

## **Minor forest products' management: problems and prospects in remote high altitude villages of Central Himalaya**

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### **SUMMARY**

Problems and prospects of minor forest resource uses and management in three remote high elevation villages in the Indian Central Himalaya were studied. Of the 45 species constituting the minor forest product resource base, medicinal plants (14 species), wild edibles (ten species) and bamboos (four species) were important both for local use and for the rural economy. A range of tree species had fodder and organic manure value. The management practices differ in the government owned forests and village community owned forests. Local communities are more conscious of sustainable utilization of the forests they own and manage. Indirect economic benefits from Forests were much higher than the direct benefits. The margin of profits to the villagers from minor forest resources could be improved by appropriate changes in the extraction, regeneration and marketing systems, together with improvement in traditional knowledge in terms of the industrial values of the products and empowerment of local communities.

**Key words:** Himalaya, medicinal plants, Villagelevel cottage industry, sustainable rural development

## Sustainable development and management of rural ecosystems in the Central Himalaya: a case study from Haigad watershed

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### **SUMMARY**

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

**Key words:** Himalaya, rural development, watershed, planning

## **Analysis and resolution of protected area–people conflicts in Nanda Devi Biosphere Reserve, India**

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### **Summary**

Conflicts between local people and protected area managers are a common problem in developing countries, but in many cases there has been little attempt to comprehensively characterize the underlying problems. Resource uses, management practices, economy and people's perceptions of problems and likely solutions were analysed in two villages near and two villages away from the core zone of Nanda Devi Biosphere Reserve in the Indian Himalaya. Agriculture, although practised on less than 1% of the area, was the primary occupation of local people. Six annual crops of a total of 22 and all four horticultural crops on private farms were damaged by wildlife, but Reserve management provided compensation only for livestock killing by wildlife and compensation amounted to only 4–10% of the total assessed monetary value of killed livestock. A variety of wild plant products were used locally but 27 were marketed by more than 50% of surveyed families; income from wild products was substantially lower than that from crops and livestock. A sociocultural change from a subsistence to a market economy, together with changes in traditional land/resource rights and institutions, has led to a number of changes in land-use and management practices. The livestock population has declined, agricultural area has remained the same and people have started cultivating medicinal species in the last 20 years. These changes seem complementary to the goal of conservation. However, changes such as abandonment of some traditional food crops and stress on cash crops lacking fodder value, requiring substantial manure inputs derived from forest litter and livestock excreta, and causing severe soil erosion, seem to counter the goal of environmental conservation. Some government-managed Reserve Forest sites were similar to the Community Forests in terms of species richness, basal area and soil physico-chemical properties. Two Reserve Forest sites showed basal areas of 160.5–191.5 m<sup>2</sup>/ha, exceeding the highest values reported so far from the region. The formal institutional framework of resource management seems to be not as effective as the traditional informal system. The Reserve Management Plan lays more emphasis on legal protection than on the sustainable livelihood of local communities and has led to conflicts between local people and reserve managers. Plantation of fodder and medicinal species in degraded forest lands, suppression of economic exploitation of local people in the market, enhancement of local knowledge of the economic potential of biodiversity, incentives for cultivation of crops with comparative advantages and lesser risks of damage by wildlife, and rejuvenation of the traditional involvement of the whole village community in decision making, could be the options for resolving conflicts between people and protected areas in this case.

**Keywords:** Himalaya, agriculture, forests, pastures, economy, conflict

## **The Eastern Himalaya Wetlands, Forests and Beliefs**

B P SINGH

### **Abstract**

The eastern Himalayan region has been blessed by rich natural resources – forests, wildlife as well as its people, who are a fount of information of traditional healing systems and beliefs. However, the region has for long suffered from indifference and from insurgency, which has in recent years, become endemic to the region. A healing process could rightly begin, with the government's initiation, and supported by NGOs and the local communities.

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### **Changing scenario of Himalayan agroecosystems: loss of agrobiodiversity, an indicator of environmental change in Central Himalaya, India**

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### **Summary.**

Environmental, biological, socio-cultural and economic variations in the Himalayas have led to the evolution of diverse and unique traditional agroecosystems, crop species, and livestock, which help the traditional mountain farming societies to sustain themselves. During the recent past, as a result of rapid changes in land use caused by socio-cultural and economic changes and various environmental perturbations, the agrobiodiversity of the Central Himalayan agroecosystems has changed steadily. A recent survey conducted in 150 different villages located along an elevated transect of the Alaknanda catchment of the Central Himalaya revealed that over a period of two decades (1970.74 and 1990.94) the cultivated area under many traditional crops had declined significantly. A micro-level study carried out in 30 villages revealed that a series of changes had occurred in land use practices over a period of 25.30 years.

The loss of agrobiodiversity and the changing socio-cultural and economic dimensions and their impacts on the sustainability of Himalayan agroecosystems are emerging as major causes of concern at local/regional/national scale, and appropriate options to meet these challenges are discussed in this paper.

**Keywords:** Himalaya, traditional agroecosystems, indicators of agrobiodiversity, sustainable development

## **Human Dimensions of Conservation in the Khangchendzonga Biosphere Reserve**

### **The Need for Conflict Prevention**

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#### **Abstract**

The Khangchendzonga Biosphere Reserve (KBR) is one of the latest additions to the protected areas network in the Indian Himalayan Region. Located in the picturesque state of Sikkim in the eastern Indian Himalayan Region with snow-clad mountain peaks, numerous glaciers, a snow- and glacier- fed stream network and high-altitude lakes, this biosphere reserve (BR) is named after the world's third highest mountain peak, Mt Khangchendzonga (8598 m), 1 of the 14 peaks in the world above 8000 m. The KBR covers an area of 2619.92 km<sup>2</sup>, 36.92% of the land area of Sikkim (Figure 1). BRs exemplify participatory sustainable resource use and ecosystem conservation. It is therefore important to consider the human dimensions of a BR from the outset and to survey stakeholders' attitudes about conservation in order to take into account the inherent traditional dependence of people on forest-based resources. Potential future conflicts of interest need to be addressed through well-thought out strategies and integration of traditional conflict prevention mechanisms. Experience gained in the KBR may be useful in light of the widely reported conflicts in other BRs and protected areas around the world. Careful and informed planning may help reduce the likelihood of conflicts arising in newly established BRs.

## **Local Peoples' Knowledge, Aptitude and Perceptions of Planning and Management Issues in Nanda Devi Biosphere Reserve, India**

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### **ABSTRACT**

Local peoples' knowledge, aptitude, and perceptions of planning and management issues were investigated in Nanda Devi Biosphere Reserve (NDBR) in Uttaranchal State of India. Conflicts ensued between local inhabitants and the management authority due to lack of community participation. Although most respondents seem to claim the knowledge of the objectives of Nanda Devi Biosphere Reserve, the source of information indicates their interaction with the management authority is not frequent. While local population seem to agree on reduced intensity of agriculture with compensation equal to loss of net income, there is a perceptible difference in responses among different age groups. While the younger generation seems to agree to move away to other areas with suitable compensation packages, the older generation prefer those options that require some adjustments in use and access to natural resources. The option of ecotourism as a source of income is acceptable to most respondents, but young and old respondents disagreed about impact of such activity on social behavior of local inhabitants. Among those groups studied, only the "self-employed group" seem to be more interested in ecotourism in comparison to other occupation classes. Gender differences in perceptions are prominent with reference to development options. While the men preferred economic opportunities, the women preferred improved living conditions. An evaluation mechanism similar to the one described in this paper will be helpful to the management authority to assess and modify their management plans to mitigate conflicts with local people

**KEY WORDS:** Biosphere Reserve; Local people; Perceptions; Planning and evaluation; Management; Garhwal Himalaya; India

## **Forest resource availability and its use by the migratory villages of Uttarkashi, Garhwal Himalaya (India)**

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### **Abstract**

Recognising the ecological importance of Himalayan forests in terms of their intrinsic values as life support system for the local people and as repository of regional biodiversity, the present study was conducted. It aimed at assessing the status of available forest resources, current levels of pressure on them and sustainability of current land use practices in a part of district Uttarkashi in Garhwal Himalaya. We quantified available standing biomass, regeneration and population of highly preferred species and their consumption patterns. The study revealed a spatio-temporal variation in resource extraction. The standing biomass of preferred woody species at low altitude permanent villages and high altitude summer camping sites (*Kharaks*) were  $140.68 \pm 26.91$  and  $477.46 \pm 31.8$  t/ha, respectively. Average fuel wood consumption per household at permanent villages was  $14.65 \pm 0.78$  kg/day whereas consumption per temporary hut (*Chhans*) at camping sites was  $36.42 \pm 3.35$  kg/day. Higher per capita consumption of fuel wood in the camping sites due to seasonal migration of local as well as transhumants locally known as *Gujjars* had put immense pressure on sub-alpine forests. An increase in the demands for natural resources was noticed due to an augmented influx of tourists, which would further lead to the degradation of already scarce resources in the sub-alpine areas. Thus increased resource extraction from the low as well as high altitude forests simultaneously, may not be sustainable in the long run. In near future this might affect the status of the undisturbed forest at middle elevation, which has relatively high available biomass and regeneration capacity.

**Keywords:** Biomass; Disturbance; Fuel wood; Migration; Himalaya

## **Conflict in Paradise Women and Protected Areas in the Indian Himalayas**

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### **Abstract**

The unique assemblages of flora and fauna in the Himalayan region make it one of the most important biodiversity hotspots on the Indian subcontinent. Seventy-five protected areas (PAs) encompassing 9.48% of the region have been created to conserve this biodiversity and the fragile Himalayan landscape (Figure 1). However, this has engendered conflicts between PA management and local communities that suffer from restrictions on access to biomass resources. When resource use in PAs is prohibited, the implications of the conflict are more severe for local women, who bear the burden of day-to-day survival. Initiatives to empower women are hampered by women's lack of education and skills and by low self-esteem resulting from their marginalization by sociocultural taboos. Incentives are needed to promote meaningful participation by women in biodiversity conservation initiatives.



## **Transhumant Pastoralism in the Nanda Devi Biosphere Reserve, India -A Case Study in the Buffer Zone**

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### **Abstract**

In the past, transhumant pastoralists in the Indian Himalaya used resources available in various subsystems for their livelihoods. Recent sedentarization of a section of the transhumant pastoralist population resulted in competition with the existing sedentary population for resources in some areas. Resources such as grazing areas and forests are becoming less productive and can no longer cover growing demand (both human and livestock). In the Niti valley (Nanda Devi Biosphere Reserve [NDBR] buffer zone), changes in government policies during the past 50 years have produced a landuse system that is not conducive to traditional transhumant pastoralism. The present article analyzes the impact of loss of grazing area on transhumant pastoralism, the current state of monetary return from livestock rearing, and the output–input ratio in terms of energy currencies in villages inhabited by transhumant pastoralist populations and villages now practicing sedentarized lifestyles. Although small ruminant-dominated animal husbandry is providing monetary benefits to local populations, the system is consuming more resources than it produces in terms of energy currencies. The prospects for transhumant pastoralism in the buffer zone villages of NDBR are discussed.

**Keywords:** Biosphere Reserve; land-use change; mountain rural economy; transhumant pastoralism; Nanda Devi; Himalaya; India.

## **Linking natural resource management with sustainable development of traditional mountain societies**

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### **Abstract**

Both in a biophysical sense and in terms of the human dimensions of the problems, mountains form a highly heterogeneous landscape. Largely occupied by traditional societies, those living close to nature and natural resources, these mountain societies are linked to the natural forest ecosystem and the human-managed agroecosystems through biodiversity driven traditional ecological knowledge. This knowledge base operates at varied levels of ecosystem complexity – sub-specific/species levels going right up to the landscape level complexity. This paper analyses the special features of this socio-ecological system complexity and considers various possibilities for sustainable management of natural resources, with concerns for sustainable livelihood of mountain communities.

