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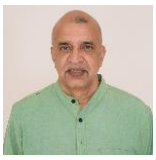

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Principal Secretary, Govt. of Karnataka- Member

Cdr. Giridharan R, Non-voting invitee

Prof. Ramaswamy - Permanent Special Invitee

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Basic inputs of progress & Photo credits

Centre Heads and members of respective centre

Report Released

2019

Vision:

Social transformation through innovation inspired by Ayurveda, Natural and Social Sciences and Technology

Mission:

Inspire minds of students and faculty to design, participate and execute innovative Trans-disciplinary socially impactful research, education and outreach programs in Integrative Health Sciences and other fields of knowledge.

Values:

Honesty, Excellence, Empathy and Dependability (HEED)

Goals:

Affordable, accessible and scalable solutions for unmet social needs

Original knowledge contributions arising from interface of Traditional Knowledge and Modern Science.

Major Achievements: 1993-2019

1993: Conceived and guided establishment of 110 Medicinal Plant Conservation Areas across 13 States, to create the largest in situ Conservation program in the tropical world.

1995: Established India's only Computerized Database & Herbarium of Med Plants of India.

1995-2012: Contributed to all National AYUSH Five Year Plans as Member of Steering Committees, in the Planning Commission, wrote chapter on TK for National Knowledge Commission, GoI.

1998: Established grass root network of folk healers across 9 States.

2000: Established Ayurveda-biology labs for bridging Shastra & Science.

2003-2019: Established thousands of herbal gardens across India

2008: Put cataloguing and digitization of medical manuscripts on National Agenda and Catalogued 17000 out of an estimated 100000 medical manuscripts.

2010: Launched the Journal of Ayurveda and Integrative Medicine (JAIM) which is today globally amongst the top five Journals in the integrative healthcare space.

2010-2019: Emerged as a major National Training Centre for Ethno Veterinary Practices (Pashu Ayurveda)

2011: Established a high quality 100-bed Ayurvedic Research hospital

2013: Established a State University for Trans-Disciplinary Health Sciences & Technology

2018: Established first Holistic Nutrition Research & Education program in the country

National and International awards

In 1998, FRLHT received the prestigious ***Norman Borlaug Award*** for its contributions to Conservation of Medicinal Plants.

In 2002 FRLHT was selected by the United Nations for the ***Equator Initiative Prize***, for linking conservation to livelihood needs.

Between 2002 & 2010, three Ministries of Govt. of India viz., Environment and Forest, Department of Science and Technology (DST) and Ministry of AYUSH, recognized FRLHT-TDU as a National Central of Excellence.

In November 2003, the Medical School in Columbia University, New York, awarded FRLHT with its first International award for cultural ***Leadership in Traditional Medicine***.

In 2011, the Govt. of India conferred ***Padma Shri*** to the Founder Director of FRLHT.

In 2018, the All Party Parliamentary Group, UK awarded ***Ayurveda Ratna*** to TDU.

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To develop a portal with geospatial capabilities, that serves the information requirements of the local population of HD Kote, as well as professionals such as ayurvedic practitioners, policy-makers, researchers, students, teachers, panchayats, asha workers, self-help groups etc.

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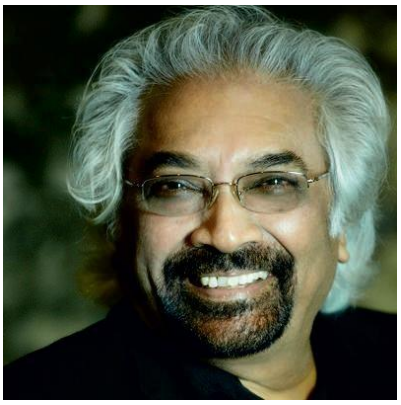
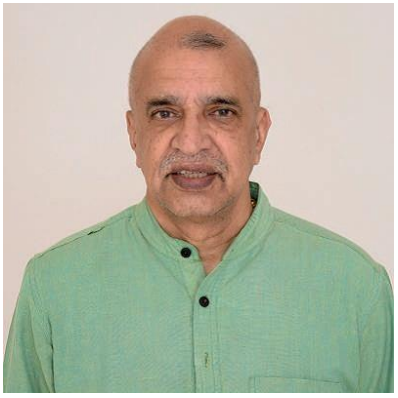



We have reason to be pleased with the performance of the FRLHT-TDU ecosystem during the year 2018-19. It has evidently been a productive year. We generated during the year Rs 35.23 cr largely through research grants, knowledge guided health services and interest income from corpus. This is an improvement of around 6 % over the previous year.

We share the pride of our creative colleagues when we note highlights of 2018-19. The Holistic Nutrition Program, supported by RIST Foundation, in the **Centre for Ayurveda-Biology**, is a milestone. It has built a new dimension in TDU building upon our earlier work. The Nutrition program integrates food chemistry, modern nutrition, and informatics, genomics and Ayurveda food pharmacology in order to design healthy food. The nutrition group has established 14 laboratories and pilot plants for creating socially impactful food products. The Ayurveda-biology Centre continues to build upon its pioneering work in metabolic disorders, neuro-biology, and medicinal plants substitutes. It has established a new group in metabolomics.

The **Ethno-Veterinary Training Program** for dairy farmers has impacted the country from Punjab to Kerala. It is amazing to see the efficacy of veterinary herbal formulations from the folk and codified traditions for management of conditions like mastitis, enteritis, FMD, repeat breeding.

The **Centre for Functional Genomics and Bio-Informatics** is an important addition into the TDU ecosystem for application of Next Generation Sequencing Technology to Ayurveda. It organized in 2018-19 series of training programs in Next Generation Sequencing Technology for 550 students, who were UG, PG and PhD scholars, post-docs, faculty from different universities and research institutes and industry. The Centre continues its research work on millets, rice and medicinal plants.

The **Traditional Knowledge, Data Science and Informatics Centre** has embarked on a frontier area of network pharmacology and has an ambitious vision of integrating this strategy with Ayurvedic pharmacology to develop a powerful platform for holistic drug discovery.

The **Clinical Research Centre** focused on research around clinical practice in the I-AIM hospital, is discovering original understanding of the mode of action of Ayurvedic interventions through its study on UTI, Parkinson's and CKD. It has established the country's first basic bio-marker lab in an Ayurveda hospital. The Centre has initiated work on wellness science and developed a tool to measure wellness score. The outreach program of this center for training therapists has been scaled up through support from BOSCH.

The **Centre for Local Health Traditions and Policy** has launched a path-breaking national scheme in collaboration with QCI for voluntary certification of traditional community healthcare providers based on ISO – 17024. The Center has certified around 600 village based healers in the states of Assam, Chhattisgarh, Gujarat, Karnataka, Madhya Pradesh, Odisha, Rajasthan, Tamil Nadu and Tripura.

The **Centre for Conservation for Natural Resources** is the country's leader in documentation, conservation, sustainable use of medicinal plants. In 2018-19 it pioneered with the support of the Government of Karnataka, Knowledge Commission and the Department of AYUSH, a Geo-spatial database and portal in a taluka to demonstrate a cost effective strategy to empower thousands of households in achieving self-reliance in primary healthcare using ecosystem specific plants.

The **I-AIM hospital** had footfalls of around 42,000 grateful customers for various health services related to NCDs in 2018-19. The HMIS system in the hospital is amongst the best in the country.

We note that the **Administrative** team headed by the Registrar is imbued with the right spirit of service to students and faculty.

Despite excellent research and knowledge service initiatives implemented by a very competent team, the FRLHT-TDU ecosystem has gaps. We need to enhance student enrollment in doctoral and master's by research programs and in diploma and certificate courses. The total number of students who received education in TDU in 2018-19 is 479. This is relatively a low number. We need to also raise corpus to around Rs 400 cr from its current level of Rs 50 cr.

The Board of Governors, the Academic Council and the Management Board have been very supportive. We are deeply grateful to our private sectors donors like the Tata's, Infosys, The Hans Foundation and several HNIs in India and abroad and to the State and Central Governments.

We expect TDU to keep on its merits and growing excellence.

Sam Pitroda — Chancellor

Darshan Shankar — Vice Chancellor

Centre for Conservation of Natural Resources

Centre for Conservation of Natural Resources (CCNR) is one of the core centers of TDU and was one of the building blocks of the organization. Its resources include a state-of-the-art National Herbarium and a Raw Drug Repository. Over the years, the center has been at the forefront in demonstrating the Medicinal Plants Conservation Program.

Over two decades, the CCNR team along with state forest departments and Community based organizations has taken a lead role in the world by demonstrating the Medicinal Plants Conservation Program through implementation of in-situ and ex-situ conservation projects in southern India.

