

ANNUAL REPORT 2011 - 12

Ministry of Environment and Forests, Government of India's

Centre of Excellence for
Medicinal Plants and Traditional Knowledge



पुरुषोऽयं लोकसम्मितः

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Printed at
Akshara Graphics
Bangalore

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Photo on the Front cover: Fruits of *Hernandia nymphaeifolia*
(J.Presl) kubitzi (Hernandiaceae)

Other Photos on:

- Content page: Flowers of *Hoya parasitica*
Wall. (Asclepiadaceae)

Beginning page of Introduction: Expert Review committee of
MoEF, at the Herbarium

- Last page of Introduction: Fruits of *Elaeagnus latifolia* L.
(Elaeagnaceae)

Beginning page of Highlights: Flowers of *Sloanea sterculiacea*
(Benth.) Rehder et Wilson (Elaeocarpaceae)

Beginning page of Reports: Fruits of *SChampereia manillana*
(Blume) Merr. (Opiliaceae)

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1. INTRODUCTION

The Foundation for Revitalisation of Local Health Traditions (FRLHT), based at Bangalore is the Center of Excellence (CoE) for 'Medicinal Plants and Traditional Knowledge', as recognized and supported by the Ministry of Environment and Forests (MoEF), Government of India, since the 10th Five year Plan i.e., 2002-03.

VISION

The center has articulated its vision as under:

Demonstration and making available field tested innovative strategy prototypes for Survey, Data collection, Research, Analysis, Education & Outreach in respect of Indian Medicinal plants and Traditional medical knowledge, in order to meet the demands of the sector, by way of accomplishing the following:

- Establishing a Referral Collection of Plant Specimens & Raw Drugs as a base for authentic identification of Indian medicinal plants
- Demonstrating the Interpretation of Traditional Medical Knowledge by using tools of modern science
- Ascertaining Geographical Distribution of Medicinal Plants for prioritizing species, habitats and zones for conservation action
- Dissemination of the Generated Knowledge, through orientation and training programs and educational material to important stake holders

The vision is being realized through:

- Bio-cultural herbarium of medicinal plants of India
- Ethno-medicinal garden
- Pharmacognostic studies of controversial botanical raw drug groups
- GIS based geo distribution maps for prioritised medicinal plants
- Training and Capacity Building initiatives for Master Trainers, Forest department personnel and other key stakeholder groups in respect of medicinal plants conservation and management.
- Informatics and computer enabled Educational products medicinal plants and Indian medical knowledge

1.1. Project Components:

The project comprises of the following six components. The details of these components alongside their central purposes are presented below:

Project Component Code & Title	Central Purpose of the Component
CE-P1: Project Coordination	The Centre of Excellence involves activities spread across different groups within and outside the organisation. The project coordination cell provides the common string to all the planned activities. It also forms an interface between the MoEF and FRLHT, liaison with other organisations and coordinates project formulation to strengthen the CoE.
CE-P2: Herbarium of Medicinal Plants used in ISM	According to the Planning Commission Task Force on medicinal plants (2002), India's herbal industry has a huge economic potential in the global market. A National Repository of the medicinal plants of India is an essential requirement to support this potential and the FRLHT Herbarium is the only medicinal plants herbarium in the country. It has been designed as a bio-cultural herbarium which brings together the vernacular names and the currently accepted botanical name of a particular species including the specific location of its presence (latitude, longitude, altitude) on the Indian Territory. This project requires expertise both in taxonomy as well as in traditional knowledge of plants.
CE-P3: Establishment of Ethno-medicinal Plants Demonstration Garden	Ethno-medicinal gardens are different from the conventional botanical gardens and arboreta in that they raise the plants which are prominently associated with different ethnic groups, besides arranging them according to a known system of botanical classification considering the family, genus, species, sub-species etc. Such gardens, therefore, represent the cultural dimensions of the botanical wealth of a region. India has one of the world's richest ethno-botanical traditions. Therefore, it is important to create regional ethno-botanical gardens in every district of the country as they can serve not only to conserve plants but also to conserve the cultural history related to natural products of the country.
CE-P4: Pharmacognosy Studies on Medicinal Plants	India needs a large number of Pharmacognosy labs because internationally acceptable standards have to be developed for almost 2000 species of medicinal plants that are used by different traditional systems of medicine. In the last 50 years the pharmacopoeial standards have been developed for only around 400 species. The FRLHT laboratory activities supported under CoE are of a unique nature because they are focused on creating what may be termed as <i>traditional knowledge guided</i> standards. This is an innovative inter-cultural strategy in the field of Pharmacognosy.
CE-P5: Distribution mapping of Medicinal Plants using GIS	The GIS technology is well known for its application in the field of conservation of Natural Resources. Under the CoE project it is for the first time that GIS applications are being made specifically focusing on medicinal plants resources.
CE-P6: Outreach (Training & Educational Material on Plants of ISM)	<p>Strengthening the competence and capacities of the different stakeholder groups in respect of different focal themes related to conservation of medicinal plants, helps build an informed cadre of personnel for addressing the emerging needs of the sector. It is envisaged to orient and train Master trainers from Forestry training Institutes, Educational institutions, NGOs and Community groups who in turn build cadres of Village Botanists, Para-taxonomists and Environmental groups to help generate field information on medicinal plants as well as its dissemination. It is also envisaged to build capacities of the frontline forest staff and forest managers in respect of medicinal plants conservation and management strategies.</p> <p>In order to make the rich traditional knowledge of the medicinal plants of India accessible to students, teachers, researchers and industry in the country, it is necessary to use IT tools to interpret and present this knowledge. This task of translation of the traditional knowledge about plants requires inter-disciplinary expertise of ISM scholars and experienced Plant Taxonomists.</p>

1.2 Project Implementation Mechanism:

FRLHT prepares the annual action plans in respect of the above project components within overall five-year project objectives and submits the same to the MoEF for approval. Within MoEF, a special Project Steering Committee under the Chairpersonship of the Addl. Secretary, MoEF, Gol appraises the annual proposals, recommends release of funds and monitors the project performance on a six monthly basis.

At the implementation level at FRLHT, each project component is headed and implemented by a senior staff member, and is monitored on a monthly basis.

During the year 2011-12, the project progressed further in the direction of achieving the goals of the Center of Excellence. Whereas the project made credible contribution in strengthening FRLHT's Resource and Knowledge base to develop it as a Center of Excellence in the field of Medicinal Plants and Traditional Knowledge, the outcomes from this project have been making significant contribution to the Indian Medicinal Plants sector.

This report provides glimpses of the highlights of the project activities pertaining to the year 2011-12 (section 2) and a matrix of detailed annual progress report (section 3).





2. HIGHLIGHTS OF THE PROJECT PROGRESS

The approved annual plan for the year 2011-12 was implemented as scheduled. Detailed physical progress in respect of the stipulated targets, under different activities, is given in a matrix format for a quick look in section 3, while the descriptive progress and highlights of the same are given below.

CE-P2: BIO-GEO CULTURAL REPOSITORY OF NATURAL RESOURCES USED BY THE INDIAN SYSTEMS OF MEDICINE

A "Herbarium" is a repository of certain kind of "plant specimens" or vegetative parts of plants collected from far and wide, which are processed, dried, mounted, labeled and housed as per a definite botanical classification scheme.

The FRLH herbarium established in 1993 is a specialized herbarium focused on Medicinal plants used in the Indian Systems of Medicine (ISM). Its aim is to represent under one roof, the diversity of medicinal plant species and those found in trade, along with their morphological variations, by collecting their herbarium specimens. This would be accomplished through different botanical surveys taken up in different habitats, ecosystems and bio-geographic zones of the country.

During the year 2011-12, the herbarium team engaged in many field explorations in different regions of the country and strived to enrich the existing collection at the Herbarium. It aimed at an addition of 150 species through ~500 voucher specimens. Additionally it focused on such collections which could represent the entire range of distribution of select medicinal plant species. Attention was also paid to take up field studies in those geographical regions which are less represented in the Herbarium. At the end of the year, the overall picture of the collections was as below:

State	No. of collections	State	No. of collections
Himachal Pradesh	27	Manipur	188
Rajasthan	203	Meghalaya	99
Chhattisgarh	12	Sikkim	201
Andhra Pradesh	147	Tamil Nadu	100
Karnataka	172	Kerala	88
Andaman Islands	192	Pondicherry	52

"FRLH" is the internationally accepted Acronym accredited by the New York Botanical gardens, New York, USA and the Herbarium of medicinal plants maintained at FRLHT is recognized by this accredited name.

The different surveys resulted in the collection of 4450 voucher specimens corresponding to 1481 collection numbers. These have brought in 647 plant species of which 149 were not present in the herbarium earlier. The total number of species was expected to rise further, as a result of detailed scrutiny of the specimens, which was still underway at the end of the year.



Prized collections during the year: L.to.R.-*Hoya parasitica* Wall.(Asclepiadaceae), *Mucuna gigantea* (Lour.) Steud. (Fabaceae), *Syzigium claviflorum* (Roxb.) Wall.ex A.M. Cowan & Cowan (Myrtaceae)

Important collections during the year:

The herbarium team undertook different floristic surveys during the year especially across the regions less represented in the herbarium. Such focused surveys yielded several important collections from the view point of the herbarium, as many of these were hitherto not represented in its collections.

Noteworthy collections from north eastern India include: *Aconitum ferox* (Atis), *Dioscorea glabra* (Turar), *Ficus semicordata* (Corakapatra), *Garcinia pedunculata* (Amlavetasa), *Melodinus monogynus* (Soh brab), *Rheum australe* (Revan chini) and *Trichosanthes wallichiana* a wild relative of the cultivated gourd, *Trichosanthes anguina*.

Noteworthy collections from Rajasthan include: *Crotalaria burhia* (Shinio), *Leptadenia pyrotechnica* (Khimp), *Momordica balsamina* (Bara-karela), *Peganum harmala* (Haramala), and *Tribulus rajasthanensis* a candidate species of *Goksura*, a medicinal plant with high volume trade.

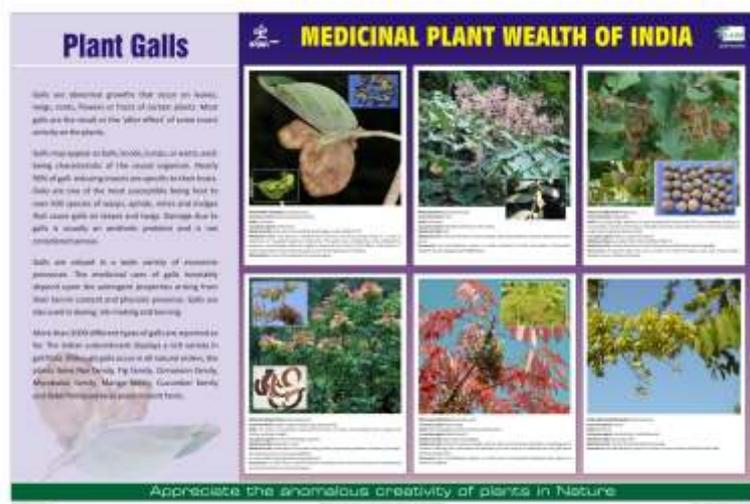
Noteworthy collections from Vishakhapatnam District, Andhra Pradesh include: 19 species which are significant in the context of their natural distribution and occurrence. Of these, *Aspidopterys indica* (Malpigiaceae) and *Cleidion javanicum* (Euphorbiaceae) were the two species reported for the first time from this region. Similarly, *Cassine paniculata* (Celastraceae) was a new addition to the Flora of Andhra Pradesh as well as to the Flora of the Eastern Ghats.

