Completed ICFRE Plan Research Projects 2009-10, RFRI

S. No.	Projects	Name of PI	Thrust Area	Research Findings
1.	Improvement of Agar/ Agarwood production in *Aquilaria malaccensis* Sub-project-I: Survey and Selection of desirable genotypes of *Aquilaria malaccensis* and establishment of their field gene bank.	Dr. (Mrs.) Papori Sharma, R.O	Genetic Improvement (Tree Improvement)	The species in India occurred from West Bengal in the west to whole North Eastern region and produces agaru (the black oleoresin solid product) and the agar oil (the essential oil) as a result of infection from some fungi. A valuable perfume retainer much priced by European perfumer for mixing their best grade scents. Hence, Survey and selection of desirable genotype of establishment of their field gene bank is necessary. • Establishment of SSO at RFRI, campus in 2008. • The maintenance of SSO has been done as per the objective. • Development of clonal multiplication protocol trough air layering has been achieved. Project approved by RAG for incomplete objective "Clonal propagation of rooting of shoot cuttings".
	Sub-project II Sub-Project II: In vitro induction of essential Oil components of *Aquilaria malaccensis* Lam. **(3 years, April, 2007 + six months extension till 30-09- 10)**	Sri Satyam Bordoloi, RO	Genetic improvement (Biotechnology)	Several problems are associated with agarwood production. Currently the demand for agarwood far exceeds the available supply. Agarwood is formed only in a small percentage of *Aquilaria* trees. Another bottleneck associated with agarwood production is the age of the *Aquilaria* plant at which agarwood is formed. External signs of the presence of agarwood are also not always obvious. Therefore, trees are often cut down indiscriminately for agarwood. To solve these agarwood production related problems, biotechnological approaches may stand as a suitable alternative. Establishment of a plant cell culture that is able to provide a source of secondary product *i.e* oleoresin or its components would make the agar industry less reliant

				on plant source. This project aims to produce essential oil/ oil components of Agar plant under *in vitro* condition using tissue culture techniques. Under this project, a very efficient callus induction protocol along with cell suspension culture technique have been standardized. Cell suspensions and callus, thus produced, were treated with various elicitor molecules for induction of essential oil and/or oil components. Initial screening of the extracts from treated and untreated cell extracts with Thin Layer Chromatography(TLC) showed some difference which may be due to induction of essential oil components. Furthermore, prescreening with olfactive detection revealed a sweet smell in the extracts from the treated cell cultures. However, for accurate analysis of the cell extract for identification of the induced molecules, a new project proposal has been approved by 12th RAG and submitted for forthcoming 12th RPC for another one year.
	Sub-project III Sub-Project III: Clonal multiplication of *Aquilaria malaccensis* through *in vitro* culture including hardening and out planting **(3 years, April, 2007+ six months extension till 30.09.2010)**	Dr. (Mrs.) Papori Sharma, R.O	Genetic improvement (Vegetative propagation)	The species is one of the most valuable non-timber forest produce harvested from the tropical forests . The seeds are recalcitrant in behaviour hence, handicap for large scale propagation. The clonal propagation of 'extreme genotype' may offer the prospect for production of 'true to type' which may likely to follow the same infestation and leads to the production of increased amount of agar oil. So, tissue culture for rapid and mass propagation of selected genotypes for future plantation programmes. • Aseptic culture has been established from leaf, node, petiole and shoot tip explants. • *In -vitro* culture has been raised from node, petiole and shoot tip explants.

				• For c ulture initiation through direct regeneration, nodal explants has been found to be best. • Sixteen to thirty fold multiplication observed in shoot regeneration. • Experiment for rooting of regenerated in vito shoots has been achieved upto hardening of rooted plantlets.
2.	Genetic improvement of *Acacia mangium* for growth characteristics, pulp and timber quality	Dr. Tara Chand	Genetic Improvement (Tree Improvement)	Mangium (*Acacia mangium*Willd.) commonly known as or Australian teak' is one of the fast growing exotic tree, which enhances soil quality by nitrogen fixation. Mangium is native to Rainforests of Australia, Papua New genea and Indonesia. Mangium was introduced in south Indian states where it performed well in humid tropics of Western Ghat which is climatically similar to humid parts of the north east India. In Assam, it was introduced as a provenance trial in year 1999 at Rain Forest Research institute, Jorhat, where some trees reached up to 20 meters in only seven years. Mangium is successfully grown for pulpwood on 6 to 8 year rotations in Malaysia and Indonesia. Though in our trial, it grew successfully desirable for pulpwood in 4-6 years and some trees surpassed 90 cm girth at breast height (1.37 m) in only eight years. On a longer rotation, Mangium can be grown for saw logs. Its wood is classified as light hardwood with good machining properties. Solid wood makes attractive furniture and cabinets, moldings and door and window components. It can be used as decorative veneer, laminated veneer lumber, particle-board and medium density fiber board. It can

