

Human Activity and its Impact on Vegetation: A Case Study in Sikkim Himalayas

P. Venu,¹ Virender Kumar and M.K. Bhasin²

Department of Anthropology, University of Delhi, Delhi-110007, India

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ABSTRACT Sikkim, the smallest hilly state of the Indian Union lies in the Eastern Himalayas. Owing to altitudinal variation (300 to 8,400 metres) the state exhibits climate ranging from Sub-tropical to Alpine. In addition to the variety of environments, there is a large variety of ethnic groups solely depending on the nearby forests for their day to day needs. High population pressure and lack of economic opportunities has led to 'over use' of environment by the way of lopping away of few economic species for sale in the nearby markets. Illicit cutting of trees has become a common feature to meet the firewood and timber demands. The present paper besides documenting the traditional man-plant relationships, ethnobotany, also analyses the catastrophic effects on the natural flora due to the increased exploitation and irregularities prevailing in the region. Few propositions are also made for the overall development of the State in the light of the observations made during the study.

Mountain areas in different parts of the world are at different levels of influence by human activities. Man's impact on mountain ecosystems are producing critical situations at faster rate owing to their third dimension on the land surface. Population pressure is indicated through population growth and density. However, pressure may be high, in some cases, in a sparsely populated area and lower in densely populated area in a large river valley. Population resource ratio and population/resource use-systems are to be thoroughly analysed to assess the real human-impact assessment.

Mountains and associated forests are sources of timber, firewood, food and medicinal plants to the people around. This dependence on plants was amicable earlier but the population increase and also their over exploitation for commercial reasons led to a change and imbalance in their relationship patterns. In the present context, Sikkim Himalayan region was taken up for the

compilation of existing information relating to ethnobotany. The paper also describes the nature of man's impact, manipulations and an evaluation of their consequences. Few propositions are also made for the overall development of the state in the light of the observations made during the study.

FIELD AREA AND ITS SIGNIFICANCE

Sikkim is entirely a hilly State and lies in the Eastern Himalayas between 27° to 28°N latitude and 88° to 89°E longitude. The State has an area of 7,299 sq.km. with borders of Tibetan plateau towards north, Nepal on the west, Chumbi valley of the Tibet on the east and Darjeeling District of West Bengal in the south. It is administratively divided into four districts viz., North, East, South and West with Mangan, Gangtok, Namchi and Gyalshing as headquarters, respectively. Various areas studied in the present investigation are given in Fig. 1.

The mountainous terrain of Sikkim consists of a tangled series of interlacing ridges rising range

1. Scientist 'B' Botanical Survey of India, Calcutta-16

2. Address all correspondence to M.K. Bhasin

above range, the elevations varying from 300 to 8,400 metres. Because of the varied altitudes, it exhibits climate ranging from subtropical to alpine. In the foothills and in the lower valleys up to 700 metres, almost torpical conditions prevail. In higher elevations the climate is temperate and moist. It is the most humid region in the whole range of Himalayas because of its direct exposure to south west monsoon. The rainy season starts from May and continues until October. Though the permanent snow line is above 5,000 metres, glaciers often descend to the height of 4000 metres effecting the overall climate of Sikkim by lowering the temperature considerably. As one moves along with area from the valleys to peaks of the mountains, the vegetation changes from Sal forests to Rhododendrons, Conifers and finally to alpine pastures. This varied climate also supports a bewildering admixture of species which are of various interests and use to the local populations.

PEOPLE AND PRACTICES

The population of Sikkim according to 1981 Census is 3,16,385 out of which 2,65,301 are rural and 51,084 urban. The average density of population per sq.km. is 45. Five castes—*Kami* (Smiths), *Damai* (Tailors), *Sarki* (Cobblers), *Lohar* (Blacksmiths) and *Maji* (Fisherman), are classified as Scheduled Castes. Bhutias, Lepchas and Sherpas are notified as Scheduled Tribes. Scheduled castes constitute about 6 per cent of the total population while the Scheduled tribes are about 31 per cent. The remaining population is constituted by Nepalese. The three main languages of the State are Nepali, Bhutia and Lepcha. Hindi is generally understood by a majority of the people.

The Sikkimese are deeply religious and spiritual. Buddhism, Hinduism and Animism are practised by different ethnic groups, but it is very difficult to classify them accurately. Some Nepalese are Hindus and others are Buddhists, while Lepchas are animists and Buddhists. Religion of the Scheduled Castes is uncertain. There are 137

Buddhist monasteries belonging to different Tibetan and non-Tibetan Buddhists. The population distribution is uneven and more concentration is in the East and South Districts of the State. These populations live mostly in isolated villages on hill tops and slopes. With the varied climate in the state, the region could be broadly divided into four ecological zones namely, Lower Hills (300-1500 metres), Mid Hills (1500-2000 metres) High Hills (2000-5000 metres) and very High Hills (Above 5000 metres), as given in Table 1.

