## ABSTRACT

The region under study is situated at an altitude of 1500 mtr with its peculiar charm, located at 22 km East from Namchi and 24 km west from Rangphoo. The place falls within Namchi district of south Sikkim between $27^{\circ}7'40"$ and $27^{\circ}11'20"$ North latitude and $88^{\circ}27'40"$ to $88^{\circ}32'20"$ East longitude occupying strategic position in the Himalayan tract. This region, thus, claims special identity in respect to it's strategic position in the sub-Himalayan hilly tract in the southern part of Sikkim. Its flora is significant from the scientific, cultural and utilitarian view points. The region provides a wide range of habitat displaying a wide range of ecological diversity. Phytogeographically also, the region occupies a key position. The region under study has an agro-forestry based economy.

In keeping with the other ecologically degenerating regions of the world, the ecosystem of this region is gravely threatened. The wanton assault on forest has depleted the green cover consequently exposing the soil to the effect of erosion, leaching, insolation and radiation thereby much of the normal biochemical cycle is lost causing a drastic reduction in the rate of natural regeneration.

Recently due to the policy adopted at the national level, large-scale plantation is being encouraged in connection with

eco-development programmes. However the utilisation of the locally available plant resource is a pre-condition for the restoration of ecological condition of the region. It is, therefore, of primary importance to understand the present day plant resource of the region. As the development and distribution of floristic elements are very much dependent on the ecological condition of the concerned region, emphasis has been given to study the floristic composition and ecological condition with special interest on the behaviour of different plant species from phytogeographical point of view. Out of the study on the earlier records on climatic factors, it has been noted that since 1850, the rainfall has been gradually declining from 3477.51 mm (1850 —1855) to 2494.5 mm (1984-1989). Thus the vegetation, now-a-days, is being subjected to stress condition as compared to earlier days.

During investigation some ecological observations on Namthang and it's environs have been made after accumulation of information from various sources. In this connection collaboration has been made with the National Bureau of Soil Survey and Land Use Planning (N.C.A.R., Nagpur, India) with it's regional centre in Calcutta. During the preparation of topographic section, it has been noted that less than 800 m elevation shows the lower erosional surface, 800-1200m the middle erosional surface and above 1200m represents upper erosional surface of the mountains. The height gradually slopes down towards south-

east having an average height of 300-600m A.S.L. The study of drainage and the river system of the region has specially been emphasised due to the fact that now-a-days catchment area has been noted to be very important from ecological point of view. In connection with the study of this aspect, it has been noted that Teesta is the main river with a large number of tributaries feeding it. The slope gradient ranges from about 33% in areas of escarpment to about 2% along the main river in the east. Landslides are frequent and their occurrence is accentuated by frequent distrubances. The unstable condition of the mountain formation and the friable nature of the terrain cause considerable meandering in the river course. River terraces, slip off slopes, hanging valleys, facetedspurs and other land features have developed due to intermittent upheavels of the land forms.

Based on the morphology as influenced by various environmental factors described and soil characteristic, soil series, the fundamental units have been classified as per U.S.D.A. soil taxonomy. The soils dominantly belong to Entisols and Inceptisols. All the soil samples are found to be acidic in nature with pH ranging from 4.5 to 5.8, and low clay content which decreases with increasing altitude. There is high Nitrogen content and low available Potassium along with medium phosphorous availability. Among the micro-nutrients a maximum range of 52.1 to 110 ppm for Iron and a minimum of 0.4 to 6.5 ppm for zinc has been observed. The available Zinc, Manganese and Copper showed negative correlation while Iron showed significant positive

correlation (r = 0.601) with the organic matter. The available Copper, Manganese and Zinc showed positive correlation and available Iron showed negative correlation with pH. The percentage of Carbon, Nitrogen and Hydrogen in Humic acid extracted from the soil of the study site is found to be greater than that in the corresponding Fulvic acids. With the increasing altitude, the percentage of Hydrogen in Humic acid is observed to be increased while the percentage of carbon showed a corresponding decline.