				be dubbed as poplar tree for North east India with more durable wood quality. Keeping in view the growth performance in earlier provenance trial and potential, some of the best performing trees (Plus tree) were selected from the trees growing in provenance trial and plantations. • Plus tree were selected by comparison-tree method also known as point grading method. • The progenies of these trees evaluated in nursery and in field. Early assessment of selected plus trees has revealed large variation in growth of progenies • In nursery, maximum height (75.59 cm) was attained by progenies of P_{T3} followed P_{T16} and P_{T1}. Whereas, maximum collar diameter (2.26 cm) was recorded for plus tree P_{T14} followed by plus trees P_T^4 , P_{T1} and P_{T16} (2.21 and 2.09 cm). In field, significantly maximum height (513.90 cm) was noticed in offspring of P_{T13} at the age of one year. This was followed by P_{T1}, P_{T5}, and P_{T10} (512.50, 510.30 and 507.20 cm). However, these were at par to each other. Minimum height (465.40 cm) was recorded in offspring of P_{T9}. In probing the diameter of the offspring's at age of one year, significantly maximum (100.27 cm) collar diameter was recorded in offspring of P_{T1}. This was followed by P_{T16}, and P_{T2}. Minimum (77.48 cm) collar diameter was observed in offspring of P_{T6} .survival of the progenies was recorded between 80-90 per cent. • A booklet of nursery and plantation management package

				was developed and published and distributed to all the Van Vigyan Kendra in northeast. • Two training on nursery and plantation techniques were organized for the 30 farmers of Demo village at RFRI campus. • 3000 seedling of *Acacia mangium* were planted in the fields of participated farmers in each year. • The Demo/Block plantations are serving as live demonstration of Mangium growing extraordi-narily well in the Assam
3.	Seed production potential, seed and seedling quality of planting stock in seedling seed orchards of *Dipterocarpus retusus* Syn. D. *macrocarpus*	Dr. Tara Chand	Genetic Improvement (Tree Improvement)	The species *Dipterocarpus retusus* Bl. locally known as *'hollong'* belongs to the family Dipterocarpaceae and is an endemic species to north east India. The species distributed in India, Myanmar, Thailand, Vietnam, Malaysia and Indonesia (Rawat, 1998). It is an important commercial timber in the northeastern region (Anon.1997 and Rajput *et al.* 1996). Further, its unique morphological character of producing up to 40 meters of clean commercial bole and preferable anatomical characters makes it most suitable species for plywood industries and is facing excessive pressure. Lately, this species declared as the state tree of Assam. The recalcitrant nature of seed and unpredictable seed years hamper natural regeneration in forest and make artificial regeneration difficult through seed. Even seed supplied for plantation is depend upon the natural forest, consequently, hampering the natural regeneration too. Understanding the importance of the species, improvement work of the species for the production of quality germplasm was initiated during 1998-99. Selection of plus tree of *Dipterocarpus retusus*, assessment of their progenies and further establishment of seedling

