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Research

Environmental Research and Development

Introduction and Objective

The Environmental Research is a Central Plan Scheme for promotion of research in multidisciplinary aspects of environmental protection, conservation and management. The objective of the scheme is to generate information required to develop strategies, technologies and methodologies for better environment management. It also aims at attempting solutions to practical problems of resource management, conservation of natural resources and eco regeneration of degraded areas. Further, the scheme also seeks to strengthen infrastructure facilities and scientific manpower to shoulder the responsibility of environmental management in the country.

Research grant is provided in the identified thrust areas of environment to various institutions/ universities and non-governmental organizations all over the country, after necessary examination, peer review and recommendation of the Expert Committees.

As per the procedure being followed now, all new proposals received for consideration of funding from the Ministry are centrally coordinated in the Research Division. After acknowledging the receipt of the proposal, the Research Division puts up the proposal to Research Advisory Committee (RAC), which scrutinizes the proposal as to whether it falls in the identified thrust areas and if so, which division of the Ministry would process the proposal. The RAC also identifies the Expert to whom the proposal could be referred for peer review.

Progress of Activities

During the year, more than 300 new proposals were considered by RAC. The proposals along with the comments of the referees are then put up before the Expert Committees, which make recommendations for the proposals. Based on the recommendations of the committees, the proposals are processed further by the Ministry. Eighteen Expert Committee meetings were organized during the year, in which 150 new projects were considered and 142 projects were reviewed and mid course corrections, if any, were suggested. Final Technical Reports (FTR) of 42 completed projects were also examined and accepted by the Committees. Twenty five new projects recommended by the Committees have been processed for financial support during the year.

In addition to this, Research Projects which help in taking policy decisions/ provide data for discussions at International fora/court cases etc. are also supported by the Ministry under the programme. Twenty seven policy research proposals received in the identified areas of policy research were



Fig 63. *Helicteres isora* in Hastinapur Wildlife Sanctu-

placed before the Evaluation Committee, constituted under the Chairmanship of Secretary [E&F] after peer review. The committee has recommended eight projects for funding out of which two projects have already been sanctioned under the programme during the year and the remaining proposals are being processed.

The research projects handled by Environmental Research (RE) Division fall in one of the following areas:-

- ◆ Environment Research Programme – Brown Agenda
- ◆ Ecosystem Research Programme – Green Agenda
- ◆ Research Programme on Eastern and Western Ghats – Site specific
- ◆ Policy Research Programme in Environment

Details of projects sanctioned and completed are given in Annexure-III & Annexure-IV respectively.

Programme wise Progress of Activities

Environmental Research Programme

The Environmental Research Programme specially deals with problems relating to air, water and soil pollution and development of suitable cost effective technologies for abatement of pollution load in the environment. Emphasis is laid on development of eco-friendly biological and other interventions for prevention of pollution and development of strategies/technologies/instruments etc. for control of pollution. Projects are also encouraged for development of biodegradable plastics, epidemiological studies, ways and means to reduce impact of (i) mining, (ii) chemical pollutions of soils, (iii) hazardous substances including pesticides, heavy metals etc. Projects relating to waste recycling and resource recovery from waste along with the development of eco-friendly and cleaner technologies are given due priority.

During the year seven new projects were taken-up while the progress of fifty three projects was reviewed. During the year, 12 projects were completed under the programme.

Ecosystem Research Programme

The Ecosystem Research programme is an inter-disciplinary programme of research, which emphasizes ecological approach for studying the relationship between man and environment. The objective of the programme is to develop a basis within the field of natural and social sciences for rational use and conservation of resources for general improvement of the relationship between man and his environment. The programme seeks to provide a scientific basis to solve the practical problems of resource management. Ecological understanding and research in this area offer tangible hope for addressing extremely complex and potentially devastating assaults on local, regional and global ecosystems. Under the programme, emphasis is laid on multi-disciplinary aspects of environmental conservation with emphasis on eco-system approach consistent with the identified thrust areas and orientation.

During the year, five new projects were taken-up while the progress of forty nine projects were reviewed and monitored and mid-course corrections were suggested. During the year, 11 projects were completed under the programme.

Eastern and Western Ghats Research Programme

The Eastern and Western Ghats Research Programme addresses itself to location-specific problems of resource management in the Eastern and Western Ghats regions of the country. The region is suffering from destruction of habitats of its unique plant and animal life due to floods, siltation, deforestation etc. besides shortage of food, fodder and fuel for rural population and shortage of raw material for the industries. Under



Fig 64. Larvae of *Plecoptera reflexa*, defoliating a shisham branch

this programme, studies relating to biodiversity, land use, impact of developmental activities etc. are taken up to restore the environmental quality of the region.

During the year, 13 new projects were taken-up while the progress of 40 projects was reviewed and monitored and mid-course corrections were suggested. Nineteen projects were completed during the year under the programme.

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Summaries/Research Findings of some of the projects completed during the year

Assessment and abatement of environmental pollution due to Hydrogen Sulphide and Methane in the coconut husk retting

The pollution was assessed by taking direct measurement in the field and analyzing parameters in laboratory experiments. It was observed that high sulfate presence in brackish water causes emission of toxic gas like H_2S as a result of mixing organics (COD) leached out from coconut husks in the process of retting. Retting sites are deprived of dissolved oxygen and have little transparency because of anaerobiosis, turbidity and colour compared to non retting zones of brackish water. The quantification of pollution from water retting was carried out through laboratory experiments and characterization pollutants from husk leachate.

