0), द्रोणागिरि (7070 मी0), ऋषि पहाड़ (6693 मी0), नन्दाघूंटी (6366 मी0) एवं कालंका (6934 मी0) पर्वत श्रेणियाँ एवं अन्य स्थान जो नंदादेवी बॉयोस्फेयर रिजर्व के समीपवर्ती क्षेत्रों में स्थित हैं, में परिवेश–पर्यटन को प्रोत्साहन प्रदान कर सकेंगे एवं क्षेत्र विशेष को विकास के पायदान तक पहुँचाने में सफल होगें ।

नंदादेवी जैवमंडल आरक्षित क्षेत्र में परिवेश पर्यटन को प्रोत्साहन प्रदान करने हेतु कुछ संभावित क्षेत्र एवं यात्रा मार्ग

क्र0सं0	मार्ग	दूरी (कि0मी0)	दिन
1.	मुन्स्यारी–मिलम–मिलम हिमखंड	54	6
2.	लोहारघाट–ढाकुरी–खाटी–द्वाली–पुरखिया–पिण्डारी हिमखंड	60	8
3.	देवाल–वान–रूपकुंड	40	5
4.	लाता–भेल्टा खरक–लाता खरक–तोलमा–सुराईथोटा	30	3&4
5.	मलारी–सुमना–ऊँटाधुरा पास–मिलम–मुन्स्यारी	70	8
6.	जुम्मा–द्रोणागिरि गांव–नंदी कुंड–फाग्ती	60	6
7.	जोशीमठ–काकभुसण्डी	57	3
8.	कुंठारखाल ट्रैक(फूलों की घाटी–माणा)	24	3
9.	भ्यूंडारखाल ट्रैक (फ्रैंकस्मिथ ट्रैक) गमसाली–फूलों की घाटी	43	5
10.	क्वांरी पास (कर्जन ट्रैक) (a) तपोवन–घाट (b) औली–क्वांरी पास–तपोवन (c) क्वांरी पास – रूपकुंड	 74 27 134	 8 4 14
11.	बाहरी नंदादेवी ट्रैक (लाठीखरग–धरांसी)	56	5
12.	रोंठीराजगैर ट्रैक (सुबाई–रौंठी)	57	5
13.	बागनी हिमखंड ट्रैक (जोशीमठ–द्रोणागिरि–बागनी)	80	6
14.	मिलम हिमखंड (टोपीडुंगा ट्रैक) मलारी–मुन्स्यारी	163	14
15.	कालिन्दीखाल ट्रैक	190	16
16	हनुमानचट्टी–फूलों की घाटी	36	5

समुदाय आधारित परिवेश पर्यटन को प्रोत्साहन

समुदाय आधारित परिवेश पर्यटन के अनुसार क्षेत्र विशेष के समुदाय की ही परिवेश पर्यटन में सुनिश्चित भागीदारी एवं सही नियंत्रण होना चाहिए एवं उससे होने वाले लाभ भी उसी क्षेत्र विशेष के समुदाय को मिलने चाहिए। यह भी देखा गया है कि वर्तमान में किसी भी नीति–निर्धारण हेतु स्थानीय जन–समुदाय की भागीदारी एवं उनके अपने मत सुनिश्चित नहीं हो पा रहे हैं। वर्तमान में पर्यटन गतिविधियों के संचालन हेतु योजनाएं बनाने में स्थानीय जनसमुदाय की भागीदारी सुनिश्चित करने की अतीव आवश्यकता है। समुदाय किसी भी क्षेत्र की जैव विविधता संरक्षण हेतु एवं अहम् भूमिका निभाते हैं एवं अगर उनको नीति निर्धारण में शामिल किया जाये तो परिवेश पर्यटन से प्राप्त आर्थिक एवं सामाजिक लाभों को भी वे ग्रहण कर सकते हैं।

हमें नंदादेवी जैवमंडल आरक्षित क्षेत्र के स्थानीय जन समुदाय के ज्ञान एवं भावनाओं का पर्यटन उद्योग बनाये जाने सम्बन्धी विचारों का आदर करना होगा। स्थानीय मजदूरों एवं बाल–श्रमिकों का, जिनका वर्तमान में दोहन किया जा रहा है उसको सख्ती से रोके जाने की भी आवश्यकता है। किसी भी नीति के निर्माण के समय वहां की महिलाओं के समूहों को जानने, बेरोजगार नवयुवकों को दृष्टिगत रखने आदि को प्राथमिकता देनी होगी एवं उससे होने वाले लाभों से भी उन्हें लाभान्वित करवाना होगा।

