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चन्द्र प्रकाश काला 'हीरामणि'

मध्य हिमालय में पर्यावरण संरक्षण की समस्याएं

दलीप सिंह

EPIDEMIOLOGY AND CONTROL OF PARASITISM IN NOMADIC SITUATIONS IN HIMACHAL PRADESH

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INTRODUCTION

Location, geography and climate

The state of Himachal Pradesh is situated south of Jammu and Kashmir, north-east of Punjab, north-west of Haryana and Uttar Pradesh and west of Tibet, between latitude 30° 22' 40" N and 33° 12' 40" N and longitude 75° 45' 55" E and 79° 04' 20" E with an altitude ranging from 350 m (low valleys) to 6,975 m (snow covered mountains) above mean sea level. Geographically the state is located in the North Western Humid Himalayan Region (NWHHR) comprising Jammu & Kashmir, Himachal Pradesh and 8 hill districts of Uttar Pradesh. It has a total geographical area of 56,673 square kilometers including 9859 square kilometers of permanent pastureland. The climatic conditions vary from hot and sub-humid tropical in southern low tracts, (450-900 m), warm and temperate (900-1800 m), cool and temperate (1900-2400 m) and cold alpine and glacial 2400-4800 m) in the northern and eastern high mountain ranges. The rainfall varies from 350 to 3800 mm per annum with temperature varying from -25°C in January to 42°C in June. The region is well known for its biodiversity (Anonymous, 1985).

Agroclimatic zones

Agroclimatically the state is divided into 4 zones on the basis of topography, rainfall and altitude (Figure 1).

| | |
|----------|-----------------------------------------------------|
| Zone I | Submountainous low hills-subtropical (upto 1,100 m) |
| Zone II | Mid hills-subhumid (1,100- < 2,000 m) |
| Zone III | High hills temperate wet (2,000- < 3,000 m) |
| Zone IV | High hills temperate dry (> 3,000 m) |

Livestock and wild animals

About 92 % population in Himachal Pradesh is rural and depends directly on agriculture, horticulture and animal husbandry (Anonymous, 1994). The rearing of livestock is an integral component of the economy of the state providing source of livelihood to most of the people, especially those inhabiting the border districts of Lahaul-Spiti, Kinnaur, Pangi and Bharmour sub division of Chamba and Bara Bangahal area of Kangra. In the remaining areas, livestock rearing is practiced generally within the framework of mixed farming. The state has a total livestock population of 50.93 lakh constituting 21.9 lakh cattle, 6.2 lakh buffaloes, 10.7 lakh sheep and 11.0 lakh goats and roughly about 1 lakh other animals (equines, mithun, yak, camel, pig, rabbit etc.) excluding poultry against total human population of 51.11 lakh living in 16,807 inhabited villages (Table. 1). Owing to differing climate in the state, it has a variety of wild life. The carnivorous animals include leopard, panther, hyena, ibex, jackal, wild dog, yellow jungle cat, fox, wolf, and marmot. Other animals are sambar, cheetal, barking deer, chausingha, ghural and hog deer. Kastura (musk deer) is found at high altitudes and hares, jungle fowl, peafowl, partridges and quails are plentiful in the lower hills. Kali pheasant is found in the low slopes and monal (snow pheasant), the state bird at high snowy altitudes (Mittoo, 1993).

Migration of livestock in Himachal Pradesh

In Himachal Pradesh, animals are kept in a wide variety of husbandry systems and in different numbers - from a single cow kept for the family to large herds and flocks maintained in a range of systems. Transhumance over long distances, from the Punjab and to the alpine meadows of the inner Himalaya is an established practice although these practices are changing in the contemporary period. Chakravarti (1998), Duffield *et al.* (1998) and Berkes *et al.* (1998) give a detailed account of transhumance in the Himalayan pasture (Figure 2). The migration is essentially practiced by people living in mountain locked backward and tribal areas which mainly include *Gaddis* and *Gujjar* tribes to find better fodder for the flocks. The traditional sheep and goat rearers called *Gaddis* are semi-nomadic (rather than nomadic

because they combine the seasonal movement of livestock with seasonal cultivation) tribal Hindu group who practice long distance herding of sheep and goats from range to range and their flocks are migratory in nature through well defined routes in Himalayan pasture (Bhasin and Singh, 1995). These animals remain confined to the low plains in zone I and II and border areas of Punjab during the winter season, but migrate to the alpine pasture land (3,000- 4,500 m above m.s.l.) in zone III and zone IV during spring and summer seasons. Shepherds of the snowy ranges are the best description of the *Gaddis* of the alpine terrain of Himachal Pradesh. The alpine zone is the *Gaddis* niche. It is a narrow geographical belt running unevenly across the north western Himalaya, with a area of approximately 19,000 km² in H.P. Although *Gaddis* keep permanent dwellings in the Kangra valley, the *Gujjars* are a Muslim buffalo herding community / tribe which follows a system of high pasture use throughout the Himalaya. They are semi-nomadic pastoralists, and have permanent homes where some families remain to tend to crops while other families take the animals to high pastures.

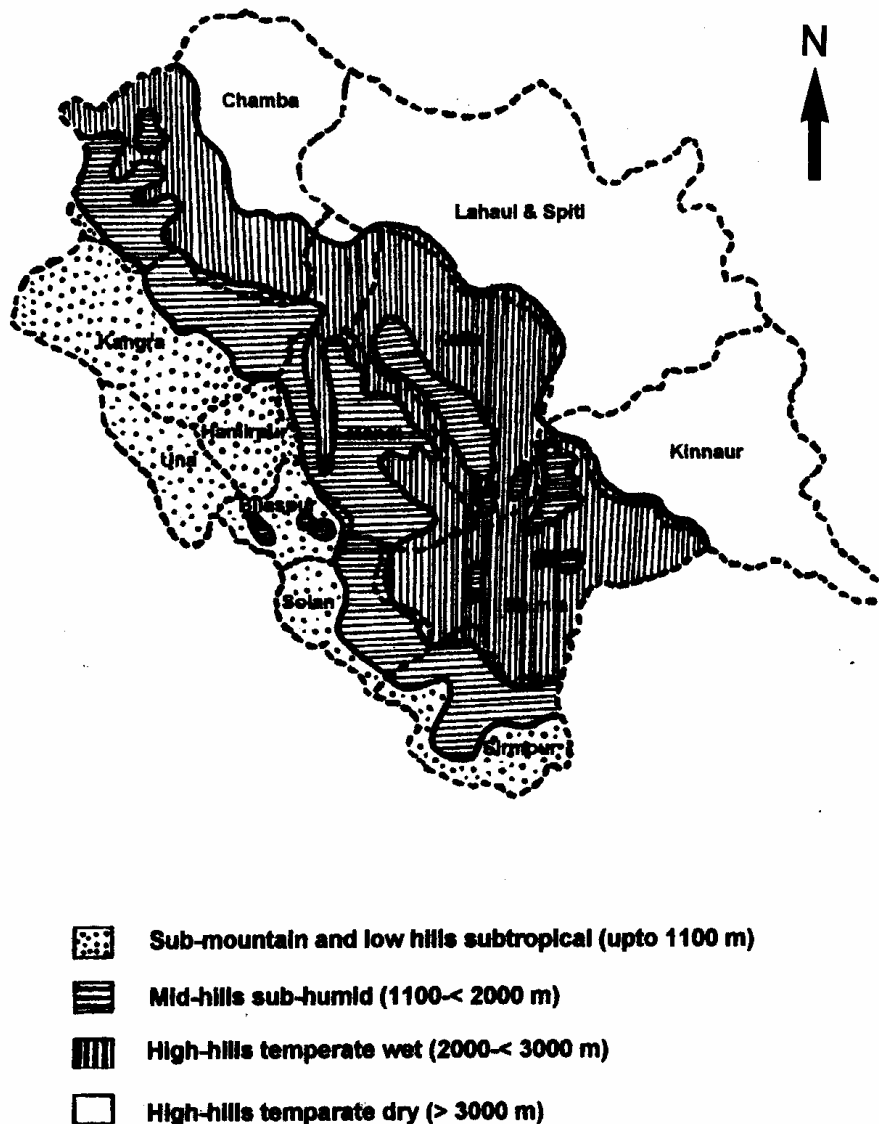


Figure 1: Agroclimatic zones of Himachal Pradesh

Table 1: District wise livestock population in Himachal Pradesh (1992 census)

| District | Cattle | Buffalo | Sheep | Goat | Dog | Others | Total | Poultry |
|---------------|-----------|----------|-----------|-----------|----------|--------|-----------|----------|
| Bilaspur | 60,461 | 86,858 | 24,615 | 63,472 | 8,770 | 1,309 | 2,45,485 | 58,844 |
| Chamba | 2,38,988 | 34,832 | 2,58,490 | 1,75,268 | 14,730 | 2,800 | 7,25,108 | 67,871 |
| Hamirpur | 60,671 | 94,089 | 49,498 | 30,719 | 8,500 | 1,783 | 2,45,260 | 28,810 |
| Kangra | 3,98,558 | 1,47,386 | 1,55,432 | 2,05,024 | 32,448 | 10,544 | 9,49,392 | 2,42,681 |
| Kinnaur | 20,937 | 3 | 57,720 | 28,622 | 2,182 | 4,358 | 1,13,822 | 5,795 |
| Kullu | 1,57,448 | 670 | 1,09,835 | 56,382 | 9,062 | 1,379 | 3,34,778 | 21,315 |
| Lahul & Spiti | 8,910 | - | 42,766 | 11,445 | 205 | 3,405 | 66,731 | 4,923 |
| Mandi | 4,30,331 | 1,07,676 | 1,96,041 | 2,03,270 | 14,184 | 5,155 | 9,56,657 | 81,363 |
| Shimla | 3,29,055 | 23,258 | 1,26,531 | 95,831 | 16,469 | 5,866 | 5,97,010 | 45,082 |
| Sirmaur | 2,35,557 | 40,108 | 27,616 | 1,15,915 | 14,850 | 4,586 | 4,38,632 | 39,475 |
| Solan | 1,43,491 | 74,349 | 19,713 | 82,541 | 10,304 | 3,042 | 3,33,440 | 46,167 |
| Una | 67,209 | 91,694 | 6,088 | 47,100 | 13,731 | 826 | 2,26,648 | 21,776 |
| H.P. (Total) | 67,51,616 | 7,00,923 | 10,74,345 | 11,15,591 | 1,45,435 | 45,053 | 52,32,963 | 6,64,039 |

Source – Directorate of Economics and Statistics, Shimla (Himachal Pradesh), 1994.

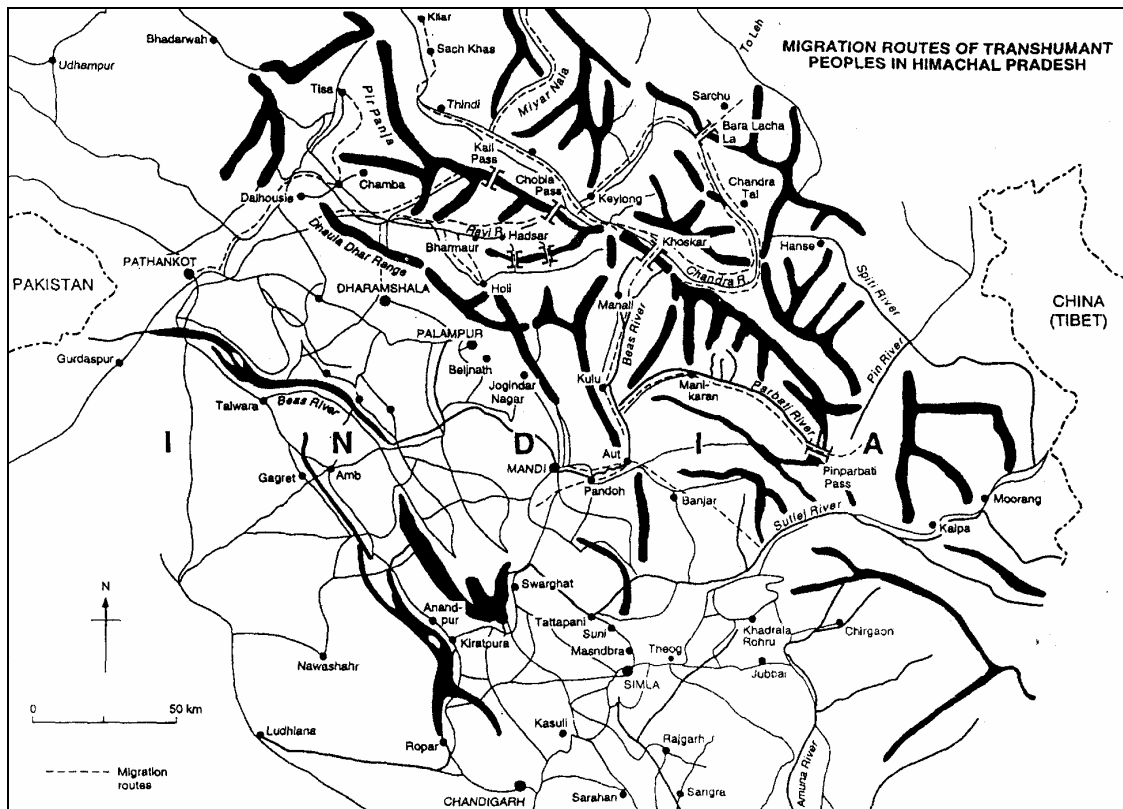


Figure 2: Migration routes of transhumant people in Himachal Pradesh [Source: M. Chakravarty-Kaul, 1998]

Epidemiology of parasitic infections in nomadic populations

Nomads are people characterised by or leading a wandering life: pastoral nomads move in search of pasture for their herds; semi-nomads practice unspecialised herding and farming; whilst transhumance is the seasonal moving of livestock to regions of different climate. Depending on the definition employed, there are between 50-100 million nomads in the world mainly in Africa, Middle East, India, and central Asia (Omar, 1992; Macpherson, 1994). Nomadism is a highly specialised mode of life enabling humans to

exploit resources that are widely distributed over space and time. Most pastoral nomads maintain a range of livestock divided in separate units capable of utilising all the grass cover in each locality. Livestock species comprise cattle, buffalo, sheep and goats besides yak and other transport animals to increase their efficiency.

Parasitism is one production problem limiting the animal productivity in these animals and the effect of parasitism may be more in areas of high moisture and rainfall and where permanent pasture situation exists and feral and semi-feral grazing system are practiced. Till seventies, the state of Himachal Pradesh was considered as a disease free zone. This concept emanated from lack of proper diagnostic facilities in the region. The paucity of studies is due to a number of factors including remoteness of some of the areas and lack of infrastructure or trained personnel. The nomad's isolation and adaptation to harsh ecological conditions prevailing in the region is in fact a hardship post for staff who are often forced to work there. The constant movement of flocks of sheep and goats and their constant interaction with other domestic and wild animals over a large area ranging different states may greatly facilitate the spread of infection among livestock as well as human beings.

Environmental factors

Environmental conditions, especially relative humidity and temperature have a profound effect on the global distribution of parasite species (Hinz, 1986) and would be an important limiting factor for parasitic infections in the environment occupied by most nomadic peoples. The southwest monsoon sets in July and ends in September with the highest rainfall in August. The rise in parasitic load could be attributed to a more favourable temperature, humidity for the development and survival of the pre-parasitic stages (Durie, 1961) leading to increased availability of infective larvae on the pasture during the subsequent months.

Those parasites with free-living stages (e.g. *Giardia* spp., *Entamoeba* spp. and nematodes such as *Trichuris* spp., Trichostrongyloidea, Strongyloidea, Ascaroidea) are markedly influenced by environmental conditions. Similarly, parasites with numerous freeliving stages, most nematodes and cestodes and those with homothermic intermediate hosts (*Sarcocystis*, *Echinococcus*, *Taenia* spp.) are influenced by environmental climatic conditions. Parasites without free living stages or the requirement of vectors or intermediate hosts for e.g. *Trichinella* spp. and those parasites with vertical mode of transmission (38 helminth parasites and many protozoans) are more independent of environmental factors. Absence of free living stages removes it from the vicissitudes of the environment and from finding a suitable host at appropriate stage of development. Pregnancy and lactation are discrete, often seasonal phenomena. So there is need for such parasite species to synchronise the larvae for passage at specific times. This is achieved by arrested development and production of offspring when conditions are too extreme, a mechanism known as hypobiosis. This is an important survival strategy for members of the superfamily Trichostrongyloidea and some genera of the superfamily Strongyloidea. Hypobiosis also allows species whose adults have limited life spans for e.g. *Toxocara canis*, to survive in the hosts for extended periods, and to correlate the resumption of development with parturition or lactation when immunologically naive young are available.

Human behavior in relation to disease transmission

Among the most important factors influencing the transmission of parasitic disease is human behavior. Nomadic pastoralists have the closest possible association with their own ecosystem. The low population density, mobility, eating habits, lack of sanitation, dwelling construction and intimate association with their animals, all have a profound influence on the transmission of parasites.

Helminths do not as a rule multiply within the host and the number of parasites is a function of the frequency of infection. Ingestion and percutaneous penetration, two major routes of entry of parasites are influenced by behavior of the prospective human host. This may be active, as ingesting soil containing infective stages of *Toxocara canis*, *Ascaris* spp., *Trichuris* spp. or *Ancylostoma* spp. or permissive, as exposing the skin to water containing penetrative larva of *Schistosoma* spp or soil containing larvae of *Necator* spp. or *Strongyloides* spp. Human and animal cestode infections may result from ingestion of

eggs directly from the faeces of definitive hosts or indirectly by contact with definitive hosts or from contaminated food, water, soil or eating utensils.

There is a close contact of man and animals in the tribal areas of Himachal Pradesh, where domestic animals are kept in basement of the house with human occupants in the first floor of same house. In addition Gaddis (semi-nomadic tribe) also remain in close contact with sheep, goat and dogs throughout the year, exposing them to many animal born diseases of occupational risk. The association of dogs with migratory flock might be playing an important role since they accompany the flock all through the valley and alpine pastures and also feed on dead/offal of slaughtered sheep and goat, though sylvatic cycle cannot be totally ruled out (Jithendran and Rao, 1996). The authors encountered situations, where nomads and butchers use the fluid from big hydatid cysts (potentially hazardous) at the site of slaughter. Snacks made from the whole blood collected from the sheep/goat at the time of slaughter is also a delicacy among the migratory tribes. Their migratory life style is likely to have no access to permanent educational, medical, and veterinary health services. They also may not have safe and sanitary water supplies leading to many zoonotic diseases.

Risk factors in acquiring parasitic infections during travel to infested areas of the region has been recorded in several instances. Increased thrust on travel tourism and pilgrimage tourism has enhanced the exposure of the public to these infections. Further, the scaling up of infection in tourists living in tents or native dwelling in rural settings and vast number of wild animals in thick belt of forest at high mountains, results in contamination of environment and infections are contracted either through contaminated food or untreated water which is common feature in the hilly regions.

Human diseases in nomadic situations

Table 2 is a summary of the intestinal parasites, found on stool specimen examination, in their order of importance. Some are parasitic zoonoses, which are naturally transmissible from animals to man by various means (Table 3). Zoonoses involving parasites are both common and important, some causing serious diseases of widely varying severity from asymptomatic to fatal. Most of the parasitic zoonoses are acquired through contaminated food and water manifesting in subclinical forms; as a result, it is difficult to visualise the magnitude of the disease problem.

Table 2: Parasites reported from human beings in Palampur area in Himachal Pradesh

| Organism | Location | References |
|--------------------------------|-----------|-----------------------------|
| Protozoa | | |
| <i>Giardia lamblia</i> | Intestine | Personal observation |
| <i>Entamoeba histolytica</i> | Intestine | Personal observation |
| Cestodes | | |
| <i>Taenia</i> spp. | Intestine | Personal observation |
| <i>Hymenolepis</i> spp. | Intestine | HPKV Annual report, 1991-92 |
| Nematodes | | |
| <i>Ascaris lumbricoides</i> | Intestine | HPKV Annual report, 1990-92 |
| <i>Enterobius vermicularis</i> | Rectum | Personal observation |
| <i>Ancylostoma</i> spp. | Intestine | Personal observation |
| <i>Trichuris</i> spp. | Intestine | Personal observation |

The cystic stage of the tapeworm *Echinococcus granulosus* is common in sheep, goat, cattle and buffaloes. Hydatidosis due to the larval stages of *Echinococcus granulosus* is of great public health importance. Primarily, the domestic herbivorous animals serve as intermediate hosts and rarely produce clinical signs despite heavy infection. Hence the metacestode infections are usually diagnosed at necropsy. Based on a survey in abattoir, sheep and goats revealed 4.4 % infection with hydatid cysts with size ranging from 2 to 4 cm and with high percentage (70 %) of viable cysts (Jithendran, 1996). Jithendran and Rao (1996) discussed the role of nomadic flocks in the spread of zoonotic helminthic infections.

Table 3: Directly transmitted zoonoses caused by helminth parasites in Himachal Pradesh

| Parasite | Vertebrate host | Diseases |
|-------------------------|-----------------|-------------------------|
| Cestodes | | |
| <i>Echinococcus</i> | Dog | Hydatid |
| Nematodes | | |
| <i>Ancylostoma</i> spp. | Dog | Cutaneous larva migrans |
| <i>Toxocara</i> | Dog | Visceral larva migrans |

Man is both a final and an intermediate host for *Taenia solium*, with chances of autoinfection. There are already reports of *Cysticercus cellulosae* infection in pigs of Kangra valley. However, in areas where villages are not supplied with sanitary facilities, wild pigs come in contact with human excreta. Illegal killing and eating of these animals further perpetuate the life cycle of *T. solium*. Heavy infection of dogs with fleas and *Dipylidium caninum* also helps in spreading infection of *D. caninum* to children, by accidental ingestion of dog flea containing cysticercoid, while playing with dogs. Similarly, observation of *Hymenolepis diminuta* in rats and man of Kangra area also suggest of zoonosis. *Enterobius* spp. infection is perhaps the most common helminthic diseases endemic in migratory lifestyle. Cutaneous and visceral larva migrans are also reported among children. Ascarid infections occur occasionally in children who generally, but not exclusively, have been associated with pigs. *Cysticercus cellulosae* have also been recorded in muscles and heart of pig at Kangra valley. Besides this, protozoan infections of *Entamoeba* and *Giardia* spp. are most prevalent in the region.

The various helminthic infection encountered in dogs of Himachal Pradesh are *Toxocara canis*, *Ancylostoma caninum*, *Dipylidium caninum* and less important filariid heart worm (*Dirofilaria immitis*) and whip worm (*Trichuris vulpis*). Infection of *Toxocara* and *Ancylostoma* species are of great importance in pups, whereas adults either suffer from acute course or sub latent infection and act as immune carriers contaminating kennels and other surroundings and thus transmitting the diseases in young litters, pet owners and children. Majority of canine helminthic diseases escape early detection due to non-specific symptoms.

Clinical manifestations of parasitic diseases

The most common symptoms of intestinal parasitic infections are constipation or diarrhoea. Diarrhoea may be bloody or purulent. Cramping abdominal pain may be predominant feature in those diseases in which the bowel mucosa or wall is invaded by the parasite, such as hookworms. Heavy infections with *Ascaris* can result in obstruction of the gut. Patients with tapeworms may be asymptomatic, except for weight loss despite increased appetite and food intake.

Peripheral blood eosinophilia (15-50 %) is one of the most important markers for parasitic infections. However, the lack of eosinophils in either the blood or body fluids does not preclude the diagnosis of parasitic infections in which eosinophilia is not a common manifestation or the load of the parasites may be very low.

Wild life diseases shared by nomadic pastoralists

Close contact facilitates exchange of many zoonotic diseases (protozoan, entomological and helminthic) and non- zoonotic diseases. Often nomadic pastoralists eat wild animals. Studies on parasitism of wild life are scanty and some of the parasites reported from captive wild and zoo animals is shown in Table 4. Wild animals occur in abundance and diversity, particularly in areas inhabited by nomadic pastoralists. Wild animals increase the number of definitive and intermediate host species, expanding the number parasite's range over space and time. The occurrence of parasite infections in wild life reservoirs complicates control efforts.

Table 4: Incidence of some gastrointestinal helminth parasites in wild/zoo animals in Himachal Pradesh

| Parasite | Host | Location | Reference |
|---------------------------|---------------|-----------|---------------------------------|
| <i>Toxascaris leonina</i> | Lion, leopard | Intestine | Kishtwaria <i>et al.</i> , 1998 |
| <i>Toxascaris</i> spp. | Lion cub | Intestine | Agnihotri <i>et al.</i> , 1998 |
| <i>Toxocara</i> spp. | Lion cub | Intestine | Agnihotri <i>et al.</i> , 1998, |

| | | | |
|------------------------------|-------------------------------|-----------|---------------------------------|
| <i>Strongyle</i> spp. | Lion cub | Intestine | Kishtwaria <i>et al.</i> , 1998 |
| <i>Muellerius capillaris</i> | Deer | Lung | Agnihotri <i>et al.</i> , 1998 |
| <i>Taenia taeniaformis</i> | Leopard/cat | Intestine | Sharma <i>et al.</i> 1996 |
| | | | IVRI Annual report, 1997-98; |
| | | | Jithendran and Somvanshi, 1997 |
| <i>Raillietina tetragona</i> | Dove, mynah, House sparrow | | |
| | Pigeon, parrot | Intestine | Chahota <i>et al.</i> , 1997 |
| <i>Cotugnia digonopora</i> | Pigeon | Intestine | Chahota <i>et al.</i> , 1997 |
| <i>Spirometra</i> spp. | Leopard | Intestine | IVRI Annual report, 1997-98 |
| <i>Ancylostoma</i> spp. | Leopard, lion | Intestine | IVRI Annual report, 1997-98, |
| | | | Kishtwaria <i>et al.</i> , 1998 |
| <i>Capillaria hepatica</i> | Monal, rodents | Liver | HPKV Annual report, 1990-91, |
| | | | Chahota <i>et al.</i> , 1997 |
| <i>Ascaridia</i> spp. | Monal | Intestine | HPKV Annual reports, 1990-91 |
| <i>Cyathostoma</i> spp. | Nightingale Air sac | | Chahota <i>et al.</i> , 1997 |

Table 5: Parasites in dairy cattle and buffaloes in Palampur (Himachal Pradesh)

| Parasites | No (%) infected* | | | |
|------------------------------------|--------------------|--------------------|--------------------|--------------------|
| | 1986-1990 | | 1993-97 | |
| | Cattle (n=1552) | Buffalo (n=530) | Cattle (n=1407) | Buffalo (n=107) |
| Flukes | | | | |
| <i>Fasciola</i> spp. | 559 (36.0) | 258 (48.7) | 88 (6.3) | 22 (20.6) |
| Amphistome spp. | 257 (16.6) | 81 (15.3) | 212 (15.1) | 12 (11.2) |
| <i>Dicrocoelium</i> spp. | 177 (11.4) | 99 (18.7) | 29 (2.1) | 2 (1.9) |
| <i>Schistosoma</i> spp. | 9 (0.6) | 2 (0.4) | 0 (0.0) | 0 (0.0) |
| Cestodes | | | | |
| <i>Moniezia</i> spp. | 45 (2.9) | 15 (2.8) | 12 (0.9) | 2 (1.9) |
| Nematodes | | | | |
| <i>Strongyle</i> spp. | 487 (31.4) | 155 (29.2) | 190 (13.5) | 17 (15.9) |
| <i>Strongyloides</i> spp. (5.6) | 142 (9.1) | | 22 (4.2) | 24 (1.7) |
| <i>Toxocara</i> spp. | 69 (3.9) | 24 (4.5) | 27 (2.1) | 2 (1.9) |
| <i>Dictyocaulus</i> spp. | 30 (1.9) | 3 (0.6) | 9 (0.7) | 0 (0.0) |
| <i>Trichuris</i> spp. | 81 (5.2) | 12 (2.3) | 21 (1.6) | 0 (0.0) |
| <i>Capillaria</i> spp. | 21 (1.4) | 6 (1.1) | 12 (0.9) | 0 (0.0) |

* Total numbers and total percentage of animals exceed expected values owing to multiple parasitism

Parasite control programme for nomads

Progress in nomadic communities is hindered by lack of adequate epidemiological data on parasitic diseases. The most appropriate, practical and cost effective methods to deliver health and veterinary care to nomadic population and their livestock is still a matter of debate. Mobile and seasonally flexible primary health care and veterinary services matching the needs of specific nomadic populations should be developed, besides seasonal check post for monitoring and surveillance of health aspects at some transit points.

Table 6: Prevalence of gastrointestinal parasites in sheep and goats Himachal Pradesh

| Parasites | No (%) infected* | | |
|---------------------------|------------------|-----------------|--------------------|
| | Sheep (n=335) | Goat (n=158) | Overall (n=493) |
| Flukes | | | |
| <i>Fasciola</i> spp. | 32 (9.6) | 14 (8.8) | 46 (9.3) |
| <i>Amphistome</i> spp. | 13 (3.8) | 4 (2.5) | 17 (3.4) |
| <i>Dicrocoelium</i> spp. | 24 (7.2) | 4 (2.5) | 28 (5.7) |
| <i>Schistosoma</i> spp. | 4 (1.2) | 1 (0.6) | 5 (1.0) |
| Cestodes | | | |
| <i>Moniezia</i> spp. | 9 (2.7) | 2 (1.3) | 11 (2.2) |
| Nematodes | | | |
| <i>Strongyle</i> spp. | 307 (91.6) | 158 (100) | 465 (94.3) |
| <i>Strongyloides</i> spp. | 16 (4.8) | 8 (5.1) | 24 (4.9) |
| <i>Dictyocaulus</i> spp. | 4 (1.2) | 2 (1.3) | 6 (1.2) |
| <i>Trichuris</i> spp. | 48 (14.3) | 2 (1.3) | 75 (15.2) |

*Total numbers and total percentage of animals exceed expected values owing to multiple parasitism

Personal hygiene, respect for good animal husbandry and health practices throughout the production, harvesting and processing of food for human consumption contributes to reducing the risk of transmission to man. Regular dog treatments, strict dog control, a prohibition on the feeding of uncooked offal to dogs and regulation of open slaughter of livestock could prevent most common zoonoses. Increase in numbers of both human and animal has also altered the ecological balance in the region. Hence role of pets, domestic and wild animals in the spread of parasitic zoonoses should be carefully considered in health planning.

The preparation of herbal medicines remains an important part of healthcare for both human and livestock, especially in rural areas in the state by the traditional migratory communities. The small and subsistence farmers in remote communities and the nomads like *Gaddis* depend largely on the use of medicinal plants based on indigenous knowledge, in the absence of veterinarians and modern veterinary medicines at high alpine Himalayan pasture land which is considered to be a museum of aromatic and medicinal plants. There is a growing need for identification and development of human and veterinary drugs based on locally available plant resources.

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SYSTEM STUDY ON SEDENTARY GADDIS OF KANGRA VALLEY

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INTRODUCTION

Gaddis, the nomadic sheep and goat herders are one of the most important migratory tribes of the Himalaya. It has been recorded that they migrate because they have always been shepherds (perhaps, traders too) and for generations they have been in the habit of moving to find pastures for their flocks. For them cultivation of crops is less important than the welfare of their flocks (Anonymous, 1994). Newal (1967), on the contrary, concludes that the Gaddis are agricultural people who take up other occupations from occupational necessity rather than desire and it is clear that they are not principally sheep rearing nomadic people but have been so far hundreds of years to raise additional means of sustenance. Notwithstanding these conflicting views, the Gaddis have always been considered as migratory graziers whose native place of habitation is Bharmour region of Chamba district in Himachal Pradesh State of India. Some authors consider them to be of Aryan origin and the original inhabitants of Bharmour region while others ascribe their origin to immigration from the plains and subsequent settlement in the hills (Anonymous, 1994). Rawat (1980) believes that due to land fragmentation and harsh climatic conditions, the Gaddis could not produce enough for their survival while living in Chamba district. Hence many of them have established permanent homes in lower regions of Kangra valley. Even here the tiny homesteads have forced them to maintain the flocks of goat and sheep to generate extra cash. These Gaddis can be considered as sedentary since they do not practice transhumance any more and have adopted many diverse professions (Rawat, 1980). The total sedentization of Gaddis can be ascribed to various political and administrative pressures and availability of diverse professions, besides the enormous difficulties faced by them during transhumance (Misri 1998) During the British time, it was believed that the large flocks of Gaddis had done enormous damage to the vegetation and forest cover. During 1915 the grazing tax levied on Gaddis was enhanced to discourage them from grazing in the forests and grasslands. Goat was considered as the greatest enemy of the vegetation (Rawat 1980). These restrictions and pressures continued unabated and during 1970 the state government froze the size of the flock and for every given up goat two sheep were allowed to be added to the flock (Verma, 1996). During post-independence period the government policies lead to the decline in grazing areas. Planting of forests and allotment of *Shamlat* lands to landless squeezed the grazing lands thus forcing the Gaddis to abandon migratory system. Restrictions in issuing the grazing permits to the Gaddis further added to their sedentization.

A survey was undertaken to understand the present socio – economic status, livestock rearing practices and feeding strategies adopted by the sedentary Gaddis. The survey was spread over 8 villages situated around Palampur in Kangra District. This paper aims at presenting the findings of the survey.

MATERIAL AND METHODS

Eight villages, Dhoong, Kulani, Lehnga, Bharmat, Nain, Gohar, Spadoo and Lohna were selected for the study. These villages have considerable population of sedentary Gaddis. The respondents were selected at random and sample size varied from 20 –40 families each village, depending upon the population of Gaddis. A questionnaire listing 23 aspects to be surveyed was prepared and information was noted down in field books. The quantitative data were analyzed and are presented in averages or percentages.

RESULTS

Out of 23 aspects enumerated under present investigation, six pertained to evince information about the reasons leading to sedentization. The questions, thus, asked were :1) how long you have been living here 2) when your family left migration 3) why did you stop migration 4) Does anybody from your family still migrate 5) would you again adopt migration, if given a chance 6) which system is better, migratory or sedentary. For the first four questions hundred percent respondents in all the eight villages had a standard answer, “we don’t know”. This amply indicated that they have been sedentary for quite

sometime. Only thirty five percent respondents in all the eight villages showed their inclination to migrate to Bharmour region but they did not wish to adopt migratory system of animal rearing. The main attractions of Bharmour region, as enumerated by the respondents are: remunerative horticulture and the scheduled tribe status of Gaddis living in that area which in turn bestows reservation and other benefits from the Government. Hundred percent respondents in the entire eight villages preferred sedentary system to the migratory system. Information gathered on- other aspects are presented below under separate headings.

SOCIO-ECONOMIC PROFILE

Literacy

The literacy percentage of the area is significantly high. Maximum literacy percentage of 94.74 % was found in village Lohna while Bharmat and Gohar followed by 77.31 and 72.9% respectively. Lehnga had the minimum literacy percentage of 50.72%. The major reason for high literacy rate can be the proximity of all these villages to Palampur, which has very good educational facilities. However, each village had its own school/schools as well. The details of socio-economic profile are presented in Table 1.

Family Structure

The sedentary Gaddis have, comparatively, small families and the people are well aware of the need to have lesser children. This could be correlated to the high literacy rate of the area. The highest number of members (6.27) per family was found in village Lehnga. It was followed by Spadoo (5.90) and Gohar (5.70). The least number of children per family (1.44/family) were found in Kulani.

Land Holding

The land holding is very small in the area. Eighty nine percent families in the area can not produce enough from their lands to sustain them. They have to purchase additional food grains from open market or the fair price shops established in the area by the government. Biggest average land holding of 0.52 ha was found in village Bharmat. The entire land holding is not cultivated. Either some portion which is not crop worthy is left for grazing or a portion of arable land is deliberately left uncultivated to produce herbage for the livestock. This fact amply illustrates the Gaddis's concern for his animals. In Bharmat 76 % of the land holding (0.40 ha/family) was put under cultivation. The highest proportion of land holding 51.85% left for grassland was found in village Dhoong.

Milk Production

The milch animals are essentially reared for the consumption of milk by the family. The average milk production/family ranges between 3.3 – 5.90 lt. Only 23 percent families in the area sell a part of the milk produced.

Lehnga village leads in wool production where a family produces an average of 115kg wool /year. It is followed by Dhoong (40.87 kg/family) and Kulani (13.8 kg/ family). In other villages wool is not produced.

Sale of Sheep and Goat

Sale of sheep and goats contributes significantly to the family income of medium and large herd owners. Gaddis belonging to Lehnga village lead in the area in sales of sheep and goat. Each family sells an average of 220 sheep and 240 goats/year @ Rs 1400 and 1750 respectively.

Annual Family Income

It was very difficult to extract the realistic information about the family income. No one keeps the accounts of sundry sales of milk or animals in small numbers. Besides, everybody was reluctant to divulge the family income. On being assured that the information will be kept a secret, round about figures were provided. Gaddis from village Lehnga are the richest with an average annual income of Rs 64,227.27/family. Gaddis of Gohar (average annual income Rs 55,500/family/year) and Dhoong (average annual income Rs 38,625/family/year) follow them.

Table 1: Socio-Economic profile of Sedentary Gaddis

| Aspect | Villages | | | | | | | |
|---------------------------------------|-------------------------|---------------------------|--------------------------------|---------------------------|--------------------------|----------------------------|------------------------------|--------------------------|
| | Dhoong | Kulani | Lehnga | Bharmat | Nain | Gohar | Spadoo | Lohna |
| Literacy (%) | 65 | 51.21 | 50.72 | 77.31 | 70.83 | 72.9 | 72.0 | 94.74 |
| Av. Member /family | 5.65 (1-16) | 4.55 (2-9) | 6.27 (4-5) | 5.10 (4-9) | 4.8 (2-6) | 5.7 (5-7) | 5.90 (3-14) | 4.4 (4-5) |
| Average no. of children/family | 2.70 (1-6) | 1.44 (1-3) | 2.09 (2-4) | 1.52 (Nil-3) | 1.7 (0-3) | 1.8 (1-3) | 2.3 (1-4) | 2.6 (2-3) |
| Av. Land (ha) holding/family | 0.42 (.08-4) | 0.34 (0.2-0.4) | 0.31 (0.12- 0.6) | 0.52 (0.2-1.0) | 0.4 (0.5-1) | 0.25 (0.16-0.04) | 0.2 (0.12-0.32) | 0.38 (0.24-0.48) |
| Av. Cultivated land/family (ha) | 0.27 (.08-2) | 0.26 (0.1-0.4) | 0.24 (0.08-0.52) | 0.40 (0.16-0.8) | 0.13 (0.16-0.8) | 0.21 (0.12-0.36) | 0.17 (0.12-0.28) | 0.32 (0.2-0.4) |
| Av. Grassland area/family (ha) | 0.14 (0.04-2) | 0.08 (0.04-0.2) | 0.06 (0.04-0.24) | 0.11 (0.04-0.2) | 0.1 (0.04-0.2) | 0.04 (0.04-0.08) | 0.04 (0.04-0.08) | 0.06 (0.04-0.08) |
| Av. Milk (Lt.) production/family/day | 5.03 (3-12) | 4.3 (3-7) | 5.90 (3-10) | 4 (3-5) | 3.5 (3-5) | 3.3 (3-4) | 3.5 (3-4) | 4.6 (4-6) |
| Av. Wool (Kg) production/family/annum | 40.87 (7-500) | 13.8 (125-700) | 115 (80-700) | - | - | - | - | - |
| Av. Sale of sheep/year/family (Nos) | 3.70 | 12.50 | 220 | - | - | 37.5 | - | - |
| Av. Sale of goat/year/family (Nos.) | 5.41 | 12.50 | 240 | - | 5 | - | - | - |
| Av. Sale price of each sheep (RS) | 1327.27 | 1350.00 | 1400.00 | - | - | 1350 | - | - |
| Av. Sale price of each goat (RS) | 1354.54 | 1650.00 | 1750.00 | - | 1500 | - | - | - |
| Av. Annual income (RS) | 38,625 (4000-200000) | 36,333 (15,000-60,000) | 64,227.27 (11,500-2,50,000) | 33,400 (15,000-80,000) | 28,450 (15000-70,000) | 55,500 (20,000-150,000) | 33,900 (12000 - 150, 000) | 32,600 (18000-50,000) |

Range in Parenthesis

Cropping Pattern

Cultivation consists of seven crop sequences in the area. These are:

- 1) Maize – Wheat + Barley
- 2) Wheat – Maize + Rice
- 3) Wheat – Maize
- 4) Wheat- Rice
- 5) Barley
- 6) Wheat + Barley – Maize + Rice
- 7) Rice – Maize.

