

Ministry of Environment and Forests, Government of India's

Centre of Excellence for
Medicinal Plants and Traditional Knowledge



पुरुषोऽयं लोकसम्मितः

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Photographs on

Front Cover: Flower bunches of
Poikilospermum suaveolens (Blume) Merr.
from Andaman & Nicobar Islands

Contents page: Flowers of *Cyrtandromea nicobarica*

Page 7: Yellow Flowers of *Butea monosperma* var. *lutea*

Back Cover: Participants of International Training Course

Ministry of Environment and Forests, Government of India's

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Medicinal Plants and Traditional Knowledge

ANNUAL REPORT 2012-13



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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 & 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 on medicinal plants & Indian medical knowledge
- Threat assessment of Medicinal Plants and Species Recovery Research

1.1. Project Components:

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

Project Component Code & Title	Central Purpose of the Component
CE-P1: Project Co-ordination	The Centre of Excellence involves many 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, liaises with other organisations and coordinates project implementation 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 which is the only medicinal plants herbarium in the country, can fulfill this need. It has been designed as a bio-cultural herbarium which brings together alongside the plant specimens, information on vernacular names, currently accepted botanical name, specific location of its presence (latitude, longitude, altitude) on the Indian Territory. This component 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)

Strengthening the competence and capacities of different stakeholder groups in respect of 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 forestry staff and forest managers in respect of medicinal plants conservation and management strategies.

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.

CE-P7:
Conservation and
Sustainable Management
of Medicinal Plants

Issues related to Population Biology & Reproductive Biology of Medicinal plants often shed light on critical elements, especially the intrinsic ones, associated with the different threats to medicinal plants, an understanding of which can broaden our current knowledge of threats. Hence studying the Population Biology & Reproductive Biology of medicinal plants is becoming utmost important to devise appropriate Species Recovery plans and Conservation initiatives in the country.

This component is therefore conceived as an addition to CoE during the year 2012-13, largely taken shape in order to address the recommendations by the expert committee which reviewed the progress of CoE during February 2012. Trying to address the recommendations, this component, considers two priority subject fields as its focal areas of study: Threat Assessment of Medicinal Plants, and Species Recovery Research.

1.2 Project Implementation Mechanism:

FRLHT prepares the annual action plans in respect of the above project components within the overall 5-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 2012-13, 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 2012-13 (section 2) and a matrix of detailed annual progress report (section 3).





2. HIGHLIGHTS OF THE PROJECT ACTIVITIES

The approved annual plan for the year 2012-13 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 2012-13, the herbarium team engaged in many field explorations in select regions of the country and strived to enrich the existing collection with a target of an addition of 150 species through ~500 voucher specimens.

The team made conscious attempts to make herbarium collections from different areas of the country so as to make complete representation of the entire range of distribution of the medicinal plant species under focus. 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
Gujarat & Rajasthan	166	Uttarakhand	393
Chhattisgarh	101	Arunachal Pradesh	95
Karnataka	19	Sikkim	111
Andaman Islands	269	Tamil Nadu	360

These surveys resulted in the collection of 1625 voucher specimens corresponding to 1348 collection numbers. These have brought in 618 plant species of which 150 were not present in the herbarium earlier.



Mangifera griffithii



Plagiostachys nicobarica



Habenaria intermedia

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 5250 such images captured during the field

visits were added to the virtual herbarium during the year.

Additionally ~5000 voucher specimens were digitised. The images were subsequently uploaded on the ENVIS website <http://envis.frlht.org/digital-herbarium-main.php>

* "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.



Important collections during the year

Noteworthy collections from north eastern India include:

Allium prattii C.H.Wright, *Aconitum palmatum* D.Don, *Berberis angulosa* Wall. ex Hook.f. & Thomson, *Bergenia pacumbis* (Buch.-Ham. ex D.Don) C.Y.Wu & J.T.Pan, *Lobelia dodiana* E.Wimm., *Neohymenopogon parasiticus* (Wall.) Bennet, *Rhododendron campanulatum* subsp. *aeruginosum* (Hook. f.) D.F. Chamb., *Spiraea bella* Sims.

Noteworthy collections from Andaman & Nicobar Islands include:

Aglaonema simplex (Blume) Blume (= *Aglaonema nicobaricum* Hook.f.), *Barringtonia reticulata* (Blume) Miq., *Byttneria andamanensis* Kurz, *Calophyllum soulattri* Burm.f., *Combretum punctatum* var. *squamosum* (Roxb. ex G.Don) M.G.Gangop. & Chakrab., - *Cyrtandromoea nicobarica* N.P.Balakr., *Elaeocarpus macrocerus* (Turcz.) Merr., *Endospermum macrophyllum* (Müll.Arg.) Pax & K.Hoffm. (= *Macaranga macrophylla* Müll.Arg.), *Ficus fulva* Reinw. ex Blume, *Horsfieldia penangiana* J.Sinclair, *Ipomoea pes-caprae* subsp. *brasiliensis* (L.) Ooststr., *Lasianthus verticillatus* (Lour.) Merr., *Mangifera griffithii* Hook.f., *Myristica irya* Gaertn., *Phyllanthus gomphocarpus* Hook.f., *Plagiostachys nicobarica* M.Sabu, Sanoj & Prasanthk., *Poikilospermum suaveolens* (Blume) Merr., *Semecarpus kurzii* Engl., *Sterculia macrophylla* Vent., *Teijsmanniodendron pteropodum* (Miq.) Bakh. and *Ternstroemia wallichiana* Ridl.

Noteworthy collections from Chhattisgarh include:

Butea monosperma (Lam.) Taub. [= *Butea frondosa* var. *lutea* (Witt.) Maheshw.], *Butea superba* Roxb., *Euphorbia heyneana* Spreng., *Glochidion hohenackeri* (Müll.Arg.) Bedd., *Juncus prismatocarpus* subsp. *leschenaultii* (Gay ex Laharpe) Kirschner (= *Juncus leschenaultii* Gay ex Laharpe), *Lepidagathis purpuricaulis* Nees, *Malva verticillata* L., *Salvia plebeia* R.Br., *Seseli indicum* Wight & Arn. and *Tricholepis radicans* (Roxb.) DC.

Noteworthy collections from Arunachal Pradesh include:

Bridelia assamica Hook.f., *Coptis teeta* Wall., *Edgeworthia gardneri* (Wall.) Meisn., *Embelia floribunda* Wall., *Illicium griffithii* Hook. f. & Thomson, *Illigera khasiana* C.B. Clarke, *Litsea monopetala* (Roxb.) Pers., *Luculia pinceana* Hook., *Macaranga denticulata* (Blume) Müll.Arg., *Madhuca butyracea* (Roxb.) J.F.Macbr., *Maesa ramentacea* (Roxb.) A. DC., *Rubia sikkimensis* Kurz, *Sarcosperma griffithii* Hook.f. ex C.B.Clarke and *Vernonia volkameriifolia* DC.

Noteworthy collections from Kerala corresponding to Taxonomic relevance and include:

Cryptocoryne retrospiralis (Roxb.) Kunth (Araceae) and *Strophanthus wightianus* Wall. ex Wight (Apocynaceae) which are endemic to India. The collections also brought many species endemic to Western Ghats, such as *Gymnacranthera farquhariana* (Hook.f. & Thomson) Warb. (Myristicaceae), *Hopea racophloea* Dyer (Dipterocarpaceae), *Nymphoides krishnakesara* K.T.Joseph & Sivar. (Menyanthaceae), *Otonophelium stipulaceum* Radlk. (Sapindaceae), *Salacia macrosperma* Wight (Celastraceae), *Apollonias arnottii* Nees (Lauraceae) Additionally, the survey brought a prized collection of a vessel-less angiosperm, *Sarcandra chloranthoides* Gardner (Chloranthaceae).



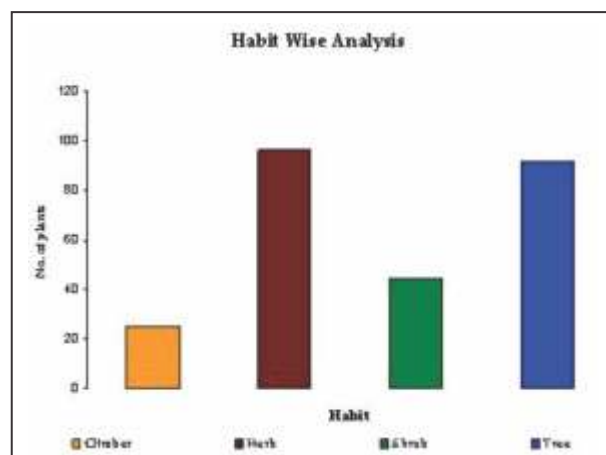
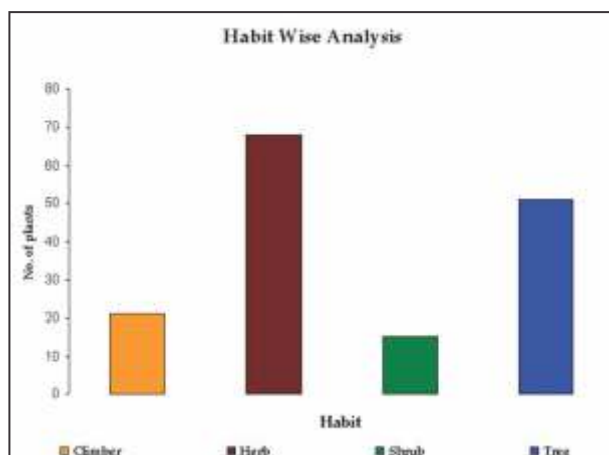
RAW DRUG REPOSITORY

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 2012-13, the team engaged in different field collections and market collections and collected 156

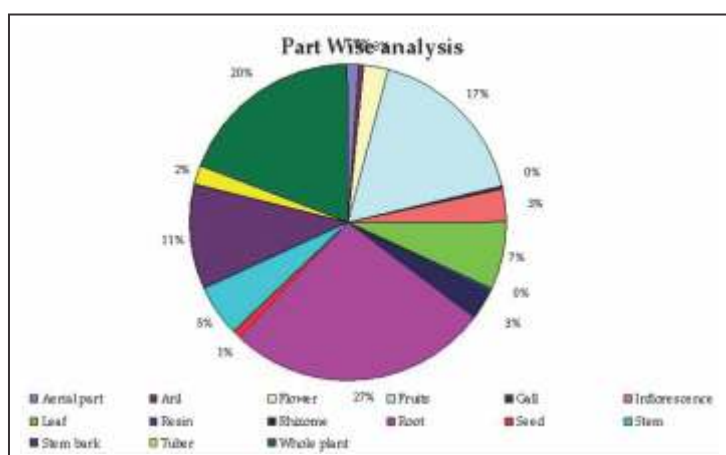
raw drug samples from the markets and 258 raw drug samples from field. These additions raised the total number of collection at the repository to 3394.