**Key words:** Agroecosystems, biodiversity conservation, landscape ecology, mountain societies, natural resource management, traditional ecological knowledge

## **Indigenous ecological knowledge, biodiversity and sustainable development in the central Himalayas**

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### **Abstract:**

The paper has looked at traditional systems of forestry and agricultural system management in the central Himalayan region. Based on a detailed analysis of traditional ecological knowledge that is linked with biodiversity, natural and human-managed, various possibilities for sustainable management of natural resources, with concerns for sustainable livelihood of local communities have been explored for the Garhwal region in the central Himalayas. It is concluded that if the development interests of local people are marginalized for a long period of time, they might adopt actions detrimental to the goal of conservation. Capitalizing on the positive dimensions of traditional knowledge and overcoming its negative dimensions through conventional science-based inputs could ease the difficult process of securing people's participation in environmental conservation together with the socio-economic development of local communities.

**Key words:** Biodiversity, natural resource management, rehabilitation ecology, sustainable livelihood, traditional knowledge and technology

## Indigenous uses and structure of chir pine forest in Uttarakhand Himalaya, India

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### SUMMARY

The various indigenous uses and structure of chir pine forests were studied in Uttarakhand state of the Indian Republic. A questionnaire survey was conducted in 50 villages of Uttarakhand to gather information on the indigenous uses of chir pine. For the study of community composition and structure of chir pine forest, at least 15 quadrats of 10 x 10 m were selected randomly across various localities, and the number of individuals, along with other dominant tree and shrub species, were enumerated in each quadrat. About 10 indigenous uses of chir pine were prominent in Uttarakhand. Besides resin, an important nonwood product, different parts of chir pine, such as cones, trunk, stems, wood, leaves and bark, were used by the local people. Chir pine is a subject of the folklore and mythology of indigenous cultures in Uttarakhand. Chir pine forest formed three major communities in Uttarakhand viz., sal-pine (*Shorea robusta-Pinus roxburghii*), pine pure stands and oak-pine (*Quercus leucomorphora-Pinus roxburghii*). These communities sustained various multipurpose trees and shrubs along with various edible mushrooms (eg. *Agaricus campestris*, *Morchella esculenta* and *Sparassis crispa*). The results of this study are discussed in the light of chir pine conservation and management policies.

**Key words:** Chir pine forest, indigenous uses, Uttarakhand, Himalaya, local communities, conservation

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## Indigenous Knowledge Systems and Sustainable Management of Natural Resources in a High Altitude Society in Kumaun Himalaya, India

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### ABSTRACT

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

**KEYWORDS:** Indigenous Knowledge. High Altitude Society. Himalaya. Natural Resources.

## **. Resource Utilization Pattern and Development in Hills --A Case for the Pindar Basin of Garhwal Himalaya, India**

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### **Abstract**

Agrarian system is well adapted in Himalayan eco-system. Hence, the people have adopted the traditional subsistence cereal farming and it becomes the main stay of Himalayan people. About 80 percent of the workable force is attached with agriculture and its allied practices, according to the census of 1991. Although, horticultural farming runs parallel with agriculture, its proportion in terms of land is quite less, resulted in a negligible place in the economy of the region. Human resources, mainly men are attached with national security after recruitment in Army. While, women play a vital and integrated role in maintaining the workable potential in the field of agriculture and are known as backbone of economy. An animal resource implies foremost and wider part in agricultural system and economy as well. Water resources are unutilized yet, while almost all the major rivers of our country are originated from and flowing through this region. Increasing population causes forest resources depletion. The economy of the region is rested either on 'traditional cereal farming' or 'money order based' development, which could not take place due to its remoteness from the main streams of the country. The impact of modern technology with innovation in agricultural system remains impracticable due to unwillingness of people in one hand and on the other hand, adverse geographical conditions like topography, climate etc. which could not permit the uses of modern innovation in the field of agriculture. As for infra-structurally, this region is lacked behind, due to its inaccessibility. While, this region is bestowed with numerous rivers, many places for tourists and pilgrims, and huge forest resources. They might be used evenly in the development processes. The practice of tourism will help for the further development, particularly, in the wake of the newly born state, Uttaranchal. The present paper aims to evaluate the present potentiality of resources and their balanced utilization in the Pindar Basin. A precise study has been done on resource utilization, ecology and environment with keeping view in mind that more or less exploitation of resources could not influence the environment and the economy of the region.

**Keywords:** Agrarian system; Himalayan eco-system; cereal farming; ecologically fragile zones; money order based, resource utilization; alpine meadows; sustainable development; ecology and environment

## **Indigenous Knowledge and Conservation Practices in Tribal Society of Western Himalaya: A Case Study of Sangla Valley**

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### **Abstract**

The tribal people of the Sangla valley of Kinnaur district of Himachal Pradesh constitute a special category of economically backward area due to its inaccessibility and inhospitable geo-climatic set-up of the region. Subsistence agriculture, livestock rearing and trading off the minor forest products are the only means of economy activities of the marginal people. The tribals have accumulated their own innovative traditional knowledge and have developed a congenial relationship with the locally available biological resources and diverse geo-climatic conditions thus, establishing a perfect harmony with the nature. These people since time immemorial are practicing the indigenous means of conservation of cultural and biological diversity. The existence of an age-old tradition of preserving forests on the ground of religious and mythological beliefs has become a key factor in the revival of degraded areas. A meaningful development of the area could only be achieved when cultural practices (based on indigenous knowledge) are synthesized with the ecological and economic development packages/programmes by involving local people of the region.

**Keyword:** Tribal societies; indigenous knowledge; conservation practices; natural resource management; sustainable development.

## **Matting rush (*Schoenoplectus lacustris* (Linn.) Palla.; Status, utility, threat, cultivation and conservation options in Manipur**

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### **Abstract**

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

**Keywords:** Economy, handicraft items, matting rush, *Schoenoplectus lacustris*, wetland

## **Traditional resource management practices for biodiversity conservation and their significance in Nanda Devi Biosphere Reserve, India**

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### **SUMMARY**

The Nanda Devi Biosphere Reserve is considered one of the most biologically diverse and socio-culturally rich biosphere reserves in India. From ancient times, the local community considered the entire biosphere area as a sacred landscape, and institutionalized a number of resource conservation and utilization practices through their customs/ traditions and religious beliefs. Traditional Resource Management Practices (TRMPs) have evolved through co-existence, interactions, and a reciprocal response between society and nature. These can be classified into four broad categories: (a) provision of a return to nature; (b) restraints on over-utilization or wastage of resources; (c) management of resources according to their use for subsistence; and (d) creation of opportunities for natural regeneration. In the last hundred years, the age-old TRMPs have been replaced by scientific management systems, which have led to alienation of the community from management of their resources. Conservation of the natural system while ignoring the social system has created severe imbalances in the overall ecosystem of the area. True participation of the local community in the scientific resource management can only be achieved by providing due credit to TRMPs. Therefore, planning of biodiversity conservation should be based on a healthy interaction between formal ecological science and traditional knowledge.

**Key words:** Nanda Devi Biosphere Reserve, Bhotia community, customary laws, traditional resource management practices, natural resources

## **Resource Flows of Villages with Contrasting Lifestyles in Nanda Devi Biosphere Reserve, Central Himalaya, India**

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### **Abstract:**

Resource use efficiency analyses of village ecosystem are necessary for effective and efficient planning of resource utilization. This paper deals with economic and energy input-output analyses of different components of village ecosystem in representative buffer zone villages, which are practicing transhumance and settled way of lifestyles in Nanda Devi Biosphere Reserve (NDBR) of Garhwal Himalaya. While the villages practicing transhumance used various natural resources spatially segregated, the villages practicing settled way of lifestyle have to manage resources from a limited spatial area through rotation and varied extraction intensities. Forests subsidized the production activity in both type of villages and the per capita resource extractions were found to be greater in transhumance village than settled village. Though crops provided maximum energy, in terms of economic criteria, animal husbandry played important role in both settled and transhumance villages. As villages representing both the situations showed different ways of adjustments to the conservation oriented land use changes, management authority needs to address the eco-development plans fulfilling the aspirations of all people traditionally using the resources of the Reserve to reduce the conflicts and encourage their participation in the conservation of the area.

**Keywords:** Himalaya; resource flow; natural resource management; protected area network; sustainable development; transhumance; village ecosystem

## **Biodiversity characterization in Nubra Valley, Ladakh with special reference to plant resource conservation and bioprospecting**

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### **Abstract**

Trans-Himalayan mountains, owing to harsh climatic conditions and a short growing season support low vegetation cover (<20%), yet it is known to harbour a unique assemblage of flora and fauna which have not been systematically inventoried and documented so far. This paper deals with spatial and non-spatial information on landscape units, vegetation characteristics and plant species diversity of Nubra Valley in Ladakh, India. Based on digital – visual (on screen) interpretation of remote sensing data coupled with knowledge-based classification we delineated 19 cover classes (11 vegetation types and 8 non-vegetation categories). The vascular plants (angiosperms and gymnosperms) were systematically collected using stratified random sampling of different landscape/vegetation to characterize plant communities and assess the distribution patterns of species. The study reveals that nearly 78–80% of plant species in Nubra are restricted to the valley bottoms. In all, 414 species of vascular plants were recorded from the study area. These belongs to 56 families and 202 genera. Of these, 102 species were reported to be used in traditional system of medicine by Amchis over 80 species are largely associated with cultivated fields and human habitation. As many as 49 species were cultivated which include several varieties of crop plants especially those of barley and buckwheat. Aspects of bioprospecting and conservation of valuable species have been discussed.

**Key words:** Biodiversity, Bioprospecting, Nubra valley, Plant resource



## **Indigenous Technical Knowledge and resource utilization of Lisus in the South eastern part of Namdapha National Park, Arunachal Pradesh**

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### **Abstract**

The *Lisus*, also known as *Yobin* are the dominant tribe in the South eastern periphery of Namdapha national park in Changlang district of Arunachal Pradesh. They spend most of their time in the forests where they practice *jhum* cultivation and hunt wild animals. The hilly terrain and inaccessibility have forced them to innovate things to save time and energy. Through time, the Lisu people have earned good knowledge of agricultural as well horticultural crop production. They also know the technique of grafting horticultural plants. Using this knowledge they get fruits they wish to grow in a short duration of time, eg. *Diospyros kaki* (*Thaj*), a fruit tree commonly grown by the Lisus. Fruiting is made only when it is grafted with a specific wild plant (*Slani* in Lisu), which is abundant in the *jhum* fallows. Different horticultural fruits like *Diospyros kaki* Linn. f. (*Thaj*), *Citrus reticulata* Blanco, (orange), *Ananas comosus* (L.) Merr., (pineapple), *Psidium guajava* Linn. (Guava) etc. are also cultivated permanently in the abandoned *jhum* lands for rehabilitation of fallow agricultural lands, which is generally not observed among other tribes of Arunachal Pradesh. The *Lisu* tribe has rich traditional as well as technical knowledge due to the numerous hardships they face, which have compelled them to innovate things and make new gadgets. Most of the households at Vijaynagar and Gandhigram have the flowing-water operated gadget used for milling rice without applying manpower. Due to difficult terrains, consisting of mountains and rivers they have built hanging bridges completely made of wood, bamboos and canes to connect village to village and to the agricultural fields. Thus, the indigenous knowledge systems and traditional technologies help in natural resource utilization among the indigenous (*Lisu*) tribe. However, such eco-friendly technologies that are energy efficient should be promoted for conservation and further replications elsewhere.

**Key words:** Namdapha, Natural resources, Biodiversity, *Lisu* tribe, Indigenous Technologies, Conservation, Traditional Horticultural Practices, Arunachal Pradesh

## **Cultivation and conservation practices of *Euryale ferox* Salisb. in Manipur**

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### **Abstract**

*Euryale ferox* Salisb. is a subtropical plant available in most of the Asian countries. *Euryale ferox* Salisb. fruits due to its use in local delicacies and for medicinal values have demand in local market. The paper highlights the management and conservation practices of *Euryale ferox* Salisb. in Manipur with a note on cultivation. Some traditional medicinal uses of the plant are also mentioned.

**Key words:** Aquatic herb, Local delicacy, Conservation practices, Cultivation practices, Manipur

## **Traditional skill of resource utilisation**

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### **Abstract**

The peasants have evolved ecological and economic sustainability in an agro-forest-livestock management system centred on *Grewia* over centuries in central Himalaya. The report focuses on the communities residing in Kature valley in Central Himalaya, who have learnt to utilize the *Grewia* for a number of domestic uses. The system's sustainability has been achieved through knowledge of local ecological processes derived through traditional means. In the past, these models of resource utilization were sustainable on account of low biotic pressure, but now with the increase in population, these ageold practices, which were providing both economic and ecological sustenance, have started showing signs of redundancy being less economical.

