CHAPTER-VI

INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY BANGALORE

Institute of Wood Science and Technology (IWST), Bangalore, was set up in 1988, under Indian Council of Forestry Research and Education (ICFRE), by upgrading the erstwhile Forest Research Laboratory merging Sandal Research Centre and Minor Forest Products Unit, functioning in the same campus. The primary objective of establishing the Institute is to carry out research on physical and chemical properties of wood and other tree products, seasoning, preservation and value addition for various specific end-uses with the twin aim of conservation of forest resources and achieving sustainability. Subsequently, activities pertaining to planting stock improvement programme were also initiated in the Institute. Four main Divisions viz. Wood Properties and Uses; Wood Seasoning and Preservation; Chemistry of Forest Products and Wood Biodegradation are functioning at IWST. The Institute maintains three field stations - a germplasm bank, a clonal bank and a nursery at Gottipura; progeny trials, clonal seed orchard at Nallal; field trials on sandal at Yelwala; two out-station marine centres at Visakhapatnam and Kochi; and two test sites at Krishnapatnam and Goa.

A Shore Laboratory for studies on marine wood biodeterioration at Visakhapatnam and a Forest Research Centre at Hyderabad are being established by the Institute.

PROJECTS COMPLETED DURING 1997-98

Project 1: Evaluation of anatomical, physical and mechanical properties of plantation grown/lesser known timbers.

Objectives: Study of anatomical structure of woods with special emphasis on identification of timber, assessment of wood quality; study of physical and mechanical properties of lesser known and plantation grown timber; classification of different end-uses and development of testing methods for wood and wood products.

Results

Anatomical description of 4 more timber species has been completed totalling 44 species for the purpose of identification. Preparation of the report as a book is in progress. Influence of anatomical features on specific gravity in *Tecomella undulata* was examined. Collection of data on specific gravity, certain anatomical features was completed. Strength properties of 8 years old *Tecomella undulata* grown under Wasteland Development in Rajapalayam Taluk of Tamil Nadu ascertained. The wood is found to be heavy, moderately strong, very steady and moderately hard and can be used for furniture, doors, window frames, tool handles and carvings.

Alternate timbers both from plantations and natural forests which have potential for making various artifacts have been suggested. As the end product produced is dependent upon anatomical structure, properties and colour of the wood, these details alongwith tree form and distribution are given for 37 species.

Pith to periphery variation on various anatomical features of 10 lesser known timber species indicated that there is a definite trend of increase in length, diameter and tissue proportions of various elements with respect to radial positions. Influence of anatomical features of teak and *Cupressus* species on growth rate specific gravity, etc. has been studied. Within tree variation in fibre characteristics, specific gravity, pulp yield and quality of 3

clones of *Eucalyptus tereticornis* of four and half year old trees has been completed for assessing the wood quality of different clones.

Work on physical and mechanical properties of 15 years old *E. tereticornis*, within tree variation of 30 years old tree of the same species grown in Bangalore and 8 years old *Tecomella undulata* grown in Agro-forestry model in Tamil Nadu has been completed. A software called CALPRO to calculate strength properties, suitability indices and classification of timber has been developed and is being upgraded. Density and calorific values of *Acacia tortalis, A. nilotica, A. eburnea, A. cupressiformis* and *Tectona grandis* have been determined for their use as fuelwood.

Strength properties of plantation grown 22 years old tree of *Pterocarpus dalbergioides* in Karnataka have been tested.

OLD PROJECTS CONTINUED DURING 1997-98

Project 2: Studies on processing of plantation grown and lesser known timbers for their rational utilization.

Objectives: (a) Effect of Growth Stresses on Processing of Timber from Plantation. (b) Modification in Design of FRI Solar Seasoning Kiln to Improve Energy Efficiency. (c) Weathering of Wood Surface and its Protection. (d) Chemical Modification of Wood. (e) Efficacy of preservatives for enhancing durability of timber.

Achievements

Magnitude and pattern of residual stress in *Eucalyptus tereticornis* and *Acacia auriculiformis* trees of plantation were determined. Results indicated varying magnitude of growth stress at their cardinal points along the height. Interestingly, growth stress observed in leaning trees were predominantly higher in magnitude compared to trees possessing vertical stems.

It was found that the double glass wall system, which is currently being used in the country, exhibited a marginal increase in heat trapping efficiency over single glass wall system, whereas glass wall with blackened wire-net was found to be most efficient over other tested systems.