METHOD OF STUDY

During the field work, families of diverse ethnic groups were visited in various parts of Sikkim. Important tree composition of various forests was recorded located in different parts of the State. Regarding ethnobotany, much information was collected in fairs which are organised on different days of a week in various places. The working method for this study is almost the same as that for the study of indigenous plant foods by Jain (1963). Plant specimens are identified both in Central National Herbarium, Howrah (West Bengal) and Lloyd Botanic Garden, Darjeeling (West Bengal).

OBSERVATIONS

From the extensive field work undertaken during 1982-84 in all the four Districts of the State, it is observed that entire forest area can be divided into six zones (Table 2).

Forest Management: State owned forests are divided into three categories: 1. Reserve forests, 2. *Gorucharan* forests (Grazing lands), 3. *Khas* forests (Grass lands). Besides, there are two minor kinds of reserves namely (1) Slip reserves (2) Road reserves. Forest of *Kazis* (Revenue Collectors), *Gompa* forests (Forests of Monasteries) and forests of Royal family do not come under State owned forests. For proper administration of the forests, the State is divided into five ranges. The Northern range has its headquarters at Mangan while the Eastern range is headquarter-

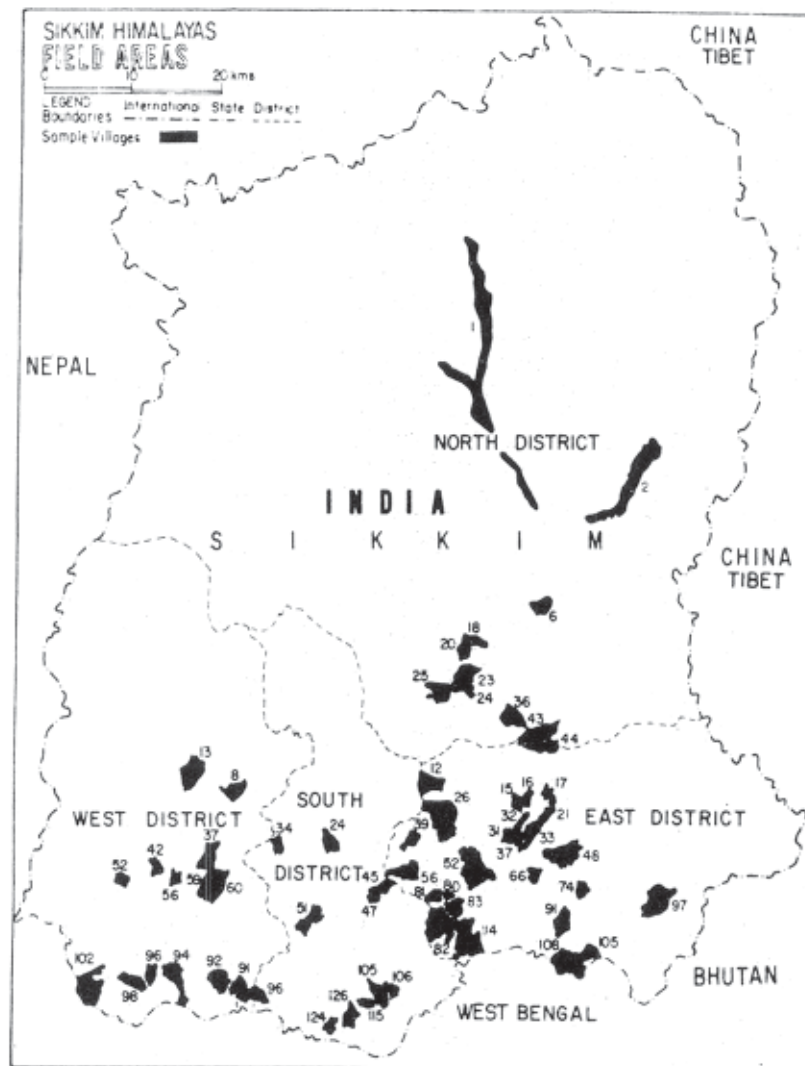


FIG. 1

1. North District: Lachen (1), Lachung (2), Naga Namgor (6), Singhik (18), Zimchung (20), Tingchim (23), Upper Mangshila (24), Hee-gyathang (25), Phadong (36), Kabi (43), Tingda (44).
2. East District: Sundong (12), Ranaka (15), Sicheygaon (16), Chandmari (17), Tathangchen (21), Tumen (26), Rewate Rumtek (31), Tadong (32), Syari (33), Samdur (37), Lingzey (Assam) (39), Assam (48), Martam (52), Khamdong (56), Aho (66), Parkha (74), Sakyong (81), West Pendam (82), Lingzey (Sumen) (83), Tar-ethang (91), Lingtam (97), Aritar (105), Rhenak (108), Central Pendam (114).
3. South District: Rabong (24), Kewzing (34), Tarku (45), Temi (47), Wak (51), Salghari (96), Rateypani (105), Bikmat (106), Sadam (115), Sumbuk (124), Turuk (126).
4. West District: Arithang (8), Yuksum (13), Yangthang (37), Sapong (42), Dentam (52), Hee (56), Banyak (59), Barthang (60), Namgoon (Kishenpong) Zoom (91), Chakung (92), Soreng (94), Karthuk (96), Rumbuk (98), Okhrey (102).

Table 1: Ecological Zones in Sikkim State Environment and Ecological Adaptation

Area	Climate	Altitude(m)	Ecological Adaptation	Crops	
				Agricultural	Horticultural
Lower Hills	Tropical	300-500	Wet and dry agriculture, sedentary farming, live-stock, horticulture.	Rice, maize, millet, wheat and mustard, pulses, soyabean, vegetables, potato	Guava, lime, lemon, ginger, orange