The cropping pattern is not essentially dependent upon resource availability; it is more so on the food preferences of the local people. Even the irrigated areas are sown during Kharif under maize by some Gaddis since they prefer maize to rice. A maximum of 100 percent families in Lohna village practice wheat – Maize + Rice crop sequence. A minimum number of 5 percent families in Bharmat sow wheat – Maize rotation. The details about the cropping pattern of the area are presented in Table 2.

Table 2: Cropping Pattern (Adoption by % families)

| | W+B-M | W-R+M | W-M | W-R | BER | W+B-MR | R-M |
|--------|-------|-------|------|------|-----|--------|-----|
| Dhoong | 78.12 | 9.37 | 9.37 | 31.2 | - | - | - |
| Kulani | 33.33 | - | - | - | - | 66.67 | - |

| | | | | | | | |
|---------|-------|-----|----|----|----|-------|---|
| Lehnga | 63.64 | - | - | - | - | 36.36 | - |
| Bharmat | - | 65 | 5 | 30 | 45 | - | - |
| Nain | - | 90 | 10 | - | - | - | - |
| Gohar | - | 50 | - | 50 | - | - | - |
| Spadoo | 19 | 45 | - | 18 | - | 9 | 9 |
| Lohna | - | 100 | - | - | - | - | - |

W: Wheat, B: Barley, M: Maize, R: Rice, Ber: Berseem,

Professions

The Gaddis in the study area have adopted many diverse professions. 18 types of professions have been recorded in the area. Out of these sheep rearing, daily wage earning by labour, autorickshaw driving, government job and farming have been adopted as solo professions, rest of the 14 professions are in various combinations (Table 3). The maximum percent families of 54 have adopted farming and daily wage earning as their profession in Spadoo village. 40.62 percent families in Dhoong survive only on daily wage earning. The profession of sheep rearing and establishment of a small-scale industry were only found in village Spadoo. Similarly auto – rickshaw driving adopted by 3.12 percent families was found only in village Dhoong. Families surviving only on pension provided to ex-servicemen of the Indian Army were found only in Gohar and Spadoo.

Table 3: Professions adopted by sedentary Gaddis (% of families)

| Profession | Villages | | | | | | | |
|-----------------------------|----------|--------|--------|---------|------|-------|--------|-------|
| | Dhoong | Kulani | Lehnga | Bharmat | Nain | Gohar | Spadoo | Lohna |
| Sheep rearing | 15.62 | 11.11 | 27.27 | - | - | 20 | - | - |
| Daily wage earning | 40.62 | 33.33 | 18.18 | 5.26 | - | - | - | - |
| Sheep rearing + Daily wage | 3.12 | - | - | - | - | - | - | - |
| Auto Driver | 3.12 | - | - | - | - | - | - | - |
| Sheep rearing + Govt. Job | 9.37 | - | - | - | - | 30 | - | - |
| Govt. Job | 12.5 | 55.55 | 36.36 | - | 10 | 10 | 10 | - |
| Govt. Job + SSI | 3.12 | - | - | 10.52 | - | 10 | 54 | 20 |
| Farming + Daily wage | 3.12 | - | 18.18 | - | 30 | 10 | - | - |
| Sheep rearing + farming | 6.28 | - | - | 21.05 | - | 20 | 18 | - |
| Pension as Ex-ser | - | - | - | 10.52 | - | - | - | - |
| Farming + Business | - | - | - | 36.84 | - | - | 9 | 40 |
| Farming + pension as Ex-ser | - | - | - | 10.55 | - | - | - | - |
| Farming | - | - | - | - | 20 | - | - | 20 |
| Farming + Govt Job | - | - | - | - | 10 | - | - | - |
| Farming + private job- | - | - | - | - | 10 | - | - | - |
| Farming + Army service | - | - | - | - | 20 | - | 9 | - |
| Sheep rearing + SSI | - | - | - | - | - | - | - | 2 |
| Farming + SSI | - | - | - | - | - | - | - | 20 |

SSI: Small Scale Industry; Ex-ser: Ex - Serviceman

Animal Rearing Practices

Animal rearing is an important sole or supplementary profession for the Gaddis of the study area. In four villages i.e.; Dhoong, Kulani, Lehnga and Bharmat 6.26, 22.23, 9.1 and 5.0 % families did not rear any animal. Cows, bulls, goats, Sheep and Buffalo are the only animals reared in the area. Buffalo was found only in four villages listed above. All the families rearing animals had atleast one cow each. The average numbers of livestock owned by a family in the study area are given in Table 4. The highest number of 87.20-animals/ family was found in village Gohar and the number of 1.90 animals/family were found in village Spadoo. Others details about the livestock are given below.

Table 4: Average No. of Livestock/family

| Village | Cows | Bulls | Goats | Sheep | Buffalo | Total |
|---------|------|-------|-------|-------|---------|-------|
| Dhoong | 1.32 | 0.51 | 21.0 | 19.0 | 0.19 | 42.02 |
| Kulani | 1.37 | 1.0 | 12.75 | 1.12 | 0.25 | 16.49 |
| Lehnga | 1.72 | 0.18 | 44.09 | 30.54 | 0.18 | 76.71 |
| Bharmat | 1.70 | 1.0 | - | - | 0.1 | 2.8 |
| Nain | 1.20 | 1.10 | 2.7 | - | - | 5.0 |
| Gohar | 1.0 | 1.20 | - | 85.0 | - | 87.20 |
| Spadoo | 1.0 | 0.90 | - | - | - | 1.90 |
| Lohna | 1.25 | 1.0 | - | - | - | 2.25 |

Herd Structure

The herd structure found in the area is very diverse. As many as ten types of herds were enumerated in the area, these are: 1) only cow 2) Cow + Bull + Goat 3) Cow + Bull + Sheep 4) Cow + Sheep + Goat 5) Cow + Goat 6) Cow + Bull + Sheep + Goat 7) Cow + Sheep 8) Cow + Bull 9) Cow + Bull + Buffalo 10) Cow + Bull + Buffalo + Sheep + Goat. The percentage presence of various animals in different herds varies from village to village. The significant feature is that all the herds have cow as a common component. The maximum percentage of cows (56.25 %) was found in herds of Bharmat. The percentage composition of various types of herds is presented in Table 5. The details about percent families owning different types of herds are presented in Table 6. Maximum number of diverse herds was found in Dhoong where Gaddis had 9 types of herds. In Lohna 100% families reared only cows and Bulls.

Feeding Pattern

The feeding of animals is clearly demarcated in three stages in the study area. These stages coincide with the availability of green /dry forage and tree leaves. These three stages are:

Dec – April: Tree leaf fodder (green) + hay/crop residues @ 10-12 kg/animal/day

May – June: Wheat straw + green grass/ only wheat straw/wheat straw + Tree leaf Fodder @ 10 kg/animal/day.

July- Nov: Green grass/Freshly conserved hay @ 20-25 kg/animal/day.

The feeding regime described above is in supplementation to the grazing which is most common in the area. At the onset of monsoon (late June) the grasslands, both private and community, are closed to grazing. During monsoon green grass is stall fed to the livestock. This continues till October when the grasslands are harvested and the herbage is conserved as hay. After the harvest, grasslands are opened for indiscriminate grazing which continues till the coming monsoon (late June).

Hundred percent families' face fodder shortage in the area. Hay and crop residues are insufficient and the shortages are made up by purchasing wheat straw which is transported from Panjab to these villages.

The tree leaf use is very common and the farmers in the area have devised fodder tree use calendars. This, perhaps is a traditional management tool or a system to avoid the tree leaf use when the anti-quality factors are active in these. A typical fodder tree use calendar of the area is

April – June: *Albizia lebbeck*, *Artocarpus chaplasha*, *Ficus auriculata*, *F. racemosa*,
Leucaena leucocephala, *Morus alba*.

July – October: Grazing

Nov – March: *Bauhinia variegata*, *Dendrocalamus hamiltonii*, *Grewia optiva*, *Terminalia alata*.

Table 5: Herd Structure (%)

| Herd | Villages | | | | | | | |
|----------|-------------|--------|--------|---------------------------|------|-------------|--------|-------|
| | Dhoong | Kulani | Lehnga | Bharmat | Nain | Gohar | Spadoo | Lohna |
| C+ B + G | - | - | - | 9.09- 13.63 - 77.28 | - | - | - | - |
| C+ B + S | 0.4 - 0.6 - | - | - | - | - | 0.4 - 0.9 - | - | - |

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LANDUSE PATTERN AND POPULATION PRESSURE IN UTTARANCHAL

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INTRODUCTION

The Uttar Pradesh Hills popularly known as *Uttaranchal* or *Uttarakhand* is located between latitudes 29°5' - 31°25'N and longitudes 77°45' - 81°E covering a geographical area of 53,485km². The Tons river separates the region from Himachal Pradesh in the north-west, while Kali separates it from Nepal in the east. Starting from the foot hills in the south the region extends upto the snow-clad peaks of the *Himadri*, marking the Indo-Tibetan boundary. The region being situated centrally in the long sweep of the Himalaya, forms a transitional zone between the per-humid eastern and the dry to sub-humid western Himalaya. The region comprises of two administrative units viz., Garhwal (north-west portion) and Kumaon (south-east portion). A separate state '*Uttaranchal*' comprising the 12 districts of these two administrative regions and Haridwar district from Uttar Pradesh was created on 9th November 2000.

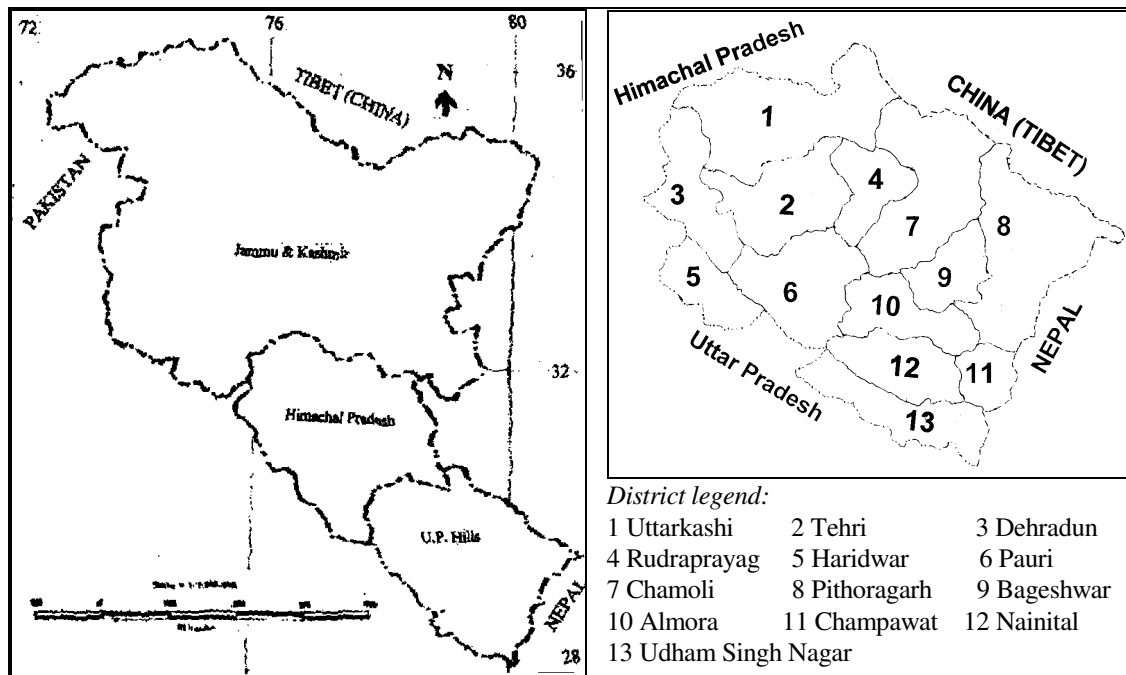


Figure 1. Uttar Pradesh Hills' location in North-West Himalaya, India and today's statehood 'Uttaranchal'

The Uttaranchal region used to play an important role in the economy of Uttar Pradesh in terms of providing off-season vegetables, temperate fruits, forest products and several other resources including manpower resources. Its natural water resources such as natural springs, waterfalls and perennial streams are used for generating hydro-electric power, for providing irrigation and drinking water. In terms of mineral resources, this region provides some amount of lime, magnesite, gypsum, sand stone, rock phosphate, asbestos, graphite, copper and lead. Many pilgrimage places viz., Kedarnath, Badrinath, Gangotri and Yamunotri and immense potential for adventure tourism makes this region a great potential area for tourism based industry. The population of the region is growing at the rates near to national average during the last two decades. But the land which is needed to support this growing population is not available or the pace of technology and infrastructure development are not able to create opportunities to increase production of resources needed. While the region in totality represents the underdeveloped regions of the country, within

the region the districts near to international borders are least developed interms of modern amenities and educational levels. In the present paper an attempt was made to assess the land use changes over two decades (1974-1994) using district wise revenue records and its relation to population growth. This includes only unsegregated data for Nainital, Pithoragarh, Almora & Chamoli, and exclude Haridwar district, and thus has limitations.

METHODOLOGIES

The data of five major categories of land use has been analyzed from agriculture census. The objective is to measure the changes in last two decades and focus on trend of changes of individual districts as well as Uttaranchal as a whole. All the districts are ranked according to the ascending order of exponential trend, and are presented in table 2-6 for different landuse pattern. Taking the general trend of statehood Uttaranchal as population mean, the deviation of individual districts for the respective parameters has been calculated. The qualitative marking (low, medium, and high) in figure 2-6 is based on the attributes of quantitative deviation from the population mean of the state as a whole. The ‘medium’ marked districts imprecisely follow the general trend of the state, while ‘low’ and ‘high’ marked districts extremely deviate the general trend. Here, 95% confidence level (CL) has been taken to mark the intermediate districts, whereas low and high deviated districts are marked below LCL and above UCL respectively.

Three different measures *viz.* population density, physiological density and agricultural density has been used to calculate the population pressure of Uttaranchal’s districts. The percentage changes over decades in these indices could reveal the pressure on agricultural land and economic disparities among the districts. Districts are arranged according to the descending order of population size (Table 7), the total geographical area is used to calculate the population density, whereas the agricultural land of the respective districts is used to calculate the physiological as well as agricultural density.

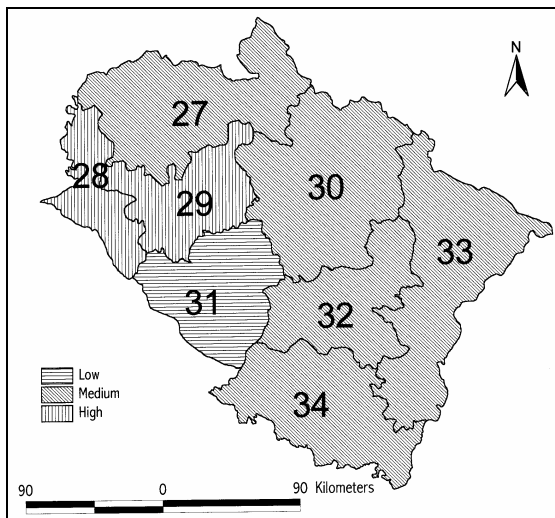


Figure 2. Changing pattern of forest cover

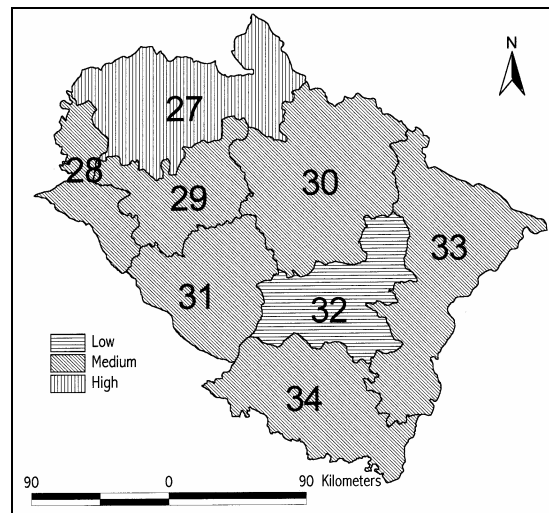


Figure 3. Changing pattern of area not available for cultivation

LANDUSE CHANGE ANALYSES

Of the 53,69,292 ha of reporting area of the Uttaranchal (this excludes Haridwar district), forest occupy 63.98% of land. This is almost the prescribed limits of landuse as per our national landuse policy. The net sown area which meets the food grain production demands of the population contributes only 12.42% of the reporting area. Uttarkashi recorded maximum forest area (726,290 ha). All the districts of Uttaranchal have more than 50% of forest land in their respective reporting area. Nainital is the only district which shows a significant amount of net sown area (204,317 ha) mainly concentrated in *tarai* region of the district.

Table 1. District-wise land utilization pattern of Uttaranchal (1993-94)

| Code-District | Total Reporting area (ha) | Percentage distribution of reporting area in major landuse category | | | | | | | | |
|-----------------------------|---------------------------|---------------------------------------------------------------------|----------------------|-----------------------|----------------------------|---------------------------|----------------------|----------------------|---------------------------|-----------------------|
| | | Forests | Non-agricultural use | Barren & unculturable | Permanent pastures grazing | Misc. tree crops & groves | Cultural waste land | Current fallow | Other than current fallow | Net sown area |
| 27 Uttarkashi | 817631 (15.23) | 88.83 (21.14) | 0.85 (5.08) | 2.47 (6.81) | 1.71 (6.12) | 0.94 (3.52) | 1.12 (2.89) | 0.01 (0.52) | 0.48 (6.06) | 3.61 (4.43) |
| 28 Dehradun | 307377 (5.72) | 68.87 (6.16) | 5.57 (12.56) | 0.54 (0.56) | 0.03 (0.04) | 1.40 (1.98) | 3.93 (3.82) | 0.92 (33.99) | 1.55 (7.42) | 17.20 (7.93) |
| 29 Tehri | 574544 (10.70) | 69.13 (11.56) | 1.88 (7.94) | 2.09 (4.05) | 0.49 (1.23) | Neg. (0.01) | 12.46 (22.68) | 0.01 (0.66) | 1.44 (12.86) | 12.50 (10.77) |
| 30 Chamoli ^a | 841382 (15.67) | 61.93 (15.17) | 2.15 (13.27) | 19.60 (55.59) | 2.59 (9.56) | 4.20 (16.24) | 3.96 (10.56) | 0.01 (1.10) | 0.19 (2.51) | 5.37 (6.77) |
| 31 Pauri | 759650 (14.15) | 59.40 (13.14) | 2.30 (12.81) | 4.50 (11.52) | 5.69 (18.93) | 8.09 (28.23) | 5.83 (14.04) | 0.02 (1.75) | 2.34 (27.76) | 11.82 (13.47) |
| 32 Almora ^b | 728701 (13.57) | 54.06 (11.47) | 2.39 (12.80) | 4.42 (10.85) | 8.33 (26.59) | 6.38 (21.35) | 8.26 (19.06) | 0.09 (7.83) | 1.03 (11.72) | 15.00 (16.39) |
| 33 Pithoragarh ^c | 637200 (11.87) | 51.84 (9.62) | 2.46 (11.52) | 4.22 (9.06) | 13.26 (37.02) | 7.18 (21.01) | 8.77 (17.70) | 0.18 (14.08) | 2.05 (20.33) | 10.03 (9.59) |
| 34 Nainital ^d | 702807 (13.09) | 57.41 (11.75) | 4.66 (24.01) | 0.66 (1.55) | 0.17 (0.51) | 2.38 (7.67) | 4.15 (9.24) | 0.47 (40.07) | 1.04 (11.35) | 29.07 (30.65) |
| Uttaranchal* | 5369292 (100) | 63.98 (100) | 2.54 (100) | 5.52 (100) | 4.25 (100) | 4.06 (100) | 5.88 (100) | 0.15 (100) | 1.19 (100) | 12.42 (100) |

*Excludes Haridwar; ^{a,b,c, & d} include Rudraprayag, Bageshwar, Champawat, and Udham Singh Nagar respectively; figures within () indicate the percentage contribution of individual district to the respective landuse pattern of the Uttaranchal.

Table 2. Changes in forest cover

| Code-District | Five-year average | | | | % change 1974-94 | Exponential trend |
|--------------------|-------------------|----------------|----------------|----------------|---------------------|-------------------|
| | 1974-79 | 1979-84 | 1984-89 | 1989-94 | | |
| 31 Pauri | 470107 | 455528 | 453119 | 450393 | -5.99 | 0.9973 |
| 30 Chamoli | 540301 | 526936 | 524265 | 523397 | -7.33 | 0.9977 |
| 32 Almora | 402299 | 394449 | 392610 | 392513 | -2.41 | 0.9984 |
| 33 Pithoragarh | 331814 | 330288 | 330335 | 330283 | -1.94 | 0.9997 |
| 27 Uttarkashi | 710458 | 710278 | 710270 | 713480 | 2.25 | 1.0003 |
| 34 Nainital | 400593 | 402208 | 404635 | 404703 | 0.90 | 1.0007 |
| 29 Tehri | 356547 | 397250 | 397249 | 397201 | 11.39 | 1.0061 |
| 28 Dehradun | 191322 | 222568 | 219519 | 218068 | 23.79 | 1.0086 |
| Uttaranchal | 3403441 | 3439505 | 3432000 | 3430038 | 0.43 | 1.0004 |

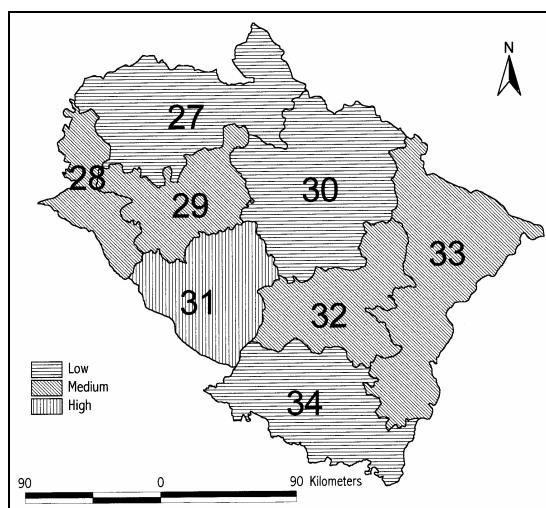
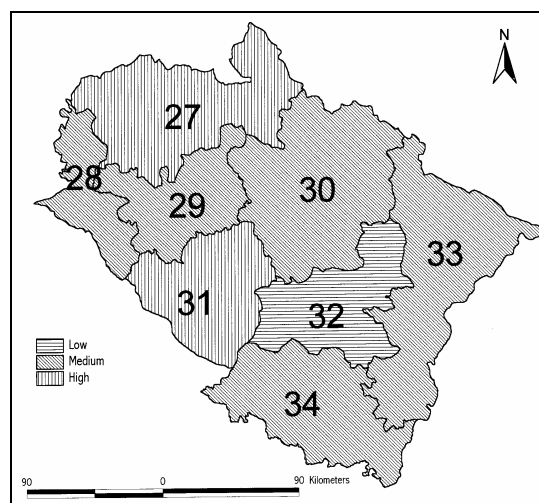
The exponential trend of Uttaranchal (>1) shows an increasing inclination of forest cover, however four districts viz., Pauri, Chamoli, Almora, and Pithoragarh show a marginal decrease in forest cover. The Pauri Garhwal is the worst affected district, whereas Dehradun, though sole urbanized district (>50% population belongs to urban settlements) shows the best use of forest cover in the last two decades.

Table 3. Changes in the area not available for cultivation*

| Code-District | Five-year average | | | | % change 1974-94 | Exponential trend |
|--------------------|-------------------|---------------|---------------|---------------|---------------------|-------------------|
| | 1974-79 | 1979-84 | 1984-89 | 1989-94 | | |
| 32 Almora | 62056 | 51153 | 46624 | 49207 | -23.39 | 0.9850 |
| 34 Nainital | 36075 | 36425 | 36186 | 37070 | 9.08 | 1.0020 |
| 29 Tehri | 22516 | 16033 | 18298 | 23029 | -5.38 | 1.0032 |
| 28 Dehradun | 17378 | 17935 | 18095 | 18713 | 6.57 | 1.0044 |
| 33 Pithoragarh | 35304 | 41471 | 39433 | 41080 | 26.12 | 1.0088 |
| 30 Chamoli | 136787 | 195914 | 197104 | 182103 | 49.97 | 1.0191 |
| 31 Pauri | 31795 | 39089 | 45694 | 51697 | 72.31 | 1.0321 |
| 27 Uttarkashi | 9050 | 10205 | 22013 | 26694 | 209.70 | 1.0791 |
| Uttaranchal | 350960 | 408225 | 423447 | 429593 | 29.12 | 1.0131 |

*Includes area under non-agricultural uses, barren and unculturable land

The land under area not available for cultivation is increasing in almost all the districts, except Almora, which is the best example of converting a significant amount of area not available for cultivation to cultivable land in the region. The Uttarkashi district situated in the high mountainous region shows that the land not available for cultivation is increasing very fast.

**Figure 4. Changing pattern of other uncultivated area****Figure 5. Changing pattern in fallow area****Table 4. Changes in the other uncultivated land* excluding fellow land**

| Code-District | Five-year average | | | | % change 1974-94 | Exponential trend |
|--------------------|-------------------|---------------|---------------|---------------|---------------------|-------------------|
| | 1974-79 | 1979-84 | 1984-89 | 1989-94 | | |
| 27 Uttarkashi | 42951 | 47113 | 34052 | 30263 | -26.60 | 0.9750 |
| 30 Chamoli | 126827 | 88770 | 137376 | 90082 | -33.61 | 0.9885 |
| 34 Nainital | 48406 | 47422 | 41484 | 46933 | -7.12 | 0.9931 |
| 28 Dehradun | 17250 | 16284 | 16036 | 16377 | -9.82 | 0.9963 |
| 29 Tehri | 73233 | 80023 | 80803 | 75016 | 4.00 | 1.0019 |
| 32 Almora | 153406 | 159531 | 168675 | 165947 | 10.20 | 1.0058 |
| 33 Pithoragarh | 147123 | 165957 | 186570 | 179571 | 30.70 | 1.0144 |
| 31 Pauri | 82213 | 113319 | 129805 | 149149 | 100.17 | 1.0391 |
| Uttaranchal | 691409 | 718419 | 794802 | 753340 | 10.80 | 1.0070 |

*Includes permanent pastures & other grazing lands, land under miscellaneous tree, crops & groves not included in net sown area and culturable wasteland

The utilization pattern of other uncultivated land shows the major dispersion among the districts.

The districts of Uttarkashi, Chamoli, Nainital and Dehradun show a decreasing trend whereas Pauri, Pithoragarh, Almora and Tehri show an increasing trend of using other uncultivated land including pastures and culturable wasteland. Pauri Garhwal district shows a steady increase of uncultivated land.

Table 5. Changes in fallow land*

| Code-District | Five-year average | | | | % change 1974-94 | Exponential trend |
|--------------------|-------------------|--------------|--------------|--------------|---------------------|-------------------|
| | 1974-79 | 1979-84 | 1984-89 | 1989-94 | | |
| 30 Chamoli | 2614 | 1742 | 1726 | 1696 | -39.83 | 0.9753 |
| 32 Almora | 10207 | 7484 | 6606 | 8333 | -24.99 | 0.9858 |
| 34 Nainital | 8851 | 8980 | 9464 | 10496 | 0.28 | 1.0107 |
| 33 Pithoragarh | 10520 | 10276 | 10331 | 13704 | 34.25 | 1.0153 |
| 28 Dehradun | 5306 | 6230 | 6480 | 7147 | 44.03 | 1.0181 |
| 29 Tehri | 4655 | 5636 | 5986 | 8373 | 88.28 | 1.0358 |
| 27 Uttarkashi | 1901 | 2472 | 2769 | 3865 | 123.44 | 1.0446 |
| 31 Pauri | 8817 | 10218 | 13103 | 17973 | 112.05 | 1.0468 |
| Uttaranchal | 52872 | 53038 | 56465 | 71586 | 32.27 | 1.0184 |

*Includes current fallow and fallow lands other than current fallow

Except Chamoli and Almora the fallow land of all the districts of Uttaranchal has been increasing steadily, though it has a very little impact on overall landuse pattern of the region as the fallow lands occupies a very small portion (<2%) of total reporting area. The fallow land of Chamoli district has decreased steadily, whereas in Pauri Garhwal it increased significantly.

Table 6. Changes in net sown area

| Code-District | Five-year average | | | | % change 1974-94 | Exponential trend |
|--------------------|-------------------|---------------|---------------|---------------|---------------------|-------------------|
| | 1974-79 | 1979-84 | 1984-89 | 1989-94 | | |
| 31 Pauri | 102914 | 101079 | 98511 | 89568 | -14.44 | 0.9913 |
| 27 Uttarkashi | 33512 | 30495 | 33081 | 30519 | -23.98 | 0.9952 |
| 29 Tehri | 74568 | 73182 | 70898 | 70925 | -5.57 | 0.9967 |
| 28 Dehradun | 56067 | 57006 | 55718 | 53461 | -2.01 | 0.9972 |
| 33 Pithoragarh | 72251 | 72700 | 72882 | 72494 | -7.09 | 0.9979 |
| 32 Almora | 111598 | 117367 | 105605 | 111184 | 2.05 | 0.9982 |
| 34 Nainital | 201417 | 205979 | 203091 | 204383 | 4.44 | 1.0005 |
| 30 Chamoli | 43195 | 46264 | 43463 | 46463 | -3.51 | 1.0021 |
| Uttaranchal | 695523 | 704072 | 683249 | 678997 | -3.67 | 0.9978 |

The very small portion of net sown area of this hilly state is reducing further, as most of the districts show a declining trend of the area. The increasing trend of all other major landuse categories of the state are mainly contributing towards the decline of net sown area as a whole. Pauri Garhwal is the worst affected district, as the area is decreasing steadily. On the other hand the largest district Chamoli is showing a marginal change in net sown area over past two decades.

POPULATION PRESSURE ON LAND RESOURCES

The population of Uttaranchal has increased 22.55% in 1991 over 1981 census, whereas cultivators has increased 12.22% during the decade. As a result the percentage contribution of cultivars to the total population in the region has decreased significantly. The disproportionate increase in cultivars has a negative impact on agricultural density. The percentage changes in population, physiological and agricultural density in 1991 over 1981 census are shown in figures 7-9 respectively.

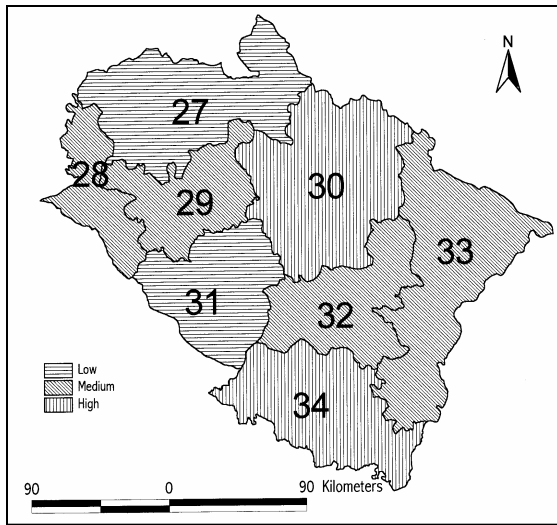


Figure 6. Changing pattern of net sown area

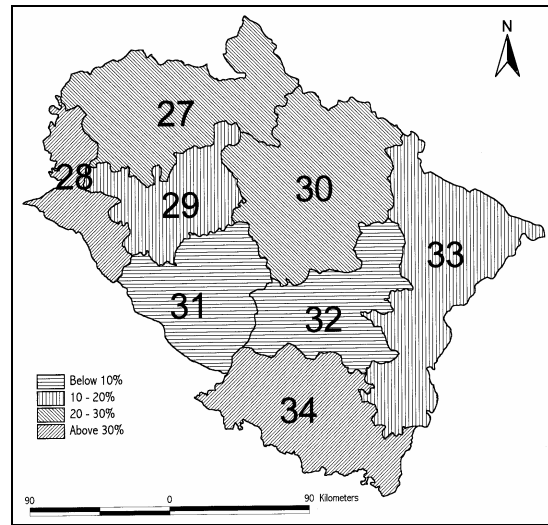


Figure 7. Change in population density

Table 7. Changing population density, physiological density and agricultural density of Uttarakhand

| Code-District | Population | | % cultivators | | Population density | | Physiological density | | Agricultural density | |
|--------------------|--------------------------|--------------|--------------------------|-----------|------------------------|------------|------------------------|------------|------------------------|--|
| | 1991 | 1981 | 1991 | 1981 | 1991 | 1981 | 1991 | 1981 | 1991 | |
| 34 Nainital | 1540174 (25.99) | 14.16 | 13.31 [-5.97] | 167 | 227 [35.93] | 515 | 693 [34.56] | 73 | 93 [27.40] | |
| 28 Dehradun | 1025679 (17.31) | 9.10 | 7.27 [-20.06] | 247 | 332 [34.41] | 1253 | 1884 [50.36] | 114 | 123 [7.89] | |
| 32 Almora | 836617 (14.12) | 23.08 | 30.76 [33.28] | 141 | 155 [9.93] | 494 | 546 [10.53] | 114 | 168 [47.37] | |
| 31 Pauri | 682535 (11.52) | 26.25 | 19.92 [-24.14] | 116 | 125 [7.76] | 421 | 448 [6.41] | 111 | 91 [-18.02] | |
| 29 Tehri | 580153 (9.79) | 38.03 | 30.85 [-18.88] | 113 | 131 [15.93] | 653 | 804 [23.12] | 248 | 235 [-5.24] | |
| 33 Pithoragarh | 566408 (9.56) | 29.94 | 30.15 [0.69] | 55 | 64 [16.36] | 469 | 500 [6.61] | 140 | 164 [17.14] | |
| 30 Chamoli | 454871 (7.68) | 35.31 | 30.92 [-12.43] | 41 | 50 [21.95] | 422 | 557 [31.99] | 149 | 159 [6.71] | |
| 27 Uttarkashi | 239709 (4.04) | 41.03 | 37.20 [-9.32] | 24 | 30 [25] | 521 | 652 [25.14] | 214 | 244 [14.02] | |
| Uttarakhand | 5926146 (100) | 23.08 | 21.14 [-8.43] | 95 | 116 [22.11] | 543 | 669 [23.20] | 125 | 141 [12.80] | |

Figures within () indicate the percentage contribution of population by individual district to the total population of Uttarakhand; and figures within [] indicate the percentage change of respective parameters in 1991 over 1981 census.

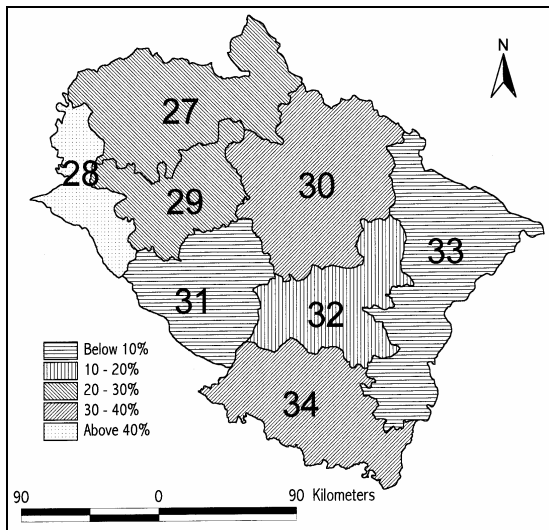


Figure 8. Change in physiological density

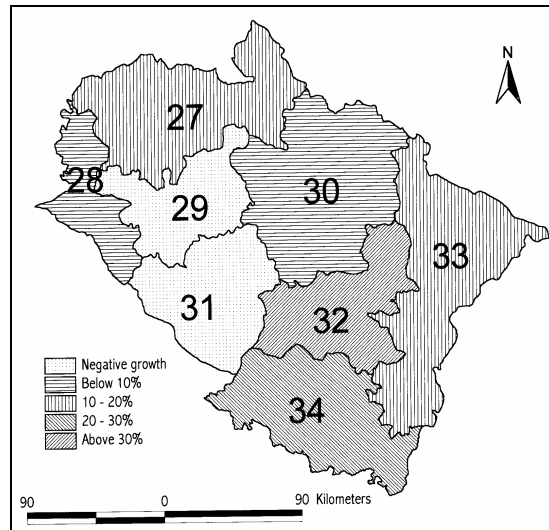


Figure 9. Change in agricultural density

CONCLUSION

As the increase in population density has aggravated the physiological density, which is the more meaningful population measure as more than 80% of the workforce in the region is dependent on primary sector (with few exception, like Dehradun). As physiological density measure the people supported by unit area of agricultural land, so difference in this density also represent the differences of population pressure on crops production in unit area. The higher physiological density (>600) of Dehradun, Tehri, Nainital, and Uttarkashi indicates the higher population pressure on the limited resources. Nainital is the only district where the physiological as well as agricultural density has increased significantly indicate the higher pressure on agricultural land together with dependency on other sectors. Almora and Pithoragarh of Kumaun and Pauri Garhwal represent a moderate physiological density (400-600) and low (<200) agricultural density. The highest physiological density of Dehradun and a very low agricultural density indicates most of the people are dependent on other than agricultural sector. The higher difference between physiological density and agricultural density indicates most of the land area is unsuitable for extensive agriculture, besides differences in agricultural density account for economic disparities in the region.