				seed orchard (SSO) is one way to supply quality seed in bulk. The pioneer work on the selection and establishment of seedling seed orchard was initiated at RFRI in 1999. A total of 93 plus tree out of 102 candidate plus trees (CPT) were selected from different natural sites in Assam and Arunachal Pradesh. Half sib progenies of 57 plus trees has been raised in progeny trials and seedling seed orchards at Deovan, RFRI.Under this project data of different pheno-events such flowering and fruiting of plus trees has been recorded. Seeds collected from plus trees have been tested for physical properties. Biochemical test for carbohydrates, proteins and sugars has been accomplished. Seeds have been sown in the nursery to evaluate germination attributes and growth performance, which has been achieved.
4.	Documentation of baseline information on shifting cultivation in North East India and restoration of selected stress sites under shifting cultivation through agroforestry in NE India **Sub project –I –** Documentation of baseline information on shifting cultivation in NE India. Sub project –II– **Restoration of Jhum land through intercropping *Rhizobium* inoculated legume trees with agricultural crops in Assam**	Dr. Vishavjit Kumar, Scientist B/ Dr. (Mrs.) I. P. Borah, Research Officer	Forest Productivity (Social forestry/ Agroforestry / Farm forestry)	Shifting cultivators are the most marginalized people. As per the estimates about 0.44 million families are dependent on shifting cultivation for their livelihood in North Eastern states. The maximum (0.12 million) families are in Nagaland followed by Manipur (0.07 million). No dynamics study on families dependent on shifting cultivation have been done except some efforts in Nagaland, Meghalaya and Tripura states. Many agencies like Food and Agriculture Organisation of United Nations, North East Council, Task Force on Shifting Cultivation Ministry of Agriculture, Forest Survey of India, and National Remote Sensing Centre have estimated area under shifting cultivation. The most reliable estimates of area under shifting cultivation in north eastern states

				are of Forest Survey of India and National Remote Sensing Centre (NRSC). As per the NRSC estimates area under shifting cultivation show decreasing trend in last decade. The area under shifting cultivation has reduced to 8772 sq km in 2005 from 34967 sq km in 2000. Nagaland has the highest area under shifting cultivation followed by Arunachal Pradesh. The shifting cultivation is mostly practiced in unclassed forest area which is under the ownership of clans/ communities. The system of common property regime provides universal access to the all community members. The shifting cultivation cycle has come down to 2-3 years in most of the states. The major transformation in shifting cultivation practices recorded are conversion of shifting cultivation lands into teak plantations, orange, kiwi, apple orchards in Arunachal Pradesh; hollong plantations, passion fruit, orange, pine apple orchards in Nagaland; cashew nut, orange, areca nut, banana, broomgrass plantations in Meghalaya; teak, gamari, banana, arecanut, orange plantations in Assam and rubber plantations in Tripura. This has given property right on lands converted into plantations/orchards. • Introduction of *Rhizobium* inoculated legume trees (*Albizia lucida and Indigofera zollingeriana*) in shifting cultivation plots cropped with rice, maize and sesame at Bay Killing and Phumen Ingti villages in Karbi Anglong Assam showed significant improvement in soil

				fertility and productivity. *Rhizobium* inoculated legume trees showed better survival percentage compared to control (un-inoculated trees). Intercropping of rice, maize, sesamom in *Rhizobium* inoculated plots gave maximum crop yield, high soil nutrient content and has better legume tree survival compared to control (traditional shifting cultivation) plots. Soil pH increased significantly in control plot. Planting of legume tree species brings the soil pH towards the acidic value through incorporation of leaf biomass. Low pH value of *I. zollingeriana* plot indicate high rate of litter fall. In successive years of cultivation low pH value was recorded due to accumulation of crop residue and leaf biomass into soil. • The plots having *Rhizobium* inoculated trees showed more soil carbon content. *I. zollingeriana* plot showed higher organic carbon content than *A. lucida*. *Rhizobium* inoculated plots showed significantly high total nitrogen, available phosphorus and exchangeable potassium content and the highest value was recorded in *I. zollingeriana* inoculated with commercial *Rhizobium.* Rice, maize and sesame yield increased significantly in *Rhizobium* inoculated plots. Comparatively higher yield was recorded in successive year in all the three crops.

