CENTRES OF EXCELLENCE

The Ministry has set up nine Centres of Excellence so far with a view to strengthening awareness, research and training in priority area of environmental science and management. These are:

- Centre for Environment Education (CEE), Ahmedabad
- CPR Environmental Education Centre (CEREEC), Chennai
- Centre for Ecological Sciences (CES), Bangalore
- Centre of Mining Environment (CME), Dhanbad
- Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore
- Centre for Environment Management of Degraded Ecosystem (CEMDE), Delhi
- The Tropical Botanic Garden and Research Institute (TBGRI), Thiruvananthapuram
- Madras School of Economics, Chennai
- Foundation for Revitalization of Local Health Traditions (FRLHT), Bangalore.

The Internal Committee of the Ministry has recommended setting up of a new 'Centre of Exellence' at Kerala Forest Research Institute, Peechi, Kerala in the field of Bamboo and Rattan. The objectives of the Centre are selection of suitable commercial species for different climatic zones, inventory of species and growing stocks estimations of Bamboo, studies on the mechanism of flowering of Bamboo and management of flowering and information networking and training.

Centre for Environment Education (CEE), Ahmedabad

EE through Children and Schools

CEE has been the Consultant to the Ministry for the World Bank supported "Environmental Education in School System" (EESS) project aimed at infusing environmental education in the school system. The greening exercise of Science, Social Studies and Languages textbooks of 6th, 7th and 8th standards, training of Master trainers and teachers and co-curricular hands-on activities. Approximately 40-50 Master trainers from each participating State were oriented to the greened textbooks as well as other support materials and for transacting these in the classroom. Also CEE facilitated training programmes for about 400-500 teachers in each State to orient teachers towards the newly greened textbooks.

CEE as State Resources Agency for 15 States and two Union Territories for the National Green Corps (NGC) scheme of the Ministry assisted the nodal agencies to conduct several programmes of NGC in these States. CEE facilitated teacher-training programmes.

Under the Centrally implemented scheme "Environmental Orientation to School Education (EOSE)" of MHRD, the process of getting proposals from NGOs through the regional desks was carried out. Twenty EOSE projects sanctioned for the year have been initiated. Apart from regular monitoring of projects a new project on "Environmentalizing Curricular Transactions in Schools" for standard 6 to 8th is being implemented by CEE in various states/UTs. The project "Dal Lake Conservation through EE" has also been initiated and is being implemented.

Scientist-in-Charge, CEE South has been appointed the Chair of the Committee of Directorate of State Education Research and Training (DSERT), Government of Karnataka, set up to revise the curriculum of the existing environment subject of standards 1st to 4th in the light of the recent Supreme Court Judgement

on Environment Education (EE).

The school programme on Science and Environment is also being implemented in 500 schools in five districts of northern region of Karnataka. The training module for the teachers training programme was designed and about 414 teachers were trained. Monitoring and follow up activities are being undertaken.

EE through Higher Education/Youth

CEE in collaboration with the Department of Environmental Sciences, University of Pune, conducted a summer course on "Environment and Development". This five-credit, full time course was offered during July 2004 to postgraduate students of the University of Pune.

The SAYEN (South Asia Youth Environment Network) India National Youth Meet on "Developing National Youth Action Plan" was organized in August 2004. Thirty nine representatives including youth from Higher Education Institutions, NGOs, youth clubs, associations and youth networks participated in the meet.

EE through Interpretation

CEE has been appointed by the Kanha National Park Authorities, Government of Madhya Pradesh for the up-gradation of the existing interpretation centre and do develop new interpretive materials for the Kanha National Park.

Under the second phase of the project 'Palamau Interpretation Programme', under which three publications, a touch screen and a website have been developed by CEE.

EE in Urban Context

During the year, three panel discussions were organized focusing on Bio-Medical Waste Management, Urban Drinking Water Management and Greening Ahmedabad.

CEE conducted a study titled "Study of Status of Solid Waste and Development of Action Plan for Integrated Solid Waste Management in Daman, Dadra & Nagar Haveli". As a part of study, stakeholders meet was held on Solid Waste Management during July 2004 at Silvassa and Daman.