Late Shri DK Ved – A Tribute

DK Ved has done seminal work by FRLHT-TDU platform (1993- 2018) on *in situ* conservation of medicinal botanicals of India. He was truly a gentleman, wise, cheerful and extremely approachable to everyone. Book titled 'Compendium of Traded Indian Medicinal Plants' written by D.K. Ved, K. Ravikumar, S. Noorunnisa Begum, J.R. Bhatt and G.S. Goraya was released by Honorable Prime Minister Shri Narendra Modi on World Environment Day, 5th June 2018.

His achievements outlined below will benefit the Indian Traditional Health sector for generations to come:

He was instrumental in creating India's only **Comprehensive database on 6580 medicinal plants** that offers invaluable information sourced from a wide range of ethno-botanical and ethno-medical literature. It provides accurate correlation of botanical names of these medicinal plants between their Sanskrit and vernacular names in 32 languages, while offering information on traditional properties and uses of plants (referenced from Sanskrit, Tamil, Pali, Urdu Medical texts from 1500BC-1900AD). It has reliable information on the geographical distribution of medicinal plants of India (sourced from floras and herbaria records) in addition to GIS maps for 300 threatened species that can aid conservation efforts. It also has over 15000 photographic images of medicinal botanicals.

The database has a module on medicinal botanicals in all India trade with accurate correlation between their trade and botanical names. A subset of this database pertaining to traded medicinal botanicals has now been adopted by the National Medicinal Plants Board (NMPB) Government of India.

He pioneered the application of IUCN's threat assessment criteria to assess the threat status of medicinal plants at State level, while developing a unique rapid assessment method called CAMP (Conservation Assessment and Management Prioritisation,) which he effectively used for assessing the threat status of >350 species of medicinal plants in 20 States of India. In the process, he trained dozens of field botanists in this assessment methodology.

He initiated **Species recovery** programs for 12 threatened species of medicinal plants.

He coordinated the creation of MPCAs (Medicinal Plants Conservation Areas) across 110 forest sites (each site with an average size of ~ 200 Ha) in 12 States of India, for conserving the wild gene pools of medicinal botanicals *in-situ,* which is perhaps the largest network of *in-situ* conservation sites in SE Asia.

He was honored with **Lifetime Achievement Award** by the National Medicinal Plants Board (NMPB), Government of India, for his invaluable contributions.

A plant from the family Eriocaulaceae has been named *Eriocaulon devendranii*. The specific epithet in the binomial nomenclature is in honour of Shri Devendra Kumar Ved for his passion for plants and contribution in conservation of medicinal plants.

Projects undertaken during the year 2018 – 19 and their highlights

1. **Under AYUSH, Government of Karnataka**.

A. To develop a geospatial database of HD Kote taluka that creates self-reliance in rural areas for managing primary health conditions.

B. To develop a portal with geospatial capabilities that serves the information requirements of the local population of HD Kote, as well as professionals such as ayurvedic practitioners, policy makers, researchers, students, teachers, panchayats, asha workers, self-help groups, etc.

1. To develop a geospatial database of HD Kote taluka that promotes self-reliance in rural areas for managing primary health conditions.

Relevance – This database is aimed at synergizing information between health conditions, medicinal plant resources and uses from Ayurveda, overlaid on a geographical map to eventually create a resource for the local population to find herbal, local solutions for primary health care management. When completed, this effort can be a model for any rural community that wishes to create self-reliance in primary health care management using locally grown plants.

Geospatial database development – This project relies on continuous coordination and communication between the GIS Team, project team members and collaborators KSRSAC (Karnataka State Remote Sensing Application Centre) and SVYM (Swami Vivekananda Youth Movement). Data was collected by four teams: (1) Health survey team covered 650 households from 30 villages, (2) Botanical survey team sampled 150 plots with GPS records and identified 499 plant species, (3) Ayurveda database team provided single drug remedies for 184 species, along with 179 shloka images and 378 plant images and (4) the GIS team performed a literature review of forest areas which indicated the presence of up to 900 plant species, which were then geo-referenced. Spatial data such as administrative boundaries, up to village level, was provided by KSRSAC. Selective portions of the database have been translated to Kannada in simple terms, in order to make it accessible by the rural population.

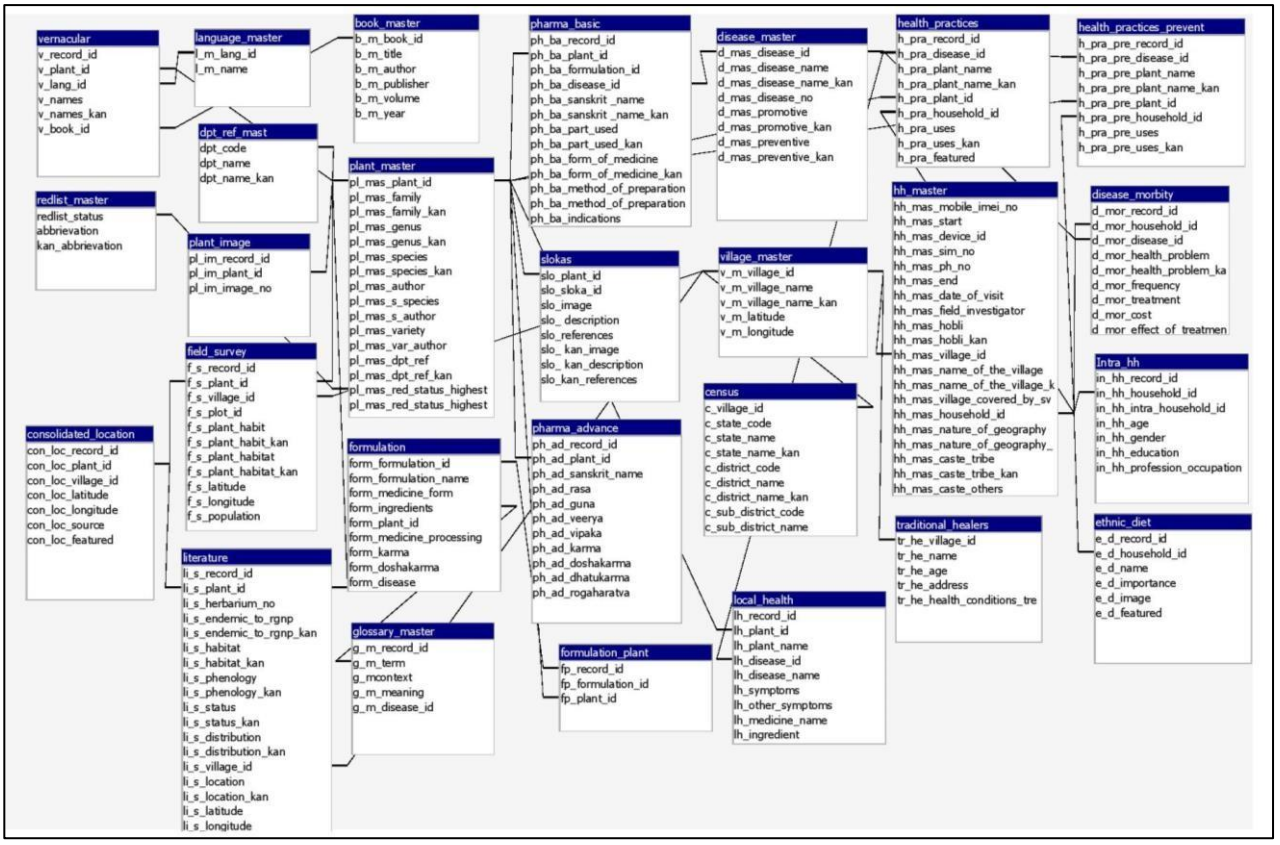
<u>Highlights of the outcome</u>

1. The database is complete and has been loaded into the Postgres Database in the TDU server.
2. Planning for the front-end for users i.e., web portals for KSRSAC and TDU are in the design phase. Technical flow diagram which depicts the structure of the database, tables, fields; the

relationships among the tables and the constraints / validations governing these tables have been discussed.

3. Software requirement System (SRS) document for the websites (Appendix 4) has been drawn up.

4. Geospatial database has been periodically updated.



Relationship diagram of the database

Team Members – Late D.K. Ved, Sathya Sangeetha, Bhagyalakshmi, Shiva Subramanya (Expert consultant), and Collaborators KSRSAC Team - Suresh B. V., A.S. Rajashekar.

2. **To develop a portal with geospatial capabilities, that serves the information requirements of end-users, people of HD Kote for managing the primary health care.**

Relevance – The portal with geospatial capabilities is visualized and designed to serve the information on medicinal plants as well as primary health care for the students, teachers, panchayats, asha workers, self-help groups, people of HD Kote and also ayurvedic practitioners, policy makers, researchers. The information on plants and health status will be queryable for the plants surrounding every village on spatial platform for education purpose and simple remedies for managing primary health care can be queried an downloaded as videos and documents.