Market Collections: The 156 samples collected during the year correspond to 140 species (106 genera and 57 families) and were procured mainly from different markets across 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 258 authentic collections from the field, which correspond to 189 species (from 161 genera and 82 families). These raw drugs were procured from Andaman & Nicobar Islands (44 samples), Andhra Pradesh (3 samples), Assam (2 samples), Chattisgarh (7 samples), Gujarat (33 samples), Karnataka (11 samples), Himachal Pradesh (2 samples), Kerala (2 samples), Madhya Pradesh (1 sample), Meghalaya (1 sample), Pondicherry (11 samples), Rajasthan (2 samples), Sikkim (6 samples), Tamil Nadu (83 samples), and Uttarkhand (49 samples). The plant part/produce wise break up as well as the habit wise breakup of the collections is depicted below:



Noteworthy collections from the markets:

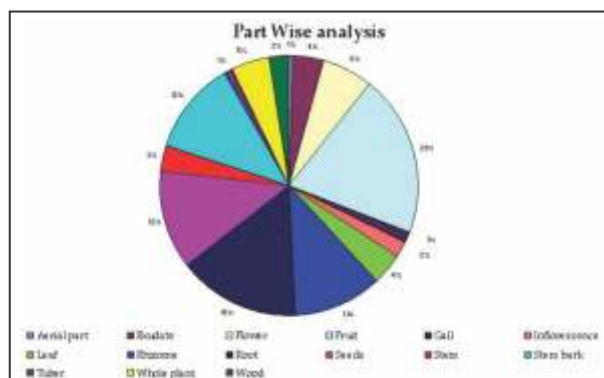
- *Doronicum hookeri* (Darunaj e aqrabi): An important medicinal plant whose roots are used as a constituent of Cardiac and nervine tonics.
- *Melissa officinalis* (Badranjboya): The lemon balm plant with varied uses was collected for the first time
- *Salvia haematodes* (Behman Surkh): An important medicinal plant whose roots are used as a constituent of Cardiac and nervine tonics



Noteworthy Collections from the field:

- *Butea monosperma* var. *lutea* : Yellow palash was collected for the first time from Chattisgarh.
- *Fumaria indica* (Parpata): Vulnerable medicinal plant with anti-inflammatory and anti-pain properties was collected for the first time.
- *Amorphophallus sylvaticus*: The tubers of vulnerable medicinal plant with restricted distribution in Southern India was collected for the first time.
- Three members of Ashtavarga namely *Roscoe purpurea* (Kakoli), *Habenaria edgeworthii* (Riddhi), *Habenaria intermedia* (Vridhhi) were collected for the first time

- *Allium stracheyi* : A vulnerable medicinal plant, collected from Uttarakhand.



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 2745 raw drugs were incorporated in the electronic database.

Training and Outreach 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 needs of the 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
Jyoti Nivas College, Bangalore	16 th July 2012	51 students
Regional Centre for Development Cooperation (RCDC), Bhubaneshwar	12–15 th December, 2012	40 participants
Ramakrishna Ayurvedic Medical College Hospital & Research Centre, Bangalore	7-8 th January, 2013	32 students

RMR's technical expertise extended to other projects of FRLHT too

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 include:

- *Inventory of Medicinal and Aromatic Plants of Sikkim* (Centre for ISM Informatics).
- *Inventory of Medicinal and Aromatic Plants of Uttarakhand* (Centre for ISM Informatics).
- Capacity building training for the Front line staff of State Forest Department, Maharashtra (Conservation Training & Education Unit).
- PG diploma in Ethno Veterinary Practices (EVP) (Centre for Education Innovation).



CE-P3: ETHNO MEDICINAL GARDEN

The Ethno Medicinal Garden (EMG) on the FRLHT campus being the live collection of Medicinal plants brought from across the country, houses different medicinal plants used in Indian systems of medicine. These are planted in specific groupings and thematic 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 39 thematic assemblages which may be grouped 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.

Live Collections in the Garden

During the year 2012-13, the garden team focused on developing garden sections around the following 3 themes:

- Resin and Gum yielding plants
- Homoeopathy plants
- Plants with Edible leaves

As a result 62 species of medicinal plants were added to the EMG, which took the total number of species in EMG to 1326.

Some of the noteworthy species added during the year are: *Illicium griffithii*, *Dendrobium wardianum*, *Gymnocladus assamicus*, *Elaeocarpus tuberculatus*, *Myrsine africana*, *Berberis asiatica*, *Mehonia nepalensis*, *Cocculus laurifolius*, *Daphne papyrifera* etc.

Garden's Educational Significance

Considering the information needs of different visitor groups to the garden, the EMG team organized many awareness and appreciation programs. During the year 4 such awareness programs were conducted.

More than 750 students from graduate and undergraduate classes from 19 different Colleges and Educational Institutions from different parts of south India visited the garden as a part of their field exposure to medicinal plants. Additionally, the garden also received visitors from Forest training institutes.

In order to enhance the user friendliness of the garden and to strengthen the interpretive value of the live collections in the garden, different interpretive signages and informative panels were developed. During the year interpretive panels and signages were affixed for 100 species under 3 themes.

As a result of sustained efforts to enrich the collections in the EMG, 62 species of medicinal plants were added during the year, to take the total number of species in the EMG to 1326.

As a step towards developing a manual on establishing a medicinal plants garden, the team held a consultative meeting with the Subject experts, Nurserymen, Environmental Educators and Garden Managers and stimulated a brainstorming discussion to discuss the learning & information needs, subject contents and other issues related to the form and presentation of the manual. The discussion helped to consolidate the views and helped the team to arrive at a draft note on the manual contents.



A view from the brainstorming meeting



Garden extends its technical expertise to other agencies involved in the for restoration of degraded landscapes

The Garden team extended its technical expertise including the planting material of medicinal plants to M/s. JTCPL, Sultanpur, Bellary for its initiative of restoring the degraded landscapes and mined areas in Bellary, Karnataka. The team oversaw the planting and creation of Green belt over 100 acres of land.



Restored Landscape at the Housing Colony of JTCPL, Bellary



Restoration planting with medicinal plants on a degraded site, JTCPL, Bellary



Visitors at the Medicinal Plant Nursery, FRLHT, Bangalore



CE-P4: PHARMACOGNOSY STUDIES

In view of the importance of the concept of Abhava prathinidhi dravya (Drug substitution) in Ayurveda and our continued interest in identifying legitimate substitutes for species of conservation concern, the work done in 2012-13 dealt primarily with this topic. Studies were conducted with the Abhava prathinidhi pair Ativisha-Musta to determine the presence of similar compounds in the pair, if any. Investigations were also done on new Daruharidra accessions of *Berberis aristata*, *Berberis asiatica* and *Berberis lycium* to establish unequivocal identification methods for *B. aristata*.

Ativisha-Musta

The logic behind the Ayurvedic concept of Abhava prathinidhi dravya is yet to be firmly established. Using the pair Ativisha-Musta as an example and in continuation of the research work done in earlier years, in depth analysis was done with specific objective of identifying compound (s) common to both species, using HPTLC, HPLC and LC-MS analytical methods.

Chemical Studies

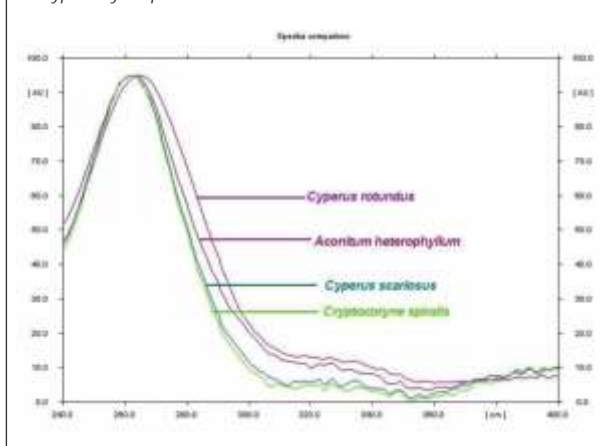
Phytochemical screening:

In 2012-13, phytochemical analysis was carried out for new accessions. Both Ativisha and Musta samples, when subjected to successive extraction and tested for different groups of phyto-constituents, confirmed the presence of alkaloids, glycosides, saponins, phytosterols, and carbohydrates.