**Key words:** Central Himalayas, Fibre extraction, *Grewia*, Indigenous Knowledge

## Traditional knowledge and biodiversity conservation in the sacred groves of Meghalaya

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### Abstract

The people of Meghalaya believe that the sacred groves (forests) are the abode of deities. It bestows the welfare of people, their cattle & land, and keeps the evil spirits away. Those who do not obey the traditional norms of these groves may have to face the wrath of the deity. A religious belief is one of the major factors for conservation of plant resources in such groves. Local people believe that the Sylvan deities would be offended if trees are cut and twigs, flowers, fruits, etc. are plucked. These groves are considered as one of the most species-rich areas for plants, birds and mammals. The mythological stories and indigenous knowledge associated with the groves have been the principal factor in preserving the sacred groves in the immaculate condition.

**Key words:** Indigenous knowledge, Meghalaya, Plant diversity, Sacred groves, *Khasi* tribe, *Garo* tribe, *Jaintia* tribe

## Diversity, extraction and status of fodder species in Askot Wildlife Sanctuary, West Himalaya, India

Samant, Rawal & Dhar

### Abstract

In view of the increasing demand for forests resources, particularly fodder and fuel species, and the rapid loss of biodiversity from forests in the Indian Himalayan region, studies assessing diversity and extraction trends, species preference and probability of use (PU) in forests are urgently required. A new approach was used to examine extraction trends of fodder species in a botanical hot spot (Gori Valley) of Askot Wildlife Sanctuary in Kumaun Himalaya, India. In all, 115 species from 100 genera and 51 families were found to be used as fodder, of which 39% were native to the Himalaya. Fodder is collected in winter and summer from woody species and in the rainy season from forbs and grasses. The low altitude village use pattern does not vary due to similarities in species and forest communities in this area, whereas it varied considerably at higher altitudes. Similar, the total number of species used was very low at both low and high altitude villages, whereas the quantity collected was very high in both areas. The PU and Resource Use Index (RUI) varied considerably between seasons. Overall, forbs, grasses and trees showed the highest PU and RUI, indicating high preferences and pressures. Forbs and grasses were preferred over woody species. The high availability of preferred species suggests that they are not under threat of disappearing, whereas the low density of the remaining species indicates their possible extinction from natural habitats in the near future. Thirty-five species were absent from the studied communities, indicating their restricted habitats. Appropriate strategies for the conservation and management of fodder species are suggested.

**Keywords:** communities, diversity, himalaya, species preference, probability of use, resource use index

## **Conserving the Himalayan forests: approaches and implications of different conservation regimes**

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### **Abstract**

The conservation of Himalayan forests is big concern in view of global agenda. Many studies in this endeavor reported that the rate of forests degradation is posing a severe threat to the landscape and existing biodiversity in the Himalayas. Currently there many conservation approaches exists and of them four are widely recognized (1) Conservation through traditional religious beliefs “traditional conserved forests” (TCF); (2) Conservation through governmental planning and schemes “government conserved forests” (GCF); (3) Conservation through creation of protected areas (PAF); and (4) Conservation through community efforts “community conserved forests” (CCF). Our hypothesis in this direction says that all the conservation approaches lead to same results concerning to forest conservation. To testify our hypothesis we have studied the forests of each conservation regimes and evaluated them based on the identified indicators. We have done empirical studies and following the cloud-free satellite data were used for last three decades (such as Multi-Spectral Scanner, Linear Imaging and Self Scanning, and Enhanced Thematic Mapper) to study a change in vegetation dynamics of the mountain forests in multi-temporal dimension. Our research concluded that community conservation approach have greater significance for biodiversity conservation and management in the Himalayan region. Here we support the model of CCF for forest ecosystem conservation, alongside the sustainable livelihood of the mountain societies. But every conservation regimes has its own importance in viewpoint of the particular objectives. Therefore, we suggests advancement and revision of PAF and GCF however, some elements of CCF can be introduced in TCF for making up it more sound in view of rapid socio-economic and cultural changes taking place in the communities.

**Keywords:** Forests, Diversity, Conservation regimes, Empirical study, Land cover, Management, Sustainable development, Remote sensing, Himalaya

## **Firewood value assessment: A comparison on local preference and wood constituent properties of species from a trekking corridor West Sikkim, India**

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### **Abstract**

Local people's preference scores for firewood species were studied through pair-wise ranking tools of Participatory Rural Appraisal technique from Yuksam Dzungri trekking trail, Sikkim, India. A wide variety of plant species used as firewood was enlisted. These woody tree species with potential firewood use value were analysed for their Firewood Value Index (FVI) considering energy value, density, moisture content and ash content. The local people's preference scores and the constituent properties were then compared with 17 widely used firewood species using Pearson correlation and multiple regressions. *Quercus* spp. and *Rhododendron* spp. were the most desirable firewood according to their high ranks in local preference scores as well as FVI compared to other species. Local people's preference ranking energy and ash contents were vital constituents for determination of firewood quality. Local knowledge and scientific assessment closely matched to each other emphasizing that highly preferred species by the communities invariably showed better firewood value. However, there were some disparities when people's perception in relation to availability of species and convenience was considered. The local knowledge could be a good tool for species selection in forestry programmes.

**Keywords:** Firewood values, forestry programme, *in situ* conservation, local knowledge

## Diversity, Distribution and Indigenous Uses of the *Hypericum* Species in Indian Himalayan Region

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### Abstract

The genus *Hypericum* is known worldwide for its traditional and modern uses. Therefore, an attempt has been made to assess the diversity, distribution and indigenous uses of the species of this genus in the Indian Himalayan Region (IHR). A total of 27 species of *Hypericum* were recorded from the IHR, of these 17 were economically important. Thirteen species were native to the Himalayan region, 3 were endemic and 6 were near endemic species. Amongst the species, *Hypericum perforatum* was the most valued species used for fuel, fodder, dying and medicine, and for the extraction of hypericin. Due to over exploitation of this species for the pharmaceutical industries, the natural populations of this species are depleting fast and this species have been placed under vulnerable category of the IUCN. Similarly, due to multiple utility of the *H. choisanum*, *H. oblongifolium* and *H. sampsonii*, these species are also facing high pressures. It is expected that like *H. perforatum*, other species of *Hypericum* may have high concentration of hypericin. Therefore, chemical extraction of these species has been suggested for the identification of potential of these species. The population assessment using standard ecological methods and development of propagation protocol have been suggested.

**Key words:** *Hypericum*, medicinal plant, diversity, distribution, indigenous uses, Indian Himalayan Region

## **Traditional forest knowledge and sustainable forestry: A north-east India perspective**

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### **Abstract**

Forests in the Asian context are part of a cultural landscape linked to livelihood concerns of traditional societies particularly those living close to nature and natural resources. From a typical forestry management perspective, timber extraction has always been a priority. However, in the present day context and circumstances, where forest resources are rapidly being degraded in the Asian tropics, the issues involved are more about sustainable forestry for economic benefits (timber and non-timber forest products) to the society, and the conservation of biodiversity through a protected area network. An understanding of the ways in which forest resources are perceived by the forest dwellers on the one hand and by the forest managers on the other is critical for designing strategies for sustainable forestry in the Asian context. There is an increasing realization that today we need to move beyond formal knowledge based on silvicultural issues, and find appropriate linkages with traditional forest knowledge generated over generations by forest dwellers through an experiential process of trial and error. Strengthening linkages between knowledge systems using community participatory management approaches is now seen as critical for sustainable forestry.

**Keywords:** Shifting agriculture; Knowledge systems; Landscape redevelopment; Sustainable forestry

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## **Conservation ethos in the tribal folklore**

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### **Abstract**

The richly forested Northeast Indian state of Arunachal Pradesh is home to 25 major tribes, which belong to the Indo-Mongoloid group and practise Buddhism, Vaishnavism or elementary form of animism based on magico-religious beliefs. They practice *Jhum* (slash-and-burn agriculture), depend on forests for supplementing their daily needs and are now taking to the newer modes of land use and settled agriculture. They have evolved their culture & tradition, myths & folktales in close association with the nature and have an intricate understanding of the complexities of the ecological processes.

Based on the field experiences with the communities, it is described the way these tribal communities perceive nature & their surroundings, their socio-religious beliefs & sanctions regarding forests & land, and the myths & folktales governing their resource use. It goes on to elucidate their sacred beliefs, and how the concept of environmental conservation is embedded in their customs and ethos. An attempt has also been made to understand the changes taking place in these closed societies, primarily due to exogenous contacts, which has damaged the traditional fabric of the society.

**Keywords:** Arunachal Pradesh, *Jhum* cultivation, Sacred forests, Conservation ethos, *Monpas*, *Sherdukpens*, *Khamptis*, *Singphoos*, *Membas*, *Khambas*, *Nishis*, *Tagins*, *Apatanis*

## **Traditional method of Chuli oil extraction in Ladakh**

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### **Abstract**

*Chuli*, the wild apricot, growing abundantly in trans-Himalayan Ladakh yields bitter kernels called Khante which are utilized primarily for extraction of apricot oil by the aboriginal communities. In remote villages, apricot oil is used for cooking, religious, cosmetic and medicinal purposes. The paper describes the traditional method for extraction of Chuli oil. One kg apricot kernel yields about 35-37% oil. The oil is light yellow in colour and has a typical apricot odour.

**Keywords:** *Chuli*, Apricot oil, Traditional oil extraction, Ladakh

## **Traditional Ecological Knowledge and Community-based Natural Resource Management in Northeast India**

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### **Abstract:**

Community-based natural resource management in northeast India has a long history. Indigenous knowledge and adaptation are the collective information, with improvement from generation to generation. The expectation is that under community control, local expertise on biodiversity will play a significant role in natural resource management through traditional practices. This paper discusses the characteristics and application of the traditional ecological knowledge of aboriginal peoples in northeast India and its role in natural resource management. Examples are provided in two different eco-cultural landscapes, i.e., Demazong (the Buddhist eco-cultural landscape in Sikkim Himalaya) and the Apatani eco-cultural landscape in Arunachal Pradesh, which illustrate the utility value of traditional ecological knowledge in sustainable natural resource management. Both eco-cultural landscapes are indeed very complex and highly evolved systems with high levels of economic and ecological efficiencies. The paper concludes that traditional ecological knowledge systems and institutions could serve as entry points into the sustainable utilization and management of natural resources. This could be achieved through the exploration of the cultural practices of the local people and integrating useful aspects into the modern natural resource management expertise. With rapidly depleting biodiversity in the developing tropic regions, there is a greater utilization today than ever before of the value of respecting the "Sacred" as a tool towards better conservation of natural resources.

**Keywords:** Traditional ecological knowledge; resource management; cultural landscape; sustainable development; northeast India



## Diversity, Distribution and Prioritization of Fodder Species for Conservation in Kullu District, Northwestern Himalaya, India

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### Abstract:

In the Indian Himalayan Region predominantly rural in character, livestock is one of the main sources of livelihood and integral part of the economy. Livestock mostly rely on fodder from wild. The diversity, distribution, utilization pattern, nativity, endemism, rarity, seasonality of availability, nutritive values, perceived economic values and pressure use index of livestock have not been studied. The present study attempts to enumerate 150 species of fodder representing trees (51 spp.), shrubs (54 spp.) and herbs (45 spp.). Poaceae (19 spp.) and Fabaceae (13 spp.) amongst families and *Salix* (6 spp.), *Ficus*, *Clematis*, and *Desmodium* (5 spp., each) amongst genera are rich in species. Maximum species were found in the 1801 ~ 2600 m zone, and the remaining two zones showed relatively low diversity. Out of the 150 species, 109 are used in summer, 5 winter and 36 throughout year. During rainy season, mostly grasses are used as fodder. Only 83 species are native to the Himalayan region, one species, *Strobilanthus atropuroreus* is endemic and 35 species are near endemic. The nutritive values of the fodder species were reviewed, and economic values and status of the species were also assessed. The pressure use index of the species was calculated on the basis of cumulative values of the utilization pattern, altitudinal distribution, availability, status, nativity and endemism. Amongst the species, *Grewia oppositifolia*, *Morus serrata*, *Indigofera heterantha*, *Quercus leucotrichphora*, *Ulmus villosa*, *U. wallichiana* and *Aesculus indica* showed highest PUI indicating high preference and pressure. Season wise prioritization of the species for different altitudinal zones has been done. Appropriate strategy and action plan have been suggested for the conservation and management of fodder species.