The user interface design for the portal is involved with principles like minimal effort, consistent display format of information across information query interfaces and simpler and localized terminology for the

technical terms. The portal follows a Model-View -Controller (MVC) architecture with Visualization-Handlers-Backend Algorithm separated and optimized for performance and reliable responses. The portal incorporates geospatial features for added visualization and information query effectiveness. The portal is visualized to facilitate decision makers & people of HD Kote for healthcare and resource management. The above efforts have resulted in development of a geospatial portal with textual, pictorial, chart/graphs and dynamic map outputs.

Highlights

1. The tools / frameworks / technologies used for development of this portal include PostgreSQL as the backend database with Post-GIS as the spatial component store, PHP as the backend scripting tool, JavaScript/j query for user interface / visualization controls, HTML/CSS for front-end presentation, niche frameworks for geospatial functionality like Leaflet and Google Charts for graphical representation. The portal is hosted on an Ubuntu 16.04 LTS server with Apache2 HTTP server and Geo-server as the geospatial mapping engine for generation and rendition of maps.

2. All the dynamic data query modules have the ability to visualize the queried data in geographic context using web based geospatial frameworks. The map interfaces have been provided with standard zoom in/zoom out tools, zoom to full extent, distance measure, feature selection functions like marker and village boundary based data query, radial / buffer area query of data, density heat maps, zoom to selected features. The data queried through geospatial interfaces display medicinal plant resource details like botanical information, species images, shlokas associated with the species, single drug remedies related to the species, the field survey plot details village wise, literature references, usage details, trade information, red list status, village profiles, with location boundary and information, generic census information.

The KSRSAC portal - The Database design and content provided by TDU has undergone value addition process as per the KGIS standards and the task is completed. The land use land change (LULC) data preparation on 0.5m satellite image for HD Kote taluk is in progress. The application development to host the database in KGIS portal is in progress.

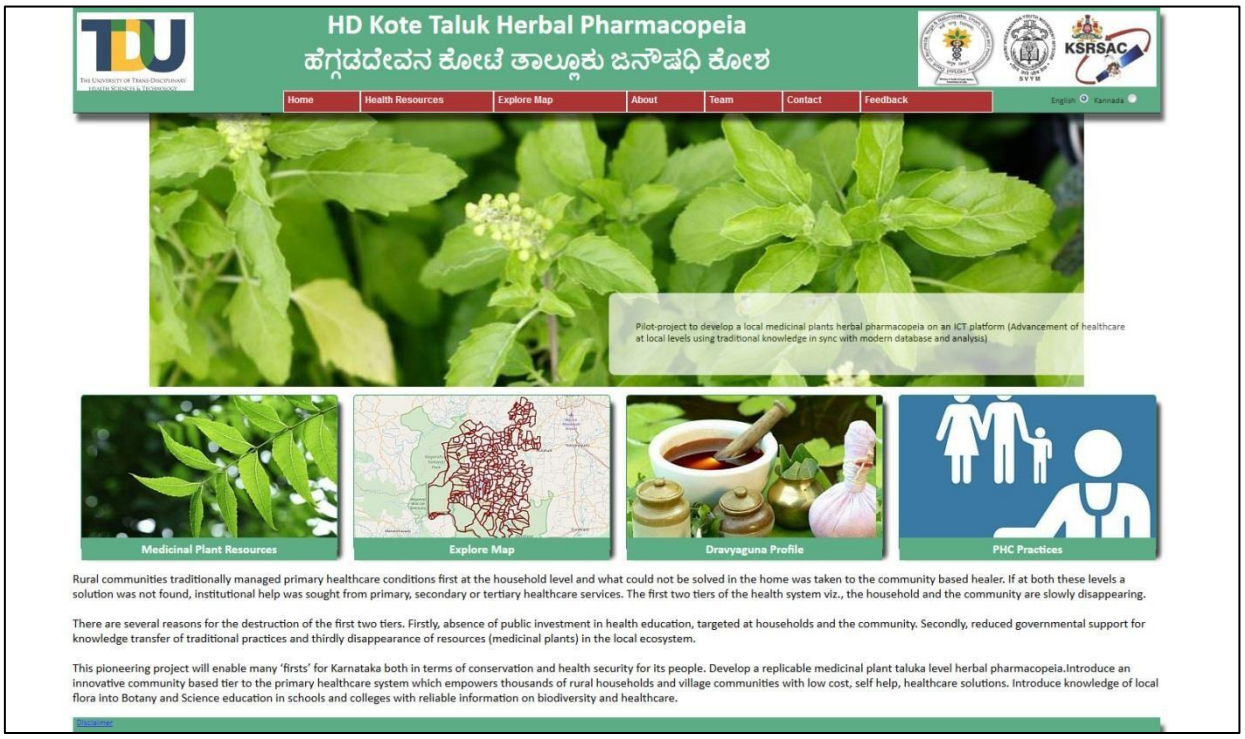
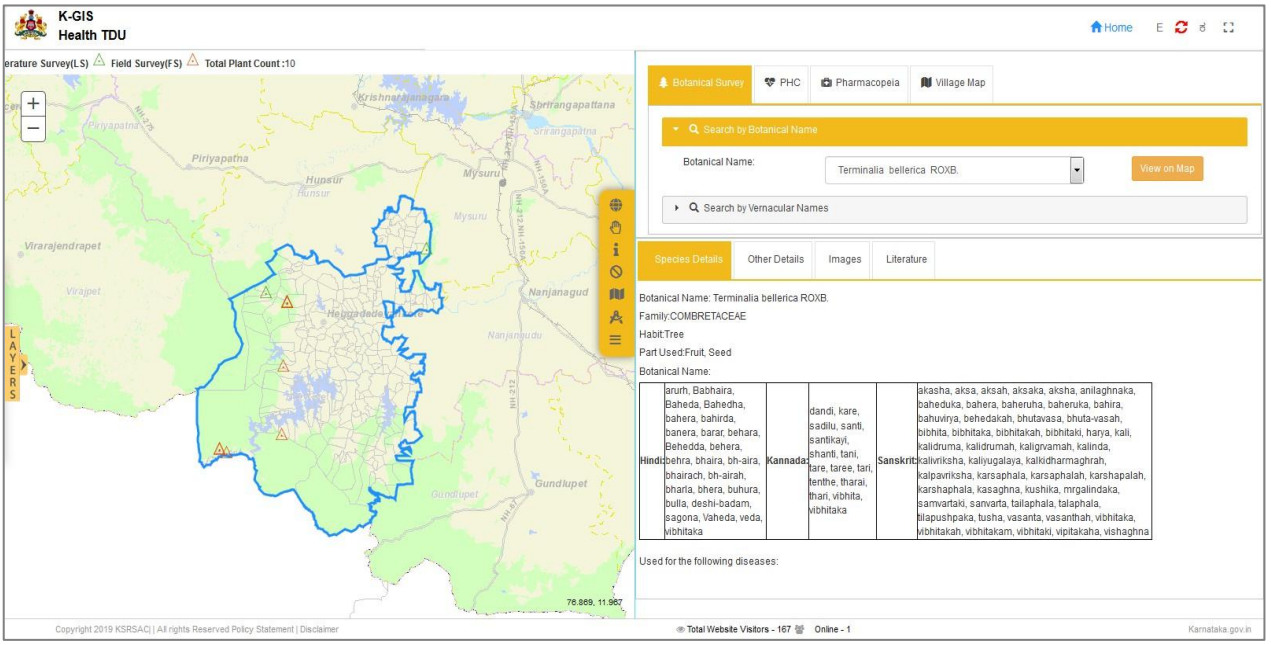
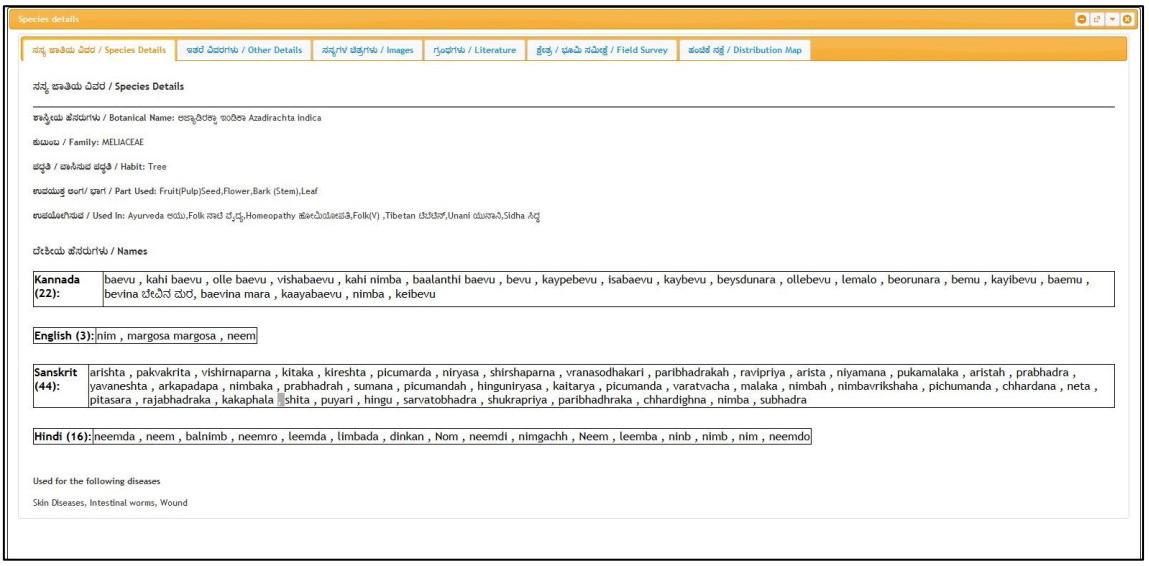