5.	Assessment of rattan diversity and conservation strategy with reference to Assam	Shri H.R. Bora, R.O	Ecosystem conservation and management (Biodiversity)	• In the present study was explored the diversity, distribution and population status of rattans in eight different protected areas of Upper Assam-namely-Karbi-anglong Wildlife Sanctuary (KAWLS), Karbi-anglong, Nambor-Doigrung Wildlife Sanctuary (NDWLS), Golaghat, Kaziranga National Park (KNP), Golaghat and Nagaon district, Gibbon Wildlife Sanctuary (GWLS), Jorhat district, Dihing-Patkai Wildlife Sanctuary (DPWLS), Dibrugarh district, Dibru-Saikhowa Biosphere Reserve (DSBR), Dibrugarh district, Pawai Reserve Forest (LKM), Lakhimpur district and Poba Reserve Forest (DMJ), Dhemaji district. In the study it is found that in four sites out of eight sites, rattans are formed more or less clustered pocket as in Karbi-anglong Wildlife Sanctuary, Kaziranga National Park, Dihing-Patkai Wildlife sanctuary, and Nambor-Doigrung Wildlife Sanctuary. In other three sites- Gibbon Wildlife Sanctuary, Dibru-Soikhowa Biosphere Reserved, Pawai Reserved Forest, Lakhimpur, and in Poba Reserved forest, Dhemaji rattans clumps are in scattered form. • In the work has been explored 13 rattan species as *Calamus tenuis, C. floribundus, C. flagellum, C. latifolius, C. nambareinsis, C. erectus, C. guruba, C. kingianus, C. khasianus, C. leptospadix, Daemonorops jenkinsianus*, and *Salaca secunda.* • Out of thirteen species recorded in eight different study sites, twelve species have been achieved from

				KAWLS, presented highest species diversity. There ten species of the genus *Calamus* and one species each of *Daemonorops* and *Salaca* have been recorded. Ten numbers of species of which nine species belonging to the genera- *Calamus* and one species of *Salaca* were recorded from NDWLS. There seven numbers of species 6 belong to the genus *Calamus* and one to *Salaca* in KNP, six species five of *Calamus* and one from *Salaca* in GWLS, five species of *Calamus* in DPWLS, four species of *Calamus* from each of Pobha RF of Lakhimpur district and Poba RF of Dhemaji district and two species of *Calamus* from Dibru-Soikhowa have been explored. • Maximum 602.0±39.2 individuals /ha was achieved in pure Cane brake of C. tenuis in Kaziranga National Park with total regeneration of 258.7±16.0/ ha. • A demonstration plot conserving genetic resources of 13 rattan species explored in different study sites have been established in Botanical Garden, Rain Forest Research Institute, Jorhat, Assam.
6.	Establishment of GIS laboratory for systematic creation, management and up-gradation of GIS based forest-database of North-east India.	Dhruba Jyoti Das, Scientist 'B'	Forest Management (Information and Communication Technology)	Geographical Information System have brought revolution in inventorying, monitoring and management of natural resources and provided a powerful tool to the scientists/decision makers. GIS is capable of providing solution to the space and time bound queries in most cost and time effective manner. Keeping in view of the importance and utility of GIS in creation, manipulation and overall management of huge forest-

				database of this region, the present project was formulated. The project is completed successfully; a full-fledged GIS LABORATORY is established in the main building of Rain Forest Research Institute, Jorhat with all basic facilities including state of the art hardware, software and data. Four hundred fifty (450) numbers of Survey of India Topographic sheets of 1:50K and 1:25K scale have been procured from Survey of India, N.E Circle, Shillong. All are stored and georeferenced in digital format. Forest cover map procured from FSI, Dehradun is re-projected and hyperlinked. Geo-referencing and digitisation of soil types, soil erosion, physiographic, geology, and agro-ecology maps is completed. Digitization of Reserved forest from available SOI toposheets is completed. Hyper linking of all available utility and topographic vector layers is completed as a part of creation of GIS based forest data base for entire North East India.
7.	Exploration and documentation of indigenous knowledge of phyto-resources among Mishing tribe of Assam	Dr. T.C. Bhuyan	Ecosystem Conservation and Management (Tribals and Traditional Knowledge System)	Visited Mishing inhabited villages in 8 districts of Assam viz.Jorhat, Golaghat, Sibasagar, Sonitpur, Lakhimpur, Dhemaji, Dibrugarh and Tinsukia district of Assam. Selected 22 locations identified for this purpose. Depending upon the number of informants, villages are selected with the help of local people in the localities. On the basis of information received from local informants recorded uses of more than 150 plants having therapeutic values, food and other indigenous plant application. Collected 49