SMALLHOLDER DAIRY IN UTTARANCHAL MOUNTAINS: PERFORMANCE INDICATORS

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INTRODUCTION

Dairy farming is an integral part of mountain agriculture. Smallholders comprising majority of mountain farmers are accustomed to rear some animals as an essential component of the farming system. Among the various basic needs the animals fulfill, milk is the most important for a family. Dairy animals are the best means to convert local vegetative biomass into useful products and work, and the high value biodiversity into the products of still higher value, such as dairy products fondly consumed by masses. That is why the dairy animals have been occupying predominant place in the herd in mountain region.

A dairy farm, to be economically successful, must look into some of the basic indicators. These indicators further guide a dairy farmer to take remedial steps towards improving the situation of her/ his dairy unit. This paper attempts to highlight performance indicators relating to the smallholder dairy farms dominating the mountain areas.

Ages at first calving, lactation length, lactation yield, calving interval, service period, etc. are the important traits associated with dairy animals that are vital for the economic sustainability of a dairy farm. Reduction in the age at first calving and dry period leads to an increase in lactation yield and productive life of the dairy animals and economy of a dairy farm.

MATERIALS AND METHODS

This study was conducted in the two districts of Almora and Nainital in Kumaon area of Uttaranchal. In each district, two Community Development Blocks (CDBs) and in each CDB three villages, i.e. in total 12 villages were selected purposely for the study. The village selection criteria were based on location and organisation. Three locations varied according to altitude from mean sea level. One of the selected villages in each CDB was in the valley (lowland) area and, in terms of cropping practices, it was largely a transformed village. The other village was in Mid-altitude upland (sloping agriculture) area witnessing traditional agricultural practices on larger scale. The other was on high altitude upland area, representing dominant traditional area with strong linkages with forest ecosystems. One of the three villages selected, irrespective of its location or agricultural system, represented a milk society or Village Dairy Cooperative (VDC). Four villages, out of 12, were purposely selected near urban area. These selection criteria were in tune with the various variables operating in a mountain farming system that would influence the performance of a smallholder dairy farm.

Selection of smallholder dairy farms was based on the criteria used earlier in the specific context of the region under study by Singh (1998). Twenty percent of the selected smallholder dairy farms were surveyed to collect intended information.

RESULTS AND DISCUSSION

Information on the performance indicators presented in Table 1 shows that figures for cows are not much satisfactory; for buffaloes, they are reasonably good. Poor performance of cows is a reflection of undernutrition, particularly during lean period. Buffaloes are better fed, for they are especially reared for milk sale. Long dry periods for cows are also a reflection of short lactation period (eight months).

Table 1: Some Performance Indicators relating to the Dairy Animals in UP Hills

| Indicators | Dairy Animal | |
|------------|-----------------------|---------|
| | Cow | Buffalo |
| 28 | Himalayan Ecology and | |

| | | |
|----------------------------------------------------------|---------------|--------------------|
| Age at first calving, years ¹ | 4 (3.6-4.5) | 5 (4.5-5.5) |
| Calving Rate, % per year ² | 57 (55-60) | 63 (58-68) |
| Calving Interval, months ³ | 16 (15-17) | 15 (14-16) |
| Number of calvings in life time ⁴ | 6.5 (5-8) | 9 (7-11) |
| Lactation Length, months ⁵ | 8 (7-9) | 11 (10-12) |
| Lactation Yield, litres ⁶ | 552 (483-621) | 1224.5 (1113-1336) |
| Average milk yield, litres per head per day ⁷ | | |
| Valley | 2.30 | 3.50 |
| Mid-altitude Upland | 2.10 | 3.00 |
| High Altitude Upland | 2.00 | 2.50 |
| Near Market Area | 2.50 | 4.00 |
| VDC | 2.60 | 5.55 |
| Average | 2.30 | 3.71 |
| Dry Period, months ⁸ | 8 | 4 |
| Service Period, months ⁹ | 7 | 5 |
| Adult body weight, kg ¹⁰ | 209 | 398 |
| Mortality, percent ¹¹ | | |
| In calves | | |
| Male | 12 | 92 |
| Female | 16 | 12 |
| In adults | 8 | 4 |

Figures in parentheses reflect range.

¹ Age at first calving is the age of the mature dairy animal when it calves for the first time.

² Calving Rate = (Number of calves born per year / Number of adult females in the population) x 100.

³ Calving Interval is the time between two successive calvings; Calving Interval = (1/ Calving Rate) x 12.

⁴ Number of calvings in lifetime = (Productive life / Calving Interval) x 12.

⁵ Lactation Length = (Calving interval x percentage of animals in milk) / 100;

Percentage of animals in milk = (Average No. of animals in milk / Total No. of milch animals) x 100.

⁶ Lactation Yield, litres = (Milk produced by dairy animals/ No. of dairy animals) x (Calving Interval/ 12).

⁷ Average milk yield per head per day = Total milk produced by all animals in milk/ Total animals in milk.

⁸ Dry Period = (Dry Period, months) – (Lactation Length, months).

⁹ Service Period is the time between calving and becoming pregnant again;

Service Period, months = (Calving Interval) – (Gestation Period);

Gestation periods for cows and buffaloes are 9 and 10 months, respectively.

¹⁰ Weight of animal is calculated from body measurements of 16 adult cows and 10 buffaloes by the following formula (Anonymous 1982; Singh 1998):

Body Weight, kg = (L X G²) / 10317;

Where, L = Length from point of shoulder to pin bone in cm; and

G = Circumference of animal immediately behind the front legs in cm.

¹¹ Mortality, %: For calves = (No. of calves died during the year/ No. of calves born during the year) x 100;

For adults = (No. of adults died during the year / No. of adults in the population) x 100.

Shortage of bulls is another important cause of long dry periods in cows in the area. Most of the villages in Uttarakhand Hills do not have a bull. Some time two or even more villages would share a single bull. Many heat periods are undoubtedly lost because the cows cannot be taken to a bull, at least in time. Artificial Insemination (AI) Centres are few and most of the dairy farmers have no access to them. The experiences of the dairy farmers with AI Centres, on the whole, are bad. Our respondents, who have easy access to the AI Centres, would complain of the poor conception rate of the AI.

The situation with respect to breeding buffalo bulls is much better without any institutional programme of any sort. Most of the villages will have at least one buffalo breeding bull. One reason of it is that

services by a buffalo bull fetch handsome returns to the family owning bull. Per service charges (on the confirmation of conception) are Rs 150. Services of a cow bull were free of cost till recently and it was customarily treated as a social service. The cow bull owners, nevertheless, have now begun to charge against rendering bull services (Rs 100 per service after the confirmation, and occasionally more).

Mortality rate in case of buffalo male calves are incredibly high (92 percent). In fact, this is a deliberate attempt of the farmers. Male buffalo calves have no value (e.g., as draught or meat animal) in the farming system in Uttaranchal Hills. They are, therefore, starved to death few days after their birth. Buffalo, unlike a cow, thus, is maintained purely for milk production purpose.

Whereas most of the performance indicators are the same for all locations, dairy animals in VDCs would show some better performance. Average milk yield of dairy animals is the highest in VDCs, followed by the animals in the villages located near market areas. It is mainly due to better feeding and care of dairy animals at the farms having close linkages with the market.

ACKNOWLEDGEMENTS

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TRADITIONAL WISDOM IN RANGE MANAGEMENT FOR RESOURCE AND ENVIRONMENT CONSERVATION IN NORTH EASTERN REGION OF INDIA

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INTRODUCTION

The North Eastern Hills Region, comprising the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura has a geographical area of 255,090 km². The region is endowed with rich natural resources but their indiscriminate exploitation has resulted in environmental and resource degradation due to prevalence of shifting cultivation, there has been wide scale deforestation in the region. Coupled with faulty agricultural practices, the need for fuel, forage and timber has further affected the forest cover and resulted in continuous deflation of this valuable resource. The fragile ecosystem of the region is under continuous stress from different angles and there is possibility of its being crumbled down if the corrective measures, based on traditional wisdom and the new technologies in the field, are not taken immediately. Also, care has to be taken to introduce sound technologies and offer workable solutions to stop the menace of deforestation, lest it can cause more harm than good. Gourou (1953) rightly pointed out, *"The disasters brought on by agricultural methods which have taken no account of the treasures of wisdom and experience accumulated in the old tropical system are a sufficient proof of latter's value, it can be improved only if the reasons for its processes are fully understood"*. Unabated exploitation of forests in the region has caused ecological imbalance. Sharma (1993) indicated high agricultural potential of the region provided suitable, eco-friendly and socially acceptable land use systems are followed. Farmers practicing shifting cultivation, though not averse to newer technologies, do not adopt them due to socio-economic reasons. However, amidst faulty agricultural practices, there exist some indigenous land use systems, developed by the tribal farmers due to their ingenuity and skill; which are eco-friendly, do not involve deforestation and take care of resources and soil health, such farming systems need to be popularized in the region under iso-agro-climatic conditions.

SHIFTING CULTIVATION: EXTENT AND IMPACT

Large quantity of forest vegetation is burnt in the shifting cultivation (Nair and Fenandes, 1985) mentioned that the forests are in danger of disappearing if nothing was done to arrest its degradation and destruction, these would vanish in a short period. With burning of forest vegetation, there is loss of wild life, flora and fauna, wild plants of diverse gene pool and rare orchids (Watters, 1960). About 300 plant species out of the native flora of NE region of India are used for edible purposes. Of these, 25 provide tubers/ rhizomes etc., which are eaten raw or boiled, over 50 are consumed as green with their leaves and tender shoots cooked as vegetables, over 10 provide flowers/inflorescence to be used as vegetables, about 150 are used as ripe fruits or raw for pickles/vegetables etc., and about 15 have edible seeds that are eaten raw or roasted.

Shifting cultivation is practiced in about 386.9 thousand ha annually and on an average 50 to 80 tones of dry matter is burnt per ha, depending on the shifting cycle. About 1.868, 21.511 and 2.228 million tones of leaves, food and litter containing 137.35, 7.46, 95.95 and 97.50 thousand tones of N P K and calcium, respectively, are burnt every year causing enormous loss of vegetation. Besides, creating, atmospheric pollution, it causes ecological and soil degradation in the region.

The shifting cultivation practice prevalent in the region causes tremendous loss of soil and nutrients (Shahlace et al, 1991) whereas, these losses can be minimized to almost negligible level by managing the watersheds (Blackburn et al, 1986, 1990; Singh and Singh 1981, Satapathi, 1996). Table 1 shows the tremendous losses of soil and nutrients due to shifting cultivation. Annual soil loss has been estimated to be 88346 thousand tones and combined loss of N, P and K 17.092 thousand tones. The area

under shifting cultivation varies from 2.6% in Assam to 96.0% in the Mizoram state of the net sown area (Sharma and Prasad, 1994).

Table 1: Soil and available nutrients (N, P and K) loss due to shifting cultivation.

| State | Area under shifting cultivation ('000 km ²) | % of net sown area | Loss ('000 tonnes per year) | |
|-------------------|---------------------------------------------------------|--------------------|-----------------------------|--------|
| | | | Soil | N+P+K |
| Arunachal Pradesh | 70.0 | 4.7 | 14490 | 3.111 |
| Assam | 69.6 | 2.6 | 12318 | 1.685 |
| Manipur | 90.0 | 64.2 | 20430 | 4.289 |
| Meghalaya | 53.0 | 27.0 | 14151 | 2.999 |
| Mizoram | 63.0 | 46.0 | 13041 | 2.738 |
| Nagaland | 19.0 | 34.5 | 7962 | 1.432 |
| Tripura | 22.3 | 8.2 | 5954 | 0.839 |
| Total | 386.9 | - | 88346 | 17.092 |

Forest production on acid soils that are poor in basic *Catino*s is limited by mineral deficiencies. The sustained production of forest eco-system is closely linked to their nutrient cycle particularly in the tropical regions where greater percentage of nutrients is contained in the biomass. The burning of forest residues during land clearing leads to considerable nutrient loss from the eco-system (Toky and Ramkrishna, 1981). Strained forest productivity in acid soils requires the use of techniques which reduce nutrient export, increase nutrient accumulation in the biomass, increase efficiency of nutrient absorption and utilization and conserve water in the system.

The hilly areas of North Eastern states are becoming increasingly deforested and denuded due to over-exploitation and shifting cultivation. Biotic and abiotic interferences have caused considerable degradation to natural resources such as soil, water and forest to the extent that flow of rivers becomes destructive during flooding and insufficient during dry seasons. Soil conservation measure and afforestation play a definite role in reducing runoff and control of damage caused by excessive runoff. Vegetation has a great effect on soil loss due to runoff. Due to continuous deforestation in NE region, the rainfall in the region is showing a declining trend during the last 10 years (Figure 1).

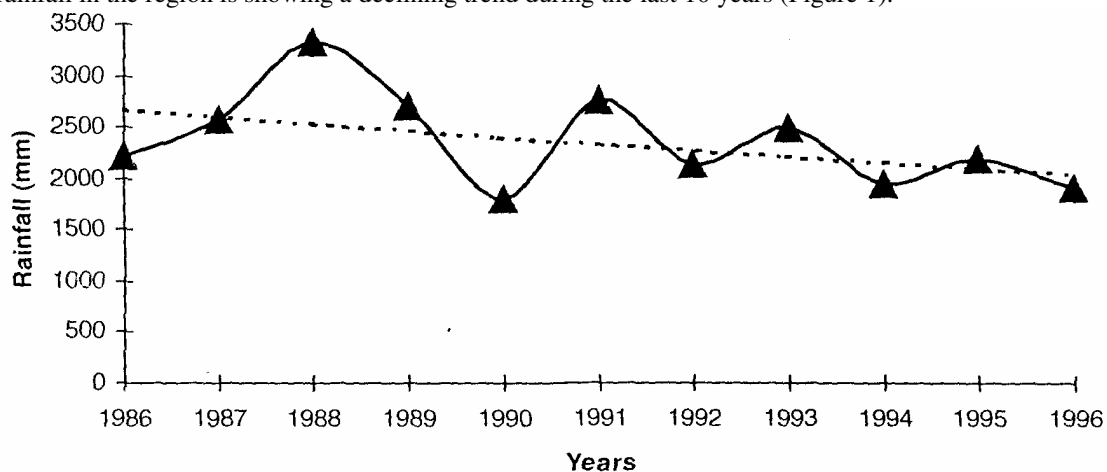


Figure 1: Declining trend in rainfall in North Eastern region

DEPLETION OF FOREST RESOURCES

Total forest area of North-Eastern Region is 167.4 thousand km², out of which 91.2 thousand km² (54.4%) area is dense forest cover and 76.2 thousand ha (45.6%) are open forests (Table 2). Arunachal Pradesh leads in forest cover with 68.6 thousand ha or 82.0% of its total geographical area.

Assam has 24.0 thousand ha under forests but it is only 30.6% of its geographical area. As a whole, the region has 63.9% of its geographical area under the forest, which is well over the guidelines of the Government that in hills 60% area should be under forest.

Table 2: Forest area in different states of the region ('000 km²).

| State | Geographical area | Dense forest | Open forest | Total forest | Forest area as % of geographical area |
|-------------------|-------------------|--------------|-------------|--------------|---------------------------------------|
| Arunachal Pradesh | 83.6 | 54.2 (65.2) | 14.4 (21.1) | 68.6 | 82.0 |
| Assam | 78.4 | 15.7 (65.2) | 8.3 (34.8) | 24.0 | 30.6 |
| Manipur | 22.3 | 5.3 (30.2) | 12.2 (69.8) | 17.5 | 78.6 |
| Meghalaya | 22.4 | 4.0 (23.0) | 11.7 (74.3) | 15.7 | 70.0 |
| Mizoram | 21.1 | 4.3 (23.0) | 14.3 (77.0) | 18.6 | 88.1 |
| Nagaland | 16.6 | 3.5 (24.4) | 10.9 (75.6) | 14.4 | 86.2 |
| Sikim | 7.1 | 2.4 (77.5) | 0.7 (22.5) | 3.1 | 44.0 |
| Tripura | 10.5 | 1.8 (32.8) | 3.7 (67.2) | 5.5 | 52.8 |
| Total | 262.0 | 91.2 (54.4) | 76.2 (45.6) | 167.4 | 63.9 |

Source: The Hindu Survey of Environment, 1997.

Table 3: Decline in forest cover between 1991 and 1995 in NE states.

| State | Forest cover (km ²) | | | Annual decrease (%) | | |
|-------------------|---------------------------------|--------|--------|---------------------|---------|---------|
| | 1991 | 1993 | 1995 | 1991-93 | 1993-95 | 1991-95 |
| Arunachal Pradesh | 68750 | 68661 | 68621 | 0.069 | 0.029 | 0.049 |
| Assam | 24750 | 24508 | 24061 | 0.494 | 0.912 | 0.696 |
| Manipur | 17685 | 17621 | 17558 | 0.181 | 0.178 | 0.179 |
| Meghalaya | 15875 | 15769 | 15714 | 0.333 | 0.174 | 0.250 |
| Mizoram | 18853 | 18697 | 18576 | 0.413 | 0.323 | 0.367 |
| Nagaland | 14321 | 14348 | 14291 | 0.164 | 0.198 | 0.052 |
| Sikkim | 3127 | 3127 | 3119 | - | 0.128 | 0.064 |
| Tripura | 5535 | 5538 | 5538 | +0.027 | - | 0.013 |
| Total | 168904 | 168269 | 167478 | 0.188 | 0.235 | 0.211 |

Data presented in Table 3, shows the decline in forest area between 1991 and 1995. While 635 km² of forest area was lost between 1991 and 1993, 791 ha area depleted between 1993 and 1995. The largest percent decrease in forest area was in Assam with 0.494% decrease during 1991 to 1993 and 0.921% decrease during 1993-95. Over all decrease in the region between 1991 and 1995 was 0.211%. Recently, a news item (Sentinel, Feb., 24, 1998) indicated that the Government has shown concern over the alarming rate of decrease in forest area in the country that was 17,000 km² between 1995-1997. With the increase in the population and at the present Annual Compound Decrease Rate in forest area in the region, the forest cover would vanish within about next 100 years. The decline would follow exponential pattern, if care is not taken to preserve this valuable resource in the region.

FORESTRY IN INDIGENOUS FARMING SYSTEMS

Sharma and Prasad (1994) have documented some indigenous farming systems of NE Region. The important ones are being discussed in following paragraphs.

Zabo Farming System:

Zabo is an indigenous farming system practiced in **Phek** district of Nagaland state. This farming system has a combination of forest, agriculture, livestock and fisheries. *Zabo* means impounding of water. The area where this farming system is followed comes under rain shadow zone. Due to deforestation or less density of forests, the rainfall in the area has been badly affected. The tribal farmers of the area developed this system due to their ingenuity, skill and the experience gathered over long time. Forestry is

an important component of the system. This farming system is followed on the hill slopes up 100% or even more.

The Zabo system has forest at the top of the hill and up to some area below the top. This serves as the catchment area for rain water harvesting. A little down below, the water is collected in ponds that are dug according to the size of the catchment and expected quantity of water available. These ponds are used as desiltation tanks and after keeping the water for 2 to 3 days in these ponds, it is transferred to a larger main tank. The desiltation ponds, are desilted every year and the material, which contains good amount of organic matter and nutrients, is put in the terraced rice fields. The tribal farmers keep their animals in bamboo enclosures a little down the main water storage tank. Generally, a few families keep their animals together in one enclosure. At the time of irrigation of the rice fields, the water from the main tank is passed through the livestock enclosures so that it can carry with it, the dung and urine of the animals. The tribal farmers do not apply fertilizers but they get 3 to 4 tones of rice yield per ha as sufficient amount of nutrients is added in the field from organic sources. The soil fertility is well maintained through this system to give optimum yield of crops.

The Zabo farming system is such that a major portion on the top hill slope is kept as forest. The grasses from this land are also used for feeding the cattle and other animals. The system has maintained the ecological balance in the area and soil erosion is very low or negligible. The tribal farmers themselves take care of the forest land and other components of the system. None is allowed to cut trees or destroy other vegetation and proper care is taken collectively for the protection of the forest land. Moreover, the tribal laws are very strict and everybody follows them dutifully.

Agriculture with Alder' System:

Alder (Alnus nepalensis) is grown in Nagaland state for enhancing soil fertility for growing crops of maize, job's tears, millet, potato, chilies, pumpkin, barley etc. The Alder grows well on lands varying in altitude from 800 to 3000m. It is a non-leguminous tree that fixes atmospheric nitrogen through nodules which develop on the roots. Alder is a multipurpose tree (MPTS) and besides improving soil fertility for growing crops, it is used as timber, furniture and fuel wood. The value of alder tree was recognized by the tribal farmers long back and more than 200 years old trees can be seen in the area. Agricultural crops, together with alder trees forms a very remunerative agro-forestry system and the ability of the tree to develop and retain soil fertility has been fully utilized by the tribal farmers of *Angami, Chakhasang, Chang, Yimchaunger and Konyak* tribes (Gokhle et al, 1985). *Knnonome* village in *Kohima* district of Nagaland is proud of its alder plantation and alder tree based agriculture.

Data given Table 4 show that per tree litter dry matter decreases with the number of plants ha⁻¹. Total litter yield depend on the number of plants and N fixed varied between 48.3 kg ha⁻¹ (60 trees ha⁻¹) to 184.8 kg ha⁻¹ (625 plants ha⁻¹). Besides fixing atmospheric N, the litter added to the soil provided P, K, Ca and other nutrient through the addition of biomass (Sharma and Singh, 1994).

Table 4: Litter yield and N added through Alder

| Alder population | Litter dry matter (Kg per tree) | Litter Yield (T/ha) | N added (Kg/ha) |
|------------------|---------------------------------|---------------------|-----------------|
| 60 | 56.3 | 3.37 | 48.3 |
| 101 | 45.3 | 5.48 | 74.5 |
| 142 | 58.1 | 8.25 | 110.5 |
| 166 | 52.2 | 8.66 | 113.5 |
| 280 | 37.5 | 10.50 | 142.8 |
| 625 | 21.7 | 13.56 | 184.8 |

Pollarding of Alder

The alder tree becomes ready for pollarding after 6 to 8 years of planting when the bark is rough and develop fissures. The alder is pollarded at a height of 2.0 to 2.5 m by the farmers and the leaves and succulent twigs are incorporated in the field. The trunk then sprouts giving new shoots called *Coppices*. One alder tree sprouts approximately 100 to 200 coppices after pollarding. About 5 to 6 coppices are left on the main trunk for regeneration. It has been estimated that if a village of 100 families could set aside about 120 ha of land to grow alder trees, all families would get sufficient cereals,

vegetables, firewood etc. The pollarding is done from November to January and the fresh cut is covered with stone to protect it from frost injury. Maintenance of alder trees is necessary for their long life. The whole trunk of tree should be kept free of parasitic growth.

Rice-based Farming System of Apatanis:

The *Apatani* tribe of Arunachal Pradesh has developed a system of cultivating rice with other crops making judicious use of available water and indigenous materials (Sharma, 1997; Mishra and Sharma, 1999). The Apatani plateau is called rice-bowl of the Apatanis, who practice wet rice cultivation. The Apatanis have a good knowledge of forest, land and water management. The Apatani plateau has a population density of 554 persons per km² against an average of 10 persons of the state. The plateau has about 21 villages in its vicinity. The farmers grow wet rice, integrated with fish culture in terraces and finger millet on the risers. The area is surrounded by high mountain having a height up to 2438 above. m.s.l.

To maintain and regulate water supply to the fields, the surrounding hills are fully covered with forests. These forest areas are well protected by the community. Apatani farmers are well aware and extremely cautious of their environment and ecology. Apart from conserving the soil from erosion, the farmers have taken up the plantation of *Terminalis myrinalia*, *Ailanthus excelsa*, *Michelia sp.* *Mangolia sp.* and bamboos. Entire surrounding hills and uplands in the area are kept conserved as forests. This helps in conserving forest resources, maintenance of ecological balance and flow of streams. It has been estimated that soil erosion, silting of rivers, drying of water sources, loss of nutrients, flora and fauna and forest resources is negligible in this area. Every stream coming from the surrounding hills is tapped soon after it emerges from the forest and the water is diverted to the fields through a net-work of channels. Use of local resources has made the system more sustainable. Nutrient and soil fertility management of the terraces is done mainly through the recycling of agricultural wastes. Paddy straw is allowed to decompose in the fields and finally incorporated in the soil. Burning/incorporation of undecomposed straw is also in practice. Pig and poultry manure is added to the fields for maintenance of soil health. Thus the farming system practiced by the Apatani tribe takes proper care of the surrounding forest and therefore, the forests and the environment have remained fully intact in this part of the state.

Bamboo Drip Irrigation System:

This system is followed in Meghalaya state in the *Jaintia* and *Khasi* hills. This system is very useful in water scarcity areas, soils have poor water holding capacity, the topography is rocky and undulating. Bamboo drip irrigation system is an excellent example of man's skill and ingenuity and glaring example in the evolution of agricultural systems (Singh, 1989). Water is carried with the help of different sizes/forms of bamboo pipes and further distributed into different bamboo water channels for application at the desired site. The special feature of the system is to convey the water to the site of actual use without leakage and loss on the way. Flow of the water from bamboo pipes can be controlled as per requirement. The tribal farmers of Jaintia hills have the necessary skill to lay-out the bamboo net-work with proficiency so that the whole unit works efficiently and perfectly. Water trickles down from the holes in bamboo pipes at the plant sites. Plantation crops, betel-vines, black pepper etc., are irrigated by this system.

Since the water is carried through bamboo pipes, the system indirectly helps the forest areas on hills. No cutting of trees and shrubs is required to clear the land for making channels through the forest areas on hills. Another benefit to forest areas is that the farmers go for settled cultivation when bamboo drip irrigation system is followed and do not resort to shifting cultivation which involve heavy deforestation. The bamboo drip irrigation system has helped in conserving forests and natural resources.

CONCLUSIONS

For sustainable forestry, there is need to introduce it as a component of the Farming Systems. The indigenous farming systems of North Eastern Region have traditional base of forestry. However, these farming systems have either remained confined to their place of origin or are on the extinct due to the

introduction of new technologies and farming systems which are more food grains production oriented and have little respect for environment. To preserve the forest wealth of the states of the region, ecology and gene pool, judicious management and care of these resources are necessary for pollution free environment and save the region from further degradation of natural resources.

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CRYOPRESERVATION OF TROPICAL AND SUBTROPICAL FRUITS

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Many of the tropical and subtropical fruit crops are reproduced vegetatively and there is an urgent need to preserve fruit crops through improved methods of vegetative propagation. Crop cultivars, parental lines, and experimental lines often require long-term preservation. Preservation is needed, also, for endangered wild species of all types.

Tissue culture technique is useful for the propagation and has several advantages like preservation of genotypes as well as decreased demand for land, manpower and decreased exposure, of axenic culture to crop-borne diseases and pests. But there are some problems with the maintenance and repeated transfers of cultures, the danger of contamination during each transferring which can cause elimination of line and genetic changes in the cultures during repeated subculturing. Loss of morphogenic potential, and other problems associated with tissue culturing, would be minimized by freeze tissues in living condition at very low temperatures such as in liquid nitrogen (-196°C). Successful cryogenic methods for doing this are now being developed. A brief review of such efforts and their use are described here.

Many tropical and sub-tropical fruit crops have proved recalcitrant to traditional cryopreservation methods. This can be overcome by vitrification of tissues that can be achieved by applying relatively simple dehydration and desiccation treatments (Benson et al., 1998). Wang et al. (1994) reported that excised embryogenic axes of mango were more tolerant to desiccation than whole seeds. After desiccation to 11% moisture content, 70% of the excised axes germinated in vitro. Embryonic axes of different moisture content lose their viability after 24 h in liquid nitrogen.

Villalobos et al. (1992) reported that dehydrated zygotic embryos of *Musa acuminata* and *M. balbisiana* were maintained in liquid nitrogen and successfully germinated after thawing at 40°C . Panis et al. (1992) reported that cryopreservation of cell suspension initiated from meristematic shoot tips of banana cv. Bluggoe (ABB) and wild BB diploid *M. balbisiana* was most efficient in presence of 7.5% DMSO. Regrowth was achieved after 100 days, when thawed cells, still surrounded by cryoprotectant.

Bhat et al. (1994) reported that air dried seeds of *M. balbisiana* with a moisture content of 13-18% were found to survive exposure to liquid nitrogen. After rapid thawing over 90% of the embryos germinated into seedlings. Panis et al. (1996) suggested that in banana embryogenic cell suspension cultures, extra cellular ice-initiation (-7.5°C) during slow freezing prevents excessive super cooling and enhances post thaw regrowth capacity. Panis et al. (1996) reported that preculturing of banana meristem for 2-4 weeks in MS medium, enriched with 0.3 to 0.5 M sucrose and then excised clumps were transferred to cryotubes and plunged directly into liquid nitrogen for storage. Panis (1996) described that embryogenic *Musa* cell suspension can be stored in liquid nitrogen, after slow freezing in the presence of DMSO. The process involves a precultivation period on media containing high concentration of sucrose followed by rapid freezing. Regeneration frequencies varied from 7.4 to 68.9%.

Pollen of 4 cultivars of lemon was stored in liquid nitrogen for 3.5 years. After 1 year, the germination rate of stored pollen was similar to that of fresh pollen (Ganeshan and Alexander, 1991). Nuclear cells of navel orange successfully cryopreserved for 40 days by vitrification. Nuclear embryos of sweet orange subjected to slow cooling at $0.5^{\circ}\text{C}/\text{min}$ down to -42°C followed by immersion in liquid nitrogen survived. The highest survival rate (91%) was obtained with highly concentrated vitrification solution PVS2 (Sakai et al., 1991; Marin and Duran, 1988; 1994; Marin et al., 1993; Perez et al., 1997). Engelmann et al., (1994) observed for embryogenic callus of willon leaf and Chio mandarin, Cleopatra mandarin, Shamouti hamlin orange and Mexican lime were cryopreserved, increased DMSO concentration (10-15%) improved growth recovery after freezing.

Somatic embryos of korean native species (*C. maxima*, *C. grandis* x *C. junos*, *C. platymamma* x *C. junos*) were given pretreatment with MS medium containing 10% DMSO and 1.0 M sucrose. The most effective vitrification solution was 10% glycerol, 10% ethylene glycol and 5% DMSO in MS medium containing 1.0 M sucrose, and for preserving somatic embryo through gradual step freezing method (Oh et al., 1997). Normah et al. (1997) reported *C. aurantifolia* seeds can be successfully cryopreserved after

desiccating them to moisture content of 12.93% while seeds *C. halimij* exhibited only 25% viability after cryopreservation at a moisture content of 9.5%.

Sterile tillers of *Vitis rupestris* were grown on a medium composed of 0.5-liter knop's solution, 0.5-ml Berthelot's micronutrients, thiamin, pyridoxine, nicotinic acid, Ca-pyrophosphate, inositol, biotin and 0.04-M sucrose. The survival after 24 days were 13% at 2°C, 46% at 7°C, 100% at 9°C and after 42 days 100% at 9°C. At the highest temperature the tiller could be stored upto 300 days without loss of viability and elongation of the tillers (Glazy, 1969). Ganeshan (1985) suggested that the technique of cryopreservation is useful for gene banks. He successfully cryopreserved pollen of 5 grape cultivars in liquid nitrogen. Moriguchi *et al.* (1988) reported that callus culture of *V. vinifera* x *V. labrusca* hybrid kyoho were stored successfully at 10°C for upto 360 days. *V. vinifera* cv. Koshusajaku callus survived storage at both 10 and 13°C for 360 days when silicone was added to the medium.

Finkle *et al.* (1979) and Ulrich *et al.* (1979) have investigated the possibility of freeze conservation of a tropical palm tree, date palm (*Phoenix dactylifera* L.). Tisserat *et al.* (1985) reported that cryopreserved pollen of date palm or Deglet Noor dusted on freshly opened spathes of 10 years old Deglet Noor. Fruit yield and developments were similar in both frozen and non-frozen pollen. Bagniol *et al.* (1992) suggested that for cryopreservation of date palm, gradients may be exhibited both for outflow of water and the penetration of the cryoprotectants. MyCock *et al.* (1997) reported late globular/early tarpedo stage date palm (*Phoenix dactylifera*) embryos can continue normal growth and development after cryopreservation provided they are pretreated with a cryoprotectant mixture of glycerol and sucrose and then dried to water contents in the range of 0.4 - 0.7 g/g. Mater (1987) reported callus of date palm was treated with a cryoprotective mixture of PEG, glucose and DMSO and frozen to -25°C for 4 months. Freezing did not affect the potential of the callus for embryogenesis although growth during the first 2 months of culture was inhibited.

Yakuwa and Oka (1988) reported that either prefreezing of intact vegetative bud of mulberry at -10°C or 20°C followed by rapid thawing at 37°C or prefreezing at -20°C or 30°C followed by slow thawing at 0°C gave high percentage of survival. Embryonic axes of longer seeds with moisture content of 18% survived after 24 h in liquid nitrogen (Fu *et al.*, 1993). Fukai *et al.* (1994) reported shoot tips of Parsimmon (*Diospyros kaki*) preconditioned on medium containing 15 g sucrose/liter and stored at 10°C. Shoot explants survived for 30 weeks at 10°C.

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Summary of completed/ongoing projects, funded by IERP, GBPIHED

ENVIRONMENTAL MONITORING AND MANAGEMENT OF WATERSHEDS IN HIMALAYAN REGION: A CASE STUDY OF SIRKHAD WATERSHED IN HIMACHAL PRADESH

The report is divided into six chapters. Chapter-I introduces the area of study by discussing the concept of watershed, major hypotheses, data sources and research methodology. The hydrogeomological profile of the study area within the backdrop of geographical profile of Himachal Pradesh has been discussed in Chapter-II. The natural resource endowment has been evaluated in Chapter- III and the socio-economic structure has been dealt in Chapter-IV. The case study of some selected villages has been presented in Chapter-V in order to analyse the changes in the socio-economic structure of the villages and also to appreciate the people's perception regarding the environmental problems and sustainable development of the area under study. Chapter-VI deals with the summary, conclusions and policy implications. A model for sustainable development of watershed has also been developed in this chapter.

The important findings and policy imperatives are as under :

The analysis of geographic background reveals that Sirkhad watershed is a homogenous landscape with very little variations in geological structure, relief and soil profiles. This micro-region gets life from the water circulation from the three tributaries - the Sir, the Sukar and the Saryali khads. There is a great symbiosis in water and soil because the entire economy is controlled through this symbiotic relationship. The slope analysis clearly brings out that the major part of the area is below 20 degrees of slope. The steep slope that is more than 20 degrees is, however, a notable feature in the eastern part which forms the dividing line for the Sir watershed. This is characterised by environmental risky zone where agriculture and grazing are hazardous. The soil erosion and land cutting are common features along all the three tributaries. This needs to be managed which can be done by examining the people's perception.

The availability of water is in abundance which is clear from the analysis of maximum, minimum and average discharges of khads for a period of 33 years. Rainfall variability is between 74 mm to 110 mm. It increases from east to west. The western part of the region, therefore, is comparatively better in terms of forest cover. But the eastern part has very poor vegetation cover. This has resulted into soil erosion especially in the area of high slopes. The water logging is common feature in the southern segment of the micro-region near Govind Sagar Lake where the three Khads join to discharge into Govind Sagar Lake. There is no doubt that this area has *Khadar* land due to new deposits of sediment but owing to water logging it cannot be cultivated properly. This area also requires some management. While the ravenous and gullied land are common along the courses of three khads, a big patch of such land is found in the upper Sir and Sukar Khad doab. A detailed study of this land is required for rehabilitation and proper development.

A comparative analysis of land use based on toposheet for the years of 1974 and satellite imagery IRS IA 1988-1989 reveals that the Sirkhad watershed is predominantly characterised by agricultural land use. The important crop are rice, wheat and maize. The diversification of agriculture should be promoted without encouraging ecological imbalances, which may be caused due to soil erosion, rock movement and removal of vegetation cover. The agro-forestry and social forestry have good scope in order to improve the ecological imbalances and enhance the scope of sustainable development. But this has not picked up in the region. This can be taken up at large scale by identifying the sensitive areas such as gullied land, wasteland and even agricultural land. The area has great potential for exploitation of minerals especially building materials but the open cast mining has been causing several environmental problems. There is need to study mining sites to understand the problems and suggest the sustainable solution. The digging of the river courses for extracting the building materials has deepened the channels. This has created artificial shortage of water for water mills. This problem also needs to be studied in detail. The area under study has great potential for some valuable minerals like gold. There is need to give due attention for scientific mining and management of this valuable mineral. The analysis of the location of different amenities and facilities clearly demonstrates that they are completely inadequate keeping in view the distribution of population and settlements. The distribution of settlements according to their sizes show that the areas between 10°-20° slopes are most suited for human habitation. This region, therefore, needs again a very careful analysis as these are the areas where man-environment relationship has better nexus. This nexus is to be properly explored at village level in order to understand the degree of ecological vulnerability and environmental problems.

This micro-region has great pressure of population as the density varies between 318 to 375

person/kg² as per 1991 census. Although the growth of population is 15.94 per cent which is below state (19.39 per cent) and national (23.56 per cent) averages, yet urbanization is picking up through the process of tertiarisation. In 1981 Ghumarwin was the loan town, but the number of towns increased to three in 1991, thereby increasing the proportion of urban population. Even though this is significantly low, there is need to promote urbanization by providing better infrastructural facilities, horizontal linkages, greater agricultural production and better marketing facilities for collection and distribution. Urbanization is an important parameter of modernisation and there is necessity to accentuate this process.

The sex ratio is not balanced because there are more females than males. According to 1991 census the sex ratio of Sir Khad watershed is 1129 which was 1074 in 1981. This reveals the trend of migration of males in search of job opportunities. The out migration is very alarming and needs to be curtailed by promoting employment opportunities at village level. This could be done by encouraging household activities by formulating policies at the Govt. level.

The sectoral work force shows that the degree of dependency is very high. Even though work force has improved from 29 per cent to 30 per cent during 1981-1991, the marginal workers have increased significantly. The primary sector provides the major scope for living as cultivators and agriculture labourers constitute 71.00 per cent of the total work force. But what is most alarming is the tertiarisation of economy and declining work force in the household activities which need to be tightened up by giving greater incentives at different scales and locales. The scope of industrialization is also to be explored. The industries could be agro-based, mineral-based, electrical and art and handicraft-based at cottage and small scale levels. This again needs through probing.

RESOURCE INDIFICATION AND TECHNOLOGY TRANSFER FOR WATER HARVESTING IN NAYAR WATERSHED AREA FOR GARHWAL HIMALAYA

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Hills, full of natural resources are facing serious problems of saving its glory due to mindless exploitation in the past. The resources are diminishing, dwindling, and now present in its extreme conditions. Water, one of the major resources for life of all living beings, is also escaping due to environmental hazards created by man in the past. Being an origin point of Ganga and Yamuna, who are the major resources of water for big part of the country, the hill people are facing serious water crisis for drinking and other purposes. Rain water-harvesting technologies, being one of the tools as remedy, can solve the problem of the people.

Present project work investigated the various socio-economic conditions, water status and water quality of the target area. The various technologies, available for rainwater harvesting have been surveyed and most fruitful and cheapest technology has been tested at field level through implementation. The total mason and craftsmen have been trained in the technology for its implementation and extension in other areas. Local people, particularly women groups have been demonstrated about the technology to reduce there water crisis problem.