Apart from these, Musta showed the presence of phenolic compounds, gums, and flavonoids. These results were confirmed to be the same as that reported in 2011-12

HPTLC profiles of successive extracts of *Aconitum heterophyllum*, *Cyperus rotundus*, *Cyperus scariosus* and *Cryptocoryne spiralis*:

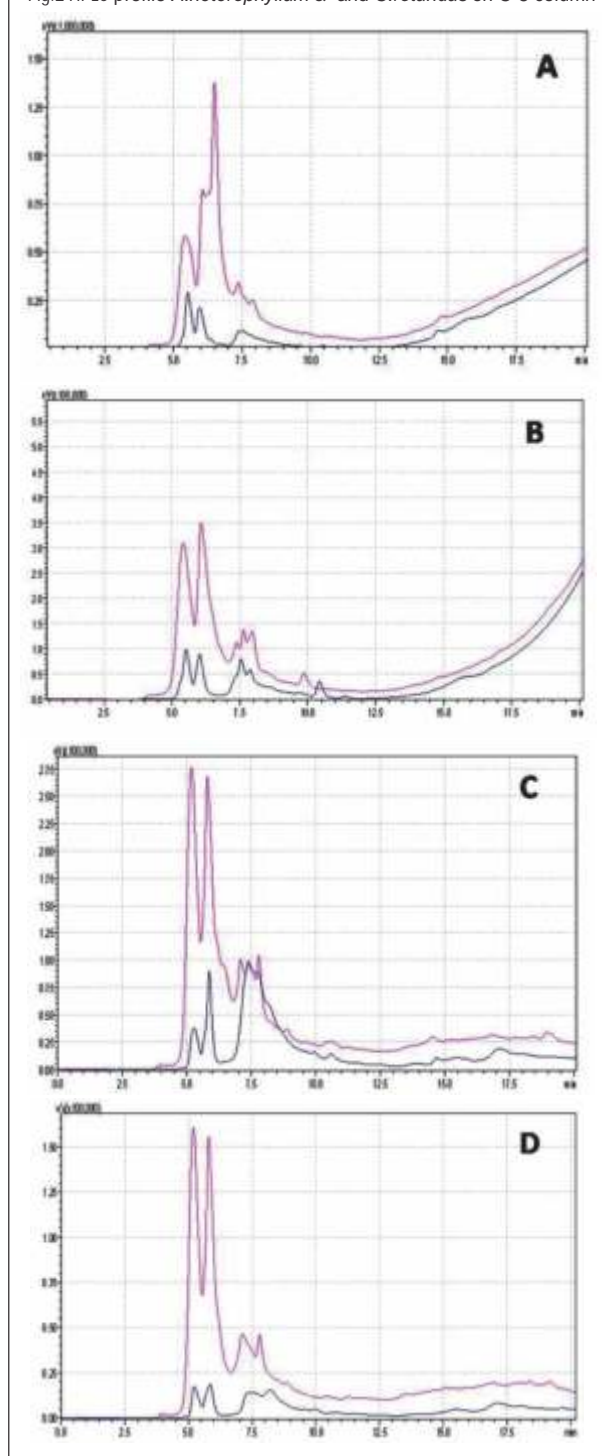
Fig.1 Spectral comparison of HPTLC band at Rf 0.5 of *Aconitum heterophyllum* and *Cyperus rotundus*, *Cyperus scariosus* and *Cryptocoryne spiralis*.



The HPTLC chromatograms of the four species are distinct. While it was seen that there were some common bands between the species, in case of hexane extract, one band in particular was seen to be present in all four species ($R_f = 0.5$). Spectral scanning of this band (Fig.1) showed that the four species had different spectral features.

HPLC profiles of *Aconitum heterophyllum* and *Cyperus rotundus* on two different columns:

Fig.2 HPLC profile *A.heterophyllum* & *C.rotundus* on C-8 column

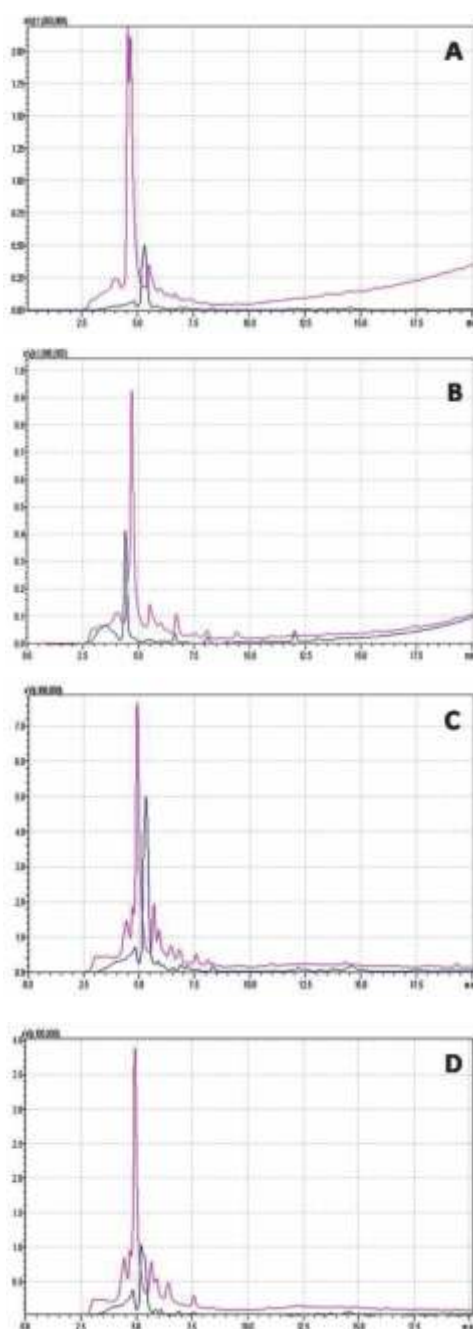


Pink-*Cyperus rotundus*, Blue-*Aconitum heterophyllum*



Earlier HPLC results on a C-18 stationary phase column from this laboratory had shown the presence of peaks of almost the same retention times in *A.heterophyllum* and *C. rotundus*. In order to obtain conclusive data, the extracts of *A.heterophyllum* and *C. rotundus* were examined on two more HPLC columns, having C-8 and phenylhexyl stationary phases. Also, the chromatograms were examined at four different wavelengths, namely 220, 254, 280 and 320 nm. The presence of common peaks in the chromatograms of *A.heterophyllum* and *C. rotundus* under these different conditions would be strong evidence for the presence of the same compound in the two species.

Fig.3 HPLC profile of *A.heterophyllum* and *C.rotundus* on phenylhexyl column



Pink-*Cyperus rotundus*, Blue-*Aconitum heterophyllum*

Aqueous extract of *A.heterophyllum* and *C. rotundus* were used for this purpose. The HPLC data are given in Figs. 2 and 3. It can be seen from the chromatograms that while *A.heterophyllum* and *C. rotundus* show peaks with very close retention times on the C-8 column, no such similarities are observed on the phenylhexyl column. The HPLC evidence from these results does not support the presence of the same compound in the two species.

There remains the possibility that compounds with no chromophoric activity (and hence not detectable by UV) could still be present in *A.heterophyllum* and *C. rotundus*. To examine this aspect, LC-MS studies were performed on the aqueous extracts of *A.heterophyllum* and *C. rotundus*.

LC-MS analysis of *Aconitum heterophyllum* and *Cyperus rotundus*:

The LC-MS traces of *A.heterophyllum* and *C.rotundus* showed peaks of close retention times of 2.83 and 3.20 min for *A.heterophyllum* and 2.87 and 3.08 min for *C.rotundus*, respectively. The peaks at retention times of 2.83 and 2.87 min have $m/z = 99.58$, which is not of diagnostic value. Matching m/z values of 266 were found for both *A.heterophyllum* and *C.rotundus* at retention times of 3.04 and 3.08 min, respectively (Fig-4 & 5).