Due to rapid urbanisation, the growth of human population has been observed to be at increased state and for this reason biotic influence on vegetation is inevitable. This increase in population coupled with the increased demand on natural forest areas for cultivation of cereals for food and also for fuel, forest areas are being destroyed at a greater pace. Similarly, increased communication, even with remote villages, facilitates more migration of people from outside along with their domestic animals and consequently more interference with the vegetation. The major part of this area has been noted to have population density of 1-4 persons/ha.

The primary virgin forest has been pushed to precarious slopes and places which are beyond human access. Majority of the forest patches are secondary in nature. Vegetation of this area has been classified on the basis of physiognomy and structural features of the plants in relation to the altitude of the hill and climatic conditions, especially the rainfall. Three vegetational zones i.e. Tropical deciduous Sal forest (Plantations 100-600m), Tropical Evergreen (600-1300m), and Sub-Tropical

evergreen (1300-1800m), have been marked out. The different plant species in various zones of primary forest have been worked out. A change of vegetational structure for secondary forest formation due to the influence of various factors have been noted. The primary vegetation was in confirmation with the description of Champion (1936) displaying at least three vertical stratification. The canopy layer composed of Sal and Teak in association, or at places, either of them forming the canopy layer. The second storey in tropical zone was formed of the species such as Schima wallichii, Albezia procera, A. lebbeck, A. marginata, Hellobia philippensis, Ficus cunia, F. nemoralis Cynocardia odorata, Elaeocarpus lancifolius. The third story is made up of such shrubs as Clerodendron spp., Osbeckia treutleriii, Mussaenda glabra, Artemisea indica, Senecio denaeiflora and among the lianes Dioscorea bulbifera, a Thunbergia lutea and Smilax aspera are common. The species of Lantana, Sida, Eupatorium etc forms thickets on regions well illuminated. The sub-tropical region have bushy tree species with not so distinct stratification, however the herbaceous and the shrubby layers are prominent. The top storey is formed by such species as, Exbucklandia populnea, Prunus nepalensis, Alnus nepalensis, Betula alnoides, Castenopsis hystrix, Litsea polyantha, Oestodus paniculatus etc. In many places, the trees are found merging with the second storey components like Vibernum erubescens, Quercus glauca, Lindera spp., Daphne involucrata, Symplocus theefolia etc. Many disturbed regions are located within the primary forest

leading to several edaphic formations. They are observed in several stages of succession depending upon the nature and extent of damage to the primary vegetation. Herbaceous vegetations are found as the first succession stage. The pioneer species observed in this region are, Euphorbia hirta, Mimosa pudica, Oxalis corniculata, and species forming thickets such as Eupatorium and Lantana along with grasses and legumes are observed. Cultivated and other useful plants with special reference to food, medicine and ornamental value available in the region have also been recorded. Special emphasis has been given on the survey of various plant materials used by the local people. Besides, common trees yielding timber, fibre and fruits have been identified.

In connection with the plant resource survey of Namthang and it's environs in Namchi (Sikkim), emphasis has been laid upon the collection of plants, identification and preparation of the herbarium. Taxonomic details are avoided except flowering and fruiting periods, local names whenever available along with local use and values if any and notes on frequency of distribution of 560 taxa with 558 angiosperms and 2 gymnosperms. The Angiosperms are further distinguished into monocot and dicot with 130 and 428 taxa respectively.

The system of Bentham and Hooker (1862-1883) with some modifications based on recent knowledge has been followed during the representation of the sequence of families. The monocots includes 130 species under 81 genera and 11 families. Similarly dicots cover 428 species under 286 genera and 74 families.

Based on total number of collection percentage occurrence of family, genera and species have been observed to be 85.05%, 77.50% and 76.42% respectively. Similarly in monocots, Family, genera and species have been represented by 12.64%, 21.95% and 23.21% respectively. The approximate ratios between the family, genus and species of the angiosperms have been worked out. The monocot-Dicot ratio in terms of family, genus and species have been calculated to be 1:6.7, 1:3.3 and 1:3.5 respectively. The genus species ratio for angiosperms is 1:1.5 approximately.