Noteworthy collections from Kerala were corresponding to Taxonomic relevance and include: *Cryptocoryne retrospiralis* (Araceae) and *Strophanthus wightianus* which are endemic to India. The collections also brought many species endemic to Western Ghats, such as *Gymnacranthera farquhariana*, *Hopea racophloea*, *Nymphoides krishnakesara* (Nymphoidaceae), *Otonophelium stipulaceum*, *Salacia macrosperma*, *Apollonias arnotti*. Additionally, the survey brought a prized collection of a vessel-less angiosperm, *Sarcandra chloranthoides*.

Development of Virtual herbarium

The herbarium team during the year, attempted to strengthen the virtual herbarium by way of enriching its image collections. Towards this end, it captured different photographs of high resolution during the field visits that depict the salient features of life form, plant parts, morphological variation, habitat and plant populations. More than 3000 such images captured during the field visits were added to the virtual herbarium during the year.

Additionally >550 voucher specimens were scanned and stored. The images were subsequently uploaded on the ENVIS website <http://envis.frht.org/digital-herbarium-main.php>



Educational Materials

The Herbarium team during the year engaged in the preparation of 4 Posters under the theme, "Medicinal Plant Wealth of India". These posters were focused on:

- Dye yielding medicinal plants: This poster illustrates the multiple significance of dye yielding plants including their medicinal, cosmetic, coloring and cultural virtues.
- Plant Galls in Indian Traditions: This poster brings to light the usefulness of different plant galls for medicinal purposes.
- Bala: This poster discusses the medicinal usage of different plants that are used under the name, *Bala*.
- Asoka: This poster brings to light the comprehensive picture of the cultural and medicinal significance of this tree species of conservation concern whose bark is traded in high volume.

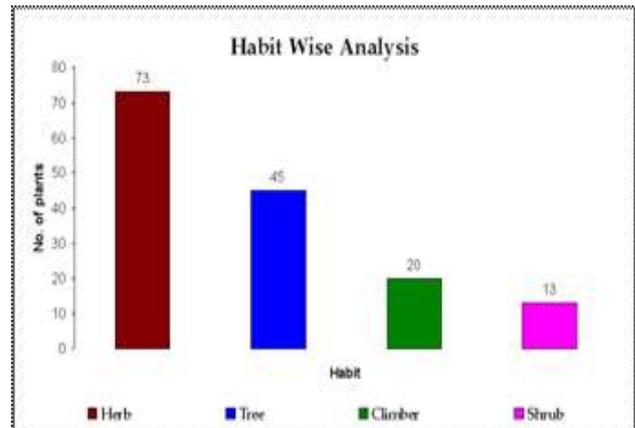
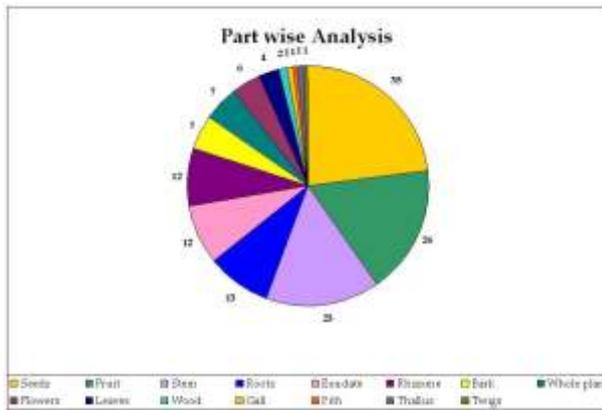
Five hundred copies each of these posters were printed and distributed among different user groups including the Forest officers, Conservationists, ISM physicians, Teachers and Students, and Educational Institutions.

RAW DRUG REPOSITORY

The Raw Drug Repository attached to the Herbarium is another manifestation of the repository of plants, and specializes in the collection of plant raw drugs used in the Indian Systems of Medicine. In order to meet its objectives, the team engages in procuring different raw drugs from the field as well as from raw drug markets across the country.

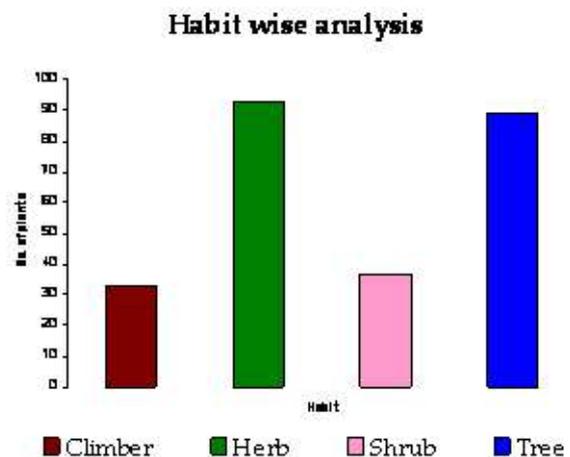
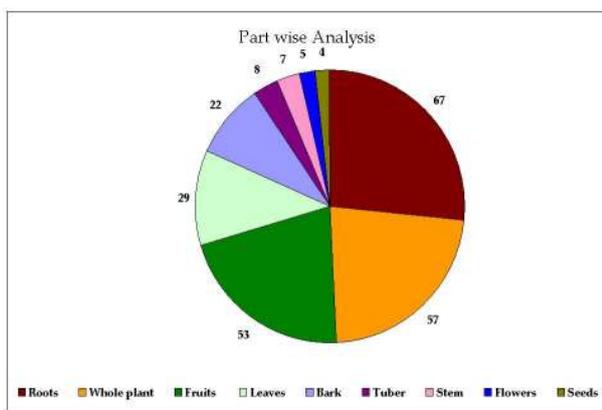
During the year 2011-12, the team engaged in different field collections and market collections and collected 152 rawdrug samples from the markets and 253 raw drug samples from field. These additions raised the total number of collection at the repository to 2980.

Market Collections: The 152 samples collected during the year correspond to 151 species (132 genera and 83 families) and were procured mainly from different markets in western India. The plant part/produce wise break up as well as the habit wise breakup of the collections is depicted below:



Authentic field collections:

The team procured 253 authentic collections from the field, which correspond to 173 species (from 143 genera and 86 families). These raw drugs were procured from Tamil Nadu (129 samples), Sikkim (38 samples), Karnataka (28 samples), Rajasthan (28 samples), Andhra Pradesh (20 samples), Gujarat (3 samples), Arunachal Pradesh (1 sample), and Tripura (1 sample). The plant part/produce wise break up as well as the habit wise breakup of the collections is depicted below:



Authentic Collection

The term 'Authentic collection' denotes a plant raw drug collected from a plant species which has been properly identified by a competent field botanist. Such collection has to be duly supported with the relevant botanical and ecological data including the physical location, date of collection, forest type/vegetation, phenology, frequency of occurrence etc.

As against this, the term 'Market collection' corresponds to a plant raw drug collected from a raw drug market or from a trader or a medicinal plant collector without proper authentication of the specific plant source.

Prized Collections

The raw drug repository has been able to stock many rare raw drugs over the years and these drugs constitute the prized collections. Some of these are enlisted below:

a) Controversial Medicinal Plants

Owing to the close similarity either in their morphological features or medicinal properties and action *vis-a-vis* a well-recognized medicinal plant drug, several other plant raw drugs come into use as 'substitutes' or 'adulterants'. As a result, such a well-recognized medicinal plant usually finds many associate 'alternates' and 'substitutes'. Such plant clusters are generally termed as 'controversial plants' which often lead to many un-resolved debates among Ayurveda physicians.

The Raw Drug Repository has in its collection, several plant raw drugs with such multiple and controversial plant sources. Some examples are given below:

- Vidanga: Fruits of *Embelia ribes* (*genuine candidate*), *Embelia tsjeriam-cottam*, *Maesa indica* and *Myrsine Africana* (Substitute candidates)
- Daruharidra: Shoot pieces of *Berberis aristata* (*genuine candidate*), *Berberis asiatica*, *Berberis lycium*, *Coscinium fenestratum*, *Mahonia leschenaultii* and *Morinda umbellata* (Substitute candidates).

B) Interesting Authentic Collections during the year:

Many medicinal plants considered 'Vulnerable', such as Jungli Suran (*Amorphophallus sylvaticus*), Harmal (*Peganum harmala*), Revand chini (*Rheum emodi*), Amlaparni (*Rheum nobile*) and *Saussurea gossypiphora* were collected for the first time during the year.

B) Interesting Market Collections

Noteworthy collections from the market during this year include many 'Critically endangered', medicinal plants such as Kakoli (*Fritillaria roylei*), Salam panja (*Dactylorhiza hatagirea*), Jadavar (*Delphinium denudatum*) and vulnerable species such as Suranjan (*Colchicum luteum*).

Database

The team maintains a raw drug database to store and retrieve relevant information of raw drug specimens. Using a standard database template, different information sets pertaining to 2290 raw drugs were incorporated in the electronic database.

Reproductive Biology studies on *Janakia arayalpathra*

RMR team during the year made significant progress with the project "*Reproductive Biology and Conservation of a Monotypic, Endemic, Critically Endangered and Red Listed medicinal plant species Janakia arayalpathra* (J. Joseph & Chandras.) Venter". Data on different parameters pertaining to the reproductive biology of *Janakia arayalpathra* were gathered. Seeds were collected and sown in the nursery attached to the Ethno medicinal garden on FRLHT's campus, and as a result, 480 seedlings were raised.

Training and Orientation activities

As was done during the previous years, the Herbarium team engaged in many outreach activities during this year too.

The team has standardised the course contents for the *Orientation Training on Herbarium techniques and Plant identification* to meet the learning requirements of graduate students of Botany, Pharmacy and Life sciences. By using this module, the team conducted 3 training events during the year as below:



Institutions participated	Dates	No. of trainees
Mount Carmel College, Bangalore	9-10 th 11-12 th August 2011	80 students; 3 teachers
Ramakrishna Ayurvedic Medical College Hospital & Research Centre, Bangalore	18-19 th August 2011	32 students

Scholarly Consultations

Dr. D.D. Tiruvengadam, a renowned International expert on Rubiaceae family, Dept. of Systematics & Evolution, MNHN, Paris, France, visited the Herbarium on 24st January 2012. The RMR team made use of his expertise and experience to enrich its understanding of Rubiaceae. Accordingly it discussed different issues related to the family Rubiaceae, and obtained several voucher specimens authenticated by him. Dr. D D Tiruvengadam, also scrutinized the image collections maintained by the herbarium and confirmed the identity of several plants.

