EXTERNALLY AIDED PROJECTS

Project 1: Collection and dissemination of market information on commercially important plants of Uttarakhand

Findings: The original project period expired on 31-03-08. However, the funding agency i.e. National Medicinal Plants Board of Govt. of India granted extension upto 31st March 2009. The field project activities are, thus completed.

Project 2: Preparation of working Plan of Dadra and Nagar Haveli Forest Division

Findings: Draft Final Report submitted to Dadra and Nagar Haveli Forest Department for acceptance.

Project 3: Delhi Development Report, Forest, Tree Crop Management, Greening of Delhi

Findings: Chapter on Forest, Tree Crop Management, and Greening of Delhi had been written and re-submitted to the funding agency after incorporating the necessary enhancement requested by funding agency.

Project 4: Demand & Supply of medicinal plant sand produce grown / found in Haryana

Findings: District wise data pertaining to cultivation, collection and demand and supply position of 11 selected medicinal plants in the state of Haryana revealed that currently there are 56 functional herbal units in the state and 66 active traders dealing in medicinal plants trade. The study estimated a demand of 690 MT/annum of these species by various herbal units, of which 379 MT is being met from within state by the local traders. Over 500 acres of land area is under cultivation of various medicinal plants.

Project 5: Researches on natural decay resistance of juvenile timbers like poplars [DST sponsored FRI 283/Path-18/External]

Findings: The information regarding the natural decay resistance of poplar clones has for the first time been brought out in India. It is a misconception that poplar wood is not durable. However, the present study reveals otherwise. There is definite variation among the clones/source material for decay resistance; even within same clone of different locations. Poplar blocks are more susceptible to the attack of the white rot test fungus *Pycnoporus sanguineus* than the brown rot test fungus *Gloeophyllum striatum*. Brown rot fungi are more confined to higher altitude regions and from the findings of the present study, it can be suggested that poplar (*Populus deltoides*) wood can be safely used for construction and furniture making at high altitudes.

Unlike most traditional timber species, heartwood of poplar is more susceptible to decay fungi than sapwood. This quality can be used while peelings are made for plywood manufacture. Leaving a central core of inner-wood would give a decay resistant material.

Decay resistance varies within a tree from base to top, maximum resistance observed at 2.5 m height, above and below it decreased considerably. Resistance was more at the base than at the top of the tree. This quality can be used for selecting logs one meter above and below 2.5 meter from the base for selecting material for manufacturing decay resistant plywood and panels.

Clone G-48 from Pind Khakli, Hoshiyarpur and S7C15 from WIMCO, Rudrapur are highly resistant clones against decay. These materials can be used selecting logs one meter above and below 2.5 meter from the base for making decay resistant plywood as well as for construction and furniture making.

Project 6: Income generation for women in rural areas of Uttarakhand through vermicomposting of organic solid waste into manure.

Findings: Four pit vermicomposting unit/ demonstration unit was constructed in FRI campus. On campus and off campus trainings were organized for the women folk of Shivpuri, Kotada, Aamwala, Kandoli, Phoolsani, Bhagwanpur, Rajawala and Telpura villages. Two vermimelas were organized. Total 775 women folk were given on campus and off-campus training and 23 vermicomposting units were constructed on the lands of the beneficiaries of phoolsaini village. Earthworms were cultured in FRI and vermicompost distributed to the rural women.

Project 7: Impact of tourism on Environment of Roopland and Pindari of Nanda Devi Biosphere Reserve of Uttrakhand

Findings: Tourist trend of both the areas, vegetation survey / analysis along the trek routes, soil samples collection and analysis for their physico-chemical characteristics along the trek route and control sites, collection of information for socio-economic studies of both the areas like village wise human population, caste composition, literacy rate, livestock population, people's participation in tourism etc have been done. For participation of stakeholders in tourism, environmental awareness among the local people, meetings were held at Khati, Vachham, Wan, LohaJung, Mundoli etc. villages of both the study sites.

Project 8: Studies on population status and berberine content in different provenances of *Berberis aristata* DC in H.P. and standardization of its propagation techniques (funded by DBT)

Findings : Chemical method for estimation of berberine in the roots of *Berberis aristata* was standardized. Forty three samples of roots of different provenances of Himachal Pradesh received from HFRI, Shimla were analyzed for berberine using the standardized method.

Maximum berberine concentration was found to be in Kharapathar (1.25%), Kinnaur and Shimla (2.50% each) provenances.