	Sub-tropical	500-1500			
Mid Hills	Temperate	1500-2000	Wet and dry agriculture, slash and burn agriculture or rotational dry cultivation, hunting and collection of minor forest produce, horticulture.	Paddy, maize, millet, wheat, soyabean, potato, vegetables, ginger	Mandarin (Oranges), large cardamum, plum, peach, peas
High Hills	Temperate	2000-2700	Dry agriculture Bhutias Transhumance	Maize, Barley, Vegetable, seed potatoes	Apple, plum, peach, peas
	Sub-alpine	2700-4000	Yak herding, horticulture, pastoral economy,		
	Alpine	4000-5000	wool, cheese, butter, hides, apple and potato are commercial commodities.		
Very High Hills	Alpine	Above 5000	Lachenpa and Lachungpa Transhumant groups visit the area, Lachenpa grow vegetable and potato at higher elevation.	Mainly used for seed potato, vegetables	Pasturage

Table 2: Important tree composition of different forest types of Sikkim Himalayas

1. Lower Hills Forest	
(a) Sal Forest	<i>Garuga pinnata</i> , <i>Terminalia crenulata</i> <i>T. chebula</i> , <i>Schima Wallichii</i> , <i>Pinus longifolia</i> , <i>Shorea robusta</i>
(b) Dry Mixed Forest	<i>Schima wallichii</i> , <i>Garuga sp.</i> , <i>Gmelina arborea</i>
(c) Wet mixed Forest	<i>Eugenia operculata</i>
2. Mid Hill Forest	<i>Castanopsis tribuloides</i> , <i>C. indica</i> , <i>Engelhardtia sp.</i>
3. Upper Hill Forest	<i>Engelhardtia sp.</i> , <i>Michelia excelsa</i> , <i>Michelia</i> <i>cathecarti</i> , <i>Quercus sp.</i>
4. Conifer Forest	<i>Tsuga brunoniana</i> , <i>Podocarpus nerifolia</i> , and <i>Pinus sp.</i>
5. Rhododendron Forest	<i>Rhododendron spp.</i> <i>Quercus lamellosa</i> , <i>Q. pachyphylla</i> and <i>Acer Campbelli</i>
6. Alpine Pastures	<i>Dwarf Juniperus</i> , <i>Rhododendron spp.</i> <i>Deschampsia caespitosa</i>

ered at Pakyong. Gyalshing is the headquarters for North western range while Namchi for South-west range. For Gangtok range, the headquarters is located in Gangtok itself.

Plants in Relation to Human Living

Information on various plant species used for various purposes has been recorded. Plants in these surroundings provide construction material for shelter, fuel, food and medicine. Among the collections of the plants, depending on the economic use, they are grouped under separate headings. An annotated list of each group is presented here. Scientific names are followed by local names which are given in Nepali (N) Lepcha (L), or Tibetan (T) languages.

1. Food Plants

Dendrocalamus sikkimensis Gamble; *Bhalubans* (N), Poaceae.

Sheath from young shoots are boiled and are used as a source of vegetable from May to July.