RMR's technical expertise extended to other projects of IAIM

The RMR team associated itself with many other projects of FRLHT beyond CoE, especially with those which involve significant botanical exploration and field surveys. These projects are:

- *Inventory of Medicinal and Aromatic Plants of Sikkim* (funded by State Medicinal Plants Board, Sikkim).
- *Inventory of Medicinal and Aromatic Plants of Uttarakhand* (funded by GEF-UNDP, New Delhi).
- *Training on documentation & assessment of LHTs and Survey of Flora used in LHTs in NE India* (funded by North Eastern Institute for Folk Medicine).

Such association brought RMR many additional opportunities to procure specimens of different species of conservation concern from several remote areas of the country including *Salacia fruticosa*, *Salacia oblonga*, *Trichopus zeylanicus* subsp. *travancoricus*, *Fibraurea darshanii*, *Anisochilus henryi*, *Anisochilus robustus* and *Dendrobium* sp.

The RMR team also extended need based support to different educational and research institutes in respect of confirming and authenticating the identification of medicinal plants. Institutions which sought the help of RMR in this regard were: Institute of Wood Science and Technology, Bangalore; National Institute of Nutrition, Hyderabad; National Institute of Unani Medicine, Bangalore besides many colleges.



CE-P3: ETHNO MEDICINAL GARDEN

The Ethno Medicinal Garden (EMG) on the FRLHT campus houses different medicinal plants used in Indian systems of medicine, and these are planted in specific groupings and plant assemblages, each one representing a definite healthcare theme or usage group. The sustained planting efforts over the years have taken the EMG to proudly showcase important medicinal plants in 33 thematic assemblages which are combined under two major themes: 1) Plants of utility value, and 2) Species of Conservation concern. These theme based plant assemblages have enhanced the user-friendliness and educational value of the garden.

During the year 2011-12, the garden team focused on 3 themes:

- Endemic and Rare Medicinal Plants
- Plants used in Unani System of Medicine
- Plants exhibiting 'Doctrine of Signatures'

As a result of sustained efforts to enrich the collections in the EMG, 70 species of medicinal plants were added during the year,

As a result 70 species of medicinal plants were added to the EMG, which took the total number of species in EMG to 1250. Some of the noteworthy species added during the year are: *Garcinia cowa*, *G. intermedia*, *Syzygium palghatense*, *S. travancoricum*, *Cinnamomum malabratum* and *Erinocarpus nimmonii* (species appeared in the Red Data Book of Indian Plants).



A Thematic plant assemblage and a group of visitors in the garden

Considering the information needs of the different visitor groups in the garden, the EMG team brought out 5 illustrated booklets on different plant groups: a) Plants used in Primary Healthcare, b) Skin & Hair care, c) Dye yielding Medicinal plants, d) Highly traded medicinal plants and 5) Aromatic medicinal plants. These booklets bring together comprehensive information about the plants under a chosen theme, and a typical plant profile contains the local name, botanical name, description, natural distribution and its medicinal uses.

EMG extends technical support to other projects

EMG has been used by visitors, scholars and research students as a place for learning and aiding their conservation research. It has offered research material in the form of seeds, seedlings and plant produce for many studies related to propagation, pharmacology, pharmacognosy of Medicinal Plants.

Many educational institutions from Bangalore made use of the educational facilities and resources available at the EMG for their educational and student research activities, during the year. Many educational institutions from Bangalore include: Bangalore University, Mount Carmel College, Maharani Lakshmi Ammanni College, Garden City College, Al Ameen college of Pharmacy, Atreya Ayurvedic College, Sri Sri College of Ayurvedic Science and Research, Mallige College of Pharmacy.

Additionally, the EMG team extended necessary technical support and offered planting material to different government departments and private firms in respect of landscaping and designing of gardens and planting material, as below:

- Forest Departments of Karnataka and Andhra Pradesh
- Balehonnur, Chickmagalur, Karnataka (2500 saplings and consultancy for garden designing)
- Honnavar, Karnataka (3000 saplings)
- Tumkur, Karnataka (2000 saplings)

- Tirupati, Andhra Pradesh (5000 saplings)
- Rajamundry, Andhra Pradesh (1000 saplings)
- Bangalore Water Supply and Sewerage Board, Govt. of Karnataka, Bangalore (2000 saplings and consultancy for garden designing)
- Income Tax Training Institute, Govt. of Karnataka, Bangalore (1000 saplings and consultancy for garden designing)
- M/s Dabur India Limited, Ghaziabad (40000 saplings of *Plumbago zeylanica*, *Piper longum* and *Hemidesmus indicus*)
- M/s Shriram properties, Shriram group of companies, Visakapatnam (3000 saplings and consultancy for designing garden)
- M/s JTPCL, JSW Energy Limited, Bellary (50000 trees and consultancy for planning and maintenance of green belt for 6 years)
- M/s Meridian County, Pune (10000 saplings and consultancy for garden designing)
- M/s Reitzel India Limited, Tumkur (2000 saplings and consultancy for garden designing)
- Sri Kalabhairaveshwara Swamy Ayurvedic Medical College, Bangalore (1500 saplings)
- Symbiosis University, Pune (Consultancy for garden designing).

The EMG team signed an MoU with M/s Arty plantz, an organization devoted to greening and medicinal plant landscaping to conduct '*nature connect programs*' using EMG facility and also to create empowering gardens across the country.

Participation in Exhibitions

As was done during the previous years, the EMG team took part in select exhibitions and public gatherings during this year too, as a means to introduce and popularize medicinal plants among the urban residents. Participation during the Flower show at Lalbagh, Bangalore on the eve of Independence Day and Republic Day witnessed an overwhelming response by the visitors. Additionally different public functions and community initiatives such as *Hasiru bhoomi* exhibition, *Food from Garden* organized by different community groups in Bangalore were the other initiatives in which the EMG took part.



People visiting the garden stall opened at the Annual Flower show, Lalbagh, Bangalore



A group of Forester trainees at the Garden Nursery during their educational trip.

CE-P4: PHARMACOGNOSY STUDIES

Authentic identity of medicinal plant raw drugs is an important determinant of the quality, safety and efficacy of herbal medicines. Increasing demand for the herbal drugs coupled with non-availability of genuine raw materials results in their substitution with different alternative materials. Studies on *Abhava Pratinidhi Dravya*, the ayurvedic concept of drug substitution not only throw light on the legitimacy of such substitutes which are bio-equivalent to the original drug, but also suggest possible alternate candidates for augmentation, as a means to offload the pressure on many species which are endangered due to excessive collection. Studies carried out this year in this direction, focused on the issues related to ascertaining the authentic identity of select medicinal plant raw drugs and explaining their chemical and bioactivity profiles.

Vidanga:

The fruit of Vidanga is one of the botanical drugs traded in high volume (>500 MT/year). The raw drug is the dried fruits of Vidanga plant that finds a significant place in several formulations in Ayurveda, Siddha and Unani systems of Medicine. Vidanga is a well-known drug for helminthiasis, indigestion and tumours. The official pharmacopoeia has correlated the authentic botanical identity of Vidanga to *Embelia ribes* Burm.f (Myrsinaceae). Its sporadic distribution in the Western Ghats, Eastern Himalayas and North eastern India however suggests that the huge quantity traded cannot be sourced by this species alone. Three other species such as *Embelia tsjeriam-cottam* A.D.C., *Myrsine africana* L. and *Maesa indica* (Roxb.) A.D.C., all belonging to Myrsinaceae family are found to be traded as Vidanga.

Embelin, the main constituent of the fruits of *Embelia ribes* is also found in *Embelia tsjeriam-cottam* and *Myrsine africana* while it is absent in *Maesa indica*. The earlier studies to examine the similarities and differences of these species involving the microscopic, molecular and phytochemical profiles brought to light quite many interesting findings. One of it being the presence of a new chemical compound in *Maesa indica* which was later isolated, characterized and named as *Kiritiquinone*. This compound is a Benzoquinone similar to *Embelin* (It may be recollected here that *Embelin* is an active chemical marker found in *Embelia ribes*, *Embelia tsjeriam-cottam* and *Myrsine africana* but not in *Maesa indica*). It would be therefore interesting to examine whether or not all these three species also exhibit the anthelmintic activity. If so, it would imply that all the three can be used as a substitute of *Embelia ribes* for this purpose. And, since *Embelia ribes* is an endangered species, finding bioequivalent substitutes would be helpful in offloading the pressure on *Embelia ribes* populations.

The marker compounds from the plant species were quantified and it was found that 5.94, 4.32 and 1.85 (% w/w) of embelin was present in *Embelia ribes*(ER), *E. tsjeriam-cottam*(ET) and *Myrsine africana*(MA) respectively and 4.4 % (w/w) kiritiquinone in *Maesa indica* (MI).

Further, the bioactivity of all four Vidanga candidates was tested by using different stages of *Caenorhabditis elegans* viz., eggs, L1 larvae and adults. Ethyl acetate extracts of all four Vidanga candidates showed highest anthelmintic activity (> 80%) on L1 larvae of *C. elegans* at 500 µg/mL. In case of adults, *E. ribes* and *E. tsjeriam-cottam* showed higher activity (~ 60%), while *Myrsine africana* and *Maesa indica* showed less activity (~ 30%) at 400 µg/mL. Levamisole was effective only at 15 mg/mL in case of L1 larvae as well as adults (~90%). The marker compounds, embelin and kiritiquinone were effective only at a concentration of 500 µg/mL and not at concentrations equivalent to that found in the crude extracts.

The extracts of all four Vidanga candidates showed 2-3 times higher anthelmintic activity as compared to their respective marker compounds and 30 times more than that of levamisole, in terms of concentration required to bring

Although the official pharmacopoeia has correlated the authentic botanical identity of Vidanga to *Embelia ribes* Burm.f (Myrsinaceae), three other species such as *E. tsjeriam-cottam* A.D.C., *Myrsine africana* L. and *Maesa*

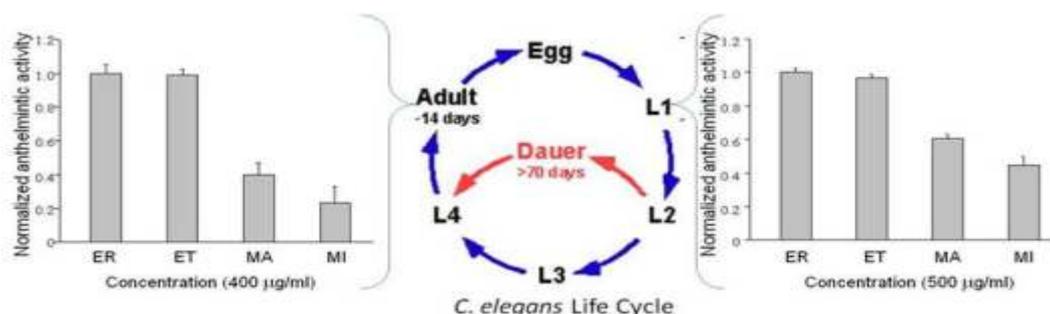


Fig. Relative anthelmintic activity of Vidanga extracts on adults and L1 larvae of *C. elegans* ER: *Embelia ribes*, ET: *Embelia tsjeriam-cottam*, MA: *Myrsine africana*, MI: *Maesa indica*

about the kill. Comparative analysis between the species used as Vidanga, showed that *E. ribes* and *E. tsjeriam-cottam* have similar anthelmintic activity indicating that *E. tsjeriam-cottam* can be a good substitute for *E. ribes* followed by *Myrsine africana* and *Maesa indica*. None of the extracts and levamisole showed ovicidal effect at the concentrations used.

