Summary of Completed/Ongoing Projects

AN APPROACH TOWARDS EQUITABLE DEVELOPMENT FOR BIODIVERSITY CONSERVATION AND SUSTAINABLE GROWTH IN GOVIND PASHU VIHAR SANCTUARY, UTTARKASHI, GARHWAL HIMALAYA

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To conserve the shrinking biomass resource is the need of the hour. There is no exaggeration to say that human survival itself is imperiled due to biodiversity loss. Keeping this view in mind several FFT's (Fact Finding Tours) programme were organised by SHER (Society for Himalayan Environmental Research) within Govind Pashu Vihar Sanctuary and National Park in which various factors responsible for the loss of phytodiversitical wealth of the region were investigated thoroughly. Letters were written to concerning authorities acquainting them with deteriorating biological diversity and giving suggestion for both *in-situ* and *ex-situ* conservation measures that could be undertaken to tutelage endangered medicinal and aromatic plants. But nothing was done in this context during the span of more than eight months. Therefore this project proposal was submitted to G.B. Pant Institute of Himalayan Environment and Development, with the main motive of development of demonstration site of *ex-situ* conservation of rare and threatened taxa.

Results of random sample plot survey revealed that *Aconitum heterophyllum* is most vulnerable to illegal exploitation practices followed by *Aconitum atrox, Dactylorhiza hatagirea* and *Jurenia macrocephala*. Species like *Polygonatum verticillatum* seems to be out of commercial exploitation. In order to collect the germplasm of some species of commercial importance several tours were organised at different pockets of Garhwal Himalaya. Efforts were made to plant living germplasm as well as seeds collected from different localities separately in nursery site. Some seeds were taken to Vikasnagar in order to workout their germination potential, and growth of seedlings during the winter season.

In totality 1,25,000 seedlings of most economically viable plant species were raised in nursery beds at Majhota Tok in Dhatmir village. All the experiments pertaining to the multiplication of these species which comprises methods of vegetative propagation and seed germination under different concentration of hormone, soil texture and sowing depth were conducted n nursery site, and were observed for sprouting of leafy shoot and survival percentage. After identifying the best results these experiments were replicated for respective species in larger scale. Finally the replicated experiments were observed for the production of usable plant part.

The effect of NIAGARA on tuber cuttings of *Aconitum atrox* at 100 ppm concentration enhances the percentage of sprouting in middle and lower segments in comparison to control within the nursery site. The fresh weight of tubers at the end of first year enhanced under NIAGARA treatment. But no effect was observed in case of number of sprout particularly in lower and middle segments. Similar studies when conducted under demonstration site exhibited a great decrease in sprouting percentage under control as well as hormonal treatment.

The response of basal part of stems of *Aconitum atrox, Aconitum heterophyllum* and *Dactylorhiza hatagirea* under 100 ppm concentration of NIAGARA showed a considerable increase in sprouting percentage in comparison to control. 12% of *Aconitum heterophyllum* plants reached to flowering stage within one year. Not only this but the percentage of flowering almost doubled on NIAGARA treatment. NIAGARA at 50 ppm concentration enhances the sprouting percentage in *podophyllum hexandrum, Paris polyphylla* and *Polygonatum verticillatum*. The fresh weight of rhizome also increased with hormone treatment in comparison to control.

Application of STIK and GA3 on cut parts of dormant shoot buds of *Dactylorhiza hatagirea* showed that the length and gross weight of roots increased significantly but the natural shape of tuber (paw shape) was distorted completely. GA3 at 100 ppm concentration significantly enhanced the germination percentage in *Aconitum atrox, Aconitum heterophyllum, Saussurea lappa* and *Selinum wallichianum*. However, in *Rheum australe* GA3 treatment does not show any positive correlation. GA3 treatment reduces the germination percentage in *Valerina jatamansi*.

Germination of *Aconitum atrox* and *Aconitum heterophyllum* observed under three textural groups of soil exhibited a very significant correlation. Sandy loam is found most conducive as far as growth and development of seedling is concerned, however germination percentage is observed highest in silty loam type of soil. In silty clay loam type of soil germination percentage was found very low almost half to that of silty loam. The fresh weight of roots also reduces gradually from sandy loam to silty clay loam.

