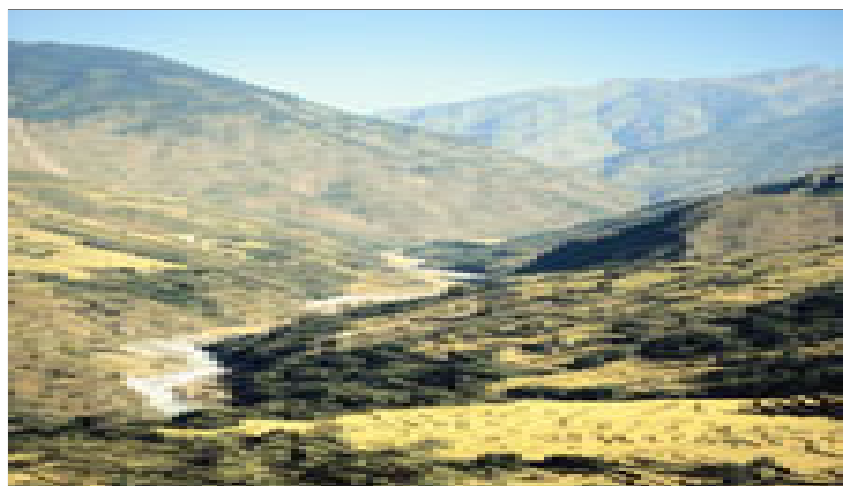


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***G.B. Pant Institute of Himalayan Environment and
Development***

(An autonomous Institute of Ministry of Environment and Forests, Government of India)

Kosi-Katarmal, Almora - 263 643, Uttarakhand, India

About the Bulletin

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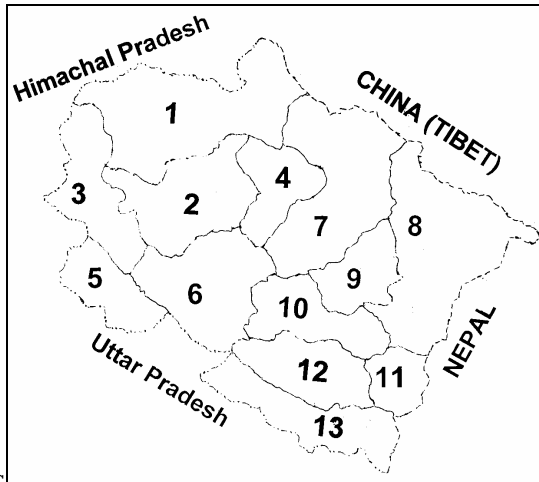
गढ़वाल हिमालय : सांस्कृतिक विविधता

जयवर्द्धन सेमवाल 'विजय'
अपने ही घर में खो गयी मुखमार

सुनील नौटियाल, के० एस० राव, आर० के० मैखुरी, मुकेश नौटियाल एवं के० एस० नेगी

information

Uttaranchal : the 27th State in Indian



Republic
Uttarakhand: carved out from northern hill region of Uttar Pradesh

District Legend

- | | |
|----------------------|---------------|
| 1 Uttarkashi | 2 Tehri |
| 3 Dehradun | 4 Rudraprayag |
| 5 Haridwar | 6 Pauri |
| 7 Chamoli | 8 Pithoragarh |
| 9 Bageshwar | 10 Almora |
| 11 Champawat | 12 Nainital |
| 13 Udham Singh Nagar | |

Total geographical area: 53,485 km²

Forest cover: about 65% of total geographical area

Population density: 132 persons/km²

Urban population: 23.18%

Sex Ratio (female/1000 males): 937

Scheduled Caste (SC): 17.48%

Scheduled Tribe (ST): 3%

Demographic Profile (1991 Census)

Districts	Population	Density (person/km ²)	Dec.growth (1981-91)	Sex ratio	% of population			Literacy rate [#] (%)		
					Rural	SC	ST	Total	Male	Female
Almora ¹	836617	153	10.46	1087	93.60	22.02	0.33	58.66	79.96	39.60
Chamoli ²	454871	48	21.75	1003	91.09	17.49	2.26	61.08	82.01	40.37
Dehradun	1025679	329	34.66	843	49.74	13.40	8.20	69.50	77.95	59.26
Haridwar	1124488	476	25.66	846	69.04	21.58	0.18	48.35	59.51	34.93
Nainital ³	1540174	229	35.52	870	67.34	15.80	5.84	56.52	67.88	43.19
Pauri Garhwal	682535	123	8.58	1060	88.11	13.52	0.22	65.35	82.46	49.44
Pithoragarh ⁴	566408	63	15.77	985	92.56	20.45	3.23	59.01	79.44	38.37
Tehri	580153	130	16.56	1058	94.33	14.20	0.11	68.38	72.10	26.41
Uttarkashi	239709	30	25.54	918	92.80	22.78	0.96	47.23	68.74	23.57

^{1,2,3 & 4} include Bageshwar, Rudraprayag, Udham Singh Nagar, and Champawat respectively. #
exclude population of 0-6 yr. age group.

Average physiological and agricultural density of Garhwal and Kumaun division together are about 670 and 140 persons per km² respectively according to 1991 census.

Estimated expenditure of Ninth Plan (1997-2002) is 44300 million rupees for Uttarakhand, out of these 28.8% is Central assistance. The amount of bank deposit (by all commercial and cooperative banks) in Garhwal and Kumaun Division is 180,435.47 and 118,955.79 lakh rupees respectively during 1994. The Credit-Deposit ratio by all commercial and cooperative banks is 20.64 and 35.63 for Garhwal and Kumaun region respectively during the period.

Principal languages: Hindi, Garhwali, Kumauni

Major cities: Dehradun, Nainital, Harwar

Trains originate from: Dehradun (Northern Railway), Kathgodam & Lalkuan (North-Eastern Railway)

Tourist/pilgrimage centers: Masoori, Nainital, Badrinath, Kedarnath, Gangotri, Yamunotri, Purnagiri, Hemkund, Valley of Flower, Corbet National Park, Rishikesh, Ranikhet, Kausani

Universities: Kumaun, HNB Garhwal, Roorkee, G.B. Pant Univ. of Agri. & Tech., Gurukul Kangri

update

HELMINTH PARASITES - A CONSTRAINT IN ANIMAL HEALTH MANAGEMENT IN HIMACHAL PRADESH

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INTRODUCTION

India has a population of 200 million cattle, 76 million buffaloes, 110 million goats, 46 million sheep and 275 million poultry, besides other livestock population reared in diverse agro-climatic conditions (Anonymous, 1997). Helminth parasitism, especially, gastrointestinal parasitism, is one of the major health problems severely limiting the animal productivity in dairy animals. In spite of significant production losses, which may run into millions of rupees (Shah and Chaudhry, 1995) the problem is neglected due to its chronic and insidious nature (Sanyal, 1998). The diverse agroclimatic conditions, animal husbandry practices and pasture management largely determines the incidence and severity of various parasitic diseases in a region. Epidemiological pattern of the parasitic diseases in the different agroclimatic zones of the country would provide a basis for evolving strategic and tactical control of these diseases. The present communication examines the status of helminth parasites in dairy animals and its management in Himachal Pradesh.

MATERIALS AND METHODS

Location, Geography and Climate

The state of Himachal Pradesh is located between the latitude 30.4° N to 33.2° N and longitude 75.8° E and 79.1° E and the altitude ranges from 350 to 6,975 m above mean sea level (m.s.l.). Agro climatically, the state is divided into 4 zones on the basis of temperature, rainfall and altitude (Fig. 1). The mean monthly minimum and maximum temperatures vary from 5.0±0.9° C in January to 20.4±1.2° C in June and 14.7±1.8° C in January to 29.6±3.4° C in June, respectively. The average monthly rainfall range from a minimum of 26.5±3.0 mm in October to maximum of 655.2±175.8 mm in August and the RH from 35.8 % in April to 77.6 % in August.

Livestock resources

About 92 % population in Himachal Pradesh is rural and depends directly on agriculture, horticulture and animal husbandry (Anonymous, 1994). 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 divisions 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 against total human population of 51.11 lakh living in 16,807 inhabited villages (Table. 1). The livestock population has been almost static during the last 10 years although the per capita daily milk availability increased from 191g in 1978 to 288g in 1989-90 (Chauhan, 1995).

Methodology

The present study was undertaken as apart of monitoring and surveillance of animal diseases in Himachal Pradesh over a period of one decade. The domestic animals (cattle, buffalo, sheep and goats) were of various ages and belonged to individual farmers or private/Government farms. Faecal samples from these animals were subjected to qualitative and quantitative examinations for Gastro Intestinal (GI) parasites. The faecal egg counts (eggs per gram of faeces, EPG) of nematode eggs was determined by the modified McMaster technique (MAFF, 1984), while fluke (*Fasciola* and *Amphistome*) egg counting was done as described by Soulsby (1982). A representative number of faecal samples were subjected to coproculture at 27° C and the infective larvae were harvested and used for larval identification (Soulsby, 1965). Meteorological data were collected from the department of Agronomy and agrometeorology of

HPKV, Palampur. Statistical analysis was done using statistical software (SigmaStat, Jandel Scientific, USA). Values of $P < 0.05$ were accepted as significant.

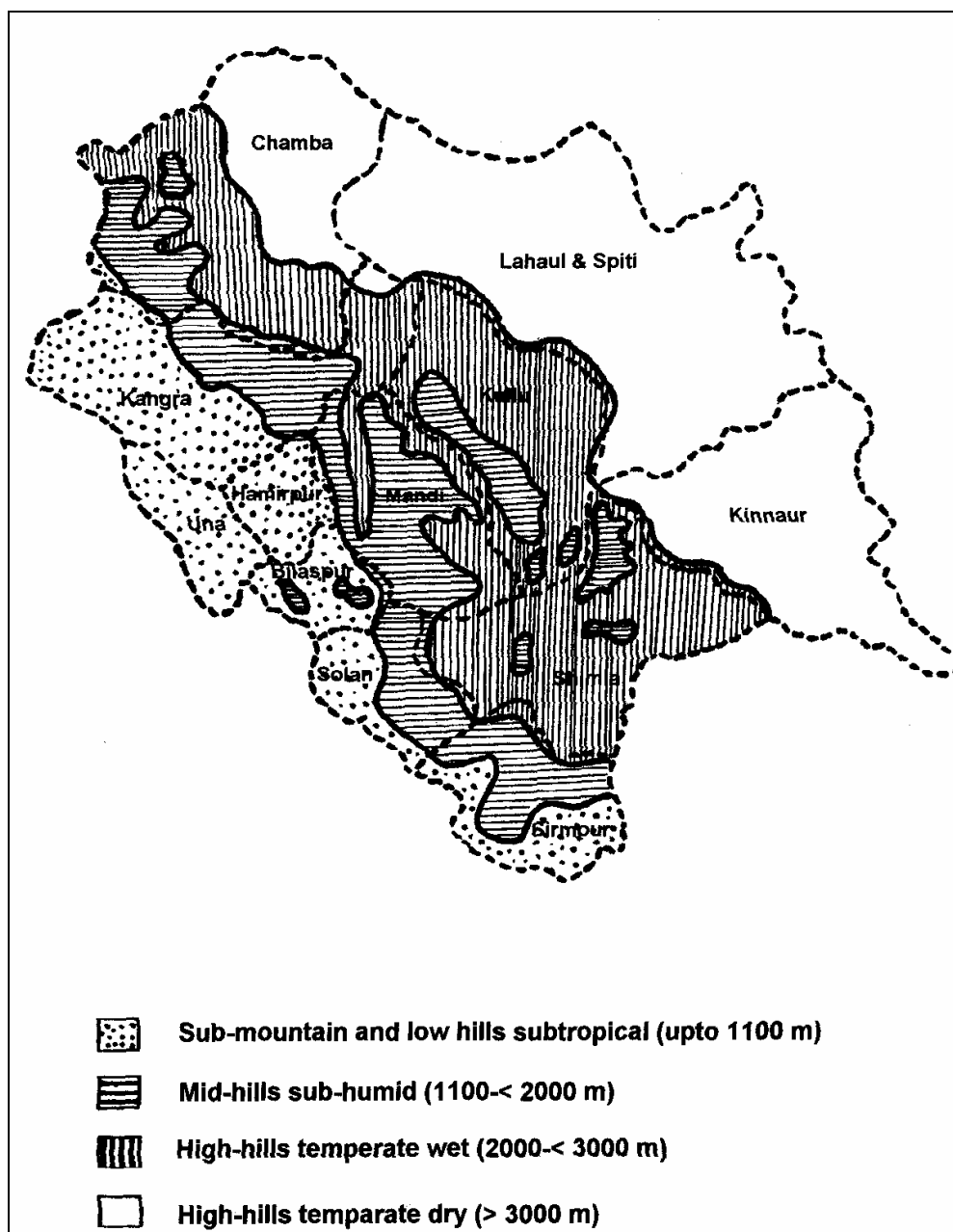


Figure 1. Agroclimatic zones of Himachal Pradesh

Migratory grazing

Western Himalaya is further characterized by the peculiar practice of migratory grazing. Some of the migratory graziers are *Gujjers* and *Gaddis*. Abundant grazing facilities are available in the higher altitude pastures where as foothills are quite suitable for winter grazing. The migratory system, which was, ecosustained in the past has now yielded to the divesting resource pressures. The rising livestock population coupled with the shrinkage of pastures is threatening the migratory grazing in the western Himalayas.

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	2,35,577	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.

RESULTS AND DISCUSSION

Meteorological data

The meteorological data (rainfall, relative humidity, minimum and maximum temperature) of the state is shown in Figure 2

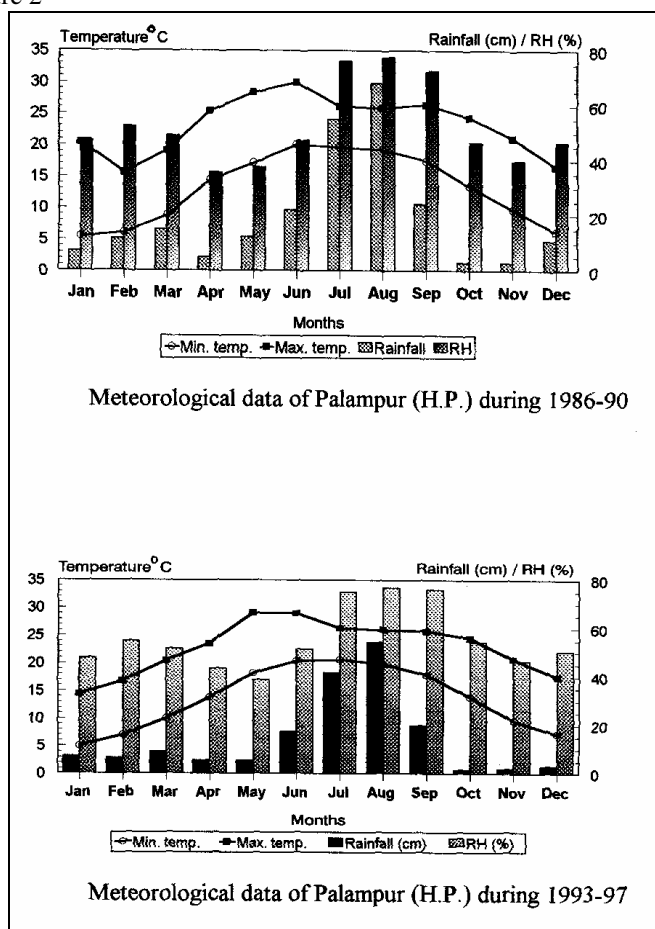


Figure 2. Meteorological data of two time-series

Status of parasitic diseases

In Himachal Pradesh, animals are kept in a variety of husbandry systems 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 Himalayas, is an established practice although is changing in the contemporary period. The traditional sheep and goat rearers called *Gaddis* are semi-nomadic, who practice large herding of sheep and goats from range to range and their flocks are migratory in nature through well defined routes (Figure 3) in Himalayan pasture (Bhasin and Singh, 1995; Chakravarti, 1998; Duffield *et al.*, 1998 and Berkes *et al.* 1998). 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 pastures (3000-4500 m above m.s.l.) in Zone III and IV during spring and summer seasons. The constant movement of flocks of sheep and goats over a large area ranging different states may greatly facilitate the spread of infection among livestock. Tables 2-4 present a checklist of most important helminth parasites observed in common livestock (cattle, buffalo, sheep, goat *etc.*) based on the studies conducted in Himachal Pradesh.

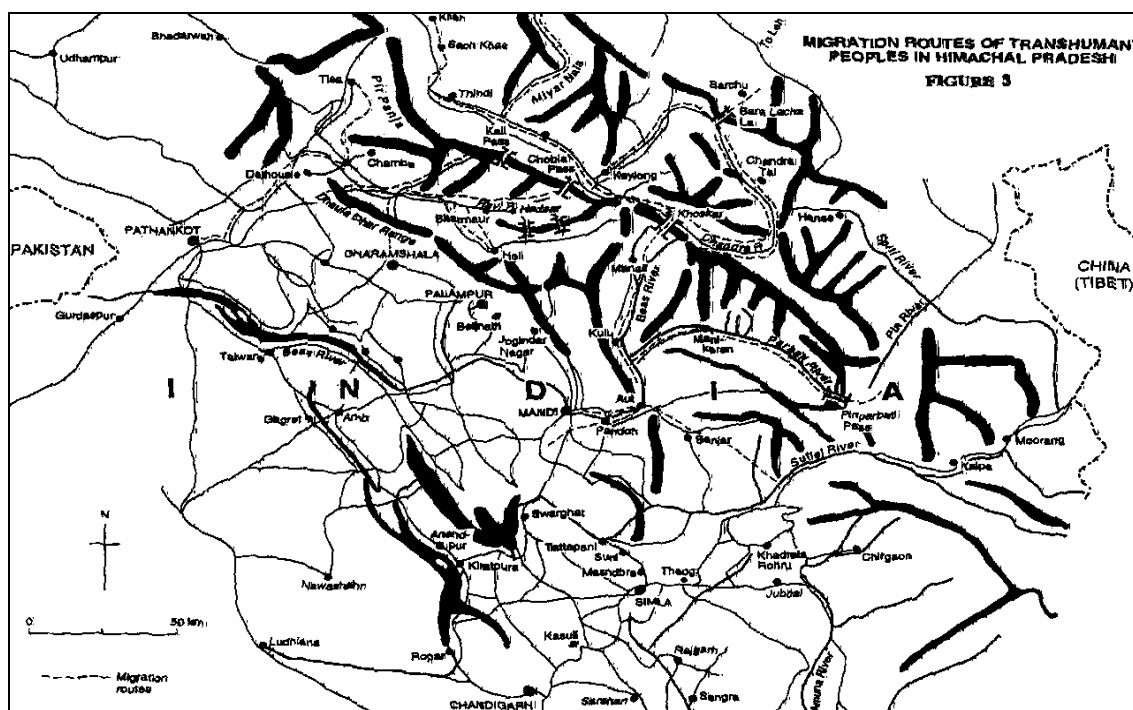


Figure 3. [Source Chakravarti, 1998]

Prevalence and seasonal pattern of helminthoses in large ruminants

Table 5 summarises the percentage infection of gastrointestinal parasites in cattle and buffaloes during the study period of two phases 1986-90 and 1993-98. Of the 1,552 cattle and 530 buffaloes examined, 1,354 (87.2 %) and 500 (94.3 %) were found positive for various GI parasites either singly or in mixed infections during 1986-1990 while, these figures were 716 (54.2 %) and 53 (50.5 %) during 1993-1997 out of a total of 1,320 cattle and 107 buffaloes. Figures 4-7 shows the seasonal prevalence of flukes and strongyles during different months in cattle and buffaloes during 1986-90 and 1993-97. In general, the second phase of the study revealed significant ($P < 0.05$) fall in the prevalence of flukes (except amphistomes) and strongyle infections in both cattle and buffaloes as compared to the first phase of the study, although buffaloes had a significantly higher prevalence of infection with *Fasciola* and *Dicrocoelium* spp. than did cattle, while for other flukes and strongyle infections, there was no significant variation between cattle and buffaloes in either phase.

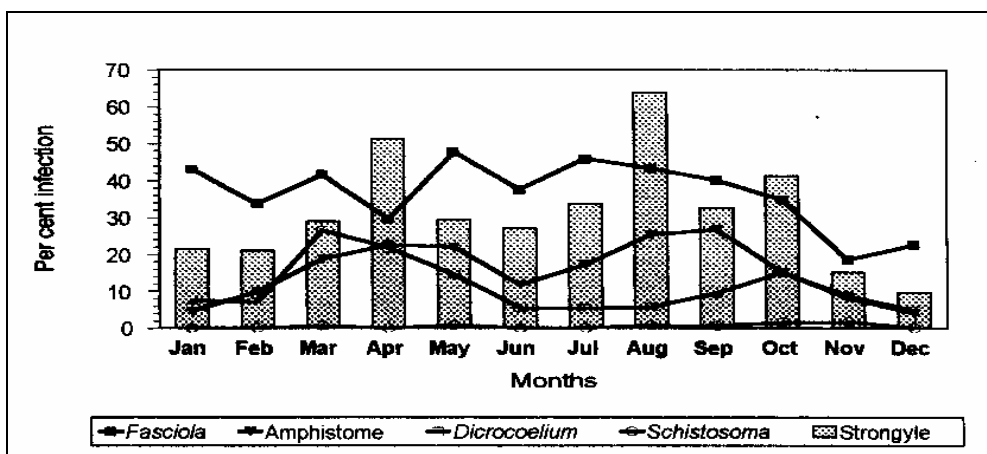


Figure 4. Meteorological data of Palampur (H.P.) during 1986-90

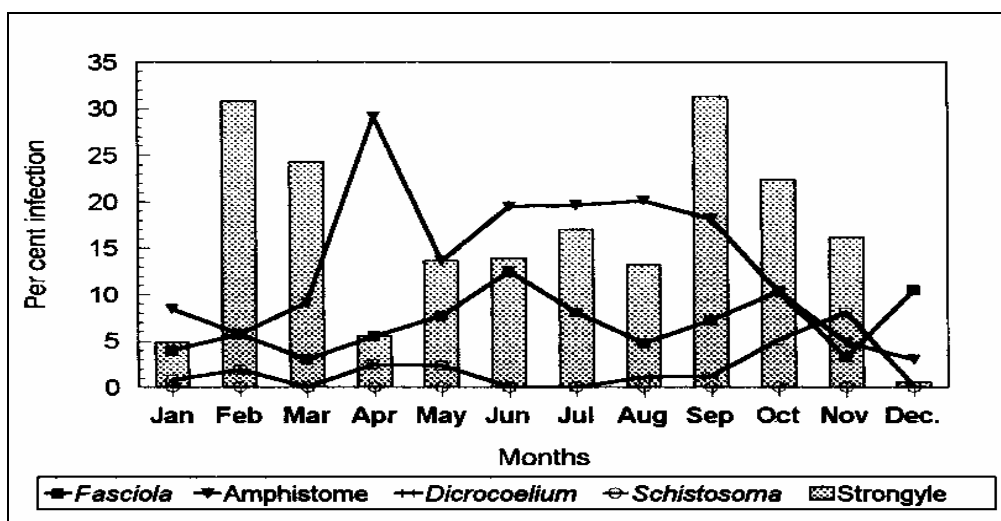


Figure 5. Meteorological data of Palampur (H.P.) during 1993-97

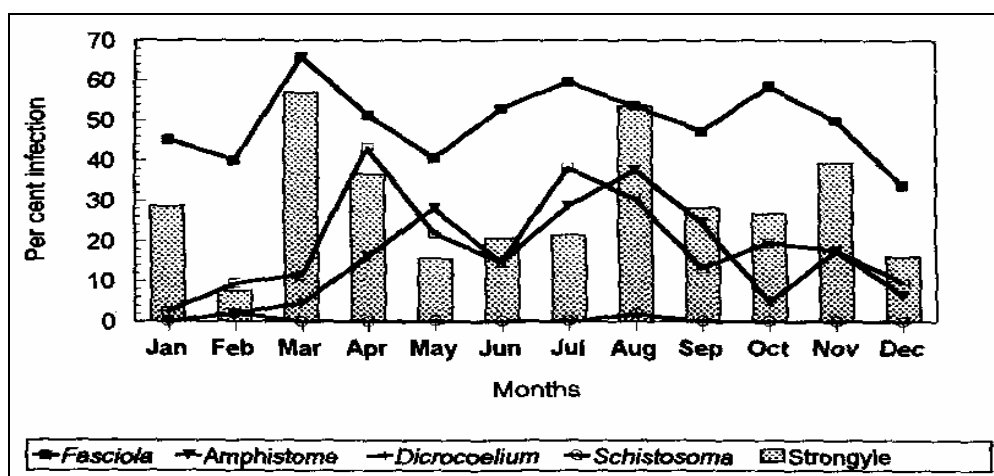


Figure 6. Monthly prevalence of fluke and strongyle infections in cattle during 1986-90 (averaged over five years)

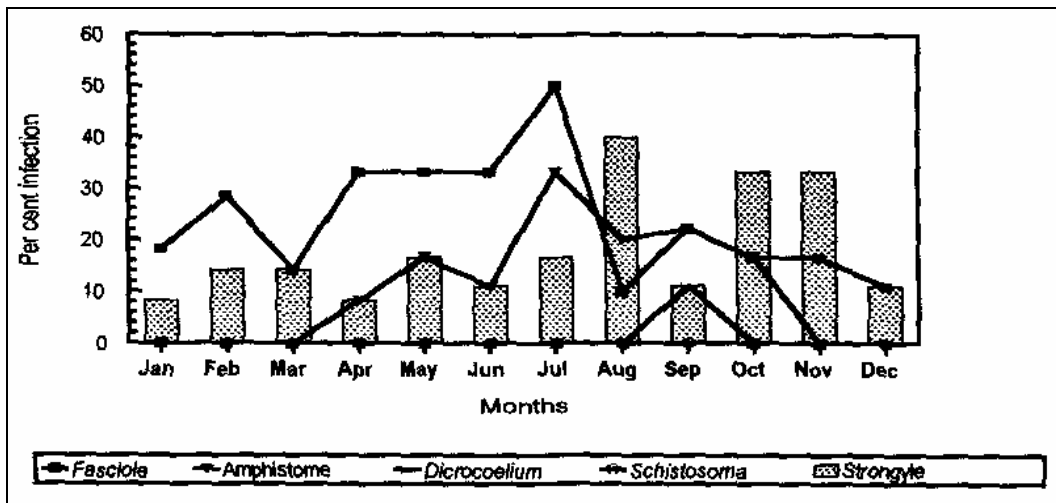


Figure 7. Monthly prevalence of fluke and strongyle infections in cattle during 1993-97 (averaged over five years)

Faecal egg count: The intensity of infection in terms of faecal egg counts for *Fasciola* and amphistome ranged from 50-300 EPG in cattle and from 50 to 400 EPG in buffaloes, with high load during the rainy and post-rainy seasons. The prevalence of *Strongyle* and *Strongyloides* spp. infections were high throughout the period of study, but the intensity in terms of EPG and the composition of the major contributors to EPG varied in different seasons. The monthly mean faecal egg counts of GI nematodes (*Strongyle* and *Strongyloides* spp.) during the study period ranged from 85 to 1750 in cattle and from 90 to 1625 in buffaloes, with high peak during the month of July to September (Figure 8). The difference in overall monthly mean egg counts between cattle and buffaloes was not significant ($P>0.05$).

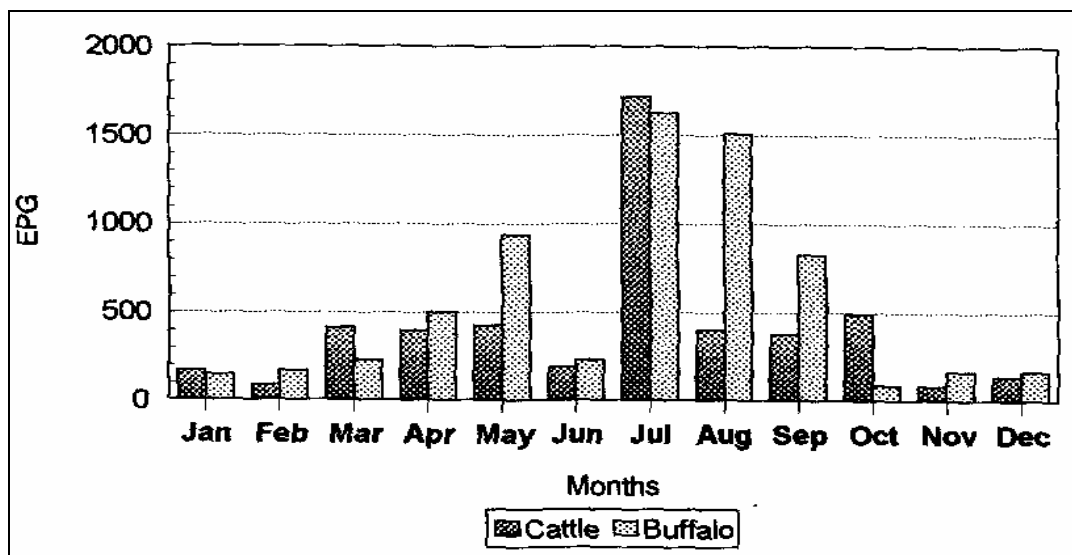


Figure 8. Nematode egg counts (EPG) in cattle and buffaloes (averaged over two years, 1990 & 1993)

Coprological studies: Coproculture showed the presence of predominant nematode species of *Strongyloides*, *Trichostrongylus*, *Haemonchus* and *Oesophagostomum*, *Bunostomum* and *Mecistocirrus* in decreasing order of prevalence. Larvae of *Strongyloides* and *Oesophagostomum* were observed throughout the year, while *Bunostomum* and *Mecistocirrus* were encountered occasionally.

Prevalence and seasonal pattern of helminthoses in small ruminants

Parasitic infections among sheep and goats were again major constraints to profitable production (Table 6). *Fasciola* (liver fluke), *Amphistome* (stomach fluke), *Dicrocoelium* (lancet fluke) and *Schistosoma* (blood fluke) are the most important flukes recorded from the state. The snails act as intermediate hosts for these fluke (Jithendran and Krishna, 1990). Strongyle revealed 93 % infection either singly or in mixed with species of *Fasciola*, *Amphistome*, *Moniezia*, *Dictyocaulus*, *Trichuris* and *Eimeria* in various combinations. The mean monthly EPG of strongyle ranged from 236 to 3400 in sheep and 325 to 5908 in goats. With high peak during June to August mainly because of species of *Strongyloides*, *Trichostrongylus*, *Haemonchus* and *Oesophagostomum* besides *Bunostomum* and *Chabertia* occasionally. Figure 9 indicate that under normal conditions the animals do possess a certain degree of GI parasitism without any clinical symptoms but worm burden reaches to pathogenic level during monsoon and post-monsoon seasons. However outbreaks of parasite induced mortality occurred mainly in spring and autumn season in migratory flocks and many such outbreaks remain unnoticed due to the grazing of flocks in far-flung areas of Lahaul-Spiti, Chamba and Kangra districts. Non-synchronized breeding also poses problems due to exposure of young animals to heavy infection before they reach the lower plains resulting in seasonal outbreaks of various helminthic diseases.

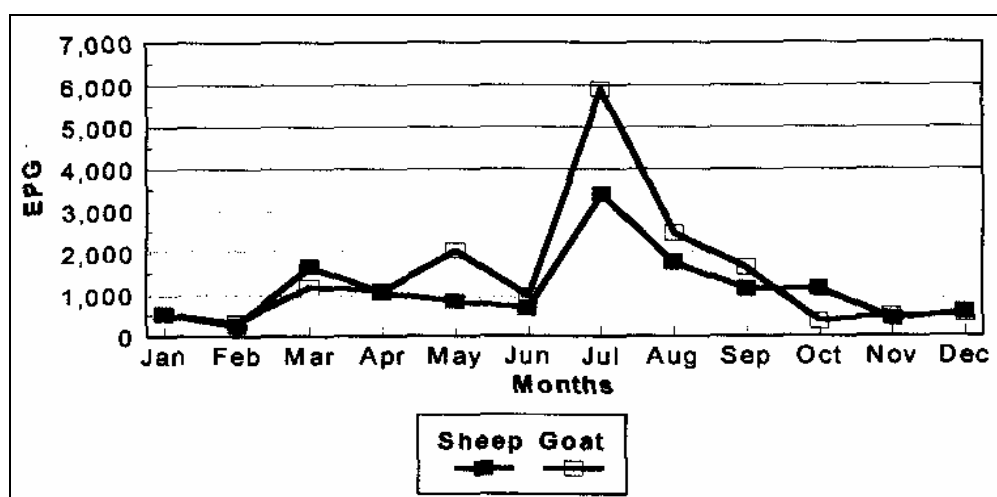


Figure 9. Mean monthly strongyle fecal egg counts (EPG) in sheep and goats in Himachal Pradesh (year, 1990)

CONTROL STRATEGIES

Livestock production offers a vast scope for development in Himalayan environment. Management of livestock is a specialized area based on knowledge, skill and dedication. An effective livestock and disease control programme is a key management operation. Animal health programme vary mildly depending on the species of livestock the climate and topography of the area. In migratory farming of pastural system the mortality losses due to diseases are generally lesser except in case of severe outbreaks of contagious diseases (Figure 10). However, parasitism is the single most entity for morbidity in livestock (Jithendran, 1998). Intelligent attention on management practices in hill areas is the need of the hour for sustainability of hill farming system.

Only tactical dosing with anthelmintic is currently in practice and no drenching strategy has been implemented in the region. Fluke infection has been treated with halogen compounds of carbon tetra chloride and hexachloroethane, which were effective with varying side effects (Jithendran and Krishna, 1991). Hexachloroethane has been reported to reduce the incidence of fasciolosis infection in several villages in mid eighties (Mathur, 1986). The drugs currently in use to check flukes are albendazole, oxclozanide, rafoxanide, nitroxynil, triclabendazole and closantel. Against nematodes, the main drugs in use during the last one decade was morentel citrate, piperazine citrate, thibendazole and mebendazole,

fenbendazole, albendazole, levamisole, tetramisole, closentel and ivermectin compounds. The present study revealed that July-September were the months with highest risk of GI parasites. Based on the seasonality of parasite prevalence, the present study suggests that broad spectrum anthelmintic treatment of dairy animals atleast twice a year, once in March-April and again in July-September should reduce the parasitism, and increase the productivity of animals in the region.

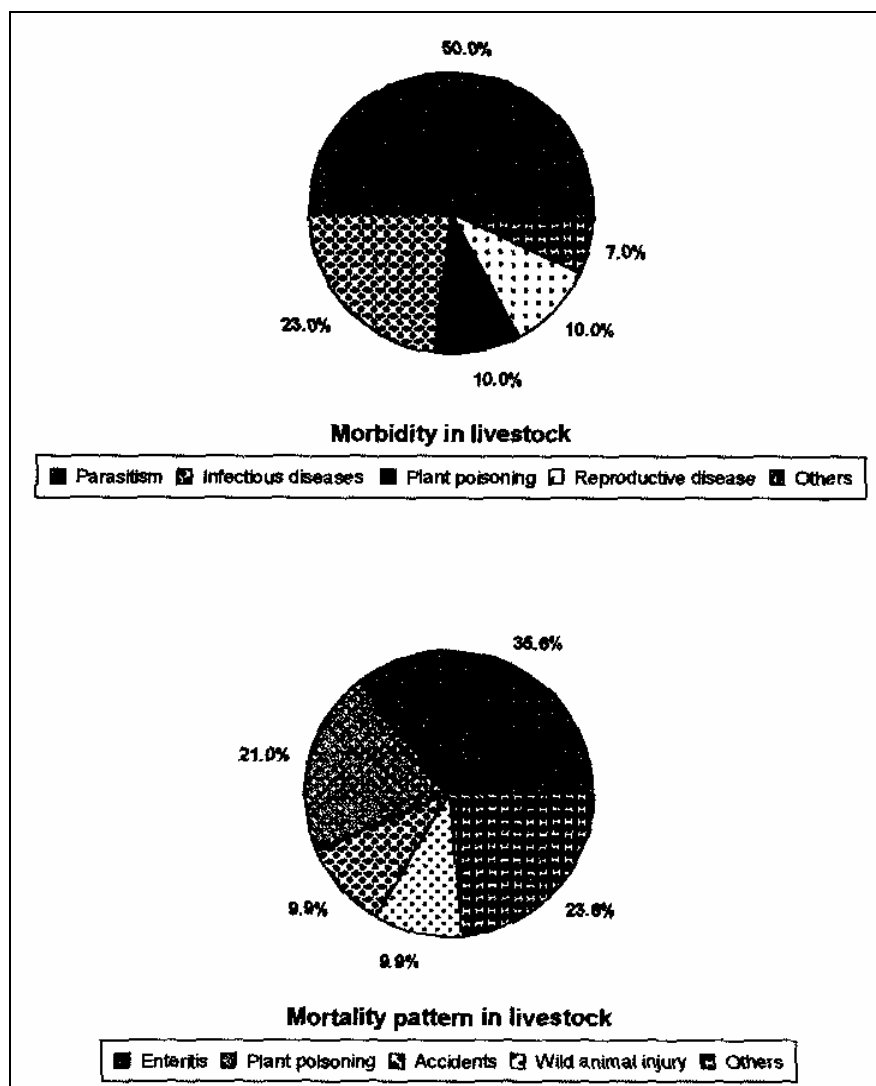


Figure 10. Morbidity and mortality pattern in livestock

Priorities for research and development of sustainable parasite control

GI parasitism is the single most important cause of production losses in small ruminants (Jithendran, 1998) as well as large ruminants (Chauhan, 1994). In the absence of an alternative to chemotherapy, the research activities aimed at minimising the use of anthelmintics and optimising their use to prevent the wide spread resistance. Recent research emphasised the role of improved nutrition in moderating the effects of concurrent parasitic infections. The use of non-protein nitrogen supplements in the form of urea molasses block (UMB) alone or medicated UMB with fenbendazole has resulted in even greater performance.