परिवेश पर्यटन सम्बन्धी महत्वपूर्ण बिन्दु जिन्हें नियमावली के अन्तर्गत क्रियान्वित किया जा सकता है

किया जाना चाहिए

- चलते व रहते समय आवाज न की जाये।
- स्थानीय परम्परा व संस्कृति का आदर किया जाये।
- मार्गों के फिसलने युक्त होने के कारण अच्छे वस्त्रों एवं जूतों का उपयोग किया जाये।
- सभी अविघटनकारी वस्तुओं को अपने साथ यात्रा वापसी में साथ लाया जाये।
- कागज को सावधानी से जलाया जाये।
- आने–जाने का भाड़ा, खाना व व्यवसाय सम्बन्धित किराये का भुगतान किया जाये।
- मजदूरों एवं अन्य सम्बन्धित कर्मचारियों के साथ मित्रता युक्त व्यवहार किया जाये।
- छोटे समूहों का इस्तेमाल किया जाये (12 व उससे कम)।
- स्थानीय क्षेत्रों द्वारा उत्पादित वस्तुओं को खरीदा जाये व उनकी सेवा ली जाये एवं वहां के बाजारीकरण को प्रोत्साहित किया जाये।
- मेहमान–मेजबान का सम्बन्ध बनाया जाये।
- वहां के स्थानीय भाषा के शब्द विशेषों को ग्रहण किया जाये।
- पर्यावरण पर पड़ रहे प्रभावों को कम किया जाये एवं संरक्षण हेतु सीधा वित्तीय सहयोग प्रदान किया जाये।
- संरक्षित क्षेत्रों का आदर किया जाये क्योंकि उन्हें किसी कारणवश संरक्षित किया जा रहा है।

नहीं किया जाना चाहिए

- नशीले पदार्थों का सेवन।
- खाना एवं गर्मी हेतु आग का इस्तेमाल।
- किसी स्थानीय व्यक्ति विशेष का बिना उसकी सहमति से फोटो (चित्र) लेना।
- धूम्रपान।
- तेज बोलना (ऊँची आवाज में बोलना)।
- बच्चों को कुछ वस्तुएं देना।

- प्लास्टिक की बोतलों को छोड़ना।
- टांफियों के कागज एवं सिगरेट के अवशेष छोड़ना।
- सुनिश्चित मार्गों से बाहर जाना।
- फूल तोड़ना।
- जड़ी–बूटी एकत्र करना।
- वन्य जीवों/उनके आवासों को हानि पहुँचाना।
- लुप्तीकृत पादप/जन्तु निर्मित वस्तुओं को खरीदना।

हकदारियों के क्षेत्र का सम्मिलितिकरण

परिवेश पर्यटन हेतु विभिन्न हकदारियों की भागीदारी एवं सहयोग अति आवश्यक होता है। किसी भी संरक्षित क्षेत्र के परिवेश पर्यटन हेतु कारगर एवं उचित प्रबन्ध नीति के लिए विभिन्न हकदारियों के मध्य सामंजस्य एवं अच्छी अभिव्यक्ति होना अति आवश्यक है। ये एक अहम् पहलू है कि किसी भी समुदाय एवं विभिन्न हकदारियों को संरक्षित क्षेत्र में परिवेश पर्यटन में सतत् विकास का केन्द्र माना जा सकता है। संरक्षित क्षेत्रों पर आधारित परिवेश पर्यटन में निम्न हकदारियों की भूमिका अहम् होती है।

- ✓ ग्रामीण/स्थानीय जनसमुदाय
- ✓ संरक्षित क्षेत्रों के प्रबन्धक/कार्य संचालक
- ✓ पर्यटक
- ✓ होटल मालिक, सेवा प्रदान करने वाले कार्यकर्ता एवं अन्य दुकान मालिक
- ✓ यात्रा संचालक, गाइड और मजदूर
- ✓ गैर सरकारी संगठन, शैक्षिक और शोध संस्थान एवं मीडिया
- ✓ पर्यटन विभाग