The project has been completed successfully with the development of a novel process for core extraction, which they call "closed anaerobic biextraction of coir". This process has the following advantages:-

- ◆ Zero discharge process – no water pollution
- ◆ Retting period is reduced to 1/10th (1 month) & Better quality coir fibres is obtained
- ◆ Occupational health hazard is eliminated
- ◆ Pith generated is marketable
- ◆ Methane can be collected and use as fuel
- ◆ Easy to harvest the processed husk
- ◆ Minimizes the retting area requirement & available water bodies for other use

A demonstration plant on the basis of the novel process with the assistance of the State Government has been set-up.

Status and Ecology of the Nilgiri Wood Pigeon and Nilgiri Pipit

Nilgiri pipit was studied in upper Bhava and Bangithapal areas and was found in unlimited numbers. Foraging ecology was also studied. Nilgiri wood pigeon was studied in Silent Valley, Eravikulam National Park, Chinar Wildlife Sanctuary etc. It was found that wood pigeon preferred evergreen forests and they were not plenty in numbers. In 158.5 ha. surveyed evergreen forest, it was 17 while 41 Nilgiri wood pigeons were found in 166 ha Shola Forest. Maximum number were recorded in May 2004 which was 51 and minimum was eight in September, 2002. The foraging ecology and breeding biology study revealed that threats were due to habitat loss and degradation, hunting and other disturbances.

Assessment of Herpeto-faunal diversity of Eastern Ghat of Orissa

The findings of the study observed that the herpetofauna of Orissa comprises of about 22 species of frogs, three species of crocodiles, 30 species of lizards, 12 species of fresh water turtles and 68 species of snakes. The amphibians are represented by four families. In the study a new species of Rhacophorid frog from Similipal Biosphere Reserve has been reported. In addition, seven additional species belonging to ranids, rhacophorids and microhylids have also been recorded. The lizard fauna of Orissa includes seven families belonging to 12 genera and 26 species. Sex ratio analysis has been conducted on adult specimens, sampled randomly. The cumulative data for each species is indicative of more males than females. With regard to turtle faunal assessment, 12 species of fresh water turtles have been recorded which includes three new records. Checklist has been prepared for amphibians, reptiles, lizards, snakes and a detailed description for each of the species have been provided. Six papers have also been published as an outcome of the project activities.

Investigation on greenhouse gas emission from agricultural fields and wetlands

The findings of the project revealed that there was a seasonal variation in Methane (CH_4) efflux from paddy fields grown with Lalat, Moti and IR64 rice cultivars. With the growth of the plants, CH_4 emission continued to increase, reaching maximum at the flowering stage and then declined at maturity.

There was difference in methane emission potential of different rice cultivars. Presence of weeds in the rice-fields mitigated CH_4 emission significantly. After application of different pesticides and metals into the soil, CH_4 flux was altered indicating its interaction with its formation processes through microbial activity in the soil. Water management, selection of rice cultivars, organic amendments and fertilizer application are promising mitigating options. Among these options, draining of water from paddy fields for a short period before the heading stage is eco-friendly, and can drastically cut CH_4 emission.

Based on CH_4 efflux, Crop growing season, cultivar difference and the area under cultivar, an annual budget for CH_4 was computed to be $1.64 \times 10^6 \text{ kg y}^{-1}$ for the rice fields of Lucknow district. Methane flux measurements from the three natural wetlands in the different seasons revealed that the Gomti River emitted maximum CH_4 from both vegetated and non-vegetated surfaces in all seasons as compared to Motijhil and Nawabganj lake. The CH_4 emission was the highest in summer season followed by rainy season and the least in winter season indicating temperature dependent process of methane formation.

Studies also revealed N_2O emission from agriculture fields and wetlands. There was no specific trend of N_2O emission in relation to growth of plants. The peak efflux of N_2O was noted just after the application of chemical fertilizers or water percolation. A wide variation in N_2O efflux was noted from the fields grown with different rabi crops. A close relationship was established between moisture regime and N_2O efflux from the crop-harvested fields.

An annual budget of N_2O in Lucknow District was worked out to be $1.67 \times 10^5 \text{ kg y}$

¹ for rabi crops and 7.19×10^4 kg y⁻¹ for paddy fields. Nitrification inhibitors play a major role in modulation of N₂O efflux from the soil. A concentration dependent change in N₂O fluxes was also noticed in the presence of nitrification inhibitor.

Biodiversity of plant pathogenic fungi in Kerala part of the Western Ghats

An extensive survey on plant pathogenic fungi in different ecosystems in the Western Ghats viz. moist deciduous, semi evergreen, evergreen, wet evergreen, shoal forests, dry deciduous forests, forest plantations and forest nurseries revealed a rich flora of pathogenic fungi harbouring the plants in different forest ecosystem. A total of 4101 fungal isolates were obtained from the diseases specimens collected and processed from 237 selected study sites. The fungal isolates fall under 99 fungal genera and 226 species. The isolates have also been tabulated as per their fungus class. The results also revealed that exotic host species are more vulnerable to the indigenous fungal pathogens and the monoculture plantations serve as reservoir of inoculum of different phytopathogenic fungi.

Extensive testing of the developed mixed culture based BOD biosensor for determining the pollutional load of industrial wastewaters: a device for rapid non-conventional monitoring

One of the most important parameter in water quality monitoring is the Biochemical Oxygen Demand (BOD). BOD requires a long incubation period (3-5 days) and considerable skill rendering the test unsuitable for direct process control. A practical alternative to such problems is a BOD biosensor easy to operate fast and a low cost device for rapid determination of BOD. A mixed culture based BOD biosensor have been developed, which is able to perform BOD analysis within 5-10 minutes as compared to the conventional 3-5 days BOD test. Biosensors are analytical devices that are sensitive to biological parameters and offer a prospect for measuring compounds of interest with convenience, speed and at low cost.