The use of nematophagus fungi and helminthic vaccines present control options that have considerable potential but are yet to be tested under local conditions. It must be stressed, however, that no single method is likely to reward if applied in isolation, but that a combination of methods is likely to be the most effective for a susceptible parasite control regime, suited to the needs of the individual farmers.

Table 2. Important helminth parasites in cattle and buffaloes in Himachal Pradesh

Parasite	(s)	Geographical area	Location	Intermediate host	Pathology	Source/study	Reference (s)
Trematodes							
<i>Fasciola gigantica</i>		Kangra, Kullu, Mandi, Chamba	Liver/bile duct	<i>Lymnaea auricularia</i>	Severe	Farm/N.E., F.E.	Krishna <i>et al.</i> , 1989; Jithendran and Krishna, 1990 HPKV Annual report, 1989-98, Agnihotri <i>et al.</i> , 1992
<i>F. hepatica</i>		Kangra	"	"	Severe	Farm/N.E., F.E.	Jithendran, 1998
<i>Dicrocoelium dendriticum</i>		Kangra, Chamba	"	?	Moderate	Farm/N.E., F.F.	Krishna <i>et al.</i> , 1989, Jithendran <i>et al.</i> , 1983
<i>Paramphistomum cervi</i>		"	Rumen	<i>Indoplanorbis</i>	Mild	Farm/N.E.	HPKV Annual report, 1990-98, Jithendran and Krishna, 1990
<i>Cotylophoron cotylophorum</i>		"	"	"	Mild	Farm/N.E.	HPKV Annual report, 1990-98
<i>Gigantocotyle explanatum</i>		Kangra, Chamba	Liver	"	Mild	Farm/N.E.	HPKV Annual report, 1990-98
<i>Gastrothylax cruminifer</i>		"	Rumen	"	"	"	HPKV Annual report, 1990-98
<i>Schistosoma indicum</i>		Kangra	Portal/mes. vein	<i>L. leuteola</i>	Mild	Farm/F.E.	Krishna, <i>et al.</i> , 1989, Jithendran and Bhat, 1999
<i>Schistosoma spindale</i>		Kangra	Portal/mes. vein	"	Mild	Farm/F.E.	Krishna, <i>et al.</i> , 1989, Jithendran and Bhat, 1999
Cestode/metacestodes							
<i>Moniezia expansa</i>		Kangra, Kullu	Intestine	?	Mild	Farm/N.E., F.E.	Jithendran and Bhat, 1999
<i>M. benedini</i>		"	"	"	"	"	IVRI Annual report, 1986-98
<i>Stelisia</i> spp.		"	"	"	"	"	HPKV Annual report, 1990-98
<i>Avitellina</i> spp.		Kangra	"	"	"	"	HPKV Annual report, 1990-98
Hydatid		Kangra, Chamba	Visceral organs	-	"	Farm/N.E.	IVRI Annual report, 1990-98
Nematodes							
<i>Toxocara vitulorum</i>		"	Intestine	-	"	Farm/N.E., F.E.	Krishna, <i>et al.</i> , 1989, Jithendran and Bhat, 1999
<i>Dictyocaulus viviparus</i>		"	Lung/bronchi	-	Mild	"	Krishna, <i>et al.</i> , 1989, Jithendran and Bhat, 1999
<i>Haemonchus contortus</i>		"	Abomasum	-	Severe	"	Jithendran and Bhat, 1999
<i>Mecistocirrus digitatus</i>		"	"	-	"	"	IVRI Annual report, 1997
<i>Strongyloides</i> spp.		"	Intestine	-	Mild	"	Jithendran and Bhat, 1999
<i>Trichostrongylus axei</i>		"	"	-	Mild	"	"
<i>T. colubriformis</i>		"	"	-	"	"	"
<i>Paracooperia</i> spp.		"	"	-	"	"	"
<i>Capillaria</i> spp.		"	Intestine	-	"	"	"
<i>Oesophagostomum</i> spp.		"	"	-	"	"	Jithendran and Bhat, 1999
<i>Trichuris</i> spp.		"	"	-	"	"	Jithendran and Bhat, 1999
<i>Sitaria digitata</i>		"	Peritoneum	-	"	"	IVRI Annual report, 1987
<i>Thelazia rhodesii</i>		"	Eye	?	Mild	Farm/C.E.	Krishna, <i>et al.</i> , 1990

F.E. - faecal examination, N.E. - Necropsy examination, C.E.- Clinical examination

Table 3. Important helminth parasites in sheep and goats in Himachal Pradesh

Parasite (s)	Geographical area	Location	Intermediate host	Pathology	Source/study	Reference (s)
1	2	3	4	5	6	7
Trematodes						
<i>Fasciola gigantica</i>	Kangra, Kullu, Shimla, Mandi, Chamba	Liver/bite dut	<i>Lymnaea auricularia</i>	Severe	Abattoir/ F.E.	N.E., Mathur, 1986; Jithendran, 1994, 1996, 1998, Mittra <i>et al.</i> , 1998
<i>Dicrocoelium dendriticum</i>	"	Bile duct	?	Moderate	"	Jithendran, 1994, 1998; Somvanshi <i>et al.</i> , 1992
<i>Paramphistomum epiclitum</i>	Shimla, Solan, Kinnaur, Chamba, Kangra, Hamirpur, Una, Bilaspur and Mandi	Rumen	<i>Indoplanorbis</i>	"	"	Vaidya, 1976, Jithendran and Krishna, 1990, Tandon and Sharma, 1981
<i>Paramphistomum cervi</i>	Kangra, Chamba	"	"	"	"	IVRI Annual reports, 1986-98
<i>P. inchikawai</i>	Shimla	"	"	"	"	Tandon and Sharma, 1981
<i>Calicophoron calicophorum</i>	Shimla, Kullu, Kinnaur	"	"	"	"	Vaidya, 1976, Tandon and Sharma, 1981
<i>C. crassum</i>	Shimla	"	"	"	"	Tandon and Sharma, 1981
<i>C. cauliorchis</i>	Shimla, Kinnaur	"	"	"	"	Tandon and Sharma, 1981
<i>C. papillosum</i>	Kangra, Kullu	"	"	"	"	Tandon and Sharma, 1981
<i>Cotylophoron cotylophorum</i>	Shimla, Hamirpur, Mandi	Rumen	"	"	"	Tandon and Sharma, 1981
<i>C. chauhani</i>	Shimla, Solan	Rumen	"	"	"	Tandon and Sharma, 1981
<i>C. indicum</i>	Shimla, Kullu	Rumen	"	"	"	Tandon and Sharma, 1981
<i>Cylonocotyle dawesi</i>	Shimla	Rumen	"	"	"	Tandon and Sharma, 1981
<i>C. scolioceleium</i>	Shimla, Hamirpur	Rumen	"	"	"	Tandon and Sharma, 1981
<i>C. streptocoelium</i>	Shimla, Hamirpur	Rumen	"	"	"	Tandon and Sharma, 1981
<i>C. tamilensis</i>	Shimla	Rumen	"	"	"	Tandon and Sharma, 1981
<i>Gastrothylax cruminifer</i>	Shimla, Chamba, Kullu	Rumen	"	"	"	Tandon and Sharma, 1981
<i>Fischoederius elongatus</i>	Shimla, Chamba, Kangra, Hamirpur	Rumen	"	"	"	Tandon and Sharma, 1981
<i>Gyganocotyle explanatum</i>	Kangra, Chamba	Liver/bile duct	"	"	"	Jithendran, 1996
<i>Schistosoma indicum</i>	Kangra	Portal/Mes. vein	<i>L. leuteola</i>	"	Farm/F.E.	Jithendran, 1994, 1998
<i>Schistosoma spindale</i>	Kangra	"	"	"	"	Jithendran, 1994, 1998

1	2	3	4	5	6	7
Cestode/ metacestodes						
<i>Moniezia expansa</i>	Kangra, Kullu, Chamba	Intestine	?	Mild	Abattoir/N.E	HPKV Annual report, 1990-98 Jithendran, 1994, 1998
<i>M. benedini</i>	"	"	?	"	"	"
<i>Stelisia</i> spp.	"	"	?	"	"	HPKV Annual report, 1990-98
Hydatid	Kangra, Chamba	Visceral organs	-	"	"	Jithendran, 1996, IVRI Annual report, 1990-98
<i>Cysticercus tenuicollis</i>	Kangra, Chamba	"	-	"	"	IVRI Annual report, 1987
<i>Coenurus</i> (Gid)	Kangra, Kullu	Brain	-	"	Abattoir/C.E	"
Nematodes						
<i>Dictyocaulus filaria</i>	Kangra, Chamba, Kullu, Sirmour, Hamirpur	Lung/bronc hi	-	Mild, severe	"	Dhar and Dash, 1982, Krishna <i>et al.</i> , 1989, 1998, Jithendran, 1984, Asrani, <i>et al.</i> , 1998, Mandial <i>et al.</i> , 1999
<i>Protostrongylus rufescense</i>	"	"	?	"	Farm/N.E, F.E.	Asrani, <i>et al.</i> , 1998, Kanwar <i>et al.</i> , 1998
<i>Muellerius capillaris</i>	"	"	?	"	"	"
<i>Varestrongylus spp.</i>	"	"	?	"	"	Dhar and Dash, 1982
<i>Haemonchus contortus</i>	"	Abomasum	-	Severe	"	Dhar and Dash, 1986, Singh <i>et al.</i> , 1992, Katoch <i>et al.</i> , 1998, Katoch <i>et al.</i> , 1999
<i>Strongyloides</i> spp.	"	Intestine	-	Mild	"	Jithendran, 1998, Mittra <i>et al.</i> , 1998
<i>Bunostomum trigonocephalum</i>	"	"	-	Moderate	"	Jithendran, 1994, 1998
<i>Trichostrongylus axei</i>	"	Abomasum	-	Mild	"	"
<i>T. colubriformis</i>	"	Abomasum , Intestine	-	"	"	Jithendran, 1994, 1998, Mittra <i>et al.</i> , 1998
<i>Ostertagia</i> spp.	"	Intestine	-	"	"	Singh <i>et al.</i> , 1992
<i>Skrjabinema ovis</i>	"	Intestine	-	"	"	IVRI Annual report, 1987
<i>Cooperia punctata</i>	"	Intestine	-	"	"	"
<i>Capillaria</i> spp.	"	Intestine	-	"	"	"
<i>Oesophagostomum</i> spp.	"	"	-	"	"	Katoch <i>et al.</i> , 1997, IVRI Annual report, 1997
<i>Chabertia</i> spp.	"	"	-	"	"	Jithendran, 1998
<i>Trichuris</i> spp.	"	"	-	"	"	"

F.E. - faecal examination, N.E. - necropsy examination, C.E. - clinical examination

Table 4. Helminth parasites incriminated in some of the disease outbreaks in Himachal Pradesh

Host	Parasite (s)	Locality in H.P.	Year	Reference (s)
Sheep	<i>Haemonchus contortus</i>	Siroli	1986	IVRI Annual reports, 1987
Sheep	Amphistomes (immature)	Siroli	1986	IVRI Annual reports, 1987
Cattle	Amphistomes (immature)	Hamirpur	1986	IVRI Annual reports, 1986
Cattle, buffalo	<i>Fasciola gigantica</i>	Agojar (Palampur)	1986	IVRI Annual reports, 1989
Sheep, goat	<i>Dictyocaulus filaria</i>	Hamirpur	1987	IVRI Annual reports, 1987, 1996-97
	<i>Protostrongylus rufescens</i>	Sirmour, Kinnaur, Kangra	1997	Asrani <i>et al.</i> , 1998, Mandial <i>et al.</i> , 1998
Cattle	<i>Mecistocirrus</i>	Palampur	1997	IVRI Annual reports, 1996-97
Pig	<i>Ascaris suum</i>	Holta (Palampur)	1987	IVRI Annual reports, 1990
Sheep, goat	<i>H. contortus</i>	Jauri	1997	Katoch <i>et al.</i> , 1998
Sheep	<i>H. contortus</i>	Nagwain	1998	Katoch <i>et al.</i> , 1999
Sheep, goat	<i>H. contortus</i> , <i>Strongyloides</i> <i>Trichostrongylus</i> spp.	Kangra	1998	Mittra <i>et al.</i> , 1998
Poultry	<i>Ascaridia galli</i>	Different localities	1986-1998	IVRI Annual reports, 1986-98

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

Parasites	No (%) infected*			
	1986-1990		1993-1997	
	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)
<i>Amphistome</i> 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.	142 (9.1)	22 (4.2)	24 (1.7)	6 (5.6)
<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 parasitisms

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

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EARTHQUAKE HAZARDS AND MITIGATION IN INDIA WITH SPECIAL REFERENCE TO NORTH EASTERN REGION

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INTRODUCTION

Natural disasters like earthquake, landslide, flood, drought, cyclone, forest fire, volcanic eruption, epidemic and major accidents are quite common in different parts of the globe. These lead to the loss of life, property damage and socio-economic disruption. Such losses have grown over the years due to increase in population and physical resources. It is believed that the natural disasters have claimed more than 2.8 million lives during the past two decades only and have adversely affected 820 million people with a financial loss of about 25-100 million dollars. These losses are not evenly distributed and are more prevalent in the developing countries due to higher population concentration and low level of economic growth. United Nations in 1987 realized the need of reducing these losses due to natural disasters and proclaimed, by its resolution no. 42/169, the current decade (1991-2000) as the International Decade for Natural Disaster Reduction (INDNDR). The main objective of this proclamation was to reduce, through concerted international efforts, the loss of life, property damage and socio-economic disruption caused by the natural disasters particularly in the developing countries.

Earthquakes are one of the worst among the natural disasters. About 1 lakh earthquakes of magnitude more than three hit the earth every year. According to a conservative estimate more than 15 million human lives have been lost and damage worth hundred billions of dollars has been inflicted in the recorded history due to these. Some of the catastrophic earthquakes of the world are Tangshan of China (1976, $M_a=7.8$, casualty > 3 lakhs), Mexico city (1985, casualty > 10,000) and North-West Turkey (August 17, 1999, $M_a=7.4$, casualty > 20,000). In India, casualty wise, the first three events are Kangra (>20,000), Bihar-Nepal (>10,653) and Killari (>10,000). Moreover, Indian-Subcontinent, particularly the northeastern region, is one of the most earthquakes-prone regions of the world.

Like any other natural disaster, it is not possible to prevent earthquakes from occurring. The disastrous effects of these, however, can be minimised considerably through scientific understanding of their nature, causes, frequency, magnitude and areas of influence. The key word in this context is "Mitigation and Preparedness". Earthquake disaster mitigation and preparedness strategies are the need of the hour to fight and reduce its miseries to mankind. Comprehensive mitigation and preparedness planning includes avoiding hazard for instance, by providing warning to enable evacuation preceding the hazard, determining the location and nature of the earthquake hazard, identifying the population and structures vulnerable for hazards and adopting strategies to combat the menace of these. In the light of the above, the author discusses the earthquake hazards in India with special reference to the northeastern region along with the mitigation strategies.

EARTHQUAKE HAZARDS IN INDIA

Seismic zonation map shows that India is highly vulnerable for earthquake hazards. India has witnessed more than 650 earthquakes of Magnitude >5 during the last hundred years and earthquake disaster is increasing alarmingly here. In addition to very active northern and northeastern seismicity, the recent events in Killari (Maharashtra) and Jabalpur (Madhya Pradesh) in the Peninsular India have raised many problems to seismologists.

The occurrence of earthquakes can be explained with the concept of "Plate Tectonics" Based on this three broad categories of earthquakes can be recognised. 1) those occurring at the subduction/collision zones (Inter-plates), 2) those at mid-oceanic ridges and 3) those at intra-plates (Acharrya, 1999). Seismic events in India mainly belong to the first category though a few third category events are also known. Earthquake events are reported from the Himalayan mountain range including Andaman and Nicobar Islands, Indo-Gangetic plain and Peninsular region of India.

Subduction/collision earthquakes in India occur in the Himalayan Frontal Arc (HFA). This arc is about 2500km long and extends from Kashmir in the west to Assam in the east. It constitutes the central part of the Alpine seismic belt and is one of the most seismically active regions in the world. The Indian plate came into existence after initial rifting of the southern Gondwanaland in late Triassic period and subsequent drifting in mid-Jurassic to late Cretaceous time. The force responsible for this drifting came from the spreading of the Arabian sea on either side of the Carisberg ridge (Fig. 1; Chatterjee). It eventually collided with the Eurasian plate in Middle Eocene after NNE drifting along counter clockwise path. The NNE ward movement of the Indian plate caused continental collision with the rates of convergence varying from 44 - 66mm per year. This led to the creation of Himalayan mountain range. The present day seismicity of this is due to continued collision between the Indian and the Eurasian plates. The important earthquakes that have visited HFA are tabulated below:

Place	Year	Magnitude	Casualty
Kangra Valley	April 4, 1905	8.6	>20,000
Bihar-Nepal border	January 1, 1934	8.4	>10,653
Quetta	May 30, 1935	7.6	About 30,000
North Bihar	1988	6.5	1000 Approx.
Uttar Kashi	October 20, 1991	6.6	>2,000
Chamoli	March 29, 1999	6.8	>150
Hindukush	November 11, 1999	6.2	no death reported

This seismic hazard status of Peninsular India, which was once considered as a stable region, has increased due to the occurrence of damaging earthquakes (Pande, 1999). The recurrence intervals of these are, however, larger than those of the HFA and their magnitude is also lesser. These belong to intra-plate category of earthquakes. The following are the important events that have rocked the Peninsular India.

Place	Year	Magnitude	Casualty
Kutch	June 16, 1819	8.5	No record
Jabalpur	June 2, 1927	6.5	-----
Indore	March 14, 1938	6.3	-----
Bhadrachalam	April 14, 1969	6.0	-----
Koyna	December 10, 1967	6.7	>200
Killari (Latur)	September 30, 1993	6.3	>10,000
Jabalpur	May 22, 1997	6.0	>55

Koyna event is a classic example of earthquake activity triggered by reservoir. Seismicity at Koyna has close correlation with the filling cycles of the Koyna reservoir. The most puzzling event in the Peninsular India is, however, the Killari earthquake, which occurred in the typical rural setting. This event was least expected from the tectonic consideration, as it is located in the Deccan Trap covered stable Indian shield. There is no record of any historical earthquake in this region. This has been considered as the most devastating SCR (Stable Continental Region) event in the world. Jabalpur event, which occurred in the urban centre, though moderate, is an important one because it is the first major earthquake in India to be recorded by the newly established broadband digital station in the shield region. Moreover, its spatial association with the Narmada Son lineament has triggered a lot of interest from the seismotectonic point of view (DST, 1999).

EARTHQUAKE HAZARDS IN THE NORTH EASTERN REGION

Northeastern region of India lies at the junction of the Himalayan arc to the north and the Burmese arc to the east and is one of the six most seismically active regions of the world. The other five regions are Mexico, Japan, Taiwan, Turkey and California. Eighteen large earthquakes with magnitude >7 occurred in this region during the last hundred years (Kayal, 1998). High seismic activity in the northeastern region may be attributed to the collision tectonics in the north (Himalayan arc) and subduction tectonics in the east (Burmese arc). The Syntaxis Zone (The Mishmi Hills Block) is the meeting place of the Himalayan and

Burmese arcs and is another tectonic domain in the region. The Main Central Thrust (MCT) and the Main Boundary Thrust (MBT) are the two major crystal discontinuities in the Himalayan arc of the Northeastern region. In the Burmese arc, the structural trend of the Indo-Myanmar Ranges (IMR) swing from the NE-SW in the Naga Hills to N-S along the Arakan Yoma and Chin Hills. Naga Thrust is the prominent discontinuity in the north. It connects the Tapu Thrust to the south and Dauki Fault to the east. This fold belt appears to be continuous with the Andaman-Nicobar ridge to the south. The Mishmi Thrust and the Lohit Thrust are the major discontinuities identified in the Syntaxis Zone (Kayal, 1988; Fig. 2). The following is the list of important earthquake events in this region:

Place	Year	Magnitude	Remark
Cachar	March 21, 1869	7.8	Numerous earth fissures and sand craters.
Shillong Plateau	Jun 12, 1897	8.7	About 1542 people died.
Sibsagar	August 31, 1906	7.0	Property damage.
Myanmar	December 12, 1908	7.5	Property damage.
Srimangal	July 8, 1918	7.6	4500 sq km area suffered damage.
SW Assam	September 9, 1923	7.1	Property damage.
Dhubri	July 2, 1930	7.1	Railway lines, culverts and bridges cracked.
Assam	January 27, 1931	7.6	Destruction of Property.
N-E Assam	October 23, 1943	7.2	Destruction of Property.
Upper Assam	July 29, 1949	7.6	Severe damage.
Upper Assam	August 15, 1950	8.7	About 1520 people died. One of the largest know quake in the history.
Indo-Myanmar border	August 6, 1988	7.5	No casualty reported.

The June 12, 1897 earthquake of the Shillong Plateau is one of the greatest event of the world. Casualty was only 1,542 compared to the magnitude of the event (8.7). This is so because event occurred at 5.15 p.m when most of the people were outdoor. Damage to the property was, however, severe. All concrete structures within an area of 30,000 square miles were practically destroyed. There was evidence of two surface faults, namely, Chidrang and Dudhnoi. It is the first instrumentally recorded event in the country. Another event of matching magnitude occurred on August 15, 1950 in the Syntaxis Zone. It caused 1520 death but was more damaging than the 1897 event. Railway line and roads were considerably damaged, landslide triggered in many places and fissures and sand vents occurred. The last major event (Ma=7.5) in the region occurred on August 6, 1988 with its epicentre in the Myanmar side of the IMR. This rocked the whole northeastern region. The tremor lasted for about two minutes killing four human lives and damaging buildings, railway tracts and roads.

HAS THE EARTHQUAKE FREQUENCY INCREASED!

Are earthquakes becoming more frequent than before! Seismologists seem not believe that there is upheaval in the occurrence of earthquakes. Gupta (1999) says that annually on an average about 18 earthquakes of magnitude, which hit Turkey, (Ma=7.4), Greece (Ma=7.2) and Taiwan (Ma=7.6) recently occur all over the world. However, these oftenly occur in uninhabited areas or virtually uninhabited areas. Unfortunately, these have now hit thickly populated areas and killed thousands of people. This does not mean that the earthquake frequency has increased. Increase in the loss of life and property damage is not due to increase in number and strength of earthquake frequency but for the rapidly increasing vulnerability of human civilization to these hazards. This can be understood by the fact that Kangra event of 1905 (Ma=8.6) and Bihar-Napal of 1934 (Ma=8.4) killed respectively about 20,000 and 10,653 people whereas 1897 and 1950 events of the northeast (Ma=8.7 each) could kill only about 1542 and 1520 people. This is because Kangra and Bihar-Nepal events struck densely populated areas of Indo-Gangetic plain whereas the northeastern region was sparsely populated in 1897 and 1950. Population concentration and physical resources have increased many times in this region since the last great event. Therefore, if the earthquake of matching magnitude visits the region now, the devastation would be enormous. Timing of the event and epicenter also

matters a lot. For instance, Killari event occurred at 3:00 hrs early in the winter morning when people were sleeping and hence the casualty was high (>10,000). Similarly, Turkey event (August 17, 1999, $M_a=7.4$) also occurred 3.00 hrs in the morning when most people were asleep killing >20,000 of them. Jabalpur event, on the other hand, occurred 4.00 hrs in the morning on summer day when most of the people were outdoor. That is why though the epicenter was near the town, the casualty was less (about 57) and property damage was also not severe.

EARTHQUAKE PREDICTION

Research on earthquake prediction started since early sixties. Intensive work is going on all over the world in this regard involving expenditure of billions of dollars. The precise prediction of seismic events remains elusive and unattainable goal as yet in spite of these efforts. According to R.R. Kelkar, Director General of Indian Meteorological Department (IMD), "Earthquake cannot be predicted by anyone, anywhere, in any country. This is a scientific truth". But seismologists continue their efforts in the hope of a major breakthrough in prediction technology in the near future. The seismologists are, however, in a position to indicate the possibility of recurrence of earthquakes in potentially large areas based on palaeoseismicity, micro seismic activities and precursors.

It has been found that earthquakes are generally, but not necessarily, preceded by some signals like ground tilting, foreshocks, change in ground water levels, variations in the discharge of springs, anomalous oil flow from the producing wells, enhance emanations of radon and unusual animal behaviour. Perhaps the first successful prediction of earthquake in the world was made by the Chinese. They predicted Haicheng event of Lioing Province (February 4, 1975, $M_a=7.3$) on the basis of micro seismic activity, ground tilting and unusual animal behaviour (Nandi, 1999). They also foretold 4 out of 5 events of magnitude 7 during 1976-77. It is believed that the Chinese have mastered themselves in the art of closely monitoring and analysing animal behaviour to forecast earthquakes. Still they failed to predict Tangshan event of 1976 ($M_a=7.8$, casualty > 3 lakhs).

In India also efforts are going on for predicting earthquakes based on the statistical analysis of past events and their recurrence intervals, swarms activity and seismic gap. However, meaningful prediction is still alluding the seismologists. Khatri (1999) identified three seismic gaps in the Himalayan region, namely, the Kashmir gap, the Central gap and the Assam gap. The Kashmir gap lies west of Kangra event, the Central gap between Kangra and Bihar-Nepal events and the Assam gap between the two great earthquakes of Assam. He further said that the great event may occur in these gaps in near future. Das and Sarmah (1996) forecasted the occurrence of high magnitude earthquake in the western part of the northeastern region at any time within next few years. Negi (in Ahmad, 1998) has predicted "Mega Earthquake" in the northeast by 2010 on the basis of theory of cyclical earthquakes. Sarmah (1999) calculated an average return period of 55 years for the earthquakes of magnitude 8 or greater. The last big earthquake of magnitude 8.7 occurred in 1950. Therefore, northeastern region is ready for an earthquake of similar magnitude. It is bare fact that the strain is accumulating in some parts of the region and any delay in the occurrence of earthquake will increase its magnitude and thus the devastation only.

EARTHQUAKE HAZARD ZONATION, RISK EVALUATION AND MITIGATION

The importance of seismological studies lies in the fact that information generated can be used to mitigate the earthquake hazards. Preparation of seismotectonic/seismic zonation maps is the first step in this direction. The basic data required for the preparation of these maps are (i) A carefully compiled earthquake catalogue incorporating details about magnitude, location of epicenter, depth of focus *etc.*, (ii) Delineation of seismic source zones from all possible sources like recurrence relation, tectono-geological consideration, palaeoseismicity *etc.*, (iii) Estimation of upper bound magnitude through statistical procedure, cumulative seismic energy release, active fault length *etc.* and (iv) Attenuation of ground shaking for better results (Das Gupta, 1999). Seismic microzonation is recommended for better result. These maps give an idea about the possibility of occurrence of earthquakes in the region and are very useful for evaluating the risk involved before designing and constructing the heavy engineering structures like dam, bridges, flyovers and large towers *etc.* These are also useful for planning human settlements that would remain safe during the occurrence of an earthquake. Seismic risk evaluation is also possible from these maps.

Indian Meteorological Department, National Geophysical Research Institute, Department of Science & Technology, Bhabha Atomic Research Centre and Regional Research Laboratory have established a large number of seismic monitoring network in the country including northeastern region. These stations are recording useful seismic data, which enables to determine the location of epicenter, useful seismic data which enables to determine the location of epicenter, depth of hypocenter, energy within the focus, orientation of the geological structure that has undergone deformation and many other parameters of earthquakes. These parameters are then utilised for preparing seismo-tectonic and seismic zoning maps. The work in seismic zoning in India was started by Indian Standard Institute (now Bureau of Indian Standard) in the year 1960 and the first map was included in the code IS: 1893-1962. A significant progress has been made since then both in seismic zoning and instrumental monitoring of seismicity. However, many questions regarding the location and nature of potential seismic zones/faults still remain unsolved and need to be addressed to in the new millennium.

EARTHQUAKE RESISTANT STRUCTURES

It is necessary to design and construct earthquake resistant dwellings in the seismic prone zones. The principles of a seismic design should be kept in mind in this regard. The important earthquake resistant features which are recommended in the latest BIS codes (IS 13828:1993) should be followed (Bhagwan and Sreenath, 1996). Normally houses are built to withstand vertical load only and as a result they collapse when subjected to horizontal stresses produced by earthquake waves. The main requirements for preventing the collapse are a lateral load carrying system of enough residual capacity to safely resist lateral forces, a monolithic roof with sufficient in-place rigidity and a strong and durable vertical load carrying system (Shukla, 1998). It is said that the buildings made after 1981 basically had no damage due to Kobe event of 1995 in Japan because these fulfilled earthquake standards of construction (Struck, 1999). Besides, good quality construction materials should be used. The importance of quality material may be realised from the fact that almost all the individual houses in Jabalpur town withstood earthquake shaking, many government and private apartments built by contractors were badly damaged. It may be due to the reason that the contractors used substandard materials.

As northeastern region is highly seismic and experienced two great events of 1897 and 1950, the people here learnt to construct flexible and sufficiently earthquake proof houses popularly known as "Assam Type" (Nandi, 1999). The scenario has changed now and these houses have paved the way for multistory masonry buildings particularly in the capital towns of all the seven states of the region. If the present trend of construction and population growth continues, the earthquake of magnitude > 7.5 will bring enormous damage to property and great loss of lives. Therefore, the administrative agencies have to strictly enforce the implementation of proper building codes and appropriate landuse policy in the region.

AWARENESS CAMPAIGN

Awareness campaign need to be launched to educate the people about the disastrous effects of earthquakes and to prepare them to face these in a better way. Prevention and mitigation begins with the information. Moreover, public education and community participation is key to the success of the implementation of reduction and mitigation programmes.

A large number of specialised as well as popular articles have been written about earthquakes in research journals and conference proceedings, which are not available to common man. The newspapers and magazines usually do not show interest in publishing articles about mitigation and hazard reduction, however, they give extensive coverage after earthquake takes place. Information and popular articles should be written in simple language and be made readily available to common man. There has to be a close interaction between the seismologists and the administrators, which would greatly help the execution of seismic mitigation programmes (Bapat, 1996). Earthquake related curricula should be introduced in the school stage of education itself. Audio-visual programmes, preferably in the local languages have to be prepared and made available to the public. Voluntary organisation and college students may be approached to take up the responsibility of awareness campaign.

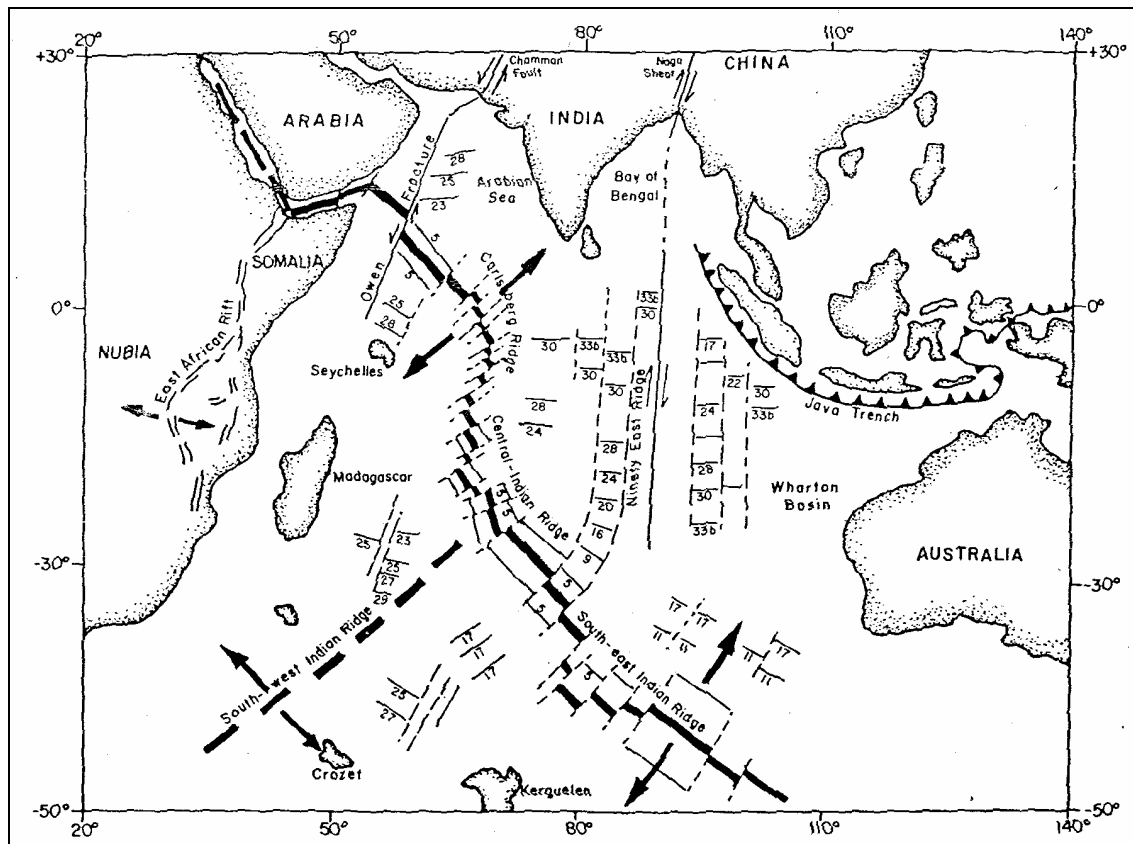


Figure 1. Major tectonic features of the Indian Ocean showing spreading of Arabian Sea on either side of the Carlsberg Ridge (after Chatterjee)

CONCLUSION

Himalayan Frontal Arc including northeastern region and Andaman & Nicobar Islands, Indo-Gangetic Plain and even Peninsular India are highly vulnerable for earthquake hazards. Earthquake, like other natural hazards, cannot be prevented from occurring. It seems socially relevant and useful earthquake prediction may not be possible in near future. Moreover, prediction may not be much useful also as building and other physical resources cannot be evacuated (Lalliana, 1997). Therefore, we have to learn to live with this disaster and try to minimise its adverse impact on human civilisation. Earthquake mitigation and preparedness programme is the key word in this context. Such programmes can be evolved through detailed study of the seismo-tectonics and seismic history of the region and by preparing seismic zonation map. Constant monitoring of the seismicity is prerequisite for this purpose.

Intensive campaign has to be launched to educate the people about the earthquakes. Popular articles have to be written preferably in local languages in local dailies and magazines. There has to be strong public opinion and political and administrative will to implement mitigation and preparedness programmes. It has been observed that we think to these only in the wake of a particular event and with the lapse of time, political, official and public interest in the problem diminishes. As a result, a large amount of money is spent on relief and rehabilitation (Bapat, 1996).

Strict enforcement of building codes for construction of masonry structures and even for small housing complex in the earthquake prone zones and strict legislation of landuse may help in fighting and reducing the miseries of earthquake hazard. However, it may never be possible for the mankind to live in "Zero Risk Situation" because even after full implementation of mitigation measures, there may be some unpredictable situation that may cause hazards (Acharrya, 1999). Satisfactory results may be obtained through pre, during and post event measures (Tiwari, 1999).

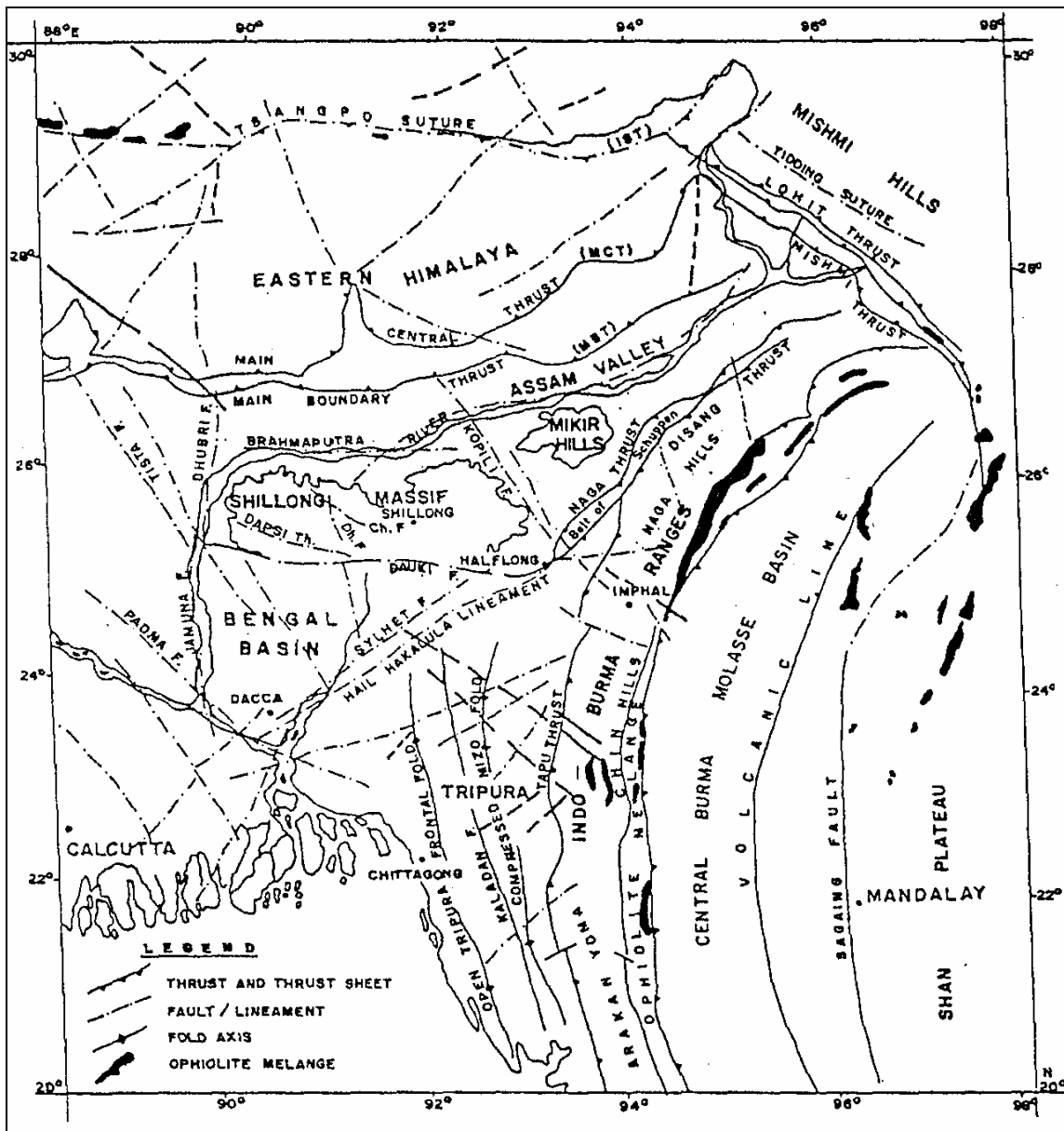


Figure 2. Tectonic setting of northeast India and surroundings (after Evans, 1964 and Krishnan, 1960).