**Keywords:** Diversity; utilization; native; endemic; nutritive and economic value; pressure use index; prioritization; conservation; Indian Himalayan Region

## Characterizing land-use diversity in village landscapes for sustainable mountain development: a case study from Indian Himalaya

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### Abstract

This study aimed to analyze the ecological, socio-economic and policy implications of land-use diversity in a traditional village landscape (900–1,000 mamsl.) in the Garhwal region of Indian Himalaya. The village landscape was differentiated into three major land-use types viz., forests, settled agriculture and shifting agriculture. Settled agriculture was further differentiated into four agroecosystem types viz., homegarden system (HGS), rainfed agroforestry system (RAS), rainfed crop system (RCS) and irrigated crop system (ICS), and shifting agriculture system (SAS) was differentiated into different stages of a 4-year long cropping phase and a 7-year long fallow phase, and forests into Community Forests (CF) and Reserve Forests (RF). HGS is the most productive agroecosystem, with soil organic carbon and nutrient concentrations significantly higher than all other forest/agricultural land-uses. Farmers capitalize upon crop diversity to cope with the risks and uncertainties of a monsoon climate and spatial variability in ecological factors influencing productivity. The SAS, a landuse adopted as a means of acquiring inheritable rights over larger land holdings provided in the policies during the 1890s, is less efficient in terms of land productivity than the traditional RAS and HGS but is maintained for its high labour productivity coupled with availability of high-quality fuelwood from fallow vegetation. Dominance of fodder trees in the RAS seems to derive from policies causing shortage of fodder available from forests. Cultural norms have favoured equity by allowing hiring of labour only from within the village community and income from non-timber forest products only to the weaker section of the society. Conversion of rainfed to irrigated cropping, a change facilitated by the government, improves agricultural productivity but also increases pressure on forests due to higher rates of farmyard manure input to the irrigated crops. Existing forest management systems are not effective in maintenance of a large basal area in forests together with high levels of species richness, soil fertility and resistance to invasive alien species *Lantana camara*. Farmers have to spend huge amount of labour and time in producing manure, managing livestock and other subsidiary farm activities. Interlinkages among agriculture, forests and rural economy suggest a need of replacing the present policies of treating agricultural development, forest conservation and economic development as independent sectors by an integrated sustainable development policy. The policy should promote technological and institutional innovations enabling parallel improvements in agricultural productivity and functions of forest ecosystems.

**Keywords:** Land-use/cover diversity, Himalaya, Resource use patterns, Sustainable development, Traditional knowledge

## Traditional skill among the *Adi* tribes of Arunachal Pradesh

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### Abstract

The tribal people living in far flung areas dependent on rich biocultural resources have always been curious in exploring the plant resources of their immediate surrounding in order to sustain their traditional livelihood system. After centuries of being in close association with nature, they have developed for themselves the indigenous skill and technology to use these resources in various parts of their life support system. In recent decades, rapid modernization and acculturation process developed in traditional livelihood system of tribal community has practically endangered their age-old biocultural heritage and traditional skills, knowledge and technology in alarming proportion. The paper based on ethnobotanical field work discusses some vital aspects of plant based traditional skills and technology practiced by the rural *Adi* community of East Siang district of Arunachal Pradesh. A number of traditional plant based technologies such as handicrafts, fishing and hunting tools, storage items, utensils used in kitchen and foods system, etc. are available among the *Adis*. While crafting these valuable and low-cost traditional handicraft technologies, the local people are dependent on locally available plant biodiversity conserved in *jhum* land, kitchen gardens and community forest. Integrated and holistic approach can revive and sustain traditional plant technology through entrepreneurship development, coupled with ecotourism and economic empowerment to the concerned indigenous community.

**Keywords:** Traditional handicrafts, *Adi* tribes, Traditional utensils, Arunachal Pradesh

## **Implications of Prior Informed Consent for the conservators of indigenous biological diversity of Northeast India**

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### **Abstract**

Despite the 1992 UN Convention on Biological Diversity (CBD) requiring the rendering of due credit and benefit to local biodiversity conservators and Traditional Knowledge (TK) holders, very few examples of benefit sharing can be seen on the ground in India. Looking to the importance of the requirement, a project on indigenous natural resources management practices of the tribal peoples of Northeastern India was implemented in the year 2005 in different regions of Arunachal Pradesh and Meghalaya. The primary goal of the project was to explore the hidden wisdom of tribal peoples regarding indigenous knowledge and use, and conservation of biodiversity. In the project, workshops of TK holders together with personal interviews were organized to seek their views and perspectives about Prior Informed Consent (PIC) and Intellectual Property Rights (IPR) relating to their knowledge and practices. Two major types of incentives to the knowledge holders can be identified: materialistic and non-materialistic. A society of poor economic status but high ethical values needs nonmaterialistic incentives. The majority of these people were of the opinion that their knowledge could be displayed in full text for non-commercial and academic purposes. Research on indigenous resources and cashing the name and fame by formal scientists, needs to be formalized through the community and knowledge holders, with explicit acknowledgement of their wisdom. With the changing and variability in altitude, biodiversity, geography, culture and social norms, the ethics and ways of accessing biodiversity were found to vary from group to group. Knowledge holders living in areas of rich biodiversity at high altitudes required the offer of maximum benefit percentage towards the welfare and conservation of community-based biodiversity. Gender variability also determined percentage of benefit sharing and types of rewards suggested for the TK holders.

**Keywords:** Traditional knowledge, Local culture, Biodiversity, Prior Informed Consent, Intellectual Property Rights, Benefit Sharing

## **Traditional Knowledge of NE people on conservation of wild orchids**

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### **Abstract**

The paper describes the information of the traditional knowledge of the people of Northeastern region to conserve the valuable wild orchid germplasm. Northeastern region of our country is the traditional home of near about 876 orchid species in 151 genera of which many species are economically important for their ornamental and medicinal values. The people of this region have a tradition of conservation of wild orchids in nature based on various religious beliefs and herbal healthcare.

**Keywords:** Orchids, Traditional knowledge, Northeastern region

## **Conservation and management of plant genetic resources of Northeast India**

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### **Abstract**

The Northeast India region is rich in biodiversity due to high rainfall and plenty of sunlight coupled with unique biogeographical positioning. It is known as the 'Cradle of Flowering Plants' because of remarkably rich and diverse flora. The valuable plant genetic resources of the region are being lost at an alarming rate due to varied human activities including shifting cultivation which have in turn led to the depletion of forest cover. Therefore, there is an urgent need for conservation, sustainable utilization and management of plant genetic resources of the region so as to meet the growing requirements of food, fodder, fibre, health, water and other needs.

**Keywords:** Plant diversity, Conservation, *In vitro* technologies, Molecular methods

## Indigenous lifestyles and biodiversity conservation issues in North Sikkim

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### Abstract

Sikkim is a well known treasure trove and hotspot of biodiversity with most of its macro fauna and flora well documented over the last two centuries. The ethnic populace living in remoter areas of the state relies on an intimate knowledge of the local bio-resources for their survival in a harsh high altitude environment. Over time this has been seen as the only means of their survival. Lack of any systematic documentation in written form and reliance on oral tradition along with recent development and modernization activities is leading to irretrievable loss of this ancient wisdom. Studies of three short projects in North Sikkim to document some of the biogeographic history including some of the traditional methods of wildlife conservation and subsistence lifestyles among the truly nomadic *Dokpas* in the cold desert and partially trans-humant *Bhutia* tribals of Lachen and Lachung valleys, who practice the *Dzumsa* traditional system of administration were conducted. Some of the management practices now degrading rapidly were more for sustainable use than conservation *per se*, and thus not in harmony with the present legal systems of the state and country. It is proposed that part of this area be declared as a trans-boundary Conservation Reserve to achieve the dual objective of conservation through sustainable use and equitable sharing of both bioresources and traditional knowledge.

**Keywords:** Sikkim, *Dokpas*, *Lachen*, *Lachung*, *Dzumsa*, *Bhutia*, Cold desert, Trans Himalaya, Biodiversity conservation

## Indigenous knowledge of *Lepcha* community for monitoring and conservation of birds

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### Abstract

The non-professional volunteers are commonly used in biodiversity assessment due to lack of experts. The bird identification skills of indigenous *Lepcha* community have been recognized and the accuracy of data generated by them has been assessed. Bird sampling was done using point count method along the transects in three locations in Dzongu, North Sikkim. Two observers, a trained 'researcher' and a local *Lepcha* folk referred as citizen scientist independently sampled birds (species by former and varieties by the latter). The mean number of species and varieties per point was not significantly different from each other. Gross accuracy of data collected by citizen scientist was high. These results showed that indigenous taxonomic knowledge of *Lepcha* community can be applied for biodiversity assessment programme provided the individual biasness of lumping and splitting is taken care.

**Keywords:** Biodiversity, Birds, Dzongu, Himalaya, Indigenous knowledge, *Lepcha*

## **Assessment of traditional rights, local interference and natural resource management in Kedarnath Wildlife Sanctuary**

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### **Abstract**

An assessment of human interference in Kedarnath Wildlife Sanctuary (KWLS) showed huge dependence of local communities on forest fringes. KWLS is under active consideration as a national park because of its unique flora and fauna. Studies have evidenced habitat destruction and successional changes in the area because of ongoing unsustainable harvesting and logging. The present study provides an integrated approach towards evaluating resource extraction and management of the sanctuary. The study was based on in-depth-semi-structured interviews and group discussions with local inhabitants of six villages and with forest officials. In addition, regeneration patterns and vegetation analysis was conducted in three land tenurial systems: community forest (CF), reserve forest (RF) and protected forest (PF). Key issues identified were wildlife offences, encroachment, pressure from unsustainable harvesting of resources and lack of livelihood opportunities. Ecological studies showed continuous change in regeneration patterns in forest patches/stands. The local survey stressed managing sanctuary fringes considering the village economy, social issues and resource requirements, and enhancing on-farm resource production to reduce pressure on forests. Forest personnel demanded more training on encroachment and poaching, these being major threats to biodiversity and bioresources. Supporting and providing better livelihood opportunities is a viable option for minimizing pressure and managing biodiversity of the area through active community participation. This study generated useful outcomes and strategies for advancing policies to reduce pressure and overcome management constraints in the sanctuary.

**Keywords:** protected area management, Garhwal, Indian Himalayan Region, traditional dependence

## Knowledge of Rural and Urban Homemakers in Indigenous Resource Management Practices

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### ABSTRACT

The study conducted on 120 rural and urban homemakers in two randomly selected panchayat wards and two municipal council wards of district Kangra of Himachal Pradesh revealed their knowledge regarding indigenous resource management practices. Results showed that knowledge levels vary among rural and urban homemakers which were tested with Z- test at 5 percent level of significance. There was significant difference among rural and urban families for indigenous practices for drying grain before storage, grain storage equipment, potato storage in basket, disposal of waste water in household drain, disposal of degradable waste, protecting clothes from insects, spraying medicine for flies, treatment of minor wounds and burns and use of medicine for boils and hypothesis was rejected for these practices but in case of stomach ache treatments the difference was non significant.

**KEYWORDS** Indigenous Knowledge. Resource Management. Management Practices

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## Forest Resource Use Patterns in Relation to Socioeconomic Status A Case Study in Four Temperate Villages of Garhwal Himalaya, India

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### Abstract

This case study explored forest resource-use patterns to understand villagers' dependency on forests in four temperate villages situated in two forested sites in Garhwal Himalaya: Mandal and Khalla in the Mandal area, Chamoli District, and Chaundiya and Dikholi in the Chaurangikhal area, Uttarkashi District. Although the literacy rate in the villages was quite high, due to lack of employment opportunities people still invariably depend on forests for their livelihood. In all the study villages more than 75% of fodder and fuelwood were extracted from the forest. The pressure exerted by human and bovine populations, coupled with unsustainable management policies, has resulted in the destruction of forest cover and ecological degradation. Agriculture (which is 70% rainfed in the Mandal area and 90% rainfed in Chaurangikhal) and employment as labourers were the main occupations of people in the study areas; in addition, remittance income (8.6% in the Mandal area and 21.3% in Chaurangikhal) and dairy farming accounted for a major portion of total household income. The study revealed a positive relationship between income and livestock population (0.995), which reveals the strong role of animal husbandry in the rural economy. The equally positive relationship between income and fodder consumption (0.930) can be attributed to extraction of large quantities of fodder to sustain dairy farming for commercial purposes. The correlation between income and fuelwood consumption was found to be negative (20.882), the likely reason being poor economic conditions, leading to dependency on the forest for fuelwood as a free source of energy.