परिवेश पर्यटन के प्रोत्साहन हेतु आवश्यक एवं कारगर रूपरेखा

स्थानीय/क्षेत्रीय/राष्ट्रीय स्तर पर किये जा सकने वाले आवश्यक प्रयास

(1) बाहर से आने वाले यात्रियों, स्थानीय निवासियों, यात्रा संचालकों, संसाधन प्रबन्धकों, शैक्षिकों, योजकों, सरकारी संगठनों एवं अन्य व्यवसायिक संगठनों, जो संरक्षित क्षेत्रों, संस्कृति एवं सामाजिक तथ्यों से सम्बन्ध रखते है उनको परिवेश–पर्यटन सम्बन्धी जानकारी प्रदान करना।

(2) परिवेश–पर्यटन को प्रभावी रूप देने के लिए आचार संहिता को लागू करना।

(3) संरक्षित क्षेत्रों में परिवेश पर्यटन की योजना एकदम स्पष्ट होनी चाहिए एवं जिसमें सभी हकदारियों की भागीदारी सुनिश्चित होनी चाहिए।

(4) विभिन्न जनसमुदायों के विचार आदि को दृष्टिगत रखते हुए परिवेश पर्यटन के विकास को प्रोत्साहन दिया जाना चाहिए जिसमें योजना प्रबन्धन एवं विभिन्न हकदारियों को लाभान्वित करने हेतु नीति निर्माण किया जाना चाहिए।

(5) परिवेश पर्यटन की योजना एवं विकास हेतु मिलजुल कर कार्य किया जाना चाहिए। जो स्थानीय स्तर पर हो एवं जिसमें वहाँ के जनसमुदाय की भागीदारी सुनिश्चित हो।

(6) स्थानीय जनसमुदाय की कार्यक्षमता को बढ़ावा देने हेतु इन्हें प्रत्येक जगह शामिल किया जाना चाहिए जिससे वे परिवेश पर्यटन सम्बन्धी विकास गतिविधियों में अपनी भागीदारी सुनिश्चित कर सके।

(7) स्थानीय स्तर पर खरीददारी करनी चाहिए जिससे विभिन्न कडियों को समाप्त किया जा सके व रोजगार के साधन उपलब्ध हो सकें।

(8) परिवेश–पर्यटन योजना को बढ़ावा देना चाहिए जिससे वह संरक्षण योजनाओं को प्रोत्साहन प्रदान कर सके।

(9) सामाजिक, सांस्कृतिक एवं पर्यावरण सम्बन्धी प्रभाव को कम किया जाना चाहिए।

(10) परिवेश पर्यटन में लोगों की भागीदारी को बढ़ावा मिलना चाहिए एवं स्थानीय जनसमुदाय को आर्थिक रूप से सहायता प्रदान करनी चाहिए।

(11) विभिन्न हकदारियों को भिन्न स्तरों पर प्रोत्साहन, एवं सशक्तीकरण प्रदान किया जाना चाहिए।

(12) परिवेश पर्यटन के संचालन एवं नीति निर्धारण हेतु पर्यटन उद्योग, लोक सेवा संस्थान आदि के विचारों एवं मतों को जोड़ा जाना चाहिए।

(13) परिवेश पर्यटन सम्बन्धी कार्यक्रमों व अन्य गतिविधियों के संचालन में स्थानीय जनसमुदाय को विभिन्न कार्ययोजनाओं के तहत सुनना चाहिए।

(14) गृह–पर्यटन, ग्राम पर्यटन एवं ग्रामीण पर्यटन हेतु यात्रा मार्गों में स्थित विभिन्न उचित ग्रामों का चुनाव किया जाना चाहिए।

उक्त सभी बिंदुओं को दृष्टिगत रखते हुए हम स्थानीय जनसमुदायों, विभिन्न सरकारी एवं गैर सरकारी संगठनों एवं विभिन्न हकदारियों के माध्यम से परिवेश–पर्यटन विकास सम्बन्धी एक उचित नीति अथवा कार्य योजना का निर्माण कर सकते हैं एवं जो प्रमुखतः नंदादेवी बॉयोस्फेयर रिजर्व के प्रबन्धन हेतु होगी। साथ ही जिसके माध्यम से हम संरक्षित क्षेत्र एवं स्थानीय जनसमुदाय के मध्य जन्में अपवादों को कम कर पाने में सक्षम होगें। संस्थान द्वारा उक्त क्षेत्र में आयोजित एक कार्यशाला में जो प्रमुख बिन्दु समक्ष आये वे–आरक्षित क्षेत्र में प्रवेश हेतु इनर लाइन परमिट की प्राप्ति में कठिनाई का होना, सम्बन्धित विभिन्न विभागों में सामंजस्य स्थापित न होना, आरक्षित क्षेत्र में भ्रमण हेतु सम्बन्धित विभागों द्वारा धनराशि तय न होना, सम्बन्धित विभागों यात्रा संचालकों के लिए धनराशि का अधिक होना आदि थे। उक्त लिखित बिन्दुओं के आधार पर हम नंदादेवी बॉयोस्फेयर रिजर्व में पर्यटकों का प्रवाह अधिक कर सकते हैं, जो स्थानीय जनसमुदायों की आर्थिकी को बढ़ा सकता है। अतः प्राकृतिक संसाधनों के उपयोग, पर्वतारोहण, पर्यटन आदि को परिवेश पर्यटन से जोड़ा जाना चाहिए एवं पर्यावरण एवं संस्कृति के संरक्षण हेतु अधिक ध्यान दिया जाना चाहिए, जिससे सतत् पर्वत परिवेश पर्यटन को बढ़ावा मिल सके एवं पर्यटकों/आगंतुकों हेतु एक उचित कार्यक्रम एवं निर्देशावली का निर्माण किया जा सके।