EE for Industry

The project titled 'Climate Change and Energy Scoping Study – Environmental Awareness Generation and Education' was completed.

EE through Experiencing Nature

Snake shows were organized on every Sunday and on a daily basis during summer vacations for the school students visiting Sundarvan. Eleven Nature Camps were organized at Mt. Abu, Bakore, Sembalpani and at Kheda wetlands in which about 400 people participated. Two art and craft camps and puppet shows were also organized at Sundarvan.

A five-day Nature Discovery Camp at Manekbaug plot in Ahmedabad for school children was also organized to orient the children to nature and develop in them a basic understanding about interesting facts about nature through activities and experimental learning opportunities.

EE for Natural Resource Management

CEE is the Environment Agency for the Andhra Pradesh District Poverty Initiatives Project (APDPIP). A manual was developed for Environment Resource Group members.

EE through Mass Media

CEE is a Video Resource Centre of TVE (Television for Environment), London and is in the process of localizing 50 'Hands-On' programme made by TVE, in one or more Indian languages.

EE for Environment and Development

Under the Environment and Development book series project, "Challenging the Indian Medical Heritage" was launched during the year.

On behalf of Ministry, CEE developed the National Report for the Commission on Sustainable Development's 12th Review Session in April 2004 on 'Water, Sanitation and Human Settlements' through a participation process.

EE through Training

CEE, in partnership with Ramboll Natura, Sweden and SADC – Regional Environmental Education Programme, South Africa has been offering the SIDA sponsored advanced international training programme titled 'Environmental Education Processes in Formal Education' for the last two years. The Asian regional component of the 2004 Course was held during 28 June – 9 July 2004 at CEE, Ahmedabad. Fifteen participants from nine countries, namely Bangladesh, Cambodia, China, India, Lao P.D.R., Mongolia, Nepal, Philippines and Sri Lanka attended the programme.

EE through Networking

CEE organized an "International Conference of Education for a Sustainable Future" in partnership with the Ministry of Environment and Forests and Ministry of Human Resources Development, from 18 to 20th January 2005 at Ahmedabad. The Conference marks the beginning of "UN Decade for Education for Sustainable Development" (DESD). As part of the World Ocean Network, supported by UNESCO, an initiative called "World Ocean Passport' has been undertaken by CEE.

Special Projects

Global Environment Facility (GEF) /Small Grants Programme (SGP)

CEE is the National Host Institution of the Small Grants Programme administered by UNDP and Ministry. As part of this programme, the National Steering Committee meeting and Regional Committee meetings to screen proposals were organized during the year.

Events

World Environment Day on 5th June, 2004 and International Ozone Day on 16th September, 2004 were observed by CEE and its offices by conducting several programmes to mark the events.

C.P.R. Environmental Education Centre, Chennai

C.P.R. Environmental Education Centre (CPREEC) has been set up to increase consciousness and knowledge about the environment and the major environmental problems of the country, and to spread the message of conservation of the environment through both the formal and non-formal sectors. Details of activities carried out by the Centre through various programmes are as follows:

Training Teachers to Integrate Environmental Education in the School Curriculum

Teacher training programmes on Integrating Environmental Education in the School Curriculum were organized in various districts in the States of Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, Orissa, Pondicherry, Tamil Nadu and the Andaman and Nicobar Islands. Programmes were also conducted in collaboration with the State Council of Education Research and Training (SCERT) and District Institute of Education and Training (DIET). Competitions were conducted to assess the knowledge gained by students.

Biodiversity Conservation Education

Training programmes on Biodiversity Conservation Education were organized in Andhra Pradesh, Karnataka, Kerala, Pondicherry and Tamil Nadu for teachers and students to motivate them to protect our natural resources. Teachers and students were taken to the nearby national parks of sanctuaries to understand the importance of forest and wildlife.