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TRENDS AND CONSTRAINTS IN LIVESTOCK REARING IN *CHANGER* AREAS OF KANGRA DISTRICT OF HIMACHAL PRADESH

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Livestock farming systems in the western Himalayan region are complex and generally based on traditional socio-economic considerations, mainly guided by available feed resources. Increasing awareness about environmental issues and preservation of the eco-system with minimum detrimental effects to future generations has led to great concern about the sustainability of agricultural production systems. The word “*Changer*” which belongs to Pahari dialect means a rough mountainous area with scarcity of water. It is a typical geographical area with undulating rough terrain, fragile geomorphy, scarce water availability during summers and high rainfall during the rainy season. The temperature range of the *Changer* area in Kangra district of Himachal Pradesh varies from 1°C to 44°C. The area is connected with a network of roads, veterinary dispensaries, artificial insemination facilities, etc. The average land holding per household is to about 0.75 hectares (ha) which consists of some cultivable agricultural land with moderate slope, few moderately to highly steep hay lands and a little homestead area for vegetable production.

Hay lands in *Changer* are quite typical. In many cases, government lands have been encroached upon by the villagers. However, there are many community hay lands where most of the villagers enjoy the rights of grazing their animals. Due to hilly region and fragile ecology there are very little employment avenues, except in the government sector. Therefore, agriculture, animal husbandry and horticulture provide some addition to income although it is very meager due to small land holdings and lack of economical and sustainable practices. In this a survey has been carried out to evaluate the current system of animal husbandry practices including trends of livestock rearing, carrying capacity of grazing lands, fodder resources and impact of all these factors on sustainable livestock rearing, keeping in view the issues of eco-conservation and profitable production.

STUDY AREA AND METHODOLOGY

A total of seven villages forming a watershed unit were selected to carry out a preliminary survey where Indo-German *Changer* Eco-Development Project is intervening for ecological rehabilitation. Information regarding all the households, types of livestock reared and number of households rearing livestock was gathered through the tools of participatory social appraisal. Demographic information of the study area is given in Table 1.

Table 1. Demographic information of the study area

Village	Households	Households rearing livestock	Households rearing livestock (%)
Garyala	9	9	100
Kuthera	40	32	80
Lanot	96	60	66
Lahat	40	13	33
Guga	23	22	96
Dib	74	52	70
Gungri	48	39	81

The area of private hay lands was taken from revenue records at *Panchayat* level. For greater precision, uncultivated agricultural lands where grazing by the particular villagers’ livestock is practiced was ascertained through participatory appraisal and added to the area. The type and number of livestock reared by each household were also ascertained. A local non-descript cow weighing about 150 kg was taken as one

Standard Animal Unit (SAU). For the purpose of calculating the SAU, the average weight of crossbred cows, adult sheep, adult goats, bulls and buffaloes was taken as 300, 30, 30, 300 and 350 kg respectively.

RESULTS AND DISCUSSION

On an average about 75 per cent households in study area are rearing different animals. The pressure in terms of SAU on grazing land of the total livestock population of the villages is given in Table 2.

Table 2. Pressure in terms of Standard Animal Units on grazing land

Village	Nondescript cows	Crossbred cows	Adult sheep	Adult goats	Bulls	Buffaloes	Grazing land (ha)	SAU per ha
Garyala	3	8	6	2	1	13	15.00	4
Kuthera	8	46	27	21	38	24	44.53	4.45
Lanot	22	66	12	7	7	18	30.40	3.11
Lahat	13	20	14	5	18	6	93.00	1.03
Guga	16	23	15	7	2	12	15.00	7.34
Dib	46	4	13	33	27	13	11.10	10.4
Gungri	8	8	18	24	52	5	7.83	9.4

It has been observed that in almost all the villages the pressure on the grazing land is much higher than the recommended figure of 2 SAUs/ha (Katoch, 1996). The grazing lands in this region are undeveloped, overgrazed, contain poor quality grasses and are infested with weeds (Jithendran *et al.*, 1998). However, villagers do not appear to attach due importance to aspects like carrying capacity, nutritional status, soil compaction and degradation due to unawareness. There is lack of awareness regarding low digestible crude protein, total digestive nutrients and mineral contents in various feeds. Feeding such poor diets results in infantile genitalia, late maturity, anemia, infertility and loss of production are found to be common problems which are generally due to feeding low quantity and poor quality feeds. A large number of such cases were found registered in veterinary institutions. The farmers were found to supplement the diet of only lactating animals with 0.5 to 1 kg concentrate. Very few farmers were found to feed the animals mineral mixture and salt. Stall feeding practices were common for only a limited period of time per day along with round the year grazing. During the period of shortage of green fodder *i.e.* in winter, tree leaves are fed to the livestock which comprise leaves of *Grewia optiva*, *Bauhinia variegata*, *Ficus roxburgii*, *Bambusa arundinacea*, *Morus alba*, *Cederella toona*, *Atrocarpus lakoocha*. *Grewia optiva* followed by *Bambusa* is considered the best fodder by the local villagers. However, though these have been found to be nutritious but are deficient in zinc (Khata and Katoch, 1983). The feed availability to various livestock in change area is given in chart 1.

At the end of winters and during early summer the availability of green fodder is even more scarce. During this period the livestock are reared solely on hay straw and crop residues. The rearing of such animals entails huge labour to the farmer and results in disappointment because of poor returns. The animals that are able to conceive, yield very little milk. However, for the farmers who are satisfied with such uneconomical yields, the up gradation of local cattle with exotic blood (Jersey and Red Sindhi breeds) carries no meaning in the absence of improved feeding practices. Such crossbreds have become common place in the *Changer* area. However, for such crossbreds, absence of integrated package of practices, their greater susceptibility to diseases, inability to adjust to native environment and consequent infertility or sterility has resulted in a sense of dissatisfaction amongst the farmers. Such substandard feeding practices have also caused anoestrous and failure of artificial insemination services resulting in general non acceptance of this technique by the farmers. Though the farmer is spending little on such animals, as he gets very output, such animals are causing ecological imbalance in the community land eco-system by overgrazing selective species of grasses resulting in depletion of vegetative cover, spread of weeds, soil erosion and loss of top layer of fertile soil with far reaching implications for the future. The survey has also revealed that pressure is more on the grazing lands which are inhabited by poor landless villagers dependant on community lands particularly in Dib, Gungri and Guga villages. However, in the villages inhabited by rich land owning farmers, the pressure is less. These people are rearing less number of animals due to other occupations outside the village. There is decrease in

grazing area, and grazing by unproductive animals has added to increased pressure on limited land resources.

Chart 1. Livestock feed availability round the year

January	Dry grass and tree leaves	
February	Dry grass and purchased wheat straw	
March		
April		
May	Dry grass and browsing of new grass and crop residue	
June		
July		
August		
September	Stall feeding	Green fodder from haylands
October	Straw feeding with dry grass	
November		
December		
January	Dry grass and tree leaves	Green fodder from fodder trees
January		

CONCLUSION

On the basis of this survey, it is concluded that research priority should be to improve the digestibility of crop residues, straws and stovers using chemical and microbiological techniques that can be adopted by marginal and small farmers. The wasteland development programmes for fodder production also need to be strengthened. Uncontrolled overgrazing by livestock leading to degradation and deforestation needs to be checked. For sustainability, emphasis must be given to develop pastures, forages, and fodder and fodder-crop systems to provide continuous and sustainable feed resources round the year. It must be kept in mind that without pre-requisites of sustainability for future animal production, sustainable rural society will remain a distant dream. Therefore, application of any animal production system in a particular geographical area must conform to the framework of sustainability and should be ecologically, technically and economically viable.

From this study it can be concluded that in *Changer* or similar areas elsewhere in Himachal Pradesh, animal husbandry practices can become economical and sustainable only if serious attention is paid to research on increased forage production, development of grazing lands and feeding management based on appropriate technology adaptable by the farmers. The intervention of Indo-German *Changer* Eco-Development Project, Palampur is a step in this direction to bring sustainability in this sector and in *Changer* area of Kangra as a whole

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LIVESTOCK BASED FARMING SYSTEM - A CASE STUDY OF KUMAON HILLS

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INTRODUCTION

The development of livestock production has been receiving significant priority as well as research attention in India in the last two to three decades. In the wake of various development programs the milk production has raised from 31.6 million tones to 60.8 million tones and egg production from 10 billion to 24.4 billion between 1980-81 and 1993-94 and the gross value of livestock output (in constant 1980-81 prices) from Rs. 7,387 crores to Rs. 17937 crores between 1970-71 and 1990-91 (CMIE, 1994). Animal husbandry in India is an integral part of crop agriculture yet it's contribution to GDP is increasing in comparison to the contribution of agriculture, which is on decline. It contributes an estimated 8.4% of the country's GDP and 35.85% of agriculture output at current prices in 1993-94. It is main source of draught poert for the farmers, besides being a source of milk, meat, skin, hides, manure, and domestic fuel. The crop husbandry which has got comparatively more attention by the policy makers, scientists, and economists so far is somewhat seems to be reached a stage of saturation whereas the livestock sector is still emerging and thus, offers a great hope for booming Indian economy. This necessitates more attention to this sector in the years to come.

Livestock keeping in India and similar other countries has multiple objectives and dimensions. The play multiple roles in rural systems and economy and have a strong human dimension, as manifested through socio-cultural link and involvement of women (Makiltkkons, 1996). Besides their well-established role in agriculture livestock have crucial role in food security and as risk aversion mechanism for sustaining family, whenever there is crop failure. Role of livestock in generating employment and income in rural areas is well established and livestock development has become an important component of rural development programs *i.e.*, "Equity and extending benefits directly to women" can be achieved through livestock development, since livestock distribution is less skewed than land. Livestock are a part of nature's chain for recycling nutrients, converting low quality and other agro bye-products into good quality and organic fertilizer. The latter being important for retaining soil fertility and productivity in ecologically fragile hill region. Moreover the farmers always take holistic view and are good example of systems manager who has to make decision on variety of factors.

The Himalayan region is vast, gigantic, diverse and youngest mountain system in the world. It occupies 591 thousand square kilometer (18% of geographical area of India) spread over 2,800 kilometer in length and 220 to 300 kilometer wide across the 11 states of India bordering china, Nepal, Myanmar, Bhutan and Pakistan. In this region, 6% of Indian population resides and 95 of India's 449 million cattle are raised under mixed farming systems. In the central and eastern Himalayas, cattle are most common (47.5%), buffalo (12.3%), sheep and goat (10.45%). Livestock are almost integral part of farming system for this region where it not only supplement the family income but also contributes FYM to the farm which is an essential requirement of largely rain-fed agriculture of this region.

The Himalayan region is characterized by small and fragmented land holdings, rain-fed subsistence agriculture, low input-low output production system, sparse population, undulating terrain poor means of transport and communication, women centered agriculture, out migration of males in search of off farm employment, poor productivity of crop and livestock, fragile eco-system, low risk bearing capacity of farmers yet rich in plant and animal diversity *etc.* with the application of local wisdom the hill people has maintained the hill ecology in spite of all those above mentioned constraints. They have sustained themselves in this difficult condition and in their endeavor the livestock were active partner. Indigenous livestock provide practical means of using natural grasslands where crop production is possible but the exotic animals cannot perform well because of higher susceptibility to environment, disease and nutritional stresses. Improved livestock management by small landholders would contribute to farm income, household nutrition and sustainability of livestock production. Mixed farming will be the choice of farmers in the hill agro-ecosystem

as livestock is an inseparable component of hill agriculture (Chander and Mukherjee, 1995).

A few reports on economics of livestock production in Himalayan region are available, but they need to be analyzed care fully before drawing any conclusions, nevertheless these reports provide some insight of the situation. Sharma and Singh (1994) have studied the economics of milk production by different type of animals in parts of Himachal Pradesh and concluded that animals are good source of income to the hill farmers. However the report of Tripathi (1995) based on economic analysis of milk production by farmers from different altitude in the hills of Himachal Pradesh, indicates loss in milk production. Report of Shankya (1993) from Nepal indicates that the livestock contributes about 20% towards the cash income of the farmer's family. Livestock contribution to the GDP of Bhutan is reported to be as high as 10% (Rai, 1992). All the above reports indicate importance of livestock sector in the hill economy. There are no such studies for Kumaon hills. Therefore a study was conducted as a part of a research project entitled "Systems Approach to Livestock Production and Health Service Delivery system In Sub-Himalayan Region" by a multidisciplinary team of scientists during 1997-99 to study overall scenario of animal husbandry in the Kumaon hills.

MATERIALS AND METHOD

The study was multidimensional, hence, quantitative and qualitative information was obtained through literature review, available records, questionnaire survey, Interviews, and through participatory rural appraisal. The diverse view points were analyzed with focused attention on farmers view as no one know better the local condition, needs and aspirations. Twelve villages of Nainital district from two randomly selected blocks (Ramgarh & Dhari) were selected randomly. From each selected villages 10 farmers were selected randomly for questionnaire survey. PRA was applied in 4 of the selected villages to collect the information.

RESULTS AND DISCUSSION

Demographic Information

General profile of the farmer

Table 1 shows the demographic information of the selected households. About 77.30% of the head of the households were literate which is higher than the average for Nainital district, which is 67.88% for male and 65.59% for female according to 1991 population census. The general profile of the households, main occupation of the heads of the family is shown in Table 2.

Types of land holdings

Type of land holdings of the farmers is being presented in Table 3. Major of the farmers were small (57.52%) followed by medium and large (29.28% and 13.20% respectively). This conforms the fact that the size of land holding is very small in the hills and most of them are uneconomic holdings. Almost all the farmers were doing mixed farming, which is inherent to the hill-farming system.

Animal resource

92.52% of the farmers had cow out of which very few of cross breed (Table 1). They mostly reared local breed of cow and buffalo. They mostly reared the cow for their male offspring used in ploughing. There is scarcity of feed and fodder in the hills, it is the wisdom of the farmers that they keep small sized animals, which served their purpose with in the limited resource. 26% of the farmers had buffalo either singly or in combination with other livestock. These buffalos and goat are fast replacing the local cow as they give good amount of milk, cow-dung and ready cash as compared to the local cow as reported by Singh (1993) and Jodha (1993). The ratio of human to livestock was 1:31:1, which is quite higher. The number of cross breed cow was very low and it was concentrated in only for the selected villages which were valley and farmers were able to feed green fodder to them.

Wealth ranking

Wealth ranking a Participatory Rural Appraisal (PRA) was carried out in for of the villages. According to the people's perception there were four categories of people *viz.* very poor, poor, medium and rich. The basis of classification was different than that of Planning Commission of India. They were based on ground reality and indicators such as possession of fertile land, type of house (Kuccha, Pucca, big, small *etc.*) nature of occupation *etc.* There were 61.06% (Table 4) very poor. This figure did not match with the figure of

people below poverty line in the block. According to the people 7.93% of them were under rich category.

Livelihood analysis

After carrying out the wealth ranking, livelihood analysis was done among few households of each categories and presented in Table 5. The share of earning from animal husbandry was 18% for rich categories and 29%, 22.5, and 36% for medium, poor and very poor categories respectively. Overall it was 26.25% in the study area, which is, more than the report of Shankyas, 1993; Raj, 1992. Major share on the expenditure for all the categories was on food and it varied from 35% for rich and 77% for very poor. The expenditure on food item decreased with the increase in income and it is in accordance to the famous law of Consumption. Further the saving was highest for rich and the very poor were in negative saving. This reflect the risk taking ability of the people as the farmer who have sufficient saving can take risk and can go for risky enterprise.

Economics of milk production

An attempt was made to calculate the economics of milk production of local cow and local buffalo. The crossbreed cow was left owing to insufficient number of them. Tabular analysis was carried out on various aspects of economics of milk production and results were presented.

Production traits of milk animals

For a local cow average age at 1st calving was 56.30 months, lactation length 257 days, dry period 205 days, inter-calving period 462 days and milk production was 1.370 liters (Table 6). Corresponding figure for buffalo were 58.60 months, 351 days 242 days, 593 days and 2.459 liters respectively. The age at first calving, lactation length, dry period and inter-calving period was much lower in case of cow than the buffalo. There was not much difference among the farms.

Expenditure on dairy enterprise

As dairying was an important subsidiary occupation in the hill area it is necessary to find out the expenditure pattern among the farmers to this sector. In the study area the animals maintained for milk purpose were mostly nondescript in nature. The comparative economics of milk production on different categories of the farms has been presented in Table-7. The total cost of milk production was more in case of buffalo and that too for large farmers.

Feed cost

The expenditure incurred on fodder and concentrate was highest in all the categories of farms. Fodder mainly consisted of green grass (purchased for feeding green and for making hay) and tree leaves (imputed value of labor for bringing the leaves from the forest was considered for this purpose). The animals were fed with little amount of concentrates like mustard-cake, wheat flour, groundnut-cake, ragi seed *etc.* depending upon availability and price in the market.

Labor cost

Labor was utilized for looking after the animals, feeding, grazing, cleaning of gothes (animal shed) and milling of animals. The females contributed about 80-90% in all the categories of the farm. Even the children helped in some of the activities of the dairying. Prevailing wage rate for male and female labor was used for computation purpose.

Efficiency of milk production

The efficiency of any enterprise depends on such combination of resources that are most economical. The profitability of dairying enterprise depends primarily on the productive traits of the breed maintained. The average lactation yield for cow was 352.09 liters and that of buffalo was 863.11 liters (Table 8) the average milk yield for cow was highest in case of medium farmers and for buffalo it was highest in case of small farmers. Net income from cow was highest for medium farmers. Overall the input-output ratio was 2:1.

Cost of production per liter of milk

Average cost per liter of milk was calculated using established cost concept and being presented in Table-9. Taking cost-A into account, maximum cost per liter of cow was on small farm (5.47Rs.) and 2.94 for buffalo on large farm. The overall cost of production per liter of milk of cow over cost-A was Rs. 5.36, over cost-B Rs. 6.36 and over cost-C Rs. 9.25 and the corresponding figure for buffalo was Rs. 2.84, 3.49 and Rs. 5.19 per liter respectively.

Marketing of milk products

In the study area the marketable surplus was not much. People used to sell their milk to the dairy co-

operatives. Mostly milk is converted in ghee and khoa and being sold to the consumers directly or through the middleman. The farmer's share in the consumer rupees was 58.82% in case of khoa marketing and it was 85.71% in case of ghee marketing. In case of khoa marketing the share of marketing margin was 17.64% and it was 20% in case of ghee.

CONCLUSION AND POLICY IMPLICATION

Keeping in view the hill-agro-ecosystem and multipurpose nature of the livestock resources, the farmers in the study area are using their wisdom to exploit the resource with sustainability in their mind. The animal resource milk production and per capita availability of milk has increased although, there is a huge potential to tap by improving feeding and breed up gradation. Sustainable development in hills can only be achieved through optimum utilization of its natural resources. Health care to the livestock needs to be strengthened and improved. The potential of indigenous livestock needs to be tapped by improving nutrient availability from locally available feed and fodder resources. Participation of local NGO's in overall development of livestock sector is essential as they can educate the farmers on available technology and other information related to it. The refinement of indigenous technology is needed, as these are time tested by the farmers.

Table 1. Demographic information of the study area

Name of the villages	Households	Human population	Local cow	Cross breed cow	Buffalo	Horses	Sheep and goat
Bhadoti	21	149	53	3	13	-	16
Chatola	54	480	97	270	35	11	40
Buribana	86	410	142	-	66	2	53
Darim	140	814	240	-	136	6	106
Gahena	40	224	86	2	37	2	14
Nellie	24	129	36	-	21	2	20
Pangarari	12	59	12	-	8	-	55
Pitholi	23	163	81	9	20	2	108
Supi	32	237	81	43	46	4	55
Saliyacot	122	703	213	43	132	5	64
Sunderkhal	121	711	105	20	157	7	24
Darmoli	89	533	105	-	114	10	106

Table 2. General profile of farmers

Particulars	No. of Households	Percentage of Households
<i>Type of family</i>		
Nuclear	502	66.62
Joint	256	33.78
<i>Main occupation of the head of family</i>		
Farming	504	66.49
Service	86	11.35
Business	66	8.70
Labor	102	13.46
<i>Literacy status of the head of the family</i>		
Literate	586	77.31
Illiterate	172	22.69

Table 3. Type of land holdings

Categories of Farm	No. of Farmers	Percentage
Small	436	57.52
Medium	222	29.28
Large	100	13.20

Overall	658	100.00
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Table 4. Wealth rank categories in the villages of Nainital district

Wealth Rank Group	AWRS Range	No. of Household	Percentage
Very poor	<44	254	61.06
Poor	44 - 62	61	14.66
Medium	62 - 81	68	16.35
Rich	81 - 100	33	7.93

Table 5. Livelihood analysis of selected households

Particulars	Rich	Medium	Poor	Very Poor
Family size	6.2	4.8	6.4	5.8
Landholding (Acre)	17.6	3.5	0.75	0.15
Livestock unit	5.6	5.4	6.7	8.4
<i>Earning (Rs.)</i>				
Agriculture	15,000.00	10,000.00	10,000.00	4,000.00
Orchard	25,000.00	15,000.00	20,000.00	Nil
A.H.	18,000.00	25,000.00	12,000.00	8,000.00
Others	40,000.00	35,000.00	12,000.00	10,000.00
Total (Rs.)	98,000.00	85,000.00	54,000.00	22,000.00
<i>Expenditure (Rs.)</i>				
Food	34,000.00	38,000.00	28,000.00	17,000.00
Clothing	12,000.00	12,000.00	10,000.00	2,000.00
Medicine	4,000.00	4,000.00	3,000.00	500.00
Education	15,000.00	10,000.00	5,000.00	1,000.00
Others	5,000.00	5,000.00	4,000.00	1,500.00
Total (Rs.)	70,000.00	69,000.00	50,000.00	22,000.00
<i>Saving (Rs.)</i>	28,000.00	16,000.00	4,000.00	Nil

Table 6. Production traits of milk animal on different categories of farm

Farm size	Age at 1 st calving (months)		Lactation length (Days)		Dry period (Days)		Inter calving period (Days)		Average milk yield/day (liters)
	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo	Cow
Small	57.00	60.00	241	352	220	252	461	604	1.267
Medium	56.50	58.20	255	340	190	240	445	580	1.546
Large	55.10	57.50	274	360	200	232	474	592	1.343
Overall	56.30	58.60	257	351	205	242	462	593	1.370

Table 7. Cost of maintenance of cow and buffalo (Rs. Per location)

Farm size	Small		Medium		Large		Overall	
	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo
Fodder	346.06	402.56	402.6	446.55	398.62	460.65	382.26	425.59
Concentrates	1065.60	1465.54	987.05	1288.66	1070.02	1680.05	1030.89	1464.08
Family labor	1070.65	1462.06	1108.26	1649.59	1207.08	1809.10	1110.66	1610.25
Depreciation of animal	361.76	422.20	349.94	465.66	395.35	480.24	339.03	436.03
Depreciation of animal shed and equipment	14.60	14.24	16.44	16.44	14.96	12.97	15.33	14.55
Interest on fixed capital	372.42	410.10	339.92	455.66	385.20	462.54	350.85	422.77
Misc. cost	106.10	109.72	135.42	149.69	151.62	190.04	121.15	106.82
Total cost	3337.19	4286.42	3339.63	4472.25	3262.85	4915.59	3350.17	4480.09

Table 8. Economics of milk production per lactation

Farm size	Small		Medium		Large		Overall	
	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo
Yield (liter)	346.06	924.00	394.23	858.84	367.98	898.56	352.09	863.11
Value (Rs.)	3460.60	9240.00	3942.30	8588.40	3679.80	8985.60	3520.90	8631.10
Value of Manure	224.47	320.47	225.60	330.08	215.00	325.82	215.69	320.64
Gross income	3685.07	9560.47	4167.90	8918.48	3695.98	9311.42	3736.59	8951.74
Net income	347.88	5274.05	828.27	4446.23	433.13	4395.83	386.42	4471.65
I/O ratio	1:1.10	1:2.23	1:1.25	1:1.99	1:1.13	1:1.89	1:1.12	1:2.00

Table 9. Cost of production per liter of milk on the basis of various cost concept

Farm size	Cost - A		Cost - B		Cost - C	
	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo
Small	5.47	2.61	6.55	3.06	9.64	4.64
Medium	4.80	2.76	5.66	3.29	8.44	5.21
Large	4.54	2.94	5.59	3.46	8.87	5.47
Overall	5.36	2.84	6.36	3.49	9.52	5.19

Table 10. Price spread for Khoa and Ghee marketing in Kumaon Hills

Particulars	Khoa		Ghee	
	Price	Percentage	Price	Percentage
Net price received by the farmer	50.00	58.82	120.00	85.71
Marketing/processing cost of confectioners	20.00	25.53	-	-
Marketing margin of wholesaler/ confectioner/retailer	15.00	17.64	20.00	14.29
Consumers price	85.00	100.00	140.00	100.00

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IN SITU MYCORRHIZAL DEPENDENCY OF *EUPATORIUM ADENOPHORUM* SPRENG IN SIKKIM AND MEGHALAYA

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INTRODUCTION

Eupatorium adenophorum locally called “Banmara” of “Kalijhar” in Nepali, is an exotic plant species growing prolifically in Sikkim Himalaya and Meghalaya plateau. It is the native species of tropical America. It has recently drawn worldwide attention for its ever increasing potential weed mostly colonising cultivated lands, cardamom based agroforestry systems, open degraded lands, jhoom fallow and natural forest especially within the altitudinal range between 1000 - 8000 ft. msl. It has an interesting history of its own. It is probable that the species was nowhere noted in Sikkim and Meghalaya hills approximately 3 and 4 decades back respectively. In the Himalayan state of Sikkim it probably started invading from southern via Doars and Assam valley, which in turn migrated from Burma. Ever since its arrival, the species has acclimatized, spread and colonized the region as noxious weed. The ability of the weed to grow luxuriantly in diverse habitats most of which being harsh and nutrient-deficient is worth mentioning. It is therefore speculated that the vigorous growth may be due to the association of species with native symbiotic mycorrhizal fungi thus immobile nutrients viz, P, K, Ca, N, Zn and water to the host (Read *et al.* 1976, Cooper and Tinker 1978, Rhodes and Gerdemann 1978, Allen 1982, and Kothari *et al.* 1991). Therefore, present study was aimed to investigate the mycorrhizal status of *E. adenophorum* under diverse field conditions in Sikkim and Meghalaya.

MATERIALS AND METHODS

Present investigation was carried out at 4 locations in Meghalaya and 7 sites in Sikkim Himalaya (table 1). While the studies in Meghalaya was conducted in July 1991 and July 1992, it was carried out in June 1996 and June 1997 at sites in Sikkim hills.

Table 1. Incidence of mycorrhizal infection of *E. adenophorum* growing at various locations in Meghalaya and Sikkim hills.

Field locations	Altitude (m)	Soil pH		Avail. Soil P (%)		Mycorrhizal Infection (%)	
		1991	1992	1991	1992	1991	1992
Meghalaya (23°20' and 24°15' N 91° 10' and 93° 80' E)							
Upper Shillong	1726	5.46	5.41	0.021	0.020	93	94
4 Mile	1550	5.65	5.66	0.018	0.018	97	96
Bijni Complex	1500	5.59	5.56	0.021	0.020	94	92
Permanent Campus	1450	5.60	5.62	0.020	0.020	94	95
Sikkim (28° 7' 28'' & 27° 4' 46'' N, 85° 58'' and 88° 55' 25'' E)							
Tadong	1350	5.66	5.69	0.014	0.014	96	95
Lower Marchak	850	5.59	5.57	0.008	0.007	95	95
Setipool	850	5.77	5.81	0.008	0.008	97	99
Kabi	1500	5.55	5.52	0.014	0.014	96	97
Bitu	1500	5.59	5.62	0.014	0.013	96	96
Namnam	1600	6.11	6.05	0.016	0.016	93	95
Lower Rabong	1500	5.72	5.77	0.013	0.013	97	99
Damthang	2050	5.79	5.85	0.016	0.017	95	96

The plant roots and soil samples were collected randomly from each sites in 25 and 5 replicates respectively. The pooled root samples were washed thoroughly, cleared and stained following the method of Koske and Gemma (1988). The mycorrhizal infection incidence was determined using method suggested by

Read *et al.* (1976). Soil pH was determined using 1:5 soil:water suspension and available soil P was estimated following method of Allen (1974) after the extraction using NaHCO₃ solution (Olsen *et al.* 1954).

RESULTS AND DISCUSSION

Incidence of mycorrhizal infection of *E.adenophorum* growing at various sites as prolific weed species was remarkably high and was found to be >93%. It was recorded as high as 99%. However, it was observed that the *Eupatorium* sp. in Sikkim Himalaya showed more mycorrhizal infection than those growing in Meghalaya (table 1). High mycorrhizal dependency of the species at all the sites investigated may be attributed to the low soil P (below 0.002%) both in hilly terrains of Sikkim and Meghalaya. Similar results were reported by Baylis (1967), Daft and Nicolson (1974) and Jensen and Jacobsen (1980). Low availability of P may further be due to the low soil pH level. The ameliorated growth of the weed species in P-deficient sites overgrowing other competing native weeds such as *Galinsoga*, *Poa*, *Artemisia* and *Lantana* sp. is attributed in part to high mycorrhizal nature of the species. The exotic weed have an edge over other weeds as it is a vigorous perennial shrub growing in dense clumps and flourishing upto 10 feet tall thus depriving others of available light and space. Gradual depletion of available soil P caused by ever increasing anthropogenic activities in the fragile ecosystems in this part of the country may directly or indirectly favour the further spread of this weed. Therefore, it is likely that the species in the near future may colonize more cultivated areas for which some effective control measures have to be soon developed.

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HILL ROADS AND ENVIRONMENT

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INTRODUCTION

Himalaya since Vedic times have been considered a vast repository of valuable medicinal herbs, minerals, forest resources *etc.* Vedic literature followed by the writings of Charaks, Susruta, Dhanwantri, Nagarjuna, Parashar, Balmiki and various other saints, bear testimony to it. "Alexander, The Great", who was much influenced because of its scenic beauty, bracing climate and agroclimatic conditions, made a great publicity of the Himalayan Herb Science in Yunan and Rome during middle ages (Anonymous, 1977; Chauhan, 1988). This potential, however, remained unexploited especially in higher reaches due to inadequate means of communication. After independence, Govt. of India, gave a special emphasis on road construction in order to bring socio-economic upliftment of tribal inhabitants. But due to lack of proper planning it resulted in serious ecological imbalances.

Society has now become aware of the environmental consequences resulting from road construction in hill areas. Right from the days of Vedas, our country has an age-old tradition of environment consciousness. During Samrat Ashok's days social forestry was at its full swing having shady trees along the roads and fruit plants on the wastelands. In this paper efforts have been made to incorporate the latest techniques for protecting the environment after extensive survey of literature (Lone *et al.*, 1992 and Chauhan, 1992).

MAJOR ECOLOGICAL PROBLEMS

There are a large number of ecological problems associated with road construction in hilly tribal areas, some of these can be summarized as below:

- i) **Deforestation:** The association between deforestation and slope instability has been a subject of considerable research. Deforestation brings about erosion and soil movement is generally accepted, but opinions differ on its impact. So far as "Creeping" slopes are concerned, greater creep velocities are found in slopes covered by trees in the region of Queensland (Australia) than in slopes merely covered by grass in region of rain forests (Brown and Shen, 1975). Prandini *et al.* (1977) reported that deforestation leads to loss of mechanical strength imparted by rock system. Reinforcing power of roots is also demonstrated by the results of *in situ* block shear tests, which show that shear strength increases with increase in root density. At higher altitudes top green layer is very thin and takes hundreds of years to come. A large number of trees along the roadsides are falling down due to road construction. Improper road construction results in soil erosion that may lead to uprooting of large trees and degeneration of lower plants. This way it leads to serious ecological imbalances affecting adversely run-off factors, temperature gradient, surface radiation *etc.* Due to loss of vegetation, the velocity of run-off also increases that results in soil erosion, hence of soil-fertility.
- ii) **Disturbance of geological strata:** Operations like blasting excavation, chipping of mountain slopes to come to desired accessibility, are involved during road construction in hill areas. These operations creates geological disturbance in the mountain body. The blasting operations set dynamic forces causing the movements of slip zones, cracks, fissures and weak planes. The geological havoc caused due to road construction in Kinnaur District in before us. The chronic problems of landslides at Tranda, Chaurah and Kadhra dhank are a few examples.
- iii) **Hill face disturbance:** Natural inclination of hill face is disturbed by road cutting operation. Down hill movement of the land slides material and disposal of excavated mass from road construction degrade and deface the nature. Growth of vegetation is affected by the loss of topsoil that causes ecological imbalances.
- iv) **Drainage pattern interruption:** Velocity of run-off at the down hills increases to a very large extent due to construction of bridges and culverts on the road as well as due to cutting for getting proper communication systems. This leads to eroding of banks and is a threat to the existence of trees and vegetation on the hill slopes. Sometimes lakes are formed by accumulation of debris from the excavated material and land slides. Such lakes formed force the water to flow through some other way destroying the side by flora *e.g.* at Nallah

on NH = 22, bridge was washed away thrice in six years because due to debris river was blocked and a temporary lake was formed. Same story was repeated at Pabbar river in Chhawara valley (Rohroo) in 1992, where a big lake (2 miles) was formed and about ten villages were vacated in order to avoid any loss to human life. This lake formed resulted in a loss of large number natural wealth both flora and fauna. This way natural drainage pattern of the area is disturbed by road construction, which sometimes results in flash floods also.

v) **Water resources disturbance:** Natural water resources get disturbed due to blasting which is used during road construction activities. Moreover, improper disposal of fuel, lubricants used in the process contaminates the surface and ground water.

vi) **Siltation problem:** A large quantity of excavated material disposed on the down hill slopes is carried by the river that gets accumulated in the dams and reservoirs and reduce their life-span e.g. siltation rate of Bhakhra Dam reservoir is very large which is due to large scale road construction in Sutlej catchment.

vii) **Destruction to flora and fauna:** Wild life gets disturbed due to blasting, hauling of machineries, shriveling sound of road rollers and noise of moving vehicles on the up-gradient. Destruction of key habitats such as resting sites, hollow trees, feeding and breeding grounds occurs due to road constructions. Some of the flora and fauna gets destroyed out right due to intrusion into forest for road construction.

viii) **Pollution:** Tremendous pollution is created due to accumulation of debris down hill. Moreover, heating of bitumen through hot mix plants produces a large number of air pollutants like oxides of sulphur, nitrogen and carbon. Long chain aliphatic hydrocarbons and aromatic compounds are also the byproducts of this heating process, which are having carcinogenic property (Cancer producing) and special precautions must be taken for protecting the labourers working under such conditions on the road construction site. Surrounding temperature gets increased and atmospheric humidity is lowered due to movements of machineries and vehicles, altering the physiological processes of the plants and thereby affecting their growth pattern. The alterations in the surrounding conditions causes interference of micro-organism life in the soil.

ix) **Destruction of medicinal wealth:** In the hill areas of Himachal Pradesh out of 3000 species of identifies plants, over 500 species possess various kinds of medicinal properties. Hundreds of plants have ethno botanical importance. There are about 150 species of aromatic plants used in different kinds of cosmetics and having different medicinal properties. But due to improper planning in road construction and processes involved during road construction, the natural wealth gets destroyed costing crores of rupees in spite of protecting the atmosphere from pollution.

PROTECTIVE MEASURES

In order to maintain balance between the road construction activities and environment certain protective measures have to be taken. Some of these measures are as follows:

i) **Environment impact assessment:** Before starting the road construction operation, environmentalists must be consulted in order to avoid any ecological imbalance.

ii) **Geological investigation:** A geologist must be incorporated in the road construction work. Blasting and chipping of mountain slopes must be done under his instructions in order to avoid any geological havoc.

iii) **State of wildlife:** During the road construction loss to flora and fauna must be minimum. It should not be disturbed. An environmentalist must be consulted prior to road construction work.

iv) **Avoidance of unstable and fissureal zones:** Roads should not be constructed in loose soil and where erosion chances are more. In such cases the help of a soil Engineer must be taken, before starting any such activities.

v) **Least disturbance to natural streams and gradients:** Natural face of the hill must be least disturbed while constructing the roads. Only the required land must be used for the purpose.

vi) **Restriction on reserve forests:** Road construction activities must be minimum on reserve forests in order to avoid any disturbance to natural wealth. This will help in maintaining the ecological balance.

vii) **Judicial way of doing work:** While cutting and disposing the debris special care must be taken so that there is no soil erosion and loss to flora and fauna.

viii) **Minimum blasting operations:** Blasting practice during road construction must be to the minimum extent in order to avoid any dynamic forces causing movements of slip zones, cracks, fissures and weak

planes.

ix) **Half tunneling must be restored:** In case of vertical rocky slopes half-tunneling must be restored.

x) **Ropeway technique:** In case of less densely thick population ropeway must be installed instead of going for road construction. This will provide protection to soil erosion, wild life and environment.

xi) **Suitable drainage system:** Along the entire side of the road, a suitable drainage system must be provided so as to avoid any flash flood, soil erosion, damage to vegetation *etc.*

xii) **Restoration of natural springs and waterways:** Natural springs and water resources must not be disturbed during road construction process, otherwise it will be a great challenge to the nature.

xii) **Rebuilding of environment:**

a) On suitable points, places must be provided that may act as scenic spots to the users.

b) Programme of social forestry must be taken upto the root level. The wastelands must be garlanded with trees, and valuable herbs and shrubs. The best example of social forestry is found in china where even single inch of wasteland is not left without plantation. Debris obtained during road cuttings must be accumulated at some appropriate place and plantation must be done on the same. This plantation will help in retaining the natural environment.

c) Plantation must be done along the banks of rivers, nallaha *etc.* in order to avoid any further cutting of soil and to protect the water reservoirs and dams from more siltation.

d) Small water tanks along with the proper drainage system must be constructed along the roadsides in order to protect both flora and fauna. Roadsides must be planted at war-level so as to give the best example of afforestation.