COMMERCIAL VIABILITY AND STRATEGY FOR SUCCESS OF ECO-FRIENDLY AGRO-BASED AND FOREST-BASED INDUSTRIES IN U.P. HILLS

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The main objectives of the project was to identify some of the potential and viable agro and forest based industries for Uttar Pradesh Hills.

An inventory of possible industries was prepared on the basis of review of literature, analysis of units registered with department of industries, analysis of resource endowment and expert opinion survey. After a conceptual analysis of resource availability, demand and skill availability five product categories (*vis-à-vis* fruit preservation, small bakery and confectionery, woolen products, ringal products and ayurvedic drugs) were selected for detailed viability study.

The viability studies are mainly based on in-depth case study of a few selected units and a market survey followed by a detailed survey of existing units in the region in relevant product category. The studies are divided in four phases viz. technical and cost studies, market studies, financial appraisal and detailed field survey.

In fruit preservation industry 14 products were analysed on the basis of operational data collected from 5 units. All products were found profitable with P/V ratio of more than 30. Break Even sale (including cost of capital) was found Rs. 10 lakh and minimum economic size of investment is Rs. 8 lakh. The market survey show that the hill products have vary low market share even in local market and they need of put sincere effort to promote their products. The survey of existing units reveal that seasonal nature of operations reduces the profitability the units require to diversify their products and operations. Efforts are also required to promote new products for proper utilisation of hill fruits like plum and pears.

Bakery and confectionery industry is a demand-based industry as raw material and other resources are not locally available. This product category was selected for the study in view of a large number of units registered with DICs [76 units]. The viability was analysed for two different categories of units - a small urban unit, and a cottage scale rural unit. Three products - biscuits, bread and bandh (bread roll) were selected for analysis. The small-scale units requires a capital investment of about Rs. 7 lakh and its break-even sale is about Rs. 6.85 lakh. A cottage scale unit requires an investment of about Rs. 35 thousand and its break-even sale is about 32 thousand. However, the technical capacity of a small scale unit is Rs. 60 lakh per annum and that of a cottage scale unit is Rs. 7 lakh. All the three products were found profitable at both the level of production, however comparative profitability differs in urban and rural markets. The profitability of most of existing units was found satisfactory but further scope for this industry is limited as it depends on local demand only.

Woolen handloom industry is a traditional industry of Bhotia families in this region. Most of the units are single production units employing a capital of Rs. 6 thousand. Annual turnover is quite low (about Rs. 25 thousand) because the activity is seasonal in nature. Although profitability of the products (blankets and carpets) was found satisfactory, the total profit of the units was very low because of low turnover. Availability of local raw material is decreasing because of deteriorating condition of animal husbandry, and the artesian has to depend on external supply. They are also unable to register their place in the international carpet market because of low quality of outputs. Therefore, they are dependent on local market and because of low market price their profitability is quite low. The survival of this industry depends on technical assistance for improvement of products and proper marketing.

Ringal and bamboo products are another traditional craft products of this region mainly used in agricultural activity. The size of this traditional market is about Rs. 90 lakh p.a. However, this can be expanded through innovation and targeting the products beyond agriculture sector particularly as decorative items. The conventional single output unit employ a vary nominal capital of about Rs. 1000. The annual capacity is Rs. 16,000 and factor income on full time basis is Rs. 51. Although the income is quite low, it can be improved through including the innovative product in product mix. The profitability of conventional products was found very low. Contrasting availability of raw material is also affecting this industry. Excessive exploitation of ringal from forest may also endanger the existence of this plant.

Ayurvedic drug industry is often referred as a prospective industry for this region. Information was collected from three units to evaluate the commercial viability of this industry. Four common products - chyawanprash, baljivan ghutti, shilajeet and chandraprabhawati were selected for analysis. The profitability of all these products were found satisfactory. However, the market share of local products even in the local market was found quite low. These units are needed to strengthen their marketing efforts. Himalayas are always thought the source of medicinal plants and this can be used as USP by units located in this region. In contrast to common belief the availability of raw material from local sources is quite low in ayurvedic drug industry. Farming of medicinal plants should be given top priority for development of this internationally

growing industry in this region.

WANO MAIN AGNI KE PRATI JANJAGROOKTA EVAM WAIGYANIK SHODH TATHA WAN SANRAKSHAN SAMBANDHIT WIBHINNA GHATAKON KE MADHYA SAMANJASYA STHAPIT KARNA

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The district Garhwal also known as Pauri, one of the twelve district of UP Himalaya is located 29°20'-29°75'N Latitude and 78°10'-78°80'E longitude, covering about 5540 km² area. The district is one of the most fascinating segments of the Himalaya, stretches from the Ramganga river that separates Pauri-Kumaun Border in the east, and to the Ganga demarcating the western border.

The forest cover in the western Himalaya (Garhwal and Kumaun) was 85.88% in 1911 (Sharma 1978) which has been reduced to 39.3% in 1984, however, for Garhwal Himalaya only, the total forest cover was interpreted only, 24.9% by satellite imageries (Singh *et al.*, 1984).

The settlements, shifting cultivation, rapid urbanization, migration of natives to urban areas, overgrazing associated with frequent and unplanned burning are some of the prime causes for such a tremendous reduction in forest cover of the Garhwal Himalaya. Landscape burning is a common practice in this region and most of the fires are set in the summer months.

The research work has been carried out from April, 1997-April, 1999. Garhwal Himalaya forests in general and pine forest in particular, experienced the wild forest fire of unprecedented magnitude during the summer months in the year 1995-1996.

Two experimental sites have been selected in Pauri and Khirsu blocks. Out of these two sites one was burned and other unburned. In each situation (burned and unburned) an area of 1 ha was protected against herbivory and herbage removal by natives. The prescribed burning was done by staff members, society members and forest officials under the prescribed fire programme on April 2, 1997 and April 11, 1997 respectively, at Pauri and Khirsu site. The study brings out the following results:

- The fire history of the burned sites of Pauri and Khirsu were taken from the forest department, civil and soyam forest office, Pauri and rural social workers of the area. Besides these the staff members of the project have collected all these valuable information, which were essential to fulfill the research objectives. These data were taken after interviewing the person in the questionnaire form. Both the burned sites did not experienced any type of fire since from the June 1995 and May 1996 forest fire. During the study period both the burned sites were completely untouched through the forest fire.
- Both burned and unburned sites of Pauri and Khirsu were dominated by *Pinus roxburghii* and other companions *i.e.*, *Cupressus torulosa*, *Cedrus deodara*, *Rhododendron arborium*, *Myrica esculenta*, and *Pinus wallichiana*. The dominant shrub was *Berberis asiatica*, associated with *Rhus parviflora*, *Rubus ellipticus* and *Pyracantha crenulata*. Chief grass components include *Heteropogon contortus*, *Chrysopogon aciculatus*, *Themida anathera*, *Apluda mutica* and *Imperata cylindrica*.
- The peak growing season was rainy. The other forbs contributed highest percentage to total aboveground biomass. The grasses were second to forbs. Among the other forbs *Anaphalis* spp., and *Rainwarditia indica* contributed maximum biomass; *Heteropogon contortus* was the major contributor among grasses. During these study period, shoot biomass showed almost identical trend on all the sites. From March until August-September, the shoot biomass increased and declined in the following months until February. The biomass values were higher on burned sites than on unburned ones. During 2nd and 3rd year, the shoot biomass was decreased in all the sites. The maximum shoot biomass was recorded on Khirsu burned site and minimum was on Pauri unburned sites. The below ground biomass as higher on burned sites than unburned sites. Litter biomass varied significantly throughout the study period on all the sites. The minimum litter biomass was recorded in April on burned sites and maximum in May-June on unburned sites.

The above ground net production (ANP) was maximum on burned sites. During 2nd and 3rd year, the

ANP was decreased in both the burned sites, while it was increased in remaining unburned sites. The below ground net production (BNP) was highest on unburned sites. The BNP increased during 2nd and 3rd year in all the study sites. Little production was maximum recorded in Khirsu burned site followed by Pauri burned, Pauri unburned and Khirsu unburned in 1st post burned year and during 2nd and 3rd year the annual litter production was increased.

- During the study period, the highest amount of litter fall was observed in June on both burned and unburned sites of Pauri and Khirsu. The lowest amount of litter was noticed in January and February on burned and unburned sites. An analysis of litter decomposition in different sampling months indicates that the litter decomposed most rapidly during rainy season in both the study sites of burned and unburned areas. However, minimum decomposition of litter was recorded during October-December on both sites of burned and unburned areas.
- There was a definite trend of standing state of nitrogen on all the study sites for live shoot biomass. The maximum values were recorded during rainy and minimum in summer season. Maximum amount of phosphorus was recorded during rainy on all the sites. Across the sites the maximum and minimum was recorded on Khirsu burned and Pauri unburned sites respectively. Standing state of potassium in live shoot biomass was recorded maximum during rainy season on the burned sites while it was recorded maximum during summer season on the unburned sites. The minimum values of potassium in the live shoot compartment did not show any definite trend. After 1st poor-burned year, the values were decreased in all the study sites.

Analysis of soil samples reveal the acidic nature of soils. Yet the burned soils had higher pH than those of unburned sites. Organic carbon (%), total nitrogen (gm^{-2}) and exchangeable phosphorus (kg ha^{-1}) were higher on burned sites whereas, potassium content was higher on unburned sites than the burned ones. During 2nd year the nutrients was increased in both the burned and unburned sites.

- The mean maximum temperature during the study period ranged between 17°C and 33°C, and minimum from 7.0 to 24°C in both Pauri and Khirsu sites. The maximum rainfall was recorded in August and minimum in May at Pauri and Khirsu sites. The relative humidity was minimum in February and maximum in July.
- Staff and society members organised various *Sangosthi*, information meetings, competition in easy writing and poster design in between the villagers, students, social workers, local group of NGO's and research scientist of the related fields. In these *Sangosthi*, invited teachers, students, *Gram Pradhans*, *Block Pramukh*, members of *Mahila Mangal Dal*, *Yuva Mangal Dal* and also the villagers, expressed their views about the nature of forest fire, causes and impact of fire in different ecosystems. All the protecting associations of the area and especially the women emphasised the formation of co-ordination group between forest department and local inhabitants to reduce the fire hazards. Staff members and invited resource persons discussed, and demonstrated the impacts and extent of fire in Garhwal Himalayan forests and highlight the Pauri and Khirsu forests as a role model with the help of posters, slide films, charts etc. and also distributed prepared articles in Hindi to the participants. Local inhabitants highly appreciated the awareness programmes and emphasised the need of such programmes in future also. During these programmes, debate, poster designing, essay writing have also been organised on the subject related to the forest fire. Participants were also encouraged by prize and certificate distribution.

In the 2nd phase during the first step of summer awareness campaigning were initiated during February and March, in different villages of Pauri and Khirsu block. Staff members have collected data on cause and extent of fire, and also encourage and suggests them various uses of forest fuel materials, especially the use of pine needles, appropriate fire suppression techniques, prescribed burning, etc. During the study period staff members collected the data after interviewing the person in questioner form.

Assessment of impacts of awareness camps and people participation to control the wild fire were made with the help of forest-records and spot-to-spot information from the natives. On the basis of our findings, public education and awareness about co-operation, co-ordination with forest department and others, as a means of forest fire prevention, does not yield immediate results and it is indeed often difficult to assess its value, but with patience and persistence it can serve as a very real weapon in the struggle against fire.

**BAGWANI VIKAS EVAM PRASAR PARIYOJNA (Horticulture Development
Project)
IN DISTRICT CHAMPAWAT**

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Meetings were held with the community informing them of the project, objectives of the organization and the benefits from horticulture development in the area if adopted, with scientific inputs. These initial meetings resulted in selection of 10 villages viz., Kota amori, Kot bhumta, Ijara, Chamtola, Mamola, Khet khola, Sanarkha, Sajoli Lekh amori and Nanla. Three beneficiaries were selected from each village totaling to 30 nos., 200 nali land was agreed upon to be planted. With due consideration to the climate and the area citrus, mango, litchi, lemon, malta and omegranade fruits were planted. Awareness camps and workshops were held with the community. *Bagwani Samitis* and women growers group were formed to propagate the project philosophy among the greater mass. The *Samitis* and the women growers group will look after the marketing aspects of the production and later will develop the area into a fruit belt. The women group will also look after the health and child education aspects in their community. The *Bagwani Samiti* has 7 members each with 40-50 percent female representation. The overall community response is very good and apart from the project requirements people have planted fruits trees of their own. The land agreed upon was 200 nali in the beginning but another 115 + 95 nali of land has been planted, totaling to 410 nalis. 10 nurseries have been developed by the community which contain ginger, dal chini, jackfruit and reetha. Another two nurseries, one for herbal plants and one for citrus fruits is also being developed by the community.

**ASPECTS OF ASCARIASIS AND HOOKWORM INFECTIONS IN TROPICAL
AND MOUNTAINOUS HIGH RAINFALL AREAS OF MEGHALAYA: AN
INVESTIGATION INTO TRANSMISSION DYNAMICS AND ANTHELMINTIC
EFFICACY OF A PUT ACTIVELY CURATIVE PLANT**

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The proposed study aimed to explore the prevalence of hookworm infection among human populations in different climatic zones of Meghalaya, and to study the development of the infective larvae, their survival and viability in varied environmental conditions; to ascertain similarities or differences between *Ascaris* materials of porcine and human origin; and to ascertain the anthelmintic effect of plant-derived components on the motility, survival and structural organization of the parasites so as to find out clues to possible route and mode of action of the plant materials used as anthelmintic in traditional medicine.

- The surface fine topography and composition of the free amino acid pool of the adult *Ascaris* from human and swine sources were analysed for differences, if any, between the two.
- The whole village populations of Nongkya village (near Umsning, Ri Bhoi district), Sutnga village (Jaintia Hills district), and rural community in and around Williamnagar (East Garo Hills district) in Meghalaya were surveyed for hookworm infection. Coprological and soil samples from the study site were collected and examined. Identification of the hookworm species was made from the infective larvae recovered from the soil samples and also from those raised from faecal cultures.

The optimal periods of development and hatching of eggs and development of L₃ larvae of human hookworm seems to occur at warmer temperatures (22-28°C) and high humidity (RH>80%) which also favour a longer period of survival of L₃ larvae. The present study suggests that the ambient climatic conditions of summer months in the rural subtropical, high rainfall area of Meghalaya are better suited for transmission and recruitment of infection as compared to cold winter months, when no development of eggs

and hence no infective larvae would occur.

- The root-tuber peel of *Flemingia vestita*, the indigenous plant of putative anthelmintic use in traditional medicinal practices among the natives of Meghalaya, was tested for its anthelmintic efficacy. Test worms (representing all helminth types, viz., nematode, cestode and trematode) were treated in vitro with the crude root-peel extract and the active principle, genistein. Changes in the motility, physical status of the parasite, and alterations in the organisation of its body surface at the morphological and ultrastructural level were observed following exposure to the test plant material. These changes provide some clues about the mode of action of the plant-derived component on the parasite.

With the localization of NSE and ChE, the organization of the cholinergic components of the nervous system in toto could be visualized in the cestode test parasite. The specific ChE in the parasite is AChE. Both NSE and ChE were found in close association with the central and peripheral nervous components, besides being present in the tegument and muscular parts of the male terminal genitalia. The whole tissue homogenate also showed a high AChE activity. After exposure to the crude peel extract and to genistein, pronounced decline in the visible stain intensity in the cholinergic components of the nervous system and tegument was noticeable, indicating extremely reduced activity of NSE and ChE in these sites. The total AChE activity was also reduced to 49.07% and 56.77%, following treatment with the peel extract and genistein, respectively. The reference drug, praziquantel also caused reduction in the enzyme activity, somewhat at par with the genistein treatment.

AcPase, AlkPase, ATPase and 5'-Nu are predominantly distributed in the tegument, subtegument, and somatic musculature. After exposure to the crude extract (50 mg/ml of the incubation medium) or genistein (0.5 mg/ml), a pronounced decline in the visible stain intensity was noticeable indicating very little or no activity in these sites. Quantitatively the activity of AcPase, AlkPase, ATPase and 5'-Nu was found to be suppressed by 97%, 95%, 88%, and 57%, respectively, following genistein treatment. The reference drug, praziquantel (0.01 mg/ml) also caused a reduction in the enzymatic activities, somewhat at par with the genistein treatment.

Phosphoserine, taurine, phosphoamine, threonine, serine, glutamate, proline, glycine, alanine, citrullin, valine methionine, isoleucine, leucine, tyrosine, phenylalanine, β -alanine, α -aminobutyric acid, γ -aminobutyric acid, tryptophan, histidine, ornithine, arginine, and ammonia were detectable in the tissue homogenate of the parasite. After exposure to the crude extract (50 mg/ml) and genistein (0.5 mg/ml), alterations were noticeable in the free amino acid pool. Following genistein treatment, quantitatively the contents of Ph.ser, Tau, β -Ala, α -AiBA, Trp, His and Val were significantly lower and Glu, Met, Ile, GABA and ammonia were slightly higher than those in the control; PhNH₂, Cit and Orn were not detectable in the treated parasite. The amino acids excreted by the control worm and as detected in the effluent were Ph. ser, Glu, Val, Met, Ile, Leu, Tyr, Phe, β -Ala, α -AiBA, GABA, His, Orn, Arg and ammonia, in the effluent of the genistein-treated parasite Gly, Ala, Met, and Orn were not detectable. The reference drug, praziquantel (0.01 mg/ml) also caused a quantitative reduction in the free amino acid contents of the parasite, somewhat at par with the genistein treatment.

EXPLORATION OF AMPHIBIAN FAUNA OF ARUNACHAL PRADESH WITH EMPHASIS ON THE CONSERVATION MEASURES, REPRODUCTIVE BEHAVIOUR AND ETHNOZOOLOGICAL INFORMATION

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This report presents the data based on the outcome of the project over three years and emphasises the need for further extensive survey in this high biodiversity zone. A.K. Ghosh (1984) collected 14 species of Amphibia from the proposed Namdapha Biosphere reserve. Chanda (1994) on the basis of earlier work and his own collections reported 22 species of Amphibia from Arunachal Pradesh. We have been able to collect and record 26 new reports from the state and 6 (Six) first reports from the North Eastern region of India. Eleven districts of Arunachal Pradesh have been surveyed for exploration of Amphibian faunistic

diversity. The upto-date list prepared on the Amphibian fauna of Arunachal Pradesh records 52 species. Chanda (1994) has reported 54 species from the whole of North Eastern region, India.

Ethnozoological study on Amphibian population is a fertile field of research attempted for the first time in Arunachal Pradesh. Names of various frogs used in food and medicine have been recorded with photographic documentation. Analysis of ecological characteristics was done on selected breeding habitats which will be a pioneering work in India. Similar studies have been done in other countries in recent years.

Due to present day ban on capture and killing of Amphibian species food spectrum of five species of Amphibia were analysed which were either killed for other purposes or died a natural death.

Planktonic biodiversity of Amphibian habitats was done for the first time in Arunachal Pradesh. So far there was no record of Phyto and Zooplanktons of the water bodies of Arunachal Pradesh.

Study of reproductive behaviour was restricted to 10 species (5 species not yet ascertained) only due to inherent difficulty in this type of work and DAPTF (Declining Amphibian Population Task Force, of IUCN-SSC group) guidelines circulated all over the world to Amphibian researchers.

The study has opened up a new trend of research in the unexplored high biodiversity zones of Arunachal Pradesh, a part of Eastern Himalayan region, one of the global hotspots of biodiversity.

Selected Abstracts

Compiled by D.S. Negi

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

Airi, S.; Rawal, R.S.; Dhar, U. and Purohit, A.N. 2000. **Assessment of availability and habitat preference of Jatamansi - a critically endangered medicinal plant of west Himalaya.** *Current Science*, 79(10): 1467-1471. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India; High Altitude Plant Physiology Research Centre, HNB Garhwal University, Srinagar 246174, India. [BIOMASS; CONSERVATION; MEDICINAL PLANT]

Nardostachys jatamansi (D. Don) DC., a critically endangered rhizome-bearing medicinal plant, is restricted to specialized habitats in high altitudes of the Himalaya, ranging from 3000 to 5000 m asl. The plant is collected from natural habitats for local consumption and trade. The existing status of the species and variations in its performance in different habitats were studied in selected sites in Kumaun, west Himalaya. Dripping moss-laden rocks (frequency 40.7%, density 15.9 individual/m²) and moist boulders (frequency 25.9% and density 16.8 individual/m²) are the most preferred habitats of this plant. Generally, density and frequency had significant ($P < 0.05$) positive relationship with altitude. The mean density in two contrasting slopes differed significantly ($P < 0.05$), showing relatively higher density on west-facing slopes. Several biological and environmental features of the individual plants contributing towards wholesome below-ground biomass were identified. For example, among biological parameters, plant density ($P < 0.01$), plant height ($P < 0.01$) and above ground biomass ($P < 0.01$) were positively correlated. So were soil nitrogen ($P < 0.05$) and moisture content ($P < 0.01$) with below ground biomass.

Arunachalam, K.; Arunachalam, A. and Melkania, N.P. 1999. **Influence of soil properties on microbial populations, activity and biomass in humid subtropical mountainous ecosystems of India.** *Biology and Fertility of Soil*, 30(3): 217-223. Department of Forestry, North Eastern Regional Institute of Science and Technology, Nirjuli 791109, India. [DEHYDROGENASE; HUMID SUBTROPICS; MICROBIAL BIOMASS; SOIL RESPIRATION; UREASE]

Microbial populations, biomass, soil respiration and enzyme activities were determined in slightly acid organic soils of major mountainous humid subtropical terrestrial ecosystems, along a soil fertility gradient, in order to evaluate the influence of soil properties on microbial populations, activity and biomass and to understand the dynamics of the microbial biomass in degraded ecosystems and mature forest. Although the population of fungi was highest in the undisturbed forest (Sacred Grove), soil respiration was lowest in the 7-year-old regrowth and in natural grassland (approximately 373 mg g⁻¹h⁻¹). Dehydrogenase and urease activities were high in "jhum" fallow, and among the forest stands they were highest in the 7-year-old regrowth. Microbial biomass C (MBC) depended mainly on the organic C status of the soil. The MBC values were generally higher in mature forest than in natural grassland, 1-year-old jhum fallow and the 4-year-old alder plantation. The MBC values obtained by the chloroform-fumigation-incubation technique (330-1656 mg g⁻¹) did not vary significantly from those obtained by the chloroform-fumigation-extraction technique (408-1684 mg g⁻¹), however, the values correlated positively ($P < 0.001$). The enzyme activities, soil respiration, bacterial and fungal populations and microbial biomass was greatly influenced by several soil properties, particularly the levels of nutrients. The soil nutrient status, microbial populations, soil respiration and dehydrogenase activity were greater in Sacred Grove, while urease activity was greater in grassland.

Basu, P.K. and Pradhan, D.K. 2000. **A new report on the availability of two varieties of *Fagopyrum dibotrys* (D. Don) Hara in the Darjeeling and Sikkim Himalayas.** *Journal of Hill Research*, 13(1): 24-27. Medical Botany and Pharmacognosy Laboratory, Centre for Life Science, North Bengal University, Raja Rammohunpur 734430, Distt.- Darjeeling, India. [MORPHOLOGY; SIKKIM HIMALAYA]

Fagopyrum dibotrys (D. Don) Hara is a common plant of the Darjeeling and Sikkim Himalayas. Plants collected from Darjeeling are different from that of Gangtok in some morphological, anatomical and chemical characters. Two varieties viz. *Fagopyrum dibotrys* (D. Don) Hara var. *dibotrys* and *Fagopyrum dibotrys* (D. Don) Hara var. *alba* are now being proposed.

Behera, Mukunda Dev; Jeganathan, C.; Srivastava, Shalini; Kushwaha, S.P.S. and Roy, P.S. 2000. **Utility of GPS in classification accuracy assessment.** *Current Science*, 79(12): 1696-1700. Indian Institute of Remote Sensing (NRSA), Department of Space, Dehradun 248001, India. [ACCURACY ASSESSMENT; BIODIVERSITY; GLOBAL POSITIONING SYSTEM; SATELLITE DATA]

Global positioning system (GPS) has become a versatile tool for georeferencing, classification and accuracy assessment of earth system data. GPS acquired geo-co-ordinates in S/A mode are used in this study to assess the classification accuracy of a vegetation type map prepared by knowledge-based hybrid classification technique. The validation of different forest types provided 55.91, 74.19, 83.87, 89.25 and 92.47% correspondence within one, two, three and four pixel(s) buffer ranges, respectively, between GPS-based information and map data. About 93 GPS points were used for this purpose. The procedure has also been automated for accuracy estimation from the GPS field points through software in the GIS domain. The study area falls under the Eastern Himalaya, which happens to be one of the 18 biodiversity hot spots of the world. This study supports the use of GPS in evaluating the classification accuracy.

Bhardwaj, M.L.; Raj, Harander and Koul, B.L. 2000. **Yield response and economics of organic sources of nutrients as substitute to inorganic sources in tomato (*Lycopersicon esculentum*), okra (*Hibiscus esculentus*), cabbage (*Brassica oleracea* var *capitata*) and cauliflower (*B. oleracea* var *botrytis*).** *Indian Journal of Agricultural Sciences*, 70(10): 653-656. Regional Horticultural Research Station, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Jachh, Himachal Pradesh, India. [FARM YARD MANURE; FUSARIUM WILT; INORGANIC FERTILISER; NEEM CAKE; NUTRIENTS ORGANIC SOURCES; ORGANIC PRODUCE; RAPESEED CAKE]

A field experiment was conducted during 1995-98 at Jachh to find out the effect of organic sources of nutrients, i.e. farmyard manure, neem (*Azadirachta indica* A. Juss) cake and rapeseed (*Brassica campestris* L. var *toria* Duth. & Full.) cake as partial or complete alternative to chemical fertilizers on yield of tomato (*Lycopersicon esculentum* Mill.), okra *Hibiscus esculentus* L.), cabbage (*Brassica oleracea* var *capitata* L.) and cauliflower (*Brassica oleracea* var *botrytis* L. and its economic feasibility. Application of sole organic sources of nutrients recorded 11-17% lower yield in different vegetable crops. However, application of 50% recommended NPK+50% rapeseed cake (0.72 tonne/ha) in tomato, 50% recommended NPK+50% neem cake (0.72 tonne/ha) in okra, 33.3% recommended NPK+33.3% farmyard manure (6.66 tonnes/ha) + 33.3% rapeseed cake (0.48 tonne/ha) in cabbage, 33.3% recommended NPK+33.3% farmyard manure (6.66 tonnes/ha) + 33.3% neem cake (0.48 tonne/ha) in cauliflower recorded higher yield which were statistically at par with recommended doses of chemical fertilisers. Net returns in organic produce of different vegetables were higher as the produce received higher price in the market.

Bhardwaj, S.D.; Andargae, W. and Panwar, P. 2000. **Effect of spacing on nutrient accumulation patterns of *Eucalyptus tereticornis*.** *Journal of Hill Research*, 13(1): 15-18. Department of Silviculture and Agroforestry, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173230, H.P., India. [BIOMASS; EUCALYPTUS; NUTRIENT ANALYSIS]

Nutrient accumulation in high density plantation of *Eucalyptus tereticornis* in midhill zone of the Western Himalayas reveals that after 12 years of plantation 1532.85 kg/ha, 196.40 kg/ha and 885.93 kg/ha of N, P and K, respectively were retained by the plantation and only 309.26 kg/ha. Nitrogen, 15.80 kg/ha Phosphorous and 138.80 kg/ha of Potassium were returned to the soil in 60x60 cm spacing. Among different tree components bole accumulated maximum nutrients followed by leaves and branch+bole in all the spacing treatments.

Bhasin, Veena and Bhasin, M.K. 2000. **A cross-cultural fertility differentials in Sikkim.** *J. Hum. Ecol.*, 11(6): 429-444. Department of Anthropology, University of Delhi, Delhi 110007. [CASTE GROUPS; DEMOGRAPHIC VARIABLES; HIMALAYAS; RELIGIOUS GROUPS; TRIBALS]

In the present study an attempt is made to study fertility differentials among different caste and tribal groups of Sikkim professing Buddhism and Hinduism, who live under similar physical and geographical environments, each leading different cultural and religious lives.

Bisht, B.S.; Bhuchar, S.K.; Bisht, S.S.; Kothiyari, B.P. and Palni, L.M.S. 2000. A functional analysis of women's participation in various activities in hills: A case study from village Arah in Kumaun Himalaya, India. *J. Hum. Ecol.*, 11(6): 487-489. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [ENERGY EXPENDITURE; FUNCTIONAL ANALYSIS; KUMAUN HIMALAYA; WOMEN]

The varied and demanding occupations of women in rural central Himalaya have been recognized by many workers but there is paucity of information with regard to energy expended by women in central Himalayan villages for performing various activities. While many studies reveal that women make implicit contributions towards subsistence economy and ecological and cultural sustainability, the defining of such contributions can be based on firm footing by providing data on energetics. The present study has attempted to analyse major functional activities of women of a remote central Himalayan mid mountain village Arah (Garur Block, Distt. Bageshwar) in Kumaun hills of U.P.

Bisht, J.K.; Chandra, S.; Bhatnagar, V.K. and Singh, Jagpal 2000. Effect of interculture operations and fertilizations on the growth, forage and fuel yield of oak *Quercus leucotrichophora* in mid hills of U.P. *Indian Journal of Forestry*, 23(1): 16-19. Vivekananda Parvatiya Krishi Anusandhan Sansthan (ICAR), Almora 263601, U.P. [FODDER; FUEL YIELD; SOIL FERTILITY]

Fodder need of cattle in hills can partially be met during winter lean period by feeding them fresh oak, leaves. Poor nutrition or soil fertility may result in poor foliage yield. For accelerating the growth of *Quercus leucotrichophora* plantation was done at 1.0 m x 1.0 m or 10,000 trees/ha. Study comprised of three interculture operations, viz., no interculture operation interculture twice (before and after rainy season), interculture quarterly (July, October, January and April) with five fertilizations viz., control, 30 kg N/ha, 30 kg N+40 kg P₂O₅, 30 kg N+40kg P₂O₅+10 t FYM/ha and 10 t FYM/ha, were undertaken to find out the optimum dose of fertilization. The experiment was laid out in split plot design at the VPKAS, Research Farm, Hawalbagh during 1988-95. The treatments were applied during initial three years only without taking fodder and fuel yield in the said period. The mean of three years (1992-93, 1993-94 and 1994-95) data revealed that the application of 30 kg N+40 kg P₂O₅/ha with FYM @10 t/ha recorded the maximum green foliage (51 q/ha) and fuel (31 l/ha) yield. In case of interculture operations weeding and hoeing twice was found promising which produced 48 q/ha green leaves and 28 q/ha fuel yield.

Bisht, J.K.; Chandra, S.; Chauhan, V.S. and Singh, R.D. 2000. Performance of ginger *Zingiber officinale* and turmeric *Curcuma longa* with fodder tree based silvi-horti system in Hills. *Indian Journal of Agricultural Sciences*, 70(7): 431-433. Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora 263601, India. [FODDER TREES; GINGER; LIGHT INTERCEPTION; TURMERIC]

A field experiment was laid out during 1994-1996 to assess the performance of ginger (*Zingiber officinale* Roscoe) and turmeric (*Curcuma longa* L.) under 10-years-old fodder trees, namely *Grewia optiva* Drummond (bhimal), *Celtis australis* (Kharik), *Quercus leucotrichophora* A. Camusex (banj) and *Bauhinia variegata* (kachnar). The results showed that yield of turmeric and ginger was affected significantly with different fodder trees. Both turmeric (12.04 tonnes/ha) and ginger (7.98 tonnes/ha) gave the highest yield with *Quercus leucotrichophora*. However, the highest green forage of trees was harvested from *Bauhinia variegata* (7.7 kg/tree). Negative correlation ($r = -0.77$) was obtained between light intercepted by the trees and yield of under grown ginger and turmeric. Association of *Quercus leucotrichophora* with turmeric and ginger was found to be the most suitable and remunerative silvi-horti combination.

Bisht, Prabha; Joshi, Ila; Chauhan, J.M.S. and Sharma, V.K. 2000. *In vitro* clonal propagation of mature *Eucalyptus* F₁ hybrid FRI-5 *E. camaldulensis* Dehn.X *E. tereticornis* Sm. *Indian Journal of Forestry*, 23(1): 28-32. Tissue Culture Laboratory, Division of Genetics and Tree Propagation, Forest Research Institute, Dehradun 248006, India. [CLONAL PROPAGATION; EUCALYPTUS; TISSUE CULTURE]

Axillary shoot bud multiplication has been achieved in *Eucalyptus* hybrid. FRI-5 (*E. camaldulensis* Dehn. x *E.tereticornis* Sm.) by using explants from a 24-year-old mature tree. Cultures were established on MS medium supplemented with BAP (1.0 mg/l) alongwith NAA (0.1 mg/l) and regular subculturing was carried out in BAP (1.0 mg/l). Elongation of shoots was achieved in 1/2 MS medium devoid of plant growth regulators. Best rooting was observed in 1/2 MS supplemented with IBA (1.0 mg/l). The method of *n vitro*

propagation of mature F₁ hybrid reported in this paper will be helpful in retaining the hybrid vigour and mass clonal multiplication of heterotic hybrid combination which has the potential to produce three to five times more volume of wood than the parent species.

Bisht, Prabha; Joshi, Ila; Chauhan, J.M.S.; Sharma, S.K. and Bagchi, S.K. 2000. Micropropagation of A 23-year-old candidate plus tree of *Eucalyptus tereticornis* Sm. *Indian Journal of Forestry*, 23(2): 149-154. Tissue Culture Laboratory, Division of Genetics and Tree Propagation, Forest Research Institute, Dehradun 248006, India. [CLONAL PROPAGATION; MICROPROPAGATION; SEED GERMINATION; TISSUE CULTURE]

Nodal explants collected from a 23-year-old Candidate Plus Tree of *Eucalyptus tereticornis* were cultured on MS (Murashige and Skoog, 1962) medium. Cultures established on 1.0 mg/l BAP + 0.1 mg/l NAA and transferred to 1.0 mg/l BAP + 1.0 mg/l NAA gave maximum multiplication of shoots followed by regular subculturing in 1.0 mg/l BAP. Rosette clumps of buds after giving them a short duration treatment (15 days) of 1.0 mg/l BAP + 0.04 mg/l GA₃ showed better elongation on 1/2 MS without using plant growth regulators. Best rooting was observed in 0.5mg/l IBA. Successful field transfer of this CPT was achieved. Owing to its high multiplication rate it is possible to produce 60,000 plantlets in a year from a single nodal explant.

Bist, M.S. 2000. Monitoring of vegetation cover and land use in Nanda Devi Biosphere Reserve. *The Indian Forester*, 126(6): 664-673. Forest Survey of India, Kaulagarh Road, Dehradun, India. [BIODIVERSITY; BIOSPHERE RESERVE; BUFFER ZONE; LAND-USE; LIVESTOCK]

India possesses a distinct identity not only its geography, history and culture but also by its vegetation which varies from tropical rain forests in Andaman and Nicobar Islands to dry alpine forests high up in the Himalayas. In between these two extremes, the country has a large variety of forest types/biodiversity. To develop and sustainably maintain adequate forest cover in the country, it is essential that the state of vegetation cover is monitored regularly, precisely and at relatively short time spans. With this in view, the present paper attempts to show the impact of changes in the forest cover in one of the India's biosphere reserve - Nanda Devi Biosphere Reserve, which was constituted by Govt. of India on Feb 4, 1998 to conserve the biodiversity and integrity of plants, animals and micro-organisms, not in isolation but in their totally as part of the wider natural eco-system, safeguard genetic diversity of the species on which their continuing evolution depends and improve the socio-economic conditions of the people living in and around the reserves. The analysis provided in the paper shows that in Nanda Devi Biosphere Reserve area, the forest cover has increased showing a positive trend, which need to be maintained.

Biswas, Sas; Jain, S.S. and Chandra, Sumer 2000. Some rare and threatened medicinal plants of Himalayan and north-eastern regions of India and strategies for their conservation. *Journal of Non-Timber Forest Products*, 7(1/2):101-111. Systematic Botany Branch, Botany Div., Forest Research Institute, Dehradun 248006, India. [AROMATIC PLANTS; CONSERVATION; MEDICINAL PLANT]

Indian Himalaya is a rich repository of medicinal and aromatic plants. This is largely due to various climatic and edaphic factors conducive to the growth and diversity of plants. In fact, in this mountainous region traditional exploitation of medicinal and aromatic plants has its roots in the remote past. Over 300 items of assorted medicinal plants are extracted and traded from this region. Indiscriminate and continued exploitation has caused depletion of certain species and driven them to the threatened category. Among the threatened species of medicinal value, the species such as *Panax pseudoginseng*, *Coptis teeta*, *Taxus baccata* spp. *wallichiana*, *Podophyllum hexandrum*, *Orchis latifolia*, *Dioscorea deltoides*, *Gentiana kurrooa*, *Aquillaria malaccensis*, *Aconitum balfourii*, *A. falconeri*, *Angelica glauca*, *Jurinea macrocephala*, *Nardostachys jatamansi*, *Rheum* spp. *Ephedra* spp. *Saussurea lappa*, *Viola* spp. *Colchicum luteum*, *Gloriosa superba*, *Coleus forskohlii*, *Alpinia galanga*, *Digitalis* spp., etc. need urgent attention of conservationists. The present paper elucidates the centre of genetic diversity and variabilities of several species of NTFPs value. There is urgent need for *in situ* conservation of population of species by the creation of reserves, ban on extraction of plants/plant parts for 3-5 years and formation of statutory committee to decide on the quantity to be extracted from localities. Various measures for conservation have been recommended in the paper.

Bose, Ashish 2000. **Ecology, economy and society in Himalayan villages.** *Economic and Political Weekly*, XXXV: 2707-2709. [ARMY; DEVELOPMENT POLICIES; NGO; PEOPLE PARTICIPATION; UTTARAKHAND]

The complex ecology and biodiversity of hill regions and the role the forests play in the delicately balanced economy of the area needs to be taken into account in formulating development policies. Even more important is the issue of how the local people can be made participate effectively in programmes of development. This is not going to be easy and outsiders, even committed NGOs can only be catalysts.