Dendrocalamus tulda Voigt; *Tamabans* (N), *Pou* (L), Poaceae. *Bambusa vulgaris* Schrad.; *Tamabans* (N), *Pou* (L), Poaceae.

These bamboo species are very commonly distributed in most of the households. The young tender sprouting buds or shoots can either be eaten raw or utilised to prepare 'Tama' by special process of natural fermentation. Tama constitutes the typical favourable food for people in this region and is eaten either most fresh in succulent condition or in the dried form which can be preserved for long time. For Tama preparation, the young shoots are taken from the ground and the outer leaf sheaths are peeled off. These young shoots are cut into small pieces and boiled in water. The water is then removed and the bamboo pieces are called *Tama bans* or *Chorabans*. This is some times eaten as it is or used in a variety of preparations which can be kept for a long time.

Arudinaria hispida Steude.; *Nigalo susha* (N), *Pramod dung* (L), Poaceae. *Arudinaria artistata*

Gamble; *Nigalo susha* (N), *Pramod dung* (L), Poaceae.

These two species are not used in Tama preparations but the tender apices of young shoots are generally eaten as cooked vegetable.

Calamus erectus Roxb.; *Befial* (N), *Ru* (L), (Arecaceae) Palmaceae.

Ripe fruits are edible which ripe in the end of February.

Ficus cunia Buch.; *Kabro* (N), Moraceae.

Young shoots are utilised in making pickles. They are available in the month of March and sold at the rate of Rs.3/- per kg.

Urtica parviflora Roxb.; *Simzoo* (N), *Surang* (L), Urticaceae.

Leaves and flowering twigs are used as vegetable and sold throughout the year.

Urtica ardens; *Sishnu* (N), *Surungbee* (L), Urticaceae.

Urtica dioica; *Leksishnu* (N), *Surungyong* (L), Urticaceae.

The tender shoots and leaves of the plant are eaten as vegetable. But before cooking, they are thoroughly boiled in order to remove the stinging effect.

Polygonum molle Don.; *Thotne* (N) *Kandyee Pain* (L), Polygonaceae.

Young shoots are used as a vegetable in the months of March and April.

Phytolacca acinosa, Roxb.; *Jingaro* (N), *Jaringbe* (L), Phytolaccaceae.

Young leaves and twigs are used as green vegetable in the month of April.

Machilus edulis Nees.; *Phunchey* (N), *Phom kung* (L), Lauraceae.

Fruits are eaten by local people and especially by women during pregnancy. Fruits ripe in the months of December to March.

Bauhinia purpurea Linn.; *Ratokoiralo* (N), Caesalpiniaceae.

Buds and flowers of the tree are used as vegetable.

Entada pursaetha DC.; *Pangra* (N), *Kulukpot* (L), Mimosaceae.

Seeds of the plant, just after ripening are sold during December. They are used after macera-

tion for washing the hair.

Nasturtium officinale DC.; *Simrayo* (N), Cruciferae.

Young shoots and leaves are eaten as cooked vegetable. This is found in streams where water flow is less.

Zanthoxylum acanthopodium DC.; *Nangryn pot* (N), *Sidipot* (L), Rutaceae.

Fruits are used as spice. They occur in the month of July.

Melia dubia Hiern; *Lapsi* (N), *Silot Kung* (L), Meliaceae.

Fruits are edible and available in the month of January.

Manihot utilissima, Pohl.; *Simul Tarul* (N), *Tun-grukthouk* (L), Euphorbiaceae.

It produces two kinds of tubers, the red and white. Red tubers are used in "Kaza" preparation. In kaza preparation tubers are peeled off, boiled and eaten.

Thumba, a local drink is made out of white tubers. These tubers are first peeled off and cut into smaller pieces. These pieces are kept in a *Bori* (Bamboo Container) and left for ten days in a nearby stream. Poisonous stuff is believed to be leached off during this time and afterwards this stuff is sun dried. Later these pieces are boiled until they are cooked in water. These pieces are now kept in *Mandro* (Bamboo Mat) and treated with yeast. Afterwards, this is kept in "Septu" (Bamboo Container) and this 'Septu' is enclosed inside with ferns to see that nothing is leaked out. This is kept for two days like this. Bad smell comes out of these baskets and after two days they will be transferred to a big earthen ware as given in Fig. 2. This is stored for ten to fifteen days and during this period, it gets fermented. This is now ready for making 'Thumba'. White tubers are rarely eaten.

Elaeagnus conferta Roxb.; *Malinds* (N), Elaeagnaceae.

Ripe fruits are edible and available in the months of March.