CONCLUSION

Although road construction in hilly areas causes a huge damage to both flora and fauna in spite of having adverse effect on environment, but without proper communication facilities, it is not possible to explore the valuable wealth of such areas. So a balance must be struck between the road construction and environment in order to minimize the ecological imbalance. Certain scientific measures must be taken into account while constructing the roads in hills. The balance between the two will lead to the prosperity of the region and no hazard to environment will occur.

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

BIOTRANSFORMATION OF LANTADENES, THE PENTACYCLIC TRITERPENOIDS FROM LANTANA (*LANTANA CAMARA*)

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Three bacterial isolates namely, *Pseudomonas pickettii*, *Alcaligenes odorans* and *Alcaligenes faecalis* were isolated at pH 7.0, 5.7 and 6.5, respectively, from soil in the presence of lantadene A (LA) as the sole carbon source. A fungal strain, *Cephalosporium* sp. was also isolated from soil in the presence of LA and glucose at pH 6.5. All these cultures were also investigated for their ability to degrade/transform LB. But none of the isolates could utilize LB, thus showing that these isolates were specific for LA. No fungal enrichment took place using LA as the sole carbon source at both the pH 5.7 and 6.5. The sets with LA and antibiotic at both the pH 5.7 and 6.5 were started with an attempt to obtain fungal enrichments and inhibit bacterial growth but these sets did not show the ability to utilize LA. There was no fungal enrichment in the presence of glucose and antibiotic at pH 5.7.

The bacterial strain *pseudomonas pickettii*, capable of degrading LA has been isolated from soil using LA as the sole carbon source at pH 7.0. The isolate is rod-shaped. Gram negative and motile. No metabolite was detected either by TLC or HPLC thus, implying that the organism is eliciting mineralization of LA. No enrichment for LA utilizing organism took place in the sets containing LA and glucose. The use of sucrose (20 mM) as cosubstrate did not enhance the utilization of LA. However, a metabolite M₅ with RRI, 0.84 (relative to LA) was detected in case of the sets containing sucrose as cosubstrate.

The isolate *Alcaligenes faecalis* brought about mineralization of LA when LA was used as the sole carbon source as well as in the presence of glucose (20 mM) as cosubstrate. Co metabolism studies using succinate (20 mM) caused transformation of LA to at least one metabolite M₄ having RRI of 0.57. At least two metabolites M₃ and M₄ could be detected when transformation studies were done in presence of sucrose as cosubstrate. The metabolite M₃ had the RRI of 0.92, which was the same as that of LB in the mobile phase, methanol-acetonitrile-water-acetic acid (71:20:9:0.01). However, it differed from the latter in channel ratio (A₂₁₀/A₂₄₀) which was higher in case of M₃. The other metabolite M₄ had the RRI of 0.57 and was produced in trace amount.

Alcaligenes odorans has been isolated at pH 5.7 from the soil under lantana bushes by enrichment technique. The isolate is Gram negative and motile. The isolate showed LA utilization of nearly 60% in 15 days. No metabolite was detected at 210 nm. However, at 240 nm, two metabolites M₁ and M₂ with RRI 0.239 and 0.478 were detected.

The biotransformation capacity of the mixed culture (pH 7.0) obtained by mixing of *A. faecalis* and *P. pickettii* was not better than the two pure cultures in the presence of LA as the sole carbon source. However, the utilization on LA was slightly higher in the presence sucrose (20 mM) as cosubstrate on incubation with this mixed culture.

A fungal strain, *Cephalosporium* sp. was isolated from soil in the presence of LA and glucose at pH 6.5. This strain brought about the transformation of LA to a metabolite M₆ having the same RRI as LB, a congener of LA. Two more metabolites M₇ and M₈ were also detected. However, the rate of transformation was very low. It utilized nearly 13% LA on incubation for 15 days.

Ten fungal cultures known to be potential degraders of complex organic molecules were used for their ability to degrade LA. LA was found to strongly adhere to the fungal mass. The protocol for the complete extraction of unutilized LA from the fermentation broth was developed. It involved filtration of fermentation broth through glass wool followed by extraction of unused LA from the mycelial mass by homogenisation of the same in the presence of acid-washed sand.

Strong abrasive action provided complete extraction of LA. *Merulius tremellosus* PRL 2845 and *Pleurotus sajor caju* did not utilize LA. No significant loss of LA was observed in case of *Phanerochaete*

chrysosporium K3, *Phlebia radiata* 2 and *Sporotrichum pulverulentum*. *Aspergillus niger* van Tieghem MTCC 2425, *Trametes versicolor* MTCC 138, *Heterobasidion annosum* MTCC 146, *Pleurotus ostreatus* MTCC 142 and *Phellinus pini* RAB-83-19 were also not fast degrader of LA and caused 11-19.5% degradation of LA during an incubation period of 15 days.

Alcaligenes faecalis showed the ability to transform LA into various metabolites in the presence of LA and sucrose. The metabolite, M₃, was produced as the major metabolite. In case of other cultures showing transformation of LA to degradation products, the amount of metabolite produced was very less. The major metabolite M₃ appeared at the same retention time as LB during the HPLC analysis using the mobile phase, methanol-acetonitrile-water-acetic acid (71:20:9:0.01). LB in the sample at this stage was on account of minuscule impurity in the LA samples used for biodegradation. However, it had a much higher channel ratio (A₂₁₀/A₂₄₀) as compared to LB. Different mobile phase were tried for the resolution of these two compounds. The mobile phase, methanol-water-acetic acid (80:20:0.01) showed a better resolution of M₃ and LB. The mobile phase, acetonitrile-water-acetic acid (70:30:0.01) was found to be the most suitable for the complete resolution of M₃ and LB. The identity of M₃ was confirmed as lantadene X (22β-tigloyoxy-3-oxoolean-12-en-28-oic acid), a *trans* isomer of LA by spectroscopic analysis. Lantadene X is a novel compound not reported to be present in the leaves of lantana plant. The other metabolites could not be characterized due to paucity of materials.

Bioassays using guinea pigs as experimental animal were done for checking the biological effects of the extracts of fermentation broth after incubation of LA with *Alcaligenes faecalis*. The animals in group A were administered LA filled in gelatin capsules, those in group B were administered extract of the fermentation broth of *A. faecalis*. The animals in group C were given empty gelatin capsules and they served as the control. The animals in group A were found to be icteric in 24 h. The animals in group B were comparable to the controls. Their gall-bladder, liver and kidneys were normal. The plasma of group B and C was creamish while that of group A was pale. Bilirubin contents, both conjugated and unconjugated were within the normal range in case of animals in group B. There was a marked increase in the bilirubin content of the animals in group A. No clinical symptoms or biochemical lesions were observed in the animals administered extract of fermentation broth as was evident from the activities of various enzymes, which typify hepatotoxicity and cholestasis.

STUDY OF INDUCED SPAWNING AND MILT MORPHOLOGY OF SNOWTROUT SCHIZOTHORAX SPP. IN THE GARHWAL HIMALAYA

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The research project was under taken with the four major objectives: (i) Induced spawning of *Schizothorax plagiostomus* (ii) Study of the milt morphology (iii) Study of fertilization, hatching and survivability rate up to yolk absorption (iv) Physico-chemical analysis of natural and confined water where the breeding experiment was conducted.

1. Breeding experiment on snow trout *Schizothorax plagiostomus* were conducted during spawning season (September-October) by using pituitary gland extract (PGE), ovaprim and stripping method. Successful results have been obtained from the breeding experiments. Usual set of brooders, 1 male: 2 females or 2 males: 1 females were used in all the breeding experiments. The better result was obtained by inducing ovaprim and stripping method.
2. The rate of fertilization in *Schizothorax plagiostomus* was ranged from 91-95% in different experimental sets. The percentage of fertilization was higher in case of stripping method instead of using hormone injections. The hatching percentage among fertilized eggs was ranged from 82 to 92 in natural ground while it was only 71 to 78% in laboratory.
3. The mortality percentage after hatching up to yolk absorption was 71.43% in natural ground during 1st year of experiment and 90% in laboratory, while after observing and providing natural habitat to hatched larvae the mortality rate was decreases up to 31.76% in natural ground and 38.88% in laboratory water

system.

4. The physico-chemical parameter of both experimental sites was observed. The variation in water temperature was 1-2°C and dissolve oxygen variation was 2-3.5 ppm in natural and laboratory water. The pH value was almost same in both the water bodies (7.0-8.2).
5. The growth of *S. plagiostomus* larvae was less in laboratory water system than the larvae growing in the natural water. Five months old *S. plagiostomus* larvae in natural water system got 77-78 mm length with 7.615 gm weight, while its growth in laboratory water system was 66-72 mm in length with 3.820 gm in weight. The difference in growth rate may be due to physico-chemical environment and availability, quality and proper supply of food.
6. The cyto-morphological study of spermatozoa of *Schizothorax plagiostomus* reveals that, the head of spermatozoa was oval shaped with long tail. The head was without acrosome. The nucleus was round and occupies most of the available space of the sperm head. The plasma membrane having very thin layer running towards the long tail forming a neck area. The tail was smooth having same thickness throughout the length without pointed end as in primitive spermatozoa of other aquatic animals.

Recommendations

Therefore, it is a great need to utilize the fishery potential of this region. This can be done not only by regulating fish landings, developing fish markets and providing selected fishing areas to the market. There is a great scope for reservoirs fishery in this region as a number of hydroelectric and irrigation projects are covering up.

So, development of hatcheries near reservoirs is very essential for propagation of fish. Certain parts of the rivers or reservoirs should be developed in to fish sanctuaries, which will be beneficial for the protection and propagation of important and endangered species. Such sanctuaries should be constructed at breeding sites/grounds of a particular species. The regulation of streams is the most important aspect in order to maintain as far as possible, the natural condition in river. The stream ahead of the dam often becomes a drain that can be breed a plethora of problems including destruction of the spawning grounds of the hill stream fishes in this region. The fishes and fish food with water quality near the barrage is highly affected. The minimum required discharge should be maintained in such parts of the river.

The fishes leave a very large number of eggs in this region in the shallow water on the side of the rivers, which ultimately develops in to fry, and fingerlings. But this fish seeds are destroyed and damaged when the water recedes leaving small patches or pockets of water, which later on get dried up due to the fall in water level of river during winter. Among these seeds the most economically important fish (*Schizothorax* spp.) seed also get destroyed. Which cover up 90% of catchments out of the total fishing in this region. To protect and procure these seeds the efforts will have to be made by recent scientific methods (*i.e.* artificial breeding and propagation, collection of seeds from unprotected areas and transfer into hatcheries and safe ponds *etc.*).

ECOLOGICAL RECONNAISSANCE OF CHAIL WILDLIFE SANCTURY IN HIMACHAL PRADESH

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The Studies were undertaken to make an ecological reconnaissance of Chail Wildlife Sanctuary and to make appropriate recommendations for conservation of biodiversity and sustainable use of available resources. The main findings of the project are as follows:

Floral components of Chail Wildlife Sanctuary *viz.* trees, cultivated plants, shrubs, herbs and grasses have been identified and documented. In all 10 species of trees, 21 species of shrubs, 16 species of herbs and 6 species of grasses have been recorded from Chail Wildlife Sanctuary.

Seven transects were laid in the Blossom and Khariun areas of the sanctuary for systematic sampling of birds and mammals. Regular monitoring of these transects have confirmed the presence of thirteen species of large and medium sized mammals in the sanctuary. These include the endangered species like Panther

Panthera pardus and Leopard Cat *Felis benghalensis*. Three species of ungulates viz. Goral *Nemorhaedus goral*, Barking Deer *Muntiacus muntjak* and Sambar *Cervus unicolor* are mostly confined to the Blossom and Khariun areas of the sanctuary. Other mammals recorded from the sanctuary are: Rhesus Macaque *Macaca mulatta*, Common Langur *Presbytis entellus*, Indian Porcupine *Hystrix indica*, Indian Hare *Lepus nigricollis*, Jackal *Canis aureus*, Himalayan Yellowthroated Marten *Martes flavigula*, Small Indian Civet *Viverricula indica* and Himalayan Palm Civet *Paguma larvata*. Census of Goral was carried out and its population was estimated to be around 44 individuals. Other aspects of ecology of Goral i.e. encounter rate, abundance, group size and habitat preference were studied. An exotic species European Red Deer *Cervus elaphus* introduced into the sanctuary about half a century ago couldn't be located and in all probability the species has become extinct from the area.

Observation and abundance of bird species has been carried out. In all 143 species of birds have been recorded. These belong to 35 families. Studies conducted on Cheer Pheasant reveals that transitional zone between grassland and oak forest is the most preferred habitat of these birds. The results of the study suggest that the population of Cheer Pheasant has remained static since the last estimate was made by Garson (1982-83). Group size of Cheer varied from 1-19. The overall encounter rate of Cheer Pheasant was 26.45 encounter per 100 hours. Sixty seven villages located inside the sanctuary were surveyed to get information of human population, number of livestock, crop predating wild animals, sources of fuel, fodder and timber extraction etc. to estimate their dependence on sanctuary's resources. Migratory shepherds along with their livestock pass through the sanctuary twice a year putting pressure on the food resources of the sanctuary. Chail being a tourist place attracts a large number of tourists every year. The increasing tourist pressure may affect the wildlife population in the long run.

IMPACT OF RIVERINE ECOSYSTEM DUE TO PROPOSED CONSTRUCTION OF DAMS AND BARRAGES AT GORIGANGA RIVER IN DISTRICT PITHORAGARH WITH SPECIAL REFERENCE TO FISH MANAGERMENTS

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Fish on being subjected to treatment of various concentrations of toxicant show a series of significant sequential behavioural responses.

- fish gets restless as evidenced by their irretic fast swimming movement and frequently dashing against walls of tank.
- tend to jump frequently probably in an attempt to get out of changed environment.
- after 6-8 hrs. of treatment mucous secretion appears enhanced and results in general increase in turbidity.
- fish breathing its last, gets completely isolated from other fishes.
- show undulating unbalanced, often jerky movement.
- settle down at bottom with belly side up.
- finally do not respond to gentle prodding and die.

Probit value of percentage mortality at various intervals (24,48,72 and 96 hrs.) of different concentrations of toxicant used are summarized in the tables. These values are plotted on graphs and LC 50 values for 24,48,72 and 96 hrs. duration are analysed using these graphs. Regarding present status of riverine fisheries, factors such as a highly diversified climate, an unstable and fragile environment and high flow diversity, have been found to be the limiting ones in the study. An estimate of number of economically important fish species, namely *Barilius* and *Glyptothorax* on the basis of catch per unit effort is obtained. The size range, weight range, ovary weight range and the number of eggs present in ovary have been calculated for the assessment of population, gonadosmatic index for breeding period and fecundity for spawning capacity.

Results of academic importance

The proposed hydroelectric dams and barrages at the sites covered in Goriganga river are long-term projects. During the construction of these projects, various materials used are likely to find their way into the

water bodies as run off through fields and drainage and may thus cause siltation in the main river and in the breeding grounds of fishes. Berkman and Rabeni (1987) found that benthic lithophilous fishes were most likely to be affected by siltation in streams. *Garra* Sp. *Glyptothorax Pseudecheneis*, *Homaloptera* & *Schizothorax* belong to this category and may be most vulnerable to siltation processes. Further many chemical substances used in construction may be harmful from the point of view of security and health of the aquatic fauna of main river and for spawning grounds of fishes.

The results of this study may provide guidelines to NHPC for the controlled use and drainage of the amount/concentration of above toxicants and also would ensure that harmful effect on spawning grounds of fishes are avoided or at least minimized, reserving for preservation of natural species.

Results of practical importance and action points for field

Application: Physical damage to the breeding grounds of economically viable fishes and obstruction in the definite routes of important migratory fish population are some of the significant adverse effects likely to be observed due to proposed construction of dams, that may put the interests of NHPC and aquaculture at cross purposes. It should be pointed out given our circumstances and needs, we can not call a halt to water resources development merely for fear of destroying the ecological balance. It is, however, important to ensure that future water resources development in this region is conceived, taking the environmental aspects fully into account, and that steps are taken in advance to minimize the adverse impact of such development.

The results of proposed study may suggest NHPC regarding the location and the capacity of reservoir *etc.* of H.E. projects during their construction in new schemes at Goriganga of which ultimately prove better for the survival of the fish fauna and increases in fish production.

NURSERY DEVELOPMENT AND PLANTATION OF CHYURA IN PITHORAGARH

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A total of 17000 saplings are planted in the target area. Apart from this area the Saplings were sent to Dehradun, Garhwal, to the VWSC's - a total of 7000 saplings.

From the 28000 saplings in the nursery the survival rate is 85.7%. As proposed the plantation was to take place in 25 hectares and the actual area covered in the proposed area is 27 hectares and another 11 hectares of plantation was covered by neighbouring villages. A total of 38 hectares is covered against 25 hectares as proposed. Some people have made their own nurseries and are supplying the sapling to other members of the community. DRDA has also shown interest considering in multidimensional use and are planning to use the species in their watershed programs.

Demonstration on the Cheura processing was done with the communities. The high participation of the community especially the women folk was appreciated. The plantation was done in the private land, which was lying as a wasteland. In case of VWSC's it was in the community owned land.

Major achievements

- Development of pesticide from Cheura Khali.
- Sensitization of the communities, of proposed area and also others towards multi dimensional usage.
- Communities interest in promotion of MPTS in this terrain.
- Understanding of the economic value of MPTS's which raises their economic status.
- Initiation of small nurseries by the villagers.
- DRDA's Consideration to use in their watershed programs.
- Village Churani regains its status again as the village of Cheura forest.

Selected Abstracts

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

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Arunachalam, Kusum and Arunachalam, A. 1999. Effect of temperature of N mineralization in soils of

humid subtropical forest regrowth in Meghalaya. *Indian J. Soil Cons.*, 27(1): 50-54. Restoration Ecology Laboratory, Department of Forestry, North Eastern Regional Institute of Science and Technology, Nirjuli 791109, Arunachal Pradesh, India. [HUMID SUB TROPICAL FORESTS; MEGHALAYA; N-MINERALIZATION; TEMPERATURE RESPONSE]

A laboratory experiment analysing, the effect of soil temperature on N mineralization was carried out in soils collected from forest regrowth of three different ages at a high altitude of Meghalaya. Ammonium and nitrate concentrations increased up to 30°C, after which it declined. Optimum N mineralization was observed between 20-30°C. At this temperature range, Q_{10} (temperature coefficient) for N mineralization was nearing 2. The relationship of ammonification and or nitrification with incubation temperature was positive.

Arunkumar, L. and Singh, H.T. 1999. **Fauna of the Yangoupokpi-Lokchao Wildlife Sanctuary, Manipur India.** *Indian Journal of Forestry*, 22(4): 304-315. Department of Life Sciences, Manipur University, Canchipur -795003. [ENDANGERED ANIMALS; ENDEMIC SPECIES; FOREST COVER; WILDLIFE]

The Yangoupokpi-Lokchao Wildlife Sanctuary in Manipur is situated on the Indo-Myanmar border. The occurrence of 86 species of fishes, 6 species of amphibia, 29 species of reptiles, 74 species of aves and 42 species of mammalia with their status have been reported in the present investigation. It has been reported to be an important wildlife sanctuary being the natural breeding and spawning ground, migratory centre and home of highly endangered animals like masheers, furtle, parakeets, birds belonging to phasianidae, serow, wild cats, toddy cats, civet cats, hoolock gibbon, elephants, etc.

Arya, K.R.; Pande, P.C. and Prakash, Ved 1999. **Ethno botanical study on tribal areas of Almora District-II.** *Ethnobotany*, 11(1&2): 100-104. Botany Division, Central Drug Research Institute, Lucknow 226001, U.P., India. [BHOTIAS; ETHNOBOTANY; KUMAON HIMALAYA]

The first paper in this series dealt with ethnomedicinal uses of 22 plants recorded from the most remote and tribal population (Bhotiyas) of Jhuni and adjoining villages near Pindari glacier of Bageshwar district in Uttar Pradesh. This communication deals with 14 more plants pertaining to some interesting ethnobotanical records available with the tribal group of the above areas.

Awasthi, Anjali; Rawat, G.S. and Rajvanshi, Asha 1999. **Assessment of human use and ethnobiological values in Tehri dam submersible area, Garhwal Himalaya.** *Journal of Non-Timber Forest Products*, 6(3/4): 199-206. Wildlife Institute of India, P.B # 18, Chandrabani, Dehradun, U.P. [FIRE-WOOD; FODDER; FUEL-WOOD; HYDRO ELECTRICITY; SOCIO-ECONOMIC]

A multi-purpose hydro-electric project which submerges a vast tract of land, displaces a mass population of approximately 30,000, promotes various socio-economic, and ecological changes is in progress near Tehri Town, Garhwal Himalaya. A study was carried out during April-May 1996 to assess the human use patterns and ethnobiological values in the area. Although the vegetation of the submergence zone is largely secondary scrub, it serves as a resource base for various needs of the locals. Of the total submerging villages (91) in both Bharirathi and Bhillangna valley, 30% were randomly selected and assumed to be representative of the whole submersible zone. Structured questionnaires were used for village survey. Of the total population, 95% use both fire-wood and cooking gas as source of energy. Average consumption of fuel-wood (household/day) was estimated to be 9.8 kg, which increases to 14.2 kg/h. hold/day during winter. *Lantana camara*, a widely distributed shrub was found to be major source of fuel-wood. Majority of fodder (68%) demand was fulfilled by the agricultural by-products and grasses and 32% by foliage fodder. Average fodder requirement per house hold was about 11kg/day. Based on the land holding pattern villages were grouped into three classes, viz., class I, class II and class III. Similarity index between three classes of villages shows a more affinity between class I and class II villages (73.4%). Respondent data analysis gave an information on 66 plant species, which are used by the inhabitants for one or the other purpose (fuel-wood, fodder, medicinal, religious and household items). The maximum number of species were used for medicinal purpose (44%) followed by fodder (18.2%), and least provided fibre values (1.5%). It was found that though the vegetation of the submersible zone appears to be degraded secondary scrub, it serves as valuable resource base for its inhabitants.

Awasti, R.P.; Godara, R.K. and Kaith, N.S. 1999. **Correlation study between va-mycorrhizae spore number, root colonization, Azotobacter population and fruit yield of july elberta peach.** *Journal of Hill Research*, 12(1): 1-4. Department of Pomology, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan 173230, Himachal Pradesh. [FRUIT-YIELDING; MICROFLORA; ROOT COLONIZATION]

Simple linear relationship worked out between all possible combinations indicates that per cent root colonization and spore number showed significant positive correlation with the fruit yield. However *Azotobacter* population exhibited very weak, non-significant positive correlation with fruit yield, except one orchard, where it showed negative correlation.

Bana, O.P.S.; Sah, V.K. and Singh, V. 1999. **Growth and biomass relations for components of black locust (*Robinia pseudoacacia* L.).** *Journal of Hill Research*, 12(1): 34-37. G.B. Pant University of Agriculture & Technology, Hill Campus, Ranichauri, Tehri Garhwal 249 199, U.P. [BASAL GIRTH; BIOMASS; BASAL DIAMETER]

The biomass production and its portioning to various components in six months to four year old plants of *Robinia pseudoacacia* L. varied remarkably with age. Higher proportions of photosynthate were allocated to roots and leaves in earlier stages, while accumulation was more in stem and branches during later stages. Satisfactory allometric equations relating to biomass of different components with girth (Bg) and Basal diameter and height (Db^2H) were developed.

Bandyopadhyay, M.K. 1998. **Glacier variation in the Himalaya.** *Geographical Review of India*, 60(4): 381-392. Department of Geography, University of Calcutta, Calcutta 700019. [GLACIER VARIATION; SNOW-LINE; TREE-RING]

The study of Himalayan glaciers began with the observations by E. Madden in 1847 and since then various organizations and individuals have been working on them. Glacier variation indicates global and/or local warming or cooling of the atmosphere. The study of glacier variation is mainly based in dating of moraines. The author adopted lichenometry and tree-ring study for short-term dating and long-term dating was mainly based on elevation and dissection of glacial terrace as well as chemical weathering of moraines. Not more than three stages of Pleistocene glaciation could be detected in the Himalaya. Study of the Himalayan glaciers has revealed various annual rate of retreat of the glaciers. Glaciers need protection as a sustainable water resource, and checking global and local warming is the only practical way to achieve the success.

Banerjee, Sumanta 2000. **From self-determination to self-destruction.** *Economic and Political Weekly*, XXXV(20 & 21): 1793-1794. . [AUTONOMY; JKLF; KASHMIR VALLEY; TERRORISM]

Both New Delhi and Islamabad have become prisoners of their own policies. Unless they are willing to give up their intractable positions and muster enough courage to control the fanatical fringe of their respective societies, Kashmir will continue to burn.

Basnet, Dewan B. 1999. **Edgeworthia gardneri Meissn. - a source of raw material of eco-friendly traditional hand-made paper of Eastern Himalaya.** *Ethnobotany*, 11(1&2): 15-118. S.R.S. Forestry Range, DJ Social Forestry Division, DGHC, 7, Oaks Rose Bank, Below Ava Art Gallery, Post Box No. 98, Darjeeling 734101. [ECO-FRIENDLY; HAND-MADE PAPER; HERITAGE; NEPALI PREFECTURE]

Edgeworthia gardneri Meissn. is a source of raw material for the unique traditional hand-made paper of Central and Eastern Himalaya. The present paper gives a brief botanical account, its distribution and eco-friendly traditional and improved methods of paper processing. Due to the wide range of domestic and international markets of paper products and paper processed from the raw material and its ecological importance, it not only provides employment opportunities to the village people but also helps in preserving the eco-friendly age-old cultural heritage of Central and Eastern Himalaya.

Bastola, D.R.; Agarwal, V.P. and Joshee, Nirmal 2000. **In vitro propagation of a Himalayan pine *P. wallichiana* A.B. Jacks.** *Current Science*, 78(3): 338-341. Department of Biochemistry and Molecular

Biology, 984525 Nebraska Medical Center, Omaha, NE 68198-4525, USA; Department of Biological Sciences, Kathmandu University, Dhukhet, Nepal; Research Laboratory for Agricultural Biotechnology and Biochemistry, P.O. Box 2128, Kathmandu, Nepal. [INDUCTION MEDIUM; INVERTED EMBRYO; MICROPROPAGATION; TISSUE CULTURE]

Four different plant tissue culture media containing varying levels of growth hormones were studied to determine the nutritional and hormonal requirements for induction and subsequent elongation of shoot buds and rooting. Germinating embryos as explants placed in an inverted position in LP medium containing BAP produced adventitious shoot buds. Activated charcoal treatment of the embryos after being exposed to BAP was necessary for shoot proliferation and elongation. Elongated shoot buds were passed to rooting media. While using this technique for micro propagation of other pines, it would be necessary to optimize the age of the explants and the duration of exposure in shoot induction medium.

Behera, Mukunda Dev; Srivastava, Shalini; Kushwaha, S.P.S. and Roy, P.S. 2000. Stratification and mapping of *Taxus baccata* L. bearing forests in Talle Valley using remote sensing and GIS. *Current Science*, 78(8): 1008-1013. Forestry and Ecology Division, Indian Institute of Remote Sensing (NRSA), Dehradun 248001, India. [FCC IMAGE; LAND-COVER; REMOTE SENSING; TAXUS BACCATA]

The yew plant (*Taxus baccata* L.) has acquired importance because it yields taxol, which is effective in the treatment of cancer the world over. There is great demand for *Taxus* from pharmaceutical companies and the species is being extracted heavily from its natural habitats throughout the world. This demand has necessitated the preparation of an inventory of *Taxus*-bearing forests for conservation and sustainable utilization. We have used remote sensing and Geographical Information System for identifying and mapping yew plants with reasonably good accuracy. IRS 1C LISS-III False Color Composite (FCC) data dated 2 January 1997 having 23.5 m ground resolution were applied for this purpose. These forests were visited on ground for a detailed vegetation analysis of the distribution of the yew plants. The raw data was corrected both radiometrically and geometrically and then enhanced using the standard image enhancement techniques such as linear contrast stretch. Various techniques of digital image classification such as hybrid clustering, masking and classification were tested to differentiate and delineate the yew-bearing forests in Talle Valley area falling in Lower Subansiri district of Arunachal Pradesh. Forests covered with various proportions of *Taxus* could be stratified and mapped with 85% accuracy. The preliminary results obtained in this study demonstrate that *Taxus*-bearing forests could be separated with a *priori* knowledge of vegetation types of the area.

Bhardwaj, C.L. and Thakur, D.R. 2000. Dry grain yield in rainfed garden pea (*Pisum sativum*) in relation to environment and management of *Mycosphaerella* blight. *Indian Journal of Agricultural Sciences*, 70(4): 231-233. Regional Research Station, Himachal Pradesh Krishi Vishwavidyalaya, Bajaura 175125, India. [GARDEN PEA; GRAIN YIELD; MYCOSPHAERELLA BLIGHT]

An experiment was conducted for 4 years from 1993-97 on the effect of sowing dates at weekly intervals and plant protection to manage *Mycosphaerella* blight in rainfed garden pea (*Pisum sativum* L.) on the dry grain yield and its loss relationship with prevailing weather parameters. The study showed that 30 November sown date gave significantly higher yield in protected (569 kg/ha) and unprotected (389 kg/ha) plots. The delay in sowing time beyond this date invariably amounted to low yield and high disease pressure. The interaction between sowing date and plant protection was not significant. The relationship of this interaction between weekly weather parameters, *viz* maximum and minimum temperatures, maximum relative humidity, cumulative rainfall, and rainy days was worked out. It was found that maximum temperatures ranging between 17.78 and 18.90°C at pre-flowering and range of maximum temperature up to 26.33°C and minimum up to 9.85°C at post-flowering coupled with high rainfall and frequency with a relative humidity of 85-88% are congenial conditions for *Mycosphaerella* blight of pea.

Bhardwaj, C.L. and Thakur, D.R. 2000. Yield loss due to leaf spot and pod blight disease complex in rainfed blackgram *Phaseolus mungo* dominated by *Cercospora cruenta* relative to meteorological parameters. *Indian Journal of Agricultural Sciences*, 70(3): 165-167. Himachal Pradesh Krishi Vishwavidyalaya, Regional Research Station, Bajaura 175125, India. [BLACKGRAM; CERCOSPORA]

CRUENTA; LEAF SPOT; PHASEOLUS MUNGO; POD BLIGHT DISEASE]

A field experiment conducted during 5 wet season during 1993-97 over 6 environments each year to investigate the yield loss relationship of leaf spot and pod blight disease complex with mean weekly weather parameter at pre-flowering and post-flowering revealed that leaf spot and pod blight disease complex dominated by *Cercospora cruenta* Sacc. The 1 July sown gave highest grain yield of 'PDU 1' blackgram both in protected (624 kg/ha) and unprotected (393 kg/ha) pots. The interaction effect of sowing dates and plant protection was not significant. The relationship of this interaction at pre-flowering with maximum temperature (30.25°C) was negative and significant (-0.982^{*}) indicating that rise in temperature would result in decrease in yield. Contrarily, maximum relative humidity of 90.70% (+0.931^{**}) and rain frequency of 2.95 days/week (+0.786^{**}) had significant positive correlation. Interestingly, all the parameters were significantly and negatively correlated at post-flowering crop period indicating that a small degree of rise or fall in these parameters would significantly reduce the yield both under protected and unprotected disease management. Reduced rainfall and its frequency at post-flowering seemed to contribute to low yield of blackgram with delayed sowing.

Bhasin, Veena 2000. **Socio-cultural adaptations in cold deserts.** *J. Hum. Ecol.*, 11(3): 215-234. Department of Anthropology, University of Delhi, Delhi 110007, India. [CASTES; ECOLOGY; ECONOMY; ENVIRONMENTAL DEGRADATION; FAMILY; POLITICS; RELIGION; TRIBES]

In India, cold deserts are arid tracts lying in the rain shadow areas of the main Himalayan range. In remote and inaccessible valleys these areas are specialised ecological niches. Adaptation to such harsh environment reflects success of human species. In high altitude areas biochemical, physiological and anatomical features of acclimatization become progressively more pronounced. Man-environment relationship is influenced by genetic make-up, socio-eco-sensitivity and cultural factors. The various high altitude populations are exposed to different degrees of stress, some of the stresses may be unique to each high altitude area. It is now clear that human beings can combine their bio-cultural capabilities to encounter environmental stresses. Some of these stresses are easily manageable by the socio-cultural factors while others are not. Cold deserts offer great cultural and social diversity as well as rich variety of social processes. Cold deserts are inhabited by distinct people having a distinct language, special social and political institutions as well as traditions art forms, religious practices and cultural values. These areas remained isolated and lagged behind in social and economic progress. In the present study an attempt is made to report three areas namely Bharmour tehsil of Chamba District, Himachal Pradesh; Lachen and Lachung of North Sikkim and Ladakh region of Jammu and Kashmir inhabited by Gaddis; Bhutias and Buddhist and Muslim groups, respectively.

Bhatia, Ranjeet; Sharma, Ravinder and Agnihotri, R.P. 2000. **Incidence, varietal preference and control of fruit borer, *Conopomorpha cramerella* (Lepidoptera: Gracillariidae) on litchi (*Litchi chinensis*) in Himachal Pradesh.** *Indian Journal of Agricultural Sciences*, 70(5): 301-304. Regional Horticultural Research Station, Dr Y.S. Parmar University of Horticulture and Forestry, Kangra, Himachal Pradesh 176201, India. [CONOPOMORPHA CRAMERELLA; COST RATIO; LITCHI FRUIT BORER; VARIETAL PREFERENCE]

In a two year study conducted during 1996 and 1997 on the occurrence of litchi fruit borer, *Conopomorpha cramerella* Snell. in 8 different blocks of district Kangra, it was observed that pest attack varied between 13.6 and 64.9%. Incidence of the borer on 9 cultivars indicated maximum attack on 'Mclean' (85.7%) while 'Seedless Early' had minimum incidence (33.3%) of the pest. The information on the borer control using 6 different insecticides revealed that the highest efficacy was obtained by using monocrotophos (@ 0.036% and 0.072%) and cypermethrin (@ 0.01 and 0.02) during both the years. The benefit: cost analysis indicated that delayed single spray (15 days before harvest) with endosulphan 0.05%, monocrotophos 0.036%, methyl parathion 0.05% and cypermethrin 0.01% resulted in high returns with a ratio of 1:35.9, 1:35.7, 1:35.1 and 1:33.5 respectively. Methyl demeton proved to be the least effective insecticide.

Bhatt, I.D.; Rawal, R.S. and Dhar, U. 2000. **The availability, fruit yield, and harvest of *Myrica***

esculenta in Kumaun (west Himalaya), India. *Mountain Research and Development*, 20(2): 146-153. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, India. [FRUIT-YIELDING; MYRICA ESCULENTA (KAIPHAL); NONTIMBER FOREST PRODUCTS; RECRUITMENT; REGENERATION; RURAL ECONOMY]

Myrica esculenta Buch-Ham. ex D. Don is a popular, potentially income-generating wild edible in the Indian Himalaya. The species prefers *Pinus roxburghii* Sarg., *Quercus leucotrichophora* A. cam., and mixed *Quercus* forests, contributing 15-26% of total tree density in the forests. It performs best in *Pinus roxburghii* forests, where its density correlates with *Pinus* tree biomass. The regeneration of *Myrica* is poor in all the habitats. However, recruitment of species increases consistently from abundant *Myrica* to no-*Myrica* stands. The fruit yield increases with tree size category and differs between habitats. The potential yield at different sites is 2.0-4.2 tonnes/ha, of which 2.8-7.2% is harvested for income generation. The income generated from *Myrica* fruit is significant, considering the regional annual per capita income. The possible impact of fruit harvesting and other disturbance factors on the regeneration of the species is discussed. There are significant options for enhancing the income-generating potential through value addition.

Bose, Ashish 2000. Demography of Himalayan villages - Missing men and lonely women. *Economic and Political Weekly*, XXXV(27): 2361-2363. . [DEMOGRAPHY; FEMALE WORKFORCE; MIGRATION; SEX RATIO]

In the villages of Uttarakhand in the Himalayas, Amartya Sen's catchy phrase 'missing women' is turned upside down. Here it is the men who go missing, forced out by an unsustainable economy, while the women work full-time on the tiny terraced fields.

Bose, Ashish 2000. Reaching the unreached in Uttarakhand: Demography, drinking water and Technology. *Economic and Political Weekly*, XXXV(25): 2090-2092. . [DEMOGRAPHY; DRINKING WATER; NGO; PRIMARY HEALTH CARE]

The basic problem in the Uttarakhand region is the hilly terrain and the absence of a transportation network, making access to basic needs like water and sanitation, primary health care and education almost impossible on a universal basis. The unreached have to be reached. Some observations on the problem of drinking water.

Brahmi, M.K.; Kaushal, A.N. and Sharma, K.R. 2000. Resin tapping from lower diameter classes of chir pine by rill method using group of different blaze width in Himachal Pradesh. *The Indian Forester*, 126(1): 83-88. Resource Survey and Management Division, Forest Research Institute, Dehradun. [CHIR-PINE FOREST; COMMERCIAL TAPPING; DIAMETER CLASS]

In the present study it was found that resin yield increased with the increase in diameter class D4 (20-22.5cm) to D1 (27.5-30cm) and the group of blaze width from B1 (8,10,12 and 14cm) to B4 (14,16,18 and 20cm). The resin yield also increase as blaze width increased within blaze group itself. The tree in diameter class D4 (20-22.5cm) yielded resin less than 2.0kg per season so it is not feasible to commercially tap the trees of this diameter class. The trees of other three diameter classes viz. D3 (22.5-25cm), D2 (25-27.5cm) and D1 (27.5-30cm) are feasible for commercial resin tapping because they yielded more than 2.0kg of resin per season. The maximum resin yield was obtained in the month of May (hottest) and the lowest in the month of October (coldest). The eight month tapping period showed the average resin yield of 2.30kg per tree per season.