The different families in order of dominance have been worked out on the basis of the number of taxa incorporated in each family. Gramineae has been noted to include maximum of 45 taxa under 33 genera, followed by Orchidaceae and compositae with 40 taxa under 19 genera and 37 taxa under 26 genera respectively.

The families in order of dominance has been worked out to represent Gramineae, Orchidaceae, Compositae, Urticaceae, Scrophulariaceae, Labiatae, Rubiaceae, Cyperaceae, Rosaceae, Leguminosae and Euphorbiaceae.

About 40 genera have been worked out in order of dominance on the basis of proportionate distribution of species in each of the genera studied. The genus Bulbophyllum recorded highest with eight species under it. The second place is shared by genera; Cyperus, Elatostemma, Polygonum, Desmodium and Impatiens with 7 species each. On the other hand, each of the genus from Clematis and 18 other genera include minimum of 3 species each.

After consulting different floras, Monographs, Journals and various other literatures supported by different authentic herbarium specimens of various herbaria, plant elements of Namtheng and it's environs have been studied from Phytogeographical point of view.

The percentage occurrence of species common to different botanical regions in the world has been prepared of which Chinese (35.71%), Japanese (10%), Malayasian (32.14%), South-East Asian (74.5%) and Central and West Asian (25.71%), Nepal (39.28%) Palaeotropical (31.25%) elements are remarkable. The European elements are represented by 1.78% and Neo-tropical, Australian and Pan-tropicals contributed, 4.42%, 4.64% and 8.30% respectively.

The percentage occurrence of various species common to different botanical regions in India has been worked-out. The study reveals that the flora of the region under study is very much akin to that of the Eastern Himalayas (79.15%) of which it forms a part, as against the western himamalyas (45.93%) or Gangetic plains (25.08%) or Malasian (32.14%) or to Nepal (39.28%). Inspite of drastic change in climatic conditions and the change undergone by different families in their dominant status since the days of Hooker, the vegetation in general retains it's dominant elements, which is Eastern Himalayan in nature.

The data presented in this part of the work is an outcome of more than 5 years of study. The plant resource survey reflects some information and knowledge which are valuable not only from

academic point of view, but also from their application point of view. The comprehensive list of plant resource will be helpful during selection of species for manipulation of forest to encourage plant cover and to develop agro-forestry in connection with ecological and economic development of the region. Besides, the ecological and phytogeographical study may help for better understanding of the trend of evolution of flora and the adaption of various plant species under present day environmental situation of stressed condition. It is reflected from the observation that a gradual accumulation of Malaysian element (32.14%) and central and West Asian elements (25.71%) is operating under the influence of predominating tropical climate as against various european elements of 1.78% and Australian 4.64% recorded from the region.

The occurrence and mutual relationship between species is an important aspect of community structure. The quality of environment can also be judged from phytosociological angle which enables to prepare a remedial measure of the malady. The study of Phyto-sociology reveals a rich vegetation. The ten dominant species are listed as follows: -

Pryneria diandra, Cymbotis vera, Eragrostis nutans, Gallium hirtiflorum, Eupatorium adenophorum, Arthraxon sikkimensis, Agrostis myriantha, Hydrocotyle himalaica, Polygonum chinensis and Bidens pilosa.

The relative density, relative frequency, relative dominance and Importance value index of Pryneria diandra and Bidens pilosa the first and the last dominant species in the list is,

33.24%, 15%, 6%, 54.24%; and 3.65%, 12%, 2.25% and 17.90% respectively. Further the dominance of the Therophytes in Natural forest, Plantation forest and grassland as (40.50%), (39.13%) and 56.49%) respectively as against Phanerophytes of 5.06% in natural forest, 12.31% in plantation forest with a surprising nil in grassland indicates a disturbed habitat condition. It further indicates a decreasing rainfall, increasing acidity of the soil and overall tendency to develop towards a xeric condition.