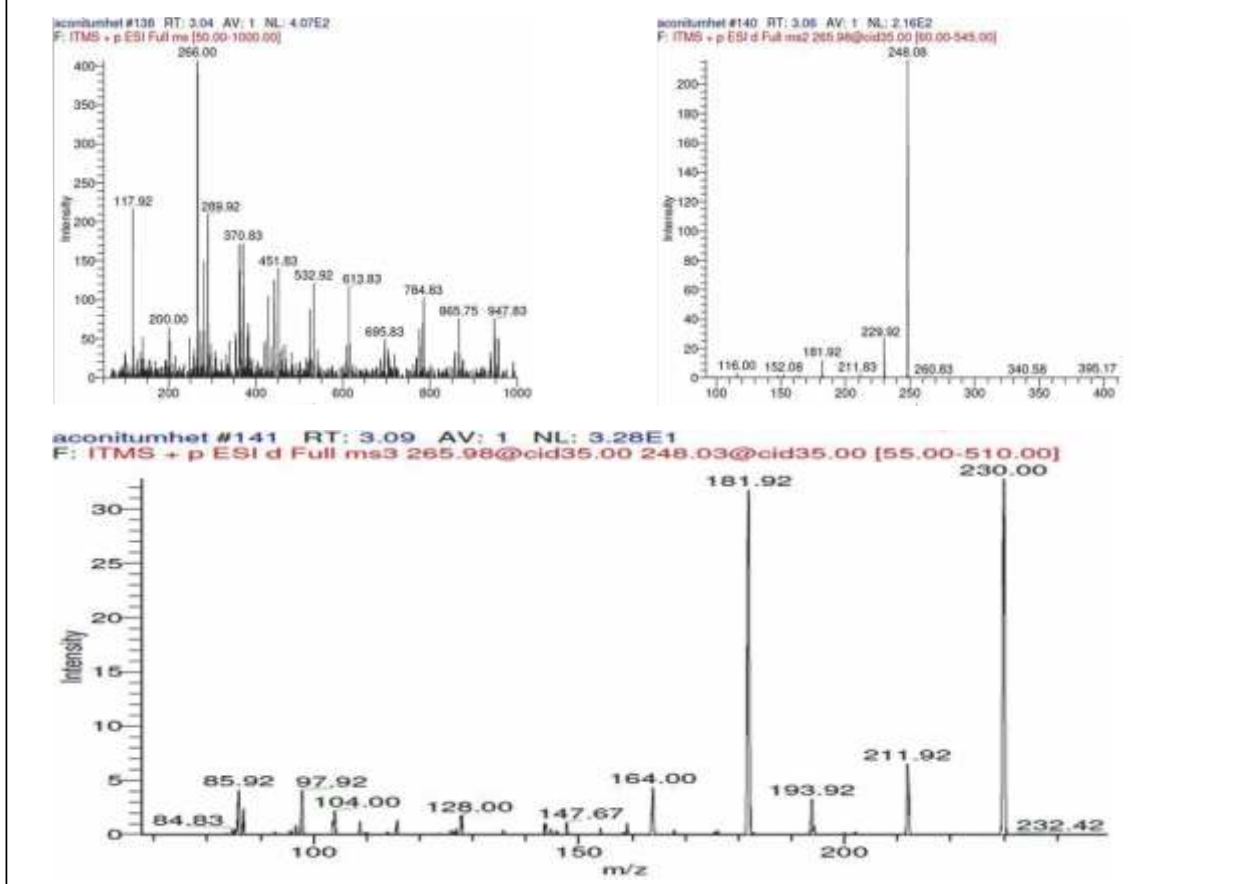
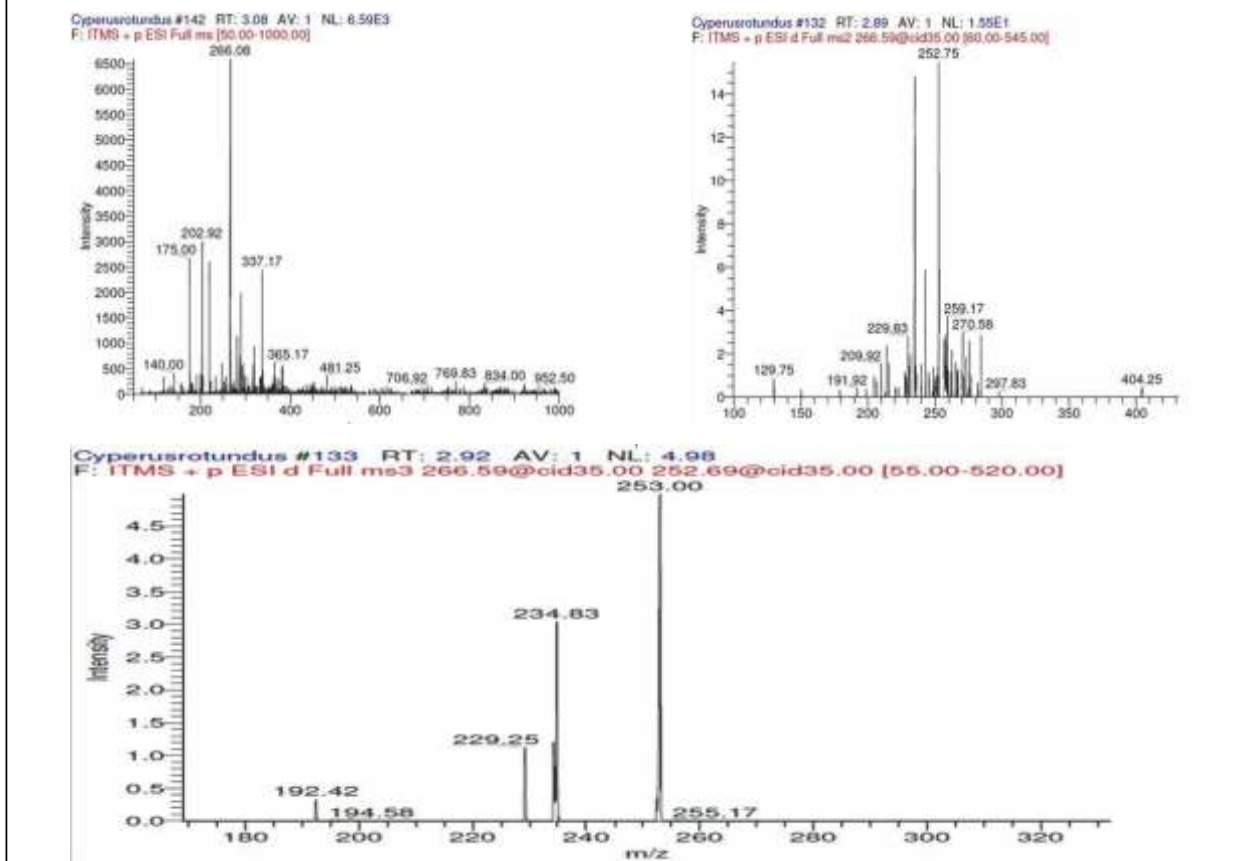
To conclude, different fragmentation patterns suggest that the peak with $m/z = 266$ present in both species is not from or derived from, the same compound. More extensive LC-MS work is needed to prove or disprove the presence of the same compound(s) in *A.heterophyllum* and *C.rotundus*. This will be taken up in 2013-14.

Daruharidra

Daruharidra is an important medicinal plant in Ayurveda. As per Ayurvedic descriptions, it was only possible to correlate Daruharidra to the genus *Berberis* and not to the species level. We have also found that pharmacognostically reliable methods to distinguish the *Berberis* species are not available. Taxonomically there is confusion to distinguish the *Berberis* species in the field unless they are in flowering or fruiting. Phytochemically all species of *Berberis* studied namely from *B. aristata*, *B. asiatica* and *B. lycium* have the chemical reference marker Berberine. Molecular Biology based methods were also studied for the same purpose.

Despite the studies conducted on Daruharidra by us, it was difficult to conclude the modern laboratory findings to distinguish the authentic Daruharidra which is *Berberis aristata* because of inconsistent HPTLC profile and DNA fingerprinting. In different accessions of *Berberis aristata* collected across periods of time, the HPTLC fingerprint pattern was found to be inconsistent. To overcome this inconsistency in HPTLC profile, the current objective of the year 2012-2013 was to compare all Daruharidra species collected since 2008.



Fig-4 Mass profile of *A.heterophyllum* and fragmentation patternFig.5 Mass profile of *C.rotundus* and fragmentation pattern.

Comparison of HPTLC fingerprints of all accessions of all *Berberis* species traded/used as Daruharidra on a single TLC plate

HPTLC profile of *B. aristata*, *B. asiatica* and *B. lycium* were observed under 254nm and white light (after derivatisation with anisaldehyde sulphuric acid) were found similar. Minor differences were seen at 366 nm.

B. aristata samples which were collected during 2008 & 2010 showed a blue colour band at R_f 0.21. which was absent in *B. aristata* collected during 2011 and also absent in all the accessions of *B. asiatica* and *B. lycium*.

Based on these results, it was not possible to unambiguously distinguish between samples of *B. aristata*, *B. asiatica* and *B. lycium*.

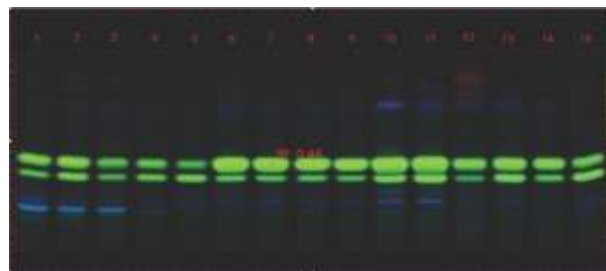


Fig 6: HPTLC of profile of *Berberis* species observed under UV 366nm

Track 1: *B. aristata* L/08/09/012
Track 2: *B. aristata* L/08/10/011
Track 3: *B. aristata* L/08/10/008
Track 4: *B. aristata* L/10/06/003
Track 5: *B. aristata* L/10/06/002
Track 6: *B. aristata* L/11/09/013
Track 7: *B. aristata* L/11/09/014
Track 8: *B. aristata* L/11/09/015

Track 9: *B. aristata* L/12/06/002
Track 10: *B. asiatica* L/08/09/13
Track 11: *B. asiatica* L/08/09/16
Track 12: *B. lycium* L/08/10/009
Track 13: *B. lycium* L/08/09/014
Track 14: *B. lycium* L/08/10/010
Track 15: *B. lycium* L/10/06/001

Validation of the developed SCAR markers for Daruharidra candidates

The Sequence Characterized Amplified Region (SCAR) markers developed based on ribosomal DNA sequence variation was not specific to their respective species, because of High homology percentage in the Internal Transcribed Spacer region of *Berberis* species.

DNA analysis will help in distinguishing the *Berberis* spp. of our interest. But its success depends largely on the authentic starting material. Thus, if taxonomically distinct, authentic samples were to be provided in one go, we can perhaps use more stringent fingerprinting methods like AFLP or a whole genome sequencing to develop specific markers, which can be used in combination with the ITS markers.