Chakravarti, P.K. 1998. Changing Scenario of recreation in Darjeeling-Sikkim Himalaya and foot hills. *Geographical Review of India*, 60(4): 534-541. Department of Geography and Applied Geography, University of North Bengal 734402. [BIODIVERSITY; ECO-TOURISM; SIKKIM HIMALAYA; SOCIO-ECONOMIC]

In the present study, the tourism's impact on the Darjeeling-Sikkim Himalayas are dealt with. On the basis of field-survey and interaction with tourists some measures are suggested to put the industry on firm footing and high light the diverse attractions that are present there.

Channa, Subhadra Mitra 2000. **The emergence of an ethnic identity: The case study of the "Gorkhali" of Garhwal, Uttar Pradesh.** *J. Hum. Ecol.*, 11(4): 251-259. Department of Anthropology, University of Delhi, Delhi 110007, India. [ETHNICITY; GORKHA; GRAHWAL; IDENTITY; NEPAL]

The Nepali population around the Dehradun district of Uttar Pradesh is in the process of evolving a new ethnic identity, namely "Gorkhali", to establish themselves as a distinct political identity in the state. This paper explores the process of evolution and the reinterpretation of the term "Gorkha" or "Gorkhali" from its invention by the British and its transformation to an ethnic concept by these people as well as explores the dynamics of political and social relationship between the local Garhwali and the immigrant Nepalis.

Chaudhary, R.S. and Sharma, P.D. 1999. **Runoff and sediment yield from Giri river catchment in Himachal Pradesh.** *Indian J. Soil Cons.*, 27(1): 1-9. Department of Soil Science, Himachal Pradesh Krishi Vishva Vidyalaya, Palampur 176062, H.P., India. [CATCHMENT; GIRI RIVER; HIMACHAL PRADESH; RUNOFF EFFICIENCY; SEDIMENT YIELD; SUSPENDED SEDIMENT CONCENTRATION]

The Giri river with about 2600 km² mountainous catchment is one of the major Himalayan tributaries of the Yamuna river system. Twelve years of daily discharge and sediment yield data collected from calibrated sections of the river form the basis for this study. The mean annual runoff in the river over twelve years was 1039.5×10^6 m³. About 75 per cent of the runoff occurs from June to September. Both annual and monthly runoff values showed a great degree of variation. The mean runoff efficiency for the catchment was 23.22 per cent. The annual suspended sediment load in the river was 2488.2×10^3 t and increased exponentially with increase in discharge. The concentration duration relationship showed unusual concentration levels during monsoon period. The annual sedimentation rate of the catchment is 95.7×10^3 t 100sq km⁻¹ which is quite high compared to the designed rate of 50×10^3 t 100 sq km⁻¹ for various reservoirs of the country. This paper is an attempt to utilize the available data towards the first hand estimation of the magnitude of the problem.

Chaudhuri, P.S. and Bhattacharjee, Gautam 1999. **Earthworm resources of Tripura.** *Proc.Nat.Acad.Sci. India*, 69(B): 159-170. Department of Zoology, M.B.B. College, Agartala - 799 004, Tripura. [DISTRIBUTION; DIVERSITY; EARTHWORMS; ECOLOGICAL FACTORS; SOIL TYPES]

This study presents the first survey of earthworm species (Oligochaeta) from Tripura, a north-eastern state of India. A total of seventeen species belonging to five families were recorded: Megascolecidae (*Metaphire posthuma*, *M. planata*, *M. houlletii*, *Lampito mauritii*, *Perionyx excavatus*, *Amyntas alexandri*, *Polypheletima elongata*), Octochaetidae (*Eutyphoeus gammiei*, *E. turaensis*, *E. scutarius*, *E. gigas*, *Dichogaster modiglianii*), Moniligastridae (*Drawida nepalensis*, *D. limella*, *D. papillifera*), Almididae (*Glyphidrilus spelaeotes*) and Glossoscolecidae (*Pontoscolexcorethrurus*). Their distribution, density and diversity, mainly in three different ecosystems (pasture, compost pit and sewage system) are discussed in relation to some of the ecological factors and soil type of the region.

Dhar, Uppeandra; Rawal, R.S. and Upreti, Jyoti 2000. **Setting priorities for conservation of medicinal plants - a case study in the Indian Himalaya.** *Biological Conservation*, 95: 57-65. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, U.P., India. [CONSERVATION PRIORITIES; MEDICINAL PLANTS; SENSITIVITY INDEX (SI); USE VALUE INDEX (UVI)]

The paper analyses available information on various aspects of medicinal plants (MPs) of the Indian Himalaya region (IHR). Among the identified gaps in knowledge, lack of objective assessment of threats was considered a major impediment in setting conservation priorities. The paper addresses this issue keeping in view the needs of users (industry) and conservation concerns of academics (biologists). An approach for prioritisation of MPs for conservation was thus developed. Prioritisation based on three indices: (i) use value index (UVI) indicate threats imposed by users, (ii) sensitivity index (SI) reflect conservation concerns of biologists, and (iii) importance value index (IVI) is the cumulative value of (i) and (ii) to prevent biased approach. Dependence of pharmaceutical industry on only 10% of the available stock and that too on non-native elements suggest that the potential of true Himalayan MPs has not been harnessed as yet. However, increased dependence on exclusive wild forms (64.6%), dominance of destructive harvest trend (69%) and

restricted distribution range of most MPs used by the industry is a pointer to the intensity of threat. The paper identifies 20 top ranking MPs for conservation in each life form.

Dobhal, V.K.; Kohli, U.K. and Mehta, D. 1999. **Genetic analysis of fruit firmness and related traits in Tomato.** *Journal of Hill Research*, 12(1): 31-33. Department of Vegetable Crops, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan 173230, Himachal Pradesh. [FRUIT FIRMNESS; GENETIC PARAMETERS; TOMATO]

Gene effects for fruit firmness, pericarp thickness and total soluble solids were studied in three crosses of tomato (*Lycopersicon esculentum* Mill.) involving four parents viz. FT 5, FT 12, V 16 and EC 174041. The character means over six generations were subjected to scaling tests. Fruit firmness and pericarp thickness were primarily governed by additive gene action though the cross FT 5xV 16 also exhibited significant dominance effect for both the traits. For TSS the crosses depicted different types of gene action and exhibited equal importance of both additive and non-additive gene actions with duplicate epistasis. Pedigree method and biparental mating has been suggested to improve fruit firmness in tomato.

Garkoti, S.C. 1999. **Changes in weight loss and nutrient composition of woody litter in three forests on high altitudinal zones of Central Himalaya.** *Tropical Ecology*, 40(1): 129-136. Botany Department, Kumaun University, Nainital 263002, India. [ACER CAPPADOCICUM; BETULA UTILIS; IMMOBILISATION; MINERALISATION; R. CAMPANULATUM; RHODODENDRON ARBOREUM; WEIGHT LOSS; WOOD LITTER]

Patterns of decomposition and nutrient release from the wood litter were determined using litter bags in four high altitude forest tree species of central Himalaya. The weight loss ranged from 23.5-27.4% after 365 days, the minimum being in *B. utilis* and maximum in *A. cappadocicum*. In both deciduous and evergreen species the rate of decomposition decreased with increase in altitude. The rates of decomposition were significantly correlated with nutrient concentrations. Of the nutrients studied potassium was released most rapidly.

Garkoti, S.C. and Singh, S.P. 1999. **Litter decomposition and nutrient release in Central Himalayan high altitude forests.** *Tropical Ecology*, 40(1): 19-26. Botany Department, Kumaun University, Nainital 263002, India. [DECIDUOUS; EVERGREEN; NUTRIENT RELEASE; WEIGHT LOSS]

Decomposition of leaf litter was studied using the litter bags exposed in each forest to examine the weight loss pattern and nutrient dynamics in three high altitude forests of central Himalaya. Leaf litter of evergreen species showed slower decomposition rates than those of deciduous species. Decomposition rates were lower than those of low and mid altitude forests of central Himalaya. There existed a significant inverse relationship between percent weight remaining and N and P concentration in residual material, indicating that N and P were not lost from the litter as fast as the structural components.

Gupta, A.; Sharma, R.K.; Mani, V.P. and Chauhan, V.S. 1999. **Variability and association analysis for grain yield and its components in hill rices.** *Journal of Hill Research*, 12(2): 99-101. Division of Crop Improvement, Vivekananda Parvatiya Krishi Anusandhan Sansthan (ICAR), Almora 263601, U.P. [CROP BREEDING; GRAIN YIELD; LEAF AREA]

Variation and association analysis were studied among 95 native rice collection of U.P. hills and three checks during wet season 1996. High heritability and high genetic advance for grains/panicle and high heritability and low genetic advance for days to flowering, biological yield/plant and grain yield/plant indicating the involvement of additive and non additive gene action, respectively for the expression of these traits. Association analysis revealed that biological yield/plant, harvest index and flag leaf area exhibited positive genotypic association with grain yield. PBT/plant, panicle length, number of primary branches/plant, grains/panicle and plant height. Hence, these may be used for carried out selection for yield.

Gupta, T.; Gupta, R.K.; Pathania, M.S. and Kaushal, P.S. 1999. **Status of forage balance in Himachal Pradesh.** *Journal of Hill Research*, 12(2): 122-125. Regional Centre, National Afforestation & Eco-development Board, Dr. Y.S. Parmar University of Horticulture & Forestry, Nauni-Solan 173230, H.P.; College of Veterinary Science & Animal Husbandry, Anjora, Durg 491 001, M.P.; Himachal Pradesh Krishi

Vishwavidyalaya, Palampur 176062, H.P., India. [FODDER; HOUSEHOLD; LIVESTOCK]

The study was aimed at estimating the forage balance in Himachal Pradesh. Stratified multistage random sampling technique was used for sample selection. The result showed that average number of livestock per household was 5.80. Contribution of forage from private land was much higher (74%) as compared to public land. The survey indicated the deficit of 32% of forage requirement of which deficit was 13% in case of grasses, 14% in case of tree fodder and 55% for straw.

Hertog, W.H.den and Wlertsum, K.F. 2000. Timur (*Zanthoxylum armatum*) production in Nepal-Dynamics in nontimber forest resource management. *Mountain Research and Development*, 20(2): 136-145. Sub department of Forestry, Wageningen Agricultural University, P.O. Box 342, 6700 AH Wageningen, The Netherlands. [AGRO-FORESTRY; COMMUNITY FORESTRY; DOMESTICATION; INDIGENOUS KNOWLEDGE; INTENSIFICATION; NEPAL; RESOURCE MANAGEMENT; ZANTHOXYLUM ARMATUM (TIMUR)]

The use of nontimber forest products (NTFPs) in tropical forest management is currently receive greater attention. Use of NTFPs starts with extraction from natural forests but may gradually be intensified to cultivation of domesticated trees. In order to enhance understanding of the evolutionary processes in NTFP production, this article analyzes the different management systems of timur (*Zanthoxylum armatum*) production in Nepalese forests. Products of this medicinal plant are regularly traded with India. Four different management regimes on open-access state lands, two different types of community-controlled lands, and private lands are described, each being characterized by a specific set of access regimes, organizational rules for collecting and managing timur, and management practices. A gradual increase in management intensity takes place from public lands to private lands as a result of various socio-economic and politico-legislative factors. In contrast to earlier Nepalese studies, increased market price rather than increased scarcity was found to be the most important factor inducing intensification. It is concluded that the effects of supply and demand factors on management intensity of NTFPs cannot be generalized; these effects depend on both the management and marketing characteristics of specific NTFPs.

Joshi, Kunjani and Joshi, A.R. 1999. Ethnobotanical study of some wild mushrooms of two valleys (Kathmandu and Pokhara) of Nepal. *Ethnobotany*, 11(1&2): 47-56. Department of Botany, Tribhuvan University, Patan Campus, P.O. Box 11121, Kathmandu, Nepal; Food value and Toxin of Wild Mushrooms Project, APINMAP/SCAMAP, UNESCO, Nepal. At present, Director General, South Asia Cooperative Environment Programme (SACEP), 10 Anderson Road, Colombo 5, Sri Lanka. [ETHNOBOTANY; NEPAL; WILD MUSHROOMS]

Use of wild plant resources in Nepal is an old practice. In the present paper, an attempt has been made to present the ethnobotany of 36 species of wild mushrooms which were collected from different parts of two valleys: Kathmandu and Pokhara of the Central and Eastern Development Region, respectively. The local people possess a remarkably detailed knowledge of species identity and characteristics. Due to high content of vitamins and minerals, some wild mushrooms can be used to fulfil human nutrition and medicinal requirements. However, at present, these useful species are under threat due to habitat destruction and over-exploitation, indicating an urgent need for conservation of species as well as their habitats.

Kala, Chandra Prakash 2000. Status and conservation of rare and endangered medicinal plants in the Indian trans-Himalaya. *Biological Conservation*, 93(1): 371-379. Wildlife Institute of India, P.B.# 18, Chandrabani, Dehradun 248001, U.P., India. [CONSERVATION; MANAGEMENT; PROTECTED AREA; RARE MEDICINAL PLANTS]

I studied the distribution pattern, population structure and conservation status of rare and endangered medicinal plant species in Spiti sub-division of Himachal Pradesh in the Indian trans-Himalaya. The entire study area was stratified into six zones based on geomorphological and phytogeographical variations. In each zone different habitat types for rare and endangered species were identified and sampled using quadrats. A total of 23 rare and endangered medicinal plants were found in Spiti, distributed over 10 major habitat types. All the rare and endangered medicinal plants were localised and found in patches. The patch size for different species varied greatly from 1 to 20,000 m². There were large differences in the

number of rare and endangered medicinal plant species within different zones of Spiti. More species of rare and endangered medicinal plants occurred close to the Great Himalayan range in the southern part of the study area. The highest mean density was estimated for *Picrorhiza kurrooa* followed by *Saussurea gnaphaloides*. The results are discussed in the light of rare and endangered medicinal plants conservation with the strong recommendation of the establishment of medicinal plants conservation areas in this part of trans-Himalaya.

Kaur, R.; Sood, M.; Chander, S.; Mahajan, R.; Kumar, V. and Sharma, D.R. 1999. *In vitro* propagation of *Valeriana jatamansi*. *Plant Cell, Tissue and Organ Culture*, 59(3): 227-229. Department of Biotechnology, Department of Forest Products, University of Horticulture and Forestry, Nauni, Solan, H.P., India 173230. [MICROPROPAGATION; VALEPOTRIATE; VALERIAN; VALERIANA JATAMANSI]

Valeriana jatamansi Jones is an important medicinal plant. This wild herb is being exploited for its roots and rhizomes which contain valepotriates, which are highly effective against leprosy. The aim of this study was to establish a practical method for rapid and large-scale multiplication of *V. jatamansi* by induction of shoot proliferation from shoot buds. The sterilized explants were established on solid medium supplemented with benzyl adenine alone or in combination with indole-acetic acid or naphthalene acetic acid. The buds cultured on nutrient medium supplemented with BA and IAA or NAA formed shoots, which after 3-4 weeks produced roots on the same medium. One hundred per cent survival was obtained on hardening and field establishment of well rooted shoots.

Kayang, H. and Sharma, G.D. 1999. Microorganisms in the food, gut contents and faeces of *Burmoniscus kempfi* (Isopoda; Philosciidae). *Journal of Hill Research*, 12(2): 114-118. Department of Botany, School of Life Sciences, North Eastern Hill University, Mawlai Permanent Campus, Shillong 793022, Meghalaya, India. [BACTERIA; FAUNA; FUNGI; MICRO-ECOSYSTEM]

Fungal and bacterial growth remained more or less constant in the control chamber, but in the experimental chamber the fungal standing crop was reduced by all levels of isopod feeding. However bacterial standing crop increased with the number of isopods. Numbers of colony forming units of fungi and bacteria were higher in faeces than in the litter. While bacterial growth was stimulated in the midgut (12×10^6 g⁻¹ dry mass), hindgut (14×10^6 g⁻¹ dry mass) and faeces (17×10^6 g⁻¹ dry mass) and then increased in the faeces (7.1×10^4 g⁻¹ dry mass).

Keatinge, J.D.H.; Qi, A.; Wheeler, T.R.; Subedi, M.; Shah, P.B.; Ellis, R.H. and Summerfield, R.J. 1999. Annual legume species as green manures/cover crops in low-input farming systems of Nepal. *Mountain Research and Development*, 19(4): 325-332. Department of Agriculture, The University of Reading, P.O. Box 236, Farley Gate, Reading, Berks RG6 6AT, UK; National Agricultural Research Centre, P.O. Box 3459, Kathmandu, Nepal; ICIMOD, P.O. Box 3226, Kathmandu, Nepal. [BIOMASS; FARMING SYSTEMS; GERMPLOASM; GREEN MANURE]

Models, which predict the duration between sowing and reproductive maturity, are used to examine the suitability of cover legumes for use in farming systems of the mid-hills region of Nepal. The National Agricultural Research Council hill research institutes at Hattiban, Lumle, and Pakhribas were selected for study. In addition, the temperature regimes of a typical span of elevations (600-2,400 m) were constructed to examine the range of environmental variability associated with cropping in this region. Models predicting rates of crop development were used to determine the feasibility of six legume cover species to reach maturity prior to the sowing period for the principal summer cereal crops. Model outputs indicate substantial variability in maturity dates resulting from genotype, site, elevation, and sowing date effects. *Vicia faba*, *Vicia villosa* spp. *dasycarpa*, and *Lupinus mutabilis* grown as autumn-sown crops across most of the mid-hills would be feasible where early sowing is possible. More caution would be needed if *Vicia sativa* or *Trifolium resupinatum* were chosen because they are only likely to mature early enough to permit unhindered summer cereal sowing at lower elevations.

Khan, S.N. and Uniyal, Kamla 1999. Growth response of two forest tree species to VAM and rhizobium inoculations. *The Indian Forester*, 125(11): 1125-1128. Forest Pathology Division, Forest

Research Institute, Dehradun. [FERTILIZER; INOCULATION; SEEDLING; VAM]

Impact of inoculations of *Acacia nilotica* seedlings with VAM and *Rhizobium* and *Populus deltoides* sets with VAM alone and in combination with fertilizers is reported. *A. nilotica* responded positively to VAM and *Rizobium* inoculations with an increase of 40.94% in biomass whereas in *P. deltoides* an increase of 37.64% was achieved with VAM inoculation in combination with normal dose of fertilizers.

Kirn, H.S.; Kapahi, B.K. and Srivastava, T.N. 1999. **Potential non-timber forest resources of commerce in the economy of tribals and others of Jammu and Kashmir state (India).** *Journal of Non-Timber Forest Products*, 6(3/4): 95-102. Department of Botany, G.G.M. Science College, Jammu Tawi 180001; Regional Research Laboratory, Jammu Tawi 180001, J&K. [BAMBOOS; HONEY BEE; MUSHROOMS; NON TIMEBER FOREST]

This paper deals with the Non-timber Forest Produce exploited by the tribal and village people in Jammu and Kashmir State to substantiate their economy. The resources include bark, galls, leaves, roots, flowers, fruits, seeds, bamboos, honey, mushrooms and various other items made there from.

Kukreti, M.C. 2000. **Vegetation and its status in the Himalayan region.** *The Indian Forester*, 126(2): 175-179. ICFRE-IDRC Project on Himalayan Eco-Rehabilitation, ICFRE, Dehradun, U.P., India. [FOREST COVER; FOREST TYPE; SHIFTING CULTIVATION]

India has a privilege and blessing of three mountain systems viz. the Himalayas, the Vindhya and the Coastal ranges. Of these three system of mountains, the Himalaya happens to be the greatest and most massive in extent and height. The mighty Himalaya is known for its rich vegetation and snow-capped peaks exerting tremendous influence on the vast majority of India's flora, fauna and ecology. In fact, the Himalayas with their snow, glaciers, forests and diverse types of flora and fauna have been the source and inspiration of forest scientists and thinkers. India has 20 Agro-ecological regions, but the Himalayas region is covered by five only. Of these Himalayan region states Arunachal Pradesh has the maximum forest cover and growing stock.

Kumar, R.; Sharma, R.L. and Walia, D.P. 1999. **Evaluation of cross compatibility/incompatibility in crosses among six apple cultivars.** *Journal of Hill Research*, 12(2): 126-129. Department of Fruit Breeding & Genetic Resources, Dr. Y.S. Parmar University of Horticulture & Forestry, Solan 173230, H.P. [APPLE CULTIVARS; POLLEN GERMINATION; POLLINATION]

Most of the apple cultivars are self incompatible and as such require cross pollination to get commercial fruit set. Keeping in view this fact, the present investigations were conducted to know the level of cross compatibility 6 apple cultivars viz. Redfree, Liberty, Co-op 12, Tydeman's Early, Starkspur Golden Delicious and Golden Spur Delicious crossed to develop 18 crosses because cases of cross incompatibility though not very frequent but do occur. *In vivo* pollen germination in 18 crosses was about 67.83 per cent with average pollen tube length of 2.20 mm after 24 hour of pollination. In addition to effective fruit set on cross pollination, pollen tube growth characteristics like presence of intermittent callose plugs without swelling at the terminal ends confirmed cross compatibility in the 18 crosses.

Kumar, Rakesh; Pandey, Rajiv and Pal, Mohinder 2000. **Non-linear regression models in bamboo *Dendrocalamus strictus* seedlings.** *The Indian Forester*, 126(2): 154-158. Plant Physiology Discipline, Botany Division, Forest Research Institute, Dehradun. [BAMBOO; REGRESSION ANALYSIS; RHIZOME; SEEDLING]

A study was conducted with non-linear regression model in Bamboo (*Dendrocalamus strictus*) seedlings to estimate the fresh weight of rhizome on the basis of fresh weight leaves. The non-linear analysis reflected that fresh weight of rhizome and leaves are not responsible for fresh weight of rhizome.

Lal, H.; Singh, Charan; Puri, D.N. and Vishwanatham, M.K. 2000. **A silvi-pastoral system to optimise resource use for biomass production from the bouldery riverbed lands of Doon Valley.** *The Indian Forester*, 126(3): 246-256. Central Soil & Water Conservation Research & Training Institute, Dehradun, U.P., India. [DIAMETER; EUCALYPTUS; FODDER; SILVI-PASTORAL SYSTEM]

A field experiment was conducted for nine years (1986-1995) to study the effect of plant spacing of *Eucalyptus* hybrid grown in association with *Chrysopogon fulvus* on plant growth, fresh and dry matter production and nutrients uptake of both tree and grass on degraded bouldery riverbed land of Doon Valley. It is evident from study that *Eucalyptus* hybrid planted at 3m x 1.5m spacing with *Chrysopogon fulvus* was found optimum with regard to plant growth, survival, dry matter production and nutrients uptake as compared to 3mx1m and 3mx3m spacings. Similarly, *Chrysopogon fulvus* grown alone exhibited better plant growth, produced relatively more fresh and dry fodder and improved the nutrients content and their uptake considerably than those grown with *Eucalyptus* hybrid planted at 3m x 1.5m and 3m x 1m spacings.

Lalramnghinglova, H. and Jha, L.K. 1999. **New records of ethnomedicinal plants from Mizoram.** *Ethnobotany*, 11(1&2): 57-64. Environment & Forest Department, Mizoram, Aizawl, India; Forestry Department, North Eastern Hill University, Mizoram Campus, Aizawl, India. [ETHNIC GROUPS; ETHNOMEDICINE; HEALTHCARE SYSTEM; HERBAL MEDICINE; MIZORAM]

Ethnobotanical research was carried out in Mizoram during 1995-1997. Out of 230 plants studied, 61 were recorded for the first time as having ethnomedicinal uses.

Lynshiang, D.S. and Gupta, B.P. 2000. **Role of catecholamines and corticosteroids in regulation of the oxidative metabolism in male *Clarias batrachus*.** *Current Science*, 78(9): 1112-1117. Environmental Endocrinology Laboratory, Department of Zoology, North-Eastern Hill University, Shillong 793022, India. [FISH RESPIRATION; METAPYRONE; RAINY SEASON; TISSUE RESPIRATION]

In vivo and *in vitro* effects of norepinephrine (NE), epinephrine (EP) corticosterone, cortisol, cortisone and metapyrone were studied on the rate of tissue (liver, muscle, kidney and brain) respiration of the male air-breathing fish, *Clarias batrachus* exposed to natural climatic conditions during winter and summer. Both NE and EP stimulated the respiratory rate of all the tissues irrespective of the season/water temperature and the mode of treatment. EP in muscle and NE in liver were comparatively more potent. Both the catecholamines were found to be more effective in stimulating tissue respiration during winter than during summer. Similarly, the corticosteroid hormones increased the respiratory rate of all the four tissue both *in vivo* and *in vitro* experiments irrespective of the season. Only cortisone had no significant effect on brain tissue respiration during summer. The corticosteroid hormones were also more effective in stimulating fish tissue respiration during winter than during summer. *In vivo* administration of metapyrone significantly reduced the rate of respiration of all the tissues. The inhibitory effect of metapyrone was reversed by *in vivo* administration of the corticoids. These findings suggest that the catecholamines and the corticosteroids are directly involved in the regulation of tissue respiration of *C. batrachus*. Due to their temperature-independent calorogenic action, these hormones might be acting as emergency hormones for the regulation of fish respiration.

Maikhuri, R.K.; Nautiyal, S.; Rao, K.S.; Chandrasekhar, K.; Gavali, R. and Saxena, K.G. 2000. **Analysis and resolution of protected area-people conflicts in Nanda Devi Biosphere Reserve, India.** *Environmental Conservation*, 27(1): 43-53. G.B. Pant Institute of Himalayan Environment and Development, Garhwal Unit, PB 92, Srinagar (Garhwal) 246174, India; Sustainable Development and Rural Ecosystems Programme, 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. [AGRICULTURE; CONFLICT; ECONOMY; FOREST AREA; PASTURES]

Conflicts between local people and protected area managers are a common problem in developing countries, but in many cases there has been little attempt to comprehensively characterize the underlying problems. Resource uses, management practices, economy and people's perceptions of problems and likely solutions were analysed in two villages near and two villages away from the core zone of Nanda Devi Biosphere Reserve in the Indian Himalaya. Agriculture, although practiced on less than 1% of the area, was the primary occupation of local people. Six annual crops of a total of 22 and all four horticultural crops on private farms were damaged by wildlife, but Reserve management provided compensation only for livestock killing by wildlife and compensation amounted to only 4-10% of the total assessed monetary value of killed livestock. A variety of wild plant products were used locally but 27 were marketed by more than 50% of

surveyed families; income from wild products was substantially lower than that from crops and livestock. A sociocultural change from a subsistence to a market economy, together with changes in traditional land/resource rights and institutions has led to a number of changes in land-use and management practices. The livestock population has declined, agricultural area has remained the same and people have started cultivating medicinal species in the last 20 years. These changes seem complementary to the goal of conservation. However, changes such as abandonment of some traditional food crops and stress on cash crop lacking fodder value, requiring substantial manure inputs derived from forest litter and livestock excreta, and causing severe soil erosion, seem to counter the goal of environmental conservation. Some government-managed Reserve Forest sites were similar to the Community Forests in terms of species richness, basal area and soil physico-chemical properties. Two Reserve Forest sites showed basal areas of 160.5-191.5 m²/ha, exceeding the highest values reported so far from the region. The formal institutional framework of resource management seems to be not as effective as the traditional informal system. The Reserve Management Plan lays more emphasis on legal protection than on the sustainable livelihood of local communities and has led to conflicts between local people and reserve managers. Plantation of fodder and medicinal species in degraded forest lands, suppression of economic exploitation of local people in the market, enhancement of local knowledge of the economic potential of biodiversity, incentives for cultivation of crops with comparative advantages and lesser risks of damage by wildlife, and rejuvenation of the traditional involvement of the whole village community in decision-making, could be the options for resolving conflicts between people and protected areas in this case.

Maikhuri, R.K.; Semwal, R.L.; Rao, K.S.; Singh, K. and Saxena, K.G. 2000. Growth and ecological impacts of traditional agroforestry tree species in Central Himalaya, India. *Agroforestry Systems*, 48: 257-272. G.B. Pant Institute of Himalayan Environment and Development, Garhwal Unit, PB 92, Srinagar (Garhwal) 246174, India; Sustainable Development and Rural Ecosystems Programme, 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. [BIOMASS; CARBON SEQUESTRATION; DEGRADED LANDS; MULTIPURPOSE TREE]

A number of multipurpose tree species are conserved as scattered trees in settled farms on terraced slopes by the traditional farmers in Central Himalaya, India. Knowledge on growth rates and ecological impacts of these tree species is limited. Ten locally valued multipurpose tree species, viz., *Albizia lebbek*, *Alnus nepalensis*, *Boehmeria rugulosa*, *Celtis australis*, *Dalbergia sissoo*, *Ficus glomerata*, *Grewia optiva*, *Prunus cerasoides*, *Pyrus pashia* and *Sapium sebiferum*, were established as mixed plantations at a degraded community forest land site and an abandoned agricultural land site in a village at 1200 m altitude in District Chamoli, India. At the abandoned agricultural land site, annual food crops were grown, along with planted trees, providing supplemental irrigation and organic manure following traditional farming practices. Survival, height, stem circumference, crown depth and width, number of branches, above ground biomass and soil physico-chemical characteristics were monitored up to five years of plantation growth. Above-ground tree biomass accumulation at the abandoned agricultural land site was 3.9 t ha⁻¹ yr⁻¹ compared with 1.1 t ha⁻¹ yr⁻¹ at the degraded forest land site. *B. rugulosa*, *C. australis*, *F. glomerata*, *G. optiva*, *P. cerasoides* and *S. sebiferum* showed more prominent differences in growth at the two sites compared with *A. lebbek*, *A. nepalensis*, *D. sissoo* and *P. pashia*. *A. nepalensis* and *D. sissoo* showed best growth performance at both the sites. A significant improvement in soil physico-chemical characteristics was observed after five years at both of the sites. Carbon sequestration in soil was higher than that in bole biomass.

Mann, R.S. 2000. Environment, ecology and culture paradigms case of Ladakhi tribe. *J. Hum. Ecol.*, 11(4): 235-243. Department of Anthropology, University of Delhi, Delhi 110007, India. [BHOTO TRIBALS; HUMAN ADAPTATION; SOCIAL ANTHROPOLOGY]

Acculturative and historical factors apart, many cultural and civilization traits the world over have originated, evolved and taken definite shapes for adaptation of humans to specific environmental components and niches. In contemporary social-cultural situations this construct is more meaningfully evident in case of inhabitants of isolated, difficult and imposing natural conditions where human adaptation, at the level of culture, with environment sounds remarkable, Ladakh, a district of Jammu and Kashmir state of India,

represents a valid instance of this kind. The Ladakhi society and its network of cultural patterns speak of high degree of adaptation to specific environmental paradigm. Both culture and environment are taken in their broad meanings. As interpretive dimension, the theoretical baggage in respect of cultural ecology is critically reviewed in the light of substantivism originating from microsetting of Ladakhis.

Mather, Richard A. 2000. **Using photomaps to support participatory processes of community forestry in the middle hills of Nepal.** *Mountain Research and Development*, 20(2): 154-161. Forest Products Research Centre, Buckinghamshire Chilterns University College, Queen Alexandra Road, High Wycombe, Buckinghamshire HP11 2JK, UK. [COMMUNITY FORESTRY; NEPAL; PARTICIPATORY APPROACH; PHOTOMAPPING]

Making information and decision-making processes accessible to disadvantaged and no literate people is a challenge for community forestry in Nepal. In studies jointly conducted by the Nepal-UK Community Forestry Project (NUKCFP) and His Majesty's Government (HMG) of Nepal Department of Forest, aerial photographs and participatory photo mapping (tracing maps over aerial photographs) were evaluated with a view to supporting participatory processes of community forestry in Parbat District of the Middle Hill Region. Results indicate that, regardless of educational status, most people accurately interpreted forest condition and profiles of community use from photographs. Photographs were appreciated because they presented authentic information, allowed consistency of interpretation between groups, and made it possible to calibrate perceptions of resources. District Forest Officer and Community Forestry Officers valued aerial photographs as robust instruments that naturally directed discussions toward community and resource issues. Results of a pilot study of the use of aerial images for surveys indicated that orthorectified aerial images may substantially reduce time spent by District Forest Office (DFO) staff in chain-and-compass surveys of community forests. Survey based on aerial images encourage the participation of users, and boundaries drawn over survey photomaps are represented in the context of important reference information contained in the photographic image. The development of a service for low-cost printing of high-resolution and geographically correct photomaps is described.

Mohsin, Faiz; Singh, K. and Singh, R.P. 1999. **Magnitude of retranslocation of N, P, K in *Eucalyptus* hybrid intercropped with aromatic crop.** *The Indian Forester*, 125(11): 1117-1124. SRF, Directorate of Research, ICFRE, Dehradun (U.P.); Scientist Incharge, CIMAP, Boduppal, Uppal, Hyderabad (A.P.); Head, Department of Forestry, Kumaun University, Nainital (U.P.). [AROMATIC CROP; LITTER PRODUCTION; NUTRIENT CONCENTRATION]

The annual litter production increased with increasing age of the *Eucalyptus* plantations both in the pure and intercropped stands with *Mentha* and *Cymbopogon* spp. An increase in litter production was recorded in all the intercropped in comparison to pure stands at all the ages. Higher concentration of N, P and K was observed in the litter of the intercropped stands, which decreased with increasing ages of the stands. Nutrient concentration in green foliage, decreased with increasing ages of the stands. It was higher in the stands intercropped with *Mentha* and *Cymbopogon* spp. than the pure stands. Magnitude of retranslocation (%) in pure as well as intercropped plantation, increased with increasing ages of the stands.

Mughal, A.H.; Ara, Tabasum and Bhattacharya, P. 2000. **Socio-Economic aspects of agroforestry in rural Srinagar of Kashmir Valley.** *The Indian Forester*, 126(3): 234-240. S.K. University of Agricultural Sciences and Technology, Shalimar, Srinagar, J&K; KVK, Malangpora, District Pulwama, S.K. University of Agricultural Sciences and Technology, Kashmir, J&K; Faculty of Ecosystem Management and Technology Forestry, Indian Institute of Forest Management, Bhopal, M.P. [AGRO-FORESTRY; FODDER; FUELWOOD; KASHMIR VALLEY; SOCIO-ECONOMIC]

Socio-economic aspects of Agroforestry are evaluated in the present study. People in the study area plant only three tree species *i.e.* *Populus deltoides*, *Salix alba* and *Robinia pseudoacacia* under Agroforestry systems, which are not scientifically efficient and so people do not meet their requirements of food, fodder and fuelwood for full year from these models. In order to make the models efficient and productive and generate interest in scientific models energies need to be diverted for on farm experiments so that people can judge by themselves performance of scientific models, which in turn will go a long way in fulfilling the

requirements of farmers to a great extent. Models devised should be socially acceptable and economically feasible so that they are adopted without much resistance.

Nadeem, M.; Palni, L.M.S.; Purohit, A.N.; Pandey, H. and Nandi, S.K. 2000. **Propagation and conservation of *Podophyllum hexandrum* royle: an important medicinal herb.** *Biological Conservation*, 92(1): 121-129. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263 643, U.P.; *High Altitude Plant Physiology Research Centre, PO Box 14, Srinagar, Garhwal 246 174, U.P., India. [CLONAL PROPAGATION; MEDICINAL HERB; PODOPHYLLOTOXIN; PODOPHYLLUM HEXANDRUM; SEED GERMINATION; SOMATIC EMBRYOGENESIS]

Podophyllum hexandrum Royle, a source of highly valued podophyllotoxin, has been subjected to heavy collection from the wilds due to ever increasing demand. This report deals with the successful propagation of this species using both conventional and *in vitro* techniques. To improve vegetative multiplication, rhizome segments were treated with α -naphthaleneacetic acid (NAA) or indole-3-butyric acid (IBA) before planting; more than doubling in rooting percentage was observed with 100.0 μ M IBA. Seed germination generally started 3 months after sowing, and pre-treatment with sodium hypo chlorite resulted in five-fold improvement, while 250.0 μ M gibberellic acid (GA_3) and a combination of GA_3 and 6-benzyladenine (BA; 250.0 μ M each) enhanced germination by nearly two-fold; other treatments were either ineffective or enhanced germination only marginally. Excised zygotic embryos germinated within 7-8 days of culture on basal medium or on medium supplemented with indole-3-acetic acid (IAA; 1.0-4.0 μ M) and BA (1.0 μ M). Multiple shoots were formed within 4-5 weeks; following rooting of these shoots, plants were transferred to hardening pots. Somatic embryos were formed from callus derived from zygotic embryos after 4 months of culture on medium containing 5.0 μ M NAA and 0.5 μ M BA. Various strategies have been discussed to encourage cultivation of this medicinal herb so as to reduce pressure on its population in the wild.

Narayan, R.; Rastogi, K.B.; Bhardwaj, V. and Kanaujia, S.P. 1999. **Genetics of yield and quality traits in garden pea.** *Journal of Hill Research*, 12(2): 95-98. Department of Vegetable Crops, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173230, H.P. [GARDEN PEA; PROTEIN CONTENT; VARIANCE ANALYSIS]

Genetics of yield and quality components were studied from six diverse genotypes resulting from five crosses. Bonneville x Lincoln, Bonneville x Solan Nirog and Lincoln x Kinnauri. All the characters showed either significant additive or dominance or both gene effects along with (i), (j) or (I) type of epistasis in one or more crosses. Simple selection procedure may not be feasible for most of the characters.

Nautiyal, A.R.; Rawat, D.C.S. and Prasad, Pankaj 2000. **Physiological aspects of seed source variation in seed germination of *Quercus leucotrichophora* A. Camus.** *The Indian Forester*, 126(3): 269-273. High Altitude Plant Physiology Research Centre, H.N.B. Garhwal University, Srinagar Garhwal, U.P. [BIOMASS; SEED GERMINATION; SEEDLING]

Seeds of *Q. leucotrichophora* A. Camus were collected from seven places in Garhwal and Kumaun regions varying considerably in their longitude, latitude and altitude and tested for their seed attributes, germinability, seedling growth and survival. Provenances differed from each other in mean seed weight, germinability of seeds and seedling growth. However, differences were significant more in rate of germination than total germination percentage. Didihat seed source gave best results over all other seed sources.