Ativisha-Musta

The Ayurvedic texts suggest the use of substitutes in the event of unavailability of specific medicinal drugs. However, the logic behind this substitution has not been explained. Our studies are an attempt to understand this logic so that it can be applied in the case of other unavailable plants of medicinal importance.

This year's work is a continuation of the work done during 2010-11 on *Aconitum heterophyllum* Wall. ex. Royle and *Cyperus rotundus* Linn. where *the latter is a recommended substitute for the former in Ayurveda*. Microscopical, phytochemical and molecular marker studies were undertaken to compare and contrast Ativisha-Musta candidate species.

Microscopy

The botanical identity of Ayurvedic Ativisha and Musta is proven beyond doubt. The former is *Aconitum heterophyllum* while the latter is *Cyperus rotundus*. In the raw drug market Ativisha is substituted in total or in part by three other species (*Cyperus rotundus*, *Cyperus scariosus* and *Cryptocoryne spiralis*). The morphological characters of these four candidate species were studied in the lab. It was found that the four species differ in the nature of the underground parts and their characters. *A. heterophyllum*, the genuine Ativisha is ovoid-conical and is a taproot/root modification while all the rest are underground stems (Rhizome & corm).

Cyperus rotundus is relatively cheap and easily available as it is a weed. *Cryptocoryne spiralis* although not as common as *C. rotundus*, is preferred as a substitute (it is known South India as "country Ativisha", "Nattu atividayam"). The substitution by *C. scariosus* in raw drug markets is more due to inability of the raw drug collectors to distinguish it in the field from *C. rotundus*. Although there is around 50% similarity in respect of the non-phytochemical parameters between the genuine Ativisha and other three substitutes, it is beyond the comprehension of the common man. Hence, the distinguishing parameters between Ativisha and other three substitutes can serve as characters for authentication of genuine Ativisha.

These include the morphology of the plant part, (tuber in case of Ativisha, and underground stem in case of others), odor and taste (lack of odor and astringent taste with Ativisha, while the other three lack these properties). At the laboratory level, the following structural parameters were helpful in authenticating Ativisha from its substitutes: presence of true cork and endodermis, extremely broad parenchymatous stellar region with fewer (4-7) vascular strands (not bundles) embedded in it and the non-detection of terpenoids.

Ativisha can be distinguished from country Ativisha not only by the above characters but also by the lack of raphide crystals. Musta (*C. rotundus*) can also be distinguished from country Ativisha by the lack of raphide crystals besides the different odor and absence of alkaloids. It is often quite difficult to distinguish the raw drugs of two species of *Cyperus* based only on morphology and internal structure. Therefore a similarity matrix was developed by considering the similarities and dissimilarities of all the four species. It was evident from this matrix that the two species of *Cyperus* shared the maximum similarity of 87% followed by *C. rotundus* and *Aconitum* with a similarity of 50%, both species of *Cyperus* and *Cryptocoryne* with a similarity matrix of 46%, followed by *Aconitum* and *Cryptocoryne* with a similarity matrix of 33%.

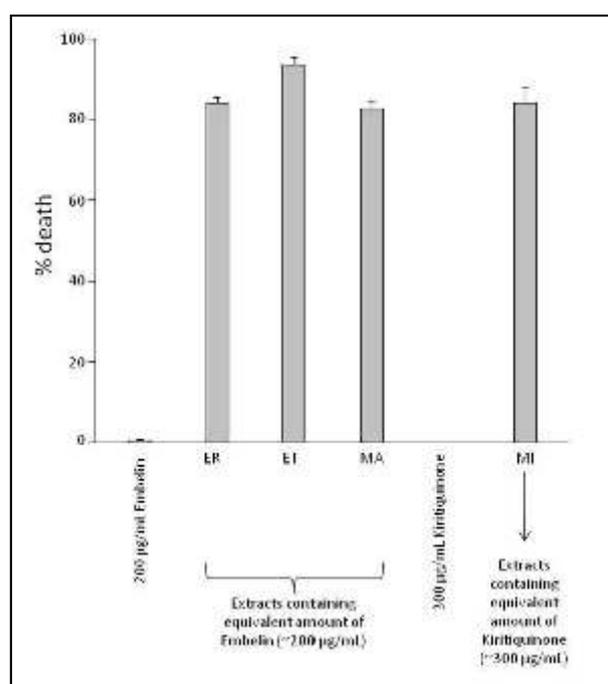


Fig.2 : Comparative anthelmintic activity of 500 µg/mL of ER, ET and MA compared with equivalent amount of Embelin and anthelmintic activity of 500 µg/mL of MI compared with equivalent amount of Kiritiquinone

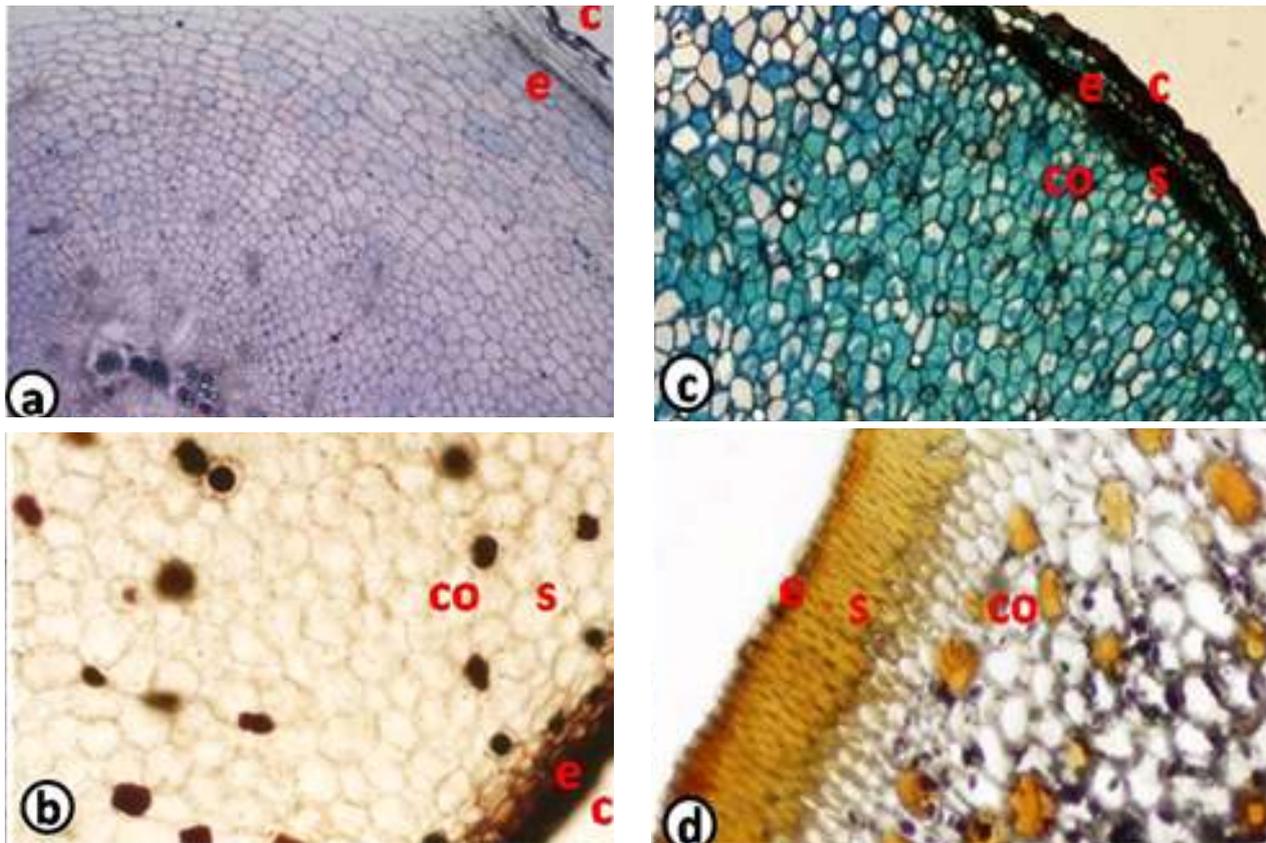


Fig. Presence of Starch grains: a. *Aconitum heterophyllum* b. *Cyperus rotundus* c. *Cyperus scariosus* and d. *Cryptocoryne spiralis*.

Phytochemical screening

In 2010-11, phytochemical similarities between Ativisha-Musta duo were not observed unlike the earlier reports. Hence, in order to confirm the results, this year the tests were performed after the extracts were prepared from larger quantities (100g instead of 10g) of the powdered material. Besides, the tests were carried out on *Cyperus scariosus* and *Cryptocoryne spiralis*. Alkaloids were detected in all four species. Saponins were found in *C. scariosus* and *C. spiralis* but not in *A. heterophyllum* and *C. rotundus*. Phenols and tannins were detected only in *C. rotundus*. The degree of similarity (both positive and negative similarities), between the four species was worked out by means of the similarity matrix. This matrix indicated that *A. heterophyllum* was found to share an identical similarity with other three species (82.3% with *C. rotundus*, 81.5% with *C. scariosus* and 84.6 % with *Cryptocoryne*). However, phytochemically the two *Cyperus* species shared the least similarity of 79.2% while *C. scariosus* shared the highest similarity of 93.85% with *Cryptocoryne spiralis*.

HPTLC profiles of the successive extracts of *Aconitum heterophyllum* and *Cyperus rotundus*

Preliminary TLC studies were carried out using silica coated glass slides and the best mobile phases for separation were established. These results were confirmed by HPTLC studies this year using pre-coated silica plates. All the extracts (except the chloroform extracts) of both species possessed common bands both under 254nm and 366 nm. Further isolation of these bands followed by the spectral characterization could help in confirmation of the identity of these common constituents.