The samples received during the year 2012-2013, *B. aristata* (L/12/09/002, L/12/09/004), *B. asiatica* (L/12/09/003, L/12/09/005), *B. lycium* (L/12/09/006) were validated using the reported SCAR markers. The samples received as *B. aristata* did not produce the required amplifications to its respective SCAR marker. The SCAR marker of *B. asiatica* and *B. lycium* was not specific to its plant species.

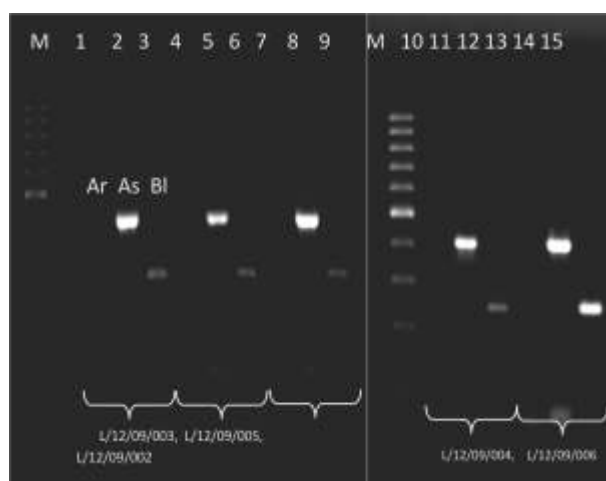


Fig.7 M: 100 bp ladder, Lane1, 4, 7, 10, 13: SCAR markers AR1F & AR1R (Specific to *B. aristata*); Lane 2, 5, 8, 11, 14 SCAR markers AS1F & AS1R (Specific to *B. asiatica*), Lane 3, 6, 9, 12, 15: SCAR markers BL2F & BL2R (Specific to *B. lycium*). Ar-*B. aristata*, As-*B. asiatica*, Bl-*B. lycium*)

Vidanga

The monograph on vidanga has been prepared and will be presented to the steering committee at the meeting in May, 2013 before finalizing and publishing.



CE-P5: DISTRIBUTION MAPPING USING GIS & MAPPING BACKWARD LINKAGES FOR TRADED SPECIES

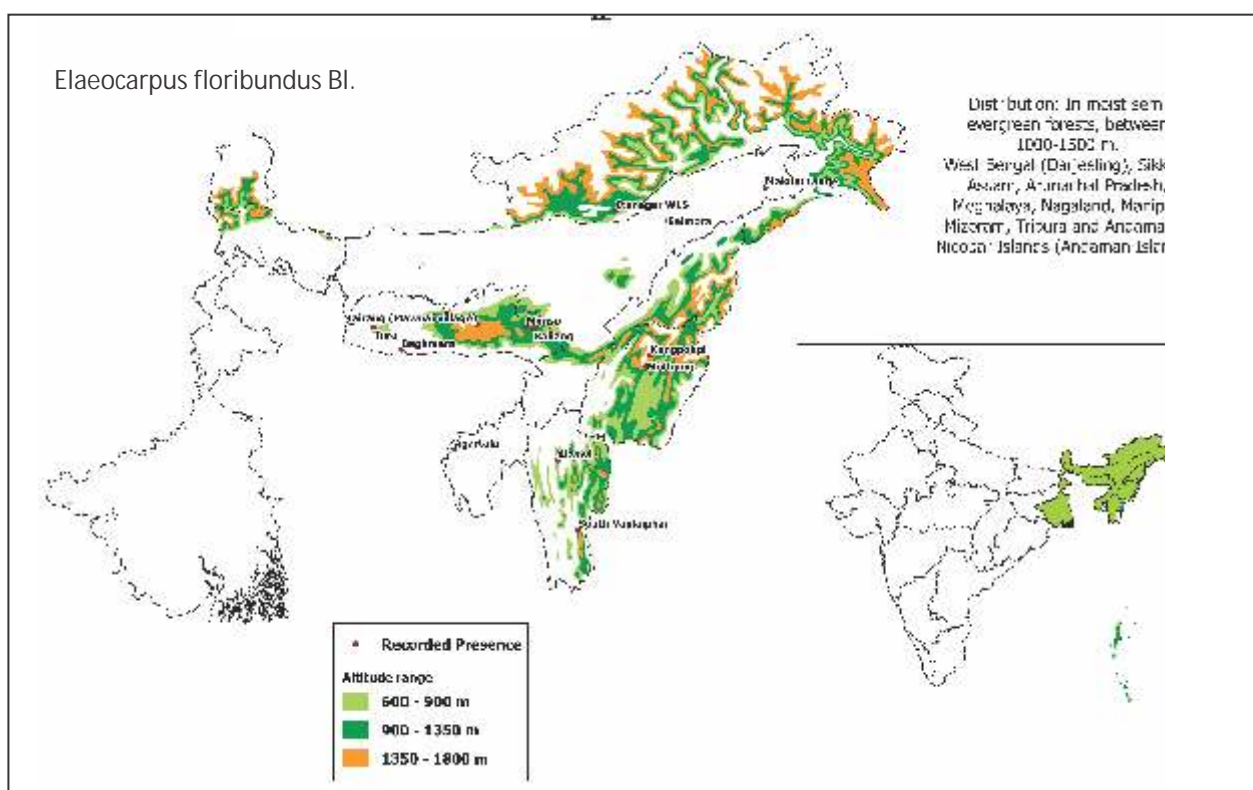
Digital Geographical Distribution Atlas of Prioritised Indian Medicinal Plants

Preparation of geographical distribution datasheets and maps was undertaken for 250 wild medicinal plant species with a focus on species of North East India. Accordingly, detailed eco-distribution maps were prepared for 25 species of conservation concern using open source GIS (Q GIS software). This digital data were incorporated into a searchable ATLAS and provided on CD-ROMs.

The ATLAS contains geographical distribution maps, showing the wild presence of a species under consideration in specific districts, along with the data compiled from published sources. It aims at providing reliable data on the natural distribution of select

medicinal plants within India, for the use of forest managers and researchers.

The Eco-distribution Maps incorporate precise geographical locations of occurrence of a 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 North East India and a total of 25 such species were dealt with for the preparation of Eco-distribution maps, so far.



Preparation of Maps depicting backward linkages for high priority wild botanicals in trade

Three high trade botanical drugs viz., Vidari, Manjishta and Anantamool/ Sariva were analysed for the correlated plant sources and mapped for the backward linkage with regions of their wild occurrence.

As per the current taxonomic understanding five species of the genus *Cycas* occur wild in India and some of these have been recorded in trade as adulterants of plant raw drugs like Vidari. These species are *Cycas circinalis*, *C. pectinata*, *C. beddomei*, *C. northotsii* and *C. sphaerica*.

For developing maps depicting identified regions of occurrence and possible sources of supply the data relating to specific sites of presence (herbarium, field records including populations) were compiled and converted into maps using QGIS and MAPWINDOW. These maps depict the occurrence of wild genetic sources of these species with the aim to guide conservation and help in educating the society on the resource availability, gaps, types of endemism and potential areas for augmentation.



CE P6: TRAINING & OUTREACH

International Training on Conservation and Sustainable use of Medicinal Plants for the participants of CoP11

In the direction of orienting the International audience, especially from the developing countries to the recent developments in the Biodiversity conservation sector, FRLHT came up with the idea of organizing a training course on Conservation and Sustainable use of Medicinal plants. Accordingly the Conservation Training team of CoE designed a 5-day course focusing on the recent developments in the field of Medicinal Plants Conservation for the participants of CoP 11. Applications were invited through CoP11 secretariat and UNDP-Ecuador Office.

The program was organized during 1-5th October 2013 at FRLHT, Bangalore. The learning sessions were

participatory in nature and included Interactive Multimedia presentations, Invited Lectures from Guest speakers, Outdoor exercises, Hands on Activities, Experience sharing & Demonstration sessions and Field visit to Medicinal Plant Conservation Areas. An exclusive reading material compendium was also prepared and given to the participants.

The program witnessed an overwhelming participation by 27 participants drawn from Benin, Brazil, China, Egypt, Kenya and Srilanka along with an observer from UNDP, New york, and select participants from other Research Institutes, NGOs and Forest department from across India.



Participants from Kenya, Brazil, Benin.



Participants with the Course Director & Resource persons

Learning Needs Assessment Exercises as a prelude to the preparation of a ToT Module on "Threat assessment of medicinal plants based on IUCN Red List categories and criteria"

As an essential element for developing a long term strategy for monitoring the Conservation status of Medicinal plants in India, a task taken up by the UNDP-GEF project implementing team at FRLHT, the Conservation Training Team began working on developing a ToT Module on "Threat assessment of medicinal plants based on IUCN Red List categories".

This ToT module, primarily intended for the use of the Institutes and agencies engaged in the implementation of UNDP-GEF project on medicinal plants conservation in Uttarakhand, Arunachal Pradesh & Chhattisgarh, is also expected to serve as an effective Training tool to create a cadre of trained manpower in these Institutes, in respect of Threat assessment methodology.