Recycling of chromium from metal finishing waste waters using electrochemical ion exchange

Removal of chromium from wastewaters is obligatory in order to avoid water pollution. The most common form is hexavalent chromium, which is toxic to man and aquatic life. Removal and recovery of hexavalent chromium has been studied using ion exchange and electrochemical ion exchange process. The percentage removal of hexavalent chromium was examined by varying experimental conditions viz. dosage of adsorbent, pH of the solution, contact time and temperature. It was found that more than 99% removal was achieved under optimal conditions and the adsorption capacity (k) for hexavalent chromium calculated from the Langmuir adsorption was found to be 66.98 mg/gm. Design of the adsorption column is calculated using the observed data. The present study aim to recover chromium by Electrochemical ion exchange (EIX) method, which combines ion exchange and electro dialysis, is used for the removal and concentration of chromate ions from effluent.

Studies on the faunal diversity in the Thar Desert of Rajasthan

A large number of surveys have been conducted in 13 districts of West Rajasthan using GIS and GPS, the study sites have been mapped. A total of 901 species belonging to Nematoda (109 spp.), Insecta (279 spp.) Acarina (41 spp.), Pisces (80 spp.), Amphibia (8 spp.), Reptilia (44 spp.), Aves (272 spp.) and Mammalia (68 spp.) have been identified and documented.

Out of 901 species identified during the study, 126 species have been recorded for the first time from the Thar Desert in Rajasthan of which 14 spp. as new records from India. The groupwise breakup is as follows: 70 n. rec. of nematodes (13 n. rec. from India), 3 n. rec. of fishes, 23 n. rec. of birds and 06 n. rec. of mammals. The identified 901 species also include 10 species as new to science, viz., 4 n. spp. of nematodes, 4 n. spp. of Acarines and one n. sp. each of Hemiptera and Diptera. One of the Nematode species under the family Nygolamidae of Doryomida has been identified as new genus.

Effect of forest fire on floristic and species diversity of Chir pine forest of mid-hills of Himachal Pradesh

Results obtained from this investigation reveal that topography, aspects and altitude affect fire behavior. There was frequent occurrence of forests fire in the foot hills and mid hills chirpine forests (Shiwalik chirpine forests) because of high atmospheric temperature, low soil moisture content and accumulation of pine needles during fire season i.e. 15th April to 15th June as compare to high hill (Himalayan chirpine forests) forests. Fire intensity was noted low at site having rough and rugged surface as compare to smooth surface sites. Occurrence of fire after 4-6 years enhances species diversity in respect of herb, grasses and shrub species. (Fire resistant species are dominant in the fire affected sites). In case of trees, shrubs and herbs majority of the species show contagious pattern of distribution in fire affected sites but under control sites all the species in case of shrub and herb show contagious distribution. All the species of grasses and ferns show contagious distribution in fire affected and in control sites. Repeated and yearly occurrence of forest fire adversely affects on natural regeneration trend of chirpine. Forest fire in general did not affect vegetation distribution in the site, but affected floristic composition. While forest fire reduces fungal population or number of fungus population/plate, it enhances bacterial and actinomycetes population/plate as compared to control sites.

G.B. Pant Institute of Himalayan Environment & Development, Kosi-Katarmal, Almora (Uttaranchal)

Introduction

G.B. Pant Institute of Himalayan Environment and Development (GBPIHED) was established in 1988 as an autonomous Research & Development Institute of the Ministry. The Institute has emerged as a leading institution for fostering scientific knowledge, formulation of policy guidelines, and development of efficient strategies for conservation and management of natural resources in the Indian Himalayan Region (IHR). The Institute executes its mandate through the Headquarters at Kosi-Katarmal, Almora (Uttaranchal), and its four regional Units located at Mohal-Kullu (Himachal Unit), Srinagar (Garhwal Unit), Pangthang (Sikkim Unit) and Itanagar (NE Unit). The Institute follows a holistic and multidisciplinary approach involving interlinking of ecology, economy and society, under the following domains:

- ◆ Land and Water Resource Management
- ◆ Sustainable Development of Rural Ecosystems
- ◆ Conservation of Biological Diversity
- ◆ Ecological Economics and Environmental Impact Assessment
- ◆ Institutional Networking and Human Investment
- ◆ Environmental Physiology and Biotechnology
- ◆ Indigenous Knowledge Systems

In this effort, special attention is placed on the intricate balance between fragility of mountains, indigenous knowledge and sustainable use of natural resources. A conscious effort is made to ensure the social acceptability and participation of stakeholder communities for the success of various programmes.

Objectives

The Institute has the three following objectives:

- ◆ To undertake in-depth research and development studies on environmental problems of the Indian Himalayan Region;

- ◆ To identify and strengthen the local knowledge of the environment and contribute towards strengthening researches of regional relevance; and
- ◆ To evolve and demonstrate suitable technology packages and delivery systems for sustainable development of the region in harmony with local perceptions.

Activities Undertaken

The targeted R&D activities of the Institute were undertaken under the following seven core programmes: Land and Water Resource Management; Sustainable Development of Rural Ecosystems; Conservation of Biological Diversity; Ecological Economics and Environmental Impact Assessment; Institutional Networking and Human Investment; Environmental Physiology and Biotechnology; and Indigenous Knowledge Systems.

Progress/Achievements made during the year

Long-and-medium-term studies towards developing suitable strategies for management of land and water resources in the IHR remained the major thrust of Institute's activities. During the year, geo-hydrological studies were undertaken at Thelu (Gangotri glacier system), Dokriani, Gangotri and Milam glaciers to understand the glacier recession processes. Realizing the importance of springs of consumptive water use investigations on spring discharge and geology were undertaken in the western Himalayan region. Erosion studies (cold deserts, Jhum cultivation, settled agriculture) were carried out for conservation implications. Considering landslide hazards as a major threat to land and water resources datasets were generated for Tectonic Deformation Field in Kumaun Himalaya using precision GPS geodesy. GPS campaigns in IHR, land slide inventory and hazard assessments were also made. Some other important studies undertaken by the Institute are (i) people and resource dynamics of mountain watersheds; and (ii) catchment area conservation and management.