Negi, Hans Raj and Upreti, D.K. 2000. **Species diversity and relative abundance of lichens in Rumbak catchment of Hemis National Park in Ladakh.** *Current Science*, 78(9): 1105-1112. Biodiversity Laboratory, Evolutionary and Organismal Biology Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Jakkur Campus, Jakkur, P.O. Bangalore 560064; Lichenology Laboratory, National Botanical Research Institute, Lucknow 226001, U.P., India. [ABIOTIC FACTORS; BIODIVERSITY; LIVESTOCK; MICRO-CLIMATIC CONDITION]

A total of 21 species of lichens were recorded from a sample of 7500 point intercepts on 75 line transects of 1 m length each on rock and soil substrates along an elevation gradient, ranging from 3300 to 5200 m in the Rumbak catchment of Hemis National Park in Ladakh, India (34°N, 72°30'E). Rocks were richer than the soil in terms of species richness, contributing to more than 80% of total species encountered in the study area. Notably, none of the fifty-six trees of *Salix* and *Myricaria* species surveyed supported lichens, presumably due to high bark peeling rates associated with the high wind speeds in the river banks where these tree species predominantly occur. While many of the species were rare, *Xanthoria elegans* emerged as the most abundant species on rocks throughout the sampling gradient. A nonlinear relationship between altitude and species diversity (richness and turnover) on rocks is demonstrated with maximum number of species being confined to the middle elevations. While rocks seem to provide a relatively stable and very fertile substrate for the rich growth of lichens, soil harbours poor diversity probably due to its unstable top layer augmented with disturbance by the grazing animals. Long-term monitoring of lichens in relation to the grazing and movement patterns of both domestic as well as wild herbivores would help in evolving strategies for conservation of lichens.

Negi, K.S.; Gaur, R.D. and Tiwari, J.K. 1999. **Ethnobotanical notes on the flora of Har-Ki-Doon (District Uttarkashi), Garhwal Himalaya, Uttar Pradesh, India.** *Ethnobotany*, II(1&2): 9-17. National Bureau of Plant Genetic Resources (NBPGR), Regional Station, Bhowali 263 132, Niglat, Distt. Nainital (U.P.), India. [ETHNOBOTANY; FLORA; HAR-KI-DOON]

Ethnobotanical studies have been conducted on the flora of Har-Ki-Doon valley situated in district Uttarkashi of Central Himalaya, Uttar Pradesh. Several exploration trips were undertaken in tribal dominated villages in remote areas during 1983-1997 for ethnobotanical studies and germplasm exploration and collection. Enumeration has been done of 72 ethnobotanical plants belonging to 35 families and 62 genera.

Negi, K.S.; Maheshwari, M.L. and Mehra, G.S. 1999. **A progressive farmer's contribution in terms of raising nursery and multiplication of geranium in remote village -Sirodi, Uttar Pradesh Himalaya.** *Journal of Non-Timber Forest Products*, 6(3/4): 141-144. NBPGR, Regional Station, Bhowali, 263132, Niglat, Distt. Nainital, U.P.; E-8, Street-E, Mayapuri, New Delhi 110064; Village- Sirodi, P.O. Bhowali, 263132, Distt. Nainital, U.P. [ECONOMIC UPLIFTMENT; GERANIUM CROP; MYM]

The present brief note highlights the status of Geranium (Egyptian strain) introduced in Uttar Pradesh Himalaya. It also encompasses location and acreage of the existing plantation under several organization, *i.e.*, Government and Non-Government for extension and identification of areas in U.P. Himalaya for further expansion.

Pandey, A.K.; Mani, V.P.; Chauhan, V.S. and Singh, R.D. 1999. **Effect of plant population, row spacing and nitrogen level on extra early composite - VL makka 88 under mid-hills of the north - Western Himalayas.** *Journal of Hill Research*, 12(2): 88-91. Vivekananda Parvatiya Krishi Anusandhan Sansthan (ICAR), Almora 263 601, U.P. [CROP CANOPY; GRAIN YIELD; PLANT POPULATION]

Field studies aimed to work out optimum plant population, row spacing and nitrogen dose for VL Makka 88 revealed that crop responded significantly upto 80 thousand plants/ha during 1994 and 1995 and upto 65 thousand plants/ha during 1996. Crop sown in rows either 45 or 60cm apart could not bring any significant differences on yield attributes and yield. With regard to N dose, the highest yield was recorded at 120 kg N/ha.

Pant, Anjana; Chavan, S.G.; Roy, P.S. and Das, K.K. 1999. **Habitat analysis for Sambar in Corbett National Park using Remote Sensing and GIS.** *Photonirvachak*, 27(3): 133-139. Wildlife Institute of India, P.B. No. 18, Chandrabani, Dehradun 248001; Indian Institute of Remote Sensing, P.B. No.9, Kalidas Road, Dehradun 248001, U.P. [FUNGICIDE; GRASSLAND; SATELLITE DATA; TOPOGRAPHY; WILDLIFE]

Habitat analysis for sambar in terms of food, cover, water, space and extent of edge in Corbett National Park using remote sensing and GIS has been attempted. Other physical parameters include climate, topography, fire history, disturbance regimes, weeds *etc.* IRS-1B LISS II data (FCC, hardcopy) on 1:50,000

scale was interpreted to generate vegetation cover and density map. Other maps showing drainage, water bodies, roads, human habitations and contours were prepared using Survey of India topographical maps. During evaluation of sambar habitat information regarding habitat parameters and their tolerance was collected from existing literature as well as during field observations. Twenty-two transects of one km. length were laid down in all the strata randomly to collect information regarding the structure and composition of the forest and also habitat use (direct and indirect evidences) by sambar. This was then integrated using condition-based equations in the GIS domain to generate suitability maps. Actual sightings on the ground to a large extent supported the results.

Panwar, Pankaj and Bhardwaj, S.D. 2000. **Performance of shrubs in sand and lime stone mines of Himachal Pradesh.** *The Indian Forester*, 126(3): 279-283. Department of Silviculture and Agroforestry, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, H.P. [BIOMASS; LIMESTONE MINE; SHOOT RATIO]

Among the three species planted *Elaeagnus umbellata* was observed to have maximum survival and growth performance then *Coriaria nepalensis* and *Indigofera pulchella*, in both sandstone and limestone mined areas. In sandstone mine it registered 82.50 per cent survival, whereas, in limestone it was 91.37 per cent. Addition of 2.5 kg forest soil per pit increased survival and growth performance in both the mines, except that of diameter and root: shoot ratio which was observed more in mine spoil alone (control).

Philip, G.; Ravindran, K.V. and Thakur, V.C. 2000. **Mapping of ophiolites: A study in the Indus suture zone of north-western Himalaya, using IRS-1C/1D data.** *Current Science*, 78(8): 1014-1019. Wadia Institute of Himalayan Geology, 33 General Mahadeo Singh Road, Dehradun 248001, U.P.; Regional Remote Sensing Service Centre, ISRO, Dehradun 248001, U.P., India. [IRS 1C/1D DATA; LITHO-UNITS; SATELLITE DATA; TOPOGRAPHY]

Ophiolites, which have been tectonically emplaced along continental margins and island arcs, are significant to the understanding of mountain belt evolution. At the same time mapping of ophiolites in the hostile and inaccessible mountainous terrains of Himalaya has always posed a great challenge to geologists. The emphasis in the present study is on the mapping of the geological features especially the lithological inferences in the Nidar Ophiolitic Complex of the Indus Suture Zone of the Ladakh and Karakoram range of NW Himalaya using high resolution IRS-1C/1D satellite data and refinement of the existing geological maps. While the published geological maps show sequential distribution and occurrence of a number of litho-units, the satellite images have helped not only in delineating the lithological boundaries more precisely but also in demarcation of a number of subunits within the already mapped litho-units. The study shows that the outcrops of the dissimilar lithological units are better delineated on satellite data-based map and hence can be used to refine the existing map of the terrain.

Pilbeam, C.J.; Tripathi, B.P.; Munankarmy, R.C. and Gregory, P.J. 1999. **Productivity and economic benefits of integrated nutrient management in three major cropping systems in the mid-hills of Nepal.** *Mountain Research and Development*, 19(4): 333-344. Department of Soil Science, The University of Reading, Whiteknights, Reading, RG6 6DW, UK; ARS-Lumle, P.O. Box 1, Pokhara, Nepal; ARS-Pakhribas, Dhankuta, Nepal. [CROPPING SYSTEM; FERTILIZER; MANAGEMENT; SOIL FERTILITY]

Combined applications of manure and inorganic fertilizer (integrated nutrient management) may allow sustainable cropping with higher productivity and larger economic benefits than applications of either one alone. This is being examined in three of the major crop rotations in the mid-hills of Nepal. These are rice-wheat on irrigated *khet* land, millet, either relayed or grown sequentially after maize, on rain-fed *bari* land, and blackgram grown after upland rice on ancient river terraces, *tar* land. At each of the six sites seven different nutrient treatments were applied either to a single crop (maize and upland rice) or to both crops (rice and wheat) in the rotation. Manure or inorganic fertilizer, or equal parts of both, were applied at a high rate and at half that rate. A treatment with no additions was also included. Crops of millet and blackgram were unfertilized. Grain yields of maize, upland rice, wheat, and rice were greater at the higher rate of N, as were straw yields. Grain and straw yields were greatest following application of fertilizer alone, except for maize at Pakhribas and wheat at Kholitar, and rice grain yields at Kholitar. For most crops, labor costs exceeded the

market value of the yields from the zero-input treatment. Partial budget analysis showed that margins were generally negative when manure was applied either alone or in combination with fertilizer, but positive with applications of fertilizer. Results imply that applications of fertilizer are advantageous in the short-term.

Pradhan, M.; Sharma, G.D. and Mishra, R.R. 1999. **Isolation and Characterization of *Frankia* from *Alnus nepalensis* D.Don of Meghalaya.** *Journal of Hill Research*, 12(1): 38-51. Department of Botany, Sikkim Government College, Tadong 737102, Sikkim; Department of Life Science, Assam University, Silchar 788001, Assam; Department of Botany, North-Eastern Hill University, Shillong 793022, Meghalaya. [GROWTH RESPONSE; MEGHALAYA; NITROGEN FIXING; SANDY-LOAM]

Scope of application of some cultural techniques in isolation of *Frankia* from root nodules of actinorhizal *A. nepalensis* has been examined. Among 8 techniques employed. 3 techniques viz. Microdissection (Technique 2, S.C.), sucrose density fractionation (Technique 1, S.C.) and nodule crushing methods (Technique 1, L.C.) were found suitable for nodule endophyte isolation in solid and liquid cultures, respectively. Although simple in nutrient composition, Defined Minimal Proportionate (DPM) medium proved superior to highly complex culture media such as BAP, Qmod and M⁶B, etc. in the isolation and sustenance of growth of *Frankia*. Axenic *Frankia* isolated from nodules of Himalayan alder highly resembled to those from other actinorhizal plants which showed characteristic cushion of hyphae < 1mm diameter, vesicles produced on short stalks and sporangia - both intercalary and terminal 96 to 172µm in length. *Frankia* isolates from local alder showed distinct colony morphology, temperature and pH requirements, carbon and nitrogen preference and nodulation speed.

Prakash, Siddhartha 2000. **Political economy of Kashmir since 1947.** *Economic and Political Weekly*, XXXV(24): 2051-2060. . [ECONOMIC BACKDROP; INDUSTRIAL POLICY; MILITANT OUTFITS; PARASITIC CAPITALISM; RENT SEEKING]

Discourse on Kashmir has been polarised either in favour of secession from India, or in support of a union with India. However the nature of state intervention within Kashmir over past 50 years is a critical missing link within academic discourse. A holistic analysis requires careful disentanglement from the evidence and a conclusion that is not biased to any one piece of the puzzle. Of course, this could result in an alternative hypothesis; one that may be a hybrid position and not necessarily a new perspective. A political economy framework sheds new light on the political intrigues that thwarted the welfare maximising benefits of the state's economic policies. Over time, this fuelled dissent, which mobilised into militancy, catalysed by several factors.

Prasad, Pankaj 1999. **Enhancement of seed germination of *Podophyllum hexandrum* royle and *Aconitum heterophyllum* wall by different treatments.** *Journal of Hill Research*, 12(2): 102-106. G.B. Pant Institute of Himalayan Environment and Development, Sikkim Unit, Tadong 737102, Sikkim, India. [BIO-COSMETIC; MEDICINAL PLANT; SEED GERMINATION]

The germinability of seeds of the *ex-situ* endangered important medicinal plant species situated at moderate altitude of Sikkim Himalaya (Kyongnosla 2800 m). It improved by 40% over control through scarification in case of *Podophyllum hexandrum* and by 45% in *Aconitum heterophyllum* due to GA₃ treatment. *P. hexandrum* showed 70% germination due to scarification and 50% by GA₃ treatment and only 30% in control. *A. heterophyllum* treatment showed 65% germination on GA₃ treatment and only 30% in control. *A. heterophyllum* showed 65% germination on GA₃ treated to seeds compared to 20% in control.

Rai, L.K.; Prasad, Pankaj and Sharma, E. 2000. **Conservation threats to some important medicinal plants of the Sikkim Himalaya.** *Biological Conservation*, 93(1): 27-33. G.B. Pant Institute of Himalayan Environment and Development, Sikkim Unit, PO Tadong, Sikkim 737 102, India. [BIO-COSMETIC; CONSERVATION; MEDICINAL PLANT; SIKKIM HIMALAYA]

There are records of about 400 plants of therapeutic value in the Sikkim Himalaya. Indiscriminate and non-systematic collection of medicinal plants has led to severe pressure on the availability of these plants, many of which are now rare, threatened or endangered. Six species, are taken as a case study, viz. *Aconitum heterophyllum* (Wall), *Podophyllum hexandrum* (Royle), *Nardostachys jatamansi* (DC), *Picrorhiza kurrooa*

(Benth), *Swertia chirata* (Ham) and *Bergenia ciliata* (Har.) Stenb. The number of plants collected from the wild in Sikkim are very high (c. 800,00 *A. heterophyllum*; 7,700,00 *N. jatamansi*; 3,100,000 *P. Kurrooa*, and 3,000,000 *S. chirata*). The six species studied are considered as test cases for successful conservation for the large number of species in Sikkim that are claimed to have therapeutic value and whose survival in the wild is threatened.

Rai, S.N.; Ansari, Yusuf; Upadhyaya, C.P.; Adhikari, S.N.; Mahato, B.; Mishra, S.M. and Rayamajhi, S. 2000. **Environment, rate of growth, effect of intercultivation and volume production in *Dalbergia sissoo* and *Eucalyptus camaldulensis* plantations at Sagarnath (Nepal).** *The Indian Forester*, 126(2): 119-131. Faculty IOF, Pohara/Hetauda, Nepal. [EUCALYPTUS; FUEL-WOOD; NEPAL; SUB-TROPICAL]

The Satarnath Forestry Development Project is the largest mechanised plantation initiative in Nepal. Of the 11000 ha planted, around 55% is *Eucalyptus* and 40% *Dalbergia sissoo*. In all 20 sites (8 planted with *D. sissoo* and 12 planted with *Eucalyptus*) were taken up for study of the diameter and height growth. Most of the plantations were intercultivated for periods varying from 1 to 5 years. The age of *D. sissoo* plantations ranged from 3 to 25 years while those of *Eucalyptus* was from 3 to 13 years. Regression equations for Age/Diameter and Diameter/Height were established for both the species under intercropped and not intercropped conditions. It was observed that intercropping gives initially good start to the plants, however in the long run, the growth is determined by the site potential and the impact of intercropping is nullified. It was seen that upto the age of 3 years the diameter growth of both *Eucalyptus* and *D. sissoo* was equal while between 3 to 11 years *Eucalyptus* had better growth than *D. sissoo*. However thereafter *D. sissoo* has better diameter growth. Regarding volume (O.B.) production in *Eucalyptus* the average scenario from the (8-13 years age) data of *Eucalyptus* gave productivity of 15.86 m³/ha/year while the best scenario (9 years of age) gave a figure of 31.01 m³/ha/year and the worst scenario gave a figure of 6.44 m³/ha/year for 13 years old plantation. In case of *D. sissoo* the average Volume (O.B.) production at 15 years was 11.17 m³/ha/year and at 25 years it was 15.35³/ha/year.

Rana, S.K.; Basandrai, A.K.; Sood, A.K. and Sharma, B.K. 2000. **Economical management of loose smut of wheat with propiconazole.** *Indian Journal of Agricultural Sciences*, 70(3): 163-164. Himachal Pradesh Krishi Vishwavidyalaya, Palampur 176062, India. [LOOSE SMUT; PROPICONAZOLE; WHEAT]

A study was conducted during 1994-95 and 1995-96 to work out a cheaper seed treatment for the control of loose smut of wheat with triazole fungicides, viz tebuconazole (Raxil), difenoconazole (Score and Dividend) and propiconazole (Tilt). Of these the wet treatment with Tilt by dipping the seed in 0.01% solution for 6 hr and dry seed treatment with Raxil (0.1%) were most effective. The former proved quite economic, costing just Rs 15.00/100 kg of seed as compared to Rs 188.00 with carboxin (Vitavax).

Rana, V.; Sharma, S.C. and Sethi, G.S. 1999. **Comparative estimates of genetic variation in wheat under normal and drought stress conditions.** *Journal of Hill Research*, 12(2): 92-94. Department of Plant Breeding and Genetics, HPKV, Palampur 176062, Himachal Pradesh. [GENETIC VARIATION; MOISTURE-STRESS; VARIANCE ANALYSIS]

Twenty five wheat (*Triticum aestivum* L.) were grown under drought and irrigated environments and eight morpho-physiological characters were recorded. The characters grain yield followed by grain weight/spike, tillers/m², 1000-grain weight grains/spike and harvest index showed high sensitivity to moisture stress. Range of mean values was higher under irrigated environment. Due to high magnitude of phenotypic coefficient of variation, heritability and genetic advance for the characters tillers/m², grain/spike and grain weight/spike in both the environments, whereas 1000-grain weight and harvest index in moisture stress environment were important traits for phenotypic selection.

Rao, K.V.P.; Singh, Ramesh; Singh, Th Raghurani and Kumar, Anil 1999. **Plant management in agroforestry.** *The Indian Forester*, 125(11): 1082-1088. ICAR Research Complex for N.E.H. Region, Manipur Centre, Imphal (Manipur). [AGRO-FORESTRY; MIXED CROPPING; ROOT PRUNING]

Agroforestry is the term given to sustainable land use systems which involve more or less intimate and interacting associations of agricultural/horticultural crops and woody perennials (tree, shrubs, palms, vines, bamboos) all on the same unit of land. This form of land use has two main objectives. Productivity,

involving a multiplicity of outputs, and sustainability which implies the conservation, or ever improvement of the environment of the environmental aspects of the system. Immediate programme of investigation and research are needed to improve existing agroforestry system. The current rapid rate of deforestation in Manipur state and other parts of the country is largely the outcome of continuing competition from agriculture. It is against this background that recent efforts to improve agroforestry techniques aimed at the integration of compatible components of forestry and agricultural system should be viewed. The aspects covered in the study are: (1) The manipulation of individual trees for vegetative and reproductive yield; (2) Effects of increasing plant population densities; (3) Effects of manipulating tree/herbaceous crop mixtures and management in agroforestry of trees grown for different purposes.

Samant, S.S.; Dhar, Upendra and Rawal, R.S. 2000. Assessment of fuel resource diversity and utilization patterns in Askot Wildlife Sanctuary in Kumaun Himalayan, India, for conservation and management. *Environmental Conservation*, 27(1): 5-13. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, U.P., India. [COMMUNITIES; CONSERVATION; DIVERSITY; PREFERENCE; PROBABILITY LEVEL]

A general decrease in abundance of wild plant species used as sources of fuel suggests that more detailed information is urgently needed on species-level trends and their conservation. Such studies have not been carried out so far in India and elsewhere; we therefore quantified the species-wise extraction of fuel from a site (Gori Ganga Valley) in Askot Wildlife Sanctuary in the Kumaun Himalaya. In all, 31 species (26 trees and 5 shrubs) were used as fuel, of which 14 were native to the Himalaya. Utilization patterns, distributions, probabilities of use (PU), resource use indices (RUI) preferences and availabilities in forest communities of these species were determined. Use pattern did not vary much amongst low altitude villages (Similarity: 52-74%), whereas along the vertical (elevational) gradient it varied considerably (Similarity: 15-31%). *Woodfordia fruticosa* (L.) Kurz, *Pinus roxburghii* Sarg., *Quercus leucotrichophora* A. Camus, *Macaranga pustulata* King ex Hk. f., *Quercus lanuginosa* Don, *Engelhardtia spicata* Bl. and *Mallotus philippensis* (Lamk.) Muell. contributed most to collections, while *Pyracantha crenulata* (Don) Roem., *Syzygium cuminii* (L.) Skeels, *Alnus nepalensis* Don and *Bauhinia vahlii* Wt. & Arn. were in lesser demand. *W. fruticosa*, *P. roxburghii*, *M. pustulata*, *Casearia elliptica* Willd. *E. spicata*, *M. philippensis*, *Q. leucotrichophora* and *Phoebe lanceolata* (Nees) Nees showed high values of PU and RUI, indicating high pressure. High density of *P. roxburghii*, *Rhododendron arboreum* Sm., *Q. lanuginosa*, *Q. leucotrichophora*, *Lyonia ovalifolia* (Wall.) Drude, *C. elliptica* and *M. pustulata* amongst trees and *Maesa indica* A.DC., *P. crenulata* and *W. fruticosa* amongst shrubs exhibited high density but the remaining species showed low density indicating their possible depletion. Intensive management of natural habitats of species highly-preferred for fuel, diversification of choice of species from natives to non-natives, large scale propagation of highly preferred taxa and plantation of seedlings in the degraded, uncultivated and marginal lands through people's participation should promote conservation and management of fuel resources.

Sarma, J.S.; Vishwanatham, M.K. and Sharma, A.R. 1999. Biomass production of trees and grasses in a silvopasture system on marginal lands of Doon Valley of north-west India 2. Performance of grass species. *Agroforestry Systems*, 46(2): 197-212. Central Soil and Water Conservation Research and Training Institute, Dehradun 248195, U.P., India. [BOULDERY LAND; CHRYSOPOGON FULVUS; CLUMP SURVIVAL; COMPETITION EFFECTS; EULALIOPSIS BINATA]

In a long-term study (1980 to 1993), the survival, growth performance and biomass production of two grass species viz. *Chrysopogon fulvus* (Spreng.) Chiov. and *Eulaliopsis binata* (Retz.) C.E. Hubb. were assessed when intercropped with four tree species viz. *Albizia lebbek* (L.) Benth., *Grewia optiva* Drumm., *Bauhinia purpurea* L. and *Leucaena leucocephala* (Lamk.) de Wit. on the bouldery reverbed lands of Doon Valley of north-west India. The survival of grass clumps was higher under the canopy of *B. purpurea* (48.3% in 1993 of the initial planting density of 20,000 clumps ha⁻¹ in 1980) and *G. optiva* (47.4%) than of *L. leucocephala* (31.1%) and *A. lebbek* (29.4%), and at 75% intensity of tree lopping (40.9%) than at 50% (37.1%). The effect of tree species on different growth parameters of grasses was not uniform, with *G. optiva* and *B. purpurea* causing comparatively more synergistic effect on clump height and clump diameter respectively. Although the performance of grasses was good under *A. lebbek* and *L. leucocephala* in the early

years (1980-1987), these tree species resulted in the lowest grass dry weight in the later years up to 1993. The beneficial effect of higher lopping intensity of 75% was observed on the growth and biomass production of grasses over 50% lopping, presumably due to increased light penetration into the under-storey. The biomass production of grasses reached a maximum at four years of growth in 1983, after which, it decreased gradually to less than half in 1993. *Eulaliopsis binata* showed higher survival, growth and biomass production than *C. fulvus* throughout the period of study. The total biomass production was highest in association with *B. purpurea* followed by *G. optiva*, which appeared to be the most suitable tree species along with *E. binata* for sustainable silvopasture development on the marginal lands of Doon Valley of north-west India.

Sastry, G. and Kumar, Pramod 1999. **Watershed responses to various conservation measures in Doon Valley.** *Journal of soil and Water Conservation*, 43(3&4): 135-140. Central Soil and Water Conservation Research and Training Institute, 218 Kaulagarh Road, Dehradun 248195, U.P. [DOON VALLEY; HYDROGRAPHS; SOIL LOSS; VEGETATIVE BARRIER]

Event based hydrographs collect from 100m x 20m monoclinical runoff plots on 8% slope indicate that bench terracing treatment with zero rainwater impounding produced the least runoff and soil loss. Although the runoff from graded bunding, vegetative barrier and combination treatments vary from 222.6 mm to 267.4 mm, soil loss was the lowest from vegetative barrier treatment. This is attributed to considerable reduction in overland flow velocities inducing deposition of soil behind the vegetative barriers. Analysis of watershed lag times indicate that the bench terracing has the maximum watershed lag time of 14.8 min. followed by vegetative barrier (9.1 min.), indicating that vegetative barriers are next best to bench terracing and superior to graded bunding and combination treatment which registered 3.1 and 6.5 minute respectively. The maize crop yields are observed to be at par under combination and vegetative barrier treatment (3316-3393 kg/ha), although graded bunding registered marginal increase in crop yields (3507 kg/ha).

Satapathy, K.K.; Bundela, D.S.; Goswami, S.N. and Pathak, K.A. 1999. **Conservation contour trenching in Mizoram - A case study.** *Journal of soil and Water Conservation*, 43(3&4): 151-156. ICAR Research Complex for NEH Region, Barapani 793103, Meghalaya, India. [CONSERVATION; CONTOUR TRENCHING; NATURAL RESOURCE; SHIFTING CULTIVATION]

Shifting cultivation widely prevalent in Mizoram is eroding natural resource base drastically. Recently, a new contour trench farming system has been initiated in Mizoram to transform shifting cultivation into settled cultivation based on scientific and economical management of land and water resources. The response of farmers has been quite positive towards new system for transforming the traditional practice. In this paper, some observations on hydrological response and economics of contour trenching works in the state have been dealt with.

Satapathy, K.K.; Jena, S.K. and Daschadhuri, D. 1999. **Dry and wet spell forecasting at Umiam (Meghalaya) for agricultural planning.** *Journal of soil and Water Conservation*, 43(3&4): 166-175. Division of Agriculture Engineering, ICAR Research Complex for NEH Region, UMIAM 793 103, Meghalaya, India. [AGRICULTURE MANAGEMENT; CROP PRODUCTION; MONSOON; RAINFALL PATTERN]

For agricultural management and planning, it is necessary to know the sequence of dry and wet periods along with forward and backward accumulation of rain water. The yield of crops particularly in rainfed condition depends upon the rainfall pattern. This paper presents the study of rainfall characteristics of monsoon, occurrence of dry and wet spell at Umiam (Meghalaya). Markov chain model has been applied through computer program to know the probability of having different conditions of dry and wet weeks and also forward and backward accumulation of rain water suitable for crop production. The study helps in deciding the time at which different crops should be grown in the area and their sequence.

Satyal, G.S.; Kumar, Kireet and Rawat, D.S. 1999. **Sustainable use of natural resources: Case study of a Tribal village in the Kumaun Himalaya.** *Geographical Review of India*, 61(2): 183-195. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora 263643, U.P. [ECONOMIC DEVELOPMENT; LAND USE PATTERN; LIVESTOCK; MEDICINAL PLANT; SOCIO-ECONOMIC

CONDITIONS]

Economic development of a rural area is largely governed by use of its land resources. Analysis of land resource has been done in the context of economic development keeping in mind the sustainability of fragile mountain ecosystem. Study of changes in land use pattern of a tribal village in the Higher Kumaun Himalayan region reveals that per capita agricultural land holding has decreased from 0.29 ha to 0.22 ha in the past thirty five years. With hardly any scope for expansion of arable land, sustainable utilization of resources for other traditional sectors of tribal economy like cultivation of medicinal plants and herbs in pasture land, use of barren land for increasing sheep population based on its biomass production capacity and strengthening the woollen industries are suggested as a viable option for sustainable economic development. Village income has successfully been used as a flexible tool to assess the impact of suggested measures.

Sharda, V.N.; Khybri, M.L.; Sharma, N.K.; Mohan, S.C. and Juyal, G.P. 1999. Green manuring for conservation and production in western Himalayas: 1. Effect on runoff, soil loss and fertility improvement. *Indian J. Soil Cons.*, 27(1): 26-30. Central Soil and Water Conservation Research and Training Institute, Dehradun 248195, U.P., India. [DOON VALLEY; GREEN MANURING; RUNOFF; SOIL FERTILITY; SOIL LOSS]

Sunnhemp (*Crotalaria juncea L*) has been found to be an excellent green manure crop, which has the inherent ability for improving the fertility status of the soil besides reduction in runoff and soil loss. Considerable reduction in runoff amounting to 18.6 per cent in green manuring (GM) - wheat system has been recorded as compared to the fallow - wheat system. The reduction in soil loss was even much higher (33.1%) which is mainly ascribed to the fast and vigorous growth of sunnhemp after the onset of monsoon, which provides a dense ground cover causing reduction in runoff and preventing detachment of soil. Apart from other beneficial effects, sun hemp provides a good source of nutrients to check the deterioration of soil health and provide ecological sustainability. A40 to 45 days old crop was effective in adding about 60 q ha⁻¹ of dry matter which was equivalent to 91.8 kg N, 10 kg P₂O₅ and 88 kg k₂O ha⁻¹. Thus, sun hemp practiced in conjunction with prominent cropping systems of the region helps not only in the conservation of natural resources of soil and water but also in supplementing the fertility status of the soil.

Sharda, V.N.; Sharma, N.K.; Mohan, S.C. and Khybri, M.L. 1999. Green manuring for conservation and production in western Himalayas: 2. Effect on moisture conservation, weed control and crop yields. *Indian J. Soil Cons.*, 27(1): 31-35. Central Soil and Water Conservation Research and Training Institute, Dehradun 248195, U.P., India. [CROP YIELDS; GREEN MANURING; MOISTURE CONSERVATION; WEED CONTROL]

The effects of sun hemp as a green crop on moisture, weed control and crop yield in prominent cropping systems of the region are discussed. Analysis of soil moisture data revealed that sun hemp was effective in conservation about 8 per cent more moisture in surface layer (0-15 cm) in green manuring (GM) - wheat system as compared to fallow-wheat and maize-wheat traditional systems. Soil moisture content was more pronounced in upper 60 cm profile as compared to the deeper soil layers, which attributed to improvement in soil physical environment. Increased moisture due to green manuring was notably instrumental in sustaining multiple cropping systems, viz., GM-rice-toria and GM-toria-wheat, where yield levels over 20-40 q ha⁻¹ year⁻¹ could be achieved under rainfed farming conditions. In monocropping systems also, green manuring resulted in 28 per cent higher grain yield when wheat was preceded by sun hemp as compared to fallow-wheat rotation. Average reduction in green weed biomass due to green manuring was to the extent of 28 per cent. Green manuring practice provided a better alternative to manual and chemical weed control which farmers are unable to afford due to their poor economic conditions.

Sharma, C.M.; Kohli, S. and Khanduri, V.P. 1999. Structural composition of mixed broadleaved-Coniferous forest along an altitudinal gradient in trikuta hills of Jammu province of the Western Himalaya. *Journal of Hill Research*, 12(2): 107-113. Department of Forestry, HNB Garhwal University, Srinagar Garhwal 246174, U.P., India. [A/F RATIO; COMMUNITY COEFFICIENT; TOTAL BASAL COVER; VEGETATION ANALYSIS]

The community structure in a series of representative mixed broadleaved - coniferous forests of

Trikuta hills in Jammu province of Western Himalaya was analysed in relation to their analytical and synthetic characters. The *Pinus roxburghii*, *Toona ciliata*, *Acacia modesta*, *Pinus roxburghii*, *Quercus leucotrichophora* and *Pinus wallichiana* were the dominant species in the tree layer at various altitudes (established as sites) from 1 to 6 respectively. Similarly *Carissa spinarum*, *Adhatoda vasica*, *Lantana camara*, *Buddleia paniculata*, *Daphne papyracea* and *Debregeasia salicifolia* were the dominant shrub species on sites 1 to 6 respectively. The values of species diversity (1.7986 on site - 1 to 3.2189 on site -3), concentration of dominance (0.01810 on site 3 to 0.3114 on site 6). Equitability (6.30 on site 3 to 17.86 on site 2) and beta diversity (1.11 on site 6 to 3.0 on site 4) were comparable with the values of these indices for the other similar types of forests of the world.

Sharma, Eklabya; Sharma, Rita; Singh, K.K. and Sharma, G. 2000. A boon for mountain populations - Large cardamom farming in the Sikkim Himalaya. *Mountain Research and Development*, 20(2): 108-111. G.B. Pant Institute of Himalayan Environment and Development, Sikkim Unit, P.O. Tadong, Sikkim 737102, India. [AGRO-FORESTRY; CARDAMOM; INCOME GENERATION; NITROGEN FIXING; SIKKIM HIMALAYA]

Farming and tourism are the primary livelihood options for mountain people in the Hindu Kush-Himalayan region. Tourism in Sikkim, a small Indian state in the eastern Himalaya, has become popular only since 1990; the main focus is on ecotourism. Only a small segment of the population is engaged in this sector, however. More than 80% of the population depends on agriculture. The developmental measures of the "green revolution" implemented in other Indian states were not successful in the Himalayan region because adequate fertilizers were never available on time, irrigation could not be developed, and soils are very fragile. Population growth and consequent fragmentation of farmland in Sikkim have caused a reduction in per capita holdings. This has forced farmers to cultivate cash crops such as potatoes (*Solanum tuberosum*), ginger (*Citrus reticulata*). The latter two have caused rapid nutrient depletion of the soil. Production of another cash crop, large cardamom (*Amomum subulatum*), a plant native to the Sikkim Himalaya, has been a boon to the mountain people of the area. Large cardamom is a perennial cash crop grown beneath the forest cover on marginal lands. Its cultivation is an example of how a local mountain niche can be exploited sustainably.

Sharma, Mithilesh; Sharma, Y.C.; Basu, Bhaskar; Chhabra, Jyotsna; Gupta, R.K. and Singh, Jagmer 2000. Uranium mineralization in the sandstones of Dharamsala, Tileli area, Mandi district, Himachal Pradesh, India. *Current Science*, 78(7): 897-899. Atomic Minerals Directorate for Exploration and Research, Department of Atomic Energy, New Delhi 110066, India; Department of Atomic Energy, 1-10-153-156, Begumpet, Hyderabad 500016, India. [MAIN BOUNDARY THRUST; RADIOACTIVE; SANDSTONES]

We report here the discovery of sandstone-hosted uranium mineralization in the basal part of Upper Dharamsala Formation in Mandi district, Himachal Pradesh. Stratigraphically, the Tertiary sedimentary rocks of Dharamsala Group (Upper Eocene to Lower Miocene; 1400 to 1900 m thick in Tileli area and locally up to 3950 m thick) are bounded by the Main Boundary Thrust (MBT) on the north-east and Palampur Thrust on the south-west, with several other crises-cross thrusts. The beds dip 30°-55° north-east. Uranium mineralization was noted at Tileli (eU₃O₈, 0.086%), and was explored by shielded probe logging of rocks exposed in five trenches. The trench face samples assayed 0.01-0.27% eU³O₈, and 0.011-0.076% U₃O₈ (beta/gamma) with negligible ThO₂. The radioactive zone is 540 m long and 5-10 m thick. Radioactivity is due to uraninite and uranophane disseminated in radioactive pockets which are enclosed in hydrated iron oxide, at places admixed with clay. In addition to Tileli, other significant uranium manifestations are Rohin Khad (50m x 10-15m); eU₃O₈, 0.069%), garlwar (70m x 5-8m; eU₃O₈, 0.063%), Chah Ka Dora (80m x 10-15m; eU₃O₈, 0.036%), Kalthar (50m 5-8m), Mangwana (5m x 2m; eU₃O₈, 0.88%) and Manjkhetar (eU₃O₈ values from grab samples). This study opens up a new environment in Dharamsala basin to locate possible new uranium prospects.

Sharma, R.P. and Kaistha, B.P. 1999. Role of different soil components in phosphorus fixation capacity of some mountain grassland soils of Himachal Pradesh. *Journal of Hill Research*, 12(1): 11-15. Department of Soil Science H.P. Krishi Vishvavidyalaya, Palampur 176062, Himachal Pradesh.

[CRYSTALLINE COMPLEX; FIXING CAPACITY; GRASSLAND SOILS]

The phosphorus fixation capacity of mountain grassland soils of Himachal Pradesh was found to be fairly high, the range being 11.09 to 25.20 m moles/100g soil in surface soil (0-0.15 m) and 12.10 to 28.73m moles/100g soil in subsurface soil (0.15-0.45m). The different inorganic soil components affected P fixation capacity in the order: Clay >amorphous Al>Crystalline Fe>amorphous Fe>extractable Al>crystalline Al>silt fraction.

Shirkot, C.K.; Jaiswal, S.; Shirkot, P. and Sharma, S. 1999. Characteristics of rhizobia isolated from *Acacia catechu* Willd. indigenous to the mid hills of Himachal Pradesh. *Journal of Hill Research*, 12(2): 130-134. Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan 173230, H.P., India. [ANTIBIOTIC RESISTANCE; FUNGICIDE; RHIZOBIAL ISOLATE]

The characteristics of rhizobia that forms symbiosis with roots of *Acacia catechu* Willd., was studied by collecting samples from forest nurseries located in the mid hills of Himachal Pradesh. The general characteristics of 92 rhizobial isolates were examined. The majority of the isolates exhibited a great deal of variation in their tolerance to antibiotics, agrochemicals and sodium chloride (NaCl). A great diversity was observed in their response to increasing temperature and changing pH. The colony morphology and acid/alkali production was found to vary amongst the isolates. Most of the isolates showed high resistance to chloramphenicol and ampicillin. Nalidixic acid and tetramethylthiuran disulfide (TMTD) were included among the most toxic groups. The isolates exhibited high tolerance to salt and 58.69% of total could grow at 4.5% NaCl and few could grow even at 5% level. The optimum temperature and pH for growth was found to be 40°C and 8.0 for majority of isolates. It is concluded that greater variation exists among *Rhizobium* species that nodulate *Acacia catechu* Willd., and a selection of strains for efficiency of the symbiotic association appears possible.