As a first step towards developing this ToT module, the Conservation training team held a series of consultations with the partner agencies in the above three states, in order to ascertain the learning needs of the teams. Three such Learning Needs assessment exercises were conducted as below:

27-28 th December 2012	G B Pant Institute, Almora, Uttarakhand
27-28 th January 2013	NERIST, Itanagar, Arunachal Pradesh
12-13 th March 2013	Pt. Ravishnagar Shukla University, Raipur, Chhattisgarh

By administering a structured Need Assessment Questionnaire, the learning needs of the participating teams, in respect of the focal theme, Threat assessment of Medicinal plants, were assessed. Findings from the need assessment exercises project a contrast between the current levels of understanding amongst the teams, as against their expected levels and help recognize the priority subjects to be included in the ToT module.

These Interactions were also made use of to provide a basic exposure to the members of the teams about the fundamental aspects of the focal themes such as Threats & threat categories, threat assessment methodology and CAMP exercise, strategies of carrying out threat assessment exercises.



Capacity building initiatives for the front-line staff & Senior Forest Officers

In the direction of building and strengthening the capacities among the frontline staff and senior officers of the state Forest departments, the Conservation training team designed and conducted 3 courses for the officers from Maharashtra during the year 2012-13.

The capacity building courses for the frontline staff were designed on the focal theme, "Identification & management of wild medicinal plant resources of Maharashtra". The learning sessions were structured around different subjects including the Diversity of

Medicinal plants of Maharashtra & their distribution, Field Identification skills & herbarium Preparation, Threats to Medicinal plants of Maharashtra, Threat assessment & Red listed medicinal plants, Conservation strategies & Medicinal Plants Conservation Areas (MPCAs), Significance of medicinal plants for primary healthcare & Local Health traditions of Maharashtra and Strategies for Community Involvement in Conservation initiatives. Two courses were conducted as below:

Dates	Place	No. of Participants
31 st October - 3 rd November 2012	Chandrapur	55 Frontline forestry staff
5-8 th November 2012	Pune	50 Frontline forestry staff



Views from different learning sessions during Capacity Building Training Courses.

Refresher Course on "Recent developments in Conservation of Medicinal Plants" for the Senior Forest Officers from Maharashtra

Forest Research wing of Maharashtra forest department requested the Conservation Training team of CoE, to organize a field exposure about the Recent developments in Conservation of Medicinal Plants" to the senior Forest officers of Maharashtra. Accordingly, the Conservation Training team designed a 1-day exposure at FRLHT campus, Bangalore, on 5th December 2012. The program focused on recent developments such as Threats & Threat Assessment strategies, RET medicinal plant species, Demand & Supply of Medicinal Plants, Cultural connotations of Health Traditions. Twenty five senior officers took part in this 1-day exposure.

Orientation and mentoring support to different context based learner groups from Karnataka Forest Department and other Govt Agencies

The Conservation training team of CoE associated itself with different mentoring and capacity building initiatives of the Karnataka Forest Department and the Western Ghats Task Force, Govt of Karnataka. Following are the initiatives, which received the technical support/ inputs by Conservation training team.



Dates	Training/ Learning Intervention	Organized by
11-12 th May 2012, Sirsi	Workshop on Fruit Trees of Western Ghats,	Western Ghats Task Force, Bangalore & Kadamba, Sirsi
21 st May 2012, Sirsi	Workshop on "Significance and restoration of Myristica Swamps	Karnataka Forest Department & Western Ghats Task Force, Bangalore
29 th May 2012, Sirsi	Workshop on "Forests & Communities' Cultures"	Forestry College, Sirsi
26 th June 2012, Bangalore	Workshop on "Forest Working Plans and necessary modifications for Forest Conservation Guidelines".	Karnataka Forest Department & Western Ghats Task Force, Bangalore
24 th August 2012, Chikmagalur	Consultative Meeting with Subject experts for Developing the "State of Environment Report of Chikmagalur District".	Karnataka Forest Department & Western Ghats Task Force, Bangalore
28 th August 2012, Siddapur,	Training of Master Trainers from VFCs on "Green Health program".	Karnataka Forest Department & Western Ghats Task Force, Bangalore
12 th December 2012, Tumku	Workshop with Forest officers & VFCs and Release of the "State of Environment Report-Tumkur District".	Karnataka Forest Department & Western Ghats Task Force, Bangalore
21 st January 2013, Mysore	National Workshop on Ayurveda Chintana Manthana.	AYUSH and Maharani's College, Mysore

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-traye*s 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 additional 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. 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.



Draft of the 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 *Shankapuspi* 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 ethno botanical 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.

Medicinal plants of Dhanvantari Nighantu (10th Century AD)

Commonly worshipped as the God of Medicine, DHANVANTRI is regarded as the origin exponent of Indian medicine. *Dhanvantari-Nighantu* is considered the most ancient (10th Century AD) of the available medical glossaries, while it is also the oldest available materia medica dealing with synonyms and properties of plant drugs documented after the period of classical texts in Ayurveda i.e. (1500 BCE-600 AD). It comprises of 6 sections dealing with plant drugs and 4 sections dealing with non-plant entities like metals, minerals and animal origin. It still remains a standard text to study the source of material drugs, despite several other lexicons of today.

The present version of Dhanvantari nighantu attempted by the CoE team is developed over seven sections to deal with 480 medicinal substances highlighting their names, synonyms, and brief description of the properties of

these drugs. The work which claims to be 'like the third eye' for the practicing physician, is extensively relied upon. The main part of the *nighantu* consists of the vegetable kingdom. The entire wealth of drugs is classified into seven categories in which the sixth category mentions the vegetable, mineral and animal drugs. The seventh category is known as '*Mishra varga*' and contains many subjects unrelated to each other. The first '*Guducyadi varga*' only contains the information of important drugs of vegetable kingdom.

The database containing 480 medicinal plants with regard to their synonyms, accepted botanical correlations, brief description of their properties and sloka references in Sanskrit will be a part of the portal www.indianmedicinalplants.in supported with plant images and easy access facilities.

Portal on Center of Excellence on Medicinal plants and Traditional knowledge

This facility is aimed at serving the diverse information needs of different user groups, including the students of modern and Indian systems of medicine, and 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 the published literature. The Beta version of the web site can be accessed at www.indianmedicinalplants.in/frlht





Screen shot of the Web portal

CE-P7: CONSERVATION AND SUSTAINABLE MANAGEMENT OF MEDICINAL PLANTS

This component is an addition to the CoE during the year 2012-13 and largely took shape in order to address the recommendations by the expert committee which reviewed the progress of CoE during February 2012. Trying to address the issues related to Population biology and Species Recovery research of medicinal plants, as flagged by the review committee, two priority subject fields were chosen for this component for the year 2012-13 as under.

Expanding Threat Assessment coverage in the country

FRHT, in a pioneering initiative of Threat assessment of medicinal plants by adopting IUCN threat categories has devised a threat assessment methodology called CAMP (Conservation Assessment and Management Prioritization) and by following this method, has conducted 17 such threat assessment exercises during 1995-2005 in 15 states of the country. As a result, threat status to 325 threatened medicinal plant species has been ascertained. The results have consequently triggered informed conservation action among the forest departments and formulation of different research initiatives to study the different aspects of such priority species.

However, the north eastern Indian states were not covered under this initiative as comprehensive as it was with other states. In order to fill this gap it was proposed to take up the CAMP exercises in select north Eastern states. Accordingly, during the year 2012-13 it was proposed to conduct the CAMP exercise in the state of Nagaland.

As a necessary preparatory step to carry out the CAMP exercise, the team engaged during the year 2012-13 in the literature search from different published and non-published sources. The literature search helped the team to gather comprehensive information related to medicinal plants of Nagaland, in respect of their distribution, population status, endemism, nature & extent of different threats, extent of conservation and other resource augmentation initiatives. The team also

prepared a priority list of threatened medicinal plants to be considered for the threat assessment.

Subsequently, the team identified the Mr. Lotha, Chief Conservator of Forests, Nagaland as the local host for facilitating and anchoring the exercise. A tentative list of ~40 subject experts was prepared who could be considered for participating in the CAMP Workshop. These included Academicians, Senior Forest Officers, Scientists & Conservationists, with sufficient field knowledge and expertise related to medicinal plants.

Though the threat assessment workshop was scheduled for the third week of March 2013, it was to be later postponed owing to the state Assembly elections 2013. The same will be taken up during the year 2013-14.

Ground truthing of species of high conservation concern

Ground truthing of the natural populations of medicinal plants is one way ascertaining their threat status and assigning conservation prioritization. Accordingly, during the year 2012-13 it was proposed to carry out the ground truthing for two species in Arunachal Pradesh: *Gymnocladus assamica* and *Illicium griffithii*.

During the year, necessary literature search was carried out for compiling the necessary information about these two species. Data on the natural distribution of the species was gathered and a plan for ground truthing was prepared.

Subsequently, a reconnaissance survey was taken up in West Kameng and Tawang districts of Arunachal Pradesh which helped ascertain the geographic location of the populations of these species and their threat perspectives.

Supplementary information was gathered from the Herbarium at Itanagar. Two nurseries (one at Dirang and the other at Bomdila) were visited to find out the



Dried fruits of *Illicium griffithii*



Well grown tree of *Gymnocladus assamica*



possibility of propagation and raising a stock of seedlings of the species. It was found that, the nursery located at Dirang was suitable for *Gymnocladus assamicus* while the nursery at Bomdila was suitable for *Illicium griffithii*.

Necessary information about the usage, collection and trade of the fruits of these two species was also gathered

during the visit. Additionally, necessary field observations were made in respect of regeneration of these species. Two field sites were tentatively identified at Rama camp for *Gymnocladus* and Bomdila for *Illicium*. Another site at Mandla was located for the experimental studies.