Image represents the Home page of the HDK website

Image Represents the Medicinal plant resources page in KGIS portal





Image

Represents the Medicinal plant resources page in HDK website

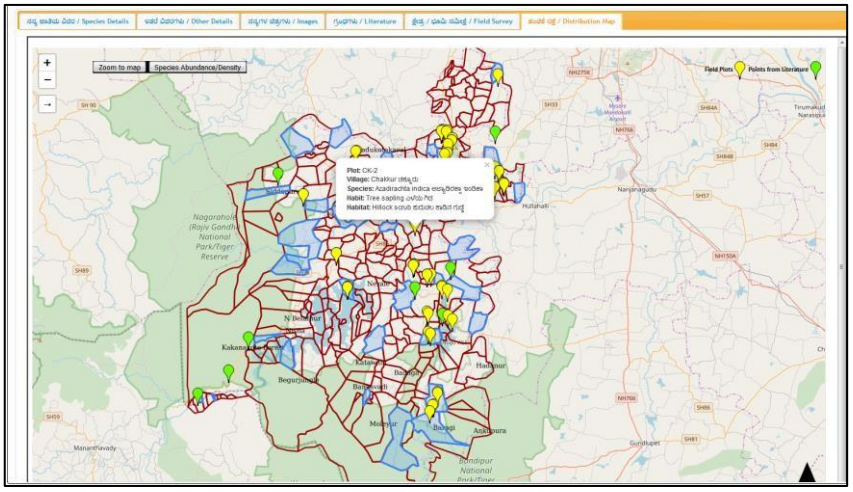


Image represents the distribution map of selected species in HDK website

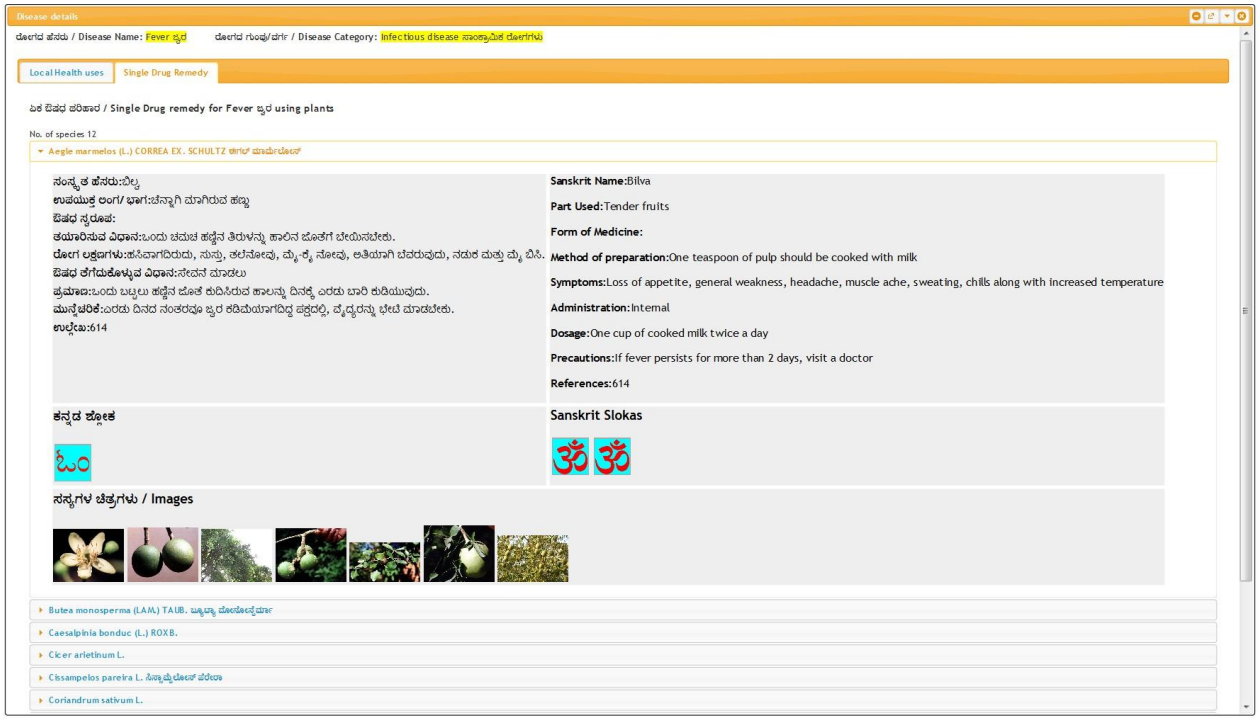


Image Represents the PHC practices page of the HDK website

Meeting with KSRSAC - TDU team for implementation of HD Kote Pharmacopeia Project

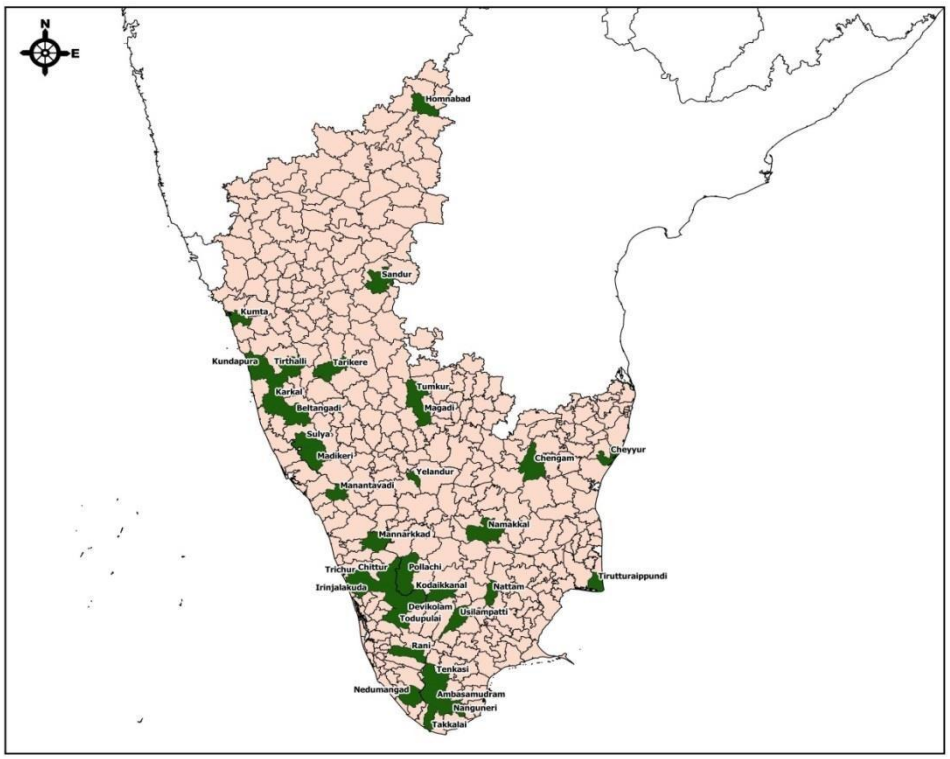
3. **Taluka level Geospatial database of Medicinal plant for 34 talukas across Karnataka, Kerala and Tamil Nadu.**

Relevance – A taluka level geospatial database with 2841 records across the three states was created as a sample, which can be queried using QGIS and PostgreSQL platform. This information was shared with experts developers of WebGis Portal Dr. Prabhakaran (Strand Life Sciences), to develop an interactive web portal useful to the Promotion of GIS enabled herbal pharmacopeia at the Talukas level for enhancing self-reliance in Primary Healthcare (PHC) of rural households, folk healers and schools