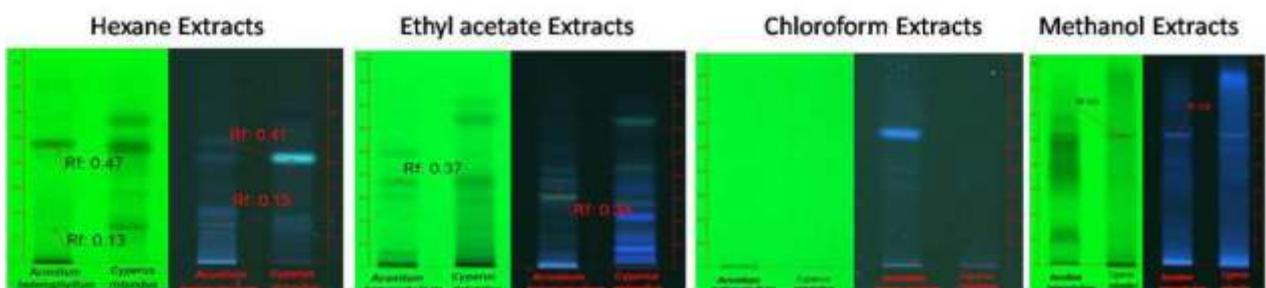


Fig 5: HPTLC fingerprints of successive extracts of *A.heterophyllum* and *C. rotundus*

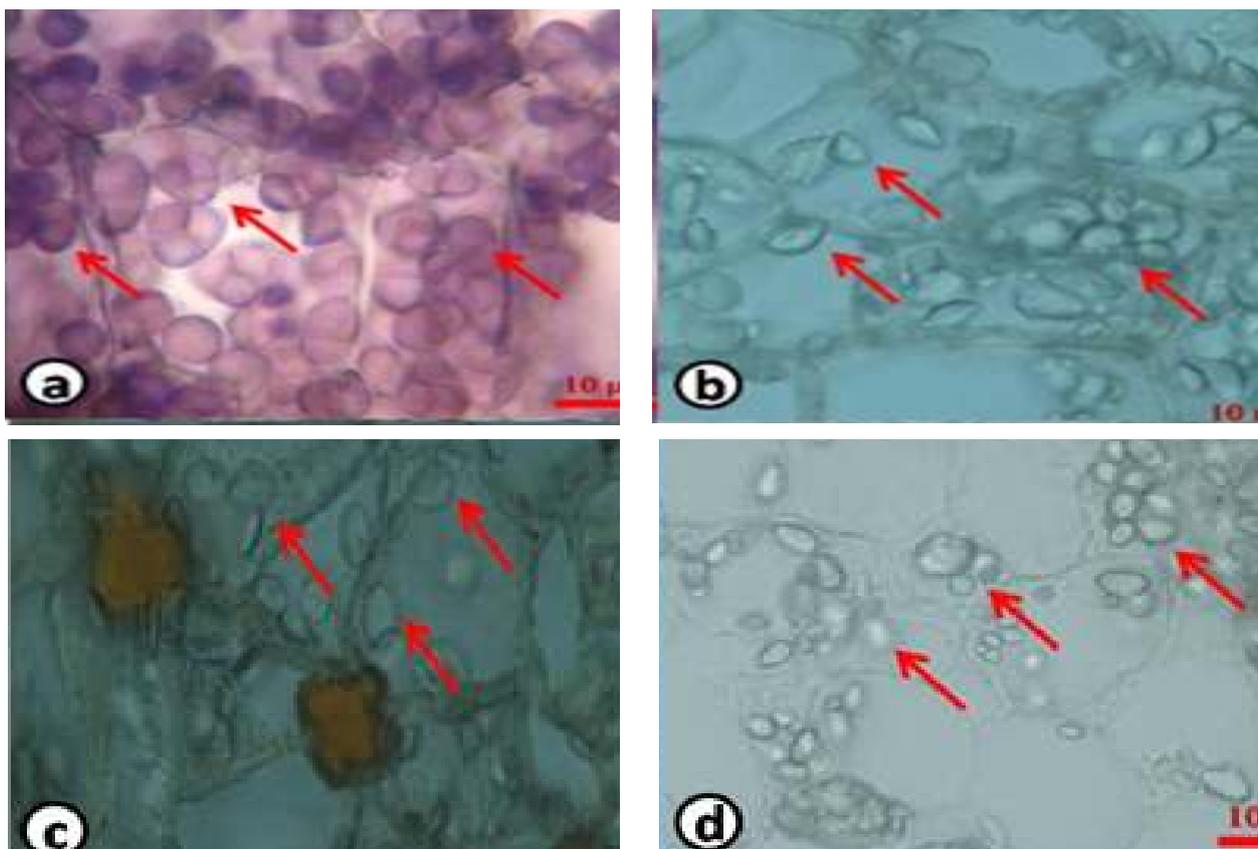


Fig a. *Aconitum heterophyllum*-T.S. of a portion from root tuber showing cork(c), endodermis(e) and broad stele with of the 4-7 strands; b. *Cyperus rotundus*-T.S. of rhizome showing cork(c), cortex(co), endodermis(e), sclerenchyma(s); c. *Cyperus scariosus*-T.S. showing cortex(co), endodermis(e) and sclerenchyma(s); d. *Cryptocoryne spiralis*- T.S. showing of corm showing cortex(co), endodermis(e) and sclerenchyma(s)

HPLC / LCMS profiles of aqueous extracts of *Ativisha* & *Musta*

In 2010-11, HPLC studies were carried out only on *A. heterophyllum* and *C. rotundus*. This year, HPLC comparison with the water extracts of *C. scariosus* and *Cryptocoryne spiralis* was carried out. It was found that at least 5-6 common peaks were present between the aqueous extracts of the different species. This suggests the possible presence of similar constituents in the 4 species which could be responsible for their similar drug activity. Preliminary LCMS studies were also carried out on the aqueous extracts of *A. heterophyllum* and *C. rotundus*. The full scan MS spectra obtained clearly showed that there were at least 3 common constituents in the water extracts of *A. heterophyllum* and *C. rotundus*.

DNA markers for *Ativisha*-*Musta*

Internal Transcribed Spacer (ITS) regions of nuclear ribosomal DNA sequence variation was used to develop species-specific SCAR marker for *Ativisha*-*Musta* candidates. The ITS sequence studied was submitted in NCBI gene bank: *A. heterophyllum* (Accession No: JF440340), *C. rotundus* (Accession No: JQ436582) and *Cryptocoryne spiralis* (Accession No: JQ436581). The designed SCAR marker was validated with the available accessions and confirmed that the SCAR was species-specific.

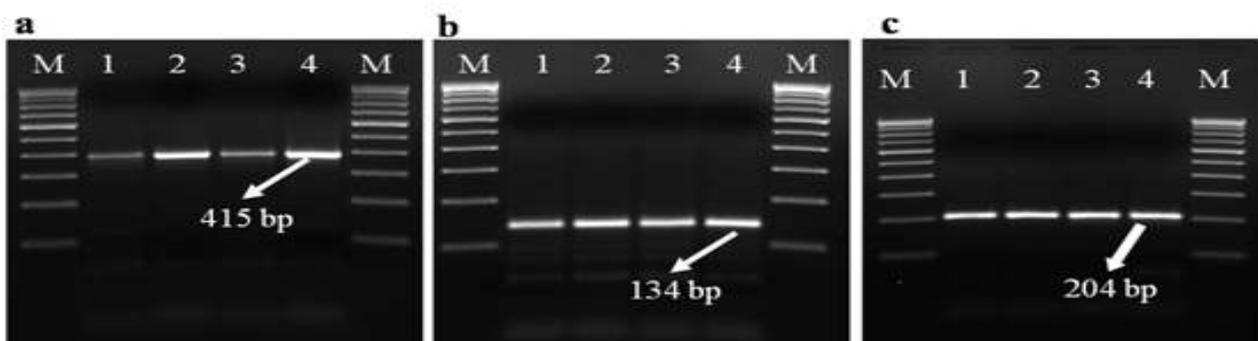


Fig: (a) *A. heterophyllum* SCAR marker amplification, (b) *C. rotundus* SCAR marker amplification, (c) *C. spiralis* SCAR marker amplification. M: 100 bp ladder

CE-P5: DISTRIBUTION MAPPING USING GIS & IDENTIFICATION ISSUES OF TRADED MEDICINAL PLANTS

Digital Geographical Distribution Atlas of Prioritised Indian Medicinal Plants

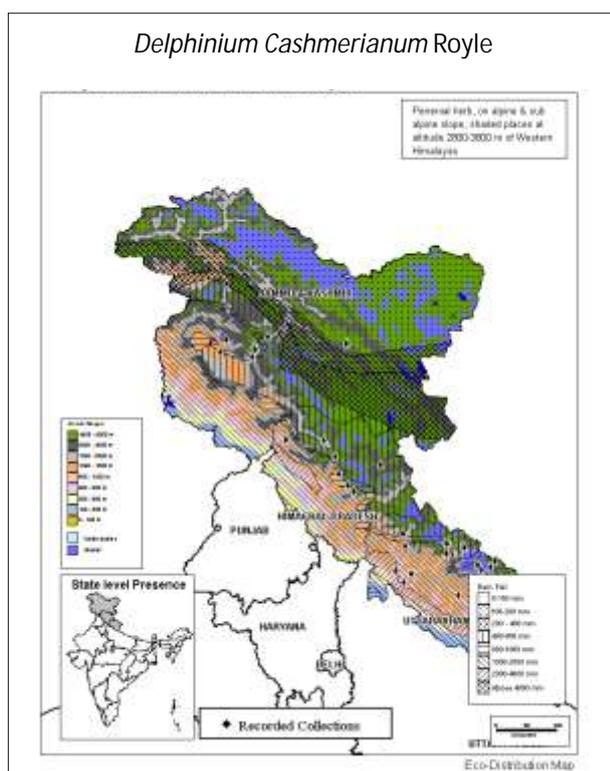
Preparation of geographical distribution database and maps was the key activity undertaken by the mapping team, and accordingly 250 wild medicinal plant species of India were considered as the target. Detailed eco-distribution maps were prepared for 25 species using GIS (Map Info software) during the year. This digital data was incorporated into a searchable database and provided on CD-ROMs. Two sets of such CD-ROMs were developed. The first one being an open access version contains geographical distribution maps, showing the wild presence of a species under consideration in a specific state/s, along with the data compiled from published sources. The second version is a restricted version which incorporates the same geo-distribution data along with eco-distribution maps with precise locations of occurrence super imposed on the digitized ecological layers for prioritized species of conservation concern.

This digital atlas is aimed at providing the forest managers and researchers reliable data on the natural distribution of specific medicinal plants within India. This updated version of the Atlas now incorporates Geographical distribution maps for 1920 species (2622 botanical names) along with Eco-distribution maps for 210 species of conservation concern.

The digital atlas, now available on the CD-ROM, is aimed at providing the forest managers and researchers reliable data on the natural distribution of medicinal plants within India.

Those species recorded in high volume trade as well as the species of high conservation concern are the priority species for geographical distribution mapping efforts. Our study on Demand and Supply of medicinal plants in India, had listed 178 medicinal plant species in high volume trade (>100 MT per year) category. Out of these, 168 species occur wild in India and these were targeted for compilation of data on their natural distribution in India for preparation of geo-distribution maps. All of these, except two, were covered in the geo-distribution mapping exercises.