Chaudhary, R.P. 2000. **Forest conservation and environmental management in Nepal: a review.** *Biodiversity and Conservation*, 9(1): 1235-1260. Central Department of Botany, Tribhuvan University, Kirtipur, Kathmandu, Nepal. [CONSERVATION; ENVIRONMENT; FOREST MANAGEMENT]

This paper provides information on the status of forests and environmental problems related to forestry in Nepal. It aims to integrate the conservation and sustainable management of forests as a part of environmental planning. A critical review of the main environmental problems with prioritization within the forestry sector: through review of all forest related documents, strategies, development plans, programs, institutional arrangements, policies mentioned in the Master Plan for Forestry Sector Nepal of 1988, and other relevant documents: identification of major gaps and constraints of forestry policy and plans and current practices of forest conservation and management have been done. The decline in forestry resources in Nepal took place in the past due to lack of appropriate policy to guide the legal, institutional and operational development for the forestry sector. Forestry policy in Nepal, in the past was shaped by political and economic motives rather than ecological considerations. Policy formulation mechanisms exist in Nepal; however, there is an excessive delay in translating policies into legislation and then into operational rules and administrative orders. There is a need to implement the international obligations by transforming them into regulations in order to make them legally binding. The data to be generated in the coming years in the areas of forestry at both national and international levels suggest that we should revise the research priorities and strategies. Research to add value to the forest resource products has yet been neglected. More attention is required on regular monitoring and evaluation of the projects. A through evaluation of the programs and planning for the forestry sector in Nepal is urgently required to update the progress and revise the programs.

Chaudhary, Vandana and Bhattacharyya, A. 2000. **Tree ring analysis of *Larix griffithiana* from the Eastern Himalayas in the reconstruction of past temperature.** *Current Science*, 79(12): 1712-1716. Birbal Sahni Institute of Palaeobotany, 53, University Road, Lucknow 226 007, India. [CLIMATIC CONDITIONS; TREE-RING]

Tree ring analysis of *Larix griffithiana* (Lindl. et Gord.) Hort ex Carr., a subalpine deciduous conifer growing in Sange, Arunachal Pradesh, Eastern Himalaya has been taken up to understand past climatic changes of this region. Rings in this tree have been found very distinct, with clear demarcation of early wood and late wood cells and have characters suitable for dendroclimatic studies. Analysis of tree growth and records of climatic parameters suggest that May temperature is the most important factor in controlling growth of this tree. Reconstruction of May temperature using ring width data of this tree has been done.

Chauhan, M.S.; Mazari, R.K. and Rajagopalan, G. 2000. **Vegetation and climatic in upper Spiti region, Himachal Pradesh during late Holocene.** *Current Science*, 79(3): 373-377. Birbal Sahni Institute of Palaeobotany, Lucknow 226007; Wadia Institute of Himalayan Geology, Dehradun 248001, India. [BROAD-LEAVED; CLIMATIC ZONES; MOUNTAIN GLACIERS]

Pollen analysis of Sutikher bog near Kunzum Pass (Himachal Pradesh) indicates that between 2300 and 1500 yr BP cold and dry climate prevailed in the upper Spiti region and glaciers advanced towards the lower elevations. Between 1500 and 900 yr BP the climate change to warm and moist, which resulted in the retreat of glaciers and shift of tree line towards the higher elevations. From 900 yr BP onwards the mountain glaciers/tree line descended with the return of cold climate which continues until the present time.

Chauhan, S.K.; Sehgal, R.N. and Gautam, P.L. 2000. Genetic divergence among progenies of chir pine (*Pinus roxburghii* sargent). *Indian Journal of Forestry*, 23(1): 70-74. College of Forestry, UHF, Nauni, Solan, H.P., India. [CHIR-PINE FOREST; COLLAR DIAMETER; DIVERSITY]

Studies were undertaken to assess the magnitude of genetic divergence among the progenies of 58 plus trees from the whole distributional range of chir pine in Himachal Pradesh (India) at the age of 5 years to identify the promising selections to be used in future improvement programme. Five growth characters, viz., plant height, collar diameter, current year growth, internodal length and spur dry weight were used to identify the cluster pattern on the basis of Mahalanobis D^2 statistics. Based on D^2 values, 58 sources were grouped into 11 clusters. The study revealed lack of parallelism between genetic divergence and eco-geographical distribution of the plus trees.

Chhetri, Deepak B. Khatri 1999. Comparison of forest biomass across a human-induced disturbance gradient in Nepal's schima-castanopsis forests. *Journal of Sustainable Forestry*, 9(3/4): 69-82. Carnegie Institute of Washington, Department of Plant Biology, 260 Panama Street, Stanford, CA 94305-4101. [BIOMASS ESTIMATION; FOREST DISTURBANCE; HIMALAYAN FORESTS; REGRESSION MODE; STUMP DIMENSIONS; TEMPERATE FORESTS; TRESSPASS CUTTING] This paper presents estimations of aboveground tree biomass (combined for boles and branches) in Nepal's *Schima-Castanopsis* dominated warm-temperate forests. The biomass estimations are presented for five forest stands purposively sampled in a larger study to represent different harvesting intensities. Two categories of biomass estimates are provided: (1) for living trees that are standing, and (2) for cut trees that have been removed. Biomass of standing trees were estimated by using diameter at breast height (dbh) and total height measurements as predictor variables in appropriate regression models. Biomass of cut trees were estimated in two steps: measurements of stump diameters and heights were used first to predict dbh and total heights of cut trees; these values were then regressed to obtain biomass estimates for the missing trees. Data were gathered from 2,361 live trees and 2,962 stumps in 170 sample plots across the five forest stands. Estimates of mean standing-alive biomass ranged from a minimum of 16 ton/ha in the severely disturbed forest to a maximum of 479 ton/ha in a relatively undisturbed (reference) forest. Estimates of mean cut biomass ranged from a minimum of 24 ton/ha in a second reference forest to a maximum of 183 ton/ha in the severely disturbed forest. The biomass estimates in the relatively-undisturbed, reference forests are well above the 95% upper confidence interval of the global mean. Similar findings of high productivity have been reported for temperate forests of the Central Himalaya in India and Eastern Himalaya in Sikkim. The findings of this study in the Nepalese Central Himalaya support the conclusion that productivity potential is high in the temperate Himalayan forests. The study's findings and methodology should be useful for preliminary development of guidelines in the region to regulate forest biomass growth, yield, and harvest.

Dabral, P.P. and Kumar, P. 1999. Effect of water management on production of tea *Camellia thea* in north-east India and west Bengal - A review. *Indian J. Soil Cons.*, 27(3): 211-219. Department of Agricultural Engineering, N.E.R.I.S.T., Nirjuli, Itanagar 791109, Arunachal Pradesh, India. [NORTH EAST INDIA; SOIL WATER MANAGEMENT; TEA; WATER MANAGEMENT; WEST BENGAL] To maximise production from tea plantations in north-east India, both irrigation system and water management strategies must encourage the development of strong root systems. This paper summarizes the research work on effect of water management aspects for tea in north-east India and West Bengal, carried out at the Tocklai Experimental Station (Tea Research Association) at Jorhat (Assam) and other research centres. Review suggests that sprinkler system of irrigation is highly suitable for tea plantation during dry period. To effectively control water table 90 cm below the ground surface during rainy season lateral drains deeper than 105 cm and submain drains deeper than 120 cm at 6 to 30 m spacings (depending on the type of soil) are recommended. In light textured soils underground pipe drainage system can be used for enhancing tea production in the region.

Dhiman, Anil Kumar and Kaushik, Purshotam 1999. Avenue trees for conservation of environment at Haridwar. *Sus. Eco. Sys. & Env.*, : 85-89. Department of Botany and Microbiology, Gurukul Kangri Vishwavidyalaya, Haridwar-249404. [AVENUE PLANTS; DECIDUOUS FOREST; HINDU

MYTHOLOGY; VEGETATION]

Haridwar is referred as holy city which is one of the oldest cities mentioned in the ancient Hindu scriptures. It is mentioned as Mayapuri, Kapila, Gangadwar and Mokshdwar in ancient scriptures and epics and this place is considered as the gateway to the four pilgrimages, Badrinath, Kedarnath, Gangotri and Yamunotri of Uttarakhand. The Indian mythology speaks that when the Gods left their footprints on the land of Haridwar, metaphorically they also left an indelible mark on the spiritual ethics of every Hindu probably because, the devout, may later follow holy paths all across. This blessed land for their spiritual upliftment. Haridwar is one of the first cities where Ganga emerges from the mountains to touch the plains and it has not only remained a preferred place of saints and sages but also served as a centre of attraction for many years for learning the arts, science and culture.

Dhiman, R.C.; Thapliyal, R.C. and Singh, Jagdish 2000. Capsule size and seed yield relationships in *Paulownia fortunei*. *Indian Journal of Forestry*, 23(1): 12-15. Forest Research Institute, P.O. New Forest, Dehradun, India. [CAPSULE SIZE; SEED GERMINATION; SEED YIELD]

Nineteen mature capsule of *P. fortunei* collected from a trial plantation raised at the Forest Research Institute, Dehradun Dun were evaluated for capsule length (CL), capsule thickness (Ct), capsule index (CL x Ct), capsule air dry weight, seed number/capsule, seed weight/capsule and thousand seed weight. Pearson coefficients of correlation developed among the studied parameters indicated positive and significant relationships of capsule thickness with capsule length; capsule index with capsule length and capsule thickness; capsule dry weight with capsule length, capsule thickness and capsule index; seed weight with capsule length, capsule thickness, capsule index and capsule dry weight; thousand seed weight with capsule thickness; and seed number with capsule length, capsule thickness, capsule index, capsule dry weight and seed weight. Best fit regression equations were developed for predicting seed number and seed weight from capsule length, capsule thickness, capsule index and capsule air dry weight.

Dhyani, S.K. and Tripathi, R.S. 2000. Biomass and production of fine and coarse roots of trees under agrisilvicultural practices in north-east India. *Agroforestry Systems*, 50: 107-121. ICAR Research Complex for North Eastern Hills Region, (Barapani), Meghalaya, India. [ALNUS NEPALENSIS; CITRUS RETICULATA; COARSE ROOTS; PARASERIANTHES FALCATARIA; PRUNUS CERASOIDES]

An understanding of the rooting pattern of tree species used in agroforestry systems is essential for the development and management of system involving them. Seasonal variation, depth wise and lateral distribution of biomass in roots of different diameter classes and their annual production were studied using sequential core sampling. The investigations were carried out in four tree species under 'tree only' and 'tree+crop' situations at ICAR Research Farm, Barapani (Meghalaya), India. The tree species were mandarin (*Citrus reticulata*), alder (*Alnus nepalensis*), Cherry (*Prunus cerasoides*) and albizia (*Paraserianthes falcataria*). The contribution of fine roots to the total root biomass ranged from 87% in albizia to 77% in mandarin. The bulk of the fine roots (38% to 47%) in the four tree species was concentrated in the upper 10 cm soil layer, but the coarse roots were concentrated in 10-20 cm depth in alder (46%) and albizia (51%) and at 0-10 cm in cherry (41%) and mandarin (48%). In all the four tree species, biomass of both fine-and coarse-roots followed a unimodal growth curve by showing a gradual increase from spring (pre-rainy) season to autumn (post rainy) season. Biomass to necromass ratio varied between 2 to 3 in the four tree species. The maximum (3.2) ratio was observed during spring and the minimum (2) in the rainy season. In alder and albizia, the fine roots were distributed only up to 1 m distance from the tree trunk but in the other two species they were found at a distance up to 1.5 m from the tree trunk. The annual fine root production varied from 3.6 Mg ha⁻¹ to 6.2 Mg ha⁻¹ and total production from 4.2 to 8.4 Mg ha⁻¹ in albizia to mandarin, respectively. Cherry and mandarin had a large number of woody roots in the surface layers which pose physical hindrance during soil working and intercultural operations under agroforestry. But the high biomass of roots of these two species may be advantageous for sequential or spatially separated agroforestry systems. However, alder and albizia have the most desirable rooting characteristics for agroforestry systems.

Farooque, N.A. 2000. Indigenous ethnoveterinary knowledge and livestock management amongst transhumant pastoralists of Central Himalaya. *J. Hum. Ecol.*, 11(5): 319-322. G.B. Pant Institute of

Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [ADAPTATION; LIVESTOCK; MANAGEMENT; PASTORALISTS]

The adaptation of transhumant pastoralists to the high altitude conditions harbour a huge variety of livestock management and cattle cross-breeding. The value of indigenous ethnoveterinary knowledge and indigenous cattle cross-breeding have not been taken seriously in the assessment of the potential for the development of the high altitude societies in general and pastoralism in particular. However, the traditional strategies and indigenous knowledge of the transhumant herders have eradicated precariously due to various reasons. As a result, these strategies and indigenous knowledge are facing danger of complete eradication and consequently the economic security of these remote societies.

Gahalaut, V.K. and Kalpna 2000. On the occurrence of small and moderate earthquakes of the Himalayan Seismic Belt. *Current Science*, 79(7): 1004-1007. National Geophysical Research Institute, Uppal Road, Hyderabad 500007. [EARTHQUAKES; SEISMIC BELT; MAIN CENTRAL THRUST]

Small and moderate magnitude earthquakes occur along a narrow belt in the Himalaya¹⁻⁴. The belt of these earthquakes, referred to as the Himalayan Seismic Belt (HSB), lies close to the surface trace of the Main Central Thrust (MCT)^{1,4,5}. It coincides with the topographic front between the Lesser and Higher Himalaya¹, the zone of increased gradient of the Himalayan rivers⁶, high interseismic elevation change rates deduced from repeat levelling measurements⁷⁻¹¹, and the high conductive feature beneath the southern Higher Himalaya¹². The hypocentres of these earthquakes mark the inferred downdip edge of the main thrust zone (MTZ)^{5,8,10,11}. In this article, we suggest that the earthquakes of the HSB occur as a result of strain accumulation of the MTZ. Our simple calculations of change in static stress¹³⁻¹⁶ due to strain accumulation on the MTZ suggest that the static stress increases on the gentle planes above and close to the downdip edge of the MTZ, facilitating the occurrence of these earthquakes.

Gupta, A.K.; Sharma, I.M.; Malhotra, R. and Sharma, S. 2000. Cultural variation and carbendazim insensitivity in *Venturia inaequalis* isolates from Kullu valley. *Journal of Hill Research*, 13(1): 11-14. Department of Mycology and Plant Pathology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173 230, Himachal Pradesh; Regional Horticulture Research Station, Bajaura, Kullu 175 125, Himachal Pradesh, India. [FUNGICIDE; KULLU VALLEY; RADIAL GROWTH]

In recent years carbendazim is not providing satisfactory control of apple scab. Three categories i.e. V_I, V_{II} and V_{III} of *Venturia inaequalis* (Cke.) Wint. isolates were recognized from sprayed, occasionally sprayed and unsprayed orchards having distinct cultural characteristics. Enhanced growth of isolated from V_{II} category was observed on modified glucose asparagine agar medium amended with 10, 100, 200 mg/ml carbendazim as compared to isolates from V_I and V_{III} categories.

Handa, A.K.; Thakur, Sanjeev and Khurana, D.K. 2000. Isozyme banding in *Populus Ciliata X Maximowiczii* hybrids. *Indian Journal of Forestry*, 23(1): 75-77. Department of Tree Improvement, Y.S. Parmar University of Horticulture & Forestry, Nauni, Solan 173230, H.P., India. [CLONES; ISOZYME ANALYSIS; POPULUS CILIATA; SOIL MIXTURE]

Isozyme analysis has been used to identify the hybrid plants of *Populus ciliata X P. maximowiczii*. Out of the five enzymes tested, three resolved well in electrophoresis. Peroxidase and esterase were polymorphic whereas leucine aminopeptidase was monomorphic.

Jain, J.D.; Guru, R.D. and Singh, Ranjeet 2000. Physical and mechanical properties of *Mangifera indica* (Mango) and *Syzygium Spp.*(Jamun) from Dehradun (U.P.). *The Indian Forester*, 126(9): 948-956. Forest Products Division, Forest Research Institute, Dehradun, India. [EVERGREEN TREE; MECHANICAL PROPERTIES; TECTONA GRANDIS]

Based on the tests carried out on small clear specimens, the physical and mechanical properties of *Mangifera indica*, Dehradun (U.P.) and *Syzygium spp.*, Dehradun (U.P.) are presented. Nail/screw withdrawal resistance, safe working stresses for structural purposes and suitability indices for different industrial and engineering uses of both the species have also been reported alongwith the corresponding values of *Mangifera indica*, Puri (Orissa) and *Syzygium spp.*, Cachar (Assam) and also *Tectona grandis*

(Malabar, Nilambur and Coimbatore) for comparison. The results have indicated that properties of both the species viz. *Mangifera indica* and *Syzygium* spp. tested from Dehradun (U.P.) are inferior in almost all the properties as compared to *Mangifera indica*, Puri (Orissa) and *Syzygium* spp., Cachar (Assam).

Jana, M.M. 2000. **Study on fertility, mortality and population planning in Sikkim.** *Journal of Hill Research*, 13(1): 28-40. Department of Geography and Applied Geography, University of North Bengal, Distt. Darjeeling 734430, India. [CLIMATIC CONDITIONS; FAMILY PLANNING; FERTILITY; SEX RATIO; SOCIO-ECONOMIC]

Sikkim located in the Eastern Himalaya, is one of the smallest states in India. Due to its wide variations of physiography, climate, soils, social and cultural aspects, the distribution and growth of population in different districts are not uniform in different decades. During the last few decades, the growth of population in the state was higher than national average and as a result, the pressure of population on limited existing resources has been increased enormously. So, to check the growth of population, various family planning programmes were introduced in different plan periods in the past but the achievements were insignificant. Recently, the achievement is some what satisfactory due to awareness about family planning and health care. The paper is dealt with fertility, mortality and different aspects related to acceptors of family planning programmes in the State. It has been observed that number of acceptors in family planning is higher among higher castes. Due to recent improvement in health care facility and introduction of family planning, birth and death rates in the State have declined considerably during the last few decades.

Jana, S.K. and Chauhan, A.S. 2000. **Ethnobotanical aspects of legumes in Sikkim.** *Journal of Non-Timber Forests Products*, 7(1/2): 46-52. Botanical Survey of India, Sikkim Himalayan Circle, Gangtok 737103, India. [FODDER; MEDICINAL; PLANT DIVERSITY; SIKKIM HIMALAYA; TIMBER]

The pea family Leguminosae is one of the largest and economically important family of the flowering plants. The family is cosmopolitan and shows the range of distribution from tropical to alpine regions of the world. Interestingly, it is not only a main source of protein in our daily life, but many other species of this family are also used as fuel, fodder, timber, gums and resins, medicinal as well as ornamental, etc. Keeping this view in mind, the family Leguminosae has been investigated ethnobotanically. Traditional uses of 34 species by both tribals and local people have been recorded besides their vernacular names, habit, phenology and distribution in Sikkim. Sixteen folk formularies which had long been practised against various ailments by the tribals of Sikkim have also been presented in the paper.

Jha, M.N.; Gupta, M.K. and Pandey, Rajiv 2000. **Factor analysis of soil nutrient distribution pattern under different plantations.** *The Indian Forester*, 126(12): 1270-1278. Forest Soil and Land Reclamation Division, Forest Research Institute, Dehradun, India. [EUCALYPTUS; NITROGEN PHOSPHORUS; SOIL FERTILITY; SOIL NUTRIENTS]

Factor analysis of soil nutrient distribution pattern under Chir, Teak, *Eucalyptus*, Shisham and Khair, in Mussoorie Forest Division (U.P.) was studied. It was done to identify underlying factors that are responsible for correlation among nutrients under five plantations. Eigen values for the first four factors were >0.90 and combined accounted for 77 per cent of total variation in the soil supporting the five plantations. The four factor model explained >90 per cent of the variance in total phosphorus; 85 per cent of the variance in organic matter and available nitrogen; and >70 per cent of the variance in total nitrogen, total potassium, and total sodium, available potassium and available phosphorus. However the four factor model explained only 62 per cent of the variance in available potassium and 66 per cent of the variance in total calcium. The four extracted factors are aggrading factor (36.6 per cent), Sodium factor (16.16 per cent), Phosphorus factor (12.67 per cent) and total phosphorus factor (11.92 per cent) obtain through varimax orthogonal factor analysis.

Jodha, Narpat Singh 2000. **Globalization and fragile mountain environments - Policy challenges and choices.** *Mountain Ressearch and Development*, 20(4): 296-299. International Centre for Integrated Mountain Development (ICIMOD), P.O. Box 3226, Kathmandu, Nepal. [DIVERSITY; GLOBALIZATION; HINDU KUSH-HIMALAYA; MOUNTAIN ENVIRONMENT]

Mountain areas are faced with a range of new problems in the context of rapid globalization and economic liberalization. There are visible incompatibilities between the driving forces and operational mechanisms of market-driven globalization and the imperatives of mountain conditions. Thus, selective over extraction of resources in response to market signals and narrow specialization that disregard local diversity are incompatible with the fragility, inaccessibility, diversity, and marginality of mountain regions. The negative impacts of globalization and new trade policies on local production systems are already visible in many parts of the Hindu Kush-Himalayan region, and niche markets with comparative advantages for mountain regions are disappearing. There is a need to adapt to the changes brought by globalization. A few key areas in which new approaches could minimize the negative impacts and harness the positive opportunities associated with globalization are outlined below for the attention of policy makers.

Kala, C.P. and Rawat, G.S. 1999. Effect of livestock grazing on the species diversity and biomass production in the alpine meadows of Garhwal Himalaya, India. *Tropical Ecology*, 40(1): 69-74. Wildlife Institute of India, P.B. No. 18, Chandrabani, Dehradun 248001, India. [ALPINE MEADOWS; BIOMASS PRODUCTION; GARHWAL HIMALAYA; LANDSCAPE UNITS; LIVESTOCK GRAZING; SPECIES DIVERSITY]

The effects of livestock grazing on the alpine (>3500 m AMSL) vegetation in Khiron Valley, Garhwal Himalaya was studied. The study area was stratified into three landscape units viz., undulating land masses (ULM), camping sites (CS) and steep slopes (SS). Within each stratum two barbed wire enclosures of 10 x 10 x 3 m (total six) were erected to exclude livestock grazing. Seasonal aboveground biomass production, both within and outside the enclosures, was estimated by harvest method at 30 days interval. Plant species diversity was calculated for all the sites using Shannon-Wiener diversity index and compared with similar landscape units of ungrazed sites in adjacent valleys. Aboveground biomass values within enclosure were $458 \pm 27 \text{ g m}^{-2}$, $419 \pm 17 \text{ g m}^{-2}$, and $412 \pm 18 \text{ g m}^{-2}$ on the CS, ULM and SS respectively. For grazed areas these values were $352 \pm 28 \text{ g m}^{-2}$, $308 \pm 5 \text{ g m}^{-2}$ and $318 \pm 7 \text{ g m}^{-2}$ on ULM, and SS respectively. The loss of biomass due to grazing and trampling by livestock was 23%, 26%, and 22% on CS, ULM, and SS respectively. *Danthonia cachemyriana* J. & S. contributed the most (86.41%) of total biomass on SS, whereas *Geranium wallichianum* D. Don ex Sw. contributed the most (55.37%) on ULM within the enclosures. Species diversity was highest ($H'=2.48$) in ULM followed by CS ($H'=2.32$) and SS ($H'=2.00$). The differences in species diversity due to grazing in one season were not clear but data from adjacent ungrazed valleys showed that heavy grazing reduces the species diversity, and promotes ruderal, and weedy species. The results are discussed in the light of biodiversity conservation.

Karthikeyan, A.; Goraya, G.S.; Kumar, Shailendra and Kalia, S. 2000. Studies on the mortality of *Cedrus deodara* (Roxb.) L. Don. in Chail forest (H.P.) and its causative factors. *The Indian Forester*, 126(12): 1326-1332. Division of Forest Protection, Himalayan Forest Research Institute, Shimla, Himachal Pradesh, India. [CEDRUS DEODARA; ROOT ROT DISEASE; SOIL MOISTURE]

A study has been undertaken in the diseased *Cedrus deodara* (Roxb.) L. Don (Deodar) forests at Chail (Himachal Pradesh) to find out the causative factor of the disease and their mortality. The infected trees showed yellowing, shortening needles and the causative pathogen was identified as *Phytophthora cinnamomi* which is causing root rot disease. The rhizosphere soil samples of the disease-affected trees showed higher soil moisture due to blockage of water conductivity. The results of the study explicit that the fungus causes water stress in the diseased trees because of root rot. Under favourable moisture conditions the activity of the pathogen becomes vigorous. However, studies are under investigation to control the disease.

Khongsdier, R. and Lama, R. 2000. A genetic study of the khyntiam of Meghalaya, north-east India. *J. Hum. Ecol.*, 11(5): 383-385. Department of Anthropology, North-Eastern Hill University, Mayurbhanj Complex, Nongthymmai, Shillong 793014, Meghalaya, India. [GENETIC MARKERS; KHYNTIAM KHASI; MEGHALAYA; POPULATION SUBDIVISIONS]

The present note is based on limited genetic markers and mating patterns among the Khyntiam, one of the Khasi sub-groups of Meghalaya, North-East India. It indicates that the Khasi population is not a homogeneous one and it is likely that this population is divided into several endogamous units.

Kumar, Jayant and Parmar, C. 2000. Standardization of sexual and asexual propagation techniques for some wild fruits of sub-Himalayan region. *The Indian Forester*, 126(8): 870-873. Regional Horticultural Research Station, Dr. Y.S. Parmar University of Horticulture & Forestry, Bajaura, Kullu, Himachal Pradesh, India. [GERMINATION; SEEDLING; SUB HIMALAYAN REGION; WILD FRUIT]

Response of six wild fruit species viz. *Carissa opaca* Stapf., *Cordia dichotoma* Forst. f., *Ficus auriculata* Lour., *Flacourtia indica* (Burm.f.) Merr., *Murraya koenigii* (Linn.) Spreng, and *Rubus niveus* Thunb., to sexual and asexual propagation was studied. Species of *Carissa*, *Cordia*, *Flacourtia* and *Murraya* can be easily propagated through seeds. However seeds of *Ficus* and *Rubus* species require some period of after ripening and stratification for germination respectively. All these species except *Flacourtia* can be propagated vegetatively by cuttings and air layering and their rooting can be improved with the application of IBA.

Kumar, Pramod; Lakshmi, N. Jyothi; Dube, S.D. and Mani, V.P. 2000. Genotypic differences in photosynthesis and its associated parameters in relation to yield among barnyard millet *Echinochloa frumentacea* genotypes under rainfed condition in hills. *Indian Journal of Agricultural Sciences*, 70(6): 374-377. Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora 263601, India. [BARNYARD MILLET; CANOPY PHOTOSYNTHESIS; CORRELATIONS; PHOTOSYNTHESIS RATE; STOMATAL CONDUCTANCE; TRANSPIRATION RATE]

A field experiment with twelve genotypes of barnyard millet *Echinochloa frumentacea* (Roxb.) Link) was conducted during 1997-98 under rainfed condition in hills to understand the photosynthetic basis of yield. A significant genotypic variations in rates of photosynthesis and its associated parameters was recorded during vegetative and reproductive phases. Mean rates of leaf photosynthesis, canopy photosynthesis, transpiration, stomatal conductance, leaf temperature depression and total dry-matter had significant positive association with grain yield, whereas the association of plant height, harvest index and test weight with yield was not significant. Mean photosynthesis rate showed positive association with harvest index and test weight. Tiller number/plant had poor negative association with grain yield.

Kumar, Rakesh; Pal, Mohinder and Pandey, Rajiv 2000. Correlation in growth parameters of bamboo *Dendrocalamus strictus* seedlings as affected by culms number. *Journal of Non-Timber Forest Products*, 7(1/2): 112-115. Forest Research Institute, P.O. New Forest, Dehradun 248006, India. [BAMBOO; DIAMETER; SEEDLING]

A study on correlation between twelve growth parameters of *Dendrocalamus strictus* was under taken. The experimental material comprised of four groups of six-month old seedlings grouped on the basis of number of culms per clump, viz., two, three, twenty-one, forty-seven and thirty-one were found significant for groups one, two, three and four respectively. The correlation of height and basal culm diameter with fresh and dry weight of culms was found positive. The fresh weight of culms, leaves, rhizomes and roots were found significant and positively correlated with their dry weights.

Kumar, Rakesh; Pandey, Rajiv and Pal, Mohinder 2000. Statistics of biomass structure of *Dendrocalamus strictus* (Roxb.) nees seedlings. *The Indian Forester*, 126(9): 993-1001. Forest Research Institute, Dehradun, India. [BAMBOO; BIOMASS; SEEDLING]

Descriptive statistics of different biomass and growth parameters of *Dendrocalamus strictus* seedlings were reported. The relative contributions of different parts of seedlings to total weight in fresh and dry conditions were also given. It was observed that the contribution of culms was maximum followed by rhizome for both the conditions. An estimate of every parameter is also worked out for different number of culms present in a clump. Similar trend was observed for the seedlings having 3 and 4 number of culms per clump for most of the parameters.

Kumar, S. and Balodi, B. 2000. Promising oil yielding plants of Garhwal and Kumaon regions of Western Himalaya. *Journal of Non-Timber Forest Products*, 7(1/2): 131-134. Botanical Survey of India, Northern Circle, Dehradun 248195, India. [AGRO-CLIMATIC CONDITION; EDIBLE FRUITS; OIL]

YIELDING]

The paper deals with promising oil yielding plant species growing at different altitudinal zones (300-3000 m) in Garhwal and Kumaon region. The importance of these species in improving the rural economy is also highlighted in this communication.

Laishram, J.M. and Devi, Y.Sunitibala 1999. **Micropropagation of *Renanthera imschootiana* Rolfe through shoot-tip, Axillary Bud, and leaf segment cultures.** *Orchid Soc. India*, 13(1-2): 1-4. Biotechnology Laboratory, Department of Plant Breeding and Genetics, College of Agriculture, Central Agricultural University, Imphal 795004, Manipur, India. [BASAL MEDIUM; LEAF SEGMENT; MICROPROPAGATION; TISSUE CULTURE]

Excised shoot-tips, axillary buds, and segments of young leaves of *Renanthera imschootiana* Rolfe grown outdoor, were cultured in VW (Vacin and Went, 1949), MS (Murashige and Skoog, 1962), and KC (Modified Knudson 'C', 1946) media supplemented with different growth additives to induce regeneration. Induction of protocorm like bodies (PLBs) in both shoot-tip and leaf explants was obtained in VW medium supplemented with 0.1 mg^l⁻¹ NAA, 1 mg^l⁻¹ BAP, and 20% v/v coconut water and MS medium supplemented with 0.1 mg^l⁻¹ NAA and 2 mg^l⁻¹ BAP. Induction of direct PLBs from axillary bud explants was obtained only in VW medium supplemented with coconut water (20%, v/v) and 1.0 mg^l⁻¹ each of NAA and BAP; the PLBs developed into plantlets.

Laishram, J.M.; Devi, Sunitibala Y.; Devi, L.Jamini and Singh, K.Homen 1999. **The effect of different concentrations of nitrogenous and phosphatic fertilizers on growth and flower quality of *Vanda coerulea* Griff.** *J. Orchid Soc. India*, 13(1-2): 15-18. Biotechnology Laboratory, Department of Plant Breeding and Genetics, College of Agriculture, Central Agricultural University, Imphal 795004, Manipur, India. [BLUE VANDA; FERTILIZER; LEAF SIZE]

Vanda coerulea Griff. plants of uniform size were grown in wooden baskets containing charcoal, pieces of bricks and tree fern and supplied with 0.2% nutrient solution containing different concentrations of nitrogen, phosphorous, and potassium and potassium at constant dose. The fertilizers were applied once in 4 days during vegetative period. The effect of different concentrations of nitrogenous and phosphatic fertilizers was analysed on the growth and flower quality of these plants. Number of leaves per plant was highest in the treatment of 40:30:20 NPK but not significantly different from other treatments except the control where no fertilizers were applied. Treatment of 30:20:20 NPK gave maximum leaf size and treatment of 30:30:20 NPK gave best results for different parameters studied such as 1st flower opening, number of flowers per spike, spike length, number of spikes per plant, flower size, and blooming period. Thus spraying of 30:30:20 NPK combination can increase cut-flower yield and quality of flower of *Vanda coerulea*.

Mahapatra, Kamal and Chauhan, Khamesh 2000. **Estimation of genetic and environmental variability for seedling traits in *Acacia catechu* Willd.** *Journal of Non-Timber Forest Products*, 7(1/2): 123-125. Department of Tree Improvement & Genetic Resources, Dr. Y.S. Parmar University of Horticulture & Forestry, Nauni, Solan, H.P., India. [BIOMASS; COLLAR DIAMETER; GERMINATION; SEEDLING]

Seeds were collected from 40 geographically isolated seed sources and sown in the nursery. After one year of growth in the nursery data were recorded on 10 randomly selected seedlings per treatment per replication on 12 quantitative traits. The study revealed that most of the nursery characters possessed high heritability along with moderate to high genetic advance which indicated that these characters are probably controlled by additive gene action and simple selection may prove effective to bring out the desired genetic improvement in these traits. However, leaf area and internodal length revealed high heritability but low genetic advance which suggested that phenotypic selection may not be effective for the improvement of these traits.

Maikhuri, R.K.; Semwal, R.L.; Rao, K.S.; Nautiyal, S. and Saxena, K.G. 2000. ***Cleome viscosa*, Capparidaceae: A weed or a cash crop?** *Economic Botany*, 54(2): 150-154. G.B. Pant Institute of Himalayan Environment and Development, P.Box No. 92, Srinagar-Garhwal, U.P., India; G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India; School of

Environmental Sciences, Jawaharlal Nehru University, New Delhi 110067, India. [CASH CROP; CLEOME VISCOSA; GARHWAL HIMALAYA; WEED]

Cleome viscosa, an annual herb locally known as jakhiya, grows naturally from seed in rainfed agricultural land and abandoned crop fields at altitudes ranging from 500 to 1500 m in scattered pockets of the Garhwal Himalaya. The seeds are mostly used as condiment. This species is a good substitute of cumin (*Cuminum cyminum*). Traditionally it is also used to cure a variety of diseases. It provides, three times higher yield when maintained by the farmers as a pure crop compared to yield obtained in mixed cropping conditions. With other food commodities, it is exchanged by the traditional farmers of Garhwal with the people of the areas where it does not grow. Because of its increasing demand, it is being sold in the market and is gaining more and more popularity. Unit now no systematic attempt has been made to study the ecological significance and economic potential of *Cleome viscosa*. This paper describes the agronomy, yield, cost-benefit analysis, uses, and ethnobotany of *Cleome viscosa*. Systematic efforts are needed to promote its cultivation on a larger scale in village community degraded land and in marginal agricultural land where traditional crops grow with difficulty.

Mao, A.A. 1999. **Notes on orchids of Senapati and surrounding hills in the state of Manipur, India.** *J. Orchid Soc. India*, 13(1-2): 55-58. Botanical Survey of India, Eastern Circle, Shillong 793003, India. [FUEL-WOOD; ORCHID FLORA; SHIFTING CULTIVATION]

The paper records 64 species of orchids belonging to 27 genera from Senapati and its surrounding hills in the state of Manipur. These include some of the rare and interesting orchids, such as *Ascocentrum miniatum* (Lindl.) Schltr., *Paphiopedilum hirsutissimum* (Lindl. ex Hook.) Stein, *Renanthera imschootiana* Rolfe, *Schoenorchis fragrans* Smith and *Vanda coerulea* Griffith ex Lindl. from the area.

Mao, A.A. 2000. **Dried-flowers making - A potential cottage industry in north-east India.** *The Indian Forester*, 126(12): 1342-1346. Botanical Survey of India, Shillong, Meghalaya, India. [COTTAGE INDUSTRY; DRIED-FLOWERS]

North-East India is one of the richest in plant diversity in India and harbours many flowering plants throughout the seasons, which are excellent for making dried-flowers. Dried-flowers making can be a potential small cottage industry for the region. This paper presents for the first time a list of plants suitable for dried-flowers making and the techniques of dried-flowers making.

Melkania, Uma and Bisht, N.S. 2000. **Identifying indicators for successful implementation of joint forest management in Arunachal Pradesh.** *The Indian Forester*, 126(5): 537-544. North Eastern Regional Institute of Science and Technology, Nirjuli, Arunachal Pradesh, India; State Forest Research Institute, Itanagar, Arunachal Pradesh, India. [CONSERVATION; FOREST COVER; JOINT FOREST MANAGEMENT; SOCIO-ECONOMIC]

Arunachal Pradesh joined the JFM stream in October, 1997 by a resolution being passed by the State Government. At present about 10 projects are being implemented under this scheme in different parts of the State. However, looking at the vast geographical area unsettled status of land, low human population, community ownership and customary laws, the whole concept requires a review specially in North-Eastern States. In the present paper an effort has been made to analyse the problems and prospects of JFM implementation in Arunachal Pradesh.

Mishra, A.; Singh, Anand; Kukreja, A.K. and Patra, N.K. 2000. **Adventitious root induction in stem cuttings of *Taxus baccata* L. for ex-situ cultivation.** *Journal of Non-Timber Forest Products*, 7(1/2): 63-66. Central Institute of Medicinal and Aromatic Plants, P.O. CIMAP, Lucknow 226015; CIMAP Field Station, Purura, Almora 768001; CIMAP Field Station, Pantnagar 763145, India. [CULTIVATION; STEM CUTTING; TAXUS BACCATA]

Auxins, combination of auxins and thiadiazuron (TDZ) have been tested for adventitious roots induction in stem cuttings of *Taxus baccata* L. Auxins [Indole-3-butyric acid (IBA), naphthalene acetic acid (NAA), indole-3-acetic acid (IAA)] at lower concentration (50 mg ml⁻¹) were observed more effective for inducing roots in stem cuttings. The combination of auxins IBA and NAA at 50 mg ml⁻¹ each showed

remarkable changes in treated stem cuttings. Generally callus formation was quite high (70%) at 100 mg ml⁻¹ TDZ with IBA, NAA individually. On the other hand the combination of TDZ, IBA and NAA (100 mg ml⁻¹ each) was highly effective for callus (>95%) as well as root induction. Beside, auxin treatments, TDZ may also be used for rapid root induction of *T. baccata*.

Mishra, Ashutosh; Sharma, C.M.; Sharma, S.D. and Baduni, N.P. 2000. **Effect of aspect on the structure of vegetation community of moist bhabar and tarai *Shorea robusta* forest in central Himalaya.** *The Indian Forester*, 126(6): 634-642. Department of Forestry, HNB Garhwal University, Srinagar, (Garhwal), India; Forest Research Institute, Dehradun, India. [CENTRAL HIMALAYA; DIVERSITY INDEX; MICRO-CLIMATIC CONDITION; ORGANIC MATTERS]

The composition of forest vegetation and community structure of Moist Bhabar and Tarai Sal forest were examined on four different aspects; namely, North-East, North-West, South-East and South-West, in District Pauri Garhwal to understand the growth behaviour of *Shorea robusta* individuals under different micro-climatic conditions. *ROBUSTA* was found dominating on all the aspects with maximum IVI, density, frequency and TBC values and has reflected regular and random distribution patterns, the highest TBC value of this species was recorded on NE facing slope (5009.04 cm²/100m²) and highest Cd value (0.4321) on SW facing slope, where minimum diversity persisted. On the other hand the lowest cd value (0.3115) was observed on SE aspect where maximum diversity existed. The maximum accumulation of organic matter was noticed on NE aspect (average value 1.51±0.61%) due to occurrence of mature Sal stand.