Wood of *Hevea brasiliensis* and *Pterocarpus marsupium*, exposed to natural as well as accelerated weathering conditions exhibited a severe deterioration of wood surface. IR spectroscopic analysis indicated significant photochemical degradation of lignin. The treatment of wood surfaces by chromium trioxide was found to restrict these photo-reactions.

Hevea brasiliensis treatment with maleic anhydride, acetic anhydride and phthalic anhydride was found to modify the nature of the wood of *Hevea brasiliensis*. Modified wood showed improved dimensional stability compared to untreated wood. Acetic anhydride was found to be the most effective chemical in imparting dimensional stability as well as anti-swelling efficiency during repeated cycles of wetting and drying. Modified wood was found to have reduced adsorption of moisture compared to control.

Durability studies were continued on treated stakes of *Hevea brasiliensis, Ficus bengalensis* and Eucalypts species. *Hevea brasiliensis* (rubber wood) stakes treated with CCA with retention of 0.5 lb/cft preservatives remained in sound condition. Treated stakes of *Eucalyptus tereticornis, Eucalyptus camaldulensis, Ficus bengalensis* were also found in sound condition whereas some of the untreated sample panels had mild attack of termites during this period.

Project 3: Studies on qualitative improvement of *Eucalyptus* hybrid oil for value addition.

Objectives : Modification of aroma by simple chemical reactions for value addition and better utilization of oil.

Achievements

Pleasant smelling oils of perfumery value have been prepared from *Eucalyptus* hybrid leaf oil.

Project 4: Phytochemical investigation of *Machilus macrantha*.

Objectives : To establish scientific debarking techniques to minimise damage to tree and have sustained yield of bark. Isolation of useful chemicals from the bark/wood. Pharmacological or pesticide evaluation of isolates for value addition.

Achievements

Scientific debarking method leaving one or two strips of bark intact along the trunk, with fungicide/insecticide spray resulted in survival of tree and regeneration of bark. Investigations of bark have been initiated.

Project 5: Studies on Red Sanders wood.

Objectives : Study of physical and chemical properties of Red Sanders wood.

Achievements

A simple method to isolate santalins, the colouring matter from the wood has been developed. Effect of visible/UV light on wood is under study.

Project 6: Research on Sandal.

Objectives: (a) Develop simple field tests to classify high oil yielding trees. (b) To study oil content and quality of wood from different provenances. (c) Utilization of spent sandal wood powder.

Achievements

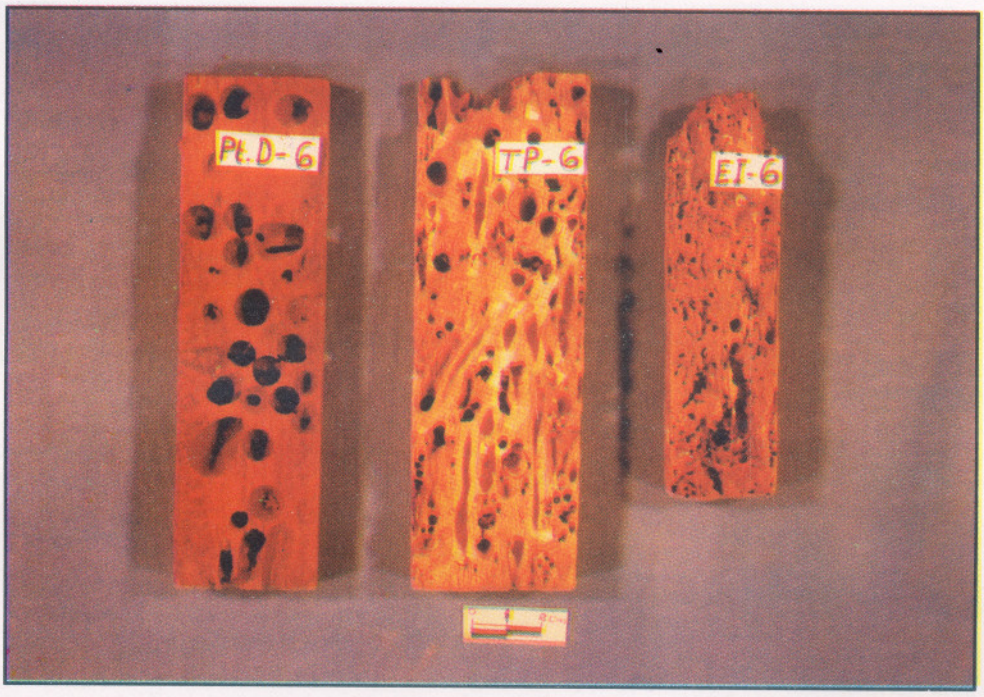
A simple and rapid method for estimating oil content in small (core) samples of sandal wood was developed. Development of colour reaction to differentiate between high and low oil yielding trees was initiated. Studies on content and composition of oil from central and transition zone in sandal wood disc have been completed. Work on utilization of spent sandalwood powder is in progress.