Shukla, N.K.; Khanduri, A.K. and Dangwal, M.N. 2000. Physical and mechanical properties of different clones of *Populus deltoides* - an assessment. *The Indian Forester*, 126(1): 31-56. Forest Products Division, Forest Research Institute, Dehradun. [CLONES; POPULUS DELTOIDES; STRUCTURAL USE]

The physical and mechanical properties based on testing of timber of 20 different clones of *Populus deltoides* obtained from trial plantation have been reported. From the basic data safe working stresses and suitability indices for different properties have also been evaluated and presented. The results indicate considerable variation in the properties of different clones. Clone S7-C3 has been found to have the highest sp. gravity and most of its strength properties are also higher as compared to other clones. Several clones meet the minimum requirement of strength not only for use as structural timber but also for door shutters, furniture items and packing cases/crates. It is suggested that more exhaustive testing of the material from other localities will help in drawing firm conclusions.

Singh, A.P. and Singh, K.P. 2000. Seasonal variation in species richness and diversity of insects on west Himalayan spruce, *Picea smithiana* as compared to silver fir, *Abies pindrow*. *The Indian Forester*, 126(2): 180-193. Conifer Research Centre, Shimla, Himachal Pradesh. [DIVERSITY; FEEDING GROUP; SEASONAL VARIATIONS; SILVER FIR]

Species Richness, Shannon Diversity and Pielou's Evenness indices of insects were studied seasonally in two natural forest stands (0.25 ha each) of West Himalayan Spruce, *Picea smithiana* and Silver Fir, *Abies pindrow*, at Narkanda (2,550 m) in Himachal Pradesh, for 4 successive years. A total of 40 species on insects (31 species on *P. smithiana* and 16 species on *A. pindrow*) were recorded on both the trees. Shannon Diversity and Pielou's Evenness indices both had greater values on *P. smithiana* as compared to *A. pindrow* for insects species in general. Shannon Diversity index peaked in May-June and then steadily declined to a minimum in October-November, on both the tree species. Amongst the 8 feeding groups found on *P. smithiana*, seasonal Shannon Diversity index and Species Richness of predators, defoliators, sap-suckers, sap-wood borers, rotten-wood borers, were synchronized and peaked in May-June. These two indices were also synchronized for cone-borers and parasitoids, but with peaks during October-November on Spruce. Similarly on *A. pindrow* only sap-suckers, defoliators and rotten wood borers were most prominent groups and these 2 indices for them were also synchronized in every season but peaked in August-September.

One 'rare' insect species, *Cucujus bicolor* was also found on *P. smithiana*, in these forests.

Singh, B.; Rethy, P.; Gangawar, H.S. and Gajural, P.R. 1999. **Seasonal variation in rooting behaviour of air layered branches in Rudraksh.** *Journal of Non-Timber Forest Products*, 6(3/4): 173-174. Department of Forestry, North-Eastern Regional Institute of Science and Technology, Nirjuli 791109, Arunachal Pradesh. [AIR LAYERED; ROOTING BEHAVIOUR]

Rooting behaviour of the air layered branches of *Elaeocarpus sphaericus* has been studied over period of 4 rainy months of 1998 in Arunachal Pradesh. Maximum rooting and survival percentage of rooted branches was found in branches air-layered in May. The period from May to June has been recommended as the best period suitable for air layering in Rudraksh in Arunachal Pradesh.

Singh, H.B.; Hynniewta, T.M. and Bora, P.J. 1999. **An ethnobotanical note on wild edible plants of Tripura, India.** *Ethnobotany*, 69(II): 26-28. Botanical Survey of India, Eastern Circle, Shillong-3, India. [EDIBLE PLANTS; ETHNOBOTANY; TRIPURA]

An account is given of 37 wild edible plants used by the Tripuri tribes of Tripura. The Tripuri tribes have a fair knowledge of plants and their utilization. Wild edible plants of the surrounding forest supplement their main diet. The present account supplements the existing information in terms of species identify and parts used in north-east India.

Singh, J.N. and Mudgal, V. 1999. **Studies on habitat condition of a few plant species of medicinal values of Nokrek Biosphere, Meghalaya.** *Journal of Non-Timber Forest Products*, 6(3/4): 192-198. Botanical Survey of India, P.O. Botanic Garden, Howrah 711103. [BIOSPHERE RESERVE; ELECTRICAL CONDUCTIVITY; MEDICINAL PLANT]

In the present investigation the vital components of various habitats of a few plant species of medicinal values, viz., soils and waters have been analysed in length. It is held from the results that basic fabrics of both components are quite delicate; as one, i.e., soils, is ecologically fragile in nature and other, i.e., waters, is quite bereft of dissolved charge carrying particles in per unit volume. In the end, the paper has been concluded with possible suggestions.

Singh, K.A. 1999. **Impact of various land uses on soil properties of sloping hills in Sikkim, eastern Himalaya.** *Indian J. Soil Cons.*, 27(1): 70-73. ICAR Research Complex for N.E.H. Region, Basar 791101, Arunachal Pradesh, India. [HILL SOILS; LAND-USE; SIKKIM HIMALAYA; SOIL PROPERTIES; VEGETATION ANALYSIS]

Some soil properties viz., organic carbon, pH, exchangeable CEC, available P,K, and Ca+Mg under four different land uses comprising of abandoned terraced crop land, terraced crop land, natural grassland and scrub forest land on a typical hillock in eastern Himalaya were investigated. Land uses and type of vegetation on hill slopes significantly influenced soil properties over a period of 12-15 years. Organic carbon was highest under scrub forest and abandoned terraced land. The abandoned terraced land had highest density of nitrogen fixing trees and herbs and also had the highest action exchange capacity after 12-15 years of abandonment. Available P and exchangeable Ca+Mg status in the soil of natural grassland were highest. Natural grass land had highest available P followed by terraced crop land. Soil pH did not differ considerably under the various land uses. Highest tree density and diversity were recorded from terraced crop land due to protection.

Singh, Lakhan and Sinha, B.P. 1999. **Constraints in watershed development in Doon Valley.** *Indian J. Soil Cons.*, 27(1): 74-77. Central Soil and Water Conservation Research and Training Institute, Dehradun 248195, U.P., India. [COMMUNITY PARTICIPATION; CONSTRAINTS; DOON VALLEY; PROJECT IMPLEMENTATION; VILLAGE DEVELOPMENT PLAN; WATERSHED DEVELOPMENT]

Integrated watershed management is now accepted strategy for area development in the country. It is necessary to identify the constraints faced by the project staff during planning, implementation and getting people's involvement. Hence, the study was conducted in Doon valley where integrated watershed management project was implemented. The major constraints identified were lack of trained staff, time

limitation, lack of cooperation from villagers at initial stage while formulating village development plan; shortage of staff and excessive work load, frequent interference by community representatives in project work, implementation of the project and lack of faith among villagers, quick planning and poor rapport, while eliciting people's participation. So, special attention has to be paid while implementing such projects to minimize these difficulties, and ensure better success.

Singh, N.B. and Chaudhary, V.K. 1999. Genetic variability and correlations studies of some growth characters in Chuli (*Prunus Armeniaca* Linn.). *Journal of Non-Timber Forest Products*, 6(3/4): 151-154. Forest Research Institute, Dehradun 248006. [BIOMASS; BASE DIAMETER; GENETIC VARIABILITY]

Information on genetic variability and genotypic correlations are of paramount importance in breeding programme of a crop. The genetic variability, heritability, genetic and correlations were studied for five growth characters, viz., plant height, base diameter, number of branches, leaf length and leaf breadth of 28 treatments (families raised from the seeds of 28 plus trees) in Chuli (*Prunus armeniaca* Linn.). The phenotypic and genotypic co-efficient of variation indicated that selection may be done for plant height, number of branches and diameter as these characters are of great value in genetic improvement of this species for the production of maximum biomass. The diameter, number of branches, leaf length and leaf breadth are positively and significantly associated with plant height.

Singh, Punam and Mehrotra, M.D. 1999. Seed-borne fungi of some forest trees and their control. *Indian Journal of Forestry*, 22(4): 320-324. Forest Research Institute, Dehradun 248006. [COPPER OXYCHLORIDE; MYCOFLORA; SEED-BORNE FUNGI; SEEDLING]

Study on seed mycoflora of *Prosopis chinensis*, *Michelia champaca*, *Bauhinia, purpurea*, *Acacia nilotica*, *A. catechu* and *Paulownia fortunei* was undertaken. In all sixteen fungi belonging to eight genera were recorded of which moulds were predominant. Maximum number of fungi, i.e., 8 appeared on seeds of *P. fortunei* and minimum i.e., 4 was recorded on *P. chinensis*. Aspergilli were present on seeds of all the tree species except *A. procera* whereas *Penicillium citrinum* was detected on *M. champaca*, *A. procera*, *P. fortunei* and *B. purpurea* and was absent on other tree species. Three species of *Phoma* were detected on *P. fortunei* only whereas *Trichothecium roseum* was present on seeds of only *A. procera*, *Fusarium avenaceum* was present on seeds of *A. procera*, *A. nilotica*, *A. catechu* and *B. purpurea* whereas it was absent in *M. champaca* and *P. fortunei*. Application of Emisan, Topsin and Bavistin @ 2g/kg and Dithane M-45, Copper Oxychloride and Thiram @ 4g/kg of seeds showed that Emisan was most effective in controlling seed mycoflora of all the tree species studied. However, in order of efficacy Emisan was followed by Thiram in *M. champaca*, *A. procera* and *A. nilotica*, Bavistin in *P. chinensis*, *P. fortunei* and *B. purpurea* and Dithane M-45 in case of *A. catechu*. However, Topsin and Copper oxychloride were least effective.

Singhal, R.M. and Singh, Dhan 1999. Integrated watershed management for sustainable development of Himalaya with special reference to mined lands. *Indian Journal of Forestry*, 22(4): 375-380. ICFRE, New Forest, Dehradun. [ECO-BASED TECHNOLOGIES; MINED LANDS; SOCIO-ECONOMIC; SUSTAINABLE DEVELOPMENT; WATERSHED MANAGEMENT]

From the various figures it is apparent that there exists a lot of water potential in the Garhwal Himalaya, for which some appropriate eco-based technologies (ebt) are required to be developed for their sustainable use. This is required to improve the socio-economic status of the people, who are in general dependent either upon agriculture or jobs. As a matter of fact industrialization of these hilly tracts excepting those based on agro and tourism, may not be economically viable due to their rigorous nature. The natural calamities like floods, which occurred in Tehri and earthquake tremors in Utrakashi and Chamoli could be well mitigated and managed to lesser degree of losses by proper management of their watersheds. Although directly these are not employed but it is very important to consider the watershed management programme in relation to forest vegetation and other land use practices in general and especially to agro-based of Himalayan tracts in particular because of the very fact that the forest vegetation plays an important role directly and indirectly in the watershed development.

Sood, Vibha Krishen 1999. Impact of Tourism on the Socio-Cultural setup of Ladakh. *Geographical*

Review of India, 61(2): 173-182. Department of Geography, Calcutta University, Calcutta 700019. [ECONOMIC GRAINS; LADAKHIS; SEX RATIO; SOCIO-CULTURAL]

Ladakh has become an important destination for the international tourists because it has preserved the unspoiled Buddhist culture, as it was a remote and a semi-closed area even for non-Ladakhi Indians till 1974. Economic gains as a result of tourism are posing substantial environmental and social threats to the Ladakhi society. Due to the abrupt opening of the region to foreign tourists this society has experienced a very rapid social change as it came into sudden contact with some of the most economically advanced societies of the world. Ladakhis believed in peaceful and harmonious co-existence with each other but with the advent of tourism this attitude of the locals has changed. On the other hand this has led to increased awareness regarding the importance of education, broad thinking, improved standard of living and preservation of culture amongst the locals.

Sultana, Aisha and Khan, J.A. 1999. **Avian community in the Kumaon Himalaya, India - a preliminary study.** *International Journal of Ecology and Environmental Sciences*, 25(2): 167-176. Conservation Ecology Research Group, Centre of Wildlife and Ornithology, Aligarh Muslim University, Aligarh 202002, U.P. [AVIAN COMMUNITY; KUMAON HIMALAYA; OAK FOREST; SPECIES RICHNESS COUNTING METHOD]

We surveyed avifauna in Kumaon Himalaya from April 1995 to July 1997 using the species richness counting and point count methods. We covered 19 sites and recorded 232 bird species out of which 87.5% bird species were sampled by the species richness counting method. The estimates of mean bird species diversity, species richness and density were found to be highest for oak patches in Almora district. The number of species recorded at each site and the estimates of species diversity and richness were positively correlated with patch size. The surveyed sites could be grouped into four broad clusters on the basis of similarity in species composition. The findings are discussed *viz-a-viz* conservation of birds in Kumaon Himalaya and creation of two more sanctuaries is recommended.

Thakur, I.K. and Kaushal, A.N. 1999. **Studies on the calorific value and specific gravity of some shrubs of Himachal Pradesh.** *Journal of Non-Timber Forest Products*, 6(3/4): 128-130. Department of Forest Products, COF, UHF, Nauni, Solan 173230, H.P. [CALORIFIC VALUE; DIAMETER; FUEL-WOOD]

Calorific values of wood of twelve shrubs are tabulated. Graphs are presented for calorific values of wood as related to species gravity at oven dry condition thereby exhibiting a direct relationship of calorific value with specific gravity. *Hippophae rhamnoides* was found to be the best among the tested species for calorific value.

Thakur, P.S.; Kashyap, Taruna and Thakur, Anju 1999. **Moisture stress conditioning influence on leaf area, stomatal sensitivity and osmolytes in *Grewia optiva* during water stress.** *Journal of Non-Timber Forest Products*, 6(3/4): 145-150. Department of Basic Sciences, College of Forestry, University of Horticulture and Forestry, Solan, H.P. [AMINO ACID; LEAF AREA; SEEDLING]

The influence of moisture stress conditioning (MSC) on drought adaptability in *Grewia optiva* was studied during this investigation. Moisture stress conditioning treatments were found to significantly alter the response of conditioned seedlings to subsequent periods of water deficit. Percentage of leaf area inhibition in moisture stress conditioned seedling was significantly less as compared to unconditioned seedlings up to 16 days of continuous water deficit. Stomatal pore length, breath as well as stomatal pore area declined with increasing stress up to 25 days of stress, however, the same in unconditioned seedlings upon subsequent water deficit was found fairly more than that in conditioned seedlings. Moisture stress conditioning treatment were found to significantly change the metabolic processes associated with the accumulation of osmolytes like soluble sugars and amino acids. Soluble sugar contents were found to be significantly more in conditioned seedlings both at 8 as well as 16 days of subsequent water stress as compared to unconditioned seedlings. Similarly, conditioned seedlings during subsequent water stress registered much higher percentage of amino acid than unconditioned seedlings. The significance of moisture stress conditioning on drought adaptability is discussed.

Tyagi, P.C.; Joshi, B.P.; Sharma, N.K. and Khullar, A.K. 1999. **Perennial pigeonpea as a vegetative barrier in maize-wheat cropping system in Doon Valley.** *Indian J. Soil Cons.*, 27(1): 41-44. Central Soil and Water Conservation Research and Training Institute, Dehradun 248195, U.P., India. [DOON VALLEY; GRAIN PRODUCTION; PERENNIAL PIGEONPEA; RUNOFF; SOIL LOSS; VEGETATIVE BARRIER]

An experiment was conducted in a randomized block design with five replications on two per cent sloping land. Pigeonpea (var. ICP88040) was raised in paired rows at 1.20x0.50 m spacing on lower part of plot under maize-wheat cropping sequence and maintained as hedge row by cutting the plants at different heights. There were four treatment *viz*; cutting of pigeonpea at maturity (April) at 75 cm height (T₁), 50 cm height (T₂), 50 cm height and incorporation of the non-woody plant material in the same plot prior to maize sowing (T₃), and sole crop of maize (T₄), followed by wheat in *rabi* season. Runoff and soil loss were monitored in one set of plots only. Treatment T₃ gave maximum maize equivalent production during all the years. Average yield for three years (1993-94 to 1995-96) revealed that treatments T₁ and T₂ yielded higher (5166 and 5139 kg ha⁻¹ respectively) as compared to 4527 kg ha⁻¹ in case of T₄. However, T₃ gave the maximum yield of 5652 kg ha⁻¹. Treatment T₃ gave minimum runoff (24%) and soil loss (5.3 t ha⁻¹) as compared to T₄, which produced maximum runoff (37%) and soil loss (12.3 t ha⁻¹). Grain yield of wheat was higher in T₄. However, total production of maize-wheat in maize equivalent was higher in T₃, T₂ & T₁ than T₄.

Upreti, D.K. and Chatterjee, S. 1999. **Epiphytic lichens on *Quercus* and *Pinus* trees in three forest stands in Pithoragarh district, Kumaun Himalayas - India.** *Tropical Ecology*, 40(1): 41-49. Lichenology Laboratory, Cryptogamic Botany, National Botanical Research Institute, Rana Pratap Marg, Lucknow 226001, India. [EPIPHYTIC LICHENS; PINUS ROXBURGHII; QUERCUS]

The paper deals with epiphytic lichen flora of *Quercus* and *Pinus* trees from three forest sites in Pithoragarh district of Kumaun Himalayas. *Quercus semecarpifolia* at altitude between 2700-3000 m has 24 species, while *Q. dilatata* at the same elevation has 15 species of lichen. Both the tree species have dominance of *Usnea* and *Ramalina* species. *Q. leucotrichophora* at lower elevation between 1600-1800 m has 14 species of the same. The only known species of *Pinus* in the area, *Pinus roxburghii* between an altitude of 1500-1600 m, has 21 epiphytic species. Both *Quercus* and *Pinus* at lower elevations exhibit dominance of *Parmelia*. A comparative account of lichen flora thriving on *Quercus*, *Pinus*, *Acer* and *Juglans* trees is also presented.

Verma, T.P.; Mahapatra, S.K.; Rao, R.V.S.; Lal, Tarsem; Sidhu, G.S. and Rana, K.P.C. 1999. **Change in soil characteristics in relation to physiography and land use in higher Himalayan region of Himachal Pradesh.** *Journal of soil and Water Conservation*, 43(3&4): 189-196. National Bureau of Soil Survey and Land Use Planning, Regional Centre, NTC Building, IARI Campus, New Delhi 110012. [GLACIO-FLUVIAL VALLEY; LAND-USE; REPOSE SLOPES; SOIL TAXONOMY]

The soils of different physiographic units of Spiti area in Himachal Pradesh have been studied for their morphological and physico-chemical characteristics and classified as per Soil Taxonomy (Anon, 1996). Summits and ridge tops are mostly covered with rock outcrops and glaciers, hence soils could not be developed in these areas. Four pedons (P1, P2, P3 and P4) were studied in side/repose slopes and two pedons (P5 & P6) in glaciofluvial valleys. P1 and P2 soils occur on steep slopes of barren mountains and are medium deep to deep, somewhat excessively drained to excessively drained, gravelly and are in the initial stage of soil development and classified as sandy-skeletal, calcareous Typic Cryorthents and loamy-skeletal, Typic Cryorthents respectively. P3 soils occur on cultivated terraces and are relatively well developed. They are deep, well drained, loam to clay loam and belong to Inceptisols and classified as fine loamy, calcareous Typic cryochrepts. P4 soils occur on pasture lands and are comparatively less developed without any diagnostic horizons and are classified as loamy-skeletal, calcareous Typic Cryorthents. P5 soils occur in upper glaciofluvial valleys and are also less developed being fragmental in nature and classified as loamy-skeletal, calcareous Typic Cryorthents. P6 soils occur on lower solifluction terraces and are relatively well developed having structural B horizons and are classified as fine loamy, calcareous Typic Cryochrepts.

Vishwanatham, M.K.; Sarma, J.S. and Sharma, A.R. 1999. **Biomass production of trees and grasses in**

a silvopasture system on marginal lands of Doon Valley of north-west India 1. Performance of tree species. *Agroforestry Systems*, 46(2): 181-196. Central Soil and Water Conservation Research and Training Institute, Dehradun 248195, U.P., India. [BOULDERY LAND; BRANCH WOOD; INTERCROPPED GRASSES; LEAF DRY WEIGHT; MULTIPURPOSE TREE; TREE LOPPING]

Bouldery riverbed lands occupy about one-third of the geographical area in Doon Valley of north-west India. These marginal lands need rehabilitation through establishment of silvopasture system for meeting the biomass requirements of resource-poor farmers. A study was carried out for 14 years (1980 to 1993) at Dehradun, involving four multi-purpose tree species viz. *Albizia lebbek* (L.) Benth., *Grewia optiva* Drumm., *Bauhinia purpurea* L. and *Leucaena leucocephala* (Lamk.) de Wit.; and two grass species viz. *Chrysopogon fulvus* (Spreng.) Chiov. and *Eulaliopsis binata* (Retz.) C.E. Hubb. Fifty and 75% of the tree crown was lopped once a year after four years of age. Tree survival decreased with age, and was highest with *L. leucocephala* (86.9% in 1993 of initial density of 625 trees ha⁻¹) and lowest with *B. purpurea* (49.3%). Canopy parameters of trees progressed differently, presumably due to their varying growth habits. The trees of *A. lebbek* were taller with more crown spread, whereas *G. optiva* had more crown height with lesser crown spread. Stem diameter growth of *A. lebbek* was highest followed by *B. purpurea*. Lopping intensity did not affect tree survival and also canopy growth in most years, but collar diameter and diameter at breast height (dbh) decreased significantly at the higher intensity of lopping. Intercropped grass species *E. binata* caused a greater adverse effect on the tree survival and growth parameters than *C. fulvus*. The biomass production (leaf and branch wood weight of lopped material) was highest at eight years of age in 1987 but showed no definite trend over the study period. *Bauhinia purpurea* produced the highest biomass and *L. leucocephala* the lowest, despite opposite trends in their survival. The performance of *A. lebbek* was on par with *B. purpurea* in the later years (1990-1993), but *G. optiva* was inferior despite its superiority in the early years (1984-1985). The effects of lopping intensity were not appreciable, but intercropping with *E. binata* decreased leaf and branch wood production significantly compared with *C. fulvus* throughout. However, the adverse effect was comparatively less pronounced on *B. purpurea* and *A. lebbek* than on *G. optiva* and *L. leucocephala*. The fibre yield of *G. optiva* also decreased due to intercropped *E. binata* compared with *C. fulvus*.

Role of Science and Technology in the Integrated Development of Uttarakhand

A three days workshop on "Role of science and technology in the integrated development of Uttarakhand" organized by Ministry of Science and Technology, Government of India and was held on 21-23 April 2000 at G.B. Pant Institute of Himalayan Environment and Development, Almora. The Honorable Union Minister and Minister of State for Science & Technology, Secretary of Department of Science & Technology, Department of Bio-technology has presided over the workshop, which was presented by a large number of delegates. The workshop focused on the specific problems of Uttarakhand, policies, strategy and approach for development of hill areas, priorities and desired actions for the region. The major priority issues and action to be implemented are discussed in details are:

Georesources: water management, land management, energy and management of natural hazards and disasters;

Bioresources: forest, agriculture, crop and animal husbandry, horticulture, biodiversity conservation and management;

Infrastructure: communication and connectivity, transport and communication, tourism, industry;

Socio-economic issues: education, health and sanitation, indigenous knowledge *etc.*

N.E. User Interface on Environmental Information Systems

A two days meet on Environmental Information Systems (ENVIS) and its user interface was organised by Ministry of Environment and Forests, Government of India and hosted by Sikkim Unit of G.B. Pant Institute of Himalayan Environment and Development on 17-18 June 2000 at Gangtok. Shri Pawan Chamling, Honorable Chief Minister of Sikkim was the Chief Guest and Dr. A.K. Kundra, Special Secretary, Ministry of Environment & Forests, Government of India has presided the meet. Shri T.R. Sharma, PCCF-cum-Secretary, Department of Forest, Environment & Wildlife, Government of Sikkim, Shri Harjit Singh, Senior Advisor, and Dr. D. Bandyopadhyay, Director of Ministry of Environment and Forests, Government of India also addressed the gathering. The meet was attended by about 100 participants from entire north-east namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, North Bengal, Sikkim, and Tripura representing Universities, R&D Institutions, NGOs, district information officers.

In the presidential address Dr. Kundra expressed his satisfaction on the functioning of the ENVIS programme. The Chief Guest, Shri Chamling expressed his satisfaction on the work of GBPIHED and highlighted the immense progress made by the State in the area of eco-tourism. He requested the Ministry of Environment & Forests to consider giving an ENVIS Centre on 'Eco-tourism' to Sikkim.

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 263643, India

Hedgerow farming to check soil erosion

Scientist at GBPIHED feels hedgerows farming is the best way to control soil erosion in the hilly north-eastern region. Speaking at training programme on 'Appropriate technology for a soil conservation farming system' at Doimukh near Itanagar the scientist admits that the Institute has been trying to popularise the Sloping Agriculture Land Technology (SALT), a package technology on soil conservation and food production. Crops could be grown in between contoured rows of nitrogen fixing trees, which would be planted in double rows to make hedgerows. These hedgerows would help in maintaining and improving soil fertility, minimising soil erosion and providing food and income for the farmers. The system would also help in water conservation in rain-fed areas.

THE BUSINESS LINE: March 1, 2000

Eco-vigilantes raise alarm as HP lifts ban on tree-felling

The Himachal government's recent decision of to allow tree felling in the state for lining its cash-starved coffers has upset environmentalists and politicians. Over one lakh cubic metres of timber is given to the villagers every year and over 50,000 trees are felled annually at throwaway prices. The state government had also set a price for protecting the trees and approached the Centre seeking compensation for preserving the green cover in the Himalaya. But the non-acceptance of this logic, the fate of the trees in Himachal now hangs in the balance.

THE TIMES OF INDIA: March 2, 2000

Desilting kills 80 pc of trout

For the past several years the production of trout in Himachal rivers has been reduced to one-fourth of its natural capacity. This was reported from Brot, having main tourist attraction of PSEB reservoir and trout fish farm in Mandi district. The PSEB repairs and desilts the two reservoirs annually and 70-80% of the marine life is destroyed due to desilting. According to local residents every year when the reservoirs are drained out for desilting, trout die in tones and the PSEB officials supply them to their superiors, even they do fishing in the reservoirs also. The most serious aspect of the problem is that one of the rare species of trout is on the verge of extinction. The attitude of the PSEB staff and ignorance of Fisheries Department have caused a huge loss to the state's endangered marine life as a whole and trout in particular.

Mahesh Chander Sharma for THE TRIBUNE: March 4, 2000

Kashmir lakes shrink due to encroachment

Though the state government to save the Dal lake in Srinagar has spent crores of rupees, the picturesque lake has shrunk due to illegal encroachment. The same is the situation of other three important lakes Wullar, Anchaar, and Nigeen in Kashmir. To conserve the dying lake the Union Ministry of Environment and Forests has banned all types of industrial activity within 7km of the lake, but the state government has not taken this seriously. Even the minister could not spell out how the Rs. 308 crore package meant for Dal lake had been spent.

THE STATESMAN: March 4, 2000

Oustees to resist Mahakali dam

Even before the launch of the proposed Mahakali dam at Pancheshwar in Uttarakhand, a clash of interests is brewing between the project's opponents and protagonists. The Mahakali project is understood to be aiming at the highest-ever dam in Asia and destined to submerge dozens of hamlets in the river valley stretching across the border between India and Nepal. The height of the dam could be 315 meters, which is 50 meters higher than the Tehri dam, now under construction in the teeth of opposition. The campaign against the proposed dam and its large reservoir is currently being spearheaded by a group of voluntary workers,

backed by Sarvodaya activists based in the hills of Uttar Pradesh, have been drumming up steady support for their anti-big dam campaign.

THE STATESMAN: March 6, 2000

National parks are no blessing for hill people

The state government is liberal in declaring parks and sanctuaries since they get a lot of money from the global agencies, but parks take away the traditional rights of the people to forest resources. People in remote villages inside the 472 km² Gobind Pashu Vihar in Uttarakhand, a sanctuary for the Himalayan snow leopard and the rare musk deer, are now in arms against such sanctuaries. The life at Sakhri, in the bed of chirpine and oak forests at an altitude of 6,000 ft is a sleepy village of about 1,000 people has not been the same ever since the Pashu Vihar was set up, as the park authorities are threatening to oust them from here and not allowing to graze goats inside the park. Out of total 56 lakh populations, 11 parks and sanctuaries in the region affect nearly 15 lakh.

THE TIMES OF INDIA: March 6, 2000

Eco-tourism is the only sustainable industry in Sikkim

Asserting government disfavoured 'reckless tourism' which could destroy Sikkim's cultural identity, the tourism minister emphasized on eco-tourism keeping in view the State's culture and character. According to him, Sikkim was one among the very few states, which had put into practice a tourism action plan for the next 15 years for the systematic and organized growth of the sector. The government is keen to involve the private sector for promoting eco-tourism in a major way, realizing that tourism is the only sustainable industry in the State.

THE SENTINEL: March 15, 2000

Building ban in hills

A government appointed committee has recommended immediate expansion of Darjeeling town and a ban on building constructions in Darjeeling, Kalimpong and Kurseong as a precaution against recurring landslides in the hills. The committee has prescribed mapping of landslide-prone areas across the hills and their categorization into high, moderate, low-risk and safe zones for construction; development of drainage system; road repair and control on traffic movement; relocating residents in high risk areas; development of alternative roads including by-pass at Darjeeling. In a report prepared over the past two years, the panel recommends a comprehensive development plan for Darjeeling hills and cautions the government that disaster will strike again if construction activities are not restricted.

THE TELEGRAPH: March 18, 2000

J&K may wrap up Dal conservation project

Dal, a post-glacial lake is one of the major tourist attraction in Kashmir is fast dying. Over two lakh dwellers on its vast catchment have been dumping their sewage and other solid wastes directly into the lake even as over 80,000 tonnes of silt comes from its denuded peaks in the catchment. After throwing millions into the lake, Jammu & Kashmir government is reviewing its Rs. 500 crore conservation plan. Possibilities are being explored if the lake could be protected without shifting over 60,000 people living in 58 hamlets and around 1,400 houseboats.

THE ECONOMIC TIMES: March 20, 2000

Rubber farming: for rehabilitation of Tripura tribals

Hundreds of tribals, who were habituated in shifting cultivation and slash and burn method and denuded the forest area, now have been rehabilitated in rubber cultivation scheme. The initiative of the Rubber Board and the World Bank for the rehabilitation of the tribals began in 1992 in West Tripura district with a target of 1,500 hectares of land under rubber cultivation, now the state has emerged as second largest rubber growing state in India. Despite resistant by locals and charges of environmental hazard by rubber cultivation, the World Bank has rated the tribal development plan in the state as one of the best projects for the world's indigenous people.

THE BUSINESS AND POLITICAL OBSERVER: March 20, 2000

Rainwater harvesting in U.P. hills likely

Over 5,000 villages in the rural areas of the Uttar Pradesh hill districts comprising a population of about 50 lakh have been facing water scarcity as the natural water resources are drying very fast. Even multi-crore watershed management project programmes launched in the early eighties with the help of the World Bank and schemes for the regeneration of natural water resources had not made any difference to the water scenario. In this context an ambitious scheme is afoot for rainwater harvesting in the 11 hill districts of western UP and a high-powered committee of the Central Ground Water Harvesting Authority had been asked to prepare a blueprint of the scheme.

THE TIMES OF INDIA: March 21, 2000

Highrises, deforestation pose threat to Sikkim ecology

Mushrooming of multi-storey building and rampant deforestation in parts of Sikkim are posing a threat to its environment. Erosion of embankments on Teesta and Rangeet rivers in the state is alarming while the Mangan market in North Sikkim district faced the threat of being washed away into the Teesta. According to the official of the urban development department, many eight-storey building had come up over the past five years in Gangtok and Tadong towns though these areas were earthquake-prone.

THE STATESMAN: March 22, 2000

More than 500 khair trees felled

In another forest scandal more than 500 khair trees have been axed unauthorisedly in Bhadsali shamlat forest in Una division of Himachal Pradesh, although revenue as well as forest departments took no notice of it. Instead of taking action they invariably tried to cover up the lapses and shielded the guilty field staff. More often than not they even refused to show the record. The flying squad wing, which was set up with the objective of checking forest offences, has become an object of ridicule.

THE TRIBUNE: March 24, 2000

Himachal to have watershed projects

The National Bank for Agriculture and Rural Development (NABARD) will launch a watershed development programme in the Himachal districts with low irrigation development and preponderance of SC & ST population. The programme envisages to spread the message of participatory watershed development involving government agencies, NGOs, agricultural research institutions, banks, and village watershed development committees. The village communities through village watershed committees, which will be assisted by NGOs, would implement the project.

THE TRIBUNE: March 31, 2000

Garhwal sal forests fall prey to climate change

Well over a lakh trees in the dense sal (*shorea robusta*) forest belt in Garhwal foothills are sick and dying as a result of climate change. The change in environment leading to high humidity in sal forests has brought heavy infestation of a metallic dark-brown beetle known as sal heartwood borer (*hoplocerambyx spinicornis*). This heartwood borer may be one of the causes of imminent death of sal, although the forest department has made the sal as monoculture, without the support of other broadleaf trees that used to grow with it.

THE HINDUSTAN TIMES: April 1, 2000

Not a drop to drink in drenched Cherrapunjee

Cherrapunjee records the world's highest rainfall suffers from acute drinking water scarcity. About 50,000 people of Cherrapunjee block in the East Khasi hills of Meghalaya with no choice but to store rainwater as there is no major water supply plant. Though the Public Health Engineering Department is there, none in Cherrapunjee can boast of the department's efficiency in providing safe drinking water to the people of this remote block.

THE STATESMAN: April 3, 2000

Vanaspati project launched in Himachal Pradesh

The Union Ministry of Health and Ayurveda has recently launched an ambitious *Vanaspati Van* project for development and conservation of medicinal plants in the alpine region of Himachal Pradesh with an outlay of Rs. 8.27 crore. The Ayurveda Minister said that out of 3,000 flowering plant species, more than 500 species were found to be having medicinal properties. More than 40 species of medicinal plants in Himachal Pradesh had been declared endangered. The Himachal Government had constituted a society for cultivation of medicinal plants, organize training programme to generate awareness of the utility of medicinal herbs.

THE HINDUSTAN TIMES: April 4, 2000

AIDS takes epidemic form in Manipur

HIV/AIDS has taken an epidemic form in bordering Indo-Myanmar with the killer disease fast spreading to all the districts of Manipur. Although the this small state in the north-eastern region occupies third rank after Maharashtra and Tamil Nadu in the country in respect of full blown AIDS cases, but the occurrence rate of in the state is much higher than the others. According to a finding of Manipur State AIDS Control Society there are 38,789 HIV infected patients while the State recorded 9,732 patients till February. Unlike others, in Manipur the disease is being transmitted more through sharing of needles and syringes by the injectable drug users (IDUs). The sero-prevalence rate in the State among IDU had gone up from nil to 50% in just one year.

THE ASSAM TRIBUNE: April 11, 2000

Tourist inflow: Bane for Sikkim's lake paradise

At 12,310 ft above sea level, the Tsomgo, a picturesque lake in Sikkim is increasingly being threatened by pollution caused by a growing number of tourists. The placid lake, located 35km east of state capital Gangtok remains frozen during the winter months until mid-May. Though an environmental organization has undertaken a clean-up of the lake during off-season, but tourism has had a telling effect on its fragile ecosystem, spawning a haphazard Shanty Bazaar around it.

THE OBSERVER OF BUSINESS & POLITICS: April 15, 2000

Mining laws being flouted in Himachal

Mining laws are allegedly being flouted in Himachal Pradesh, apparently with the connivance of the authorities and without prior permission of the forest department. Most of these mines are situated in the tribal areas of Bharmour in Chamba district and Kahaniyara in Kangra district, where unscientific indiscriminate quarrying causes lot of devastation. No joint inspection of the mining areas was conducted with the forest department before giving these lucrative mines to the influential people. Besides, the district authorities, ignoring the pleadings of the forest department, the government was also not allegedly adopting strict measures to recover arrears of royalty amounting to over Rs.3.82 crore from the mining lessees in the state.

THE PIONEER: April 16, 2000

J&K licenses killing of endangered species

Though hunting of endangered species is banned in most parts of the country, the Wildlife Act of Jammu & Kashmir 'licenses' killing of five types of scheduled listed animals, killing of which is totally banned by central and international wildlife acts. The state Wildlife Act, 1978 provides rules for issuing various kind of hunting licenses to Indian and foreigners by the Wildlife Warden and even trophies are given to the best shooters under the 'Royal game'. This includes hunting of Tibetan antelope, ibex, Tibetan wolf and gazelle of Ladakh in-lieu-of prescribed license fees. The amount thus collected goes to the state exchequer as royalty for indulging in the killing of these animals and birds under royal sports. Under growing pressure from various groups, the state government set up a sub-committee in December 1996, but neither any recommendations nor any amendments has yet made to the Act for protecting the endangered species.

THE TRIBUNE: April 17, 2000

After bounty snowfall, it is forest fires

An unusually hot summer has triggered off forest fires in the first half of April this year in the mid-hill areas of Himachal Pradesh, which witnessed 19 sessions of snowfall in January. Although forest fires are not unusual during summer, the abnormal weather condition prevailing in the region for the past few months have made things worse. The pine forests, which are prone to fires, have been the worst-hit. The failure of the forest department to take necessary preventive measures has aggravated the problem.