Training Programmes in Ecologically Fragile Areas

Nilgiri Biosphere Reserve

The students and teachers from various colleges and schools visited the CPREEC's gene pool of

Medicinal Plants (190 species) to understand the importance and the usefulness of these indigenous herbs. An exhibition on Nilgiri Biosphere Reserve Conservation was organized at Gudalpur to conscientize the people on the importance of Nilgiri Biosphere Reserve.

Andaman and Nicobar Islands

CPREEC has imparted environmental education to school teachers and students, women and villagers on the importance of the marine ecosystem in the ecologically fragile area of the Andaman & Nicobar Islands. Film shows were also organized. An exhibition on "Biosphere Reserves of India" was organized during the Annual Island Tourism Festival at Port Blair.

Exhibitions

Exhibitions were organized on Conservation of Wetlands, Biosphere Reserves of India and Solid Waste Management.

Painting and elocution competitions on the themes of the exhibitions were also organized for school students, while video films were screened for visitors.

Environmental Law Education

Law Seminars were organized in the States of Andhra Pradesh and Tamil Nadu for law students, judiciary, advocates, academicians and NGOs.

Conservation and Restoration of Sacred Groves

CPREEC maintained 10 existing sacred groves in the States of Andhra Pradesh, Karnataka and Tamil Nadu. Soil and water conservation measures were implemented in the sites after analyzing their quality to choose appropriate species for plantation.

Training programmes on the importance of sacred grove conservation were mainly targeted for villagers, priests and NGOs. School teachers and students, women were also trained through folk media. Saplings were distributed to school students and women for rearing in their schools and residence respectively.

Women and Eco-Development

Training programmes were conducted on Women and Eco-development in the States of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. The focus was on health and nutrition, construction of smokeless chulha, vermicomposting, conservation of fuel wood, paper bag manufacturing, kitchen gardening and nursery raising to increase their earning. Saplings and seeds were distributed to the participants. Community smokeless chulhas were installed in schools with noon meal scheme.

Eco Model Village

CPREEC's eco village Nenmeli, Kanchipuram district, Tamil Nadu, is used as a training centre for school teachers and students, farmers, women, NGOs and government officials for watershed management, biodiversity conservation, sacred groves, organic farming and a gene pool of medicinal plants with more than 82 species.

Audio Visual Campaign using the Video Van

Audiovisual shows and a lecture on the importance of environment were conducted for students. Informative and attractive posters on various environmental themes were displayed at prominent locations in the village. The video van traveled to remote villages in Orissa, Andhra Pradesh, Kerala and the Nilgiri Biosphere Reserve.

Writing of textbooks

As an outcome of the Supreme Court ruling on making environmental studies – a compulsory subject in all levels of education. CPREEC has been assigned the task of writing the textbook on Environmental Studies for undergraduates by the University of Madras.

CPREEC has also written the textbooks on Environmental Science for Std. I to V, under Matriculation syllabus, Environmental Science for Std. I to V under CBSE syllabus and Environmental Science for Std.

IX and X under ICSE syllabus.

Research and Surveys

Survey of ground water in Kancheepuram

CPREEC carried out a survey of ground water in and around Kancheepuram town. About 70 ground water sources were surveyed and analysed involving students, teachers and NGOs. The Total Dissolved Solids (TDS) level exceeded 1000 mg/l in most of the samples. About 15% of the samples showed high nitrate content.

CPREEC conducted a water quality survey in the residential areas of Pallikkaranai to raise consciousness about the contamination levels of the water.

National Green Corps (NGC) Programme

Organized training programmes for the teacher-coordinators in the States of Andhra Pradesh, Tamil Nadu and Goa for the newly selected eco clubs. Training programmes were also conducted for the eco club members of various schools in Andhra Pradesh and Tamil Nadu through audio visual programmes and hands on activities.

GLOBE Teachers' Training Programmes

CPREEC conducted workshops on the GLOBE protocol for teachers of four districts in Tamil Nadu.

Award for Environmental Education

The third C.P.R. Environmental Education Centre Annual "Award for Environmental Education" was given to Shri V. Ramalingam, Teacher, Jeevanandham Government High School, Pondicherry.