Project 7: Studies on durability of different timbers and timber products against bio-deterioration under terrestrial and marine conditions.

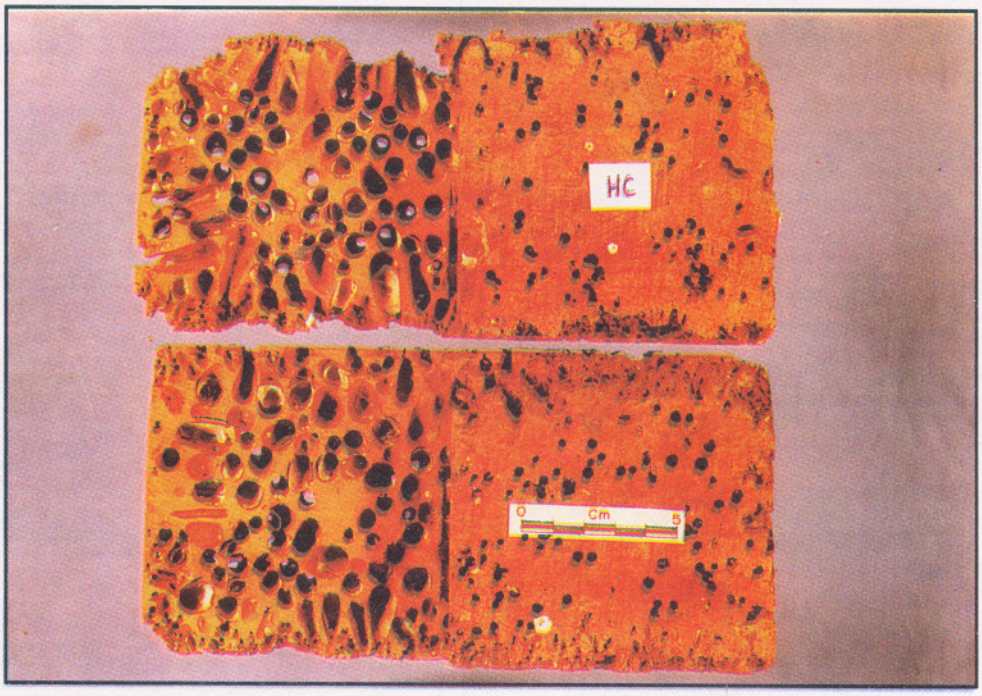
Sub-Project 7(1): Control of biodeterioration with the help of water-borne preservative and bioactive substances under terrestrial conditions.

Objectives: (a) Collection of literature on bio-control methods, preservative treatment etc. (b) Collection of wood and plant extractives and other bioactive substances. (c) Testing efficacy of

Sandalwood in a depot in Tamil Nadu showing damage to heartwood caused by *Aristobia,* termites and fungi



Natural durability studies at Kochi. Split halves of *Pterocarpus dalbergioides* (Pt.D), *Terminalia paniculata* (TP) and *Erythrina variegata* (EI) showing heavy destruction by marine borers within 6 months



Natural durability studies at Goa. Two panels of *Haldina cordifolia* completely destroyed by marine borers within 7 months

Popularization of marine wood protection technology in the field . Fishermen listening to scientists near Chennai

the bioactive substances. (d) Treatment of secondary species and laboratory evaluation of treated material. (e) Recommendations for end-users.

Achievements

Clean, odourless chemical fraction was prepared from creosote by steam distillation. The isolate showed encouraging results in its efficacy to prevent wood decay when impregnated into rubber wood. Commercial wood preservative chemicals like wood guard, wood shield etc. were tested to assess their efficacy against wood decaying organisms. Fungal metabolite of *Gliocladium* (Trichoderma) virens has been tested against wood decay and results are encouraging.

Sub-Project 7(2): Natural durability of different timbers and timber products against decay under terrestrial conditions.

Objectives: (a) Literature collection regarding primary, secondary and tertiary timber species. (b) Collection of available plantation timbers and its products. (c) Testing the durability class. (d) Recommendation for end uses.