साराँश

नंदादेवी एवं उससे जुडे अन्य पर्वत जो नन्दादेवी बॉयोस्फेयर रिजर्व के अंतर्गत आते हैं के अंदरूनी क्षेत्रों पर यात्रायें समस्त रूप से समाप्त कर देने से स्थानीय जन–समुदाय की आर्थिकी पर प्रभाव पड़ा। इस हेतु स्थानीय जनसमुदाय द्वारा सरकारी तंत्र के विपरीत प्रयास भी किये गये, परन्तु अभी तक उनको कोई सफलता नहीं मिल पाई है। हालाँकि कोर जोन के कुछ भाग पर्यटकों हेतु खोले गये हैं परन्तु स्थानीय हकदारियों के अनुसार ये क्षेत्र पर्यटकों के आवागमन को बढ़ाने हेतु उतने सफल नहीं है जितने कुछ वे क्षेत्र जहां कि पर्वतारोहरण की अपार संभावनायें हैं, स्थानीय समुदायों/हकदारियों के अनुसार अन्तर्राष्ट्रीय व राष्ट्रीय स्तर के पर्यटक उक्त क्षेत्र में मात्र भ्रमण न पसन्द कर पर्वतारोहण की ओर अधिक आकर्षित होते है। संरक्षण मानकों को समक्ष रखते हुए अगर कुछ संभावित क्षेत्रों को खोला जाये, उन हेतु कुछ सुविधाएं उपलब्ध करवायी जाएं एवं कुछ यात्रा मार्गों की पहचान की जायें तो यह हितकारी हो सकता है। जैसा कि विदित है कि परिवेश–पर्यटन स्थानीय आर्थिकी से सीधा सम्पर्क रखता है अतः परिवेश पर्यटन पारिस्थितिकीय अनुरूप, सामाजिक एवं आर्थिक और सांस्कृतिक अनुरूप होना चाहिए।

आज नितान्त आवश्यकता है तो मात्र इस बात की कि परिवेश पर्यटन के विकास हेतु सभी हकदारियों (स्थानीय जनसमुदायों, सरकारी एवं गैर सरकारी संगठनों, यात्रा संचालकों आदि) के विचारों को एक मंच पर रखकर एक बार पुनः नीति–निर्धारण किया जाये एवं एक स्पष्ट नीति का निर्माण किया जा सके। अंतरिम उद्देश्य यह होना चाहिए कि जो मतभेद वर्तमान में नंदादेवी बॉयोस्फेयर रिजर्व क्षेत्र में स्थापित हो चुके हैं, उनके लिए कोई पर्यटन उद्योग सम्बन्धी योजना बनाई जाए जो उक्त क्षेत्र में संचालित की जा रही अन्य संरक्षण एवं विकास सम्बन्धी गतिविधियों के लिए एक सहयोग रूपी मील के पत्थर का कार्य कर सके।

छायाचित्र 1. नन्दादेवी पर्वत का एक विहंगम दृश्य

छायाचित्र 2. वन, बुग्याल एवं बर्फ का संगम – गढ़वाल हिमालय

छायाचित्र 3. बुग्यालो का चारागाह के रूप में उपयोग

छायाचित्र 4. सीमान्त गांव में संस्थान द्वारा आयोजित एक कार्यक्रम के दौरान ग्रामीण महिलाओं से चर्चा करते संस्थान के कर्मचारी