Addressing issues in sustainable development of the rural areas of IHR has been another R&D priority of the Institute. Extensive surveys were conducted in the representative blocks/village clusters of the region relating to poverty and resource-use pattern to chalk-out strategies for natural resource management. Catchment restoration work (Bhimtal lake, Nanital) was initiated seeking community participation and plantation of 7000 saplings of different multipurpose tree species were carried out. Strengthening of existing Rural Technology Center at HQs (Kosi-Almora), establishment of a Rural Technology Park at Maletha village in Tehri district in the central Himalayan region, and continuation of demonstration model at Midphu, Itanagar in northeast, effectively contributed in capacity building of rural farmers through trainings on simple, cost-effective and appropriate rural technologies.

The indigenous knowledge relating to natural resource management and healthcare was documented and digital database was further strengthened based on primary survey and secondary information. The Himalaya being a biodiversity hotspot, concerted R&D efforts were made across IHR for understanding biodiversity patterns and suggesting appropriate strategies for conservation of biological diversity. The user-friendly biodiversity database, developed for Himalayan Biosphere Reserves (BRs), is first of its kind to facilitate information dissemination among stakeholders especially the ones concerned with management of BRs. The completed studies on species and community responses to habitat alterations in climate sensitive



Fig 65. Construction of laying of geotextile and filter media for root zone treatment

timberline zone of west Himalaya provided first hand data set to understand the dynamics of change in this ecotone in the Himalaya. Further strengthening of ecological data sets from identified species rich areas in different parts of the Himalaya was also continued during the year.

Being the lead coordinating Institution for identified Himalayan BRs, the Institute conducted extensive surveys to prepare the feasibility documents on proposed Cold Desert BR (J&K and HP) and Tawang & West Kameng BR (Arunachal Pradesh). The activities for establishment of gene banks across the Himalaya were further strengthened through R&D interventions in arboretum (HQs & Sikkim Unit), and herbal gardens (HQs, Sikkim & HP Unit). These sites were used extensively for teaching, training and demonstration for different target groups. The efforts of developing propagation protocols for high value (both economically and ecologically) plants were continued for important medicinal and multipurpose plants. Mass number of *in-vitro* raised seedlings of bamboo (*D. hamiltonii*) were field transferred for hardening and their subsequent plantation. Studies were also completed on Vesicular Arbuscular Mycorrhizae (VAM) in important tree species.

Identification of strategies for ameliorating environmental damage and looking at alternate pathways for development is yet another important work areas of the Institute. Quick environmental appraisal studies, preparation of environmental management plan and development of landscape stabilization plans for two hydropower projects of Uttaranchal were among major achievements of the Institute. Also, data set was further strengthened for tourist flux and associated vehicular pollution in selected tourist destinations in the western Himalayan region. Institute's Integrated Eco-development Research programme (IERP) has been meaningfully complimenting to the R&D needs of the IHR. Based on the recommendation of project evaluation committee, a total of 34 projects (13 to Universities, nine to NGOs and 12 to Government Institutions) were funded for execution in different parts of IHR. Execution of coordinated research programme on "sacred forest/hill" for eco-restoration is another important activity under IERP which blends science with religion.

Demonstrations of the R&D outcome is another major activity of the Institute for wide scale dissemination among the end users. During the year, following demonstrations were undertaken:

- ◆ Slopping watershed environmental engineering technology (SWEET) was demonstrated and maintained in 92 ha community/individuals wasteland;
- ◆ Silvi-pasture demonstration on 41 ha community/ individuals wasteland yielded 680 quintal fodder grass;
- ◆ Conservation models in six different schools of Uttaranchal;
- ◆ One demonstration each under income generating, rural energy and yield increasing practices, land resource management, soil and water conservation at five different villages in Uttaranchal.

Training material was also developed for these programmes. Organization of training workshop, seminars, discussion meetings, etc. for capacity building is a regular dissemination activity of the Institute through which a range of stakeholders were trained. During the year, promotion of capacity building and skill development were also ensured through many ways.



Fig 66. *Taxus baccata* – an important medicinal tree

R&D achievements from the Institute are gradually finding place in the policies of IHR and the line departments are making use of them.

Various areas where the Institute continued to provide inputs for large scale implementation and to ensure environment-friendly development in IHR are:

- ◆ Adoption of Institute's approach on technology demonstration and dissemination in five State of NE through a network of NGOs;
- ◆ Catchment Area Conservation and Management;
- ◆ Watershed Management;
- ◆ Environment-friendly livelihood support and income generating activities (particularly for women);
- ◆ Development of environmental management plan for hydropower projects;
- ◆ Promotion of technological backup for development of medicinal plant sector;
- ◆ Rehabilitation of wastelands;
- ◆ Improved efficiency of farming practices, etc.