				species and planted in the nursery for further studies. Some of the important information on the plant species used by ***Mishing*** tribe are – *In* **Pneumonia**- *Solanum indicum (***Banko***), Coriandrum sativum (***Dhania***), Piper nigrum (***Jaluk***), Polygonum plebeium (***Bonjaluk***), Oxalis corniculata (***Aguyup***), In* **Dysentery**- *Solanum indicum* **Banko***), Mangifera indica (***Kedi***), Ocimum sanctum (***Tulasi***),In* **Gastric-** *Terminalia chebula (***Hilika***),T.bellirica (***Bhomura***), Embilica officinalis (***Amlokhi***), Asparagus racemosus (***Satmul***),* **In Joint pain**- *Musa balbisiana (***Kopak***), Ananus comosus (***Matikothal***),* **In insect repellent**- *Vitex negundo (***Posotia***), Eupatorium odoratum (***Gate gere***),* ***Citrus maxima*** **(**Rabab tenga), **Cattle disease**- *Crinum defixum (***Bon naharu***),* **Tongue infection**- *Cassia fistula (***Sonaru***),***Headache***- Heteropanax fragrans (***Keseru***), Pistia stratiotes (***Bor-Puni***),***Bone fracture***- Tinospora cordifolia (***Soguni lota***), Dillenia serpentose. (***Ou-lota***),* **Jaundice-** ***Plumbago zeylanica*** Poka aming (Mish), ***Costus speciosus*** pake jig jig (Mish) etc. Some of the women are also interviewed particularly problem in women e.g. ***Alstonia scholaris (L.)*** bark is used to cure pain during periods. ***Euphorbia hirta*** sor-mon-dotke (Mish) given to women to increase breast milk after child birth etc. It is also observed that some time the medicine man applied more

				than one plant for treatment of a particular disease to provide more impact. Uses of some of plants as insect repellent, plant application to cure jaundice and bone fracture are interesting information.
8	Study of reproductive Biology and Seed Production in Clonal Seed Orchard of *Gmelina arborea* **(3 years, April, 2007)**	Dr. Tara Chand, Scientist-B	Genetic Improvement (Tree improvement)	*Gmelina arborea* (Roxb.) belongs to family Verbenaceae and occurs naturally in tropical and subtropical countries of Asia (Nair, 2001) between 50 to 1300 m elevations. It is medium to large tree that reaches up to 35 m in height and 3 m diameter and is grown under various farm and agro forestry schemes. *G. arborea* besides an excellent sawn timber has also gained widespread acceptance as a plantation species worldwide due to its rapid growth and multiplicity of uses in pulp and fibre production. The wood is used for many solid wood products including furniture, pellets boxes moulding and veneer. *Gmelina arborea* grows rapidly and can be harvested under short rotation, and is thus progressively becoming an alternative to the species harvested from natural forests (Alfaro and De-camino, 2002). Forecasts on the species indicate that there would be about 800,000 ha of *Gmelina arborea* plantations in the tropical and sub tropical by 2020 (Dvorak, 2003). Further, it is estimated that at present less than ten per cent of the total plantations of *G. arborea* have been derived from improved quality seed (Dvorak, 2003) The preliminary work on genetic improvement of *G. arborea* had been carried out by Kumar and Matharoo, 2003, at the RFRI Jorhat using various conventional genetic tools and different divergent populations were assembled in gene bank of the species and two Clonal seed orchard were

				established at two sites, Naharoni (Assam) and Teliamura (Tripura). These orchards are now of age 7-8 years and some of them have started bearing flower and fruits. So study has been undertaken to know the Pattern and time of synchronized flowering, Clonal variation in reproductive structure and seed parameters, seed germination and growth performance of seedlings raised from seeds produced by these clones to bring the improvement programme to logical point. Keeping in view proposed to study the reproductive biology and seed production in Clonal Seed Orchard of *Gmelina arborea.* Under this project, 70 clones of *Gmelina arborea* established in Clonal Seed Orchard were monitored for different pheno-events in Clonal Seed Orchard for two years. Periodical observations were made on vegetative and reproductive events. Data of flower and inflorescence recorded from randomly selected ramets and assessed. Data on various pollination vectors recorded. Fruit development observed from the day of pollination until maturation and dehiscence. Physical properties of seed have been recorded. Seed collected from different clones were sown in nursery evaluated for germination attributes and seedling quality.