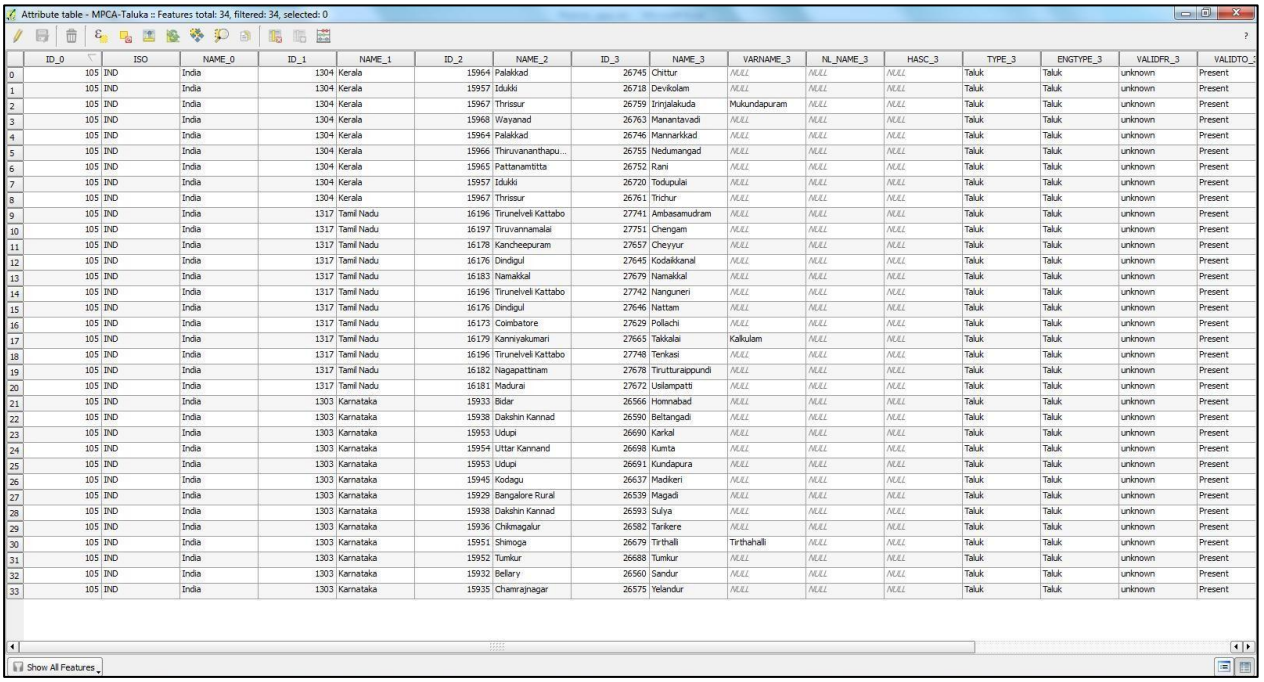
Highlights of the outcome

1. The outputs of geospatial format which can be included on any geospatial website or geo-server to visualize.

2. Distribution of each genus or species is queryable and a click on each species will represent the presence on a dynamic geospatial platform.



Demonstration of the model on Presence of Medicinal plants in 34 Talukas of Karnataka, Kerala & Tamil Nadu



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13	105	IND	India	1317	Tamil Nadu	16183	Namakkal	27679	Namakkal	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
14	105	IND	India	1317	Tamil Nadu	16196	Tirunelveli Kattabo	27742	Nanguneri	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
15	105	IND	India	1317	Tamil Nadu	16176	Dindigul	27646	Nattam	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
16	105	IND	India	1317	Tamil Nadu	16173	Coimbatore	27629	Pollachi	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
17	105	IND	India	1317	Tamil Nadu	16179	Kanniyakumari	27665	Takkalai	Kalkulam	NULL	NULL	Taluk	Taluk	unknown	Present
18	105	IND	India	1317	Tamil Nadu	16196	Tirunelveli Kattabo	27748	Tenkasi	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
19	105	IND	India	1317	Tamil Nadu	16182	Nagapattinam	27678	Tirutturaippundi	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
20	105	IND	India	1317	Tamil Nadu	16181	Madurai	27672	Usilampatti	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
21	105	IND	India	1303	Karnataka	15933	Bidar	26566	Homnabad	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
22	105	IND	India	1303	Karnataka	15938	Dakshin Kannad	26590	Beltangadi	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
23	105	IND	India	1303	Karnataka	15953	Udupi	26690	Karkal	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
24	105	IND	India	1303	Karnataka	15954	Uttar Kannand	26698	Kumta	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
25	105	IND	India	1303	Karnataka	15953	Udupi	26691	Kundapura	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
26	105	IND	India	1303	Karnataka	15945	Kodagu	26637	Madikeri	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
27	105	IND	India	1303	Karnataka	15929	Bangalore Rural	26539	Magadi	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
28	105	IND	India	1303	Karnataka	15938	Dakshin Kannad	26593	Sulya	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
29	105	IND	India	1303	Karnataka	15936	Chikmagalur	26582	Tarikere	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
30	105	IND	India	1303	Karnataka	15951	Shimoga	26679	Tirthalli	Tirthahalli	NULL	NULL	Taluk	Taluk	unknown	Present
31	105	IND	India	1303	Karnataka	15952	Tumkur	26688	Tumkur	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
32	105	IND	India	1303	Karnataka	15932	Bellary	26560	Sandur	NULL	NULL	NULL	Taluk	Taluk	unknown	Present
33	105	IND	India	1303	Karnataka	15935	Chamrajnagar	26575	Yelandur	NULL	NULL	NULL	Taluk	Taluk	unknown	Present

Show All Features

Image Represents the Attribute Table of 34 talukas of Karnataka, Kerala & Tamilnadu.

4. **Documentation of sustainable harvesting practices related to the wild tubers mainly "Makaliberu" by communities as medicine and nutrition.**

Relevance - As there is increasing modernization and means for people in the forests also to migrating their dependency on the forest resource is reducing likewise the traditional knowledge in their present lifestyle also is reducing .In the context of Savandurga forest an attempt is made to tap the evolving location specific traditional ecological knowledge of the tribal communities on forest resources, their values, usage, dependency attitude and practice which will give insights for better management and fins relevant solutions to conserve and sustain the medicinal plant resources in the area.

Highlights - The interview also tapped the harvesting practices of tubers with special focus to *Decalepis hamiltonian* tubers, its ecology, methods of harvest and conservation.

Study Area - The Savanadurga State Forest is situated in Bangalore rural district between latitudes 12.847° and 12.945°N, and longitudes 77.275° and 77.326°E, covering an area of 27 km^2. Average rainfall in Magadi taluk for the last decade is 806mm. The Savanadurga State Forest forms a part of the Deccan plateau and is covered by peninsular gneiss, granites, basic dykes and laterites. According to 2011 census, there are 49624 households in Magadi taluk with total population 203841 out of which 167122 is rural population.

Study area with 5 sampled villages

Methods – Semi structured questionnaires of five types (Focused Group Discussion, individual harvesters / collectors, sellers/traders, households & market survey) were designed, field tested, and wetted by experts in the field and TDU. Semi structured interviews and group conversations were conducted with local inhabitants, especially collectors, harvesters of **"makaliberu"** was conducted to gather information on medicinal uses of plant species from 35 informants including male, female respondents and traditional healers from five villages closer to Savandurga state forest (*Polohalli, Jodukatte village, Jodukatte colony, Guddahalli, Jenukalpaya & Dabgulli*). Data on age, gender, community, educational status and income of respondents were also gathered. Information regarding the medicinal plants and tubers collected from the forest for food and nutrition were documented. The interview also tapped the harvesting practices of tubers with special focus to *Decalepis hamiltonian* tubers, its ecology, methods of harvest and conservation.

5. Strategic initiatives for "Conservation of Medicinal Flora, associated with India's Medical Heritage

Relevance: To recognize, document and establish India's ownership of various medicinal plants, a national herbarium (~6500 botanicals) is necessary. This resource would also be useful in establishing quality standards in industries that use these plants and their products.

Highlights of progress/ achievements: About 1,845 voucher specimens corresponding to 615 plant species critically identified, labeled and digitized. These plant species were collected from West Bengal, Nagaland, Manipur and Tamil Nadu.

Team members involved: Prof. K. Ravikumar, Dr. N. Dhatchanamoorthy and Dr. S. Noorunnisa Begum

6. **Revisiting of 7 MPCAs established during 2007-2009 in West Bengal. 2017-2020 Conservation of RET Medicinal plants**

Relevance: MPCAs focus on *in situ* conservation of medicinal plant species of high conservation concern and to capture the diversity of medicinal plants in different forest types and geographical areas. They conservation of the gene pool of the plant species

Highlights of progress/ achievements:

i) Medicinal Plant species captured in three MPCAs, West Bengal

S.No.	MPCA	Forest type	Medicinal Plant Species collected
1	North Sevoke, Mahananda Wildlife Sanctuary, North Bengal	Tropical Moist Deciduous Forest	249
2	Sursuti, Gorumara National Park, North Bengal	Tropical Moist Deciduous Forest	290
3	North Rajabhatkhawa, Buxa Tiger Reserve, North Bengal	Tropical Moist Deciduous Forest	239

ii) Some of the rare and endemic medicinal plant species authenticated from North East India (West Bengal, MPCAs).