Seed of *Aconitum heterophyllum* sown at the depth 0.5cm exhibit a very high germination percentage in comparison to seed sown at the depth of 0.1 and 0.3cm. The percentage of emergence of true leaf as well as fresh weight of roots also increased with increasing depth 0.1 to 0.5cm.

The work for the transplantation of seedling and plantlets in demonstration site started during the month of October and November. One year old seedlings/plantlets of *Aconitum atrox, Aconitum heterophyllum, Paris polyphylla, Polygonatum verticillatum, Saussurea lappa* and *Selinum wallichianum* were transplanted in well prepared terraced field during the October month of 1995 and 1996. Adequate care of plantlets in demonstration site was taken during the winter season and dry summer months. For the restoration of degraded land more than 15,000 plantlets of *Hippophae rhamnoides* were planted with the help of local people.

Various Eco and TRUGA (Training for Rural Gainful Activities) campus were organised at Dhatmir village in order to raise awareness amongst the local populace regarding the biological diversity of the region and to motivate them for cultivation of these herbs in their private land. 10 progressive farmers were selected from Dhatmir village and were trained in various aspects of agrotechniques pertaining to the cultivation of medicinal herbs. With the completion of project duration (3 years) in December 1996, the land owners of demonstration site were involved directly in ongoing project activities under supervision of SHER. In addition to this three trained farmers were also provided with the seedlings of *Aconitum atrox* and *Aconitum heterophyllum* which they planted in their private land. Today many farmers are willing to cultivate these medicinal herbs, but the main hurdle is non-availability of Germplasm. In order to meet out the demand of villagers and to conserve the genetic resources SHER is engaged in establishing a Germplasm and Technical Resource Centre (GTRC) within the Govind Pashu Vihar Sanctuary and National Park.

ASSESSMENT OF BIODIVERSITY AND INFRASPECIFIC VARIATION AMONG TWO REPUTED MEDICINAL PLANT GENERA *ACONITUM* L. (RANUCULACEAE) AND *PODOPHYLLUM* L. (PODOPHYLLACEAE) IN THE HIMALAYA

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Aconitum in North West Himalaya is represented by 10 species and 2 varieties and *Podophyllum* by one species. A detailed studies on biodiversity assessment and infraspecific variations of *Podophyllum hexandrum, Aconitum balfourii, A. falconeri, A. heterophyllum, A. laeve, A. violaceum* was carried out based on field studies as well as earlier collections in herbaria. Although most species of these genera exhibit remarkable morphological variations, no infraspecific taxa have been recognised (except under *A. heterophyllum*) as these variations are observed to be continuous. A new variety *A. heterophyllum* var. *roylei* has been described. *A. heterophyllum* and *A. violaceum* are shown to be morphologically highly diverse. Genetic diversity in this group is least studied. The taxonomic treatment of the genus includes a key to all species, correct nomenclature, distribution and useful taxonomic notes, where possible. In the present study *A. ovatum* and *A. cordatum* have been shifted back under *A. heterophyllum. A. kashmiricum* is also treated here as a morphological variant of *A. kashmiricum. A. balfourii* var. *rhombilobum, A. falconeri* var. *latilobum, A. heterophyllum* spp. *parciflorum, A. laeve* var. *curvipilosum*, *A. violaceum* var. *robustum* and *A. violaceum* var. *weileri* have been reduced as synonyms under their typical varieties. *A. falconeri* has been reported for the first time from Kumaon Himalaya. Lectotypification has also been done for a few species.

A critical observation was also made on the nature of micromorphological characters (hairs) of 4 species of *Aconitum* and one species of *Podophyllum*. All the species (*A. balfourii, A. heterophyllum, A. laeve* and *A. violaceum*) studies for hairs can be easily differentiated based on hair characters. The hairs varied mainly in density, type, orientation and its presence and absence on different parts of plants.

Extensive field survey was undertaken to Valley of Flowers, Hemkund, Sunderdonga, Pindari, Har Ki Dun, Milam, Shujua bugyal glaciers and collected all available species of *Aconitum* (*A. balfourii, A. laeve, A. heterophyllum* and *A. violaceum*) and *Podophyllum hexandrum*. The population of these plants throughout its range was observed to be very sparse and decreasing day by day and receding towards higher and higher elevation as also observed by Shah (1985).