Comparison of progress in compared to previous year

| Major Activities | Achievements made in previous year | Achievements during the year |
|--|--|---|
| Hydrological monitoring of glaciers | Monitored selected parameters at two glaciers | Monitoring selected parameters in three glaciers |
| Analysis and prioritization of plant families | Five families completed | Data collection / synthesis for eight families completed |
| Hydroelectric project (Environmental appraisal studies) | Studied two sites in H.P. | Studies on two sites in H.P. and two sites in Uttaranchal. |
| Documentation of IKS | Survey conducted | Survey completed / Data compilation ongoing |
| Enriching ex-situ gene banks | Activity strengthened at HQs and H.P. | Activity strengthened at HQs, H.P. and Sikkim units |
| Eco-restoration of degradation areas | Sites selected | Plantation of 3100 plants done |
| Propagation packages of economically important plants/ Microbial studies | Studies conducted for bamboo, <i>Rhododendron</i> and <i>Taxus baccata</i> | Large scale multiplication of bamboo |
| Demonstration of SWEET | 26 ha. land was treated/ model for wasteland restoration maintained | 92 ha. land treated/ maintained |
| Livelihood options | Silvi-pasture development (five ha.) Demonstration of farm technology for high value plants Demonstrations on environment friendly rural technologies (Rural Technology Complex) | Silvi-pasture development maintenance (41 ha.) Demonstration were maintained Five more demonstrations were taken up/ maintained |
| Dissemination of R&D outcome | Publication of the Institute were brought out and distributed among end-users | New publications and modifications in old ones were brought out in the material for more clarity. |

State-wise status

The four regional units of the Institute, one each at Himachal Pradesh, Srinagar-Garhwal, Sikkim and Itanagar (NE Unit) caters to the specific demands/R&D priorities of the respective states.

- ◆ In the Himachal unit studies on cold desert, protected areas and biodiversity conservation were focused
- ◆ At the Garhwal unit studies/cultivation packages for medicinal plants and land restoration were worked out
- ◆ In the Sikkim unit studies on landslides and disaster management were undertaken. Conservation of threatened *Rhododendron* spp. through bio-technological tools was also carried out
- ◆ In the NE unit at Itanagar efforts were put on indigenous practices of resource management, jhum cultivation and demonstration through the network of NGOs for a range of environmental friendly technologies.

Budget Allocation

The budget allocation for the Institute during 2005-06 is Rs.750 lakhs (Plan).

Research on Wetlands, Mangroves and Coral Reefs

Research activities under Wetlands, Mangroves and Coral Reef Programmes are overseen by specific Advisory Committee and Sub-committees under Wetlands, Mangroves and Coral Reefs.

During the year, six projects were approved for assistance on various wetlands. The list of projects sanctioned during the year, is given in Annexure-III.

In Coral Reef Programme, The National Coral Reef Research Centre at Port Blair was provided financial assistance for strengthening infrastructure of the centre. The centre is continuing its activities to bio-physical monitoring related to health of coral reefs.

National Natural Resource Management System (NNRMS)

Objectives

The main objective of National Natural Resource Management System (NNRMS) is utilization of remote sensing technology with conventional methods of monitoring of natural resources such as land, water, forests, minerals, oceans etc. for attaining sustainable development by addressing the following aspects:

- ◆ Optimal utilization of the country's natural resources by a proper and systematic inventory of the resource availability.
- ◆ Reducing regional imbalances by effective planning and in tune with the developmental efforts.
- ◆ Maintain the ecological balance with a view to evolve and implement the environmental guidelines.



Fig 67. A flower of *Phoenix paludosa*, a mangrove species

The Standing Committee on Bio-resources and Environment (SC-B) constituted by the Planning Commission advises on the methods of using the remote sensing technology for optimal use and management of natural resources in the country.

Activities undertaken so far

The SC-B had identified 49 priority areas for taking up remote sensing based studies in tune with key environment and ecological issues of the country. They encompassed forest, grassland, plant and faunal resources, wastelands, land degradation, water and air pollution etc. for information requirements for the Man and Biosphere Reserve Programme and some typical areas like mining, coastal areas, wildlife habitats, etc. The Committee (SC-B) met 20 times so far and sponsored about 89 remote sensing application projects addressing key environmental and ecological issues such as management of forests, grassland, faunal resources, wetland, coastal areas, mangroves and coral resources, land degradation, impact of mining and industrialization, river pollution etc. Fifty five projects have so far been completed.

The potential user agencies for utilizing the outcome/information generated in the projects sanctioned by the Ministry under NNRMS programme are the Central Government Departments/Agencies, and the Ministry of Environment and Forests itself including the various organizations under its administrative control like FSI, ZSI, BSI etc.

Progress/Achievement made during the year

During the year, the Standing Committee Meeting of National Natural Resource Management System on Bio-Resource and Environment was held on 28th April, 2005. The Committee considered 10 proposals and recommended nine projects under NNRMS Programme. The Committee had also reviewed the recently completed projects and accepted the Final Technical Reports of five recently completed project.

Budget Allocation

The budget allocation of the Scheme during 2005-06 was Rs.9.00 crore (RE).

Forestry Research

Indian Council of Forestry Research and Education

Introduction

The Indian Council of Forestry Research and Education (ICFRE) is the apex body in the national forestry research system to develop a holistic forestry research through planning, promoting, conducting and coordinating research, education and extension on all aspects of forestry for ensuring scientific management of forests, tree improvement, forestry productivity through scientific and biotechnological researches, bioremediation of degraded land, efficient utilization of forest produce, value addition of forest products, conservation of biodiversity and climate change, effective agro forestry models for various agro ecological zones, policy research, environmental impact assessment and integrated pests and disease management.



Fig 68. Tissue culture of raised plants of *Opoxylum indicum* at Forest Research Institute, Dehra Dun.

Objectives

- ◆ To undertake, aid, promote and coordinate forestry education, research and their applications.
- ◆ To develop and maintain a national library and information centre for forestry and allied sciences.
- ◆ To act as a clearing-house for research and general informations related to forests and wildlife.
- ◆ To develop forestry extension programmes and propagate the same through mass media, audio-visual aids and extension machinery.
- ◆ To provide consultancy services in the field of forestry research, education and allied sciences, and
- ◆ To undertake other jobs considered necessary to attain these objectives.