Sl. No	Botanical Name	Family	Habit
1.	*Achyranthes bidentata Blume*	Amaranthaceae	Herb
2.	*Agapetes hookeri* (C. B. Cl.) Sleum.	Ericaceae	Herb
3.	*Anemone howellii* Jeffrey & W. W. Smith	Ranunculaceae	Herb
4.	*Crawfurdia speciosa* Wall.	Gentinaceae	Climber
5.	*Dendrobium longicornu* Lindl.	Orchidaceae	Herb
6.	*Elsholtzia fruticosa* (D. Don) Rehder	Lamiaceae	Herb
7.	*Elsholtzia strobilifera* (Benth.) Benth.	Lamiaceae	Herb
8.	*Euonymus frigidus* Wall.	Celastraceae	Shrub
9.	*Gaultheria fragrantissima* Wall.	Ericaceae	Shrub

10.	*Gaultheria hookeri* C.B.Clarke	Ericaceae	Climber
11.	*Gaultheria nummularioides* D.Don	Ericaceae	Small shrub
12.	*Gentiana capitata Buch*.-Ham. ex D. Don	Gentinaceae	Herb
13.	*Hemiphragma heterophyllum* Wall.	Scrophulariaceae	Herb
14.	*Heracleum wallichii* DC.	Apiaceae	Herb
15.	*Hypericum hookerianum* Wight & Arn.	Hypericaceae	Shrub
16.	*Hypericum oblongifolium* Choisy	Hypericaceae	Shrub
17.	*Hypericum patulum* Thunb.	Hypericaceae	Shrub
18.	*Impatiens radiata* Hook. f	Balsaminaceae	Herb
19.	*Isachne sikkimensis* Bor	Poaceae	Herb
20.	*Leycesteria gracilis* (Kurz) Airy Shaw	Caprifoliaceae	Shrub
21.	*Liparis bootanensis* Griffith	Orchidaceae	Herb
22.	*Magnolia campbellii* Hook.f. & Thomson	Magnoliaceae	Tree
23.	*Mahonia acanthifolia* Wall. ex G. Don	Berberidaceae	Shrub
24.	*Parochetus communis* D.Don	Fabaceae	Herb
25.	*Persicaria wallichii* Greuter & Burdet	Polygonaceae	Herb
26.	*Pimpinella diversifolia* DC.	Apiaceae	Herb
27.	*Piptanthus nepalensis* (Hooker) Sweet	Fabaceae	Herb
28.	*Pleione praecox* (Sm.) D.Don	Orachidaceae	Herb
29.	*Pratia montana* (Reinw. ex Blume) Hassk.	Campanulaceae	Herb
30.	*Rhododendron griffithianum* Wight	Ericaceae	Tree
31.	*Rubus paniculatus* Smith	Rosaceae	Climber
32.	*Rubus rosifolius* Sm.	Rosaceae	Herb
33.	*Smilax munita* S.C.Chen	Smilacaceae	Shrub
34.	*Smilax myrtillus* A.DC.	Smilacaceae	Climber
35.	*Stellaria sikkimensis* Hook. f.	Caryophyllaceae	Herb
36.	*Swertia chirata Buch*.-Ham. ex Wall.	Gentinaceae	Herb

37.	*Symplocos glomerata* King ex C. B. Clarke	Symplocaceae	Tree
38.	*Symplocos lucida* (Thunb.) Zuccarini	Symplocaceae	Tree
39.	*Taxus wallichiana* Zucc.	Taxaceae	Tree
40.	*Tsuga dumosa* (D. Don) Eichler	Pinaceae	Tree
41.	*Valeriana hardwickii* Wall.	Valerinaceae	Herb
42.	*Zanthoxylum oxyphyllum* Edgeworth	Rutaceae	Straggling shrub

*Rarity is provided based on the field survey

Team members involved Prof. K. Ravikumar, Dr. N. Dhatchanamoorthy, Dr. Debabrata Saha and Dr. S. Noorunnisa Begum

Deciduous & Temperate forest, Tonglu MPCA, West Bengal

***Elsholtzia fruticosa* (D. Don) Rehder**

Evergreen forest, Manipur

***Pleione praecox* (Sm.) D.Don**

7: Study on development and bottlenecks in production of galls.

Relevance:

Pistacia integerrima belongs to family Anacardiaceae, it is a dioecious tree and is native to Asia. In India, it is called by different names such as kakroi, kakring, kakra, kakkar, kakar singhi, kakarsinghi. ***Pistacia chinensis* subsp. *Integerrima*** is well known for formation of galls on leaves and petioles. Galls are one of the ingredients of Chyavanparash.

Highlights:

- Market studies done in Chennai, Bengaluru, Thrissur, Mumbai, Delhi, Chhattisgarh, West Bengal to assess the substitutes and adulterants of Karkatashringi.
- *Baizongia pistaceae* inducing horn shaped galls on *Pistacia integerrima* had been reported from the study area.
- In *Baizongia pistaceae*, lifecycle takes two year to complete.
- Majority of the galls have been observed on the end of fresh shoots of the tree.
- It has been observed that the aphid first settle on small, inside the apical buds of the elongated shoots and causes the shoot to bend

Team members involved: Dr. S. Noorunnisa Begum, Mr. R. Patturaj, Dr. Malale Gowda and Dr. N. Pavithra

Advisors: Prof. K. Ravikumar, TDU; *Gurinder Singh Goraya IFS* (Retd), Mr. Amit Bhat, Jivanti Dabur Pvt. Ltd. Uttarakhand and Dr. Vineet Jishtu, Field Botanist, Conifer Forest Research Institute, Shimla.

8. Plant Wealth of Lalbagh Botanical Garden.

Relevance:

Lalbagh Botanical Gardens or Lalbagh is a botanical garden established in 1760 by Hyder Ali. Spread over 97-ha (240 acres) in Bengaluru, it is home to various forms of sub-tropical plants species and a popular recreational space. The central glass house made in 1890 is still used for several annual flower shows. The last plant survey, “Plant wealth of Lal-Bagh” was written by M. H. Mari Gowda and M. Krishnaswamy in 1968. As this historical garden is an important educational tool a project to was a provide checklist of the plant species of Lalbagh with updated nomenclature was proposed.

Highlights of progress/ achievements:

Completed survey in Lalbagh, identified plants, collected specimens and, processed these for scientific documentation. During this survey we found about 530 tree species, 320 herbs and shrubs. We are compiling information to bring out an illustrative book “Trees of Lalbagh”.

Publications/Research papers/ invited talks related to the activity during the year.

Lalbagh starts digitisation of its rich plant wealth
https://www.deccanherald.com/state/lalbagh-starts-digitisation-705314.html

Lalbagh to create digital record of its plant wealth
https://www.thehindu.com/news/cities/bangalore/lalbagh-to-create-digital-record-of-its-plant-wealth/article25700446.ece

Red alert in Bengaluru's Lalbagh: Many trees 'missing'
https://bangaloremirror.indiatimes.com/bangalore/cover-story/red-alert-in-bengalurus-lalbagh-many-trees-missing/articleshow/69817334.cms

Team members involved: Dr. K. Ravikumar, Dr. S. Gokul, Dr. N. Dhatchanamoorthy and Dr. Noorunnisa Begum

Book Published:

The Prime Minister, Shri Narendra Modi released "Compendium of Traded Indian Medicinal Plants on the occasion of World Environment Day, in New Delhi on June 05, 2018.

Scientific Papers published:

1. Seethapathy Gopalakrishnan Saroja, Kaliyamoorthy Ravikumar, Berit Smestad Paulsen, Hugo J. de Boer and Helle Wangensteen. Ethnobotany of dioecious species: Traditional knowledge on dioecious plants in India. *J. Ethnopharmacology* 221: 56 - 64. 2018.

2. K. Ravikumar, A. C. Tangavelou, N. Dhatchanamoorthy and Syed Noorunnisa Begum. Ethno-medico botany of Malayali tribes in Sittilingi hills, Harur taluk, Dharmapuri district, Tamil Nadu. *My Forest* March. 2018.

3. Umeshkumar L. Tiwari and K. Ravikumar. Floristic Diversity, Vegetation Analysis and Threat Status of Plants in Various Forest Types in Dharmapuri Forest Division, Tamilnadu, Southern India. *Not. Sci. Biol.* 10(2): 297-304. 2018. DOI: 10.25835/nsb10210158.

4. K. Ravikumar, N. Dhatchanamoorthy, A. C. Tangavelou, T. S. Suma and S. Noorunnisa Begum. New additions to the Angiospermic flora of Nagaland, India. *Pleione* Vol. 12 (1):118-127. 2018.

5. N. Dhatchanamoorthy, K. Ravikumar and Kreni Lokho. Additions to the flora of Manipur state, North-Eastern India. *Pleione* Vol. 12 (1):132-143. 2018.