Achievements

Wood attacking and related fungal cultures were maintained by repeated sub-culturing the material. LVL (Laminated Veneer Lumber) made from rubberwood was evaluated for natural durability by conducting accelerated lab tests.

Sub-Project 7(3): Studies on insect pest problems of timber kept in storage, used as building material and in other structures and its control.

Objectives : (a) Identification of the timber pests. (b) Studies on the bio-ecology, seasonal occurrence, extent of damage and natural enemies. (c) To study and evolve appropriate prophylactic and other control methods.

Achievements

Incidence and seasonal occurrence of timber borers were very intense in the heartwood of sandalwood stored in the depots (private and Government) in Karnataka, Tamil Nadu and Andhra Pradesh. The loss of wood in depots is as much as 20%. Similarly, termite attack on sandal trees in plantations was also very intense and about 20% of the timber is lost prior to felling itself. Bostrychid attack on Eucalyptus, Cashew, Mango and Subabul was also noticed in considerable proportion leading to loss of 10-15% timber.

Treatment of wood with 1% Chlorpyriphos was found to be adequate as prophylactic against termites and borers during the experimental period of 21 months. The experiment is being continued. Twenty-five percent of the sandal logs in depots have turned hollow due to borers and termite attack and fungal decay. On an average 198.6 Kg of heartwood is lost for every ton of sandal.

Sub-Project 7(4): Studies on durability of different timber and timber products against bio-deterioration under marine conditions.

Objectives: (a) Long term observations on the fluctuations in occurrence, distribution and ecology and biology of marine wood-boring and fouling organisms. (b) To assess natural durability of

different species of Indian timbers and various panel products. (c) To assess the efficacy of wood preservatives in enhancing durability of timber species.

Achievements

Data on natural resistance of 65 timber species were collected from Kochi waters and on 40 timbers from Krishnapatnam and Goa waters. All species except *Cleistanthus collinus* were destroyed within 3 to 8 months by marine borers. Ten species of wood-borers, namely *Bankia campanellata, Bankia rochi, Dicyathifer manni, Lyrodus affinis, Lyrodus pedicellatus, Teredo fulleri, Teredo furcifera, Teredo parksi, Teredothyra smithi* and *Martesia striata* were collected and identified from damaged timber structures at Krishnapatnam. A report has been finalised in this regard.

Observations on durability of 8 timber species (*Albizia chinensis, Bombax ceiba, Erythrina variegata, Ficus mysorensis, Melia dubia, Samanea saman, Toona ciliata* and *Trema orientalis*) treated with CCA and CCB exposed at Krishnapatnam and Kochi waters against attack by marine borers were made. Data have been collected, analyzed and report is ready. Experiments at Krishnapatnam are being repeated with higher doses of preservatives. Similarly, experiments were initiated under World Bank FREE Project using panels of *Bombax ceiba* and *Albizia falcataria* treated with alternative preservatives like Ammoniacal-copper-quarternery (ACQ), Ammoniacal-copper-citrate (ACC), Ammoniacal-copper-zinc-arsenate (ACZA). Regular observations on the condition of the following treated catamarans fabricated out of alternative timbers are being made :

- Three catamarans of *Bombax ceiba* at Visakhapatnam (launched in 1986).
- Two catamarans of *Albizia falcataria* at Chennai (launched in 1990).
- Thirty one catamarans of *Bombax ceiba* at Visakhapatnam (launched in 1997).

Project 8: Diseases and pests of seedlings in nurseries, plantations and natural forests.

Sub-Project 8(1): Diseases of seedlings in nurseries, plantations and natural forests.

Objectives : (a) Survey for incidence of disease and pests in nursery and plantation. (b) Develop different methods to control the pest and diseases. (c) Maintenance of healthy seedlings in nursery and plants in plantations.

Achievements

Experiments were conducted to control seedling diseases in nursery seed beds and seedlings by bio-control method using different species of *Gliocladium*. The nurseries and plantations maintained by SFD, UNDP, World Bank Projects and NGOs were regularly inspected for incidence of pest and diseases and suitable control measures were suggested.

Sub-Project 8(2): Study of insect pests of nurseries, plantations and of natural forests and their control.

Objectives : (a) To identify the pest problems and study the seasonal occurrence and population intensities. (b) To study the biology, host spectrum, natural enemies etc. (c) To evolve suitable prophylactic and other control measures.