The Eco-distribution Maps incorporate precise geographical locations of occurrence of the species (as latitude and longitude co-ordinates of specimen related records accessed from the herbaria and different publications). Interpreting the correlation between such precise locations and the related ecological parameters (altitude range, rainfall range, soil type) provides an understanding of the pattern of natural distribution of a species. Priority was given to the species of conservation concern and a total of 210 such species were dealt with for the preparation of Eco-distribution maps, so far. It includes 95 species assessed and assigned



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CE P6: OUTREACH

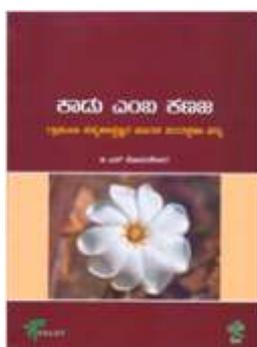
Capacity building of front-line staff of State Forest departments

Continuing the task of building capacities among the frontline staff of Forest department, the training team this year focused on the states of Jharkhand. Necessary correspondence and preparations began, while 2 courses were scheduled during February 2012. However the courses had to be postponed owing to the incompatibility of the available time of the in-house subject experts. Courses would be planned during 2012-13.

Dialogues were initiated during the year with the State Medicinal Plants Board, Sikkim for designing a Training of Trainers from the forest department of Sikkim. The dialogues have resulted in developing a draft proposal and the same was sent for consideration.

Self-study material on Medicinal plants and Vegetation monitoring activities for the frontline staff of Forest department

The training team designed and brought out 2 volumes of self-study material in Kannada covering select topics on Medicinal plants conservation for the use of the frontline staff of the forest department. These volumes are expected to serve as reference cum post-training learning material amongst the frontline staff. Following are the volumes:



- *Kaadu emba Kanaja* (Significance of Forests and Medicinal Plants): This volume brings together basic information on select focal topics, such as Diversity of medicinal plants, Forest types, NTFP species, Threats to medicinal plants and RET species, Sustainable methods of medicinal plants collection, Need for conservation and conservation strategies including MPCAs.

- *Sasya Parisara Adhyayana* (Principles and techniques of Plant identification and Vegetation monitoring): This volume highlights the necessary field skills field forest personnel is expected to acquire while engaged in conservation initiative. It provides comprehensive information on: Morphological features of plants and Plant identification techniques, Botanical exploration and inventorisation strategies, Herbarium and seed-raw drug collection

techniques, methods of vegetation monitoring, documentation of traditional knowledge.



CD-ROM on Plants in *Astanga Sangraha*

Astanga Sangraha is a classical Ayurvedic text by *Acharya Vagbhata* of 600 AD, who is considered as one of the *Brihat-trayees* of Ayurveda. It contains in-depth knowledge of different medicinal plants. The terms *Astanga* and *Sangraha* respectively correspond to eight main branches of Ayurveda and compilation of information pertaining to these eight branches. *Astanga Sangraha* is probably the first classical text to quote single drug of choice (*agrya oushadha*) in various diseases and when compared to other classical texts such as *Caraka Samhita* and *Susruta samhita*, it offers additional references to several plants.

The database activity on the Plants of *Astanga Sangraha* was initiated during the previous year in which around 9000 records were compiled. During the current year >11,000 more records of citations were added which took the database to 20,000 records pertaining to 900 species of plants.

This database in the form of a CD-ROM brings together comprehensive information of around 900 plant drugs correlated to 1078 distinct botanical names including the synonyms. It also offers detailed clinical data and descriptive information for 528 plant species with 1300 plant images and comprehensive reporting and searching facility. The information is supported by 20,000 citations from the classical text, which corresponds to 1614 distinct Sanskrit names, of which the identity of 150 is still obscure.



A page view from the CD ROM, Plants in Ashtanga Sangraha.

All the Sanskrit names are grouped under specific basonyms which are further linked to their respective synonyms. The botanical correlation of these Sanskrit names is indicated in the sequential order of their accepted appropriateness along with the reference sources, while the status of the botanical correlation is shown under four categories: Identified, Controversial, Doubtful/Probable and Unidentified.

Book on Controversial sources of Plant drugs

Practice of Ayurveda requires proper correlation between the classical drug names and the modern nomenclature of such entities. In respect of plant drugs, the classical names need to be correlated to their corresponding botanical names. Our studies have indicated that, 10-15% of the plant drugs included in around 600 popular formulations of Ayurveda found in the market, possess controversial or non-confirmed identity with many regional variants. Even this practice of using plant drugs with regional variations is not foolproof. For instance, the popularly known plants such as *Brahmi* and *Shankapuspī* correspond to more than 1 plant species which are used in north and south India.

Our observations indicate that there are around 100 classical plant drug names which are correlated to more than one botanical identity and thus leads to controversial identity. It is therefore necessary to address this issue especially when there is sufficient knowledge about the species correlated and the specimens available for verification.

A detailed writeup on 25 plant drugs with such controversial identity was prepared after screening 600 commercial products. Critical analysis of each plant was done by: a) reviewing the botanical correlations as reported in ethnobotanical literature of past 100 years, b) examining their identity based on their morphological description and their synonyms with the help of Ayurvedic *Samhitas* and *Nighantus*, and c) by revisiting the results carried out by leading Ayurvedic experts.

Website on Plants used in Indian systems of medicine

This facility is aimed to serve the diverse information needs of different user groups, including the students of modern and Indian systems of medicine, as it offers comparative profiles of about 500 plants used in Ayurveda, Unani, Siddha, and folk systems of Medicine. The wealth of Information pertaining to the properties and uses of these plants remarkably illustrates the range and depth of authentic knowledge of Indian medical heritage as found in the different classical texts of Indian Systems of medicine.

The website has incorporated about 800 images and offers dynamic and user-friendly features: The nomenclature section in it provides botanical and vernacular names of plant entities in 15 languages, while the section on Ayurveda, Siddha, Unani, and folk provides the pharmacological profiles. Additionally, the Pharmacology section offers important pharmacological action of the focal plant as reported in published literature.

3. COMPONENT WISE PROGRESS-GLIMPSES

CE-P1: PROJECT COORDINATION

Sl. No.	Title of Activity	Targets	Achievements
1.	Review of physical & financial project progress	<p>Conduct 2 six-monthly Steering Committee meetings</p> <p>Conduct 6 bi-monthly project review meetings</p> <p>Timely audit of project accounts</p>	<ul style="list-style-type: none"> 1st Steering Committee meeting was held on 5th July'11 and approved the annual action plan (2011-12) and budget. 2nd Steering Committee meeting was held at FRLHT campus on 7th February 2012. It reviewed the progress and approved the release of balance funds as per the approved budget for 2011-12. <p>Bi-monthly project review meetings held at FRLHT with the project staff.</p> <ul style="list-style-type: none"> Project accounts for the year 2010-11 were audited and the Utilization Certificate submitted to the MoEF. Utilization Certificate and Expenditure statement for the year 2011-12 was prepared for submission to MoEF.
2.	Preparation of Progress Reports	<p>Preparation of Annual Progress Report (bi-lingual) for 2010-11</p> <p>Preparation of 2 six-monthly progress reports</p>	<p>Annual Report for the year 2010-11 (bi-lingual) finalized, printed and handed over to MoEF for tabling it in the Parliament.</p> <p>The present report is the 2nd six-monthly Progress Report for the year 2011-12. The 1st such report was prepared and submitted to the Steering Committee meeting held in February 2012.</p>
3.	Liaison with other organizations to further the objectives of CoE	<p>With BSI and its regional centres for sharing of herbarium sheets</p> <p>With AYUSH for sharing information on medicinal plants in ISM</p>	<p>Necessary dialogues initiated with BSI, for procurement/ exchange of Herbarium sheets</p> <p>Web enabled database on Indian medicinal plants (medicinal system wise) being developed for NMPB.</p>

CE-P2: HERBARIUM OF MEDICINAL PLANTS USED IN ISM

Sl. No.	Title of Activity	Targets	Achievements
1.	Strengthening of Herbarium	<p>Addition of 150 medicinal plant species to herbarium (=500 voucher specimens)</p> <p>Addition of voucher specimens to cover the range of distribution and morphological variations of medicinal plant species (=1000 voucher specimens).</p>	<p>Field Surveys and botanical collections were undertaken in the regions less represented in the herbarium. Following is the breakup of such collections:</p> <p>North Eastern India:</p> <ul style="list-style-type: none"> • Manipur: 188 collections. • Meghalaya: 99 collections. • Sikkim: 201 collections. <p>North West Himalayas:</p> <ul style="list-style-type: none"> • Himachal Pradesh: 27 collections. <p>North West India:</p> <ul style="list-style-type: none"> • Rajasthan: 203 collections. <p>Central India :</p> <ul style="list-style-type: none"> • Chhattisgarh: 12 collections <p>Southern India:</p> <ul style="list-style-type: none"> • Andhra Pradesh: 147 collections. • Karnataka: 172 collections. • Tamil Nadu: 100 collections. • Kerala: 88 collections. <p>Andaman Islands: 192 collections.</p> <p>These specimens are under processing and identification.</p>
2.	Development of virtual herbarium	<p>Addition of 2000 images of medicinal plants, their habitats and medicinal</p> <p>Addition of 500 digitized herbarium sheets</p>	<p>>3000 images of plants depicting the salient features (habit, flower, fruits, plant modification, exudates etc) that aid in their identification were added.</p> <p>> 600 voucher specimens scanned and stored as high resolution images.</p>
3.	Design of educational and extension material	<p>Preparation of manuscript of a book on Wild Indian Medicinal Plants of high Conservation Concern, by including relevant information from different regions of India.</p> <p>Design and produce 4 Posters on select themes of medicinal plants</p>	<p>Focal species shortlisted, format of the compilation finalized. Compilation reached the advanced stage of completion.</p> <p>4 posters under the theme Medicinal Plant Wealth of India were designed and printed on the focal topics: i) Dye yielding medicinal plants, ii) Plant Galls in Indian Medical traditions, iii) Bala, and iv) Asoka.</p>
4.	Training programmes	Organize 2 training programs on herbarium techniques	<p>2 Training programs on Herbarium techniques and Plant identification for graduate students in Botany conducted:</p> <ul style="list-style-type: none"> • 77 students+3 teachers from Mount Carmel college, Bangalore 9-10th August 2011 and 11-12th August 2011 • 32 students from Ramakrishna Ayurvedic Medical College Hospital & Research Centre, Bangalore during 18-19th August 2011.

Sl. No.	Title of Activity	Targets	Achievements
5.	Strengthening of Raw Drug Repository	Collection of 250 raw drug samples from the field	152 fresh samples from the field collected and properly processed and added to the collectiuons.
		Collection of 150 samples from raw drug markets	150 Raw drug samples from different raw drug markets were procured and properly processed and added to the collectiuons
		Thematic display of medicinal plant raw drugs for educational purposes	Thematic arrangements focused on trikatu, trimada and triphala, and single plant-multiple drugs completed with relevant herbarium sheets alongside the drug.
		Bottling of samples into display bottles, labeling the bottles.	> 150 raw drug samples labeled. Regular maintenance of specimens with replenishments done
		Computerisation of Raw drug sample data	Data pertaining to 150 raw drug samples entered into the raw drug database.
		Preparation of final draft and printing of "Catalogue of raw drug collections".	Final draft as Print ready dummy prepared.