MHRD Scheme of Environmental Orientation to School Education

Generated and printed resource materials, and prepared of water testing kits for distribution to 49 participating NGOs under the above scheme in the State of Andhra Pradesh, Karnataka, Orissa and Tamil Nadu.

Vatavaran Travels 2004

In collaboration with the Centre for Media Studies, New Delhi CPREEC organized Vatavaran Travels 2004, a festival of environment and wildlife films, at Chennai in November, 2004. Shri A. Raja, Hon'ble Minister of Environment and Forests, Government of India, inaugurated the film festival.

Symposia on *Recent Shifts in Media Operations* and Panel discussions on *Environment and Wildlife Film Making in India: Insight, Concerns and Planning – The Route Ahead* were organized, in addition to CPREEC's exhibition on *Rainwater Harvesting* at the venue of the film festival.

Publications

Several resource materials were published and distributed to teachers and students participating in the training programmes. These include:

- Quarterly Newsletter ECO NEWS
- Two issues of the EMCBTAP – ENVIS newsletter *echoheritage.com*
- Journal of Environmental Education
- New booklets on Conservation of Wetlands, Biosphere Reserves of India and Solid Waste Management
- Sacred Groves: Ecological Heritage

Award to CPREEC

CPREEC was awarded the Dr. M.S. Swaminathan Award for Environment Protection – 2004 instituted

by the Rotary Club of Madras East and Earthcare.

Centre of Ecological Science (CES) Indian Institute of Science (IISC), Bangalore

The Centre was recognized as a Centre of Excellence to conduct research and undertake education and training in the broad area of ecology of Western Ghats. The Centre conducted research in the area of behaviours of sociobiology, conservation biology, biodiversity and forests dynamics, eco-development, environmental history and policy, human ecology, climate change and energy. The overall performance of the centre is evaluated by a Monitoring Committee. Major research Projects conducted during the year are:

Behaviour of social insects: Research on behaviour of social insects was focused on wasps, ants and honey bees.

Ecology of Asian elephants: Monitoring of long term demography of the elephant population of the Nilgiri Biosphere Reserve and documentation changes in birth rate, mortality and sex ratio.

Western Ghat Biodiversity Information System: Sahyadri: Western Ghats Biodiversity Information System has been designed (http://ces.iisc.ernet.in/biodiversity/Welcome.html) adapting the state-of-the-art database technology and the information related to Western Ghats biodiversity.

Tropical forest diversity and dynamics: Long term dynamics of tropical forests in the Nilgiri Biosphere Reserve through the establishment of permanent plots in different vegetation types.

Joint Forest Management in India: A study on the performance of JFM was carried out in six states (Andhra Pradesh, Gujarat, Karnataka, Rajasthan, Tripura and West Bengal) in collaboration with research and academic institutions, and NGOs in the respective states.

Non-timber forest product yield in the Western Ghats: Sixteen non-timber forest product species are being monitored for yield attributes since 1997.

Climate change and climate variability: Studies of climate change include reconstruction of past climate change, modeling future climate change impacts on forests, and mitigation strategies for coping with climate change.

Acoustic sampling of cricket communities in tropical evergreen forests of the Western Ghats: The species diversity of acoustically communicating crickets (Order Orthoptera) is being assessed in three sites, Kudremukh National Park, Mookambika Wildlife Sanctuary and Sharavathi Valley Wildlife Sanctuary, using acoustic spot sampling.

Plant-animal interactions: Several aspects of plant-animal interactions, including the ecology of the ant-plant (*Humboltia*) system and the foraging ecology of the giant squirrel (*Ratufa indica*) have been investigated.

Workshop: The Centre organised a workshop on the follow-up to the conference of parties to the International Convention on Biological Diversity.

Centre for Mining Environment, Dhanbad

The Centre for Mining Environment (CME) was established by the Ministry in 1987 at the Indian School of Mines (ISM), Dhanbad with the main objectives to impart training to in-service field personnel in environmental science and technology with particular reference to environmental management in mining area, to carry out research in mining environment, conducting regular academic programmes etc.