Achievements

Surveys were conducted in nurseries and plantations of Sandal, Teak, Eucalyptus and Mangroves in Karnataka, Andhra Pradesh and Goa. The incidence of white flies, *Aleurodes* sp.

was found in alarming proportions. Observations on plantation grown teak trees showed that the major pests in addition to defoliators are arboreal termites and bark-eating caterpillars. Incidence of defoliators, *Hapalia machaeralis* and *Hyblaea puera* was at the peak during the months of August to October in Karnataka. Survey of mature plantations and natural forests of teak in Sirsi, Dandeli, Haliyal areas revealed the incidence of heartwood borer, *Alcterogystia cadambae* upto the extent of 15%. Sandal plantations showed incidence of sap sucking pests like *Inglisia bivalvata, Saissetia* sp., *Ceroplastes* sp. and lac insect *Kerria lecca*. Attack of lac insects in Gottipura and Nallal plantations was regularly monitored and controlled by spraying chemicals (Quinalphos/Dimethoate). Plantation grown sandal trees showed presence of borer pests like *Zeuzera coffeae* and heartwood borer, *Aristobia octofasiculata*. Studies revealed that spraying of Eucalyptus oil and high boiling fraction of oil (5 and 10%) was very effective in suppression of parthenium plants, which showed immediate wilting and blackening.

Project 9: Studies on Biofertilizers.

Objectives: (a) Literature collection regarding VAM fungi and its application to different forestry species. (b) Collection of pure strain and composite spores of different species of VAM and multiplying them. (c) Efficacy of VAM application to different forestry species. (d) Extension of the technique for the end users.

Achievements

Composite VAM spores were multiplied in nursery by pot culture technique using maize as nurse seedlings and now sufficient stock of VAM soil is available for further application to different forestry seedlings and distribution. Mycorrhizal soil was made available to State Forest Departments of Karnataka and Goa to inoculate seedlings at nursery for better growth and biomass production. Sandal seedlings were inoculated with VAM soil to see the efficacy of VAM on growth of plants. Better technique has been evaluated to inoculate minimum inoculum and to get more association with host roots in root trainer. Studies on comparative efficacy of VAM inoculum with that of inorganic and organic fertilizer has been conducted in nursery and results are being analyzed.

Project 10: Studies on mangroves and coastal vegetation.

Objectives: To study the occurrence, distribution, systematics, ecology and biology of marine borers, foulers, fungi and associated organisms in mangroves of Goa, Karnataka and Andhra Pradesh.

Achievements

Mangrove areas of Goa, Visakhapatnam, Kakinada and Krishnapatnam were surveyed for studying the entomofauna. Psychids were found to be the common defoliators in mangroves. Attack by grass-hoppers on *Excoecaria agallocha*, by *Pteroma plagiophleps* on *Rhizophora* and by unidentified Lepidopterans on *Avicennia* was very common. Gall formation on leaves was very pronounced on *Sonneratia apetala* in Goa. The coccids, *Icerya aegeptreia*, were also found infesting *Avicennia* leaves at Goa. Attack of stem borers on *Avicennia* saplings was observed in Kakinada mangroves. The material collected is being studied.

Mangroves along Goa coast were regularly monitored for incidence of marine wood borers and foulers. It was found that *M. striata, M. nairi, D. manni, B. rochi, L. pedicellatus, S. terebrans* and *S. annandalei* among the borers, and barnacles, bivalves and oysters among foulers were quite common.

NEW PROJECTS TAKEN UP IN HAND DURING 1997-98

Project 11: Chemical and utilization studies on *Pterocarpus marsupium* wood.

Objectives: To develop method for *in situ* conversion of soluble colouring principles into insoluble complex to prevent leaching.

Progress made

Optimum extraction of colouring and non-colouring material of wood using different solvent systems is in progress.

EXTENSION

Consultancies for Andhra Timber Products (Visakhapatnam) regarding marine borer attack on timber imported from Malaysia; for IPPM (Rajamundry) and Tamil Nadu News Prints & Paper Ltd. (Karur, Tamil Nadu) regarding insect attack on logs stored in their depots were taken up and report submitted.

Enquiry from BVH Mines, Chitradurga, regarding lac insect attack on *Acacia auriculiformis* plantations was attended to suggesting remedial measures based on field survey conducted by the Divisional staff. Termicide received from Pest Control India Pvt. Ltd., Mumbai, was tested for its efficacy. In addition, a number of enquiries from individuals pertaining to insect damage on house-hold furniture etc. were attended to and control measures were suggested. A video film on catamarans is being produced.