Rhododendron arboreum Sm. *Gurans* (N), Ericaceae.

Flowers of this species are sour in taste and

used in pickle preparation.

Eryngium foetidum; *Brahmadahoina* (N), Umbelliferae.

Leaves are used in pickles and sold throughout the year.

Sechium edule Linn.; *Ishkush* (N), *Sukuth Ayong* (L), Cucurbitaceae.

Boiled tubers are eaten. Taste is very much similar to that of boiled potato.

2. Medicinal Plants

Lycopodium spp. Linn.; *Nageswari* (N), Lycopodiaceae.

Plant pounded is applied externally in case of ulceration between toes for fungal infection.

Abies sp Juss.; *Gopresala* (N) Pinaceae.

Bark and leaves are used in fumigation.

Acorus calamus Linn.; *Bojho* (N) Araceae

Pounded roots are given orally to cure nausea and vomiting

Smilax sp Roxb.; *Kukurdaini*, (N) Liliaceae.

Brushing with its stem relieves toothache.

Hedychium flavum, Roxb.; Zingiberaceae.

Pounded rhizome is given internally in case of abdominal burning and excessive thirst.

Piper sp.; *Chabak*, (N) Piperaceae

Pounded leaves are given internally to cure bodyache.

Viscum angulatum, Heyne; *Harchur* (N) Loranthaceae.

Plant powder is applied externally and given in the form of decoction internally in case of bone fracture.

Polygonum sp. Linn.; *Pinase Jhar*, (N) Polygonaceae.

Root juice is given internally in case of cough.

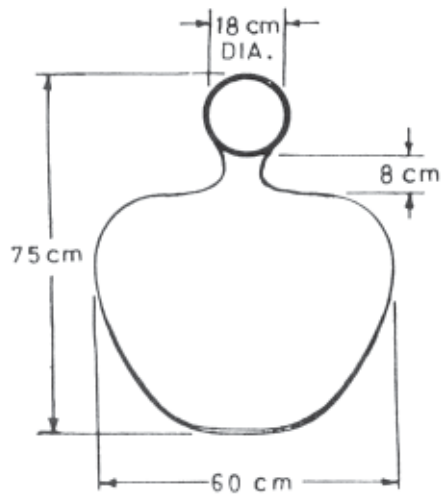
Stephania hernandifolia Walp.; *Tambarki*, (N) Menispermaceae.

Leaves of this plant are used in opening up boils.

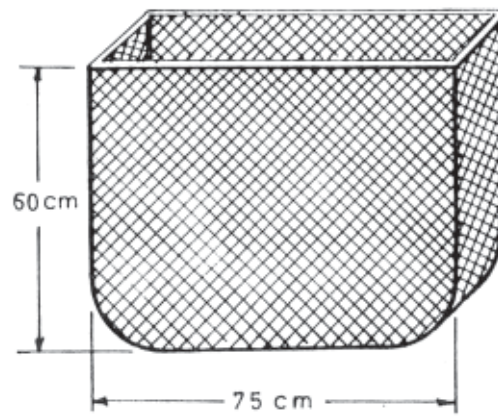
Dichroa febrifuga Lour.; *Basak*, (N) Scrophulariaceae.

Leaves pounded are made into decoction and administered internally in case of fever.

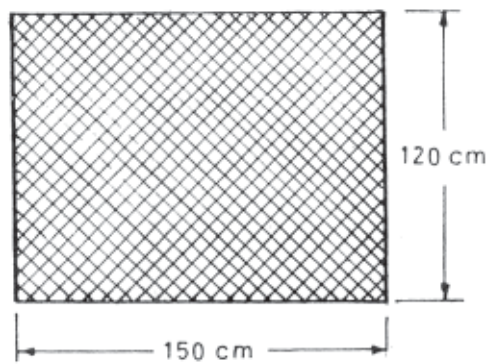
Astilbe rivularis Ham.; *Kurakhen*, (N) Saxifragaceae.



GEMPA
(EARTHENWARE POT)



SEPTU
(BAMBOO CONTAINER)



MANDRO
(BAMBOO MAT)

FIG. 2

Decoction of root is given internally in case of joint pains.

Rubus ellipticus Roxb.; *Asilu* (N), Rosaceae.

Root of the plant is used as a medicine in colic pains. Fruits are eaten by hillmen.

Prinsepia utilis Royle; Araliaceae.

The oil of the plant is used externally for rheumatism and pains resulting from fatigue.

Drymaria cordata Wild.; *Abijalo* (N), Caryophyllaceae.