6. N. Dhatchanamoorthy, K. Ravikumar and S. Noorunnisa Begum. Notes on new distribution of two Endemic species of Southern India. ISSN: 0972-4206. *Phytotaxonomy* Vol. 17, pp 55-57. 2018.

7. N.M. Ganesh Babu, K. Ravikumar and N. Rama Rao. New plant records for southern India from the District of Chitradurga in Karnataka. *Phytotaxonomy*. Vol. 17. 2018.

Chapters in Book

1. S. Noorunnisa Begum, **K. Ravikumar** and D.K. Ved. **Ethnobotanicals of Western Ghats** in Ethnobotany of India. Vol. 2. Western Ghats and West Coast of Peninsular India. Pullaiah, T., K.V. Krishnamurthy and Bir Bahadur (eds.) 2017. Apple Academic Press, Oakville, Canada and Waretown, NJ. ISBN 978-1-77188-404-4. 2017.

2. D. K. Ved, S. Noorunnisa Begum and **K. Ravikumar. Trade in Indian Medicinal Plants** in Ethnobotany of India. Vol. 5. The Indo-Gangetic Region and Central India. Pullaiah, T., K.V.

Krishnamurthy and Bir Bahadur (eds.) 2017. Apple Academic Press, Oakville, Canada, and Waretown, NJ. ISBN 978-1-77188-599-7. 2017.

Talks delivered:

Dr. S. Noorunnisa Begum, delivered a talk on Importance of Taxonomy at **Al-Ameen Arts, Science and Commerce College, Bangalore on** 27th February 2019 on eve of National Science Day.

Dr. S. Noorunnisa Begum, delivered a talk on Taxonomy and application at Goodwill Christian College for Women, Bengaluru**, on** 27th February 2019 on eve of National Science Day.

Dr. S. Noorunnisa Begum, delivered talk on 14th March 2019 on Traded medicinal plants of the country at Govt. First grade college, M.G. Road, Chickballapur on the occasion of National Science day.

Workshops conducted:

Dr. S. Noorunnisa Begum with Dr. M. Sanjappa conducted Two-day lecture workshop titled Plant Systematics – Concept and Applications under the auspices of Science Academies' Education Programme was held on 11th and 12th of October 2018.

Training programs:

Two days training program on Identification of medicinal plants and raw drug and herbarium techniques for BAMS students of Govt. Ayurveda Medical College Bangalore on 5th and 6th July 2018; Government Ayurveda College Bengaluru on 25 to 27 February 2019; Atreya college of Ayurveda on 10th and 11th December 2019; Atreya Ayurvedic Medical College, Bangalore and SDM College on 28th & 29th Jan 2019,

Herbarium team anchored six day training cum field visit for Degree students from Gurunanak College, Chennai (1st to 6th September 2018).

Orientation program on Medicinal Plants – Identification and Herbarium technique was conducted for 2nd year BAMS students of SDM College 28 and 29 January 2019.

One day Orientation on advanced research in Plant Taxonomy for teachers was conducted on 12th February 2019.

Inter Centre Program:

Three days Training on identification of commonly used medicinal plants and their utilization (10th to 12th January 2019) was jointly organized by Centre of Conservation of Medicinal Resources Centre for Functional Genomics & Bio-informatics and Center for Holistic Nutrition and Ayurveda Biology, TDU, Bengaluru

Other activities:

The herbarium team took Anatomy sessions for the School training program titled "Knowing the Unknown".

9. Knowing the Unknown

Relevance of the Project: Unless students locate their individual stand points in relation to the concepts represented in textbooks and relate this knowledge to their environment, knowledge is reduced to the level of mere information. To bridge this gap, TDU initiated a “Nature appreciation program” for the students of higher secondary schools. This program helps children to understand and appreciate our natural resources, and learn how to conserve those resources for future generations through hands on experience, observation, experimentation and outdoor learning.

Highlights of Progress/Achievements:

260 students in total, from schools in Bangalore, participated in one day programs held between June 2018 and March 2019. The general perception among students was that only a few plants are medicinal. Thus, our program which shares that most of the plants have medicinal value was surprising to them. The practical sessions on anatomy were useful particularly for those wishing to pursue a career in the life sciences. The program also included a basic understanding of medicinal plants for primary health care.

Publications: Reports on School program

Team Members Involved: Dr. Abdul Kareem and Ms. Amrita. G

10 Teachers Training Program

Relevance of the Project: TDU has developed a unique one day program on Plant Morphology, Primary Health Care, Biodiversity Conservation and Innovative Teaching techniques for the teachers of KKEHS School, BEET School and various other schools of Bangalore.

Highlights of Progress/Achievements: Around 60 teachers have participated during the month of June 2018- Feb 2019.

Publications: Reports on Teacher’s Training program

Team Members Involved: Dr. Abdul Kareem and Ms. Amrita. G

11. One day Orientation program on Plant Morphology, Plant Anatomy, Primary Health Care and Biodiversity Conservation for the students of Government School.

Relevance of the Project: The Transdisciplinary University **(**TDU) with the support of Infosys Foundation has developed a unique one-day orientation program for the students pursuing their secondary education, to give them an opportunity to learn the basics of plant taxonomy, anatomy, primary health care and biodiversity conservation.

Highlights of Progress/Achievements: Around 467 students participated in one day program conducted for the students of 8 Government School, during the month of Nov 2018-Feb 2019. Students could relate to the environment and learn the basics of plant morphology, hands on experience in anatomy, primary health care and fun activity on biodiversity conservation. Students were very enthusiastic to learn and interactive in the respective sessions delivered to them.

Publications: Reports on School program

Team Members Involved: Dr. Abdul Kareem and Ms. Amrita. G

12. Preparing model people biodiversity register for 10 divisions of Manipur state

Relevance of the Project: National Biodiversity Authority (NBA) has been working in close collaboration with State Biodiversity Boards (SBBs), research/educational institutions, State Governments and civil society organizations such as Agriculture University, IBSD, Manipur University and Manipur Folk Healers Association, to provide technical support for the constitution of BMCs and preparation of PBRs. So far, 1122 People Biodiversity Registers (PBRs) are developed in India in 10 states with the participation of range of stake holders. Manipur Biodiversity Board has till now completed 10 PBRs with the help of selected BMCs in the state.

Highlights of Progress/Achievements: The proposed activities resulting in the submission of the model PBRs of 10 divisions will be completed in a period of 7 months with the active academic, administrative and financial support of Manipur Biodiversity Board. Project has started in December 2018 and still ongoing.

Publications: Reports on exposure visit

Team Members Involved: Dr. Abdul Kareem and Dr. Chetan H.C.

Publication:

Book on Conservation Assessment and Management Prioritization for the Medicinal Plants of Manipur

Summer camp for school students was published in ZOO print magazine

Activity on Biodiversity Conservation

Garden visit

Students' involvement in herbal preparation (Golden milk)

Students observing cells and tissues of Monocot and Dicot plant

13. Ecozone: For Toyota Kirloskar Motors, Bidadi

1. Created demonstration plots for forest types of South India

a. Tropical thorn Forest

b. Dry deciduous Forests

c. Moist deciduous Forests

d. Semi-evergreen Forests

e. Evergreen Forests

2. Established thematic gardens; Sacred groove, plants used in craft and toy making, organic farming, Bambusetum etc. Established a nursery, revised species list in Miyawaki plantation and planted saplings. Provided plants for ceremonial mass plantation for CSR projects.

14. Women Technology Park (WTP): Project funded by DST, Government of India

A holistic approach was taken to empower rural women through Women Technology Park project. The members of Self-Help Groups (SHG) and interested individuals are trained to take up various activities which are of no cost or low cost, to make best use of their available time and resources. By this, women can earn a descent amount of money to fulfill their basic economic needs. Women from 14 villages enjoyed the benefits from this project, which initially intended to address members from just 4 villages in north Bengaluru. Total number of participants who attended various programs is 944.

15. Other consultancy activities

Supplied plants for gardening for Kanha Shantivanam, Hyderabad.

National Academy for Customs Indirect Taxes and Narcotics (NACIN), Bengaluru: Landscaping and supplied saplings. Completed Phase II

Jakkur Lake plantation: Completed Phase II

Vermi composting units established

Two Medicinal plant nurseries established

Established additional nursery for tall tree saplings. 50,000 saplings capacity

Exclusive nursery for Orchids/ferns of 50,000/-

Developed propagation protocols for 5 plants

Training/ awareness programs; 100

Guest lectures conducted; 25.

Collaboration with other institutes; Government Ayurvedic College, Bengaluru; to conduct National Workshop on Drayaguna Prathinidhi, University of Horticulture, Bagalkot, Geometry Construction Company, Mangaluru.