**Keywords:** Forest use; livestock; fuelwood; fodder trees; income sources; poverty; Gahrwal Himalaya; India



## Conservation and Management of Community and Natural Resources: A Case Study from North East India

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### Abstract

From the days of origin, men develop a close relation with nature. Nature provides the raw materials to build and develop culture. As the indigenous people are living on the mercy of nature, they are to develop various measures to conserve and manage the community and natural resources for the security of larger social system. The present paper examined the various conservation processes that have been developed by certain indigenous communities of Northeast India. The examples cited clearly indicate the strategic measures adopted by each community with regard to process of storing, utilization of plants and herbs, conserving the sacred grooves etc. It is also observed that community fair has developed because of close relations of environment and community life. The paper also indicates the knowledge system with emphasis on the traditional knowledge that had developed depending on cultural values.

**Keywords:** Eco-system. *Vanaram*. Sacred Grooves. *Thaan*. *Jun Beel Mela*

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## Role of traditional conservation practice: highlighting the importance of Shivbari sacred grove in biodiversity conservation

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### Abstract

Recognizing the importance of sacred groves in biodiversity conservation and management, and the recent threats to them, the present study was conducted in Shivbari sacred grove of Himachal Pradesh. The study aimed at documenting the floral wealth of Shivbari and promoting plantation of indigenous species in participation with local people. For this, systematic field surveys in different seasons were conducted in Shivbari from April 2005 to November 2009, and liaison was maintained with the local community and temple management authority for gaining insight into the history and problems of Shivbari and initiating plantation activities. A total of 69 flowering plant species were identified inside the grove, which include 14 trees, 9 shrubs, 3 lianas and 43 herbs. This represents almost 2% of the total flowering plant species occurring in the state of Himachal Pradesh. *Mallotus philippensis* followed by *Putranjiva roxburghii* was the most dominant tree species. *Adhatoda zeylanica* was the most common shrub species, while *Achyranthes aspera* was the most common herb species. The grove harbours 23 plants species that are in high demand in the market, and at the same time also influences the microclimate of the area. The temperature inside the grove was significantly lower than the temperature outside the grove. The recent changes in socio-economic status of the local people and a shift towards market-oriented economy have threatened the survival of Shivbari. However, the deeply held beliefs of the pilgrims, local people and priest offer a ray of hope. During the course of the study, 3,000 plants were planted inside the grove out of which 60% have survived.

**Keywords:** Biodiversity, Conservation, Himachal Pradesh, Sacred grove, Shivbari

## **Toko-Patta (*Livistona jenkinsiana* Griff): Adi community and conservation of culturally important endangered tree species in eastern Himalaya**

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### **Abstract**

Arunachal Pradesh, being a largest state of Northeast India, harbours great number of plant species which are endemic to region. The diversity and endemism of state has kept it in the category of biodiversity hot-spot. Though, in recent past, numbers of plant species are being listed as rare, endangered and threatened because of increasing threats from anthropogenic and other natural factors. In the list of threatened species, *Livistona jenkinsiana* Griff- locally called, Toko by the *Adi* tribe has also been mentioned. Based on the village and forest survey, initially it was observed that Toko is good in numbers and conserved by the tribal communities of Arunachal Pradesh. This dichotomy of *Toko* being reported as threatened and actual large number of population maintained by tribes has necessitated conducting the study in the East Siang district of Arunachal Pradesh. The study was conducted during 2005-2008. East Sing and *Adi* tribe have been selected purposively. A sample of 303 male (138) and female (165) *Adi* members were chosen as the respondents of the study. The ecological attributes of the species, biocultural dimensions, gender role, institutional relation and conservation of species in varying habitats were studied. Using personal interview and PRA methods data were collected. Results indicate that *Toko* is conserved in jhum lands, Morang forest and home gardens at the larger scale. The women play a significant role in conservation of this species. Number of bioculturally important products is made out of the leaves and fruits of *Toko*. Indigenous institution has still great role to control overexploitation of this species and solve the dispute on Toko. This species is conserved at large scale on the individual ownership; however, the collective conservation of *Toko* in Morang forest by the *Adi* tribe is an appreciable effort. From six villages, total 33,026 numbers of trees were recorded in 2008 at the range of 110-180 m altitude.

**Keywords:** *Toko-Patta*, Endangered biodiversity, Biocultural knowledge, *Livistona jenkinsiana* Griff, Conservation, *Adi* tribe, Eastern Himalaya, Arunachal Pradesh

## **Traditional Knowledge and Biodiversity Conservation: A Preliminary Study of the Sacred Natural Sites in Uttarakhand, Central Himalaya**

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### **ABSTRACT**

Cultural diversity is closely linked to bio-diversity. The study of these interrelationships need to be studied mainly for the simple reason that culture is not only the ethical imperative for development, it is a condition of its sustainability; for there exists a symbiotic relationship between habitats and cultures, between ecosystems and cultural identity, and that this relationship constitutes a determining factor in ensuring sustainable human development. The association of religion with eco-system management is interwoven in the symbolic network of the Himalayan traditional communities. Infact, we cannot think of ecology in the Himalaya without religion. The present study deals with the study of sacred natural sites (forests/groves, pastures, water bodies), within the State of Uttarakhand, and the inherent traditional knowledge based systems, the taboos, as regards the resource exploitation and other traditional beliefs and customs, in practice surrounding these sacred natural sites. Even though, dilution in norms and taboos restricting the resource use, has undoubtedly got diluted in many of the sacred forests, a significant number of very-well preserved sacred forests, with religiously guarded taboos, do exists, which warrants a detail study, for their floral and faunal diversity.

**KEYWORDS** Conservation. Culture. Sacred Natural Sites. Social Taboos

## **Indigenous knowledge and sustainable development in the Tones Valley of Garhwal Himalaya**

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### **Abstract**

The inhabitants of the Tones Valley have survived on their traditional management practices for their needs. The paper has looked at traditional systems of forestry and agricultural system management in the west-central Himalayan region. Based on a detailed analysis of traditional knowledge that is linked with biodiversity, natural and human-managed, various possibilities for sustainable management of natural resources, with concerns for sustainable livelihood of local communities have been explored for the tribal region in Tons Valley. It is concluded that, if the development interests of local people are marginalized for a long period of time, they might adopt actions detrimental to the goal of conservation. Capitalization of the positive dimensions of traditional knowledge and overcoming its negative dimensions through conventional science-based inputs could ease the difficult process of securing people's participation in environmental conservation and management together with the socio-economic development of local communities.

**Key words:** Indigenous knowledge, Tones valley, transhumant

## **Traditional Culture and Biodiversity Conservation: Examples from Uttarakhand, Central Himalaya**

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### **Abstract**

Cultural diversity in remote mountain regions is closely linked to biodiversity, as there is a symbiotic relationship between habitats and cultures, and between ecosystems and cultural identity; indeed, religious rules and rituals often strengthen this relationship and are characterized by a conservation ethic. The present paper presents an analysis of information collected from knowledgeable members of mountain communities in the State of Uttarakhand, Central Himalaya. The data collected are analyzed within the framework of traditional knowledge-based systems (TKBS) methodology, using the conservation purpose of rules and practices as a means of typifying the information on sacred natural sites (forests/groves, pastures, water bodies), on the phenomenon of dedicating forests to a deity, on the inherent taboos regarding resource exploitation, and on other traditional beliefs and customs, in order to understand the environmental and conservationist implications of these rules and practices. The analysis shows that the cultural precepts of remote Uttarakhand mountain communities can be considered a precondition for sustainable development. In fact, the association of religion with ecosystem management is inherent in traditional Himalayan communities' culture; one cannot think of ecological systems in the Himalaya without religion. However, this knowledge and related conservation rules need to be strengthened in the face of current change.

**Keywords:** Nature conservation; culture; sacred forests; taboos; traditional knowledge-based systems (TKBS); Uttarakhand; Himalaya; India.

## **Pashmina production and socio-economic changes in the Indian Changthang: Implications for natural resource management**

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### **Abstract**

A unique pastoral community uses the arid rangelands of eastern Ladakh, known as Changthang, northern India. The nomadic people rear a variety of livestock such as sheep, goats, horses and yaks, which provide them with various goods and services. Nevertheless, the needs and aspirations of the people are changing. There is a trend towards increasing the livestock population, especially of a breed of goat that produces one of the finest natural fibres: Pashmina, which is the mainstay of their economy. This increase in goat population, however, is jeopardising the long-term survival of the wild herbivores in the region, and as such is not sustainable. We present information on the current trends in socio-economy, Pashmina production, wildlife conservation, and the conflicts of interest between wildlife and nomads in the region. On the basis of this information, we make suggestions for the conservation of natural resources in the region. We recommend preserving the historical societal norms and notions of the people, and capitalising on them to manage natural resources. We also recommend joint management of natural resources by the local people, State and non-governmental organisations. Our findings provide a platform on which a grazing policy for the region may be formulated.

**Keywords:** Changthang; large herbivores; livestock; cold desert; Trans-Himalaya; Pashmina; CBNRM.

## **Integrated Natural Resource Management: Approaches and Lessons from the Himalaya**

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### **ABSTRACT**

Losses of forest cover, biodiversity, agricultural productivity, and ecosystem services in the Himalayan mountain region are interlinked problems and threats to the sustainable livelihoods of 115 x 106 mountain people as well as the inhabitants of the adjoining Indogangetic plains. Until the 1970s, environmental conservation, food security, and rural economic development were treated as independent sectors. The poor outcomes of sector-oriented approaches catalyzed efforts to address environmental and socioeconomic problems concurrently. The identification of "key" natural resource management interventions is an important dimension of integrated management. Projects to rehabilitate the degraded lands that cover 40% of the Indian Himalaya could be key interventions provided that they address both socioeconomic and environmental concerns across spatial and temporal scales. However, projects of this type, e.g., investments in conifer plantations on degraded forest lands, have failed because their designs did not take into account the needs of local residents. This study illustrates a case of land rehabilitation in a small isolated village close to the alpine zone. Vital elements of this project strategy included identifying local perceptions and knowledge and involving the local people in the selection and implementation of the interventions needed to restore the land. Communities were found to be more concerned with the immediate economic benefits from bamboo and medicinal species than the longterm benefits of tree planting. The villagers eventually reached a consensus to plant broadleaved multipurpose trees in association with bamboo and medicinal species. Despite assurances that all the economic benefits from rehabilitation would go to the community, the people would not agree to voluntary labor, although they did absorb significant costs by providing social fencing, farmyard manure, and propagules from community forests. Households shared costs and benefits according to traditional norms. The economic benefits to the local people exceeded the rehabilitation cost over the 7yr life of the project. There were significant onsite environmental benefits in terms of improvements in soil fertility, biodiversity, protective cover, and carbon sequestration, and offsite benefits from more productive use of labor, reduced pressure on protected areas, and the introduction of rare and threatened medicinal species onto private farmland.

**KEY WORDS:** bamboo, community decision making, Himalaya, India, integrated natural resource management, land rehabilitation, medicinal plants, reforestation, village.