ICFRE has eight regional research institutes and three research centres in different bio-geographical regions of the country to cater to the forestry research needs of the nation. The regional research institutes are located at Dehradun, Shimla, Ranchi, Jorhat, Jabalpur, Jodhpur, Bangalore and Coimbatore and the centres are at Allahabad, Chhindwara and Hyderabad.

Activities undertaken by the Institute

- ◆ Forest Research Institute (FRI), Dehradun obtained VAC-FRI technology for treatment of green bamboo.
- ◆ Use of *Pseudomonas fluorescense* as root protectant against the infection of *Fusarium solani* was confirmed in the seedlings of Shisham.
- ◆ Bamboo-endomycorrhiza system was worked out for the integration of mycorrhiza in boosting the growth and proliferation of *D. strictus*.
- ◆ Methods were standardized for production of alpha cellulose and its derivatives from *Lantana camara* for a variety of applications paving thereby a way for management of this obnoxious weed by its utilization into products of commercial importance.
- ◆ Reaction conditions were standardized for production of polysaccharide derivatives – graft co-polymers of *Cassia occidentalis* seed gum with vinyl monomers; water soluble quaternized and cyanoethylated TKP; water soluble carboxymethyl cellulose, and organo soluble cyanoethyl cellulose from cellulose of *Dendrocalamus strictus* bamboo and cotton linters.
- ◆ *Ex-situ* conservations of 120 species belonging to 80 genera and 4 families of forest origin from central India have been made in Tropical Forest Research Institute (TFRI) campus.
 - ◆ Non-destructive harvesting methods of Kalmegh (*Andrographis peniculata*) standardized.
 - ◆ Multiplied 3,00,00000 wasps of *Trichogramma rosi* and introduced in 200 hectare teak plantations of Maharashtra and Madhya Pradesh to minimise the out break of Teak defoliator and skeletonizer. It minimised more than 50 per cent annual loss of teak growth.



Fig 69. Fungus on tree trunk

- ◆ An agroforestry model consisting of tree species (*Tectona grandis*, *Gmelina arborea* and *Embllica officinalis*) and crop species (soyabean and wheat) has been developed and demonstrated to produce high yield with *E.officinalis*.
- ◆ Developing a suitable database on biodiversity.
- ◆ Selection of potential mycorrhizas and other beneficial microbes for the reclamation of bauxite mine spoils.



Fig 70. Lac cultivation on *Flemingia macrophylla* under open condition

Progress/Achievements during the year

- ◆ In order to promote medicinal plants as agroforestry cash crop, Centre for Social Forestry & Eco-Rehabilitation(CSFER), Allahabad planted twenty species of medicinal plants.
- ◆ Institute of Forest Productivity (IFP), Ranchi concluded the project titled, Soil-vegetation interaction with special reference to nutrient cycling in some selected plantations under different edaphic conditions.
- ◆ The FRI, Dehradun concluded the project : Identification and upgradation of Braconid parasites (Hymenoptera) of major insect pests in National Insect Reference Collection (NIRC) and Doon Valley.
- ◆ FRI, Dehradun conducted a study on drying of natural dye solution using vacuum drying and spray drying through Central Food Technological Research Institute (CFTRI), Mysore. The vacuum drying was found to be superior than spray drying.
- ◆ Arid Forest Research Institute (AFRI), Jodhpur carried out studies on biomass of existing vegetation in marshy (waterlogged) areas.
- ◆ Arid Forest Research Institute (AFRI), Jodhpur have developed cultivation practices of sena, guggal, *Aloe vera*, *Asparagus racemosus*, *Withania somnifera*, *Catharanthus roseus* and *Ocimum sanctum* for Jodhpur conditions.
- ◆ Institute of Wood Science (IWST), Bangalore laid experiments to study the effect of different storage conditions, viz. temperature and moisture content on viability of Sandal seeds.

Periodic change in moisture content at different relative humidities at 5, 15, 25 and 35°C was recorded to study the effect of different RH on the equilibrium moisture content. Adsorption isotherms were developed.



Fig 71. *Nuracanthus sphaerostachyus* – an endemic species

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- ◆ AFRI, Jodhpur conducted survey for availability of candidate plus trees (CPTs) in different areas. Selected 30 CPTs in the irrigated tract of IGNP canal area from the plantation raised in 1987 and 35 CPTs in the unirrigated areas in the farmers field.
- ◆ Himalayan Forest Research Institute (HFRI), Shimla is standardizing agro-technologies for mass propagation of some important medicinal plant species of temperate region, nursery techniques of the indigenous species of cold deserts such as *Capparis spinosa* and is developing efficient methods of preparation of compost from different locally available raw material.
- ◆ TFRI, Jabalpur collected data on socio-cultural aspects of Korku tribe and their dependence on forests in M.P. Vegetation survey for the availability of NTFPs in the selected villages, revealed that fruit and bark, seed oil as medicine and fuelwood etc. of 38 species are being used by Korkus.
- ◆ ICFRE and its institutions also provided consultancy service related to forest management and forestry research to several organisations.

Comparison of progress

The activities are mostly over long term duration ranging from three to five years and progress during the year is steady. In case of forest extension activities there is distinct change during the year compare to the last year. Regional workshops to formulate extension strategies of institutes of ICFRE have been organized during 2005-06 which is a new step in this year.