Mishra, V.K.; Raina, J.N. and Nayak, B.K. 2000. **Multipurpose trees enrich degraded watershed an approach for rural rehabilitation.** *Journal of soil and Water Conservation*, 44(1 & 2): 60-71. College of Forestry, UHF Nauni, Solan, H.P.; Foresters Training School, Government of Orissa, Bhubaneswar 751003. [FERTILITY; FUEL-WOOD; MULTIPURPOSE TREE; WATERSHED MANAGEMENT]

Watershed Management through integrated approach of Agriculture, Horticulture Dairy of Forestry Practice, was taken up by Dr. Y.S. Parmar, University, Solan in its Horticultural Research Station at Dhaulakuan, Himachal Pradesh. Among other Forestry programmes a high density plantation of three multipurpose trees i.e. *Eucalyptus tereticornis*, *Melia azedarach* and *Leucaena leucocephala* was established. Soil characteristics like pH, ECe Organic Carbon, available N,P,K, exchangeable Ca and Mg are estimated to assess the soil ameliorative properties. A comparison of soil chemical characteristics between the experimental plot and the adjoining unplanted area reflected interesting informations. It was noticed that while pH and ECe depressed the status of Organic carbon, exchangeable Calcium and Magnesium, and available N.P.K. improved under plantation. Besides the optimum production of fuel-wood, fodder and small timber the soil ameliorative property of vegetation on degraded barren watershed is a suitable biological method of soil and water conservation at low cost technology.

Misra, K.K. and Jaiswal, H.R. 2000. **Effect of plant bioregulators and potassium nitrate on seedling quality of Bael (*Aegle marmelos Correa*).** *Journal of Non-Timber Forest Products*, 7(1/2): 126-130. Department of Horticulture, G.B. Pant University of Agriculture & Technology, Pantnagar 263145, Dist.-Udham Singh Nagar, India. [FIBROUS ROOTS; PLANT BIOREGULATORS; SEEDLING]

The effect plant bioregulators and potassium nitrate on seedling quality of Bael (*Aegle marmelos Correa*) was studied. Seedling growth like height, number of branches, leaves, secondary roots, dry weight of leaves, stem and top was found maximum with foliar sprays of GA₃, 1000 ppm while number of fibrous roots per seedlings, length of tap root and dry weight of roots were found maximum with foliar sprays of IBA, 1000 ppm. The top:root ratio was found maximum with GA₃, 1000 ppm and minimum with IBA, 1000 ppm. The correlation (r) among most of the morphological traits was found positive and significant but correlation among number of branches per seedling with dry weight of leaves, fresh weight of top with dry weight of leaves and stem, dry weight of top with fresh weight of top, dry weight of leaves and stem were found stronger.

Muller-Boker, Ulrike and Kollmair, Michael 2000. **Livelihood strategies and local perceptions of a new nature conservation project in Nepal.** *Mountain Research and Development*, 20(4): 324-331.

Department of Human Geography, Institute of Geography, University of Zurich, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland. [INTERNAL/EXTERNAL PERCEPTION; KANCHENJUNGA; LIVELIHOOD STRATEGIES; LOCAL INSTITUTIONS; NATURE CONSERVATION; NEPAL]

The recently established Kanchenjunga Conservation Area Project (KCAP)-jointly managed by the Department of National Parks and Wildlife Conservation (DNPWC) and World Wildlife Fund (WWF)-is based on the principles of the new participatory concept of nature conservation. The main objectives are to protect the unique environment of the Kanchenjunga region and to help local communities improve their standard of living. This study focuses on existing livelihood strategies and local institutions as well as on the local population's perception of the participatory approach. A theoretical consideration of the different concepts of nature and conservation is regarded as helpful in understanding locally observed processes. The results show wide diversification in the economic system that contributes to sustaining livelihood. Various local institutions have established governance over particular resources. With regard to the KCAP, it became obvious that nearly all interviewees had expectations that went far beyond the intended and economically feasible potential of the project. This is largely because they do not entirely comprehend the principal aim of "conservation". On the other hand, most of the local people believe that conservation of nature is necessary in their region and that it is only possible through a joint effort made by everyone in the community.

Muruganandam, M. 1999. Aquaculture potential for integrated watershed development in Shiwalik and north western Himalayas: Problems and prospects. *Indian J. Soil Cons.*, 27(3): 234-242. Central Soil and Water Conservation Research and Training Institute, Dehradun 248 195, India. [COLDWATER AQUACULTURE; INTEGRATED WATERSHED DEVELOPMENT; WATER HARVESTING STRUCTURES]

To conceptualise Himalayan aquaculture and identify existing practices, constraints and opportunities so as to establish and develop an organised fish farming and improve watershed management in foot hills of Shiwalik and other North Western Himalayan tracts, a field study comprising a regional survey in three representative blocks, each in Kumaun (Jaspur), Garhwal (Sahepur) and Shiwalik foot hill plain (Sukhomajri) was initiated in Feb. 1997. The survey indicated that, conceivably, aquaculture development in Himalayas can take pressure off the fragile ecosystem, where the existing agriculture suffers from on-site and off-site effects of deforestation, soil erosion and nutrient loss, especially in monsoon and unsustainable farming practices such as cultivation along the slope and extensive monoculture. Although aquaculture and water harvesting are two age-old intervention points with many positive influence on socio-economic development they have been currently restrained by various biological, structural and watershed perplexities particularly in Himalayan regions. If watershed based promotion, for the efficient utilisation of natural resources in integration with other sectors of upland economy, promoting Integrated Farming Systems (IFS), is adopted a quantum jump in fisheries yield and thereby better socio-economic conditions would be automatically assured. This, however needs an array of efforts to overcome the confronting problems through identified researchable issues.

Naithani, Ajay K.; Nainwal, H.C.; Sati, K.K. and Prasad, C. 2001. Geomorphological evidences of retreat of the Gangotri glacier and its characteristics. *Current Science*, 80(1): 87-94. Department of Geology, HNB Garhwal University, Srinagar, Garhwal 246174, India. [GANGOTRI GLACIER; MAIN CENTRAL THRUST; MICRO-CLIMATIC CONDITION]

The Gangotri glacier which has the 258.56 km² of glacierized area is receding as evidenced by various geomorphological features and morphometry parametric. Because of subsidence and the fast degenerating nature of the glacier, middle part of ablation zone is full of supraglacial lakes. The study shows that retreat was much slower before, compared to what was after 1971. Series of hummocky moraines indicate a faster retreat of the ice.

Nath, B.K.; Singh, C.K. and Sinha, A. 2000. Distribution of the ABO and RH blood groups in ADI (mixed) tribal population of Arunachal Pradesh. *J. Hum. Ecol.*, 11(6): 493-494. Department of Zoology, J.M. College, Pasighat 791103, Arunachal Pradesh; Department of Zoology, V.K.S. University, Ara 802301, Bihar. [ARUNACHAL PRADESH; BLOOD GROUPS; ENDOGAMOUS POPULATION;

POLYMORPHISM]

Distribution of the ABO and Rh blood groups among the Adi (mixed) tribal population of East Siang District, Arunachal Pradesh was studied. The prevalence of blood group frequencies, A>O>B>AB, was fairly similar to that of their Mongoloid stock from South China. These frequencies have not changed very much from earlier reports despite the inter-tribal and tribal-nontribal marriages in recent years.

Nath, Sankar Kumar; Sengupta, Probal; Sengupta, Saradindu and Chakrabarti, Amitabha 2000. Site response estimation using strong motion network: A step towards microzonation of the Sikkim Himalayas. *Current Science*, 79(9): 1316-1326. Department of Geology & Geophysics, Indian Institute of Technology, Kharagpur 721302, India. [EARTHQUAKE; GEOTECTONIC CONDITION; MAIN CENTRAL THRUST; SEISMIC HAZARD]

Site response in the Sikkim Himalayas is studied using digital accelerograms recorded by a seven-station-strong-motion network, established to monitor the earthquakes in the region in an effort to microzone the area. Depending on the criterion that signal-to-noise ratio must be ≥ 3 , out of more than fifty earthquakes recorded during May-August 1999, only fifteen events are chosen for the non-reference-receiver-function-type estimate of the site amplification factors. Site response curves (with ± 2 standard deviation uncertainty) at all the seven sites and the contour maps at central frequencies 1,3,5,7,9 and 11 Hz show station to station variation of the site factors at different frequencies, reflecting the changes in geologic/geotectonic/soil conditions. The nonlinearity of the site factor is also observed due to its strong frequency dependence. Results of this investigation reveal the significance of site response studies in the microzonation for seismic hazard assessment.

Pande, P.K.; Negi, J.D.S. and Sharma, S.C. 2000. Species diversity, turn-over and resource apportionment among various plant species in a Western-Himalayan forest. *The Indian Forester*, 126(7): 727-741. Centre for Forestry Research and Human Resource Development, Chhindwara, Madhya Pradesh, India; Division of Ecology and Environment, Forest Research Institute, Dehradun, India. [BIODIVERSITY; BROADLEAF FORESTS; DIVERSITY INDEX; HIMALAYAN FORESTS]

In this paper, species diversity, species turn-over and resource apportionment among the various species at selected sites of Western-Himalayan forest situated at Sandev, Distt. Pithoragarh (U.P.) are described. The whole area is divided into four sub sites as per their aspect, altitude and vegetation. In general, *Quercus leucotrichophora*, *Pieris ovalifolia*, *Rhododendron arboreum*, *Alnus nepalensis* and *Macaranga denticulata* dominate the site except site-III, where *Pinus roxburghii* forms its community with *P. ovalifolia* and *R. arboreum*. The density value range (plant/100m²) was 6.37-12.37 for tree layer; 21-74 for shrubs and 6182-11400 for herb layer. Total basal cover (cm²/100m²) ranged in between 1986-4612 for tree layer; 17-50 for shrubs and 246-497 for herbaceous layer. Diversity-index is higher for herbs and lowest for trees. Site-IV is more diverse than of the other sites for trees and shrubs while site-II is more diverse than of the other sites as far as herbs are concerned. Site-III and IV are the more similar sites whereas site-I and IV showed least similarity. In general, log and log-normal distribution of species is followed by most of the sites for all the life-forms, which is indicative of higher interspecific competition among the various species at their respective sites.

Philip, G. and Mazari, R.K. 2000. Shrinking lake basins in the proximity of the Indus Suture Zone of northwestern Himalaya: a case study of Tso Kar and Startsapuk Tso, using IRS-1C data. *Int. J. Remote Sensing*, 21(16): 2973-2984. Wadia Institute of Himalayan Geology, 33-Gen. Mahadeo Singh Road, Dehradun 248001, India. [INDUS SUTURE ZONE; REMOTE SENSING; SATELLITE DATA]

The study of active tectonics in Himalaya is important as this helps to understand the style of evolutionary process of this gigantic mountain system in more specific terms. The formation of lakes, regarded as the crown stage development of an orogenic belt, is an impressive geomorphic feature that adorns the Himalayan belt end to end. Tso Kar and Startsapuk Tso are the two ancient lakes that lie south of the Indus Suture Zone in the northwestern Himalaya. An attempt has been made to map to the former extent to these lakes, using remote sensing techniques, for providing vital clues in elucidating the paleo-environmental conditions under which these water bodies were developed. It is observed that the dimension of these lakes

has constantly fluctuated in time due to ongoing compression in the collision regime and possible climatic influences that have been recorded on a large scale globally. An added advantage of this study has been to evaluate the high spatial resolution data of the Indian Remote Sensing Satellite (IRS-1C) for geomorphological, lithological and structural inferences in the arid, inaccessible and complex terrain like the northwestern Trans Himalaya.

Raina, J.N. and Kumar, Pardeep 2000. Physico-chemical characterization and fertility status of some forest nursery soils of district Sirmour in Himachal Pradesh. *The Indian Forester*, 126(6): 657-663. Department of Soil Science and Water Management, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. [NURSERY; SANDY-LOAM; SOIL FERTILITY]

The present study was undertaken to determine physico-chemical properties and fertility status of some forest nursery soils of district Sirmour in Himachal Pradesh. Analysis of surface and sub-surface soil samples collected from the nurseries was carried out. The soil pH was found neutral and electrical conductivity was in safe limits (less than 0.8 dsm^{-1}). The CEC values ranged between 7.1-16.8 cmol/kg soil and were higher in surface soils as compared to sub-surface soils. Organic carbon status was rated medium, while available N,P and K were categorized as low to medium, high and medium, respectively. Available Ca and Mg were in adequate amounts and $\text{SO}_4\text{-S}$ was found high. In order to have healthy nursery seedlings, there is a need to apply recommended doses of chemical fertilizers in conjunction with organic manures, however, phosphatic fertilizer application can be reduced by 25 per cent of recommended dose.

Raizada, A. and Samra, J.S. 2000. Rehabilitation of an abandoned limestone mine in the lower western Himalayas - Impact assessment on vegetation development and floristic diversity. *The Indian Forester*, 126(8): 842-855. Central Soil and Water Conservation Research and Training Institute, Dehradun, India. [BIO-ENGINEERING; DIVERSITY INDEX; FLORISTIC DIVERSITY; LIMESTONE MINE]

Rehabilitation of mine spoiled areas through suitable bioengineering measures and allowing natural succession of vegetation to progress is an essential step towards ecosystem recovery. In this paper, the effect of such measures accompanied with protection of an abandoned limestone mine have been described. Development of vegetation and its phytosociological characteristics were compared with an adjoining but slightly disturbed natural forest situated in the lower sub-humid Himalayan region. In the rehabilitated area, an introduced species *Leucaena leucocephala*, had the highest Importance Value Index (IVI) of 66.05, followed by a sedge species *Eriophorum cosmosum* (IVI 58.85) and *Acacia catechu* (IVI 51.85). The area also supported a significant growth of *Thysaloena maxima* and *Saccharum spontaneum*. In the adjoining non-mined forest, the highest IVI value was recorded for *Corchorus laurifolius* (55.98), followed by *Mallotus philippensis* (47.55), *Murraya koenigii* (38.71) and *Bauhinia retusa* (37.02). These species, which are associates of *Shorea robusta* forests, are valuable fodder species in the region specially during the winters, and were, therefore, not harvested while timber yielding species like *Shorea robusta* and *Toona ciliata* are now totally absent from the area. Cluster analysis and ordination by Principal Component Analysis (PAC) revealed distinct loading of plots along different axis due to an underlying edaphic gradient, external seeding and soil moisture availability. Diversity (H') of tree species in the natural forest was higher than the rehabilitated area, which otherwise had higher diversity values for shrubs and grasses. It is suggested that existing levels of biotic disturbances be restricted for some more time to provide an opportunity for late colonizers to establish themselves in the area.

Ramprasad, B.K.; Miral, M.S.; Pant, R. and Rao, K.S. 2000. Identification of potential water harvesting sites using GIS & remote sensing technologies: a case study of Sadiyagad watershed, central Himalaya, India. In: *Integrated water resources management for sustainable development. 1 ed. (Eds: Mehrotra, R.; Soni, B. and Bhatia, K.K.S.) National Institute of Hydrology, Roorkee, 1224-1233. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, India. [GIS TECHNOLOGY; REMOTE SENSING; SATELLITE DATA; WATER HARVESTING]*

The identification of water resources and its proper management practices are very essential with respect to the population growth and their increasing needs. Geographical Information Systems (GIS) and Remote Sensing (RS) are powerful tools to manage and analyze spatially distributed information. ArcView, a

powerful desktop GIS to visualize, update, analyze geographic information, and create quality presentations that brings the power of interactive mapping and analysis, was used in the present study. An attempt was made for the identification of potential water harvesting sites which can fulfill both the drinking and irrigation needs of the population living in the Sadiyagad watershed. The GIS and Remote Sensing techniques provided the base information on the land-cover and land use maps, the pattern and placement of villages, forest, agricultural land and road network. Using an elevation contour map prepared in ArcInfo (version 3.4); a Digital Elevation Model (DEM) was prepared in ArcView (version 3.0) on a desktop computer system. From the DEM model we have development models for Flow Direction, Flow Accumulation, Stream Channel and finally Unique Basins to split the whole watershed into 9 basins. Spring criteria and stream criteria maps were developed using the land use and infrastructure maps to reach our final target of finding the suitable sites for the construction of storage tanks. In all 40 sites were identified which could be developed for harvesting runoff water for the purpose of irrigation and other domestic uses. Out of these, 21 sites are within 100m from the road and easily accessible; about 50Km² area can be irrigated within 1/2km distance from these potential sources in the Sadiyagad watershed.

Rana, R.S. and Singh, L.N. 1999. **Eradication of *Lantana camara* and wasteland utilization in KANDI region of Himachal Pradesh.** *Indian J. Soil Cons.*, 27(2): 137-140. Regional Research Station, H.P.K.V. Dhaulakuan, Distt. Sirmour 173 001, H.P., India. [CHEMICAL CONTROL; GRASS PRODUCTION; HIMACHAL PRADESH; LANTANA CAMARA; WASTELAND]

An experiment of *Lantana camara* eradication for utilization of wasteland was conducted in two sub-watersheds of Markanda catchment in Kandi region of Himachal Pradesh. Chemical control of *L. camara* with 1 per cent Glyphosate (41% a.i) spray in September or October on regenerated *L. camara* growth which had been cut earlier (5-8 cm above ground level) in the month of May and June was found to be most effective and economical. From *L. camara* controlled area, mean green fodder yield of 17.6 and 11.9 t ha⁻¹ was obtained with fertilizer application @40 kg N and 20 kg P₂O₅ per hectare and no fertilizer application respectively. The net returns from the green grass yield in *L. camara* controlled area from the second year onwards is Rs 6000 ha⁻¹ and with fertilizer application higher returns of Rs. 8000 ha⁻¹ could be obtained.

Rana, Rajesh K.; Kaushal, P. and Negi, Y.S. 2000. **Benefit - cost analysis of agro-forestry trees in eroded soils - a case study of Upper-Swan catchment in district Una (H.P.).** *The Indian Forester*, 126(12): 1297-1308. Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. [AGRO-FORESTRY; ERODED SOILS; FODDER; FUEL-WOOD]

Establishment of successful agro-forestry plantations in fragile eco-systems such as eroded soils is a difficult job as it involves relatively higher cost and generates less returns. Site specific benefit-cost studies for plantations on such sites thus are important. The present study was undertaken in the Upper-Swan river catchment area of Una District in Himachal Pradesh. This catchment area is peculiar for its eroded soils. Tree species, *Dalbergia sissoo*, *Albizia lebbek*; *Toona ciliata* and *Grewia optiva* were considered for analysis. Plantation being sparse the calculations were done on per 100 tree basis at relatively higher (12%) rate of returns. Results indicated that the plantations under consideration were profitable as both, Net Present Worth (NPW) and the Benefit-Cost ratio (B-C ratio) criteria testify it. *Grewia optiva* being very popular and useful fodder species of the area, yielded the highest NPW (Rs. 11,644) followed by *Dalbergia sissoo* (Rs. 5,611), *Toona ciliata* (Rs. 5,155) and *Albizia lebbek* (Rs. 3,350). However, the B-C ratio was found to be the highest for *Dalbergia sissoo* (2.59) followed by *Toona ciliata* (2.58), *Grewia optiva* (2.35) and *Albizia lebbek* (1.97).

Rao, K.S.; Nautiyal, S.; Maikhuri, R.K. and Saxena, K.G. 2000. **Management conflicts in the Nanda Devi Biosphere Reserve, India.** *Mountain Research and Development*, 20(4): 320-323. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643; G.B. Pant Institute of Himalayan Environment and Development, Garhwal Unit, P.O. Box 92, Srinagar 246174 (Garhwal); School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110067, India. [BIODIVERSITY; BIOSPHERE RESERVE; BUFFER ZONE; MANAGEMENT]

Biosphere reserve models around the world are becoming increasingly people-oriented and conservation-conscious in achieving their objectives. However, reserves established in developing countries,

such as the Nanda Devi Biosphere Reserve in India, are facing management versus people conflicts due to the insensitivity of management to both genuine and irrational demands coming from people who are motivated by potential economic benefits. The present case study focuses on the issue of crop and livestock depredation by wildlife as a major source of conflict. Feasible solutions in the given socio-economic context are outlined here; some of these are being tested by the authors in the study area. The results are expected to provide more sustainable livelihood measures and stimulate greater participation in conservation programs.

Rawat, G.S. and Bhainsora, N.S. 1999. Woody vegetation of Shivaliks and outer Himalaya in north western India. *Tropical Ecology*, 40(1): 119-128. Wildlife Institute of India, P.B. 18, Chandrabani, Dehradun 248001, India; Kendriya Vidyalaya, Forest Research Institute, P.O. New Forest, Dehradun 248001, India. [BHABAR TRACT; DOON VALLEY; SAL REGENERATION; SHIVALIK HILLS; SPECIES DIVERSITY]

Structure and composition of forests across the Shivaliks, Doon Valley and outer Himalaya in Dehradun District, North Western India were studied using stratified random plots. Richness of woody species, Importance Value Index (IVI) of trees, and regeneration of sal (*Shorea robusta* Gaertn.), the climax species of the region, have been compared. Based on 'TWINSPAN' analysis 17 groups or tree associations were segregated with Eigen values ranging from 0.216 to 0.729 which largely follow increasing rainfall and moisture gradient. Absence of *Anogeissus latifolia* in the outer Himalaya marked the difference from the tree associations of other two zones. The richness of woody species was highest in Shivaliks (62) followed by Doon Valley (56) and outer Himalaya (54). Of 1001 individuals of sal measured for GBH, the pole size (10-20 cm girth class) formed about 4% of the population. Outer Himalaya had significantly higher density of sal saplings (<10 cm girth class) compared to Shivaliks (paired $t=2.62$ $p < 0.05$) and Doon Valley ($t=2.29$ $p < 0.05$) but the latter two zones were similar in sapling densities. Sal attained highest girth in Doon Valley ($X_{...}=126.2 \pm 12.3$ cm) and lowest in the outer Himalaya ($X_{...}=56.0 \pm 6.4$ cm). Within Shivalik the tree densities (ha^{-1}) varied among valley bottom (260.9 ± 64.1), middle slope (265.7 ± 77.9) and Shivalik ridge (254.6 ± 100.7). However, tree densities in Doon Valley (640.0 ± 253.9 ha^{-1}) and outer Himalaya (643.7 ± 257.7 ha^{-1}) were much higher compared to Shivaliks. Areas disturbed due to lopping and cutting, particularly in Doon valley and outer Himalaya were dominated by *Lantana camara* Linn., and exotic shrub. Though *Lantana* thickets seem to protect sal seedlings from the frost and other injuries, overall plant species diversity was very low in such areas. Influence of terrain, topography and protection has been discussed along with the conservation implications.

Ray, P.N. 2000. Status of joint forest management in Tripura. *The Indian Forester*, 126(5): 483-492. Principal Chief Conservator of Forests, Tripura, India. [JOINT FOREST MANAGEMENT; MANAGEMENT STRATEGY; MINOR FOREST PRODUCTS; RURAL DEVELOPMENT]

The Joint Forest Management programme was initiated in Tripura in December, 1991 and since then there has been reasonable progress in involving the people living around the forests to protect and improve the forests and in their share the benefits therefrom. It was at first initiated in Melaghar, West Tripura District and resulted in turning the barren lands into verdant forests with protection made available by Forest Protection and Regeneration Committees. Upto Dec. 1999, 165 such committees have been formed which protect 18,566 ha of forest land. A few microplans have been prepared which intend to provide aided natural regeneration. Plantation of bamboo and other species, underplanting of canes, plants of medicinal value etc. have been undertaken. Benefits have come as bamboos fuelwood, honey, minor forest produce, leaves etc. although the programme is still in its infancy. The committees formed are vulnerable as they have no force of law. Moreover forest produce is required to be cultivated to increase income of the members of the committees, but there are no such plans so far. The constitution and the bylaws of the committees are yet to be framed. Forest offenses in such managed areas are not covered by laws except the Indian Forest Act. Mechanism for the distribution of benefits is still to be worked out and there is the paucity of funds for this programme. Flexibility in taking up works is also needed. Smuggling across the border is cause of concern. Coordination with other agencies is necessary because the benefits from such management are usually lower than benefits available from other agencies programmes. Territorial confusion with administrative unit exists. Law and order problems also handicap free working in the field. Such issues need to be looked into to attain

success. The programme should commence from selected areas as Joint Forest Management is still evolving and neither the staff nor the people are ready to take it up everywhere. Positive benefits in selected areas are likely to enthuse all concerned. The staff should be trained in this new concept. Coordination committees should be formed at all levels and ensure participation of different govt. departments, professionals, NGOs and eminent persons. A network, if formed, will definitely make JFM an effective tool for forest conservation and rural development. Operational methodology should be worked out satisfactorily e.g. coordination between Panchayats and FRRCs. The Committees should also create own funds for the sustained working of the programme when Govt. assistance will not be available to them.

Rikhari, H.C. and Palni, L.M.S. 1999. **Fire affects ground flora dynamics of forest ecosystem: A case study from Central Himalaya.** *Tropical Ecology*, 40(1): 145-151. G.B. Pant Institute of Himalayan Environment and Development, Kosi, Almora 263643, India. [BIOMASS; CENTRAL HIMALAYA; FIRE-WOOD; PRODUCTIVITY; TURNOVER TIME]

This study deals with the impact of a fire event on ground flora dynamics (composition, diversity, biomass, productivity and turnover) of oak mixed broadleaf forest ecosystem within Binsar Wildlife Sanctuary (2500 m amsl; 29°39'-29°44'N lat and 79°41'-79°49'E long) of Central Himalaya. A change in some of the dominant ground vegetation species, and diversity was recorded following a fire event. Except for total nitrogen and organic carbon, values for phosphorus, potassium and pH were also affected by fire. The live above-and belowground biomass increased from February and was maximum in September and October, respectively. Shoot: root ratio for different seasons, i.e., winter, summer and rainy was higher for fire affected site compared to unaffected site. Values of total net primary productivity in fire affected and unaffected sites were 330 and 48 g m⁻², respectively. Turnover rate of belowground parts and total biomass in the fire affected site were much less in comparison to the unaffected site (belowground 0.28 and 0.83; total biomass 0.56 and 0.94, respectively).

Rikhari, H.C.; Sharma, S.; Nadeem, M. and Palni, L.M.S. 2000. **The effect of disturbance levels, forest types and associations on the regeneration of *Taxus baccata*: Lessons from the Central Himalaya.** *Current Science*, 79(1): 88-90. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [BROADLEAF FORESTS; SEED GERMINATION; TAXUS BACCATA]

Taxus baccata L. subsp. *wallichiana* (Zucc.) Pilger has come into prominence in recent years because of its over exploitation from the Himalayan forests for pharmaceutical drugs. Despite wide elevational distribution (1770-3400 m elevation), it never forms extensive stretches and commonly occurs as undercanopy species. Further, it is an extremely slow-growing tree with poor seed germination. Along the disturbance gradient *Taxus* shows different population patterns. Least disturbed mixed broadleaf forest association shows stable population. The number of seedlings was related to crown cover and soil pH. The size class distribution of *T. baccata* population indicates that this species is on its way out at the study site. The threat is not only because of excessive harvesting but also due to degradation of forest sites for other reasons.

Sahoo, P.K.; Kumar, Sandeep and Singh, R.P. 2000. **Neotectonic study of Ganga and Yamuna tear faults, NW Himalaya, using remote sensing and GIS.** *Int. J. Remote Sensing*, 21(3): 499-518. Department of Civil Engineering, Indian Institute of Technology, Kanpur 208016, India. [EARTHQUAKE; LANDSLIDE; REMOTE SENSING; TECTONIC ZONE]

The Ganga and Yamuna rivers emerge from the Himalayas along two major faults known as the Ganga and Yamuna Tear Faults respectively. The two major strike-slip faults transverse to the Siwalik range are clearly seen in satellite imagery of the Dehradun area. Earthquake records, landslide and recent changes in geomorphological features indicate that the area between the Main Boundary Thrust and the Main Frontal Thrust is tectonically active. An effort has been made to study the tectonic evolution and neotectonism of the Ganga and Yamuna tear faults. Spectral and spatial enhancement techniques have been employed to the digital data of IRS-1B LISS-I to delineate the lineaments and major faults of the area. Based on Mohr's theory, failure criteria and statistical analysis of remotely sensed lineament data, horizontal compressive stress

values (S_{Hmax}) have been estimated at various sites of the study area. These data are found to be consistent with the published (S_{Hmax}) orientation determined from earthquake focal mechanism solutions. Active faults and lineaments have been extracted from the remotely sensed lineament data. Past earthquake data and depth to basement contour data have been used in an integrated approach with available Geographic Information System (GIS) techniques to reconstruct a present-day regional geodynamic model. Attempts have been made to investigate the genesis of Ganga and Yamuna Tear Faults and possible causes of recent tectonic activities of the area with the help of the proposed geodynamic model.

Saini, R.P. 2000. **Medicinal plants of Darjeeling hills - A study by silviculture (Hills) division, Darjeeling.** *The Indian Forester*, 126(8): 822-837. Divisional Forest Officer, Working Plan Division (N), Darjeeling, West Bengal, India. [BIODIVERSITY; MEDICINAL PLANT; SILVICULTURE]

The forest areas are well endowed with plants having useful medicinal properties very well recognised by village and tribal people. Generally the village folks even now cure their ailments by treatments from such plants having medicinal value. Efforts were taken during 1997-1999 by Silviculture (Hills) Division, Darjeeling to raise different medicinal plants collected from forest areas on the basis of information extended by local people. Since 1997 nurseries have been started at different Ranges of the Division viz. Lava, Sukna, Bhuttabari Kalijhora, Sonada and Lloyd Botanical Garden, Darjeeling to raise medicinal plants and study various information on the parts of plants used flowering time, fruiting time, seedling, method of propagation and above all ailments for which it is applicable has been gathered and stated for ready reference in this article.

Saraf, A.K.; Goyal, V.C.; Negi, A.S.; Roy, B. and Choudhary, P.R. 2000. **Remote sensing and GIS techniques for the study of springs in a watershed in Garhwal in the Himalaya, India.** *Int. J. Remote Sensing*, 21(12): 2353-2361. Department of Earth Sciences, University of Roorkee, Roorkee 247667; National Institute of Hydrology, Roorkee 247667, India. [GROUND-WATER; REMOTE SENSING; SATELLITE DATA]

Water has been described as the elixir of life the source of energy that sustains life on earth and the factor that governs the evolution and the functioning of the universe. Increased use of water in the face of the impairment of the natural environment and ecology and the drying up to springs and reduction in their discharge and those of streams in the Lesser and Outer Himalayas are the most serious problems calling for study and exploration of groundwater resources in the Himalayan region. The hilly regions of India are facing a serious water availability crisis, particularly during summer months. Viable sources of water such as springs in the Himalayas, which are plentiful in the hills, are drying up due to rapid and unplanned developments. The present study deals with the delineation of springs in the Chandrabhaga watershed using remote sensing and GIS technologies. The study demonstrates that the coincidence of lineaments derived from merged satellite data, and the drainage density show good correlation with the present spring locations in the Chandrabhaga watershed. The study shows also that the locations of various springs have changed since 1981 perhaps due to rapid changes in the landuse pattern in the watershed between 1981 and 1997. Besides landuse, topography, geology and geological structures are among the most influential factors affecting spring location and discharge. An integrated approach of remote sensing and GIS is proved to be an efficacious technique for the study of springs in a mountainous watershed.

Satapathy, K.K. and Dutta, K.K. 1999. **Revegetation of eroded hill slopes - An experience with geojute in Arunachal Pradesh.** *Indian J. Soil Cons.*, 27(3): 227-233. ICAR Research Complex for NEH Region, Umiam 793 103, Meghalaya, India. [ARUNACHAL PRADESH; ERODED HILL SLOPES; REVEGETATION; VEGETATIVE MEASURES]

Landslides in road risers, agricultural land, stream lines in the hill areas of Arunachal Pradesh is a common but destructive phenomenon specially during the rainy season. A pilot project on "Revegetation of badly eroded land by use of Geojute and other material" was undertaken in the eroded sliding area during the years 1991-95. The effect of Geojute materials in stabilizing and revegetation of the badly eroded lands were evaluated. Geojute nets were used to cover the eroded surface over which different plant species were planted in different treatments. Besides Geojute nets, materials like Netlon and wiremesh were also used in critical

areas to prevent further erosion over the slide surfaces. The areas were further guarded with a series of gabion structures at the lower reaches of the slopes and across the waterways. *Ipomea carnea* (*besharam*) was observed to be the first to establish followed by *Thysanolaena maxima* (broom grass). Geojute material could prevent surface erosion and provided support temporarily for new vegetation to establish over the eroded area up to a period of 6 months (one rainy season), provided the material was laid out properly, species planted timely and free grazing of animal was prevented in the treated area. Series of gabion structures constructed at the lower reaches of the slide area and across the waterways facilitated silt deposition to the extent of 1478 m³, in the uphill stages of the waterways, further strengthening the stability of the area treated with Geojute material. The material was found suitable in area with low and medium slopes where erosion is caused mainly by surface runoff. However, in areas where the land slide is caused by sub-surface flow, the material could not prevent the slide. Geojute was found more advantageous to use in comparison to other materials e.g. Netlon and wiremesh, due to its drapeability character, whereas other materials could not be used effectively over eroded surface having exposed stony material.

Shamet, G.S. 2000. Vegetative propagation of Chir Pine (*Pinus roxburghii* Sargent) through stem cuttings and basal sprouts. *Indian Journal of Forestry*, 23(1): 36-40. Department of Silviculture and Agroforestry, Dr. Y.S. Parmar University of Horticulture & Forestry, P.O. Nauni-Solan 173230 (H.P.). [PINUS ROXBURGHII; SEEDLING; VEGETATIVE PROPAGATION]

The study was conducted to determine the effect of various auxin formulations on rooting behaviour of seedling, ramet and sprout origin cuttings in *Pinus roxburghii*. Significantly high rooting of 71.4 per cent and 61 per cent was obtained when seedling origin cutting were treated with auxin formulation (IBA, NAA) and struck in summer (May) and rainy season (July) respectively. While first cycle ramet cuttings produced 49.9 per cent success in rainy season, the sprout cuttings from 15-yr old chir trees produced highest rooting of 81.5 per cent in mist when such cuttings were treated with 7500 ppm NAA-Ac during summer.

Sharma, A. and Deka, P.C. 2000. Studies on genetic variability in *Bambusa* germplasm through isozyme analysis. *Journal of Non-Timber Forest Products*, 7(1/2): 53-58. Department of Agricultural Biotechnology, Assam Agricultural University, Jorhat 785013. [BAMBOO; ENZYMES SYSTEM; GENETIC VARIABILITY; GERMPLASM]

Eighteen different bamboo germplasm involving eight species of *Bambusa* were collected from different parts of North-east India. Analysis of glutamate oxaloacetate transaminase (GOT), peroxidase (PER) and esterase (EST) isozymes were carried out utilising leaf samples collected from these germplasm through vertical polyacrylamide gel electrophoresis. All the biotypes could be discriminated on the basis of their isozymic banding patterns. There was no total uniformity in the genotypes of biotypes in most of the species. From high to negative affinity was recorded between different *Bambusa* species in the Pearson Similarity Co-efficient Matrix. In UPGMA cluster analysis the species were separated into two groups. Widely cultivated species were separated from the species cultivated in localized geographical areas.

Sharma, J.K. 2000. Morphological studies on Apricot and its wild relatives. *Journal of Hill Research*, 13(1): 5-10. Department of Fruit Breeding and Genetic Resources, Dr Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173230, Himachal Pradesh. [POLYGRAPHS; VEGETATIVE CHARACTER; WILD GROWING PLANT]

A critical morphological comparison of three wild forms of apricot relatives viz. chulli, suhara and zardalu was carried out among themselves as well as with apricot cv. New Castle. The studies revealed that both chulli and suhara were found quite different from apricot whereas zardalu was found similar to apricot. Both chulli and suhara need to be classified as separate botanical varieties of *Prunus armeniaca* L. However, zardalu should be treated as *Prunus armeniaca* L.

Shirkot, C.K.; Jaiswal, S.; Shirkot, P. and Sharma, Shallu 2000. Greenhouse evaluation of effectiveness of *Rhizobium* strains for *Acacia catechu* Willd. in mid-hills of Himachal Pradesh. *Journal of Hill Research*, 13(1): 1-4. Department of Basic Sciences and Biotechnology, Dr Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173230, Himachal Pradesh, India. [ANTIBIOTIC; GREEN-

HOUSES; NITROGEN FIXING; SANDY-LOAM]

A total number of forty two rhizobial were tested for their symbiotic effectiveness with *Acacia catechu* Willd. Under sterilized soil conditions. Four isolates Sn-20, Nn-63, Uf-76 and Nr-94 were found highly effective in increasing the early growth of seedlings in green house. Isolate Sn-20 showed more than 250% symbiotic effectiveness over the uninoculated nitrogen control as it produced highest root weight and shoot dry weight. The isolate Sn-20 also possessed a differentiating intrinsic antibiotic resistance marker.

Singh, Arun P. 2000. **Nectar feeding insects on *Paulownia fortunei* blossoms: Evaluating potential nototribic pollinators.** *The Indian Forester*, 126(11): 1179-1186. Entomology Division, Forest Research Institute, Dehradun, India. [BIOMASS; INSECTS; NECTOR FEEDING; POLLINATION]

Pollination potential of different families of insects, visiting *Paulownia fortunei* (Scrophulariaceae) flowers nototribically nectar feeding, was determined for the three time periods (forenoon, afternoon and evening) of the day at New Forest (78°00'E and 30°20'N), Dehradun, India, during its peak flowering period (22nd-28th March 2000). Comparative pollination potential was determined on the basis of three parameters (i) duration of time period spend for nectar feeding, (ii) the mean height of insects dorsum from the ground, in relation to the mean vertical diameter of the corolla tube at the point of placement of anthers and stigma in it, taken for assessing its potential in making contact with the anthers (pollen) and stigma, and (iii) the presence or absence of hairs on the dorsum of the insect considered for estimating its potential to brush, carry pollen from the anthers and deposit it on the stigma. Twelve species of insects consisting representing five families [Xylocopidae (1), Bombidae (1), Apidae (3), Vespidae (3) and Syrphidae (4)], were sampled. The duration of time spent by the different families on *P. fortunei* blossoms varied significantly (a) in general ($CD_{(0.05)} = 1.22$; Xylocoopidae > Apidae > Syrphidae > Vespidae > Bombidae), (b) with respect to the three individual time periods ($CD_{(0.05)} = 0.94$; forenoon > afternoon > evening) and (iii) also with respect to the interaction between two (a) and (b) ($CD_{(0.05)} = 2.11$; maximum duration of time spent by Xylocopidae, Apidae and Bombidae was in the forenoon and for Vespidae and Syrphidae it was in the afternoon]. On the basis of the physical body structure and size (last two parameters) only two families [Xylocopidae (*Xylocopa fenestrata* Fabr.) and Bombidae (*Bombus haemorrhoidalis* Smith)] out of five, were determined as suitable potential pollinators of *P. fortunei* flowers. As, Xylocopidae spent more duration of time than Bombidae (first parameter) for nectar feeding on these blossoms, hence its role in pollination of *P. fortunei* was greater than Bombidae.