Flowering branch of *Illicium griffithii*



3. Component-wise Physical Achievements - A quick glance

CE - P1: PROJECT COORDINATION			
Sl. No	Title of Activity	Targets for 2012 -13	Achievements
1	Review of physical & financial project progress	2 six-monthly Steering Committee meetings	The Steering Committee meeting was held on 11 th January 2013 under the chairmanship of Shri Hem Pande, Additional Secretary, MoEF at FRLHT Bangalore.
		6 bi-monthly project review meetings	4 bi-monthly project review meetings held at FRLHT with the project staff.
		Timely audit of project accounts	(i)Project accounts for the year 2012-13 have been audited and Utilization Certificate submitted to the MoEF.
		Preparation of progress reports	Progress report up to Dec'12 has been prepared.
2	Writing of new proposals to strengthen CoE	Liaison with state forest departments to carry out trg programme with their fund support.	Liaison and discussions with senior officers of State Forest Department of Maharashtra resulted in organizing a trg program for frontline forestry staff as well as senior officials, with the funds provided by the forest departments.
3	Liaison with other organizations to further the objectives of CoE	With BSI and its regional centres for sharing of herbarium sheets	-We are in touch with BSI, for procurement/exchange of Herbarium sheets
		With AYUSH for sharing of information on medicinal plants in ISM	-A web enabled database on Indian medicinal plants (medicinal system wise) being developed for NMPB.



CE - P2: HERBARIUM OF MEDICINAL PLANTS USED IN ISM

Sl. No.	Title of Activity	Targets for 2012 -13	Achievements
1	Strengthening of Herbarium	Addition of 150 medicinal plant species to herbarium (=500 voucher specimens)	Surveys in Gujarat, Karnataka, Rajasthan, Sikkim, Tamil Nadu and Uttarakhand have resulted in addition of 1034 collection numbers. Based on the critical identification of the collected specimens so far 85 species are new addition to the herbarium.
		Addition of voucher specimens to cover the range of distribution and morphological variations of medicinal plant species (=1000 voucher specimens).	Eight Hundred voucher specimens, from different geographic regions, have been collected, processed and maintained.
2	Development of virtual herbarium	Addition of 2000 images of medicinal plants, their <i>officinale</i> parts & habitats	Added 2000 plant images from various botanical surveys undertaken.
		Addition of 5000 digitized herbarium sheets.	So far 1800 voucher specimens have been digitized during the current year .
3	Training programmes	Organize two training programmes in herbarium techniques	Completed two training programs for 1. Ramakrishna Ayurveda college, Bangalore. 2. Regional Centre for Development Cooperation (RCDC), Bhubaneswar, (NGO) from Orissa.
4	Strengthening of Raw Drug Repository	Bottling of samples into display bottles, labeling the bottles.	Two hundred dried and processed raw drug samples have been bottled, labeled and added to the repository.
		Computerization of Raw drug sample data into the data entry module.	Raw drug samples related data has been added to the computerized database in respect of 270 raw drug samples,
		Thematic arrangement of the medicinal plants repository for educational purposes.	Themes on Threatened medicinal plants and Plant exudates have been added.
		Addition of 250 Authentic raw drug samples (field collection from properly identified plant sources).	Added 152 authentic raw drug samples to the raw drug repository.
		Addition of 150 market samples.	- Added 129 market samples to the raw drug repository.



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

Sl. No.	Title of Activity	Targets for 2012 -13	Achievements
1	Strengthening of ethno-medicinal garden	Collection of propagules of 75 additional medicinal plant species.	Extensive field visits were undertaken to identify and collect propagules of such medicinal plant species which were not available in our live collection. As a result 52 species have been added.
		Establishment of 5 new themes in the EMG.	Two new themes have been added: 1. Resin and Gum yielding plants 2. Memory enhancer and anti-aging plants
		Strengthening & maintenance of thematic layouts established during the previous years.	This has been an on-going activity.
2	Design, preparation and affixing of educational signage	Preparation and fixing of educational signage (5 themes + 150 individual species).	Educational signage's have been prepared and installed in respect of 2 themes and 100 plant species.
3	Educational & Extension programmes	Organizing 10 EMG based awareness-cum-educational programmes on medicinal plants.	Eight programmes were conducted.
		Prioritize the contents & structure of educational material on nursery techniques.	Consultative meeting with the subject experts and stakeholder groups to prioritize the contents & structure of educational material on nursery techniques is planned for feb'13.



CE-P4: PHARMACOGNOSYSTUDIES STUDIES

Sl. No.	Title of Activity	Targets for 2012 -13	Achievements
1	Abhava Dravya	Comparative studies on collected accessions of <i>A. heterophyllum</i> & <i>C. rotundus</i>	<p>One accession each of <i>C. scariosus</i> and <i>C. spiralis</i> was obtained this year and following studies were undertaken:</p> <ul style="list-style-type: none"> - <u>Microscopy</u> No distinguishing character was observed with microscopic analysis - Histochemistry indicates presence of Alkaloids and Terpenoids in <i>C. rotundus</i>, <i>C. scariosus</i>, <i>Cryptocoryne spiralis</i> while only alkaloids were detected in <i>A. heterophyllum</i>. - <u>Chemistry</u> The results show that the two species have some peaks in common. - HPTLC studies do not show common bands - LCMS studies of peaks having same retention times in HPLC were found to be different on analysis of their MS data. - <u>Molecular Studies</u> Species specific markers were designed and have been validated with <i>A. heterophyllum</i>, <i>C. rotundus</i> and <i>C. spiralis</i>. - Complete ITS regions of three accessions of <i>C. scariosus</i> were amplified and sequenced. - <u>Publications</u> Manuscript under review with Journal of Alternative and Complementary Medicine. - Draft manuscript on review is under internal review.
2	Book on Molecular markers for Indian Medicinal Plants	1.Publication of book on Vidanga	Monograph has been compiled and is in the process of being edited, Peer review, Layout and publication still to be done.
		2. Draft of book on "DNA markers for Controversial Plant Drugs"	Book outline has been prepared. Chapters under internal peer review.
3	Brainstorming workshop		Post Steering Committee approval of 2012 -13 budget on 11.01.2013. We will plan to conduct it before end of March 2013.



CE-P5: DISTRIBUTION MAPPING USING GIS & MAPPING BACKWARD LINKAGES FOR TRADED SPECIES

Sl. No	Title of Activity	Targets for 2012 -13	Achievements
1	Generation of geographical distribution maps and Eco-distribution maps for prioritized wild medicinal plants using GIS.	Generate geo-distribution maps for 250 prioritized species.	Shortlisted 250 prioritized medicinal plants and undertook extensive literature survey to compile data upto district level on presence of each of these. Datasheets have been prepared for 180 species (Country, State and District level). Geo-distribution maps have been generated for 150.
2		Generate Eco-distribution maps for 25 prioritized species.	Shortlisted species of conservation concern /endemics/narrow endemics/ threatened/ Documentation - Detailed literature survey followed by preparation of datasheets completed for 25 species. Tabulation – Each species occurrence data in terms of locations are tabulated for 20 species. Map Generation - Draft maps prepared for 13 species..
3		Maps depicting backward linkages with regions of occurrence for selected high priority botanicals in trade.	As per the current taxonomic understanding five species of the genus <i>Cycas</i> occur wild in India. These species are <i>Cycas. circinalis</i> , <i>C. pectinata</i> , <i>C. beddomei</i> , <i>C. northotsii</i> and <i>C. sphaerica</i> . For developing map/s depicting identified regions of occurrence and possible sources of supply data relating to specific sites of presence (herbarium and field records) has been compiled and converted into precise lat -long coordinators
4		Revised and updated Atlas (on CD) incorporating the consolidated database on Geo-distribution of >2200 wild medicinal plant species and Eco-distribution maps of >220 species of conservation concern.	The Revised atlas has been programmed and converted from the previous version in Visual Basic to the DotNet framework, with user friendly facilities. This output is expected to be completed by mid - March 2013.



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

Sl. No.	Title of Activity	Targets for 2012 -13	Achievements
1.	Develop a ToT Module on Threat assessment of medicinal plants based on IUCN Red List categories and criteria.	Develop and design the ToT module and conduct simulated workshop	<ul style="list-style-type: none"> Preliminary interactions with the Institutes associated with the implementation of the "Long term strategy for monitoring the conservation status of medicinal plants" from 3 project states (Arunachal Pradesh, Chhattisgarh and Uttarakhand) held at Bangalore. Field visit to Uttarakhand was taken up during 27 -28th December 2012 and the learning needs assessment of the implementing team (GB Pant Institute, Almora) was carried out.
2.	Capacity building training & mentoring interventions on identification, conservation & management of medicinal plant resources.	Design and develop 2 capacity building training courses for the frontline staff of Maharashtra SFD	<ul style="list-style-type: none"> Need based Capacity building course on "Identification and management of wild medicinal plants resources of Maharashtra" was designed; Based on this module, 2 courses were conducted for frontline forestry staff and middle level officers of Maharashtra forest department at Chandrapur (31st October-3rd November 2012), and Pune (5-8th November 2012). Both the courses witnessed an overwhelming participation of 55 and 50 participants respectively. Maharashtra FD requested the CoE training team to design a "1 -day exposure on Medicinal plants" for their senior forest officers. Twenty five senior officers took part in this 1 -day exposure at FRLHT campus on 5th December 2012.
		Orientation and mentoring of context based learner groups from Karnataka Forest Department	<ul style="list-style-type: none"> The training team of CoE associated itself with different mentoring and training initiatives of the Karnataka Forest Department initiated by the Western Ghats Task Force, Govt of Karnataka. Eight training workshops received the mentorship inputs.
3.	Preparation of Annual Progress Report of the CoE project	Preparation and printing of Annual Report (bilingual) for the year 2011 -12	<ul style="list-style-type: none"> Annual progress report of CoE for the year 2011 -12 in its page design dummy form was prepared and kept ready for printing. Translation of the same into Hindi is also complete.
4.	Develop and provide inputs for high priority communication initiatives	<ul style="list-style-type: none"> Design and implement the International training on Conservation and Sustainable use of Medicinal Plants for the participants of CoP11 Provide contents for the Exhibition panels for CoP11 	<ul style="list-style-type: none"> The International training course was conducted for select participants of CoP 11 at FRLHT, Bangalore during 1-5th October 2012. The program witnessed an overwhelming participation of 25 participants drawn from Benin, Brazil, China, Egypt, Kenya and Sri Lanka along with an observer from UNDP, New York and participants from Research Institutes, NGOs and Forest department from across India. Technical contents in their basic form on 10 select themes were made available for developing exhibition panels for use in CoP11.