Project 9: Deployment of the promising F1 hybrids of *Eucalyptus citriodora* and *Eucalyptus torelliana* for establishment of vegetative multiplication garden and their field trials [FRI/338/G & TP-17/External/2006-2009]

Findings: Natural (spontaneous) hybrids of *E. torelliana* and *E. citriodora* have been picked up based on established morphological genetic makers. To evaluate the growth performance, the hybrids along with the parents and proper control have been established in field trials at 10 locations in the state of Punjab, Haryana, Uttarakhand and Uttar Pradesh. Some of the hybrids between *E.citriodora* and *E.torelliana* displayed superior growth at the age of one and half year. Hybridization has released a new spectrum of variation for making useful selections from these two species. The resistance of hybrids to *Cylindrocladium quinqueseptatum* inherited from *E. torelliana* parent may be helpful for planting the hybrids on sites where *E.citriodora* is prone to the fungus. Some of the genotypes of F_2 generation of FRI- 4, *E. citriodora* and *E. torelliana* parents also showed good growth. Preliminary studies carried out on oil contents of F_1 hybrids of *E. citriodora* and *E. torelliana* have revealed variation in yield and odour. The vegetative multiplication garden of selected genotypes has been established at FRI to get rejuvenated shoots for conducting experiments on rooting of cuttings.

Project 10: DNA fingerprinting of shisham (*Dalbergia sissoo*) clones planted in Punjab [FRI-364/G&TP-21/External]

Findings: Sixty seven clones of shisham (*Dalbergia sissoo*) obtained from Punjab Forest Department were characterized and fingerprinted using RAPD-DNA markers. Twenty two most divergent and distant clones were identified and recommended to Punjab Forest Department for using those clones in their plantation and improvement programs. The level of genetic diversity existing between clones has been estimated and the closely related clones were listed. DNA fingerprints of 67 clones developed and provided to Punjab Forest Department.

Project 11: Development of Live Red Data Book [FRI-277/Bot-42/External/2006-2009]

Findings: Rare and threatened species (*Buchanania lanceolata, G. travancorica, Calophyllum calaba , G. wightii ,Coscinium fenestratum, Humboltia vahliana Cyathea nilgirensis, Myristica malabarica Cyrtostachys renda , Poeciloneuron indica ,Diospyros buxifolia,Syzygium mundagam ,Garcinia , Diospyros buxifolia, Myristica malabarica- , Calophyllum calaba, Garcinia wightii , Garcinia travancorica, Humboltia vahliana , Buchanania lanceolata)* collected from different parts of India and species were reintroduced in the Botanical Garden.

Project 12: Expert system for Indian woods - their microstructure, identification, properties and uses

Findings: Final Draft report' and "Users Manual" submitted. Suggestions received on the same are being incorporated.

Project 13: Wood Anatomy of important commercial timbers of Assam with notes on their properties and uses.

Findings: Described wood anatomy, properties and end uses of 52 timber species from Assam state. The important findings of the project are given below:

1. The card and dichotomous key will ensure the correct identity of the woods of selected tree species of Assam state for utilization point of view and for further researches. It was prepared on the basis of 178 wood anatomical and physical features.
2. Cluster analysis was also done to see the affinity of different species on the basis of the 178 wood anatomical and physical features plus 4 characters of form and commercial importance. Dendrogram showed that species belonged to same genera and genera to same family grouped together while genera of different families grouped separately. For example, members of Magnoliaceae and Dilliniaceae grouped together. In the same way species belongs to Elaeocarpaceae grouped in the same cluster. It showed that physical and wood anatomical features had also significance in taxonomy and phylogeny.
3. Dichotomous key was prepared for the genus *Elaeocarpus* and *Dillenia* at species level.

Project 14: Development of micropropagation protocol for clonal multiplication and germplasm conservation of *Swertia chirata* Buch.-Ham. A medicinally important herb[FRI-333/Bot.-47-Ext. (NMPB, New Delhi)]

Findings : In vitro shoots of Swertia chirata were multiplied on large scale. 10-15 fold multiplication was obtained on MS medium supplemented with 1.0mg/l BAP + 0.5mg/l IAA + 50mg/l Ads. In vitro rooting was standardized. 92% rooting was obtained on ½ strength MS medium supplemented with 1.0mg/l IBA.

Rooted plantlets were hardened and acclimatized under control conditions, thereafter, transferred to soil and pots. A complete tissue culture protocol has been developed.

Project 15. Study on the impact of riverbed material collection on Silviculture, ecology and environment in Uttarakhand Himalayas. (Funded by UFDC).

Findings: Field studies were initiated in 7 rivers viz. Yamuna and Amlawa of Chakrata Forest Division, Gaula, Dabka, Nandaur and Nihal of Haldwani Forest Division and Kosi of Ramnagar Forest Division of Uttarakhand. Data were collected with respect to the impact of material extraction on ecological successions, accumulation of debris, change of river course, soils, volumes of ditches and gradient of catchments as well as lower courses. The following recommendations were made as per findings of study:

- Treatment of upper catchments to reduce debris transported downstream.
- The extraction of riverbed materials in the centre portion of the river is essential to control bank erosion during the influence of flood in rainy season. It is necessary to follow strict rules of extraction by leaving at least 25 m control wide strips on both the sides of the river. The soil on both the sides of the strips should be replenished and controlled by making spurs and dykes at suitable interval (50 m). It will not only bind the soil but also make favourable condition for regeneration and aggregation of species. The spurs will prevent debris accumulation in the adjoining forests.
- The monitoring of extraction area is necessary to prevent formation of deep ditches and removal of soil. Quantity of debris /annum should be calculated from extraction sites by random selection of ditches per hectare. Monitoring involves measurement of chemical, physical, and biological parameters to evaluate the magnitude of change that occurs following remedial and restoration activities and to estimate the rate of recovery of an ecosystem. The patch should be regulated where heavy extraction is done. This work is required to be done in Gaula and Yamuna rivers where extraction is not being regulated. This may cause damage to the ecology of the river and loss of property and life.
- The extraction of materials should not be started from the river mouth in case of perennial rivers. It may cut the river to other direction as in the case of Asan and Timli areas where river course has been changed and back flow is noticed at some places. It creates loss of water in the river and also loss to aquatic fauna.
- The extraction helps in deepening of central river channel, the water in rainy season flows in this channel without making bank erosion. The deepening of central channel enhances succession of the bank resulting regeneration of desired species. Nihal river is an example where debris have been accumulated in the centre of the river as a result the flood water enters in the nearby agricultural

Plate 1.1 Debris accumulation in untrained rivers-damage to forest vegetation

fields and also causes loss of property and lives. Regeneration and succession is badly affected due to heavy debris accumulation. The accumulation of debris is not only harm to forest regeneration.

- The extraction of riverbed materials should be incorporated in the Working Plans of respective divisions as the river mining work is carried out in forest areas of the divisions.

Project 16: Development of Silvicultural practices for promoting cultivation of *Taxus baccata*, *Rhododendron arboreum* and *Phyllanthus amarus* (GO/ UA-18/ 2005) (funded by NMPB.)

Findings: It was observed that germination of freshly harvested seeds in *Phyllanthus amarus* was slower than that of older seeds. Seeds from the first capsules to dehisce after harvest (dark green seeds) had higher percentage germination than those from capsules dehiscing later (light tan seeds). Experiment was carried out on the Effect of Nitrogen and Phosphorus doses on the Biomass production of *Phyllanthus amarus* plants in nursery stages. The results showed that N30P50 had highest the plant height, number of branches, collar diameter, root length, fresh and dry weight of shoot. Further increase in level caused general decrease in plant growth rate. *Phyllanthus amarus* seeds were broadcasted for germination at three different degraded sites in Uttarakhand (Raipur, FRI and Premnagar). It was observed that 5 cm X 5 cm spacing gave highest biomass percentage in *P. amarus.* Experiment was conducted on rooting of branch cuttings of *Taxus baccata* and *Rhododendron arboretum* at Chakrata nursery. It was concluded that best results were recorded in 10,000 ppm IBA in both species (Ta*xus baccata* and *R. arboreum).* Morphological observation of flower study of *Taxus baccata* was conducted. Grafting and air layering in Rhododendron were also performed.

Project 17: Development of Technological package for the production and quality evaluation of seeds of important medicinal plant species under National Medicinal Plant Board (Project No. GO/UA-8/2005).

Findings: Seeds of 100 species of medicinal plants were collected from Ranikhet (Almora), Rishikesh, Mandal (Gopeshwar), Munsiyari (Pithoragarh) and Ramnagar in Uttarakhand. Seeds were extracted, cleaned and upgraded with the help of dodder sieve and gravity separator. The viability of seeds was evaluated by direct germination test and indirectly through TTZ test. Seed morphological parameters such as seed length, width,

Two information booklets on Medicinal Plants Seeds

shape, colour, 1000 seed weight, number of seeds in a single fruit and number of seeds in 1 kg were recorded. Seeds were pretreated with different growth promoters such as GA_3 0.1%, KNO_3 0.2%, H_2O_2 0.1% and subjected to germination test monthly.

Some of the important medicinal species on which studies were conducted are *Abroma augusta, Arus precatorius, Aegle marmelos, Andrographis paniculta, Artemisia vulgaris, Asparagus racemosus, Berberis asiatica, Bergenia ligulata, Catharanthus roseus, Celastrus paniculatus, Coleus barbatus, Costus speciosus, Cymbopogon martini, Gloriosa superba, Hippophae salicifolia, Lepidium sativum, Myrica nagi, Ocimum gratissimum, Peganum harmala, Plantago ovata, Potentilla fulgens, Saussurea lappa, Solanum nigrum, Woodfordia frutocosa,* etc. The research findings has been compiled in the form of two booklets on medicinal plants seeds.

Project 18: Raising of Demonstration Plantations for Augmenting Fuelwood and Fodder Resources and Promoting Income Generation in Two Villages of Uttarakhand[Funded by: Uttarakhand Council of Science and Technology]

Status: Under this project, model plantations of fuel, fodder and income generating species were established in two villages in Uttarakhand. Socio-economic survey showed greater requirement of fuel and fodder species in village Jadi, Chakrata whereas income generating species were in greater demand in village Hadam Dandasli, Dist. Tehri Garhwal. Mulbery, Walnut, Chullu, Kathal, Aonla, Carissa etc. were planted as cash generating species. In future, villagers will get fuel, fruits and fodder from this plantations and these sites will promote income generation in the villages. The plantations are now being maintained by the villagers.