## Biodiversity conservation through a traditional beliefs system in Indian Himalaya: a case study from Nakuleshwar sacred grove

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### Abstract

Sacred groves are well recognized in the world in terms of biodiversity conservation. The present study was conducted in the Nakuleshwar sacred grove, in the valley of Thal kedar hill in the Kumaon region of Pithoragarh district in Indian Himalaya, in appreciation of its role in biodiversity conservation. The study aimed at the documentation and inventory of the sacred grove, its phytodiversity, threats and conservation in the Himalayan region, and to achieve this, systematic field surveys were conducted during 2007–2010 covering all four seasons. A total of 83 species from 71 genera and 50 families were identified, of which 43 species are flowering plants, including 7 trees, 7 shrubs, 4 climbers and 25 herbs, and 40 species are non-flowering plants of which lichens are represented by 12 species from 8 genera, bryophytes 6 species from 5 genera, and pteridophytes 7 species from 9 genera, while gymnosperms are represented by a single species. *Acer oblongum*, *Cinnamomum tamala*, *Cedrus deodara*, *Coriaria nepalensis* act as keystone species in the grove. *Ophiopogon inermis* is a common herb during the rainy season while *Goodyera hemsleyana* (Orchid) is a new distribution record for the western Himalaya. A total of 43 species from 38 genera are used ethnobotanically by local people for various ailments. *Mahonia nepaulensis*, *Asparagus adscendens*, *Thalictrum foliolosum*, *Cinnamomum tamala* and *Berberis asiatica* are highly exploited species and need to be conserved. Climatic conditions of the grove are moderate and the floristic patch of the grove is completely different from the plant diversity of the surrounding area and matches with the diversified floral wealth of comparatively higher altitudes. Due to anthropogenic pressure, this grove is facing new threats of degradation, hence needing special attention.

**Keywords:** Indian Himalaya, Kumaon Himalaya, Nakuleshwar sacred grove, Phytodiversity, Conservation

## Water Harvesting Traditions and the Social Milieu in India: A Second Look

Shri Krishan

### Abstract

India has a variety of local community traditions of water harvesting. There are a number of scholars and activists who tend to valorise premodern wisdoms without critically evaluating their sociocultural context and realising how deeply they were embedded in the social hierarchy of their times. There has been, of course, a great deal of stress lately on a kind of “eco-golden age”. This is clearly a case of an “anachronistic projection of modern phenomenon on to the screen of tradition”. Seen from such a perspective, all pre-industrial societies would exhibit a kind of harmony with nature. However, most of the times, it was the demographic and technological factors that made these societies less harmful to the environment. It was not that they wished to protect the whole canopy of nature. This reappraisal demonstrates how precepts and rites, culture and customary practices and state policy interact to lay the bases of water harvesting traditions. Social customs are the necessary conditions for sustaining these traditions, while local autonomy in resource management is the critical sufficient condition but it never results in equitable access for all.

## **Traditional management practices of natural resources of forest dependent communities in Arunachal Pradesh - A case study of fringe villages in Banderdewa forest range**

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### **Abstract**

Forest dependent tribal communities in Arunachal Pradesh have acquired the wisdom on natural resource management through vigorous interacting with the nature and through continued growth of indigenous knowledge system. Fringe village of Banderdewa forest range harbour human who perform NTFP extraction and other livelihood options such as traditional farming, fisheries, cattle rearing, etc. The similarity and differences of traditional management practices of forest dependent community were studied to know the socio-political dynamics as our sites were classified into two categories, i.e. settled and encroached villages.

**Keywords:** Natural resource management, Forest dependence, Tradition, Arunachal Pradesh

## **Role of indigenous knowledge system in conservation of forest resources—A case study of the *Aka* tribes of Arunachal Pradesh**

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### **Abstract**

Indigenous knowledge is the basis for local level decision-making in agriculture, healthcare, food preparation, education, natural resource management, and a host of other activities in rural communities. Forest resource conservation is a global issue. Arunachal Pradesh inhabits about 26 major tribes and number of sub tribes. Forest is their main source of economy and livelihood. Tribes have evolved Indigenous knowledge system (IKS) that is vital in conservation of forest resources. An attempt has been made to analyze the role of IKS, beliefs and sacred groves of the *Aka* tribes in conservation of forest resources. The indigenous knowledge systems of conservation of plants, animals, sacred groves, etc. have been discussed. Primary data has been generated by conducting survey in 37 villages inhabited by *Aka* tribe.

**Keywords:** Forest conservation, Indigenous knowledge, Sacred groves, Taboos, *Aka* tribes

## **Diversity, indigenous uses and conservation status of medicinal plants in Manali wildlife sanctuary, North western Himalaya**

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### **Abstract**

In the moutaineous regions human populations are dependent on plants for their sustenance particularly for medicine. In India, more than 95% of the total medicinal plants used in preparing medicines by various industries are harvested from wild. There is a great need to recognise the potential of bioresources at their fullest. Therefore, the present study focused to assess the medicinal plants diversity in Manali wildlife sanctuary of North western Himalaya, identify species preference, native, endemic and threatened medicinal plants and suggests conservation measures. A total of 270 medicinal plants belonging to 84 families and 197 genera were recorded. Maximum medicinal plants were reported in the altitudinal zone, 2000-2800 m and decreased with increasing altitude. Out of the total, 162 medicinal plants were native and 98 were endemic to the Himalayan region. Maximum species were used for stomach problems, followed by skin, eyes, blood and liver problems. Thirty seven species were identified as threatened. *Dactylorhiza hatagirea*, *Aconitum heterophyllum*, *Arnebia benthamii*, *Lilium polyphyllum*, *Swertia chirayita*, *Podophyllum hexandrum*, *Jurinella macrocephala*, *Taxus baccata* subsp. *wallichiana*, etc. were highly preferred species and continuous extraction from the wild for trade has increased pressure which may cause extinction of these species in near future. Identification of active ingredients and mass multiplication of the potential species have been suggested in view of economic importance. Regular monitoring of populations and habitats of threatened medicinal plants, restricted harvesting and habitat protection are suggested.

**Keywords:** Medicinal plants, Diversity, Indigenous uses, Nativity, Status, Conservation, Manali wildlife sanctuary



# Lopping of Oaks in Central Himalaya, India

## The Link Between the Garhwali People and Their Forests

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### Abstract

This study examines the practice of lopping of *Quercus leucotrichophora*, *A. Camus* and *Quercus floribunda* Lindley ex Rehder in Garhwal Himalaya. The study objectives were to investigate the lopping process, the factors that influence it, and the changes it has undergone between 1993 and 2006, specifically, age and gender roles, method of fodder collection, type of branches and trees lopped, and weight of oak foliage bundles. Data were collected for 49 fodder collection trips in Beli village, Tehri Garhwal District, Garhwal Division. Four closely interlinked factors influenced forest use—gender roles, availability of oak foliage in the forest, number and type of livestock per household, and type of agricultural crops planted. The results indicate that lopping practice is not static. It has undergone fundamental changes between 1993 and 2006. Beli villagers continued to collect fodder basis, varied the fodder species collected, and rotated the location of trees lopped throughout the year in 2006, as they did in 1993. Foliage collection intensified until early 2000 when there was a marked decrease in the amount of foliage available in the forest. As a result, the villagers began to reduce their total reliance on the forest and agriculture for income and instead began to send their children to school in preparation for employment outside the village. This change in livelihood strategy is reflected in the lopping practice. Fodder collection trips decreased from 5 in 1993 to 3 times a day in 2006. The number of people collecting *Q. Floribunda* decreased from 26 to 12, with fodder being collected mainly by women aged 21 to 26. This has resulted in females carrying significantly greater loads in 2006 ( $P = 0.0004$ ). Examining the lopping practice provides insights into the impact of fodder collection on forest ecosystems and, in turn, the forest's impact on peoples' lives.

**Keywords:** Lopping; forest use; fodder; oaks; *Quercus leucotrichophora*; *Quercus floribunda*; gender; indigenous resource use; Garhwal Himalaya; Uttarakhand.

## Culture and Biodiversity Conservation: Case studies from Uttarakhand, Central Himalaya

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### Abstract

Cultural diversity is closely linked to biodiversity. The study of these interrelationships need to be studied mainly for the simple reason that culture is not only the ethical imperative for development, it is also a condition of its sustainability; for there exists a symbiotic relationship between habitats and cultures, between ecosystems and cultural identity, and that this relationship constitutes a determining factor in ensuring sustainable human development. The association of religion with eco-system management is interwoven in the symbolic network of the Himalayan traditional communities. Infact no one can think of ecology in the Himalaya without religion. The present study deals with the study of sacred natural sites (forests/groves, pastures, water bodies) along with the phenomenon of dedication of the forests to a deity, and the inherent *taboos* with regard to the resource exploitation and other traditional beliefs and customs being practiced in the Central Himalaya, and attempts to bring out the inherent environmental principles behind these practices.

**Keywords:** Conservation, Culture, Sacred forests, Traditional knowledge-based systems

## Bird hunting techniques practised by War Khasi community of Meghalaya, North-east, India

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### Abstract

Hunting for wild birds is stimulated by a variety of human uses of bird species, which constitute important subsistence items in the livelihoods of the people living in *War* area of Meghalaya. In this paper, it is analysed the findings of an Ethnoecological research on traditional ecological knowledge associated with bird hunting techniques. In order to gain access the resources, hunters have developed a series of techniques and strategies described and discussed in the present work. The principal hunting techniques encountered are locally known as *Suh Sim*, *Suh Sim Um*, *Suh Lynglit*, *Riam Shynroh*, *Riam Dkhoh* and imitation. The study was conducted in 5 selected villages of South Meghalaya. The choice of hunting technique depends on the habits of the bird species. From conservation perspectives, active hunting techniques (*Suh Sim* and *Suh Sim Um*) have the greatest impact on the local bird diversity. Additional studies concerning bird hunting activities are desirable in order to regulate bird hunting in the region, with the objective of promoting sustainable use of bird resources for welfare of the local human communities.

**Keywords:** Traditional Ecological Knowledge, Bird catching, *War Khasi*, South Meghalaya

## **Biocultural value and conservation of “*tara*” tree (*Calamus erectus* Roxb.) at biodiversity hot-spot: A study with *Adi* tribe of Arunachal Pradesh, India**

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### **Abstract**

Arunachal Pradesh is considered as one of the megabiodiversity centres, and lies in eastern Himalayas. State is abode of 26 major tribes (with 110 sub-tribes) who have developed unique cultural bonds with the forest resources across the five distinct climates, thus sustaining tremendous biocultural diversity in the state. With passage of time, now sustainability of biocultural resources and related livelihoods are questioned with various environmental and anthropogenic factors. Present study reports biocultural value of tara (*Calamus erectus* Roxb.) for *Adi* tribe and its conservation by them. Study was conducted in selected villages of East Siang district (in subtropical climate) of Arunachal Pradesh. Methods used for data collection include personal interviews, participant observations, transect walking and historical and anthropological records from selected *Adi* members. Results indicated that tara is an important resource for making house roof and handicrafts. The handicrafts are important source of income for *Adi* women. In remote villages, a considerable number of *Adi* people depend on tara therefore they conserve it. Elderly *Adi* members living in remote villages have greater amount of biocultural knowledge on use of tara. Conservation status of *Calamus erectus* was observed to be greater in community forests which are managed by indigenous informal institution- called *Kebang* headed by *Gaon Burha*. The prime need of the time is to plan strategy for participatory conservation of tara (*Calamus erectus*) by involving *Adi* people and giving them economic incentives. Tara has been in use of *Adi* members of mountain ecosystems for generations with cultural attachment, hence there is a need of policy to promote its use with the help of scientific value addition that may promote economic viability of *Calamus erectus* even in the changing social systems also.

**Keywords:** Tara (*Calamus erectus*), biocultural value, conservation, *Adi* tribe, Arunachal Pradesh

## Indigenous knowledge of oak tasar silk cocoon cooking and a method of its improvement using pineapple extract

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### Abstract

Oak tasar (*Antheraea proylei* J.) cocoons are difficult to reel due to high amounts of protein tannin complexes. Traditionally the tasar cocoons are cooked in an earthen pot for 5-6 hrs with approximately 1 % sodium carbonate or are cooked for 24 hrs with ashes of paddy husk and banana leaf. Cocoons are then reeled in semi-moist condition on an inverted face of an earthen pot or on thigh of the reeler. This traditional method employed gives relatively low reeling performance and low fuel efficiency. To overcome the drawbacks of the traditional methods, studies were carried out to develop a novel, simple, economic and effective oak tasar cocoon cooking and reeling method readily accessible to the common tasar silk reelers and weavers using pineapple extract which is abundantly available in the North eastern states of India. The proteolytic activity of the pineapple extract helps in partial solubilisation of the proteinaceous silk gum (sericin) involved in binding the silk (fibroin) strands together in silkworm cocoon. Cocoon cooking by the standardized enzymatic procedure developed during the present investigation, viz. pressure cooking for 30 minutes and soaking in pineapple extract for 12 hrs at room temperature gives a very high reeling performance as compared to traditional method.