5.	Creation of database on Nighantus (lexicons of plants in ISM)	<ul style="list-style-type: none"> ▪ <u>To create a database of plants in <i>Dhanvantari Nighantu</i> (10th AD)</u> - Compilation and data entry - To add Sanskrit slokas on source drugs & To translate Sanskrit slokas into English - Design data structure and compile Ayurveda profile on source drug entity & botanical data on correlated species <u>Develop prototype of the CD on plants in <i>Dhanvantari Nighantu</i></u> 	<p><i>Dhanvantari nighantu</i> is the oldest available materia medica (10th AD) dealing with synonyms and properties of plant drugs documented after the period of classical texts in Ayurveda i.e. (1500 BCE - 600 AD). It comprises of 6 sections dealing with plant drugs and 4 sections dealing with non-plant entities like metals, minerals and animal origin.</p> <p><i>Activities pertaining to profiling of 300 plants with details like Sanskrit sloka, reference in the form Sanskrit scripts and its translated form into English have been carried out. Database structure has been created and data has been appropriately classified and entered under given parameters like main names, synonyms, types and 15 Dravyaguna parameters .</i></p>
6.	Web portal on plants in ISM	<p>a) Design domains for different user groups.</p> <p>b) Develop a common domain on master list of plant species used in ISM for common users.</p> <p>c) Develop a domain on Plants of ISM for ISM students</p> <p>d) Develop a domain on medicinal plants in Charaka samhita (1500 BCE-200 AD) for students</p>	<p>a) A tentative design of the portal has been designed by incorporating domain facility for different user groups like 1) Common user 2) Students of Ayurveda, Siddha, Unani 3) Medicinal plants Herbarium domain for botany students, 4) Domain on Traded plants for Industry etc.,</p> <p>b) A common domain has been created by providing master list of Botanical names of medicinal plants used in ISM with its synonyms. This domain will be expanded for common users including primary health care facility for general public.</p> <p>c) Domain for ISM students with details of 500 plants used in Ayurveda, Siddha, Unani and Folk has been provided.</p> <p>d) This domain has incorporated the master list with Sanskrit names along with its synonyms appearing in 12,000 citations. By incorporating its bibliography (Reference, Chapter, number and verse) with clinical details, this domain shows the depth of understanding on medicinal plants in classical texts of Ayurveda.</p>



CE-P7: CONSERVATION AND SUSTAINABLE MANAGEMENT OF MEDICINAL PLANTS

Sl. No.	Title of Activity	Targets for 2012 -13	Achievements
1	Expanding Threat Assessment coverage in the country	Organize CAMP workshop for Nagaland. Preparation of checklist of medicinal plant species along with their threat status (Nagaland).	<ul style="list-style-type: none"> Literature survey: Procured publications on the flora of Nagaland and consulted journals available at FRLHT for compiling a tentative list of species of high conservation concern for Nagaland. Identification of partner institute for facilitating threat assessment workshop: Organized a meeting with Mr T. Lotha IFS, CCF Nagaland to work out modalities of organizing the CAMP workshop in Nagaland during March 2013. Identification of experts : Tentative list of experts and field botanists, etc from the state and the region has been prepared who could participate in the workshop.
2	Ground truthing of select species of high conservation concern	Designing experiments, site selection, pooling information related to ecology and distribution of selected species.	<ul style="list-style-type: none"> Shortlisting of species for ground truthing. : Pooling of information on RET plants from Arunachal Pradesh where this study will be implemented is taken up and based on the data the sites will be selected. The two species Tentatively selected are <i>Gymnocladus assamicus</i>, <i>Illicium griffithii</i>, Collection and reviewing of secondary information: Literature consultation on ecology and resource management and methodology for the species have been started.
		Design experimental plots for selected species.	<ul style="list-style-type: none"> Identification of experimental sites based on available information and in consultation with other agencies: Consultations with SFD, research institutes and NGOs have been initiated. DFO Bomdila, DFO Shergaon, WWF, NERIST, SFRI



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.
- Forest Departments of Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Maharashtra, Meghalaya, Nagaland, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and Andaman & Nicobar Islands for facilitating and 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.
- Dept of Ayush, Govt. of India, New Delhi.
- Dept. of science & Technology, Govt. of India, New Delhi.
- Western Ghats Task Force, Govt. of Karnataka, Bangalore.
- Karnataka Knowledge Commission, Govt. of Karnataka, Bangalore.
- Many other Individuals, Subject experts, and Research & Educational Institutions



5. PROJECT TEAM

Implementation of this multifaceted project was steered by the Advisor FRLHT with separate Program leaders for each of the project components. The team members of CoE project 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, Senior Program Officer
5. Sumathi R, Research Officer
6. K Haridasan, Jt. Director
7. N. M. Ganesh Babu, Research Officer
8. Padma Venkat, Director, FRLHT
9. Balasubramani S.P., Research Associate
10. Subrahmanya Kumar
11. Sathya Sangeetha, Research Officer
12. Vijay Barve, Sr. Program Officer
13. Sugandhi Raani, Data Entry Operator
14. Somashekhar B S, Assistant Director
15. Venugopal S. N, Assistant Director
16. Shilpa, Research Fellow



6. EXPENDITURE STATEMENT

UTILISATION CERTIFICATE 1st APRIL 2012 TO 31st March 2013

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. 9,24,211/- (Rupees Nine Lakhs Twenty Four Thousands Two Hundred and Eleven Only)
6. Amount received from Ministry of Environment and Forests No. date and date of sanction	Nil
7. Total amount that was available for expenditure incurred during the financial year 2012-13 inclusive of Interest	Rs. 9,62,598/- (Including Interest of Rs. 38,387/-)
8. Actual expenditure incurred during the financial year 2012-13	Rs. 1,09,85,162/- (Rupees One Crore Nine Lakhs Eighty Five Thousand One hundred and Sixty Two Only)
9. Unspent balance refunded if any (please give details of cheque no. date)	NIL
10. Balance amount/(spent in excess) available at the end of March 2013	(-) Rs. 1,00,22,564/- (Rupees One Crore Twenty Two Thousands Five Hundred and Sixty Four Only)
11. Amount allowed to be carried forward to the next financial year i.e., 2013-14.	(-) Rs. 1,00,22,564/- (Rupees One Crore Twenty Two Thousands Five Hundred and Sixty Four Only)

Certified that the expenditure of **Rs. 1,09,85,162/-** (Rupees One Crore Nine Lakhs Eighty Five Thousand One hundred and Sixty Two 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 Accountants
FRN:005160

Rani.N.R
Partner
M.NO:214318

Date: 29/04/2013

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

Director
Foundation for Revitalisation of
Local Health Tradition
74/2, Jarakabande Kaval, Post Attur
Via Yelahanka, Bangalore
Ph: 080-28568007, Fax: 080-28567926
Accepted Bank Countersigned



**COMPETENT AUTHORITY
MINISTRY OF ENVIRONMENT & FORESTS**

FOUNDATION FOR REVITALISATION OF LOCAL HEALTH TRADITIONS

Project: Centre of Excellence

Annexure to Utilisation Certification for the period 01-04-2012 to 31-03-2013

Activity wise expenditure as on 31-03-2013

Sl No.	Activity in Project mode	Budget 2012-13 (Since sanction letter is not received this budget is internally made by FRLHT)	Expenditure	Balance Budget
1	Project Co ordination	800,000	752,325	47,675
2	Herbarium of Medicinal Plants used in ISM	3,300,000	3,101,010	198,990
3	Establishment of Ethno-Medicinal Plants Demo Garden	2,110,000	1,939,868	170,132
4	Pharmacognosy Studies	2,250,000	1,763,655	486,345
5	Distribution Mapping of Medicinal Plants using in GIS	1,680,000	1,481,157	198,843
6	Outreach (Training & Educational Material of Plants of ISM)	1,730,000	1,587,145	142,855
7	Conservation and Sustainable Management of Medicinal Plants	1,310,000	360,002	949,998
	Total	13,180,000	10,985,162	2,194,838


Signature of Principal Investigator


Signature of Sr. Accounts Officer


Signature of Head of the Organisation

For G Anantha & Co.
Chartered Accounts
FRN:005160

Rani.N.R.
Partner
M.NO:214318



Place: Bangalore
Date: 29/04/2013

Director
Foundation for Revitalisation of
Local Health Tradition
74/2, Jarakabande Kaval, Post Attur
Via Yelahanka, Bangalore-560 106
Ph: 080-28568007, Fax: 080-28567926

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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