Discussing the current status of the species, it is said that owing to the medicinal virtues, most species of the genus have become critically endangered in their type localities. Both *in-situ* and *ex-situ* efforts are recommended to conserve the genetic diversity in these species.

LANDUSE AND LAND CAPABILITY MAPPING IN PART OF KUMAON LESSER HIMALAYA

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The main objective of the study is to evolve an optimum landuse framework based on scientific and pragmatic land capability classification, for the sustainable development of rural ecosystems in the Lesser Himalayan watersheds of Kumaon. The research problem was approached by catering the analytical components of Landuse survey and mapping, geomorphological mapping, soil survey and analysis, environmental hazard zone mapping, land capability classification, landuse planning and delineation of viable agro-ecological units. Sim Gad Watershed encompassing a geographical land surface of about 53.90 km^2 in the Lesser Himalayan ranges of district Almora, in Kumaon region of Uttar Pradesh has been selected as the study area for the present investigation.

The landuse survey and geomorphological mapping were carried out using Survey of India topographical sheets at scale 1:50000, cadastral maps, and field survey and mapping. The physio-chemical analysis of soils was done using standard soil survey techniques including intensive and extensive sampling and laboratory and field experiments. Landslides and erosion were considered as principal environmental hazards, and delineated and mapped using field survey, remote sensing and GIS techniques.

The land capability classification is based on the scientific parameters of surface slope, soil depth, soil texture and erosion status. The entire land surface of the watershed except, forests, portions of uncultivable wasteland and areas under other uses, were surveyed for land capability analysis, and classified into three categories of land - (a) good quality land, (b) medium quality land, and (c) poor quality land. Out of these three classes of land identified in the region, the first two were found suitable for the purpose of crop farming.

An optimum landuse framework was evolved for the watershed based on the land capability classification, environmental hazard status and through community participation. Drastic changes have been suggested in the traditional landuse pattern through increasing the forest cover from 52.13 percent to as much as 63.14 percent by bringing and a considerable proportion of wasteland under community forest. The area under cultivation has been reduced by 1.10 percent while the land of the watershed under horticulture has been proposed to be increased from existing merely 2.60 percent to 9.54 percent of the total geographical land surface of the basin.

Finally, taking into consideration the, the proposed land use pattern, the availability and productive potential of natural resources, and people's needs, problems and development options, the entire watershed was divided into three viable and coherent agro-ecological units - (a) Fodder-horticulture unit, (b) Fodder-agriculture unit, and (c) Fodder - vegetable unit.

ESTABLISHMENT OF MODELS FOR REHABILITATION OF REGRADED `JHUM' LAND IN A WATERSHED USING `SWEET IN MIZORAM'

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Mizoram which lies between 21°35'-24°39'N latitude and 92°16'-93°39'E longitude is basically a rugged mountainous terrain state in North East India where about 2/3 of the population depend on agriculture for their livelihood. Owing to the fact that the state hardly has flat land, it favours slash-and-burn or `jhum' or shifting agriculture. Shifting cultivation has been practiced by the farmers from time immemorial and is the major source of livelihood of the people. Due to high population pressure, highest proportion of land of the state are now found under shifting cultivation and also, the `jhum' cycle in recent years has been reduced to 2-3 years. This reduction in jhum cycle results in excessive deforestation, increased soil erosion, loss of soil fertility, depletion of soil nutrient contents, destruction of microbiological activities in the soil, increased weed pressure and unsustainability of, and unsuitability for crop production.

Therefore, shifting cultivation has always been a subject of disapproval by foresters, conservationalists through academic dismissal by economists, ecologists and to the reluctant tolerance by administrators. Heavy and prolonged monsoon in the state further aggravate the danger of soil erosion inevitably linked with the shifting cultivation. Despite all these detrimental effects, shifting cultivation has not been possible to be eradicated. Under the New Land Use Policy (NLUP), the Government of Mizoram identified the poor `jhummias' and provided them some incentive to take up multipurpose fast growing tree species in their land and to wean away from shifting cultivation, however, it hardly yield any fruitful result. The farmers were not ready to change their traditional practices. In order to overcome the above problems, the needs and desires of local people and their interactions with the local resources have been taken into care while devising various models using `SWEET' (Sloping Watershed Engineering Technology) for rehabilitation of degraded jhum land in Mizoram Himalayas.