The Centre's R&D activities during the year focussed in the following area:

- An assessment of overburden dump rehabilitation Technologies adopted in CCL, NCL, MCL and SECL mines
- Investigation into the air quality status and its impact on social spectrum in the industrial belt of Korba Coal field, Chattisgarh.
- Impact of Mining on the pattern of land use changes in mines and their neighbourhood in selected

mining areas of Jharkhand.

- Investigation into the noise status of some selected non-coal mining complexes with a view to developing abatement and control measures.

Academic Activities

The Centre offers post-graduate academic programmes of M.Tech. (Env. Sc & Engg.) and Ph.D. (Env. Sc. & Engg.). Over 120 students have successfully completed these programmes and are well received by the various industrial, research, regulatory and consultancy organizations. Currently 15 students are pursuing this course in 2004-05.

A National Seminar on Environmental Engineering with special emphasis on Mining Environment was organised jointly by Centre for Mining Environment, ISM and Institution of Public Health Engineers, Indian at ISM during 19-20 March, 2004.

Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore

The Centre was established in June, 1990 as a Non-Governmental Organisation under Societies Registration Act, on the basis of a project proposal prepared by Bombay Natural History Society (BNHS), Mumbai. The Centre is financially supported under the scheme "Centre of Excellence" operated by the Ministry.

The mission of SACON is to "help conserve India's biodiversity and its sustainable use through research, education and peoples' participation". Objectives of the Centre are to:

- design and conduct research in Ornithology covering all aspects of bio-diversity and Natural History.
- develop and conduct regular courses in Ornithology and Natural History for M.Sc., M.Phil., Ph.D. and also, short-term orientation courses in the above subjects.
- create data bank on Indian Ornithology and Natural History, disseminate knowledge relating to Ornithology and Natural History for the benefit of the entire community, and
- to confer honorary awards and other distinctions to persons who have rendered outstanding services in the fields of Ornithology and Natural History.

A Governing Council headed by Secretary(E&F), is vested with overall responsibility of Governance and financial management. A Research Advisory Committee advises the Centre on scientific matters.

The important achievements of Centre are as follows:

- Studies on edible nest of swiftlet, megapode, Narcondam Hornbill and Andaman Teal of Andaman Nicobar Island have resulted into management plan for better conservation of these birds. Studies on globally threatened birds like Nilgiri Laughing Thrush, and the impact of commercial plantations replacing Shola forests and grasslands of Nilgiri are some of the important contributions.
- Habitat monitoring by SACON in Keoladeo National Park, Bharatpur was helpful in framing appropriate strategies for protecting the Siberian Crane habitats.
- SACON's demonstration of people's participation in the conservation of elephant corridors in the Nilgiris, is one of the major output will go a long way in the conservation of protected area.
- SACON has discussed the bird mediated dispersal of tree seeds based on which the forest department has started raising appropriate tree species for afforestation programme.
- A long term programme has been executed for the conservation of Lessor Floricam, one of the endangered species.
- SACON has established a toxicological laboratory to study the impacts of pesticides and industrial effluents on birds and mammals.

- Expertise of SACON is being used for EIA by various agencies.
- The Centre organised the first PAN Asian Ornithological Congress.
- SACON has undertaken number of research projects under avian ecology which include Nilgiri Wood Pigeon, Nilgiri Pipit, Grey-headed Bulbul, Lesser Florican, Avifauna of Silent Valley National Park, Conservation of Edible-nest Swiftlet, survey of Great Pied Hornbill, database on Indian ornithology.
- Under Man and Biodiversity Conservation, pesticide contamination of fish, environmental contaminants effecting fauna, physiological effects of air pollution on birds, reptile diversity, etc. have been studied.
- Under Ecosystem structure and function, biodiversity monitoring of Anaikatty Forest Reserve, Monitoring and Modeling of Keoladeo National Park, studies on mammals, birds in Sikkim in Teesta Basin have undertaken.
- UNDP project on "Inland Wetlands of India" , 500 wetlands covering 25 States and 72 Districts were mapped through Regional Remote Sensing Agencies involving 15 states coordinators.
- SACON is also involved Nature Education Programme and Nature Clubs for the students of various schools.