THE PIONEER: April 20, 2000

Scorching heat burns valley apple orchards

Delicious and Maharaja – the best varieties of apples grown in the Kashmir valley are in danger due to abnormal temperature. According to meteorological department the excess heat shortens the period of ripe resulting smaller size and dull in colour. Rafiabad, Baramulla and Sopore fall in the highland region, which supplies 60% of total apples cultivated here are going to suffer most due to heat.

THE INDIAN EXPRESS: April 24, 2000

Kashmiris becoming eco conscious

A severe dry spell last summer has taught the people of Kashmir the value of protecting the environment, with many taking to planting trees and informing the authorities of illegal logging to prevent catastrophes in the future. The reduce flow of water in the mountain streams and the river Jhelum, the lifeline of Kashmir Valley last year, caused widespread concern among the people. Kashmiris have become more conscious of the need to preserve forests, keen to plant trees lining their field and vacant plots in their villages. There was also a considerable amount of public cooperation on the government effort to dredge Dal lake, a landmark in Srinagar, as the surface area of the lake increased from 11 to 14 km².

THE PIONEER: May 3, 2000

Hydel projects threat to Chamba's ecology

Environmentalists of Chamba district of Himachal Pradesh have expressed grave concern over the threat to ecology caused by the hydropower projects, as the river Ravi is becoming a dumping site for debris and silt of these projects. The 'environmental meet' held at Chamba opposed the setting up a cement plant in the district would play havoc with the greenery of the region. The meeting observed that these projects were causing landslips, soil erosion and degradation of environment enormously as the geological formation of the Chamba zone was quite fragile.

THE TRIBUNE: May 5, 2000

Ecological crisis in Himachal

The snow clad and ravishingly beautiful Himachal Pradesh, once known for its flourishing apple orchards, is now afflicted with a serious water crisis and is also facing a threat of its forest wealth. The decision of Himachal Pradesh Government to lift the 16 year old ban on felling trees for commercial purposes will only aggravate the situation. Well known environmentalist and leader of the eco-consciousness movement 'Chipko', Sunderlal Bahuguna, has appealed to the people to relaunch the Chipko agitation against the anti-forest policy of the State.

THE DECCAN HERALD: May 9, 2000

HC bans Shahtoosh trade in J&K

In a landmark victory for wildlife conservation, the Jammu & Kashmir High Court has issued a judgment prohibiting trade in Shahtoosh in the state, followed by the public interest petition filed by the Wildlife Protection Society of India on May 1998. The fact that the trade was still permitted in the state has been the single largest hurdle in the endangered Tibetan Antelope (Chiru). These antelopes are slaughtered in thousands on the Tibetan Plateau in China for the collection of precious wool, which is then smuggled to

Srinagar, the only place in the world where it is woven.

THE STATESMAN: May 10, 2000

Poaching rampant in Rajaji National Park

Neither forest officers nor experts are able to explain why elephant herds are leaving the Rajaji National Park and moving close to villages and towns as the reports of extensive destruction have come from adjoining areas of Garhwal foothills and farmers have demanded compensation for their destroyed crops from the local forest department. A recent census shows that the elephant population in the park has dwindled from 800 to 350. Massive illegal felling of trees and hunting of animals in the park by politically-backed forest mafia are the main reason behind it, according to villagers.

THE HINDUSTAN TIMES: May 12, 2000

Institutional reforms needed for replacing *jhum* cultivation: Study

Practices of *jhum* or shifting cultivation among the hill tribes in the north-eastern region is 9000 years old and is still an integral part of the culture, as more than 80% of the tribal population are associated with it. The permanent cultivation in the form of either wet rice or horticulture in the terraces or plains of the foothills of north-eastern states is gaining popularity, as wet rice cultivation has become the most favourable alternative source of subsistence among marginal farmers of the hill tribes. Social scientists have cautioned that this technology transformation designed to bring about a complete switch over from *jhum* may alienate a vast majority of the hill tribes from their land, if the changes are not accompanied by suitable institutional reforms.

THE ASSAM TRIBUNE: May 13, 2000

Wullar, then and now

Wullar lake, once quite magnificent and largest freshwater expanse in Asia, is now dying as pollution and encroachment are fast accounting for its beauty. The lake has also social and economic significance as it provides water for drinking, irrigation, besides providing a habitat and breeding ground for a variety of birds, fish and other aquatic life. If the forest and dryland degradation in the lake catchment area continues without any proper check, it is feared that the economic, social and environmental costs will be very severe.

THE STATESMAN: May 21, 2000

Close 23 HP limestone mines: CMRI

The Central Mining Research Institute (CMRI) has recommended closure of 23 limestone mines employing about 5700 persons in the Sataun and Kamroo areas of Sirmour district of Himachal Pradesh. The CMRI report has pointed out that mining operations were haphazard and not conforming to the stipulated guidelines thereby resulting in environmental degradation. However, 3 mines owned by political leaders, have been found in the 'suitable' zone are among 26 mines located in the area.

THE TRIBUNE: May 21, 2000

UP denotifies land near Corbett

Environmentalists, wildlife-lovers are aghast at the denotification of 62 hectare of prime forest sharing boundary with the Corbett Tiger Reserve in Uttar Pradesh. The land falls between Corbett and Sonanadi Sanctuary near Kotdwar and is considered as one of the last remaining migratory routes for elephants in the state's greatly disturbed 'Terai' belt. Even the National Park authorities were not taken into consideration in denotification order, also, none in the Environment Ministry could explain the reason for not involving either the Corbett authorities or the Advisory Committee members in such crucial move.

Ajay Suri for THE INDIAN EXPRESS: May 22, 2000

Successful propagation of medicinal trees in J&K

The Jammu & Kashmir Forest Research Institute (JKFRI) has successfully conducted experiments for the propagation of rare medicinal trees like Bhahmirukh, Rasount, and Harar, which are used for

manufacturing important medicines including anti-cancer drugs. To give a boost to the programme, the Institute has undertaken a scheme to set up quality plant production unit at Tangmarg, where 7000 such medium-sized trees have been found natural vegetation. Vegetative propagation by raising cuttings of these trees has been necessitated as natural re-vegetation of these medicinal and other trees has been a serious problem, admits the Director of JKFR. According to him, experiments with different treatment of root promoting hormones are also being conducted to achieve 100% success.

THE TRIBUNE: May 23, 2000

20% of geographical area classified as wasteland

According to 'Wastelands Atlas of India', about 20% of the country's total geographical area falls under various categories of wasteland. The hilly states have a relatively large proportion of degraded lands mainly due to snow cover and degraded forests. The Jammu & Kashmir, Himachal Pradesh, Manipur, Nagaland, and Sikkim recorded more than 50% of area as wastelands.

THE BUSINESS STANDARD: May 24, 2000

Recovery of panther skins in Nainital raises eyebrows

The Kumaon region of Uttar Pradesh bordering China and Nepal through its Champawat and Pithoragarh districts is now proved to be a wild life parts smuggling prone area. Within a fortnight, recovery of more than 70 panther's skins in Nainital district has led to a demand for a Central Bureau of Investigation (CBI) inquiry by a tiger protection committee of the state. According to police sources, the incidents of seizure of wild life skin parts are registered and an inquiry is on, however, no arrest has been made so far.

THE TIMES OF INDIA: May 24, 2000

U.P. hill areas thirsty despite host of rivers

About 60% of more than 15 thousand villages in the 12 districts of the Uttar Pradesh hill region, now proposed to be carved out as a separate Uttaranchal state, do not have portable water. Deforestation has led to drying up of hundreds of streams, which flowed amidst the greenery and large spread of roots all over the mountainside to provide moisture as well as to hold top soil in place. Besides, climatic changes are also causing some glaciers to melt in the region. Receding glacier of Gomukh and Yamunotri, the sources of two mighty rivers Ganga and Yamuna respectively in Uttarkashi district has come up with evidences. Despite the officials candidly admit the magnitude of the problem, but the U.P. hill development department does not have any information about the phenomenon.

THE TIMES OF INDIA: May 25, 2000

Fluoride poisoning in Karbi Anglong, hundreds crippled

An intense tragedy is being unfold in and around Karbi Anglong district where slow poisoning by drinking ground water in the remote part of the state is alarming. Hundreds of villagers have been affected, many of them crippled for life, because of drinking of poisonous water containing fluoride in some parts of Karbi Anglong district of Assam. Tekelanguin is the worst affected area where every fourth person has been affected by hydro-fluorosis distressing a population of nearly one lakh. The District Council authorities, alarmed over the development, has extended a water supply scheme to Tekelanguin area for supply of fluoride free water, besides massive awareness campaign.

THE ASSAM TRIBUNE: June 2, 2000

आर्थिक संकट में नंदादेवी जैवमंडल क्षेत्र के लोग

नंदादेवी जैवमंडल को आरक्षित क्षेत्र (बायोस्फियर रिजर्व) घोषित करने से इस क्षेत्र के पर्यटन और भेड़ बकरी पालन व्यवसाय पर बुरा असर पड़ रहा है। पूरे विश्व में इस समय ३२४ जैवमंडल क्षेत्र हैं। इनमें से उत्तरी भारत के मध्य हिमालयी क्षेत्र उत्तराखण्ड के चमोली, पिथौरागढ़ और बागेश्वर जनपदों के २२२६.७४ वर्ग किलोमीटर क्षेत्र में यह आरक्षित क्षेत्र १८ जनवरी १९८८ को घोषित किया गया। इसके बाद स्थानीय निवासियों के केन्द्रीय जैवमंडल भंडार (कोर जोन) से सारे अधिकार प्राकृतिक संसाधनों के उपर से

करीब-करीब समाप्त कर दिए गए, इससे ग्रामीणों का इस क्षेत्र की प्राकृतिक संपदा के संरक्षण के प्रति मोह भंग हो गया है। जैव विविधता संरक्षण के लिए गोविंद बल्लभ पंत हिमालय पर्यावरण एवं विकास संस्थान का सतत विकास विभाग आरक्षित क्षेत्र में औषधीय पादपों की परम्परागत कृषि तकनीक के बारे में डा. आर. के. मैखुरी, डा. सुनील नौटियाल और डा. के. एस. राव ने संयुक्त रूप से एक रपट तैयार की है। रिपोर्ट में कहा गया है कि आरक्षित क्षेत्र के लोगों में जैव संरक्षण के प्रति नकारात्मक दृष्टिकोण पैदा हो गया है। इससे लोगों को आर्थिक संकट का सामना करना पड़ रहा है। नंदादेवी जैव मंडल आरक्षित क्षेत्र के पादपों का कोई पेटेंट न हो इसके लिए भारत सरकार को पहल करनी होगी। यदि इस क्षेत्र में उगने वाले दुर्लभ औषधीय पादपों का व्यावसायिक दृष्टिकोण से उत्पादन होने लगे तो लोगों को न सिर्फ स्वरोजगार मिलेगा, बल्कि संवेदनशील भारतीय सीमा मानव सुरक्षा से युक्त होगी।

अमर उजाला: जून २, २०००

छोटे पेयजल स्रोतों से योजना बनाना खतरनाक

छोटे पेयजल स्रोतों का दोहन करने की प्रवृत्ति गलत है क्योंकि इन स्रोतों से आपूर्ति तो पूरी नहीं हो पाती है पर जमीन की नमी व हरियाली पर दूरगामी विपरीत प्रभाव पड़ता है। ये बातें विश्व पर्यावरण दिवस पर पर्यावरणीय सुरक्षा एवं जल स्रोतों का संरक्षण विषय पर आयोजित गोष्ठी में कही गईं। पहाड़ों में भी मैदानों की तरह जमीन के नीचे पानी का स्तर गिरता जा रहा है इसीलिए उत्तराखंड में भी हिमांचल की तर्ज पर पानी की हार्वेस्टिंग शुरू की जाए ताकि वर्षा का अधिकतम पानी जमीन के अंदर जाए इससे पानी का जलस्तर उपर आएगा और नमी व हरियाली बरकरार रहेगी। सरकार से मांग की गयी कि हिमालयी क्षेत्र में व्यापक सर्वेक्षण कर इस बात का पता लगाया जाए कि भूमिगत पानी की तुलनात्मक स्थिती क्या है, वनों की पानी सोखने की क्षमता का अध्ययन किया जाए और तभी अगले ५० वर्षों में पानी की जरूरत देखते हुए जल ग्रहण क्षेत्रों के व्यापक विकास की योजनाएं बनाई जाएं।

अमर उजाला: जून ६, २०००

उत्तराखंड में जड़ी-बूटी से संबंधित योजना बनेगी

प्रदेश के वन सचिव ने कहा है कि उत्तराखंड में लुप्त होती जड़ी-बूटियों के संरक्षण और विकास के साथ ही कृषकों की माली हालत सुधारने के लिए उत्पादक संस्थाओं की राय से वन विभाग एक महत्वाकांक्षी योजना बनाने की तैयारी कर रहा है। उन्होंने कहा कि एक ओर उत्तराखंड के संपन्न वनों से कीमती औषधियों का दोहन हो रहा है, दूसरी ओर स्थानीय लोगों को इसके व्यवसाय में अपेक्षित भागीदारी नहीं मिल रही है। शासन उत्तराखंड में जड़ी-बूटी विकास व संरक्षण के लिए प्रयासरत हैं बहुराष्ट्रीय कंपनियों के पेटेंट की मार से बचाने के लिए विभाग यहाँ की प्रजातियों पर आधारित पुरानी चिकित्सा पद्धति के साक्ष एकत्रित करेगा, दुर्लभ व महत्वपूर्ण प्रजातियों के संरक्षण के लिए इनके मूल स्थान पर बायोडाइवर्सिटी को ध्यान में रखकर संरक्षण, विकेंद्रीकरण व कृषिकरण के कार्यक्रम चलाए जाएंगे। उत्तराखंड में वन विभाग की क्षमता बढ़ाने के लिए चालू वर्ष में साढ़े छह करोड़ रुपये केन्द्र सरकार की ओर से खर्च किए जाएंगे।

अमर उजाला: जून १२, २०००

J&K hospitals dumping waste in rivers and lakes

Various hospitals and nursing homes in Jammu & Kashmir have been found grossly violating the Bio-medical Wastes Management and Handling Rules, 1998 and polluting some rivers, lakes and other water bodies and leaving many green areas infertile or turned them into pools of filth. Srinagar's Anchar lake which is located next to Sher-I-Kashmir Institute of Medical Science, the biggest hospital in the state has sustained

extensive damage. In this context a meeting of the advisory committee on waste management decided to take punitive action against such institutions and clinics found not conforming to the prescribed rules.

THE ASIAN AGE: June 13, 2000

Arunachal Pradesh to increase forest cover

The best aspect for nature conservation in the state of Arunachal Pradesh is its thin population and in an enviable position with 82% of its land still under forest cover. Committed to increasing the protected area network and State's bio-rich areas, the WWF has launched a special package for the Namdapha Tiger Reserve committing a financial assistance of Rs. 22.17 lakhs to improve the management of the national park.

THE HINDU: June 13, 2000

बर्फ कम होना पर्यावरण के लिए खतरे की घंटी

विश्व प्रसिद्ध पिंडारी ग्लेशियर अब पहले जैसा खूबसूरत नहीं रहा, ठीक नीचे भूस्खलन होने के कारण वहां जाने वाले लोग अब इसे छू भी नहीं सकते। यही नहीं जीरो प्वाइंट (जहां से ग्लेशियर देखते हैं) लगातार पीछे खिसक रहा है। ग्लेशियरों पर बर्फ लगातार कम होती जा रही है, जो देश के पर्यावरण के लिए खतरे की घंटी है। ख्याति प्राप्त भूगर्भविद् प्रो० खड्ग सिंह बल्लिया ने अब से कई वर्ष पहले अपने एक भाषण में कहा था कि सन् २००० से हिमालय रेगिस्तान बनने की दिशा में आगे बढ़ने लगेगा। लगता है वह दौर शुरू हो गया है। आज से करीब १७ साल पहले पिंडारी ग्लेशियर के ठीक नीचे भूस्खलन शुरू हुआ था, वह अब लगातार बढ़ता जा रहा है। पिछले १७ सालों में ग्लेशियर को जोड़ने वाली पहाड़ी टूटती जा रही है, और अब जीरो प्वाइंट खिसककर आधा किमी पीछे आ गया है। इसी स्थान से अब लौट जाना पड़ता है, अब से १५ साल पहले तक अभियान पर जाने वाले पिंडारी ग्लेशियर तक जा सकते थे, लेकिन बाद के वर्षों में भूस्खलन बहुत तेजी से हुआ और बीच में खाई बढ़ती जा रही है। पर्यावरण वैज्ञानिकों का मानना है कि भूस्खलन इसी गति से हुआ तो आगामी १० वर्षों में जीरो प्वाइंट एक किमी पीछे तक खिसक जायेगा। हिमालय क्षेत्र में स्थित कफनी ग्लेशियर का स्वरूप भी निरंतर बिगड़ रहा है। इस ग्लेशियर पर भी बर्फ काफी कम होती जा रही है और लंबी-चौड़ी दरारें दिख रही हैं। इससे स्पष्ट है कि ग्लेशियर तेजी से टूट रहा है। वैज्ञानिकों का मानना है कि पर्यावरण असंतुलन के कारण हिमालय पर अब बर्फ घटती जा रही है। हिमालय पर बर्फ का कम होना समूचे विश्व के पर्यावरण के लिए खतरनाक है। वनों के विनाश, असंतुलित निर्माण, खनन, प्रदूषण आदि के कारण पर्वतीय क्षेत्र में मौसम लगातार बदल रहा है। गर्मियों में वर्षा और वर्षात के मौसम में सूखा पड़ने जैसे परिवर्तन बहुत चिंताजनक हैं।

अमर उजाला: जून १३, २०००

गंगोत्री का मंदिर खतरे में

गंगा का उद्गम गोमुख ग्लेशियर न सिर्फ तेजी से पिघल रहा है। बल्कि गंगोत्री मंदिर के ठीक उपर पहाड़ में दरार पड़ गई है। हिमालय के इस हिस्से में पहाड़ लगातार टूट रहे हैं। भारतीय भूवैज्ञानिक सर्वेक्षण के वैज्ञानिकों का कहना है ग्लेशियर सालाना ५० मीटर पीछे जा रहा है। भूस्खलन से गंगा का स्वाभाविक प्रवाह रुक गया है। अगर यह स्थिति जारी रही तो हमारी संस्कृति की आधार श्रोत गंगा लुप्त हो सकती है। पिछले २५ साल में गोमुख हिमनद ४ किमी पीछे खिसक गया है। हिमालय की चौखम्बा पर्वत श्रृंखला से निकले गोमुख ग्लेशियर की लंबाई कभी ३२ किमी थी जो अब सिर्फ १९ किमी रह गई है। ग्लेशियर की मोटाई भी एक किमी कम हो गई है। हिमालय का पर्यावरण यहां तेजी से बदल रहा है। वैज्ञानिकों का कहना है कि गोमुख दुनिया का सबसे तेजी से पिघलने वाला ग्लेशियर है। यात्रियों व पर्वतारोहियों के दर्जनों दल कुली खच्चरों के साथ ग्लेशियर को रौंदते हैं। पालीथीन प्लास्टिक का कचरा टनों के हिसाब से बिखरा पड़ा है। जे०एन०यू० के पर्यावरण विज्ञान संस्थान के डा० इकबाल जो वहां पर ग्लेशियर का अध्ययन कर रहे हैं, उनका

कहना है कि दुनिया भर में केवल गंगोत्री ग्लेशियर की बर्फ तेजी से पिघल रही है। इसका पिघलने का मुख्य कारण इस इलाके में बढ़ता मानवीय हस्तक्षेप और बढ़ते पर्यटकों का दबाव है। इस इलाके में पंडों तथा साधुओं ने गंगा को जितना बेचा है उतना ही कारोबार यहां काम कर रही कोई २० स्वयंसेवी संस्थाओं ने गंगा के नाम पर किया है।

जनसत्ता: जून २६, २०००

आकर्षण खोती जा रही है फूलों की घाटी

नंदादेवी बायोस्फियर के अंतर्गत पड़ने वाली विश्वविख्यात फूलों की घाटी अव्यावहारिक वन नीति के चलते अपना आकर्षण खोती जा रही है। जिससे इसका अस्तित्व भी खतरे में पड़ता जा रहा है। साढ़े दस हजार फीट की उंचाई पर स्थित फूलों की घाटी एक दशक पहले तक दुनिया भर में फूलों की विविधता के लिए विख्यात थी। अव्यावहारिक वन नीति के चलते अब वहां फूलों की कुछ ही प्रजातियां देखने को मिल रही हैं। पूरी घाटी के एक तिहाई से ज्यादा हिस्से में जंगली घास-फूस व झाड़ियों का साम्राज्य स्थापित हो चुका है। वन अधिनियम १९८० के लागू होने के बाद केन्द्र सरकार ने ६ नवंबर १९८२ को फूलों की घाटी को राष्ट्रीय पार्क घोषित कर दिया गया, जहां पशुओं के अलावा भेड़-बकरियों को भी प्रवेश के लिए प्रतिबंधित कर दिया। तब से यह घाटी धीरे-धीरे जंगली घास व झाड़-झंकाड़ से घिरने लगी है। झाड़ी और घास के कारण जमीन में खिले बचे-खुचे फूल प्रकाश न मिलने के कारण विलुप्त होते जा रहे हैं।

अमर उजाला: अगस्त ८, २०००

गढ़वाल हिमालय : सांस्कृतिक विविधता

जयवर्द्धन सेमवाल विजयश

हेमवती नन्दन बहुगुणा गढ़वाल विश्वविद्यालय, स्वामी रामतीर्थ परिसर, टिहरी गढ़वाल

गढ़वाल और कुमाऊँ हिमालय की सांस्कृतिक एवं जैविक विविधता ने इस क्षेत्र को विश्व के समक्ष अपनी अलग पहचान बनाने में अहम भूमिका निभायी है। एक ओर महाकवि कालीदास अपने ग्रन्थ कुमार सम्भव में इसे अश्विनी क्षेत्र कहते हैं तो दूसरी ओर अनेक ग्रन्थों में इसे देवताओं का निवास स्थान माना गया है। इस क्षेत्र की सांस्कृतिक विविधता यहाँ के निवासियों की धारणाओं व उनके परम्परागत विश्वासों के बारे में बरबस ही ध्यान आकृष्ट कर चिन्तन करने को विवश कर देती हैं। एक ओर जहाँ इस क्षेत्र के किसी भाग में दुर्योधन को पूजा जाता है वहीं दूसरी ओर कहीं हनुमान जी स्थानीय निवासियों द्वारा पूज्य नहीं हैं। क्या है इस सांस्कृतिक विविधता का महत्व . एक आलेख:

सम्पूर्ण भारत वर्ष में हिन्दू धर्म के अनुयायी हनुमान जी की पूजा करने के साथ साथ उन्हें अनेक हिन्दू धर्म ग्रन्थों के अनुसार अश्वथामा, बलि, व्यास, कृपाचार्य तथा विभीषण के साथ अमर मानते हैं, लेकिन उत्तराखण्ड क्षेत्र के चमोली जनपद में एक सूदूरवर्ती भोटिया जनजातीय गाँव है **द्रोणागिरी**। इस गाँव में हनुमान जी का नाम तक लेना गलत माना जाता है। स्थानीय प्रचलित मान्यता के अनुसार, सुषैन वैद्य के निर्देश से लक्ष्मण के प्राण रक्षा हेतु हनुमान जी संजीवनी बूटी के लिए इस क्षेत्र से पर्वत का एक भाग उखाड़कर ले गये थे। इस गाँव के लोग हनुमान जी के इस कृत्य से बहुत दुःखी हैं। उनका मानना है इसी कृत्य के कारण प्राणदायिनी औषधि संजीवनी इस क्षेत्र से विलुप्त हो गयी। यहाँ हनुमान जी के स्थान पर पर्वत देवता का मंदिर है और पर्वत पूजा की जाती है। स्थानीय निवासियों की आस्था के अनुसार पर्वत देवता अभी भी अत्यधिक कष्ट में हैं और उनके दाहिने भाग से, जिसे हनुमान जी उखाड़ कर ले गये थे, निरन्तर खून की धारा बह रही है।

पर्वत देवता के क्षेत्र से बेमौसम जड़ी बूटियाँ लेना भी पाप माना जाता है। ऐसा करने में वर्षा हो जाती है। गाँव के लोग वर्षा के लिए बेमौसम जड़ी बूटी लेने वाले को कोसते हैं, और वह व्यक्ति ग्रामीणों के कोपभाजन का शिकार बनता है। गाँव वालों की पर्वत के प्रति अटूट श्रद्धा देखते ही बनती है। यह भी एक संयोग है वास्तव में जब भी कोई व्यक्ति (पर्यटक, शोधार्थी, वैज्ञानिक) बेमौसम जड़ी बूटी निकालता है उस दिन अतिवृष्टि हो ही जाती है। वहाँ पर सब कुछ प्रकृति पर ही निर्भर है। यह बात तो दीगर है कि उत्तराखण्ड के हर क्षेत्र की सांस्कृतिक विविधता के पीछे मानव जाति का ही कल्याण निहित है। यहाँ पर भी पर्वत पूजा के पीछे जनहित ही दिखायी देता है। वह क्षेत्र (द्रोणागिरी) जड़ी बूटियों का अनमोल खजाना है। हो सकता है, पर्वत से जड़ी बूटियों को संरक्षित करने की यह उनकी अपनी एक विशेष प्रकार की परम्परागत संरक्षण की पद्यति हो। उस क्षेत्र के निवासियों के अनुभवी और दूर दृष्टि वाले पूर्वजों को यह आभास जरूर रहा होगा कि भविष्य में मानव अपनी स्वार्थ पूर्ति के लिए प्रकृति के साथ क्रूर व्यवहार भी कर सकता है। इसलिए हम कैसे इस क्षेत्र की सम्पदा को जिसे हम अपने पसीने से सींचते आ रहे हैं, बचायेंगे, फिर उन्होंने शुरू की होगी पर्वत पूजा। फिर भी !

इस क्षेत्र के निवासी पूर्ण रूप से आत्म निर्भर हैं और कृषि के अतिरिक्त भेड़ पालन भी उनका व्यवसाय है। भेड़ की ऊन से ये कालीन तथा विभिन्न प्रकार की वस्तुएं जैसे चोगठा (ओढन) पंखियां तथा लवा (परम्परागत महिला परिधान) आदि बनाते हैं। इनको अपने हाथ से बनाये सामान की बिक्री के लिए बहुत दूर पैदल चलकर सड़क मार्ग पर आना पड़ता है। वहाँ से सड़क मार्ग द्वारा ये लोग जोशीमठ पहुँचते हैं। यहाँ

परिवहन आम लोगों के लिए व्यवस्थित नहीं है। और इन लोगों को अपने सामान की बिक्री के लिए आसानी से बाजार उपलब्ध नहीं हो पाता है। ये लोग विभिन्न प्रकार की जड़ी बूटियों का उत्पादन भी करते हैं। वह भी इनकी एक नकदी फसल है। इस वैज्ञानिक युग में भी इस क्षेत्र के अस्सी फीसदी लोग विभिन्न बीमारियों के उपचार हेतु परम्परागत चिकित्सा पद्धति पर ही निर्भर हैं (मैखुरी इत्यादि, १९९८, नौटियाल इत्यादि, १९९८)।

अतः आज जहाँ सभी देशों के बीच पेटेन्ट (एकस्व) की होड़ चल रही है उसके चलते हमें भी अपने क्षेत्र की अमूल्य धरोहर (जैविक एवं सांस्कृतिक विविधता) को लिपिबद्ध कर अतिशीघ्र भविष्य की पीढ़ियों के लिए संजोकर रखना ही होगा।

सन्दर्भ:

नौटियाल, एस०, मैखुरी, आर० के०, एवं राव, के० एस० (१९९८)। परम्परागत चिकित्सा पद्धति में जड़ी बूटियों का योगदान: एक विशिष्ट अध्ययन। *हिमा.पर्यावरण*, १०(२): २०.२१।

मैखुरी, आर० के०, नौटियाल, एस०, राव, के० एस० एवं सक्सेना, के० जी० (१९९८)। रोल ऑव् मेडिसिनल् प्लान्ट्स इन

टे-डि-शन.अल् हेल्थ् केयर सिस्टम् : ँ केस् स्टडि फ्रॉम नन्दा देवी बायोस्फियर रिजर्व । *कर.रेन्ट्*

साइ.अन्स्, ७५ (२) :

१५२ . १५८।

अपने ही घर में खो गयी मुखमार

सुनील नौटियाल, के० एस० राव, आर० के० मैखुरी*, मुकेश नौटियाल एवं के० एस० नेगी**
 गो० ब० पन्त हिमालय पर्यावरण एवं विकास संस्थान, कोसी कटारमल, अल्मोड़ा।
 गो० ब० पन्त हिमालय पर्यावरण एवं विकास संस्थान, गढ़वाल इकाई, श्रीनगर। रूद्रप्रयाग, गढ़वाल।
 राष्ट्रीय पादप आनुवांशिक संसाधन ब्यूरो, क्षेत्रीय अवस्थान, भवाली, नैनीताल।

नूतन कृषि अनुसंधानों और तदनुसार उपजी कार्य संस्कृति के फलस्वरूप उच्च हिमालयी क्षेत्र की शानदार कृषि परम्परा लुप्त होने के कगार पर है। रासायनिक खादों का अत्यधिक प्रयोग और वानिकी की विलायती अवधारणा ने हिमालय के पुरुषार्थी जनमानस को परम्पराएं त्यागने और संक्षिप्त रास्ता अपनाने का आदी बना दिया है। बेशक हिमालय की वादियों में तथाकथित परदेशी फसलों को उगाने का प्रयोग एक सीमा तक सफल रहा है परन्तु इस प्रयोग के परिणाम स्वरूप संवेदनशील हिमालय की अनेक पारम्परिक उपज प्रजातियां लुप्त हुई हैं। पंत और नेगी (१९९७) ने एक वैज्ञानिक अध्ययन कर मध्य हिमालय क्षेत्र से धान की ५१० पारम्परिक उपज प्रजातियों का उल्लेख अपने शोध पत्र में किया है। एटकिन्सन ने १९८२ के हिमालयन गजेटियर में ४८ धान की उपज प्रजातियों को सूची ब) किया है और साथ ही साथ यह उल्लेख भी किया है कि यहाँ पर करीब एक हजार से भी अधिक अवज्ञात/अवर्णित पारम्परिक उपज प्रजातियाँ थी (मैखुरी इत्यादि, १९९७)। आज केवल कुछ ही प्रजातियाँ यहाँ के किसानों द्वारा कहीं कहीं पर उगायी जा रही हैं। यहाँ पर निकट पूर्व में स्थानीय निवासियों के सामाजिक, आर्थिक, सांस्कृतिक परिवेश में हुए परिवर्तनों और साथ ही सरकारी नीतियों का यहाँ की पारस्थितिकी के अनुकूल न होने के कारण कई परम्परागत फसलों की प्रजातियाँ विलुप्त होने के कगार पर हैं या आज उनका अस्तित्व ना के बराबर है, उनमें से कुछ प्रमुख धान की पारम्परिक उपज प्रजातियाँ है . नग्योण, सुनार, रिखवा, थापाचीनी, दूदा, घ्यासू, लालमाटी, रामज्वाण, सुकनन्दी, आनन्दी, पिंगला, साबरी, पार्वती, राजभोग, नन्दिनी, राजमति, झाफुली, बिन्दुली, झुमरी, काजुरी, जिरूली, जयन्ती, बाकुली, रत्ना, चेना, हंसराज, मुंगर्या, नरकोटार, नानसाटि, लोभ्याल, बुरकी, स्याल, मदगुरी, चवर, सावनपति, कलों इत्यादि।

धान की पारम्परिक दुर्लभ प्रजाति कलों तो परम्परागत रूप से इस क्षेत्र के निवासियों द्वारा औषधि के रूप में प्रयोग की जाती रही हैं। इसके चावलों का हलवा नवजात शिशु की माता को आन्तरिक शक्ति प्रदान करने एवं भुने चावल (भात) संबंधित बिमारियों मुख्यतः लिकोरिया के उपचार हेतु उपयोग में लाये जाते थे। वर्तमान में धान की एक बेहतरीन सुगन्धित पारम्परिक उपज प्रजाति **मुखमार** तो लगभग अतीत के इतिहास में दर्ज हो ही गयी है। इस प्रजाति को अन्य कई कारणों के अतिरिक्त काफी हद तक स्थानान्तरित किया है, आर०आर० ४२० ने, जो कि धान की सुगन्धित आधुनिक किस्म है। प्रारम्भ में जब इस किस्म को स्थानीय निवासियों को उगाने के लिए प्रेरित किया गया तो उस समय सरकार द्वारा जलागम प्रबन्ध परियोजना के तहत कुछ वर्षों तक इस प्रजाति के बीज के साथ खाद भी किसानों को सब्सिडी के रूप में वितरित की गई। परिणाम यह हुआ कि शुरूआती दौर में यह आधुनिक प्रजाति **मुखमार** की तुलना में अधिक उत्पादन देने लगी और स्थानीय कृषकों का मुखमार के प्रति मोह भंग हो गया। किन्तु शनैः शनैः आर०आर० ४२० की उपज में कई पारिस्थितिकीय कारणों से स्वाभाविक रूप से कमी आती गई। और अब फिर कृषकों का ध्यान आकृष्ट हो रहा है मुखमार एवं अन्य कई पारम्परिक उपज प्रजातियों की ओर। यदि भविष्य में भी इसी तरह इस संवेदनशील क्षेत्र के लिए यहाँ की पारिस्थितिकी के विपरीत नीतियाँ बनायी जायेंगी तो एक दिन सभी पारम्परिक उपज प्रजातियाँ अतीत के पन्नों में बन्द हो जायेंगी . इसमें दो राय नहीं। धान की तरह ही गेहूँ की

दो प्रमुख स्थानीय किस्में सफेद मुंडर्या और लाल मुंडर्या तो आजकल बहुत ही कम कृषि जोतों में देखने को मिलती हैं।

वर्तमान समय में और अन्य परिवर्तनों में से कुछ एक पर जन सामान्य तो नजर डाल ही सकता है उदाहरणार्थ, किनगोड़ जैसे (बरबेरिस प्रजाति) बहुमूल्य औषधि पादप जो कुछ वर्ष पहले तक उत्तराखण्ड के जंगलों और खेतों के किनारे बेहिसाब मात्रा में उगते थे, अनायास ही दुर्लभ हो गए हैं। लेंटाना, पार्थीनियम, कालाबॉसा (यूपेटोरियम) और तमाम फालतू घास आज इस क्षेत्र में अपना साम्राज्य फैला चुकी हैं। साम्राज्यवादी प्रवृत्ति की लेंटाना ने तो पर्वतीय प्रदेश के अनेक बहुमूल्य पादपों को ग्रस लिया है। उत्तराखण्ड सहित तमाम हिमालयी क्षेत्र का दुर्भाग्य रहा है कि जब कभी भी यहाँ के वानस्पतिक ढाँचे पर वैज्ञानिक चर्चा हुई है तदोपरान्त अनुकूल नीतियों का कार्यान्वयन यहाँ की पारिस्थितिकी के अनुसार बहुत ही न्यून हुआ है। उत्तराखण्ड के कृषि जोतों के बिखरे स्वरूप को देखते हुए सब्जी उत्पादन की बातें जोर शोर से की जाती हैं परन्तु उन जोतों में सैकड़ों वर्षों से उगाए जा रहे कोदा, झंगोरा, मार्छा, ओगल-फाफर, चिचुआ जैसी फसलों के महत्व पर कभी चर्चा नहीं होती, यह जानते हुए भी कि पर्वतीय प्रदेश की इन पारम्परिक फसलों में महत्वपूर्ण पौष्टिक तत्व उपस्थित हैं और इनके उत्पाद बाजारों की विज्ञापन आधारित संदिग्ध अवधारणाओं को अनायास ही बदल सकते हैं।

इस क्षेत्र के निवासी सैकड़ों वर्षों से यहाँ पर ओगल फाफर, मार्छा, चीणा, चिचुवा एवं अन्य कई फसलों की पारम्परिक उपज प्रजातियाँ उगा रहे हैं। उत्तरकाशी, पिथौरागढ़ और चमोली के जनजातीय क्षेत्रों का भोटिया समुदाय तो वर्षों से इन पारम्परिक फसलों के अतिरिक्त अन्य कई संजीवनी सदृश्य वनस्पतियों (यथा फरण, चोरू, छिप्पी, कूट, अतीस, हत्ताजड़ी) को न केवल उगा रहा है अपितु उनका समुचित संरक्षण भी कर रहा है (नौटियाल इत्यादि, १९९८, मैखुरी इत्यादि, १९९८)। अब बदलती मान्यताओं और बाजारों के अभाव में इस जनजातीय समुदाय की नई पीढ़ी का ध्यान इन फसलों से विमुख होकर आधुनिक नकदी फसलों की ओर आकृष्ट हो रहा है। इस प्रकार अपनी ही भूमि पर अनेक दुर्लभ और बहुमूल्य पादप लुप्त हो रहे हैं और उनकी जगह ऐसी फसलें और घासें उगाई जा रही हैं जो वस्तुतः इस क्षेत्र की मृदा में आत्मघाती असंतुलन पैदा कर सकती हैं।

हिमालयी क्षेत्र के इस विशिष्ट भू-भाग को अब राज्य का दर्जा प्राप्त हो चुका है, यहाँ के आर्थिक स्रोतों में जड़ी बूटियाँ (औषधीय पादप) और विशिष्ट हिमालयी फसलें (मसलन कोदा, झंगोरा, ओगल, फाफर, उवा, जौ एवं अन्य कई पारम्परिक फसलें आदि) शामिल हैं। इस हेतु सरकारी तंत्र को नई मानसिकता विकसित कर पा'चात्य ढर्रे को यहाँ की परम्पराओं पर थोपने से बाज आना होगा और वैज्ञानिक शोध संस्थाओं को यहाँ के विशिष्ट और सर्वथा मौलिक वानस्पतिक स्वरूप के महत्व को अपने तर्कों के द्वारा सिद्ध करना होगा। यदि अभी भी सुबह की खोयी **मुखमार** सांझ ढले लौट आए तो मान लिया जाएगा कि वह खोयी ही नहीं थी।

सन्दर्भ:

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