Singh, D.N. 2000. **Status of black-necked cranes in Arunachal Pradesh.** *The Indian Forester*, 126(10): 1136-1140. Field Director, Namdapha Tiger Reserve, Arunachal Pradesh, India. [APATANI PLATEAU; ARUNACHAL PRADESH; BLACK-NECKED CRANE]

The black-necked Cranes arrive in Arunachal Pradesh during winter months to keep away from cold climate of Tibet. They have been reported in the past from Gandhigram and Apatani plateau areas of the state but at present they are restricted to Santhi valley and Zemithang areas only. The present paper is a study on its range, status and behaviour in Arunachal Pradesh.

Singh, Jayendra and Yadav, Ram R. 2000. **Tree-ring indications of recent glacier fluctuations in Gangotri, western Himalaya, India.** *Current Science*, 79(11): 1598-1601. Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow 226007, India. [GANGOTRI GLACIER; TREE-RING]

A 410-year-old (AD 1590-1999) ring-width chronology of Himalayan pine (*Pinus wallichiana*) based on large replication of samples derived from a pure, mixed age stand growing on thick soil with almost even topography near Chirbasa, Gangotri has been developed. This makes the longest chronology of this species developed so far from the Indian region. The chronology shows abrupt surge in tree growth during the late 20th century, with the highest growth indices recorded in the 1990s. Strong correlation noted between tree growth and winter temperature shows that the winter warmth is one of the main factors responsible for the twentieth century growth surge. This growth surge is closely associated with the area vacated by the Gangotri glacier. Low growth prior to the 1950s reflecting cooler conditions indicates that the glacier should have been stationary for a long time with some episodic advances.

Singh, Lakhan; Sinha, B.P. and Rao, D.U.M. 1999. Critical negligence of people's participation - A case study of Uniyal gaon. *Indian J. Soil Cons.*, 27(3): 254-257. Central Soil & Water Conservation Research & Training Institute, Dehradun 248195, India. [MISANTHROPY; PEOPLE'S PARTICIPATION; REVOLVING FUND; VILLAGE INSTITUTION]

Watershed Management Projects were started to arrest and reverse the trend of natural resource degradation and regenerate natural resources. The present investigation was conducted in Uniyalgaon under Doon Valley Integrated Watershed Management Project (Tehri Garhwal) Uttar Pradesh. The data collected were through personal interaction informal group discussion and recorded conversations. The results revealed that the villagers have a feeling of getting the subsidized items as free dole as 'their right'. The poor villagers were not given an equal opportunity to benefit from the afforestation work done in the common property of the village. The project functionaries were found to be not responsive to the needs and suggestions of the villagers. The executive committee members of *GAREMA* (village institution) had short vision of getting some personal gains but did not see common good of the society.

Singh, R.K.; Rawat, G.S. and Dhawan, S. 2000. A study on preparation and chemical analysis of compost using different organic matters. *The Indian Forester*, 126(8): 809-813. Silviculture Division, Forest Research Institute, Dehradun. [C/N RATIO; FARM YARD MANURE; ORGANIC MATTERS]

The Forest Research Institute, Dehradun has prepared compost by using variety of organic matter by using the Berkeley method. The compost so prepared was analyzed and the results of the analysis have shown that all the composts prepared have nutrients in substantially higher quantities and they are considerably better than Farmyard Manure and the compost being generally prepared.

Singh, S.P.; Tewari, Ashish; Singh, S.K. and Pathak, G.C. 2000. Significance of phenologically asynchronous populations of the central Himalayan oaks in drought adaptation. *Current Science*, 79(3): 353-357. Department of Botany, Kumaun University, Nainital 263002, India. [HIMALAYAN OAKS; LEAF PRODUCTION; LEAFING POPULATION]

In this paper we describe asynchrony in leaf production of the two major central Himalayan oaks *Quercus floribunda* and *Q. leucotrichophora* with major focus on their adaptational significance to an unusually severe drought of 1999. In each oak, early and late leafing populations were differentiable and individuals of such types could occur adjacently. However, by and large, they tend to occupy different microsites, early leafing concentrating on moist microsites and late leafing on drier ones. Analysis of association between the two populations within each oak indicated that there was no significant association in distribution. The study provides some direct evidence of adaptational significance of having asynchronous populations. The capacity of the late leafing population of *Q. floribunda* to employ high osmotic adjustment during the drought, and protecting buds even when leaves were dry and dead enabled them to survive the severe drought of 1999.

Singh, Sadhna; Kalia, Manoranjan and Malhotra, Sumati Rekha 2000. Effect of addition of popped amaranth flour on sensory and nutritional quality of babbar. *J. Hum. Ecol.*, 11(5): 359-361. Department of Food Science and Nutrition, Himachal Pradesh Krishi Vishvavidyalaya, Palampur 176062, H.P., India. [NUTRITIONAL QUALITY; SENSORY EVALUATION; TRADITIONAL RECIPES]

Babbar - a traditional rice based product of Himachal Pradesh, also known as ankalian or cheelai was prepared. An attempt was also made to improve its nutritional quality through the addition of popped amaranth flour. The results revealed that the addition of popped amaranth flour into rice flour reduced the colour, texture and taste scores. But, they still scored fair on the ten point hedonic scale. The addition of popped amaranth flour into raw and parboiled rice flour increased the protein, fat, fibre, lysine, calcium, phosphorus, iron and riboflavin contents but niacin content was decreased.

Singh, Sadhna; Malhotra, S.R. and Kalia, Manoranjan 2000. Nutritive value of some specialized legume/pulse based preparations of Himachal Pradesh. *J. Hum. Ecol.*, 11(5): 355-357. Department of Food Science and Nutrition, Himachal Pradesh Krishi Vishvavidyalaya, Palampur 176062, H.P. [LEGUME/PULSE; NUTRIENT CONTENT; TRADITIONAL RECIPES]

The study was undertaken to determine the nutrient content of some specialised legume/pulse based recipes consumed in Kangra district of Himachal Pradesh. The preparations included Bengal gram whole and dhal, green gram whole, *Telia mash*, *Rongi Madhra*, *Kabuli Chana*, *khatte massar*, *Rajmash*, *Sappu Bari*, mixed bengal and *black gram dhal* and *Khatti arhar dhal*. The nutrients analysed included crude protein, crude fat, total ash, crude fibre, carbohydrate and energy contents. The results are presented on dry and fresh weight basis.

Sinha, S.K. and Hegde, Sadanand N. 1999. **Regeneration of Plantlets from *in vitro* leaf culture of *Renades arunoday* hybrid (*Aerides rosea loddiges ex paxt. x Renanthera imschootiana Rolfe*).** *J. Orchid Soc. India*, 13(1-2): 19-24. Division of Orchidology, State Forest Research Institute, P.B. No. 159, Itanagar 791111, Arunachal Pradesh, India; Orchid Research Centre, SFRI, Tipi, Bhalukpong 790114, Arunachal Pradesh, India. [LEAF CULTURE; LEAF PRIMODIA; SEEDLING; VANDA HYBRID]

Leaves of *in vitro* raised 6 months old seedlings of *Renades Arunoday* hybrid were inoculated in 1/2 strength Murashige and Skoog (1962) medium supplemented with 2% sucrose and different growth regulators viz. IAA, BAP, NAA, KN etc., alone and various combinations of BAP and NAA. Explants showed better response (90%) to proto-com-like bodies (PLBs) and callus initiation in 2 mg^l⁻¹ BAP whereas in the presence of 0.5 mg^l⁻¹ NAA, only 20% of the explants responded within 7 wks of culture. Cent per cent explants responded in a combination containing 1 mg^l⁻¹ BAP and 0.5 mg^l⁻¹ NAA. The morphogenetic potential was best sown in entire leaf culture followed by leaf base segment. The subsequent subculture in BM supplemented with 1 mg^l⁻¹ each of BAP and NAA showed best differentiation of PLBs into plantlets with well developed roots and shoots.

Srivastav, P.K.; Singh, T.S. and Singh, N.I. 2000. **Clonal propagation of *Quercus serrata* Thunb. syn. *Q. acutissima* Carr. through air layering.** *The Indian Forester*, 126(8): 879-884. Regional Tasar Research Station, Mantripukhri, Imphal, Manipur, India. [AIR LAYERING; CLONAL PROPAGATION; ROOTING MEDIUM]

A break through has been made in clonal propagation of *Quercus serrata* auct. non Thunb. syn. *Q. acutissima* Carr. through air layering. 250 ppm conc. of IBA was found to be the best dose followed by 500 ppm dose of NAA for induction of rooting as well as for final survival of air layers after transplantation. While June was found to be the best period for raising the air layers, saw dust was found as the best rooting medium for raising air layers.

Tamta, Sushma; Purohit, V.K.; Nandi, S.K. and Palni, L.M.S. 2000. **Chemical induction of root formation in *Quercus leucotrichophora* L. stem cuttings.** *Indian Journal of Forestry*, 23(2): 135-138. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [BROADLEAF TREE; SEED GERMINATION; STEM CUTTING]

The effect of some auxins (IBA and NAA), phenolic compounds (phloroglucinol and coumarin), a combination of auxins and phenolics, and ABA have been examined in order to stimulate adventitious root formation in semi-hard wood cuttings of mature *Quercus leucotrichophora* L. trees. To determine the most appropriate time for raising plants, seasonal effect, if any, on rooting was also examined. Cuttings collected and planted during the monsoon season survived and good rooting was obtained in some treatments while experiments carried out in other seasons did not result in root initiation and the cuttings generally dried up within 5 weeks. Both the auxins (IBA or NAA) and the phenolics (coumarin or phloroglucinol) when applied alone, IBA + phloroglucinol and ABA did not induce rooting. A combination of IBA + coumarin (0.5 + 5.0 µM) was quite effective (50% compared to 0% in control) in inducing root formation during monsoon season only. This treatment could be used for vegetative multiplication of this species.

Thakur, D.R.; Sharma, Vinod and Pathik, S.R. 2000. **Evaluation of maize (*Zea mays*) cultivars for their suitability for babycorn under mid-hills of north-western Himalayas.** *Indian Journal of Agricultural Sciences*, 70(3): 146-148. Regional Research Station, Himachal Pradesh Krishi Vishvavidyalaya, Bajaura 175125, India. [BABY CORN; CULTIVARS; TASSEL; ZEA MAYS]

Out of 30 cultivars of maize (*Zea mays* L.) evaluated for babycorn production at 2 locations (Bajaura and Sundernagar) during 1995-97, the hybrid 'VL 42' gave significantly highest marketable

babycorn yield followed by hybrids 'MEH 133' and 'MEH 114'. All these hybrids remaining statistically at par with each other, had significantly higher cobs/plant than composite 'Early Composite'. Per cent husk amid barrenness were less in hybrids than composite, whereas fodder yield was more in 'Early composite' than hybrids. Removal of tassel just after its emergence gave 18% higher marketable babycorn yield than no de-tasseling.

Thakur, P.S. 2000. **Comparative performance of multipurpose tree species growing at degraded site.** *The Indian Forester*, 126(8): 895-900. Department of Silviculture and Agroforestry, University of Horticulture and Forestry, Solan, H.P. [CANOPY; LEAF AREA INDEX; MULTIPURPOSE TREE]

Comparative growth performance in a three age-series plantations of 15 MPTs at degraded site was revealed that tree species namely *B. retusa*, *L. leucocephala*, *A. altissima*, *B. ceiba*, *G. robusta*, *M. composita*, *U. laevigata* and *A. oblongum* have excelled in height and diameter growth over the remaining tree species e.g. *A. catechu*, *A. nilotica*; *T. arjuna*, *T. chebula*, *T. bellerica* and *Q. leucotrichophora* up to 9 years of tree growth. Maximum height and diameter growth was attained by *M. composita* where values were 7.23 and 9.41 cm, respectively up to 9 years of growth. The minimum height was obtained for *T. chebula* during the same duration. Leaf area index (LAI) ranged between 1.14 and 2.50 for all the MPTs with *G. robusta* recording the highest (2.50) while *T. chebula* the lowest (1.14). Tree species with higher LAI have excelled in growth performance over the species with lower LAI.

Tiwari, B.K. 2000. **Non-timber forest produce of North East India.** *J. Hum. Ecol.*, 11(6): 445-455. Centre for Environmental Studies, North-Eastern Hill University, Shillong 793014, India. [NON-TIMBER FOREST PRODUCE; NORTH EAST INDIA]

This paper analyses the status of diversity, conservation and management, collection and harvest, processing, pricing and marketing of non-timber forest produce (NTFP) of north east India. The study reveals that the regions is extremely rich in NTFP's rural people are heavily dependent on the NTFP's for their subsistence, livelihood; the management practices are traditional, the collection and harvest methods are not sustainable, processing and value addition facilities are generally non existent and a large share of benefits accrue to the traders and middle-men who are mostly outsiders. The study suggests that immediate financial, managerial and technological interventions are required for ensuring sustainability of the NTFPs of the region.

Tiwari, Meera; Pant, C.C. and Tewari, V.C. 2000. **Neoproterozoic sponge spicules and organic-walled microfossils from the Gangolihat Dolomite, Lesser Himalaya, India.** *Current Science*, 79(5): 651-654. Wadia Institute of Himalayan Geology, 33 General Mahadev Singh Road, Dehradun 248001, India; Geology Department, Kumaun University, Nainital 263001, India. [BIOMINERALIZATION; DIVERSITY; LESSER HIMALAYA; MICROFOSSIL]

Isolated hexactinellid and monaxon sponge spicules with cyanobacterial filaments have been discovered in the Gangolihat Dolomite. The microfossils described were recovered in the thin sections of cherty dolomite and phyllite. Comparable sponge spicules are reported so far from lower Vendian sediments; therefore an early Vendian age can be suggested for the Gangolihat Dolomite. The main purpose of this communication is to document the presence of sponge spicules and silica bio-mineralization during the sedimentation of Gangolihat Dolomite in the Kumaun Lesser Himalaya, India.

Uniyal, R.C. and Nautiyal, A.R. 2000. **Phytotoxic effects of *Ougeinia dalbergioides* benth. on some food crops.** *Indian Journal of Forestry*, 23(2): 221-225. High Altitude Plant Physiology Research Centre, HNB Garhwal University, Srinagar Garhwal 246174, India. [GERMINATION INDEX; LEAF LITTER; SEED GERMINATION]

Seeds of two millet and two pulse crops were germinated under the influence of top soil, rhizosphere soil, soil mulched with dry leaves and green leaves leachate of *O. dalbergioides* and also in the aqueous extracts of its green leaves, leaf litter and bark. Presence of tree components in the germination medium substantially suppressed the germinability of crop seeds but the magnitude of inhibition varied with the crop as well as tree component. Overall, irrespective of the test crops, rhizosphere soil and aqueous extract of green leaves caused considerable reduction in germination. Not only the final percentage of

germination was reduced but the germination was delayed also.

Valdiya, K.S. 2000. **Free access to topographical maps: coping with natural hazards, assessing development potential and monitoring environmental changes.** *Current Science*, 79(4): 479-480. Geodynamics Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore 560 064, India. [DEVELOPMENT POTENTIAL; GEOGRAPHIC INFORMATION; NATURAL HAZARDS; TOPOGRAPHICAL MAPS]

Appreciating that topographical maps embody a wealth of geomorphological and geographical information in a capsule form, and acknowledging that the making of geological maps is essential for the assessment and management of natural resources, planning for development, and hazard-coping endeavours, these maps should be freely available to all scientific workers. There should be no restriction on the use and publication of contour map; showing precise delineation of geomorphological-geological boundaries, the locations of deposits or reserves of natural assets, the sites of development activities, and the zones identified as prone to natural hazards.

Yadav, A.S. and Tripathi, R.S. 1999. **Studies on the demography of *Eupatorium odoratum* in a secondary successional community.** *Tropical Ecology*, 40(2): 269-273. Department of Botany, School of Life Sciences, North Eastern Hill University, Shillong 793022, India. [EUPATORIUM ODORATUM MORTALITY; SEEDLING COHORTS; VEGETATION CANOPY]

Survivorship of different age groups, population flux, and age structure of *Eupatorium odoratum* L. population have been studied permanent quadrats for two and half years in a five year old fallow. The longevity of established populations increase with age of individuals. The increasing influence of established plants of *E. odoratum* and other associated species such as *Imperata cylindrica*, adversely affected the survival of seedling population. The results indicate that the population of *E. odoratum* begins to decline after six years in a secondary successional community.

UNDP - GEF/CCF Small Grants Programme

Background: Small Grant Programme, co-founded by Global Environmental Facility (GEF) and the Country Co-operation Framework - India (CCF-I) Environment Programme seeks to support activities which demonstrate community based approaches that could reduce threat to the global environment. The programme is rooted in the belief that global environment problems have local solutions and that with small amounts of funding local communities can undertake activities, which shall make a significant difference to their lives and in their environment. Small Grant Programme (SGP) is administered by the UNDP and Ministry of Environment and Forests (MoEF), Government of India. It is being implemented by Centre for Environment Education (CEE) as the National Host Institute (NHI). CEE is a national institute of excellence for Environment Education supported by MoEF and affiliated to the Nehru Foundation for Development, Ahmedabad.

Activities supported by SGP:

SGP provides grants to organisations for activities that address local problems related to:

1. Land Management
2. Water Management
3. Biodiversity Conservation

In addition, good proposals in the areas of climate change and international water are also

considered.

SGP mainly supports activities that:

- ☞ Promote innovative local response in the themes specified.
- ☞ Build local capacity to implement sustainable development strategies.
- ☞ Demonstrate high replicability and scaling up potential.

- ☞ Create public awareness on environmental issues.
- ☞ Address livelihood and gender concerns.

Who can submit proposals?

The following types of organisations can submit proposals:

- Non-Governmental Organisations (NGOs)
- Community Based Organisations (CBOs)
- People's Organisation
- Universities
- Schools
- Local Co-operative Societies

Agencies which work at the community level to

address local aspects of the global environmental issues can submit proposals.

Time frame and funding:

SGP provides a maximum funding of 15 lakhs over a time frame of two years. Agencies interested in developing projects under SGP may contact CEE at the following address:

Centre for Environment Education
Nehru Foundation for Development
Thaltej Tekra, Ahmedabad 380 054
E-mail: ceeindia@vsnl.com

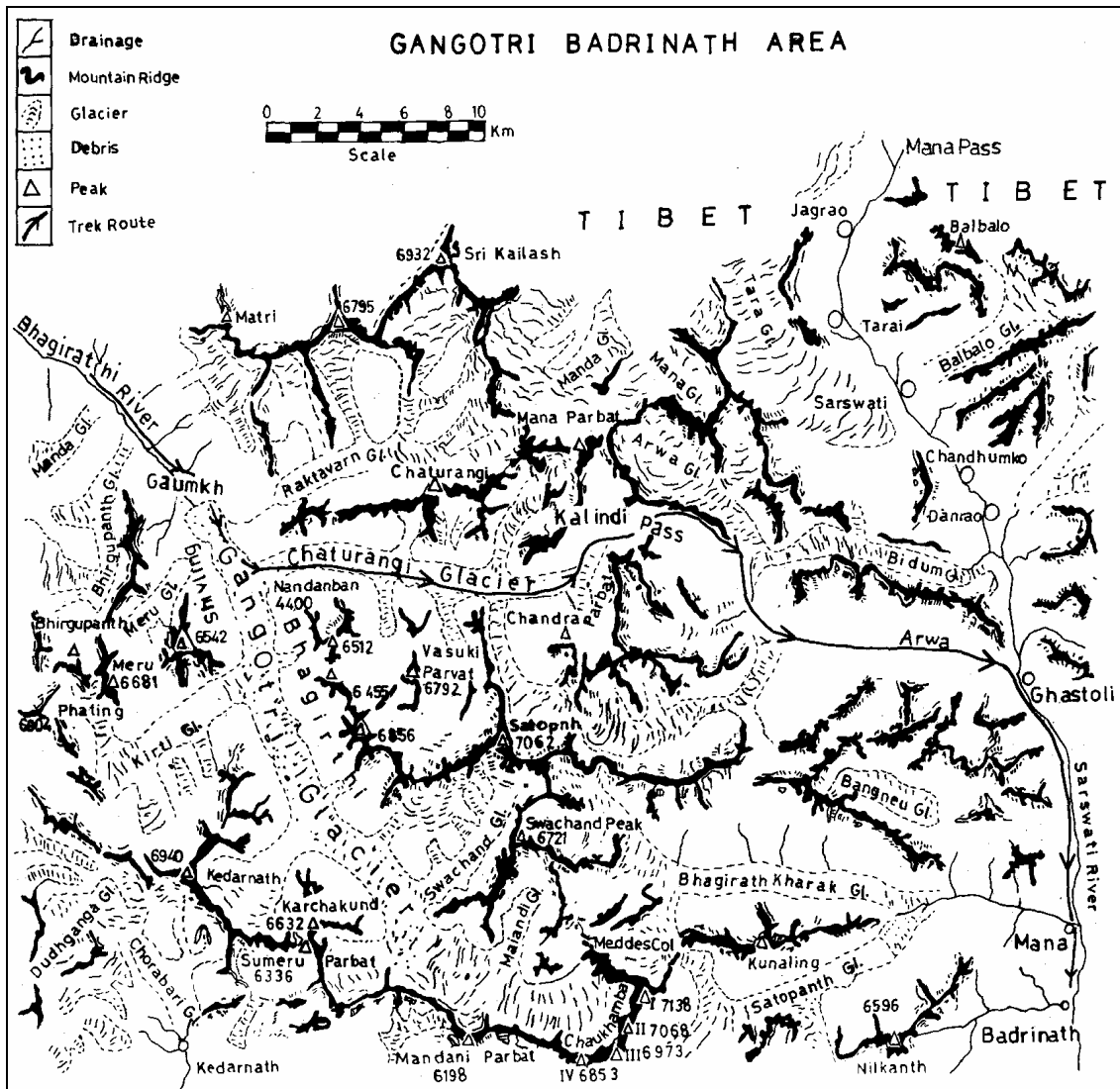
REPORT

Glacial Research Expedition Gaumukh to Badrinath via. Kalindi Pass (19510ft.)

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The Gangotri glacier is located in Uttarkashi district of Garhwal Himalaya. The Gangotri glacier is one of the biggest glacier in Himalaya. It is 30.20 km long (Naithani et al. 2000) and width varies between 0.5 to 2.5 km. Numerous small sized glaciers join the main Gangotri glacier from all sides and from the Gangotri group of glaciers. The total ice covers approximated 200 km² with 20 km³ of ice volume (Vohra, 1981), and it is the valley total glacerized area is about 258.56 km² long (Naithani et al. 2000). The Bhagirathi river originates at the snout of glacier located at Gaumukh, from which the melt water-giving rise to Bhagirathi gushes out.



The Expedition

Glaciology expedition snout to source from Gangotri glacier to Badrinath via Kalindi Pass was organised from August, 27 to September 6, 2000 under Glaciology projected of GBPIHED Kosi, Almora. The area covered during the expedition is situated in Garhwal Himalaya of Uttaranchal. The expedition was initially planed in 1999 but due to some reason it could not happen. Ultimately the dream became true in the end of August 2000 with the support of four high altitude porters who faced this challenge with me, the utmost bravery and courage. Preparations were going on for the attempt which proved to be satisfactory.

The route for this expedition was Gangotri-Gaumukh-Basukital-Suralaya-Seweta and then through Kalindi pass (19510feet) (Plates on cover page). The objective of this research expedition was to explore about the Gangotri glacier catchment with regards to source of sediment, ablation zone, line of equilibrium, accumulation zone, tributary glaciers, and geo-morphological landforms, etc. In addition, of soil (debris), water, and ice sample were also collected from the different parts of glacier catchment for scientific investigation. After completing all necessary, logistic and administrative formalities, the team started for the expedition from 25 August 2000 from Uttarkashi. On 26 August, 2000 the team started from Gangotri and reached for Bhojbas, where the base camp was situated (for six month glacier discharge and suspended sediment monitoring-April-Oct) Gangotri to Bhojbas, a 14 Km trek was well known to me, as plenty of times during the last two years I have crossed this way. We reached Bhojbas at 1 p.m. and there after made

necessary preparations and technical gear, ready for the next day. It was a plus point with me, that I did not need acclimatization around upto 4000 m. On August 27, 2000 journey was started early morning at 6.15, towards Nandanvan via Gaumukh "the lateral ice cave and the snout of Gangotri glacier, from where holy Ganges gushes out. After an hour's tiring glacial zigzag trekking from snout we reached the confluence of Raktavarana glacier. During this course we passed an outlet of a stream flowing down cascades through the wall blocking the entrance to the valley. After another two hours of laborious march we arrived at the outlet of Chaturangini valley. We turned left from this point as an exposed traverse over an ice wall where huge boulders and ice slabs made climbing very difficult. We reached the Chaturangini glacier the surface of which was completely covered by stones. We crossed it on its side by passing over a very steep and stone covered slope of the moraine. On reaching its edge, we had an unexpectedly beautiful view of green meadows and crystal streams. This was Nandanvan, a pleasant grassy pasture (4335 m) in the fork of Gangotri and Chaturangini glaciers. From Nandanvan the peaks Kharchkund, Kedardome, Kedar peak, Kirti Stambh, Shivling, Thalisingar, Bhirgu Pant and Meru were clearly visible.

From Nandanvan we proceeded to Chaturangini valley. On our way we came across a pleasant meadow along side a stream, then a crust of the moraine. Behind this one could see peaks Meru massif and the east face of Bhirgupant. An Unnamed peak rises far ahead of us. After a march of 8-9 Kms., we reached the confluence of Chaturangi and Basuki glacier, a rope was fixed to climb 60°-65° slope, a mixture of mud and scree. And then we descended diagonally right towards the snout of lateral glacier from the bed of gully, diagonally left upon a very steep unstable slope (danger of stone and avalanche). From its edge we have the view of the shallow moraine lake Basukital (4900m). a little stream coming out from their black ridge of Basuki peak that feeds the Basuki lake. We pitched our tent on the NW ridge of Basuki Parvat.

On 28th August 2000 we left for Basukital through the depression between true left lateral of Chaturangini glacier and north face of Bhagirathi II peak and rhyme rock walked on the ridge with gentle gradient.

The next day the team descended towards Suralaya Sweta junction point and followed cairn marked route. The previous day we followed through middle where few glacier tables were observed. The route leads to a precipitated crest of the moraine and traversing the avalanches ridden slopes of Basukiparvat which reach the outlet of the Sunder valley. We camped at near Suralaya, in a small grassy pocket. Next day we started to Sweta glacier and Satopant peak appears all of sudden from behind a bend with the mighty rock wall surmounted by seracs rising in the back gravel. We crossed the glacier and climbed upon the crest of the moraine then diagonally left across a steep rocky slope, we came to the edge of fields covered with the boulders at the foot of the rock water. This pinnacle ends the ridge dividing the Sudar and Suralaya valley. Then we headed towards a huge block behind which we camped (5200m). From the bivouac near the boulder we went slightly uphill reaching the outlet of Suralaya valley which is surmounted by an unnamed peak and Mana Parvat. Further, we have a steep and tough trek across the Suralaya glacier and along the northern slopes of Chandra Parvat we camped at the left moraine of the Seta glaciers near its junction with the Chaturangini glacier. Here we found the accumulation zone of the Gangotri glacier the way was very tough and adventurous. On both sides of the glacier, scenes are amazing. We also heard the roaring sound of avalanches falling in this area. It was dreadful event of my life. Next day we moved early at 6 a.m. Our team should have reached Kalindi Pass early, but we could reach only at 8.30 a.m. at Kalindi pass base camp after a long trek on accumulation zone in chilling cold. We could clearly see from Kalindi Pass base camp. Due to malting of ice and snow the crevasses were opening. It might be dangerous for us to ascend the pass summit as we all are tired and facing headache and our porter Kedar was unfit. We took rest at this point, and pitched tent at Kalindi base camp.

The next day trek was for Kalindi Pass. Hence the team marched towards east, through medial moraine of Sweta Kalindi glacier and then to north-east, since the route through the moraine turned towards east and negotiating a crevasses started descending on an ice field and reached a boulder ridges from where turned towards north through the left lateral moraine of Kalindi glacier and reached the Kalindi Pass. Kalindi Pass separates the boundary of Gangotri glacier catchment from Badrinath valley. We reached here at 8 a.m. (Plate 4) many peaks and glacier are visible from this height. After an half hour rest as per my suggestion two porters were cutting curve steps in an ice wall which were approximately 130 feet. They have done just half of work suddenly porter Bardev Singh skid from this wall and reached down with rolling and bouncing.

We were shocked to see him fall but he said I am okay. After an hour of efforts we rescued him. The pass was completely filled with ice and snow and chilled cold storm was blowing. Ice and snow was malting in the pass at 11 a.m. So for the safety point of view I canceled descending and decided to stay at pass. We pitched tent at a safer side. In the night we were hearing the roaring sounds of frequent avalanche breaking, and the speedy blinbirds was over the pass and cruelly shaking our tent, and we all were facing acute headache, we could not sleep properly.

Next day at 5.30 a.m. we trek to another route with the help of map and struggled against two broad crevasses with the help of rope and technical gear. Ultimately we succeeded to ascend the pass and reached the snow field, and searched our ice axes which were fallen the previous day, and started to ascend from the snow field which was slightly dangerous as it is filled with loose boulders and snow and ice with 55°-60° gradient slope. Within one and half hour we successfully ascended, and reached another glacier catchment and after one hour we reached near Arwa tal (lake). And we pitched our tent by this pleasant place. Now Arwa tal lake has filled with sediments only a rivulet flow over the lake, which comes from Arwa glacier. Next day we departed to Ghastoli, which was 16 km. from Arwatal, during the trek, many streams which feeds to Sarswati river were crossed. Next day we trekked 12 km from Ghastoli and reached Mana village and then Badrinath.

The observation

From the snout of Gangotri glacier to Kalindi base camp we observed nine tributary glaciers of Chaturangini glacier. Chaturangini glacier is the longest glacier of Gangotri glacier system. The numerous enchanting glacier lakes spread over the glacial system (Plate 2), generally is responsible for glacial outburst events. Observation were also made regarding active landslide, rock fall avalanche prone zone and different debris fans. Debris fans along the lateral moraine of the glacier system can be responsible for extra sediment supply or sporadic events to the sub glacial channel in normal discharge cycle in monsoonal period (Kumar et al. 2001). This can be proved from oblique lateral moraine eroded landforms in the glacial valley (Plate 3). The ablation zone of the Gangotri glacier is covered by a thick pile of supraglacial moraines and is characterized by several serrac ice sections, melting into pool of supraglacial lakes. Because of subsidence and fast degenerating nature of the glacier and the supraglacial lakes scattered in the entire glacier system (Naithani et al. 2000). A clear line was also visible between ablation and accumulation zone. One could observe that this line is thinning as well as tributary glacier's snout, the ablation zone was also covered with debris and boulders with giant longitudinal and traverse crevasses. And in the accumulation zone some stagnant ice pillars were found near Kalindi glacier (Plate 1). Some observations were also made through ground trotting through geocoded data (IRS-1D 1998 and IRS-1C 1998) and toposheet (53 0/1) survey of India of this area. Change detection work is still in progress.

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Plates (as displayed in the cover page):

1. Stagnant ice pillars in accumulation zone of Gangotri glacier
2. Supra glacial lake in ablation zone of Gangotri glacier
3. Oblique view of eroded lateral moraine of Gangotri glacier
4. Glacial expedition team reached on summit of Kalindi Pass

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NEW ADDITIONS IN BIBLIOGRAPHICAL DATABASE ON HIMALAYA

R.C. Prasad

Library and Information Centre

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Information embodied in documents is a great national and international resource. Scientific and technological knowledge has been expanding at a terrific speed. With the result, especially the scientists have been facing problems to cope with the relevant literature. It is becoming more and more difficult for them to keep themselves up-to-date and well informed in the field of their specialization. In the changed context nobody could afford to neglect information already available in some form. Not only that the available information had also to be collected and passed on to the persons who could use them profitably with in the shortest possible time. Now the modern library, with a few exceptions is regarded as a service institution and its aim is to enable the users to make the most effective use of resources and services of the library. This type of library acquires material, processes it, and makes it available for use rather than preservation. In order to facilitate the use of a library, Librarians provide tools like library catalogues, shelflist and subject bibliographies, etc.

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In this current subject bibliography (Supplement of the Bibliography published in ENVIS Bulletin: Himalayan Ecology and Environment 3(1&2): 92-112), an attempt has been made to categorize the books on Himalaya (Procured in the Library and Information Centre of G.B. Pant Institute of Himalayan Environment and Development after the publishing of ENVIS Bulletin 3(1&2)) under major subject headings. Entries are arranged using combination of Author, Title and Publisher Indexes, under various major subject headings. The present bibliography is the result of the extracts from the database of library, which is being maintained by the software package **PALMS (Prasad Automated Library Management System)**, developed by the author himself. In displaying data and entry format Indian Standards have been followed which reads - Author. Title : Subtitle. Place of Publication, Publisher, Year of Publication. Pages.

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News & Views

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

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

CAPART favours eco-friendly technologies in hill areas

In an workshop organised jointly by the Dehradun based Himalayan Environmental Studies and Conservation Organisation & CAPART, a funding agency under the Ministry of Rural Development has stressed upon the need to undertake an intensive programme of promoting appropriate technologies in the hill and mountain areas which were in harmony with bio-physical, socio-economic and institutional environment. CAPART would also initiate various programmes in collaboration with ICIMOD, Nepal for promoting sustainable development pattern in the hill as well as mountain areas of the country.

THE PIONEER: January 6, 2001

Killer quake overdue in Himalayan region

Studies have shown that over 50% of the Himalayan range was overdue for a great earthquake (over 7.8 on the Richter scale). It was not possible to predict when and where the earthquake would occur, however, western Nepal, Kumaun, and western Bhutan falls under the higher probability zones. Since the Indian plate continues to push into Eurasia, it creates stresses which are periodically released in the form of earthquakes. The GPS measurements of Indian Institute of Astrophysics showed that sufficient stress had accumulated to drive a magnitude-eight earthquake along at least 50% of the Himalayas.

THE HINDU: January 13, 2001

Around 4000 HIV cases in HP

The total number of HIV positive cases in Himachal Pradesh has been estimated to be between 3,500 to 4,000. The HIV sentinel surveillance data collected in 1999 indicated that over 80% of the cases were in Hamirpur, Kangra, Shimla, Bilaspur and Mandi districts of the State. Community based studies revealed that the incidence of reproductive track infection (RTI) and sexually transmitted diseases (STDs) is also very high in the State.

THE TRIBUNE: January 15, 2001

Reckless quarrying a threat

Palampur town of Himachal Pradesh has been facing a serious environmental threat because of unscientific quarrying in the area. Residents are worried over large scale quarrying being carried out in the adjoining village of Lohna, as it is leading to the destruction of valuable forests. Hills in the state have been indiscriminately stripped of forest cover during the past 10 years, resulting in flash floods, landslides and a change in the rain pattern. Despite all claims made by the government, nothing worthwhile has been done to check illegal mining and quarrying.

Ravinder Sood for THE TRIBUNE: January 17, 2001

J&K to have 1 lakh solar lights

In the view of power scarcity, the Jammu & Kashmir Energy Development Agency has prepared a project for installation of one lakh solar lights for UNDP/World Bank funding. It was stated that over 60,000 improved 'chullas' were being set up in the state during the current financial year under the National Programme on Improved Chullas. The Union Minister of Non-Conventional Energy Sources is assisting in the implementation of various non-conventional energy related programmes in the state.

THE TRIBUNE: January 20, 2001

Slow, painful death at Corbett

Though elephant poaching is uncommon in the region but the killing of three elephants in short span has alarmed the Corbett National Park in Uttaranchal. According to park authorities the male tusker was fed nails and sharpnel to bleed it to a slow and painful death. The Park authorities admit that elephants were killed for ivory, but they did not traced out the culprits responsible of elephant killing in the Park.

THE HINDUSTAN TIMES: January 21, 2001

Van Gujjars struggle for every drop

Although the myth persists that the Van Gujjar community, a nomadic tribe is well off, earning decently from selling milk and ghee, the reality is in stark contrast, with many families fighting impoverishment and struggling to maintain their cattle. As such, Gujjars at Rajaji National Park are dependent on the forest, their symbiosis with the environment is remarkable. But the degradation of Rajaji forest is putting immense stress on water and fodder availability, as most of the streams are running dry.

THE PIONEER: January 23, 2001

Construction in Nainital green belt banned

Pushed by popular consternation over possible adverse impact of urbanisation on the environment and ecology of the Sat Tal and the Bhim Tal lakes around Nainital, the Uttaranchal government has ordered stopping of construction work in June Estate, a massive green-belt area in the lakes vicinity. Residents have demanded that the Government reverted to the original land-use pattern of the green-belt of June Estate, notified in the master-plan of Bhim Tal town.

THE PIONEER: January 24, 2001

Kol dam to uproot 800 families

As many as 800 families of Mandi, Bilaspur and Solan district of Himachal Pradesh would be affected or displaced by the construction of 800MW Kol Dam Hydel Project. The villagers demand that government should undertake responsibility of their rehabilitation and compensation with assurance of employment to at least one member of each effected family. The prime cause of apprehension of the people is the nightmarish experience which the oustees of Bhakra and Poong Dams and other projects underwent over past four decades.

THE TRIBUNE: February 7, 2001

Mahseer faces extinction

Mahseer, rated as one of the best game fish in the world, is today an endangered species, undergoing

slow extinction, as the construction of dams, has further threatened its survival. The Himachal Angling Association had been pressing upon the State Fisheries Department, to evolve a technology for the controlled breeding of golden Mahseer, which is the native of the Sutlej and the Beas and replenish the dwindling stock of the fish. But members of the Association regretted that the protection, propagation and development of fisheries seemed to be least interest of the government as all suggestions given by them had simply been gathering dust.

THE TRIBUNE: February 7, 2001

Mizo seismologist warns of quake disaster in Aizawl

The US seismologists warned of a Gujarat like disaster in Aizawl in the event of high intensity quake in Mizoram, which falls in the highest seismic-risk zone in north-eastern region. The state capital would witness massive destruction in case of a high-intensity quake as safe building codes have not been followed in constructing high-rise building. The State Geology and Mining Wing and Central Mining Research Institute are preparing to open a Disaster Management and Mitigation Centre.

THE ASSAM TRIBUNE: February 23, 2001

People forced to vacate homes

Notwithstanding the Vishwa Hindu Parishad's (VHP) attempt to saffronisation of the vexed Tehri dam issue, the BJP Governments in Uttaranchal and at the Centre have sounded an alarm to abandon the old town and 125 villages around the S-shaped valley formed at the confluence to the Bhagirathi and Bhilangana, without putting in place the infrastructure in the villages that would be cut off by the submergence of the old Tehri town. VHP are to undertake fast-unto-death on the eve of the closure of the gates close to there the aging environmentalist, Mr Sunder Lal Bahugana had adopted similar forms of protest after the devastating Uttarkashi earthquake of 1991.