**Keywords:** Proteolytic enzymes, Sericin, Fibroin, Oak tasar silk cocoons, Cocoon cooking, Single silk filament reeling

## BIODIVERSITY CONSERVATION THROUGH TRADITIONAL BELIEFS SYSTEM: A CASE STUDY FROM KUMAON HIMALAYAS, INDIA

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### Abstract

The present study was carried out in Malay Nath sacred grove of Kumaon Himalaya, India, in appreciation of its role in biodiversity conservation. The whole grove is dedicated to the local deity "Malay Nath", and showing semi-temperate type vegetation of the region. Rituals and cultural beliefs of the local peoples of Kumaon are plays significant role in conserving biodiversity. The study aimed at the documentation and inventory of the sacred grove, its phytodiversity, threats and conservation in the Indian Himalayan of Kumaon region, and to this, systematic field surveys were conducted during 2007-2010 covering all four seasons viz., summer, rainy, winter and spring. A total of 64 species in 58 genera under 47 families were identified, of which 35 species are flowering plants and 29 species are non-flowering plants. The dominant family was Parmeliaceae of lichen which recorded the maximum 6 species. 35 plant species under 32 genera and 23 families are used as an ethno-medicinal and the information about the ethno-medicinal plants was gathered from knowledgeable elderly local peoples of the area. *Hedychium spicatum*, *Bergenia ciliata*, *Origanum vulgare*, *Berberis asiatica*, etc. are highly exploited species and need to be conserved.

**Keywords:** Kumaon Himalaya; Malay Nath sacred grove; Ethnobotany; Conservation.

## **BIODIVERSITY STATUS, DISTRIBUTION AND USE PATTERN OF SOME ETHNO-MEDICINAL PLANTS**

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### **Abstract**

The erosion of plant biodiversity is a matter of global concern. Due to unawareness the building blocks of entire ecosystems are disappearing. Some medicinal plants like *Taxus baccata* Linn., *Thymus serpyllum* Linn., *Coleus forskohli* Will., *Oroxylum indicum* Linn., *Valeriana hardwickii* Wall., *Malaxis acuminata* D. Don, *Habenaria edgeworthii* Hook. f.ex. Collett., *Costus speciosus* (Koen.) Sm., *Dioscorea deltodea* Wall., *Gloriosa superba* Linn., *Polygonatum cirrhifolium* Wall. and *Polygonatum verticillatum* Linn., *Thalictrum foliolosum* DC., *Berberis aristata* DC., *Baliospermum montanum* Will., *Bergenia ciliate* (Haworth) Sternb., *Clerodendrum serratum* Linn., *Valeriana jatamansii* Jones, *Celastrus paniculatus* Will., *Habenaria intermedea* D. Don, and *Curculigo orchioides* Gaerth are reached on the border of extinction. The 2008 IUCN Red List shows that the number of threatened plant species is increasing gradually (IUCN 2008). Therefore, there is an immediate need for conservation steps to be taken up along with promotion of conservation of medicinal plants.

**Keywords:** Threat categorization; Biodiversity; Use pattern; Ethno-medicine.

## **Diversity, Utilization pattern and indigenous uses of floristic diversity in Murari Devi and surrounding areas of Mandi District, Himachal Pradesh (India)**

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### **Abstract**

The value of medicinal plants in traditional healthcare practices provides clues to latest areas of research and in biodiversity conservation is now glowing. However, information on the uses of plants for medicine is deficient from interior areas of Himalaya. Keeping this in view the present study has been conducted to study the diversity, utilization pattern and indigenous uses of floristic diversity in Murari Devi and surrounding areas of Mandi District in Himachal Pradesh, India. A total of 220 species of medicinal plants belonging to 88 families and 184 genera were recorded and used by the inhabitants of the area. These medicinal plants comprise of 31 trees, 134 herbs, 50 shrubs and 05 ferns. From the total 35 were near endemic to Indian Himalayan Region. The present study represents an area specific approach for short or long term management planning in the study area, using information on different attributes.

**Keywords:** Diversity, indigenous uses, utilization pattern, Murari Devi, Himachal Pradesh

## Extraction, Utilization Pattern and Prioritization of Fuel Resources for Conservation in Manali Wildlife Sanctuary, Northwestern Himalaya

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### Abstract:

Fuelwood is the main source of the energy in mountainous regions. Hence, annual wood consumption is very high. Information on fuelwood resources, and their extraction and availability is very scanty. Therefore, present study was carried out to study the diversity of fuelwood species, annual collection, preference and availability of fuel species in the forests. Thirty four species (25 trees and 9 shrubs) were extracted for fuel by the inhabitants. Total collection and species preference was highest for *Picea smithiana*, *Cedrus deodara*, *Indigofera heterantha*, *Pinus wallchiana* and *Sorbaria tomentosa*, respectively. Resource use index indicating use pressure was highest for *P. smithiana*, *C. deodara*, *I. heterantha* and *Abies pindrow*, respectively. Besides native species, some non-native horticultural and agroforestry species such as *Malus pumila*, *P. domestica*, *Celtis australis*, etc. were also being used as fuel. Preferred species showed their availability in eight forest types whereas, population and regeneration status was poor. Therefore, immediate actions are suggested to sustain current and future demand of fuelwood. The afforestation of degraded, uncultivated and marginal lands through high quality and preferred fuel species might reduce pressure on wild and selective species.

**Keyword:** Fuelwood; Resource Use Index; Communities; Conservation

## **Analysis of Local Attitudes Toward the Sacred Groves of Meghalaya and Karnataka, India**

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### **Abstract**

The sacred groves of India represent a long-held tradition of community management of forests for cultural reasons. This study used social science research methods in the states of Meghalaya and Karnataka to determine local attitudes toward the sacred groves, elements of sacred grove management including restrictions on resource use, as well as ceremonies associated with sacred groves. Over a seven-month period, 156 interviews were conducted in 17 communities. Residents identified existing taboos on use of natural resources in the sacred groves, consequences of breaking the taboos, and the frequency and types of rituals associated with the sacred groves. Results show that numerous factors contribute to pressures on sacred groves, including cultural change and natural resource demands. In Meghalaya, the frequency of rituals conducted in association with the sacred groves is declining. In both Meghalaya and Karnataka, there is economic pressure to extract resources from sacred groves or to reduce the sacred grove size, particularly for coffee production in Kodagu in Karnataka. Support for traditional ceremonies, existing local community resource management, and comprehensive education programs associated with the sacred groves is recommended.

**Keywords:** sacred grove, community management, sacred forest, traditional conservation practices, sacred natural sites, Meghalaya, Karnataka, India

## **TRADITIONAL ECOLOGICAL KNOWLEDGE OF UTTARAKHAND (INDIA): A FUTURISTIC APPROACH**

Shikha Uniyal Gairola

### **Abstract**

The paper has looked at traditional ecological knowledge of Uttarakhand state in India. Based on a detailed study of traditional ecological knowledge that is linked with biodiversity, natural and humanmanaged, various possibilities for sustainable management of natural resources, with concerns for sustainable livelihood of local communities have been explored for the Garhwal and Kumaun region of Uttarakhand. It is concluded that if the development interests of local people are marginalized for a long period of time, they might adopt actions detrimental to the goal of conservation. Capitalizing on the positive dimensions of traditional knowledge and overcoming its negative dimensions through conventional science based inputs could ease the difficult process of securing people's participation in environmental conservation together with the socioeconomic development of local communities.

## Elderly *Adi* Women of Arunachal Pradesh: “Living Encyclopedias” and Cultural Refugia in Biodiversity Conservation of the Eastern Himalaya, India

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### Abstract

Elderly women of a particular socioecological system are considered to be “living encyclopedias” in biocultural knowledge systems. These women play a pivotal role in retaining and passing on biodiversity-related traditional knowledge to the next generations. Unfortunately the fast changing sociocultural values and the impact of modernity have rendered their knowledge somewhat less valuable and they are being treated as “cultural refugia.” Our study on the importance of these women in the conservation of indigenous biodiversity was conducted in 14 randomly selected villages dominated by the *Adi* tribe of East Siang District, Arunachal Pradesh (northeast India). Data were collected from 531 women (381 elderly and 150 young to middle aged) during 2003–2008 using conventional social science methods and participatory rural appraisal. One innovative method, namely “recipe contest,” was devised to mobilize *Adi* women of each village in order to energize them and explore their knowledge relating to traditional foods, ethnomedicines, and conservation of indigenous biodiversity. Results indicated that 55 plant species are being used by elderly *Adi* women in their food systems, while 34 plant species are integral parts of ethnomedicinal practices. These women identified different plant species found under multistory canopies of community forests. Elderly women were particularly skilled in preparing traditional foods including beverages and held significantly greater knowledge of indigenous plants than younger women. Lifelong experiences and cultural diversity were found to influence the significance of biodiversity use and conservation. The conservation of biodiversity occurs in three different habitats: jhum lands (shifting cultivation), Morang forest (community managed forests), and home gardens. The knowledge and practice of elderly women about habitats and multistory vegetations, regenerative techniques, selective harvesting, and cultivation practices contribute significantly to food and livelihood security while sustaining an array of threatened plant species. Basically, knowledge of elderly women on using biodiversity in food and medicinal systems was found in three categories namely: “individual,” “community,” and “refined.” We identified a need to develop holistic policies to recognize and integrate knowledge and practices of elderly women with local level of planning on sustainable conservation of biodiversity as well as community-based adaptations.

**Keywords** Culturally refugia elderly women, Traditional knowledge, Indigenous biodiversity, Conservation, *Adi* tribe, Eastern Himalaya



## **Socio-economic importance, domestication trends and in situ conservation of wild Citrus species of Northeast India**

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### **Abstract**

Northeast India is rich in Citrus genetic diversity representing several wild and cultivated species. Besides commercially cultivated species, several wild, semi-wild and domesticated species namely *Citrus indica*, *C. macroptera*, *C. ichangensis*, *C. latipes*, *C. megaloxycarpa* and *C. assamensis* are found to grow in Northeast India. These species have great potential in improvement of Indian Citrus industry being source of genes for combating biotic and abiotic stresses. The natural diversity of these genetic resources is shrinking at alarming rate due to large scale deforestation, shifting cultivation practiced in these areas and climate change scenario in this important hotspot of biodiversity. Socio-economic importance of each species have been studied during surveys and interesting domestication trends were observed based on their cultural and economic significance, which led to “in situ on farm” conservation of *C. indica*, *C. macroptera* and threat to *C. megaloxycarpa* and *C. ichangensis*. Consequently, genetic resources of most of these species are facing severe threat of extinction necessitating policy interventions and adoption of dynamic conservation and management strategies. Species specific conservation strategy especially through “in situ on farm” conservation has been proposed with suitable sites in Northeastern Indian states based on population structure and suitability of habitat. Farmers’ support through “The Biological Diversity Act, 2002” and “The Protection of Plant Varieties and Farmers’ Rights Act, 2001” of India would bring the required impact on management of these complex genetic resources of Citrus. In the present study, we have documented the current status, socioeconomic potential, domestication trends and associated traditional knowledge of these wild and semi-wild *Citrus* species occurring in Northeast India and enumerated suitable conservation strategies and desired policy interventions for their dynamic conservation and sustainable utilization.