Centre for Environmental Management of Degraded Ecosystems (CEMDE), Delhi

The Centre for Environment Management of Degraded Ecosystems (CEMDE), under the aegis of School of Environmental Studies, Delhi University, New Delhi has been functioning as the one of the Centres of Excellence of the Ministry since 1997. During the year, the institute carried out the following activities:

- Barren hilltops and slopes of low lying hillocks of Asola and Bhatti wildlife sanctuary in Delhi have been ecologically rehabilitated with 15000 ramets of eight species of grasses, 3000 saplings of six woody species, 8000 ramets of two bamboo species and their associated microbes. The restoration technology developed is being practiced by the Eco-task force of the Territorial Army. A Herbal Garden has been developed by the Eco-task force with know-how developed by the CEMDE.
- As a result of five-year studies on the ecosystem development on flyash mounds, it has been found that species like *Leptochloa fusca* accumulate toxic elements in roots and no accumulation was found in the shoots. Some grasses exclude toxic elements altogether. These grasses are useful in the ecosystem development and biomass production on solid waste dumps.

Fig 73. *Leptochloa fusca* - a hyper accumulator of toxic elements

Fig 74. *Artabotrys nicobarianus* (Annonaceae) - an endemic plant of Great Nicobar rediscovered after 100 years

- The CEMDE has been working on the ecosystem functions and dynamics in the Great Nicobar Biosphere Reserve (GNBR) – one of the biologically richest tropical evergreen forest ecosystems and hottest of hotspots. A total of 38 community types have been mapped and the species diversity appears to be among the highest in the tropical rainforest ecosystems of the world. Floristic surveys have yielded at least

four species new to science, besides several rediscoveries and additions to the flora at family, genus and species levels. A total of 36 exotic species have been recorded in the island of which 12 are known invasive species. These species may endanger the endemic flora and fauna.

Tropical Botanic Garden and Research Institute, Thiruvananthapuram

Tropical Botanic Garden and Research Institute (TBGRI), Thiruvananthapuram with its mandate for conservation and sustainable utilization of tropical plant diversity is recognized as a National Centre of Excellence in *ex situ* conservation of tropical plants. TBGRI also functions as the National Gene Bank for medicinal and aromatic plants of peninsular India and has a Bioinformatics Distributed Information Centre.

R&D Activities/Achievements by the Centre during the year are as follows:

- Research activities continued under 60 research projects, funded by international agencies like World Bank, National agencies such as Government of India departments viz. MoEF, DBT, DST, CSIR and ICMR and State Government Departments such as the Kerala Forest Department, the State planning Board and KSEB. Among these, 12 projects are newly obtained during the year. Besides the externally funded projects, 50 in-house programmes/projects funded by Kerala State Council for Science, Technology and Environment (KSCSTE) are also being implemented.
- Over 400 accessions belonging to trees, medicinal plants, palms, bamboo, orchids, ferns etc. were introduced to the Garden during 2004.
- Three genera and 20 species of fungi and five species of flowering plants were described as new to science.
- Beautification of the garden with the planting of different varieties of *Ixora, Hibiscus* and mixed groups of foliage was done. The aesthetic garden in front of the main building was completed. About 800 plants were planted in the shrubbery area.
- Nineteen bamboo offsets from Arunachal Pradesh were planted. Exploration to Wayanad and Coorg resulted in collection of 13 offsets. Studies on reproductive biology of *Dendrocalamus hamiltonii* and *Ochlandra* species were completed. Propagation and distribution of saplings were continued. A bamboo museum establishment is in progress.
- Detailed morphological characterization of accessions of *Costus speciosus, Pellionia heyneana* and *Aegle marmelos* were carried out. Supply of plant materials of MAP was undertaken by the Unit.
- Orchid germplasm enrichment was continued. New additions were made from Marcel Lecofle Orchidees, Paris. CITES checklists for *Aeridis* and *Coelogyne* were corrected and submitted. By way of orchid breeding 56 orchid crosses were made, seedlings of one hybrid was introduced to the field. *Vanda merrilli* flowered for the first time in TBGRI.
- Interesting new accessions introduced to the Arboretum include rare and endemic species of the Western Ghats like *Aglaia bourdillonii, Syzygium lanceolatum* and *Syzygium travancoricum.* Propagation trials done in *Chukrasia tabularis* and *Connarus wightii* were found to be successful.
- Propagation studies were conducted and about 500 seedlings were raised. A new infrastructure facility of a mist house was constructed at the Palmetum with the aid from Department of Biotechnology.
- In-*vitro* multiplication protocols for many threatened plants was developed. Cryopreservation methods have been standardized for a dozen species. R&D programmes on seed biology of endemic species are in progress.