A number of group meetings with fishermen were held in villages near Chennai and Visakhapatnam to popularise the advantages of wood preservation. Lectures were delivered at Manonmanium Sunderanar University (Tirunelveli) and Sri Pushpam College, Poondi, (Bharatidasan University) on marine wood-infesting organisms.

An exhibition on sandal and its products was organised during the International Seminar on Sandal. An international seminar on "Sandal and its products", was organised by IWST, 18-19, December, 1997, at Bangalore.

A total number of 240 samples received for wood identification were disposed of. About 4000 samples are under investigation. Lectures were given to probationers of IRICEN, Pune, progressive farmers, NGOs and foresters.

Twenty four treated wood samples received from Government/Private agencies were analysed for preservative content. Two preservative formulations developed by wood preservative composition manufacturer were analysed for their efficacy.

Lectures were delivered to trainees (foresters, NOGs and teachers) during the "Joint Workshop on demonstration/training programme on Forestry" under UNDP programme at Sirsi during March 1997. Lecture and demonstration programmes in wood preservation methods were delivered to foresters, NGOs, entrepreneurs, students from Agricultural universities from Bangalore, Dharwad and Solan and also to probationary engineers of Indian Railways, Pune, during Seminars and Training programme.

Exhibition of minor forest produce and their utilization was arranged during International Sandal Seminar held in December 1997. Demonstration of portable distillation unit to farmers, NGO's and State Forest Departments was conducted periodically.

a. Consultancy to various agencies on utilization of non-wood forest products, agarbathis etc. rendered.

b. A number of sandal oil samples was analyzed for State Forest and Police Departments.

Extension activities were carried out in different villages along Chennai and Visakhapatnam coasts and advantages of wood protection techniques were demonstrated and explained with the help of pamphlets, brochures, publications, photographs and other display materials.

Consultancy services like testing of samples, advice in right choice of timber, Identification of wood samples, testing of new pesticides and preservation etc., were rendered to various agencies (CBI, Indian railways, NGO's, Universities, Forest Departments, Fisheries Research Organisations etc.) during the year. Library is equipped with one connection of V-SAT and a computer. 29 National journals are being currently subscribed by the library. There are 48 computers in the Institutes.

Brochures "Treated catamaran : a boon to fishermen" and "Biodeterioration of wood and its prevention in Indian coastal waters" were prepared. Pamphlet on "Treated catamarans to benefit poor traditional fishermen", 1997, 4 pp. (in English and Telugu) was published.

The following Video Films were produced 1. Fabrication and Treatment of Catamaran. 2. Sandal.

Teaching Support was provided to (1) Students of various agricultural universities, Forest rangers. (2) Probationers of Indian Railways.

A kisan mela on "Demonstration plantation: success or failure" under UNDP project was organised at Devenhally Taluk of Bangalore.

The following Technologies/Expertise have been demonstrated to end users:

1. Treated Catamaran for the benefit of the poor traditional fishermen at Chennai and Vizag. End users: Fishermen of Andhra Pradesh and Tamil Nadu.
2. Sap-displacement technique for treating small girth timber and bamboo (An on-site treatment procedure especially useful in rural areas) to university officials, foresters. End users: Rural people, Small Scale Industries
3. Proper Utilisation of plantation grown timber.
4. Approximately 12000 quality seedlings of different species (Teak, Jack, Amla etc.) have been distributed to the farmers of 13 villages of Karnataka and Andhra Pradesh under UNDP Project.
5. Demonstration of Portable essential oil distillation unit for extraction of essential oil to the NGO's, Farmers etc.

Brochure on Catamarans, Sandal, Tamarind, Moringa, Bamboo, Bio-deterioration (English), Casuarina, Eucalyptus and Neem were translated in Telugu and Kannada languages was also published.

Technical Bulletin

1. Sandal seed orchard (English)
2. A Rapid and Non-destructive Technique for Estimating Growth Strains in Trees & Logs (English).

Pamphlets

1. Sandal (English)
2. Sap Displacement Technique (English)
3. Sap Displacement Technique (Telugu)

FINANCIAL STATEMENT

SUB-HEAD	EXPENDITURE (Rs.)
PLAN	
A. REVENUE EXPENDITURE	
a. RESEARCH	54,65,118.80
b. ADMINISTRATIVE SUPPORT	46,00,835.30
B. LOANS & ADVANCES	1,00,000.00
C. CAPITAL EXPENDITURE	1,89,218.10
NON-PLAN	5883004.00
UNDP (Strength ICFRE)	4,43,597.15
World Bank	56,43,042.55
GRAND TOTAL	**22,324,815.90**