**Keywords:** *Citrus*, Domestication, Ethnobotany, Genetic diversity, In situ conservation

## **Biodiversity and recipe contests: Innovative socioecological approaches to capture ecological knowledge and conserve biodiversity in Arunachal Pradesh**

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### **Abstract**

Despite the continued efforts being made by government and policy makers to articulate ways of preserving biodiversity and its associated knowledge systems, a limited success has been recorded in environmental learning for conservation. The 'biodiversity contests' among younger generations of native people, and 'recipe contests' of uncommon forest plants and field crops among rural women are two important methods that have been devised to reduce erosion of indigenous biodiversity based knowledge systems. This paper demonstrates about the contests based approaches applied in mobilizing rural and school children, and elders of *Adi* tribe to enhance their ecological knowledge about local plant species. These contests were organized among *Adi* school children and rural women, respectively of East Siang district of Arunachal Pradesh. Different events including radio talks, public meetings, contact with key individuals, circulation of posters and pamphlets and group discussions were organized to sensitize the members about events. In second phase, individual schools and villages were contacted to set-up the biodiversity and recipe contests. Results indicated that school children demonstrated encouraging results by presenting systematic herbaria of local plants, including uses, ecology and source of learning. The children from rural backgrounds had more knowledge than those from more settled areas, and were able to contribute more than 100 forest and semi-forest plants in their collections. Sampling and preparation of herbarium excelled knowledge among children about local species. Creation of vertical knowledge networks among school children, and group contests resulted in revealing more knowledge about local biodiversity as compared to individual participation, thus reflecting synergism. During recipe contests, *Adi* women showed a sound knowledge of local biodiversity, presenting as traditional foods with more than 50 indigenous forest based plants, many of which are locally uncommon. Significantly, the *Gaon Burha* (village headman) helped in diffusion of knowledge on plants and expanding learning networks created by children and women. It is concluded that creating a platform on which contests based ecological knowledge of community is collaborated with formal knowledge systems, can ultimately contribute in conserving biodiversity more sustainably.

**Keywords:** Biodiversity contests, Recipe contest, Traditional ecological knowledge, School children, *Adi* women, Conservation, Knowledge network, Arunachal Pradesh

## **Ecoculture and subsistence living of *Monpa* community in the eastern Himalayas: An ethnoecological study in Arunachal Pradesh**

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### **Abstract**

This study explores the interconnectedness between ecocultural knowledge and subsistence livelihoods of *Monpa* tribal communities in the West Kameng and Tawang districts of Arunachal Pradesh, India. For such indigenous and tribal peoples, local cultures, spiritual beliefs, social and ethical norms and interconnectedness with local ecosystems is the essence of their social capital. For *Monpa* people, ecocultural capital plays a particularly significant role in subsistence and conservation of natural resources. The *Monpa* have rich and diverse socio-cultural, economic and spiritual perceptions of their natural resources and landscapes. These ecocultural and spiritual values represent a challenge for resource managers seeking to integrate them in their top-to-bottom approaches to resource use and regulation. Results indicated that the ecological knowledge codified in *Monpa* language and culture varied according to altitude and peoples' access to particular ecosystems. Their overall ecocultural diversity, enhanced through cultural networks across communities, allowed the *Monpa* a wide degree of food availability and enhanced their health and well-being. Their diverse knowledge systems and cultural network among community members significantly affect the management practices pertaining to agriculture, animal husbandry, forest and aquatic resource's access pattern, food availability and maintaining the health of human and nature. The survival strategies intermingled with location specific ecological knowledge and indigenous management practices buffered by myths, customs, sacredness and traditional values assured sustainable and subsistence livelihood in harsh ecology; and maintaining the resilience of rainfed ecosystem. They emphasize the need for respectful land use, and described general landscape conditions consistent with such use.

**Keywords:** Ecoculture, Sacred ecology, Conservation, Subsistence survival, Economy, Natural resources, *Monpa* tribe

## **Institutional arrangement and typology of community forests of Meghalaya, Mizoram and Nagaland of North-East India**

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### **Abstract**

Most community forests in hill regions of northeast India have been managed by traditional local institutions for centuries and most of these institutions remain functional even today. Higher forest coverage on private and community lands as compared to government land indicates that traditional institutions effectively manage community forests in the region. The present study was conducted through a survey of literature and field work using participatory research tools viz., PRA exercises, group discussions and questionnaire interviews with key informants in northeast India. We categorized the institutions involved in conservation and management of forests into three major types: traditional, quasi-traditional and modern. Traditional institutions with hierarchal structure were found in all states and are intact and functional in the state of Meghalaya. Quasi-traditional institutions, a blend of traditional and modern institutions were prevalent in Nagaland while modern institutions have almost replaced traditional institutions in Mizoram. We recorded at least eleven types of community forests viz., group of village forest, village forest, restricted forest, sacred forest, clan forest, cemetery forest, regeneration forest, bamboo forest, recreation forest, village reserved forest and medicinal plantation in villages of three states. The tribal people, through long-term trial and error experiments, have developed an elaborate, functional and generally democratic system of conservation and management of forests and associated natural ecosystems. Several forest and natural resource management lessons can be learnt from the institutional structure and decision making system of the evolving and dynamic institutions of tribal communities of the region.

**Keywords:** sustainable; natural resources; community institution: tribal

## Availability and Use of Willow Species in Representative Cold Desert Areas of Northwestern Himalaya, India

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### Abstract:

Willow species (*Salix fragilis* L. and *S. alba* L.) are important elements of cold desert agroforestry systems in the Lahaul valley, northwestern Himalaya. Their ability to grow through shoot-cuttings plantations under extreme and xeric climatic conditions of cold deserts, makes them ecologically suited and socially accepted for forestry programmes. Willow species in cold deserts may combat desertification and can thrive well in these areas as compared to any other species. *Salix fragilis* L. and *S. alba* L. are under cultivation in the Lahaul valley. However, *S. fragilis* is widely cultivated under the agroforestry and plantation forestry systems. In the Lahaul valley, willow species are used as subsistence resources and for socio-religious purposes. The present study was carried out to examine the vegetation analysis, density, diversity and distribution of willow species, present status and potential willow plantation sites and uses. The results of present study revealed that a higher species density was recorded at middle altitude villages (Jahlma-3,000 m asl and Hinsal-2,700 m asl), except, a higher density of *S. fragilis* was at Khoksar (3,200 m asl) in plantation forestry on south-facing slopes. In forests, *S. Fragilis* was planted mainly along the water channels, resulted a low density. The shrubby willow species occurred naturally in the entire Lahaul valley up to an altitude of 3,850 m asl. 81% of households felt the scarcity of willow trees, whereas, 19% of households were satisfied with the willow trees they owned. The majority of willow species were planted in middle altitudes on privately owned irrigated lands. It was rated most potential prospective willow planting site by the farmers. Small size of land-holdings was one of the main constraints for establishing a large number of willow plantations. Commercial aspects of willow species need to be investigated to encourage the farmers to plant more willows further.

**Keywords:** Willow; Agroforestry; Forestry; Species diversity; Himalaya

## **Traditional beekeeping shows great promises for endangered indigenous bee *Apis cerana***

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### **Abstract**

Nagaland dwellings plentiful bee flora is as a natural endowment. Indigenous techniques, equipments and traditional beekeeping knowledge are goldsmith due to simplicity and low cost input, shows great promise to visionaries for their envisage. The suitable agro-climate, plenty bee flora and immemorial practice with rich traditional knowledge offers enormous potential for development and success of apiculture in this state. The outfit survey accomplished in six districts of Nagaland revealed that 26% beekeepers were rearing both species (*Apis cerana* and *Tetragonula iridipennis*) and rest only *A. cerana*. The 74.67% peasantry indulged in apiculture and average number of beehive/ beekeeper was 3.78 where as highest beehive/ beekeeper was observed in Kohima. The 65.33% beekeepers were interested to rear in indigenous box and 34.67% beekeepers were interested to scientific beehive. A keywords: majority of beekeepers responded, the wax moth attack is higher in scientific box, while literate new generation, and trend beekeepers were interested with scientific beehive. The *Naga* tribes know different indigenous methods of colony capture, different types of traditional bee hives and indigenous methods of pest management. Simultaneously gruesome traditional honey harvesting method and *jhoom* cultivation direct threaten to bees which require scientific intervention for conservation to *A. cerana*. Honey bee role as a pollinator to enhance the crop productivity and conserve the plant biodiversity are more valuable than bee hive products.

**Keywords:** Traditional knowledge, Indigenous methods, Indigenous beehive, Honey bee, *Naga* bee dance

## **THE RELIGIOUS, SOCIAL AND CULTURAL SIGNIFICANCE OF FOREST LANDSCAPES IN UTTARAKHAND HIMALAYA, INDIA**

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### **Abstract**

The present study was an attempt to understand the community behavior of cultural and tradition rich forested landscapes towards the conservation and management of forest resources. The present study was conducted in five selected protected forests (Chanderbadni, Jameswar, Ulkagari, Ansuiya Devi and Maroor) located in four districts of Garhwal Himalaya, India. Conservation practices and belief system was discussed with local inhabitants residing within and around the vicinity of these forests. A well-structured semistructured questionnaire dataset was developed for formal and informal discussions with the communities. Deities of both genders are worshiped; however, people have more faith in feminine deities compared to male deities. The awareness among villagers regarding the conservation is historical. Different festivals and traditional celebrations are held to keep the heritage intact with younger generations. No use of weapons, restrictions to pregnant women, and ban on spitting and making of toilets around the core zones has restricted the entry by the local communities. Demarcation around the boundaries by red flags or statues of gods or goddesses have been erected in the forested landscapes to put votive offerings, which ultimately give protection to these landscapes in the form of social conservation.

**Keywords:** Religion; Tradition; Conservation; Communities; Demarcation.

## **Chuskor: an indigenous watermill for sustainable resource utilization by the Monpa tribes of Arunachal Pradesh, India**

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### **Abstract**

The Monpas are one of the major tribes of Arunachal Pradesh inhabiting the western-most part of the state. They live in close proximity to the forest and other natural resources with rich indigenous knowledge system (IKS) for sustainable development. Chuskor, an indigenous technique for grinding grains into fine flour operated by water power for sustainable water resource utilization is reported here. We also analyse the role of Chuskor as an IKS which, if preserved and continued, may help in the sustainable utilization of renewable resources by local people in difficult mountainous areas.

## **Developing sacred forests into biodiversity heritage sites-experiences from the state of Uttarakhand, Central Himalaya, India**

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### **Abstract**

The provision of declaring Biodiversity Heritage Sites (BHS) in the National Biodiversity Act 2002 provides an opportunity to give recognition to the community initiatives vis-a-vis the institution of the sacred natural sites (SNS). In brief, the salient feature of the Biodiversity Act 2002, as relates to the BHS, is that the state government in consultation with the local bodies may notify in official gazette, biodiversity rich areas, including the SNS as BHS. Subsequently, under sub-section (2) of section 37, the state government in consultation with the Central government may frame rules for the management and conservation of BHS. As per the guidelines framed by the National Biodiversity Authority of India (NBAI), Chennai, for the selection of the sacred natural sites as BHS, and for the constitution of Biodiversity Management Committee (BMC) to manage the BHS, 13 sacred forests across eight hill districts of Uttarakhand were selected. The present paper in brief, attempts to bring forth the salient features of the sacred sites as relates to the precise status of the taboo system or the traditional norms governing the resource utilization, the floral diversity, ecosystem services provided, importance in terms of refuge for wild endangered species of fauna, eco-tourism potential, and else. The paper in addition incorporates the experiences gained in the constitution of BMC, and ends with recommendations as to how to proceed with the establishment of the biodiversity heritage sites *vis-à-vis* sacred forests.

**Keywords:** Biodiversity, Biodiversity heritage sites, Biodiversity management committee, Ecosystem services, Sacred forests and *taboo*

## **‘Traditional Sacred Groves’, an ethnic strategy for conservation of microbial diversity Nathaniel**

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### **Abstract**

‘Sacred groves’ represents a traditional effort to conserve biodiversity. They are rich patches of undisturbed forests and serve as a natural habitat for many endemic, rare, primitive and economically valuable organisms representing a micro-level biodiversity hotspots. In this study, *Bacillus* spp. and related genera characterized from native soils of the pristine sacred groves of Meghalaya, India revealed dominance of *Bacillus*, *Paenibacillus*, *Lysinibacillus* and *Viridibacillus*. All the isolates exhibited good plant growth promoting traits when screened for traits like phosphate solubilization, 1-aminocyclopropane-1- carboxylate deaminase and catalase activity, production of auxin, siderophores, hydrogen cyanide and ammonia. Bacteria native to the pristine niche of sacred groves showed better plant growth promoting activities as compared to isolates from disturbed forest as well as type strains implicating the importance of sacred groves and their potential role in microbial diversity conservation.

**Keywords:** Sacred groves, Meghalaya, Microbial diversity, Conservation, Plant growth-promoting