Fig 75. Endemic lesser known fruit tree *Baccaurea courtallensis* of Western Ghats

- Commercial Tissue culture Unit focussed on mass production of *in vitro* raised plants. About two lakh plants were developed which comprised *Anthuriums, Vanilla, Banana, Nepenthes* etc. Tissue culture of two bamboos has been initiated.
- Genetic diversity evaluation of 15 species of Pleurotus has been done. Eight isolates of *Aspergillus* were subjected to ITS-RFLP analysis. Molecular phylogeny of six isolates of *Streptomyces* was completed. Mycorrhizal association of *Janakia arayalpathra* and *Garcinia travancorica* were evaluated. 1499 collections were added to the mushroom herbarium.
- Assessment and mapping of NWFP is Southern Kerala were carried out in Thenmala, Kaniyar, Devikulam, Marayoor etc. Reproduction biological studies on *Morinda reticulata* and *Impatiens grandis* have been completed.
- The Pilot Participatory Programme for Conservation and Sustainable Utilisation of Medicinal and Aromatic Plants has been successfully completed and the reports submitted to the Kerala Forest Department.
- Ethnopharmacological assays were carried out on selected medicinal plants for anticancer, antiviral, hepatoprotective and antioxidant properties.
- Conservation biology studies on the rare tree species of Western Ghats continued. Phenology and pollination mechanism of *Cassine kedarnathi* and seed dispersal mechanism in *Cassine* and *Palaquium* were studied.
- Region wise list of tree species of Western Ghats was prepared in order to take up palynological studies. Tow hundred pollen slides of 40 tree species were prepared.
- One book and over 45 research papers were published in national and international journals.

Madras School of Economics, Chennai

The Ministry had recognised the Madras School of Economics (MSE) as a Centre of Excellence in the area of Environmental Economics for a period of five years from 1st April, 2002. It was agreed to collaborate with the Centre of Excellence in the following subject areas:-

- Development of Economic Instruments
- Trade and Environment
- Cost benefit analysis
- Applied aspects of Environmental Economics for the Ministry's policy decision making; and
- Development and maintenance of website on issues related to Environmental Economics.

Under the Scheme of the studies entrusted to MSE include

- Study on Leather Industry-MSE has taken up a study an Impact of Environmental Regulations abroad on India's leather exports and suggestions for policy action.
- Fly Ash Utilisation by Brick Manufacturers- The Study would suggest possible instruments that can be applied so as to promote the use of fly ash based bricks.
- The Ministry has also decided to utilise the expertise of MSE and to obtain their economic inputs on issues of environmental policy referred to it. A study entitled Economic Analysis of Environmental Impact Assessment in India- Costs of Delays, Impacts and Mitigation Measures has been recently entrusted to MSE. The duration of study will be one year and would focus on four sectors namely (i) mining (ii) Power generation thermal power generation (iii) infrastructure primarily roads and ports and (iv) Chemical industries.
- An Environmental Economics Website has been developed and periodically upgraded.

Foundation for Revitalization of Local Health Traditions, (FRLHT), Bangalore

The Ministry has recognized Foundation for Revitalization of Local Health Tradition (FRLHT) as a Centre of Excellence in October 2002. An Ethno-Medicinal garden & nursery has been established in the FRLHT campus. Five hundred twenty nine species have been planted, including 35 Red listed plants. FRLHT's main objective is to demonstrate the contemporary relevance of Indian Medical Heritage by designing and implementing innovative programmes, on a size and scale that will have societal impact. Its three thrust areas are:

- Conservation of the natural resources used by Indian systems of medicine and
- Exposition of the theory and practice of traditional systems of medicine,
- Revitalization of social processes for transmission of the heritage.