Leaves and even whole plants are smouldered. Fumes inhaled through the nose in complaints of headache. Plant juice is applied in case of normal fever.

Bauhinia variegata Linn.; *Taki* (N), Papilionaceae.

Dried buds are used for cough, diarrhoea and dysentery.

Oxalis corniculata, Linn.; Oxalidaceae.

The juice extracted from the leaves is used in the treatment of boils. Curry preparations made from these leaves are said to improve the appetite and digestion of dyspeptic patients.

Cedrela toona Roxb.; *Tooni* (N), Rutaceae.

The bark of the tree is a powerful astringent and used in chronic dysentery.

Rhus succedanea Linn.; *Bhalayo* (N), Anacardiaceae.

The juice of the leaves is used in curing indigestion and vomiting in children.

Impatiens sp. Linn.; *Chilaini* (N), Balsaminaceae.

Plant juice is applied on forehead in case of headache.

Hydrocotyle rotundifolia Roxb.; *Batulpati* (N), Umbelliferae.

In case of sprain, root is tied on the affected part and leaves pounded are given internally simultaneously.

Hydrocotyle conferta (R.W.); *Machajhar* (N), Umbelliferae.

Leaf juice is given orally in case of infantile diarrhoea.

Hydrocotyle asiatica Linn.; *Kalhenyole* (N), Umbelliferae.

It is used in stomach troubles. Leaves are also used in skin diseases.

Rhododendron arboreum Sm.; *Gurans* (N), Ericaceae.

It is administered as an errhine.

Rhododendron companulatum Don.; *Nilochimal* (N), Ericaceae.

The dried twigs and wood are used as remedy for chronic fevers.

Dillenia scabrella Roxb.; *Phamsikol* (N), Dilleniaceae.

Bark leaves and fruits are used in local medicine. The juice of the fruit when mixed with water works as a cooling beverage and as a cough mixture.

Shorea robusta Gaertn.; *Tatural* (N), Dipterocarpaceae.

The resin of the leaves is used in dysentery and fumigations.

Scoparia dulcis Linn.; *Sano Khareto* (N), Scrophulariaceae.

Pounded plant is given internally in case of dysentery.

Plantago erosa Wall.; *Chamchijhar* (N), Plantaginaceae.

Pounded leaves are applied locally in case of itch and scabies.

Plantago sp. Linn.; *Simejhar* (N), Plantaginaceae.

Plant juice and leaf juice are applied externally in case of cuts and wounds to check bleeding and promote healing.

Rubia cordifolia Linn.; *Majitho* (N), Rubiaceae.

Its root made into paste and used as an ointment in skin diseases.

Nardostachys jatamansi; *Jatamansi* (N), Valerianaceae.

It is a good medicine for palpitation and hysteria. The oil has the property in increasing growth of hairs.

Trichosanthes palmata Roxb.; *Indrani* (N), Cucurbitaceae.

Fruit smoked as a cure of asthma. Root is also used in the lung diseases of cattle.

Eupatorium adenophorum Wall.; *Kalijhar* (N), Compositae.

Leaf juice is applied to cuts and wounds to promote healing.

3. Plants used as Fire Wood

Alnus nepalensis Don; *Uttis* (N), Betulaceae.
Nyssa sessiliflora Hook; Cornaceae.
Shorea robusta; Depterocarpaceae.
Castanopsis tribuloides Fagaceae
Beilschmiedia sp. Nees.; Lauraceae.
Amoora Rohituka W.B.A.; *Lali* (N), Meliaceae.
Prunus nepalensis Ser. Rosaceae.

4. Plants used in House Construction

Alnus nepalensis Don; *Uttis* (N), Betulaceae.
Shorea robusta; *Tatural* (N), Dipterocarpaceae.
Castanopsis sp. Spach; *Katus* (N), Fagaceae.
Quercus pachyphylla Kurg; *Katus* (N), Betulaceae.
Juglans regia Linn.; *Okhar* (N), Juglandaceae.
Michelia sp Linn.; Magnoliaceae.
Cedrela Toona Roxb.; *Tooni* (N), Meliaceae
Cryptomeria japonica Don.; *Dhupi* (N) Taxodiaceae.