THE STATESMAN: March 26, 2001

Hindi Section

हिमालय में लू और चेरापूंची में पड़ेगा भयंकर सूखा

हिमालय में आज जहाँ हम बर्फ से ढंके पहाड़ देख रहे हैं वहीं कल हवा के गरम थपेड़ों के कारण खड़ा होना मुश्किल हो जायेगा। इसी तरह राजस्थान में दूर तक पानी ही नजर आएगा, चेरापूंची के लोग बादलों के दर्शन को तरसेंगे और पतझड़ में पेड़ों पर हरी पत्तियां दिखाई देंगी। हाल ही में जारी इंटरनेशनल कमीशन फॉर स्नो ऐंड आइस और विदर ऐंड वर्ल्ड की ताजा रिपोर्ट में मौसम के बदलते मिजाज का हवाला दिया है रिपोर्ट में कहा गया है कि भारत का औसत तापमान 2010 तक लगभग 2 डिग्री तक और 2050 तक 4 से 5 डिग्री तक बढ़ जाएगा। समूचे विश्व में औसत तापमान अब तक तीन से चार डिग्री तक बढ़ चुका है। रिपोर्ट में कहा गया है कि आने वाले वर्षों में मौसम में कुछ ऐसे परिवर्तन देखने को मिलेंगे। मसलन दिसंबर में लू भरी दोगहरी और वनस्पतिविहीन हिमालय भी हमें देखने को मिल सकता है। मंसूरी, शिमला, नैनीताल, देहरादून, ऊटी, कुल्लू, लद्दाख सहित कई दूसरे पहाड़ी शहरों के तापमान में भी जबरदस्त बढ़ोत्तरी हुई है। विश्व के गर्म होते मौसम का असर भारत की बर्षा पर भी देखने को मिल रहा है। मौसम के गर्म होने से भारत के ग्लेशियर भी तेजी से पिघल रहे हैं। इसका असर यह होगा कि 2030 तक हमारे समुंद्री तल 20 सेंमी तक बढ़ जाएंगे। इससे प्राकृतिक आपदाओं में बढ़ोत्तरी तो होगी ही मलेरिया, डेंगू सहित कई चर्म रोग भी फैलेगे। कई जल स्रोत सूख जाएंगे। विश्व प्रसिद्ध फूलों की घाटी, उड़ीसा में स्थित चिलका झील सहित कई दूसरी धरोहरों पर संकट मंडरा रहा है। भू वैज्ञानिकों का कहना है कि फूलों की घाटी और चिलका झील की उम्र अब सिर्फ 70 से 80 साल रह गई है।

अमर उजाला: जनवरी 17, 2001

दो साल में भूकंप से तबाह हो सकता है समूचा उत्तरांचल

अगले दो साल में उत्तरांचल के ज्यादातर इलाकों और उत्तर प्रदेश के मुरादाबाद, बरेली, पीलीभीत, रामपुर समेत कई जिलों में भीषण भूकंप की आशंका है जिसकी तीव्रता 8 तक हो सकती है। यह चेतावनी भाभा परमाणु अनुसंधान केंद्र के भूकंप अध्ययन केंद्र ने दी है। इसके विभागाध्यक्ष डॉ जी.के. जैन के मुताबिक आने वाले दो साल में भूकंप की चपेट में आने वाले जो सबसे खतरनाक क्षेत्र समझे जा रहे हैं उनमें उत्तरांचल के उत्तरकाशी, टिहरी गढ़वाल, चमोली, देहरादून, नैनीताल और उत्तर प्रदेश के बिजनौर, मुजफ्फरनगर, मेरठ, गाजियाबाद, मुरादाबाद, पीलीभीत, रामपुर, महाराजगंज, गोरखपुर, देवरिया, मऊ, बलिया, बस्ती गोंडा, बरेली, सीतापुर, बुलंदशहर, अलीगढ़, मथुरा जिलों की पट्टी शामिल है। यहां किसी भी क्षण भूकंप आ सकता है जिसकी तीव्रता रिक्टर पैमाने पर 6 से 8 के बीच होगी। भारत विश्व के उन पांच देशों में शामिल है, जहां भूगर्भीय आपदाओं का सबसे अधिक खतरा रहता है। भारत के हिमालय क्षेत्र और पश्चिम तटीय क्षेत्र सबसे अधिक खतरनाक हैं। नब्बे के दशक के बाद से भारत में भूकंपों की संख्या में लगातार वृद्धि हो रही है। चीन के शहर शंघाई में 27 दिसंबर, 2000 में जारी इंटरगवर्नमेंट पैनल ऑन क्लाइमेट वेंज (आईपीसीसी) की रिपोर्ट में स्पष्ट किया गया था कि भारत के मध्य हिमालय और तटीय क्षेत्रों में 1998 के बाद से जमीनी हलचल अचानक बढ़ गयी है। रिपोर्ट में कहा गया था कि 90 के दशक के बाद से भारत में प्राकृतिक आपदाओं में भारी बढ़ोत्तरी हो रही है और यहां आने वाले वर्षों में किसी भी क्षण भूकंप आ सकता है।

अमर उजाला: जनवरी 30, 2001

कस्तूरी मृग अभ्यारण की सुरक्षा सीमा सुरक्षा पुलिस करेगी

भारत तिब्बत सीमा पुलिस ने अस्कोट के कस्तूरी मृग अभ्यारण की सुरक्षा का काम अपने हाथ में ले लिया है। यह आशंका जताई गई है कि इस अभ्यारण में नेपाल के माओवादी शरण ले सकते हैं। इस अभ्यारण की अब निरन्तर निगरानी होगी और आईटीबीपी की दो बटालियनें वहां तैनात की जाएंगी। यह बटालियनें नियमित पैट्रोलिंग, गार्ड ड्यूटी, प्रशिक्षण जारी रखेंगी। सप्ताह में दो बार आईटीबीपी की स्थानीय वाहिनी के कमांडेंट अभ्यारण का दौरा करेंगे और साल में एक बार वहां पर आपरेशन

क्रिया जाएगा। योजना आयोग ने बार्डर डेवलपमेंट स्कीम के तहत यह जिम्मेदारी सौंपी है। इस अभ्यारण क्षेत्र में पशु चिकित्सा का अस्पताल खोलने की भी भविष्य में योजना है।

अमर उजाला: जनवरी 30, 2001

सेलिक्स अब तराई में भी उगोगा

हिमाचल प्रदेश एवं जम्मू कश्मीर में पैदा होने वाला सेलिक्स वृक्ष अब उत्तरांचल और तराई क्षेत्र में भी उगाया जा सकेगा। इमारती लकड़ी तैयार करने और घरेलू उद्योगों में इस्तेमाल की जाने वाली सेलिक्स लकड़ी उत्तरांचल के लिए अब वरदान साबित होगी। गोविंद बल्लभ पंत कृषि विश्व विद्यालय के उद्यान वैज्ञानिकों ने शोध करने के बाद सिद्ध कर दिया है कि सेलिक्स वृक्ष कृषि वानिकी के लिए पापुलर से अधिक लाभप्रद है। शोध के अनुसार सेलिक्स को उत्तरांचल और तराई में धान, गेहूं की खेती के साथ उगाया जा सकता है, क्योंकि इसकी पत्तियां पतली और हल्की होने के कारण सूर्य के प्रकाश को नीचे उगाई जाने वाली फसलों के लिए अवरोध उत्पन्न नहीं करती है। इससे पेड़ की वृद्धि जलोरोपित भूमि में भी प्रभावित नहीं होती है, क्योंकि यह पेड़ अपनी जड़ों की वृद्धि धान के खेत की तरह पत्तियों से तने को आक्सीजन उपलब्ध कराकर करता है। सेलिक्स के पौध की छाल, गठिया, बुखार, दस्त, और पेचिश के इलाज में काम आती है। इसमें सेलीसिन नामक पदार्थ पाया जाता है, जो दर्द निवारक के रूप में काम आता है। अपने महत्वपूर्ण गुणों के कारण सेलिक्स अब उत्तरांचल और तराई क्षेत्र के लिए 21 वीं सदी में वरदान साबित होगा।

अमर उजाला: जनवरी 23, 2001

हिमाचल में भविष्य में भारी भूकंप की आशंका

भारत तिब्बत सीमा पुलिस ने हिमाचल प्रदेश के कांगड़ा क्षेत्र में भविष्य में भूकंप की आशंकाओं के चलते राहत और बचाव की अभी से तैयारियां शुरू कर दी हैं। वाडिया इंस्टीट्यूट आफ जियॉलाजी देहरादून ने विज्ञान एवं प्रौद्योगिकी मंत्रालय भारत सरकार को भूकंप आने संबंधी संभावना की रिपोर्ट काफी पहले सौंप दी है। मैक्सिको की सेंटर फार अर्थ स्टडी ने भी हिमाचल प्रदेश में भूकंप की भविष्यवाणी की है। विज्ञान व प्रौद्योगिकी मंत्रालय को हिमाचल प्रदेश में संभावित भूकंप की रिपोर्ट मिल चुकी है, लेकिन मंत्रालय ने अभी तक अपनी तैयारियां शुरू नहीं की हैं। जबकि रिपोर्ट के आधार पर आईटीबीपी ने तैयारियां प्रारंभ कर दी हैं। रिपोर्ट के आधार पर हिमाचल प्रदेश के कांगड़ा क्षेत्र में यह भूकंप सन् 2005 के आसपास आ सकता है। रिपोर्ट में कहा गया है कि इस भूकंप से क्षेत्र के 97 प्रतिशत भवन ध्वस्त होंगे, भूकंप की तीव्रता रिक्टर पैमाने पर 8.5 होगी। यदि रात में 12 से 4 बजे के बीच भूकंप आएगा तो मृतकों की संख्या पौने चार लाख के आसपास और यदि भूकंप दुपहर में आएगा तो मृतकों की संख्या 88 हजार के करीब होगी, इनमें महिलाओं की संख्या ज्यादा होगी। आईटीबीपी ने इसी रिपोर्ट के आधार पर कांगड़ा के पास कुल्लू में अपना आपातकालीन स्टॉक जमा कर दिया है।

अमर उजाला: जनवरी 30, 2001

गंगा का प्रवाह न रुके, इसके लिए योजना तैयार

उत्तरांचल सरकार ने टिहरी बांध की सुरंग तीन और चार को बंद करने की अपनी योजना को बिना किसी बाधा के अंजाम देने के लिए प्रयास तेज कर दिए हैं। सरकार ने एक ऐसी योजना भी बनाई है कि कम से कम डेढ़ साल तक गंगा की धारा के प्रवाह को अविरल बनाए रखा जा सके। सरकार ने गंगा के प्रवाह को अप्रभावित रखने के उद्देश्य से जो योजना तैयार की है उसमें एक सुरंग को बंद करते समय कुछ हिस्सा खुला छोड़ दिया जाएगा। इससे जो पानी जलाशय में नहीं पहुंचेगा, वह एक धारा के रूप में आगे गंगा से मिला दिया जाएगा। गंगा का प्रवाह अविरल बना रहे, इसके लिए इंजीनियरों व वरिष्ठ अधिकारियों से मौके पर जाकर योजना के मुताबिक काम शुरू करने को कह दिया है।

दैनिक जागरण: मार्च 29, 2001

फूलों की घाटी : एक शोध समीक्षा

चन्द्रप्रकाश काला 'हीरामणी'

गोविन्द वल्लभ पन्त हिमालय पर्यावरण एवं विकास संस्थान, कोसी-कटारमल, अल्मोड़ा २६३ ६४३

विश्वविख्यात फूलों की घाटी जो कि उत्तरांचल राज्य के चमोली जिले में स्थित है, विगत दो दशकों से संरक्षण की नीतियों के तहत विवादों से घिरी हुई है। विवाद का प्रमुख कारण १९८२ से इस घाटी में मवेशियों के चरान-चुगान पर प्रतिबन्ध लगाना माना जा रहा है। जिसके फलस्वरूप यहाँ पर कुछ वनस्पति प्रजातियों के विस्तार को लेकर प्रकृति प्रेमी सहज रूप में ही बहुत ही चिन्तित है। कुछ वनस्पतिविदों का मत है कि १९८२ से इस घाटी के ८७.०५ वर्ग कि.मी. क्षेत्रफल को राष्ट्रीय पार्क घोषित करने के उपरान्त सरा (पोलीगोनम पॉलिस्टीकियम्) नामक पौधा इस राष्ट्रीय पार्क में लगातार फैल रहा है। फलस्वरूप इस पार्क के विभिन्न वनस्पति प्रजातियाँ संकटग्रस्त हो चुकी है और इस पार्क की नैसर्गिक सुन्दरता नष्ट हो रही है।

उपरोक्त सभी तथ्यों एवं धारणाओं के वैज्ञानिक विश्लेषण के लिए मैंने 'फूलों की घाटी राष्ट्रीय पार्क' पर अपना शोध कार्य १९९३ में प्रारम्भ किया। वन अनुसंधान संस्थान, देहरादून में इस शोध कार्य की विस्तृत जानकारी 'इकोलाजी एण्ड कनजरवेंसन ऑफ एलपाइन मिडोज इन द वैली ऑफ फ्लावर्स' नामक शोध ग्रन्थ में समाहित है। फूलों की घाटी में मवेशियों के चरान-चुगान से सम्बन्धित तुलनात्मक अध्ययन के लिए मैंने इसी वर्ष (२१ जून से १ जुलाई २००१) इस घाटी का भ्रमण किया। जिसके दौरान मुझे १९९३ से २००१ तक घाटी में निम्न परिवर्तन दिखाई दिए।

घाटी की वृक्ष रेखा (३३००+२०० मी. ऊँचाई) के समीपवर्ती कुछ भू-भागों पर जहाँ १९९३ में पॉलीगोनम प्रचुर मात्रा में फैला हुआ था आज भोजपत्र (वेटुला यूटीलिस) का जंगल उग रहा है। लेकिन यह परिवर्तन वृक्ष रेखा के समीपवर्ती व अंदरूनी उन भू-भागों तक ही सीमित है जहाँ पर कि पूर्व में मानव द्वारा वृक्ष रेखा पर अत्यधिक दबाव रहा होगा। चूंकि फूलों की घाटी मुख्यतः एक बुग्याल है जिसमें शाकीय वनस्पतियों का ही वर्चस्व रहता है और पालसियों (भेड़ बकरी चुगाने वाले) के ईंधन व अन्य जरूरतों के लिए लकड़ी वृक्ष रेखा व इसके समीपवर्ती भू-भागों पर ही प्राप्त होती है। अतएव: पूर्व में इस वृक्ष रेखा पर अत्यधिक दबाव रहा होगा जिसके फलस्वरूप भोजपत्र व रोडोडेन्ड्रान के जंगल, जो कि वृक्ष रेखा पर बहुतायत में पाये जाते हैं, या तो खत्म हो गये या कम हो गये। लेकिन १९८२ में इस दबाव के हटने से यह वृक्ष रेखा अपने पूर्व स्वरूप में लौटने का प्रयास कर रही है। जिसका ज्वलंत उदाहरण भोजपत्रों द्वारा कुछ स्थानों पर पॉलीगोनम को विस्थापित करना है।

फूलों की घाटी राष्ट्रीय पार्क में १०५ किस्म की औषधीय प्रजातियाँ पायी जाती हैं। जिनमें ३० औषधीय प्रजातियाँ पूरे हिमालय क्षेत्र के लिए संकटग्रस्त श्रेणी में रखी गयी हैं। हथजड़ी, या सालमपंजा (डेक्टाइलोराइजा हर्टोजीरिया) एक महत्वपूर्ण औषधी है जिसका प्रयोग टॉनिक के रूप में किया जाता है। और यह संकटग्रस्त श्रेणी में रखी गयी है। इसके बनों से एकत्रीकरण पर पूर्ण प्रतिबन्ध लगा हुआ है। लेकिन यह विलुप्तप्रायः महत्वपूर्ण औषधीय पौधा फूलों की घाटी से पूर्ण प्रतिबन्ध के बावजूद भी निकाला जा रहा है। हथजड़ी का घनत्व फूलों की घाटी में १९९५ में ५-६ पौधे प्रति वर्ग मी० था लेकिन २००१ में यह घटकर २-३ पौधे प्रति वर्ग मी० तक ही सीमित रह गया है। १९९५ में हथजड़ी इस सम्पूर्ण क्षेत्र में सबसे अधिक फूलों की घाटी में पाया जाता था लेकिन आज इसकी पूर्ण रूपेण देखभाल न होने से यह औषधीय पौधा फूलों की घाटी में भी विलुप्त होने के कगार पर पहुँच गया है।

मेरे पिछले ९(नौ) सालों के लगातार अध्ययन से यह पता चलता है कि फूलों की घाटी राष्ट्रीय पार्क में जून से सितम्बर तक ५२० किस्म की पादप प्रजातियाँ उगती है। इनमें से ४९८ फूलों की प्रजातियाँ (एन्जियोस्पर्म) है, यह सारे फूल एक साथ नहीं खिलते। बल्कि प्रत्येक पुष्प का अपना-अपना समय का जीवन चक्र होता है। मार्स मैरी गोल्ड (कैल्था

पैलूस्ट्रीस) व प्रिमुला बर्फ पिघलने के साथ ही खिलने शुरू हो जाते हैं। और १०-१२ दिन के अन्दर ही अपना जीवन चक्र पूरा कर देते हैं। इसके बाद विभिन्न पुष्पीय पादप जैसे लिली, पोटेन्टिला, फ्रिटीलेरियाँ, जिरेनियम, पोलीमोनियम, कैमैनुला, कोराड्डेलिस, ससुरिया, एनीमोन्स, एकोनाइटस व विभिन्न आर्किडस अपने-अपने जीवन चक्र को समयानुसार पूरा करते हैं। अन्त में जब लगभग सभी फूलों का जीवन चक्र पूरा हो चुका होता है तब पॉलीगोनम् व इमपेसियन्स घाटी की रमणीकता को अक्षुण्ण बनाने में अपना महत्वपूर्ण योगदान प्रदान करते हैं।

फूलों की घाटी प्रकृति द्वारा भारत को दिया गया एक वरदान है। जरूरत है इसके समुचित प्रबन्धन व रख-रखाव की। जड़ी बूटीयों के विदोहन को रोकने के लिए वन्य जीव अधिकारियों व कर्मचारियों में एक परस्पर सामंजस्य की भावना की नितान्त आवश्यकता है। जबकि सतह पर ऐसा हो नहीं रहा है। फूलों की घाटी राष्ट्रीय पार्क के प्रबन्धन के लिए पिछले तीन सप्ताह से डी० एफ० ओ० का पद रिक्त पड़ा हुआ है। वन्य जीव विभाग की नीव का मुख्य पत्थर गेम गार्ड होता है जिसकी ड्यूटी इन राष्ट्रीय पार्कों व अन्य अभयारण्यों में भ्रमण करके वन्य जीव व वनस्पतियों के संरक्षण की होती है। लेकिन इनके लिए प्रोन्नति की गुंजाइश बहुत ही क्षीण है। जिससे इनकी कार्यशीलता पर सीधा असर पड़ता है। फूलों की घाटी में कुछ गेम गार्ड पिछले १५ सालों से कार्यरत हैं, तथा यह विभाग में पिछले २५ सालों से कार्य कर रहे हैं लेकिन इनकी आज तक कोई प्रोन्नति नहीं हुई है। सबसे दुखद बात यह है कि फूलों की घाटी में गेम गार्डों की नियुक्तियाँ एक दण्डनीय नियुक्ति मानी जाती हैं। प्रोन्नति के अवसरों की क्षीणता व दण्डनीय नियुक्तियों के कारण फूलों की घाटी का समुचित प्रबन्धन नहीं हो पा रहा है।

यह सार्वभौमिक सत्य है कि नीव का पत्थर जितना मजबूत होगा उतनी ही इमारत टिकाऊ होगी। अतएव यदि हम इन प्राकृतिक धरोहरों व संसाधनों के रख-रखाव के लिए चिन्तित हैं तो इन नीव के पत्थरों को मजबूती प्रदान करने की आवश्यकता है। पॉलीगोनम् फूलों की घाटी में १९८२ से पहले भी था और आज भी है। फ्रैंक स्माइथ ने १९३८ में फूलों की घाटी में पॉलीगोनम् के अस्तित्व पर प्रकाश डालते हुए लिखा है: कि पॉलीगोनम् एक लम्बा, मजबूत, तने वाला पौधा है। जो कि भेड़ बकरियों के अत्यधिक प्रयोग वाले क्षेत्रों में अत्यधिक नाइट्रोजन युक्त पोषक पदार्थों के जमा होने के फलस्वरूप फैलता है। यह पौधा भू-स्खलन वाले कुछ क्षेत्रों में वृक्ष रेखा के आस-पास अधिक मात्रा में पाया जाता है। जहाँ इसका कार्य मृदा का क्षरण होने से रोकना है। पॉलीगोनम् घाटी में केवल अपने वास स्थलों में ही उग रहा है। फूलों की घाटी में चरान पर प्रतिबन्ध के कारण पॉलीगोनम् की ऊँचाई में अवश्य ही वृद्धि हुयी है। तथा इसके वृक्ष रेखा के समीपवर्ती भागो, जहाँ तक की पर्यटक अधिकतम संख्या में पहुँच पाते हैं, में अधिक उगने के कारण आम पर्यटकों को आभास होता है, कि पॉलीगोनम् घाटी की अन्य वनस्पतियों को समाप्त कर रहा है। जबकि ऐसा नहीं है।

इस वर्ष के अध्ययन के दौरान यह मेरा सुखद अनुभव रहा है कि कुछ संकटग्रस्त औषधीय पादप जैसे मेगाकारपिया पौलीएण्ड्रा (वड़ामूला), पिकोराइजा कुरूवा (कुटकी), साइप्रीपीडिएम हिमालयीकम्, फ्रिटीलेरीया रोयली, एकोनिटम वालफोराई, व जूनीपेरस कम्प्यूनिस की जनसंख्या में पिछले एक दशक से घाटी में वृद्धि हुई है। मेगाकारपिया के १९९५ में केवल १२ से अधिक पौधे घाटी में नहीं थे, लेकिन २००१ में यह संख्या २७ हो गयी है। उपरोक्त सभी तथ्यों के विश्लेषण से यह ज्ञात होता है कि फूलों की घाटी को जरूरत है समुचित रखरखाव व आधारभूत संरक्षण की, न कि अपने स्वार्थ से जुड़े हुए विवादों की।

मध्य हिमालय में पर्यावरण संरक्षण की समस्याएं

दलीप सिंह

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हिमालय का मध्य क्षेत्र अपने ऐतिहासिक काल से ही भारतीय संस्कृति एवं भौतिक संसाधनों का प्रतीक रहा है। यहाँ की प्राकृतिक छटाएं, हिमनद, वनस्पतियों, जीव-जन्तु एवं आध्यात्मिक विलक्षणताएं सम्पूर्ण विश्व के लिए आर्कषण का केन्द्र रही है। इस आर्कषण को बनाए रखने में वनों एवं वनस्पति समुदाय का महत्वपूर्ण स्थान है। आदिकाल से ही मध्य हिमालय अपने वातावरण के कारण व्यास जैसे महर्षियों के लिए विश्व के सर्वोत्तम ग्रंथों की रचना भूमि रही है। राष्ट्र के श्रद्धास्थल चारों धाम; केदारनाथ, बद्रीनाथ, यमनात्री तथा गंगोत्री भी इसी भू-भाग में स्थित है। सुख और समृद्धि की सदेशवाहक गंगा-यमुना जैसी पावन नदियों का उद्गम स्थल भी यही पवित्र भूमि में है। यहाँ की विशिष्ट संस्कृति, प्राकृतिक निधि, जैव विविधता और प्राकृतिक सौन्दर्य की रक्षा करना न केवल राष्ट्र की सुरक्षा की दृष्टि से आवश्यक है वरन् मानव जीवन के सुखद भविष्य के लिए भी अति आवश्यक है। अतः यह क्षेत्र आज के प्रदूषण और अज्ञाति के युग में शांति का क्षेत्र बना रहे यह केवल यहाँ के निवासियों का दायित्व नहीं वरन् सम्पूर्ण मानव जाति का कर्तव्य है। हमारे धार्मिक ग्रंथों में यहाँ की जीवनोपयोगी वनस्पतियों एवं नदियों का वितरण सर्वथा मिलता है। आयुर्विज्ञानियों का मत है कि संसार में ऐसी कोई भी वनस्पति नहीं है जो कि औषधियुक्त न हो। मनुष्य एवं वनों का प्रकृति प्रदत्त संबंध है यही कारण है कि पेड़-पौधे हमारे धर्म एवं संस्कृति के अभिन्न अंग बन रहे हैं। परम्परागत रूप से पेड़-पौधों को पूजने का विधान हमारी संस्कृति में प्रचलित है। आज भी पीपल, आम, बरगद, पंया, बट, तुलसी, केला, अनार आदि को पूजे जाने का प्रावधान विद्यमान है, जो कि वनस्पतियों के संरक्षण का परिचायक है। भारतीय जीवन में वृक्षों के प्रति कितना बड़ा अनुराग रहा है, इसका अनुमान मत्स्यपुराण में वर्णित इस श्लोक से लगाया जा सकता है:

दश कूप-समाख्यापी, दशव्यापी समोद्दः ।

दश हृद-समः पुत्रो, दश-पुत्र समोद्दमः ।

अर्थात्, दस कुओं के बराबर एक बावड़ी है, दस बावड़ियों के बराबर एक तालाब है, दस तालाबों के बराबर एक पुत्र है और दस पुत्रों के बराबर एक वृक्ष है। वृक्षों के प्रति ऐसी श्रद्धा भाव और भक्तिमय प्यार विश्व के किसी अन्य देश में देखने को नहीं मिलता है। भारतीय समाज में सदैव ही वृक्षों को देवता रूप में पूजा जाता है तथा वृक्षों को पुत्र से ऊँचा स्थान दिया है। ऐसी स्थिति में उनके काटे जाने की बात भी अकल्पनीय लगती है। पुराणों में पर्यावरण संरक्षण के लिए जल को देवता स्वरूप मानकर उसके नजदीक गंदा करना तथा पेड़ों को काटना पाप माना जाता था। वनों के प्रति जो अगाध प्रेम भाव मानव जीवन में पहले दिखाई देता था वह आज कहीं नजर नहीं आता है। परिणामस्वरूप जल स्रोतों एवं वनों का ह्रास लगातार होता जा रहा है।

यद्यपि दूसरी पर्वत श्रृंखलाओं की अपेक्षा हिमालय कम उम्र का है किन्तु भारत के लिए प्रकृति का यह एक अद्भूत उपहार है। हिमालय भारत की जलवायु को ही नियंत्रित नहीं करता, अपितु उसे सदाबहार नदियां देकर लोगों को निरंतर व निश्चित जीवन भी प्रदान करता है। देश की भारी जनसंख्या के लिए हिमालय वस्तुतः जीवन नियामक है। वन सम्पदा, जलसंपदा, खनिज के अतिरिक्त कृषि, पर्यटन का आधार भी हिमालय है। सम्पूर्ण राष्ट्र के विकास पर हिमालय का अत्यधिक प्रभाव पड़ा है उसकी आध्यात्मिक, सांस्कृतिक, सामाजिक, राजनैतिक एवं आर्थिक गतिविधियों पर उसका असर विचारणीय है। आज भी वैज्ञानिक, हिमालय की तमाम अनुकूलताओं का अध्ययन करते हुए अधिक से अधिक लाभ प्राप्त करने के अन्वेषणों में लगे हुए हैं। बहुमूल्य जड़ी-बूटियों को भण्डार, धार्मिक स्थलों का केन्द्र, मोहक दृश्यों का स्वामी, पावन नदियों का उद्गम स्थल, सरोवरों का अद्भूत स्रोत, यह विराट हिमालय लोगों के आकर्षण का केन्द्र रहा है। राष्ट्र व प्रदेश के पर्यावरण निवारण एवं संतुलन को बनाये रखने में जहाँ एक ओर मध्य हिमालय की सशक्त भूमिका युगों-युगों से रही है, वहीं दूसरी ओर जनसंख्या की आशातीत वृद्धि के कारण इस भाग के वनों पर निरंतर दबाव बढ़ता ही जा रहा

है। गंगा-यमुना जैसी जीवनदायिनी नदियों, जिनके विषय में भारतीय संस्कृति में कहा गया है कि "गंगे तव दर्शनात् मुक्तिः"। यानि गंगा के दर्शन मात्र से ही मोक्ष की प्राप्ति होती है। लेकिन आज सामाजिक मूल्यों और जीवन शैली में इतना अभूतपूर्व परिवर्तन हो गया है कि राजा भारीरथ के पुरखों का क्लृप्त धोने वाली गंगा, शहरों का मलमूत्र व फैक्ट्रियों का कचरा ढोते-ढोते इतनी प्रदूषित हो गई है कि उसका पानी मानव योग्य तो दूर जानवरों के योग्य भी नहीं बचा है। यही नहीं गंगा अपने उद्गम सिल से ही प्रदूषित हो चुकी है और सारे भारत को सुख समृद्धि देने वाली गंगा-यमुना का उद्गम सिल भोगवादी पर्यटन की बढ़ती संख्या के कारण गंदगी एवं कूड़े कचरे के ढेर से प्रदूषित होकर विपन्नता व नाना प्रकार की बीमारियों की जननी बन गई है। वस्तुतः हिमालय राष्ट्र के सुरक्षा कवच के रूप में ही कार्य नहीं करता है अपितु मौसम, वर्षा, जलवायु आदि का भी नियंत्रित करता है।

हिमालय की हिमाच्छादित चोटियों, सघन रतणीय वन, धरती की हरियाली जीवन के लिए अति महत्वपूर्ण है, ये पर्यावरण को शुद्ध तथा प्रदूषण मुक्त रखते हैं। मनुष्य या अन्य जीव जन्तुओं का भोजन, जीवन रक्षक जड़ी बूटियाँ एवं जिस हवा में हम साँस लेते हैं वह भी वनस्पतियों पर निर्भर करती है। इसके अतिरिक्त भूमि की उर्वरा शक्ति बढ़ाने, भूमि अपरदन, भूक्षरण, बाढ़ आदि घटनाओं को रोकने में भी वनस्पतियाँ सहायक होती हैं। वनों का आधार मिट्टी है मिट्टी के ऊपर वनों की जड़े बढ़ती और पनपती है। दूसरी ओर वृक्षों की पत्तियाँ सड़-गल कर मिट्टी का निर्माण करती हैं। इस प्रकार वन और मिट्टी का आपस में प्रत्यक्ष संबंध है। जिन क्षेत्रों में वन समाप्त हो गये हैं, ऐसे भागों की सतह नंगी होने के कारण वहाँ अपरदन, अपक्षरण व भू-क्षरण की घटनाएँ तेजी से हो रही हैं। फलस्वरूप, धरातल की मिट्टी बह जाने के पश्चात् बची हुई नंगी चट्टानों में वनों का विकास नहीं हो पाता है। जिससे जलवायु में विभिन्न प्रकार की अनियमितताएँ आ जाती हैं। हिमालय के पर्वतीय भागों में जलाने के लिए लकड़ियों का सर्वाधिक प्रयोग किया जाता है। जिसका वनों पर भी अत्यधिक प्रभाव पड़ता है। वस्तुतः इन पर्वतीय भागों से प्रतिवर्ष लाखों टन मिट्टी बहकर मैदानों की ओर चली जाती है। वृक्षों के कट जाने से तीव्र वर्षा व हवा से भूक्षरण की गति और तीव्र हो जाती है, जिससे ६० से ६५ प्रतिशत वर्षा का जल बह जाता है। भूक्षरण से न केवल भूमि की उर्वरा शक्ति नष्ट होती है वरन् नदियों व जलाशयों में पानी बढ़ जाने के कारण भूमि के साथ-साथ जन-धन की हानि भी होती है। पर्यावरण को विनाश और प्रदूषण से बचाने के लिए सबसे महत्वपूर्ण कारक वन सम्पदा है।

वनो के ह्रास को देखते हुए भारत सरकार द्वारा सन् १९८० में वन अधिनियम लागू किया गया। जिसमें हिमालयी क्षेत्रों में १००० मीटर से ऊपर की ऊँचाई पर स्थित वनों के कटान पर प्रतिबन्ध लगाया गया। जिसे वन विभाग बार-बार दोहराता रहता है, किन्तु इस अधिनियम के कारण जहाँ एक ओर सीनीय लोगों को अपनी पारम्परिक उपयोग की वस्तुओं तथा पीढ़ियों से आ रहे वनों पर अधिकार से वंचित होना पड़ा है, वहीं दूसरी ओर वन विभाग के बनने के बाद भी वनों का अनियमित दोहन निरंतर जारी है। जिससे पर्यावरण असंतुलन की स्थिति गम्भीर होती जा रही है। फलस्वरूप, प्राकृतिक आपदाएँ एक के बाद एक विकराल रूप धारण कर रही हैं। स्काटलैण्ड के वैज्ञानिक रावर्ट चैम्बर्स ने ठीक ही कहा है कि "वन नष्ट होते हैं तो जल नष्ट होता है, पशु नष्ट होते हैं तो उर्वरता विदा हो जाती है और तब ये पुराने प्रेत एक के पीछे एक प्रकट होने लगते हैं; बाढ़, सूखा, आग, अकाल और भूस्वमरी।" जो कि आज सर्वत्र देखने को मिलता है।

हिमालय क्षेत्रों में प्रकृति प्रदत्त अनेक दुर्लभ संसाधनों का ह्रास हो चुका है, परन्तु हिमालय में अभी भी थोड़ी बहूत, दुर्लभ जड़ी-बूटियाँ, फोना और फ्लोरा बचे हुए हैं। लेकिन आज हिमालयी क्षेत्र वनों की अंधाधुंध कटान भूक्षरण, प्राकृतिक जल स्रोतों के ह्रास की विषम स्थिति से गुजर रहा है। वनों का कटान नए वृक्षारोपण की अपेक्षा तेजी से हो रहा है। आज राज्यों के वन विभागों के नियंत्रण वाले वनों में वृक्षों का घनत्व मुश्किल से ५० प्रतिशत रह रहा है। सिविल, पंचायत और अन्य गौचरों का भी अत्यधिक इस्तेमाल किया जा चुका है। मवेशियों के खुरों से छोटी-छोटी वनस्पतियाँ लगातार नष्ट होती जा रही हैं। तथा झाड़ियों को स्थानीय लोग अपनी ईंधन की आवश्यकताओं को पूरा करने के लिए काट देते हैं जिससे वह प्रायः लुप्त होती जा रही है। नतीजन प्राकृतिक आपदाएँ दिन प्रतिदिन बढ़ती ही जा रही हैं। यद्यपि मनुष्य प्रारम्भ से ही प्रकृति का शोषण अपने हित में करता आ रहा है, परन्तु आज के वैज्ञानिक युग में अनुसंधानों एवं तकनीकी विकास के फलस्वरूप प्राकृतिक स्रोतों का उपयोग एवं दोहन और भी सरल हो गया है। ऐसी स्थिति में जबकि

सम्पूर्ण हिमालयी क्षेत्र पर्यावरण प्रदूषण व अन्य अनेक विकट समस्याओं से जूझ रहा है; कृषि योग्य भूमि की कमी, पेयजल व वन क्षेत्र की कमी, बढ़ते तापमान व खिसकते ग्लेशियरों से विश्व में एक नये प्रकार के तनाव व अशांति को अनुभव किया जाने लगा है। विचारकों का मत है, कि भविष्य में विश्व परिदृश्य में होने वाले तनाव जल स्रोतों व अन्य प्राकृतिक संसाधनों के नियंत्रण के लिए होंगे। ऐसी स्थिति में मध्य हिमालय का यह क्षेत्र जो कि न केवल राष्ट्र के लिए रक्षा कवच के रूप में कार्य करता है बल्कि जलवायु, जल की आवश्यकता, प्राकृतिक स्रोतों एवं भौतिक सम्पदा के भण्डार के रूप में मनुष्य की आवश्यक आवश्यकताओं की पूर्ति करता है, के पर्यावरण असंतुलन में उत्तरोत्तर वृद्धि होती जा रही है। यह स्थिति प्रत्यक्ष रूप से वनों के अनियमित दोहन व शोषण के कारण पैदा हुई है। वस्तुतः वर्तमान समय में मुख्य समस्या हिमालय के पर्यावरण संरक्षण एवं विकास की है।

वस्तुतः निरन्तर हो रहे वन विनाश से जलाभाव एवं प्रदूषण में वृद्धि एवं जलवायु में परिवर्तन जैसे प्रभाव स्पष्ट दिखाई देने लगे हैं। आज जंगलों का अंधाधुंध कटान व आग से जलने के कारण जमीन की जल संग्रहण शक्ति लगातार समाप्त होती जा रही है। नतीजन कहीं बाढ़ की विभिषिका तो कहीं सूखे का संताप आदि कोई न कोई समस्या हर समय बनी हुई है। सरदार पटेल ने कहा था कि "यदि रेगिस्तान के बढ़ते हुए प्रसार को रोकना है और मानव सभ्यता की रक्षा करनी है तो इसके लिए वन सम्पदा के क्षय को अवश्य रोकना होगा"। यदि भूमि वनों से आच्छादित रहेगी तो पर्यावरण संतुलन भी बना रहेगा, वन्य जीव संरक्षित रहेंगे, जड़ी बूटियों एवं औषधीय जीव-जन्तुओं का वर्चस्व कायम रहेगा, मौसम वर्षा आदि नियमित एवं लाभप्रद सिद्ध होगी, साँस लेने के लिए स्वच्छ हवा एवं पीने के लिए स्वच्छ जल प्राप्त होगा और मानव जीवन अनेकों बीमारियों से मुक्त रहेगा।

वस्तुतः वर्तमान युग में हम हिमालय की ओर उचित ध्यान देने के बजाय उसका अधिक से अधिक दोहन करने में लगे हुए हैं और सड़क तथा टिहरी जैसे बाँधों के निर्माण में लाये जाने वाले बुल्डोजरों व डाइनामाइट के विस्फोटों के द्वारा हिमालय को जर्जर बनाने का कार्य कर रहे हैं जिसके कारण भूक्षरण, भूस्खलन, बाढ़, भूकम्प जैसी समस्याएँ निरन्तर बढ़ती जा रही हैं। लेकिन जब तक हम इस ओर गम्भीरता पूर्वक सोच विचार करके क्षेत्रीय आवश्यकताओं एवं भौगोलिक परिस्थितियों के अनुरूप योजनाओं का निर्माण नहीं करते हैं तब तक पर्यावरण की समस्या का समाधान होना मुश्किल ही नहीं वरन् असम्भव भी है। अतः आज यदि मानव प्रकृति पर अपनी स्थिति एवं निर्भरता अनुभव कर सकता है तो हर व्यक्ति का कर्तव्य है कि वह पर्यावरण संरक्षण के प्रति उत्तरदायी बने। इसके अलावा पर्यावरण सुरक्षा के लिए जन चेतना, पुराणों में कहीं गई बातें एवं मानव का प्रकृति के साथ विवेकपूर्ण सम्बन्ध व सह-अस्तित्व की भावना का ज्ञान होना अनिवार्य है तभी पर्यावरण को विनाश होने से बचाया जा सकता है।