Medicinal Plants Distribution Maps using GIS

A GIS has been developed and utilized for Eco-distribution mapping of medicinal plants species of conservation concern. The use of GIS tool for mapping the natural distribution of medicinal species "conservation concern" is useful for both conservation action as well as for promoting their cultivation.

During the year the distribution maps of 250 prioritized species using a GIS platform have been prepared on 1:10 million scale. Eco-distribution maps on 1:6 million scale have been prepared for 40 endangered species showing precise lat-long locations derived from floras, herbaria and field studies. They are also overlaid with soil, rainfall, and forest type and altitude data, so as to provide users with an ecological interpretation of their distribution.

Creation of a Bio-cultural repository of Medicinal plants

A Herbarium and Raw Drug Repository of the medicinal plants of India is being established by the Centre. This repository is expected to serve as a national repository of the medicinal botanicals of the country.

During the year 500 new species used by the different Indian systems of medicine have been added to the repository taking the total collection in the herbarium to around 2200 species. Over 3000 new accessions have been added to the repository. 800 new images have been added. In addition 300 raw drug samples have been collected and 2000 herbarium records digitized.

Development of Educational Material on the rich traditional knowledge of the Medicinal Plants of India

India has one of the world's richest documented traditional knowledge heritage on medicinal plants manifested in medical texts of Ayurveda, Unani & Siddha systems of medicine.

During the year the Centre have developed a comprehensive database on 500 botanicals and their traditional applications in the Siddha system of medicine. 250 species of the Unani system of medicine and their applications have similarly been completed. Materia-medica of 100 new species have been added to the homeopathy plant database and a unique cross-cultural study completed on 50 controversial plants of Ayurveda based on analysis of modern and indigenous morphological description of plants.

Training to village botanists in identification and monitoring of Medicinal Plants

During this year, four courses on parataxonomy for 36 village botanists have been organized in Tamil Nadu and well-designed training modules developed on these courses. The topics covered by the modules include vegetation monitoring, herbarium preparation, species identification, seed collection, bio-cultural documentation, and IPR issues related to biodiversity & traditional knowledge.

Establishing an ethno-medicinal demonstration garden

The garden is being designed to serve as a model ethno-botanical, educational herbal garden, which can be emulated by other institutions in India.

Two hundred new accessions including 37 Red Listed medicinal plant species have been added to the garden during the year. Three new thematic gardens on zodiac signs, aromatic plants and poisonous plants have been created. The nursery has designed and developed a package of 21 plants useful in primary health care for an outreach programme aimed at 2000 home herbal gardens in Bangalore city. It has also developed a package of 40 species for 100 institutional gardens. Aesthetic landscaping has been done in specially selected spaces in the garden displaying rare orchids and endangered species.

Pharmacognostic studies on prioritised medicinal plants

A chemical finger printing diagnostic kit has been developed and pharmacognostic standards developed for *Andrographis paniculata* and *Withania somnifera* including quantification of their reference marker compounds.

A plant called Vidari is in very high usage (~100 formulations) in Ayurveda Industery for its medicinal properties has been subjected to finger printing using DNA techniques. However, at four different botanical species are used by the industry in the name of Vidari. Even though Ayurveda allows for substitution, it is important to establish the correct botanical identity of Vidari as part of the requirement of Good Manufacturing Practice. DNA standard fingerprints have been developed for these species so that they can be used for quality control requirements.

UPDATES 2004-05

- Nine Centres of Excellence set up in various notable areas continued their diverse activities in their respective fields during the year.
- A new Centre of Excellence in the field of bamboo and rattan at Kerala Forest Research Institute, Peechi, Kerala has been recommended to be set up by the Internal Committee of the Ministry under the scheme.