State-wise status

| Name of state | No. of Projects completed in 2004-2005 | No. of ongoing Projects in 2004-2005 | No. of Projects initiated in 2004-2005 |
|-------------------|--|--------------------------------------|--|
| Uttaranchal | 8 | 18 | 3 |
| Uttar Pradesh | 4 | 5 | - |
| Haryana | - | 1 | 4 |
| Punjab | 2 | 4 | - |
| Tamil Nadu | 6 | 26 | 5 |
| Kerala | 5 | 20 | 5 |
| Pondicherry | 2 | 7 | 1 |
| Andaman & Nicobar | 1 | 1 | 1 |
| Andhra Pradesh | 1 | 6 | 7 |
| Karnataka | 1 | 4 | 7 |
| Goa | 2 | 1 | - |
| Assam | 2 | 17 | 3 |
| Meghalaya | - | 6 | 1 |
| Manipur | - | 4 | - |
| Tripura | - | 5 | - |
| Nagaland | - | 4 | - |
| Mizoram | - | 3 | - |
| Arunachal Pradesh | - | 3 | - |
| Rajasthan | 2 | 24 | 3 |
| Gujarat | - | 3 | - |
| Himachal Pradesh | 7 | 14 | 8 |
| Jammu & Kashmir | - | - | - |
| Jharkhand | Nil | 11 | Nil |
| West Bengal | 2 | 11 | 2 |
| Bihar | Nil | 2 | Nil |
| Sikkim | Nil | 1 | Nil |
| Others | 28 | 53 | 18 |

Budget Allocation

The budget allocation of the ICFRE during the year was Rs.49.35 crores (Plan) and Rs.16.4153 crores under Non-Plan.

List of research institutes and advanced research Centres under the administrative control of the ICFRE

Institutes under the control of ICFRE are:

- ◆ Forest Research Institute, Dehra Dun
- ◆ Institute of Forest Genetics and Tree Breeding, Coimbatore
- ◆ Institute of Wood Science and Technology, Bangalore
- ◆ Tropical Forest Research Institute, Jabalpur
- ◆ Rain Forest Research Institute, Jorhat
- ◆ Arid Forest Research Institute, Jodhpur
- ◆ Himalayan Forest Research Institute, Shimla
- ◆ Institute of Forest Productivity, Ranchi
- ◆ Centre for Social forestry and Eco-Rehabilitation, Allahabad
- ◆ Centre for Forestry Research and Human Resource Development, Chhindwara
- ◆ Forest Research Centre, Hyderabad

Indian Institute of Forest Management (IIFM)

Introduction

The concept of professional management of forests was conceptualized in response to the recommendations by the National Commission on Agriculture. The impetus generated by the recommendations culminated to set up the IIFM. It was established in 1982 as an autonomous institution of the Ministry and governed by a Board of Governors.

Objectives

The IIFM, as a sectoral management institute, imparts education in forest management, which is a judicious combination of management, social, and forestry sciences. The specific objectives of the Institute are:

- ◆ to provide training in management and related subjects to persons from Forest Services, Forest departments, Forest Development Corporations and forest related industries;
- ◆ to select and prepare outstanding and talented young persons for careers leading to management responsibilities in forestry and forest related systems; and
- ◆ to meet the need of Indian forestry and forest related industry and commerce with respect to updating information on forestry management through research, consultancy and publications.

Activities undertaken so far

The activities of the Institute can be broadly categorized into four categories:

- ◆ Educational-Post Graduate Diploma in Forest Management, Post Masters course in Natural Resource Management and Ph.D. (Research Centre, FRI Deemed University).
- ◆ Manpower Development Programme (MDP) Training and Workshops

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- ◆ Research
- ◆ Consulting

Progress/Achievements made during the year

- ◆ Implementation of National Project Operational strategy for sustainable forestry development with community participation in India funded by ITTO, Japan
- ◆ Livelihood promotion through community participation (ICCF)
- ◆ Building capacity of the village level institutions for collaborative Natural Resource Management in India funded by Japan Social Development Fund (JSDF).

Comparison of Progress in compared to previous years

| | Research (Completed & ongoing) | Consultancy (Completed & ongoing) |
|---------|--------------------------------|-----------------------------------|
| 2003-04 | 28 | 10 |
| 2004-05 | 26 | 8 |

Budget Allocation

The budget allocation of the Institute during 2005-06 under Plan and Non-Plan component was Rs.5.00 crores under Plan and Rs.77.99 lakhs under Non-Plan.

Research on Wood Alternatives and Panel Products

Indian Plywood Industries Research & Training Institute, Bangalore

Introduction

Indian Plywood Industries Research and Training Institute (IPIRTI), Bangalore an autonomous body of the Ministry conducts research and training in all aspects related to panel products from wood and other lignocelluloses.

Objectives

The research mandate of the Institute includes:

- ◆ Research on all aspects of production of sawan timber, manufacturing plywood and other allied engineered and reconstituted wood or lignocellulosic products, including improvement of materials, manufacturing processes, improvement of machines and appliances, conditions of work - time and motion studies – standardization of methods of working condition of factories, and
- ◆ Inspection, certification and testing of all forest products viz. plywood, wood, timber, hardboard, particleboard, chipboard furniture, glue-lam, compreg, doors, panel doors, block board, flush doors, veneered panels, veneers, laminated panels, composite boards, and the products of allied trade and industry,
- ◆ Contribution made by the institute since its inception in the areas of wood products/composites research and providing timely technological interventions and extension of research finding, transfer of technology and commercial interaction with the industry resulted in establishment of organized plywood and allied industry sector.

Keeping this in view the Institute's Vision is "Conservation of natural forests through development and adoption of efficient technologies for manufacturing wood alternates and panel products from renewable fibers, including plantation timbers and bamboo to meet the vital needs of our developing society".

Activities undertaken in the field of research

- The activities undertaken by IPIRTI in areas of research and standardization and testing till are:
- ◆ Wood/wood based composites
 - Plywood, Block Board, flush Doors, LVL
 - Saw milling, Finger Jointing, Glulam agro/forest/Wood residues, Bamboo etc.
 - ◆ Composites from non-wood lignocellulosic materials
 - ◆ Standardization and Testing
 - Evolving/Revising national material/product standards
 - Testing for conformity to Indian Standard Specifications.