5. Plants used in Furniture Making

Terminalia myriocarpa Steud.; *Panisaj* (N), Combretaceae.
Terminalia tomentosa W.B.A.; *Pakasaj* (N), Combretaceae
Juglans regia Linn; *Okhar* (N), Juglandaceae.
Duarbanga sonneratioides Ham.; *Lampatay* (N), Lythraceae.
Michelia sp. Linn.; Mgnoliaceae
Cedrela Toona Roxb.; *Tooni* (N), Meliaceae

6. Dye Yielding Plants

Juglans regia Linn.; *Sungey* (T) *Okhar* (N)
 The leaves of the plant are boiled and dye extracted has ash colour.
Rubia cordifolia Linn.; *Nhyem* (L), *Majitho* (N), Rubiaceae.
Rumex neplensis Spr.; *Hlhale* (N), Polygonaceae.
 It gives brown colour when yielded for dye.
Mehuwia sikkimensis; *Kesari* (N),
 Bark of the tree yields yellow colour.

STRATEGIES

Appropriate and right strategies could be planned only if the following aspects are properly identified and assessed in a more pragmatic way:

- (a) The needs of the people around
- (b) State of resources management and possibilities of improvement.
- (c) Long term changes in the ecosystem through the implementation of national programmes.

The requirements of the people include fire wood and timber for various needs. Firewood for cooking purpose and timber for agricultural implements and for construction of cheap dwelling houses. Normally they meet their requirements from *Khas* forests and rode side plantations. In many areas, particularly in East Sikkim, these sources are drying up and the local people are encroaching upon reserve forests. Village women require to go long distances to gather wood from these forests. In areas like Rabangla, people are using costly woods like Champ (*Michelia* sp.) as firewood along with other trees. Urban populations of Gangtok, Rangpo, and Singtam demand charcoal for their fuel requirement. In fact, Gangtok is the principal market for charcoal and there is huge demand for it. Many important nitrogen fixing tree species (*Alnus* sp.) were cut in charcoal making at lower altitudes. Liquor shop owners mostly Nepalese, locate all over the state, particularly where ever there is bazar or junction of more than one route of transport and consume firewood in significant quantities. Trees like *Nyssa sessiliflora* and *Castanopsis* have been eliminated totally in few parts of East and South Districts of the State.

The biggest problem of the State is the shortage of firewood fuel for defence purposes. The task force of Department of Environment has ascertained in several localities that on an average about 4 kgs. of fuel wood is required per head per day. The total requirement of State in

that way could be accounted to 5 lakh (0.5 million) tonnes per year. The quantity required for cardamum drying at the rate of 2 kg. per kg. of cardamum (in traditional kilns) demand another 23,000 tonnes per year. The industrial demand from the state as well as from the neighbouring states can be reckoned at 1,77,000 tonnes. Thus the total requirement of fuel wood would be 7.0 lakh (0.7 million) tonnes (Task Force Report, 1982). This colossal quantity of firewood requirement is a big problem to the State.

Regarding timber requirement, orange traders consume lot of timber for box wood planking. Rangpo, Mangan and Melli are the principal markets for its sale. Much Sal (*Shorea robusta*) is cut off earlier from Rangpo and Singtam towns of Tista Valley. *Juniperous* plantations are cut off heavily for the sake of pencil industry at lower altitudes. Such an unplanned felling resulted in the total depletion of the stocks in few areas. Thus the high demand for timber and firewood resulted in heavy discrepancies. Reduction of waste at all stages of production and utilisation is a must to cope with the shortage of forest products. It requires modern logging techniques for felling and logging of trees. Illicit cutting of trees is a common feature particularly near the habitation of the area. The marking system, under which a group of persons is allocated timber for their personal use has become ineffective. This resulted in overfelling and illicit felling in many instances. Large scale encroachment on *Gorucharan* and *Khas* forests has taken place. Lack of proper demarcation of these areas from other lands and eviction of encroachers without punishment are the reasons for the persistence of this problem. The pressure of enhanced livestock population contributed significantly to degradation of forest resources. Accessible areas in the East District of the State are badly exposed and natural regeneration of few economically important species such as Sal is affected.

Another cause of the degradation of these forests has been the hill roads. Development of such a vast communication system with total disregard to environmental aspects resulted in debris

covering forest vegetation, orchards and agricultural fields. Land slips became a regular phenomenon during rainy season. Plantation of soil binding species such as *Agave* is to be encouraged in this geologically sensitive region.