CE-P3: ESTABLISHMENT OF ETHNO-MEDICINAL PLANTS DEMO GARDEN

Sl. No.	Title of Activity	Targets	Achievements
1.	Strengthening of ethno-medicinal garden	Collection of propagules of 65 new medicinal plant species.	Propagules of 70 species collected
		Establishment of 3 new themes in the EMG.	3 more garden themes were added: <ul style="list-style-type: none"> • Endemic/ rare medicinal plants • Plants used in Unani system of medicine • Doctrine of Signatures and plants with incredible therapeutic properties
		Further strengthening & maintenance of thematic plant assemblages in the garden brought in during previous years.	Continued during the year
2.	Design and affixing of educational signages	Preparation and fixing of educational signages (6 themes + 150 individual species).	Signages for 150 individual plant species and 7 thematic plant assemblages erected.
3.	Educational & Extension programs	Organizing 4 awareness-cum-educational programs on medicinal plants of EMG	6 programs organised
		Preparation of 5 books on the focal themes of the garden	Booklets on 5 garden themes prepared; 500 copies each of the titles printed.

CE-P4: PHARMACOGNOSY STUDIES

Sl. No.	Title of Activity	Targets	Achievements
1.	Strengthening of ethno-medicinal garden	<p>Continued during the year</p> <p>Continuation of laboratory work in respect of Daruharidra</p> <ul style="list-style-type: none"> • Collection of new accessions of <i>Berberis aristata</i> • Anatomy and HPLC & HPTLC fingerprint of new accessions <p>Physicochemical analysis, Phytochemical screening and validation of molecular markers with new accessions</p>	<p>5 new accessions collected</p> <ul style="list-style-type: none"> • Morphological studies of 3 accessions completed. • Physicochemical & phytochemical screening not initiated; Validation of molecular markers completed for 3 new accessions
2.	Vidanga	<p>Preparation of Vidanga monograph</p> <ul style="list-style-type: none"> • Preparation and storage of Kiritiquinone as marker in the lab • Collection of new accessions of <i>Myrsine africana</i>, <i>Embelia tsjeriam-cottam</i>, <i>Maesa indica</i> • HPTLC profiling & quantification of KQ in <i>Maesa indica</i> & Embelin in other Vidanga candidates • Preparation of extracts of Vidanga for testing anthelmintic activity • Standardization and completion of treatment protocol and comparative analysis for anthelmintic activity of extracts (<i>E. ribes</i>, <i>E. tsjeriam-cottam</i>, <i>Maesa indica</i>, <i>Myrsine africana</i>) and marker compounds (Embelin and Kiritiquinone) with respect to toxicity to the worms. • Preparation of a manuscript for 'Comparative analysis for anthelmintic activity of species traded as Vidanga'. • Validation of SCAR markers developed earlier for <i>E. ribes</i> on different market and field samples of Vidanga (<i>Embelia tsjeriam-cottam</i> & <i>Maesa indica</i>) • Development of RAPD or ITS sequence based markers for all Vidanga candidates (earlier RAPD-SCAR done for <i>E. ribes</i>). 	<ul style="list-style-type: none"> • Prepared and stored KQ as marker in the lab with all spectral data • Could not be completed • Profiling and quantification of Embelin & KQ in Vidanga completed • Extracts from all Vidanga candidates done and given for testing of activity • <i>Embelia tsjeriam-cottam</i> showed 90% kill; <i>Embelia ribes</i>, <i>Maesa indica</i> & <i>Myrsine africana</i> showed around 80% kill after 3 hr treatment at 500 µg/ml concentration; KQ trials completed and showed ~51% kill at 500 µg/ml; Embelin also showed ~80% kill after 3h treatment at 500 µg/ml; • ? Manuscript preparation reached the advanced stage of final draft. Primers designed showing cross specificity by high homology. Looking for other alternative fingerprinting methods including more RAPD markers. • Initiated and reached different stages of completion

Sl. No.	Title of Activity	Targets	Achievements
3.	Abhava Dravya	<p>Comparative studies of the accessions of <i>A. heterophyllum</i> & <i>C. rotundus</i></p> <ul style="list-style-type: none"> • Collection of 3 accessions of <i>Aconitum heterophyllum</i>, <i>Cyperus rotundus</i>, <i>Cyperus scariosus</i>, <i>Cryptocoryne spiralis</i> (minimum of 3 samples each) • Anatomy, histochemistry, powder microscopy of new accessions • Article on Comparative pharmacognostic studies of the <i>Ativisha Musta</i> candidates. • Phytochemical studies on the collected accessions of <i>Aconitum heterophyllum</i> & <i>Cyperus rotundus</i>. • Comparative HPLC, HPTLC fingerprints of <i>Aconitum heterophyllum</i>, <i>Cyperus rotundus</i>, <i>Cyperus scariosus</i>, <i>Cryptocoryne spiralis</i>. • Collection and isolation of characteristic common peaks of <i>Aconitum heterophyllum</i> & <i>Cyperus rotundus</i> and identification of these components using spectral data, LCMS • Review articles on chemical constituents & pharmacological activity to be submitted for publication <p>Development of markers and validation of markers for the <i>Ativisha-Musta</i> candidates (including new candidates).</p>	<ul style="list-style-type: none"> • 2 new accessions of <i>Aconitum heterophyllum</i> received. • Anatomy, histochemistry and powder microscopy completed • Final draft prepared • Comparative phytochemical screening done for all 4 species • Comparative HPLC, HPTLC fingerprints completed for all 4 species • Some of the common peaks of <i>A. heterophyllum</i> & <i>C. rotundus</i> characterized in LCMS wrt MW. • Final versions of the drafts prepared and were ready for submission; designed species specific Primers. • <i>A. heterophyllum</i> and <i>C. rotundus</i> molecular markers were validated with all the available accessions
4.	Book on DNA markers	Publication of book on DNA markers for Indian Medicinal Plants	Drafts prepared for each chapter and sent for internal review.

CE-P5: DISTRIBUTION MAPPING OF MEDICINAL PLANTS USING GIS AND IDENTIFICATION ISSUES OF TRADED MEDICINAL PLANTS

Sl. No.	Title of Activity	Targets	Achievements
1.	Generation of distribution maps for prioritized medicinal plants	Generate Eco Distribution maps for 25 sps (Endemic/Near Endemic)	<ul style="list-style-type: none"> Shortlisted 28 endemic and near endemic species from different bio geographic zones as candidates for preparing Eco Distribution maps. Data sheets prepared for 28 species Prepared tabulation sheet with Latitude-longitude co-ordinates of locations. Eco-distribution maps completed for 25 species.
		Generate Geo Distribution maps, along with Datasheets, for 250 prioritized species.	<ul style="list-style-type: none"> Shortlisted 250 species for geographical Distribution mapping (prioritized based on rapid appraisal of pattern of distribution) Data sheets prepared for 250 species and Geo maps generated.
		Update the Digital ATLAS (CD)	<ul style="list-style-type: none"> Corrections and updating of maps and datasheets. Revised and updated version of ATLAS prepared.

CE-P6: OUTREACH (TRAINING & EDUCATIONAL MATERIAL ON PLANTS OF ISM)

Sl. No.	Title of Activity	Targets	Achievements
1.	Developing a cadre of Master Trainers across FD Training institutes	Organize 1 Master ToT course for the master trainers from select FD training Institutes from across the country	Program was scheduled during February 2012; could not be conducted as the in-house resource persons were not available owing to their pre-occupation with the 5-year technical review of CoE.
2.	Capacity building of front-line staff of State Forest departments in respect of Identification and Management of Wild Medicinal Plant Resources	Organize 4 capacity building training courses in 2 states for the frontline forest staff (2 back to back courses in each state)	2 programs for the frontline staff of Jharkhand scheduled during February 2012; However the courses had to be postponed owing to the incompatibility of the available time of the in-house subject experts; Courses would be planned during 2012-13.
3.	Design and print the Operational Guidelines for Conservation and Management of Medicinal Plants Resources in India	Planning and execution of the printing of the final dummy draft.	Final draft submitted to MoEF. It has been decided to postpone the printing as a more comprehensive coverage of this theme, including the aspects relating to cultivation and sustainable utilization, was planned as an outcome under the Gol-UNDP-GEF project on "Mainstreaming Conservation and Sustainable Use of Medicinal Plant Diversity in three Indian States".
4.	Design and Produce user friendly training material	Design and Produce user friendly self-study material in vernacular language for the use of frontline forestry staff	2 volumes of self-study material in Kannada designed and produced: <ul style="list-style-type: none"> • Kaadu emba Kanaja: (Significance of Forests and Medicinal Plants) • Sasya Parisara Adhyayana: (Principles and techniques of Vegetation monitoring)
5.	Develop web compatible information on medicinal plants in vernacular for wider dissemination	Make available in Kannada select information sets on medicinal plants, for up linking with Wikipedia of Karnataka Knowledge Commission, Govt of Karnataka	<ul style="list-style-type: none"> • MOU signed with Karnataka Knowledge Commission. • Translation of Select info sets into Kannada done. Info to be uploaded on to the portal of the Knowledge Commission.
6.	Controversial source of plant drugs (Top 25 aushadhis of Ayurveda)	<ul style="list-style-type: none"> • Identify top 100 drugs used by the industries. • Prepare a document that discusses the issues, current understanding, areas to be taken up for literary study and other field information. • Prepare a manuscript 	<ul style="list-style-type: none"> • Top 100 controversial Ayurvedic drugs identified by analyzing > 600 formulations in the market; multiple botanical correlations identified and flagged. • A draft with information on 22 drugs, prepared.

Sl. No.	Title of Activity	Targets	Achievements
1.	CD on Plants in Astanga Sangraham (Continuation of previous year's activities.)	Peer review of prototype CD on plants in Astanga Sangraham.	Incorporated changes /modifications based on peer review comments. Label and cover of the CD designed and printed; CD ready for release.
2.	Web site on Plants in Indian Systems of Medicine	Upload the web version of Plants in Indian Systems of Medicine database for the public.	The database on Plants in Indian Systems of Medicine linked to the section on "Center of excellence on medicinal plants and traditional knowledge" of www.frlht.org

4. INDIVIDUALS AND AGENCIES ASSOCIATED

The achievements under the project would not have been possible without the active support of many agencies and individuals. We would like to gratefully acknowledge the support provided by the following:

- Ministry of Environment & Forests, Gol, New Delhi.
- State Forest Departments of Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Himachal Pradesh, Jammu and Kashmir Karnataka, Kerala, Maharashtra, Meghalaya, Nagaland, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal, for participating in several activities of CoE and granting necessary permission and providing logistic support during the field floristic surveys.
- National Medicinal Plants Board, New Delhi.
- State Medicinal Plants Boards of Arunachal Pradesh and Meghalaya.
- Forest Development Corporations of Maharashtra, Uttar Pradesh and Karnataka.
- Western Ghats Task Force, Govt. of Karnataka, Bangalore.
- Many other Individuals and Subject experts

6.PROJECT TEAM

Implementation of this multifaceted project was steered by the Advisor FRLHT with separate Program leaders for each of the project components. The staff members of I-AIM involved with the project implementation during the year are:

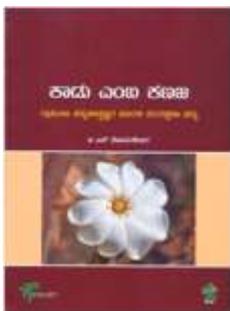
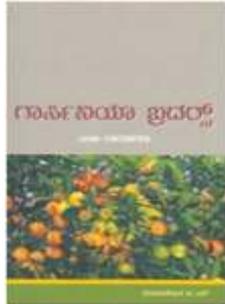
1. D K Ved, Advisor and Principal Investigator – CoE
2. Naresh, Office Secretary
3. K Ravikumar, Assistant Director
4. S. Noorunnisa Begum, Program Officer
5. K Haridasan, Jt. Director
6. N. M. Ganesh Babu, Research Officer
7. Padma Venkat, Jt. Director
8. Gina R. Kuruvilla
9. Balasubramani S.P. Research Associate
10. Subrahmanya Kumar
11. Sathya Sangeetha, Research Officer
12. Vijay Barve, Sr. Program Officer
13. Sugandhi, Data Entry Operator
14. Somashekhar B S, Assistant Director
15. Venugopal, Assistant Director
16. Shilpa, Research Fellow



6. REPORTS, PUBLICATIONS AND EDUCATIONAL MATERIAL

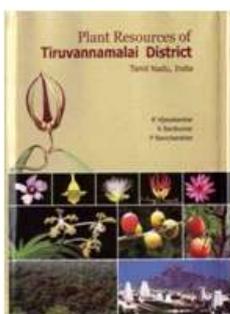
Books

Somashekhar B S. 2011. *Garcinia Brothers emba Gaarudigaru* (Kannada) (An Ecological profile of *Garcinias* -the captivating endemic tree species of Western Ghats). Snehakunja, Honnavara, Uttara Kannada. 156 Pages, Rs.100.