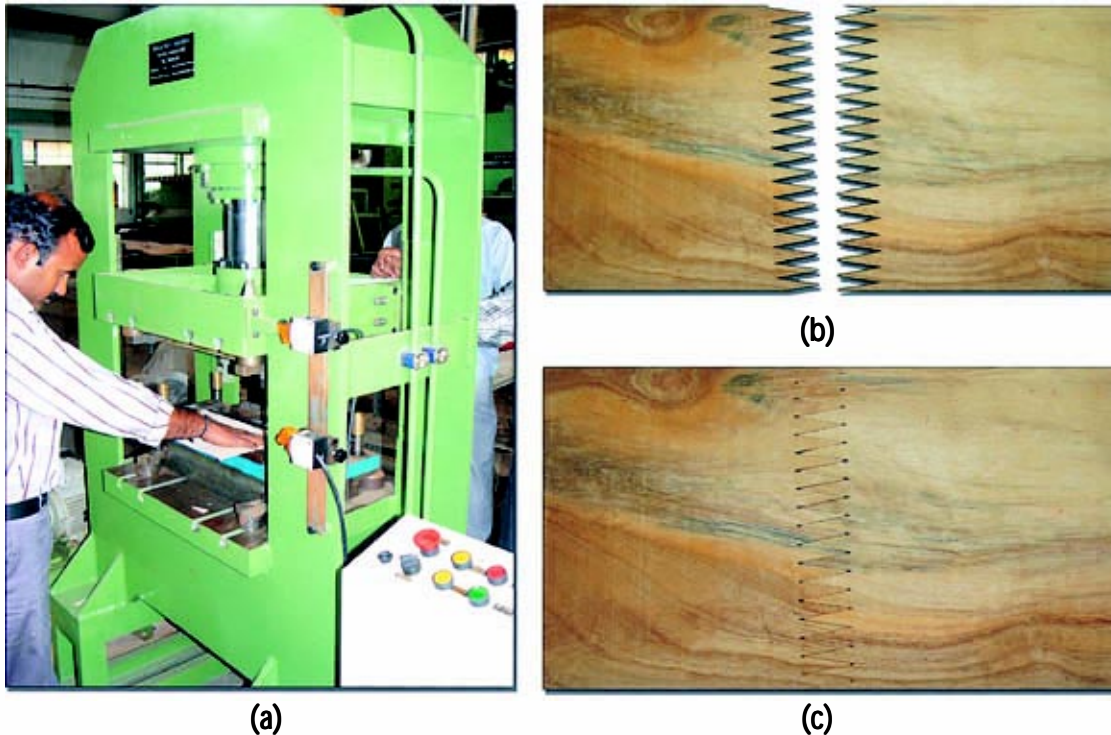


Fig 72. (a) Veneer Finger Shaping Machine developed at IPIRTI in use, (b) Veneers with Finger Shapes cut by the Machine, (c) Veneer Joint made with Finger Shaped veneer

The research and training activities of the Institute are carried out under the supervision and with the approval of the Research Advisory Committee.

Activities made during the year

During the year, the institute undertook 43 projects of which 35 projects were funded through its own resources and eight projects sponsored by various organizations. The projects cover product development from plantation wood, bamboo, agro and forest residue, process development and development of new resins. Emphasis was given to meet R&D need of the industry, develop wood alternatives from bamboo and other lignocellulosic materials. Binding materials based on synthetic polymer, where phenolic compound has been replaced by material of natural origin like cardanol, lignin and tannin, were also developed.

Of the thirty five institute funded projects, nine were completed and out of eight sponsored projects, seven were completed. Three research reports/technical reports of the completed projects have been released and six research reports are under vetting/printing.

Development of machine for efficient veneer finger jointing

A machine for efficient veneer finger jointing, was designed, developed, installed and commissioned. Trials were taken on different species of timbers and different thicknesses of veneers. The performance of machine is found to be very good. Testing of strength properties of finger jointed panels is being undertaken. The machine will help in producing longer core and cross band veneers which will eliminate core gaps and over lap in manufacturing of plywood especially to benefit the industries.

Development of products from new generation eco-friendly materials.

Moulding dyes for skin board of 1950×950 mm size for door using Bamboo Mat Board (BMB) has been designed, order for fabrication work was issued and the work is under progress. A few products such as centre table using bamboo flexi ply, chair using moulded seat and back rest from BMB, and Kids play house using BMB, Bamboo Mat Veneer Composites (BMVC) and Bamboo Mat Corrugated sheet (BMCS) were fabricated.

Effluent treatment of chemicals discharged from Plywood Industries

Experiments were conducted on treatment of effluents discharged from the washings of resin kettle, glue spreader and preservative treatment tank so as to minimize the pollution level.

Initial studies were carried out to reduce the pollutant level using the coagulating agents supplied by the company.

Budget Allocation

The budget allocation of the programme during 2005-06 under Plan and Non-Plan was Rs.2.95 crore and Rs.1.0679 crore respectively.

Wildlife Research

Introduction

Wildlife research is coordinated by Wildlife Institute of India (WII), Dehradun. It covers ecological, biological, socio-economic and managerial aspects of wildlife conservation in various parts of the country. The research projects generate valuable scientific data, help evolve study techniques relevant to the India ground condition, and also create a group of trained field biologists, socio-economists and wildlife managers. The scientific information generated is utilized for management of protected areas.

Activities undertaken

A total number of 50 research projects on diverse aspects on wildlife and coordinated by WII is at various stages of implementation. These projects are either grants-in-aid projects of WII or sponsored as collaborative projects.



Fig 73. Indian Rhino at Kaziranga National Park



Fig 74. Lacte species of *Ganoderma lucidum* of *Dalbergia sisoo*