Quality of life is substandard as regard to medical facilities. The human population, residing in isolated villages on hill tops and slopes, depends mostly on the natural remedies for their body ailments. Because of the difficult terrain with varying altitudes, and meagre hospital facilities, people prefer to go to herbal doctors instead of Government Hospitals which are distantly located. The body ailments include cuts, fever, headache, cough, body pains, rheumatism, intestinal and gynaecological disorders. The herbal doctors in these regions are called 'Jhankris'. Though a list of forty-two species are recorded in the survey used for various body ailments, collection of many species is limited to just local population requirements. However, collection and marketing of some crude herbs is an economic activity of few populations and carried out with the least regard for conservation. Gangtok, Rabangla and Rhenok are the principal crude drug markets in the State and the large scale collection of *Lycopodium* (*Lycopodium* sp. *Jatamansi* (*Nandostachys* sp.), Aconite (*Aconitum ferox*) and calmus *Acorus calmus* may result in depletion of these medicinal herbs totally in the long run. Possibility of cultivation of these economically important plants is to be investigated to counter depletion of these plants.

Sikkimese living in rural areas are very poor. Their staple food is boiled rice and maize which they eat twice a day. However, a large number of food plants that grow wild are gathered from the forests to meet their nutritional requirements. Among the twenty nine species recorded in the survey, only bamboos are seen growing in few households. *Phyllostachys* sp., *Bambusa* sp. and *Arundinaria* sp. are to be encouraged as part of garden plantation as they would substitute daily requirements of the people. Other plants recorded in the survey are collected from the nearby village forests both for their personal use and to sell

in nearby markets to earn some money. Collection of dye yielding plants is another major activity of women and children. Government cottage industry located at Gangtok and about sixty five carpet weaving units spread over the State readily purchase this dye material from the people. Stripping of barks of Walnut (*Juglans regia*) is a common noticeable problem with people in reserve forests. *Majitho* (*Rubia cordifolia*) was also lopped off heavily in Chungthang, Lachen and Lachung ares.

In the light of the above demands from local people, new strategies are to be developed and a sustained supply is seen to be maintained to meet these needs.

The economic structure of the state is distinctly agricultural base. Forest and agriculture go together and would be complementary if practised by people in the form of agroforestry.

Trees like *Salix aquatica*, *Salix viminalis* and *Eucalyptus* are to be encouraged in the forest farming practices. These programmes definitely would help the existing dilemma of the State in meeting the fire wood demand. Traditional kilns which are used for cardamum drying are to be improved to curb the wastage of fuel. Plantations on road sides, river banks and in village barren grounds is to be encouraged to complement the Public Works Department (P.W.D.) mesh works.

To meet the timber needs of the state, instead of exploiting reserve forests, suitable species are to be grown in captive plantations. This type of forestry is entirely commercial and a bankable proposition. A perusal of the land utilisation budget (Table 3) indicates that out of 7,299 sq. km. total area of the State, 14.61% of the land is under permanent pastures and miscellaneous tree crops. This constitutes about 106.66×10^3 hectares of land. Besides, even under agriculture which constitutes 79.06×10^3 hectares land, net area sown is only 64.93×10^3 hectares while the area under fallow uncultivated land etc. together form 14.13×10^3 hectares. This vast area of land could be profitably used for various programmes of social forestry. Such a plan leads to revegetating the waste land of the State. This will have

distinct environmental, social and economic benefits and help people in multiple ways.

If the agroforestry system is widely adopted in the State it would be possible for large quantities of fruit, nuts, green vegetables and herbs could be grown. This could lead to great improvement in the diet of the people. Collection of some fruits from the plants growing wild is to be replaced immediately with organised and proper cultivation of these species in the waste land available to supplement the nutritional demands of people. Inherent problems in the

Table 3: Land utilisation in Sikkim

S. No.	Land use	Area $\times 10^3$ Hectare	Per cent
1.	Forest land	256.21	36.34
2.	Permanent pastures and culturable waste	102.49	14.04
3.	Land under misce- llaneous tree crops	4.17	0.57
4.	Agriculture	79.06	10.83
	(a) Net area sown	64.93	
	(b) Area under culturable fallow	0.50	14.13 1.96
	(c) Uncultivated land	7.02	
	(d) Waste land in operational holdings	6.61	
5.	Barren and unculturable waste	209.01	28.64
6.	Land put to non- agricultural use	69.96	8.58

management of forests such as marking system, is to be taken care of. There should be stringent rules to control overfelling and illicit felling. The involvement of people is very important in the integrated development of forests. These populations, particularly Lepchas, Sherpas and few Nepali groups know much about the forests, having lived for many centuries in this habitat. They have a great practical knowledge of Natural History and with a little proper scientific training, they could successfully farm the forests. Many tribals particularly of Dzongu, Lachen and Lachung regions suffer unemployment for

the most part of the year. Their services could be profitably used by involving them in the over all eco-development of the region. If such activities are taken up, poverty could be easily banished in the state and unemployment greatly reduced. A photo-synthetic model of development is needed for the overall development of the State (Khoshoo, 1982).

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