Somashekhar B S. 2011. *Kaadu emba Kanaja* - A learner's Reading material companion in Kannada on Medicinal Plants Conservation. FRLHT, Bangalore. 84 pages.

Somashekhar B S. 2011. *Sasya adhyayana* - A learner's primer in Kannada on Vegetation profiling and Ecological monitoring exercises. FRLHT, Bangalore. 66 pages.



Vijayasankar R., K. Ravikumar and P. Ravichandran, 2012. *Plant Resources of Tiruvannamalai District*. Bishen Singh Mahendra Pal Singh, Dehradun. 769 Pages, Rs.450.

Addition to India from Andaman & Nicobar Islands. *Taiwania* 56 (3): 257-260.

3. Karthigeyan, K., R. Sumathi & J. Jayanthi. 2011. On the occurrence of *Pseuduvaria reticulata* (Blume) Miq. (Annonaceae) from Andaman & Nicobar Islands, India. *Indian Journal for Forestry*, 34(4):473-474.

Invited Presentations

1. Ravikumar, K. *Wild plants as emergency food and anti-dotes for survival in the forests*. Jungle Familiarization Course 4-12th January, 2012, Sathyamangalam. Central Reserve Police Force and Tamil Nadu Forest Department, Sathyamangalam, Tamil Nadu.

2. Ravikumar, K. *Wild plants as emergency food and anti-dotes for survival in the forests*. Forest Survival Course 14-17th February, 2012, Raipur. Central Reserve Police Force, Raipur, Chhattisgarh.

3. Somashekhar B S. *Medicinal Plants cultivation, Collection and Marketing-Overview of the existing scenario*. Workshop on Development of Medicinal Plants in *Krishi Aranya Prothsaha* Scheme of Govt of Karnataka, 2-3rd May 2011, Bangalore. Karnataka Medicinal Plants Authority, Bangalore.

4. Somashekhar B S. *RET Medicinal Plant species from Karnataka-Success stories of their conservation*. State level Workshop for Science Teachers on International Year of Biodiversity & Forests, 5-6th June 2011, Jogimatti. Karnataka Rajya Vijnana Parishat, Bangalore & Karnataka Forest Department, Chitradurga.

5. Somashekhar B S. *Biodiversity for Human Health-Overview of the contribution by Medicinal Plants for Healthcare*. National Conference on Biodiversity and Sustainable Development, 20-21st August 2011, Sree Siddaganga College of Arts, Science and Commerce, Tumkur.

6. Somashekhar B S. *Medicinal Plants Diversity of Tumkur District and critical gaps for conservation*. Review workshop on strategies for Biodiversity conservation of Tumkur District, 17th January 2012, Tumkur. Western Ghats Task Force, Bangalore & Karnataka Forest Department, Tumkur.

Research Papers

1. Karthigeyan, K., R. Sumathi, J. Jayanthi & C. Livingstone. 2010. *Peristylus balakrishnani* (Orchidaceae), a new species from the Andaman Archipelago, India. *Kew Bulletin*, 65(3):491-493.

2. R. Sumathi, J. Jayanthi and K. Karthigeyan *Liparis atosanguinea* Ridl. (Orchidaceae), a New Orchid

Radio Science Lectures

1. Somashekhar B. S. *Species Recovery of critically endangered plants- an efficient conservation strategy*. "Vijnaanaada Munnade-Recent trends in Science" Radio Lecture series. All India Radio, Bangalore. 5th June 2011.

2. Somashekhar B. S. *RET species of Karnataka-an overview*. "Vijnaanada Munnade-Recent trends in Science" Radio Lecture series. All India Radio, Bangalore. 12th June 2011.

3. Somashekhar B. S. *Cultural heritage contributes to Biodiversity Conservation*. "Vijnaanada Munnade-Recent trends in Science" Radio Lecture series. All India Radio, Bangalore. 19th June 2011.

4. Somashekhar B. S. *When the Natural resources become the Cultural Resources*. "Vijnaanada Munnade-Recent trends in Science" Radio Lecture series. All India Radio, Bangalore. 26th June 2011.

ACCOUNTS AND AUDITED STATEMENTS

**COMPETENT AUTHORITY
MINISTRY OF ENVIRONMENT & FORESTS**

FOUNDATION FOR REVITALISATION OF LOCAL HEALTH TRADITIONS

Project: Centre of Excellence

Annexure to Utilisation Certification for the period 01-04-2011 to 31-03-2012

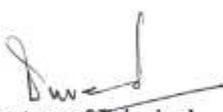
Activity wise expenditure as on 31-03-2012

Sl No.	Activity in Project mode	Budget 2011-12	Expenditure up to 31 st March 2012	Balance Budget
1	Project Co ordination	900,000	873,841	26,159
2	Herbarium of Medicinal Plants used in ISM	3,000,000	2,923,071	76,929
3	Establishment of Ethno-Medicinal Plants Demo Garden	2,150,000	2,147,354	2,646
4	Pharmacognosy Studies	1,850,000	1,696,754	153,246
5	Distribution Mapping of Medicinal Plants using in GIS	1,300,000	1,175,995	124,005
6	Outreach (Training & Educational Material of Plants of ISM)	1,585,360	1,132,828	452,532
	Total	10,785,360	9,949,843	835,517

Balance Budget as on 31.03.2012 Rs. 835,517/-

Add: Interest earned during 2011-12 Rs. 88,694/-

Balance amount available at the end of 31.03.2012 Rs. 924,211/-






Signature of Principal Investigator Signature of Sr. Accounts Officer Signature of Head of the Organisation **Rekha K R Parthasarathy**
M.NO:29695

**Place: Bangalore
Date: 12/09/2012**

Director
 Foundation for Revitalisation of
 Local Health Tradition
 7/12, Jarakabande Kaval, Post Attur
 Yu Yelahanka, Bangalore-560 106
 Ph: 080-28568007, Fax: 080-28567926

UTILISATION CERTIFICATE
1st APRIL 2011 TO 31st March 2012

1. Title of the Project	Centre of Excellence
2. Name of the Organisation	Foundation for Revitalisation of Local Health Traditions
3. Principal Investigator	Advisor FRLHT
4. Ministry of Environment & Forests Letter No. and date of sanctioning the project	No. 13-06/2007-CS-I dated 22 nd November 2011
5. Amount Brought forward from the Previous financial year quoting Ministry of Environment & Forests Letter No and date on which the authority to carry forwards the said amount was given	Rs. 5,99,243/- -(Rupees Five Lakhs Ninety Nine Thousand Two Hundred and Forty Three Only)
6. Amount received from Ministry of Environment and Forests No. date and date of sanction	Rs. 1,01,86,117/- (1) Rs. 49,00,757/- Sanctioned vide No. 13-06/2007-CS-I Dated 22.11.2011 (2) Rs. 52,85,360/- Sanctioned vide No. 13-06/2007-CS-I Dated 02.03.2012
7. Total amount that was available for expenditure incurred during the financial year 2011-12 inclusive of Interest	Rs. 1,08,74,054/- (Including Interest of Rs. 88,694/-)
8. Actual expenditure incurred during the financial year 2011-12	Rs. 99,49,843/- -(Rupees Ninety Nine Lakhs Forty Nine Thousand Eight hundred and Forty Three Only)
9. Unspent balance refunded if any (please give details of cheque no. date)	NIL
10. Balance amount available at the end of March 2012	Rs. 9,24,211/- (Rupees Nine Lakhs Twenty Four Thousands Two Hundred and Eleven Only)
11. Amount allowed to be carried forward to the next financial year i.e., 2012-13.	Rs. 9,24,211/- (Rupees Nine Lakhs Twenty Four Thousands Two Hundred and Eleven Only)

Certified that the expenditure of **Rs. 99,49,843/-**-(Rupees Ninety Nine Lakhs Forty Nine Thousand Eight hundred and Forty Three Only) mentioned against column 8 was actually incurred for the project/scheme.

This certificate is issued at the request of FRLHT


Signature of Principal Investigator


Signature of Sr. Accounts Officer


Signature of Head of the Organisation

**For G Anantha & Co.
Chartered Accounts**

FRN:005160/S


Rekha K R
Partner
M.NO:29695

Date: 12/09/2012

Our Ref. NO. 13-18/99-CSC

Director
Foundation for Revitalisation of
Local Health Tradition
74/2, Jarakat
Via Yelahanka
Ph: 080-28568007, Fax: 080-28568008
Accepted and Countersigned

The Foundation for Revitalisation of Local Health Traditions (FRLHT), based at Bangalore is the Center of Excellence (CoE) for 'Medicinal Plants and Traditional Knowledge', as recognized and supported by the Ministry of Environment and Forests (MoEF), Government of India, since the 10th Five year Plan i.e., 2002-03.

The center has articulated its vision as under:

Demonstration and making available field tested innovative strategy prototypes for Survey, Data collection, Research, Analysis, Education & Outreach in respect of Indian Medicinal plants and Traditional medical knowledge, in order to meet the demands of the sector.

The vision is being realized through:

- Bio-cultural herbarium of medicinal plants
 - Ethno-medicinal garden
- Pharmacognostic studies of controversial botanical raw drug groups
 - GIS based Geo distribution maps for prioritised medicinal plants
- Training and Capacity Building initiatives for Forest department personnel and other key stakeholder groups.
 - Informatics and computer enabled Educational products



जहाँ है हरियाली ।
वहाँ है खुशहाली ॥

MoEF



पुरुषोऽयं लोकसम्मितः

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