Conducted classes for TDU; BSc student

Trained volunteers to work in garden and nursery

On Social Media**:** Indian Express -24 articles, FB posts- more than 200, TV 9 News telecast, Documentary film by NACIN

Rural Women trained under WTP project on nursery development

Pharmacists and doctors group visit to garden

16. Academic Programme

The Conservation degree course is offered by Centre for Conservation of Natural Resources, which has decades of institutional and research experience in conservation science, and offering it as a combination of traditional and modern sciences. It has been involved in various outreach programs for promoting community-based conservation and related policy areas. The Centre has launched Masters and Undergraduate programs since 2017. Currently, we have two batches of Masters and one batch of Undergraduate course ongoing.

UG & PG courses

Degree / Specialization/Academic years
MSc Life Sciences (Conservation Future)
MSc Life Sciences (Conservation Future by Research)
BSc Life Sciences (Conservation Sciences)

MSc Student visiting at Tamarind Grove Biodiversity Heritage Site near Nellore

PG and UG students visited Ramanagara Vulture Sanctuary, Ramanagara.

17. Development of a comprehensive database on folk level medicinal uses recorded in ethno-botanical publications; connect this with the local communities of India (Pilot phase). Supported by the Infosys Foundation.

Relevance (scientific/social) of the project: At present, there is inadequate effort being made to compile information from various published sources on ethno-botanical uses in the digital form at the national level. The present effort documents published information available on ethno-medicinal uses for both human and animal health care. This project is visualized to become a ready reckoner on ethno-medicinal uses at Taluka or District level, connecting diverse communities across India through link up with the 'People of India' project. The potential users of this information would encompass: National Biodiversity Authority employees, regulatory bodies, PBRs, patent office's etc. This information will also guide primary health care programs about locally available medicinal plants, their uses and traditional

knowledge at Taluka levels. It will also be a treasure-house of lakhs of vernacular names of plants along with their scientific names, thus establishing authenticity of the raw materials used in traditional formulations.

Highlights of progress/ achievements:

Digitization process of the folk medicinal uses from more than 50 ethnobotanical publications has been initiated. In this process, information for 2000 additional species will be appended, thus increasing the potential of the database for the future (earlier botanical entities = 2500; proposed growth of the database would be up to 4000 species). This project is presently supported under INFOSYS grant.

Publications/Research papers/ invited talks: A ethno-meduse module is being developed with user interface (Pilot phase)

Team members involved: Dr. Suma Tagadur, Mr. Vijay Srinivas, Dr. Venugopal SN

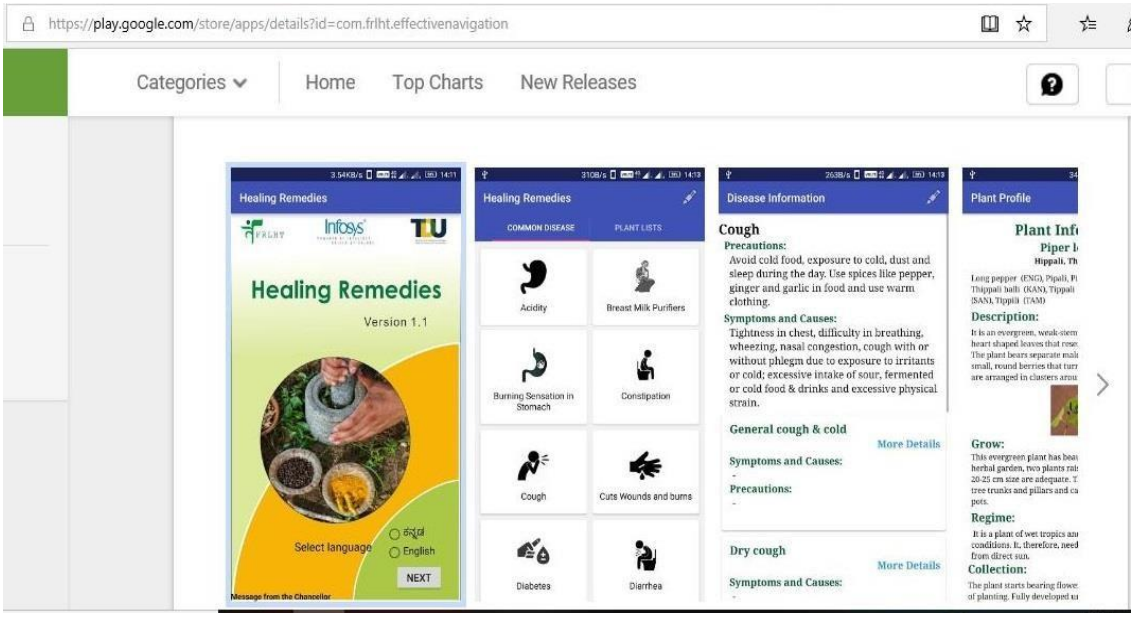
Project/program title: Home remedy website (Kannada and English version has been designed) and Healing Remedy and android App (multilingual version 1.1.) App. Supported by Infosys foundation.

Relevance (scientific/social) of the project: The contents in the site and app covers select aspects of Universal Health Coverage (WHO guidelines). Several themes such as Child Health, Old-Age care, Women's Health, Diabetic care, Skin care, Liver care, Mother and Child care, and Indigestion have been included. Number of visitors for the home remedy website is 1.82 lakh hits and mobile app more than +100 installation

P**ublications/Research papers/ invited talks**: Website: http://homeremedy.in/ and Mobile apps: https://play.google.com/store/apps/details?id=com.frlht.effectivenavigation

Team members involved: Dr. Suma Tagadur, Mr. Vijay Srinivas, Dr. Shilpa Naveen, Dr. Venugopal SN

Screen shot of home remedy website.



Screen shot from google play store on healing remedies app version 1.1 in Kannada and English languages.

K. Ravikumar, N. Dhatchanamoorthy, A. C. Tangavelou, T. S. Suma and S. Noorunnisa Begum. New Additions to the angiospermic flora of Nagaland, India. *Pleione* 12(1): 118 - 127. 2018.

18. **Sustainable Harvesting, Value Addition, Warehousing and Marketing of Selected RET and High Traded Medicinal Plant Species Covering 22** Joint Forest Management committees (**JFMCs) in 18 Forest Divisions of Karnataka, India.** Funded by National Medicinal Plants Board (NMPB), Govt. of India through Karnataka Forest Department.

Relevance: This project promotes 'Good Collection Practices' for 19 species collected from wild such as: development of species specific sustainable harvesting, post harvesting techniques such as storage and value addition, and market linkage of sustainably collected products. The main goal of this project is to supply quality raw drugs/semi processed products directly to herbal industries by establishing alternative value chain through community based organizations such as Joint Forest Management Committee (JFMCs), Eco development committee, Forest Development Agency and self-help groups. To ensure quality raw materials, infrastructure facilities such as storage warehouses, drying yard and equipment were developed at 22 JFMCs in Karnataka under this project.

Highlights of Progress:

Coordinated the mid-term project review conducted by Ministry of AYUSH, Govt. of India, New Delhi.

Buyer-sellers interactive meeting was organized on 29th March 2019 in Bengaluru, which was attended by representatives from 17 herbal industries across Karnataka. By signing Memorandum of Understanding (MoU) with JFMCs, they are interested in buying sustainably harvested produces.

Organized market linkage to the sustainably collected fruits of *Terminalia chebula* (Myrobalan). It was sold at Rs.13/ kg as compared to the market value of Rs.9/ kg of fruits. This price appreciation was due to the adoption of good collection practices, including post harvesting techniques which yielded high quality of fruits.

Monitored sustainable harvesting of *Sapindu semarginatus* (Soap nut) in Honnasgadde JFMC in Shivamogga district, Karnataka. Organised marketing of soap nut with M/s Bubble Nut Wash, a herbal industry in Bengaluru. The market value of soap nut was Rs.8/kg, but M/s Bubble Nut Wash purchased the soap nut at Rs.25/kg, apart from bearing transportation charges. This has enabled the local community to adopt sustainable harvesting techniques.

Grading the *Terminalia chebula* fruits

Team Members Mr. Jagannatha Rao R., Ms. Rajashree G. Mavinkurve, Ms. Deepa G. B.

19. **Resource Augmentation of selected RET and High Traded Medicinal Plant species Covering 22 JFMCs in 18 Forest Divisions of Karnataka, India** funded by National Medicinal Plants Board (NMPB)through Karnataka Forest Department

Relevance: The group has provided technical support to Karnataka Forest Department for establishment of medicinal plants plantation including maintenance, soil-moisture conservation, awareness programmes, micro-planning, fencing, monitoring and evaluation, and entry point activities to conserve selected species through Artificial Regeneration (AR) and Aided Natural Regeneration (ANR) models. This helps in conservation and restoration of gene pool of selected medicinal plants and also ensures supply of authentic raw material to AYUSH industries in the future.

Highlights of Progress:

Facilitated Karnataka Forest Department to maintain the plantation raised under two models such as AR and ANR.

Coordinated the midterm evaluation of the project by Ministry of AYUSH, Govt. of India.

Team Members: Mr. Jagannatha Rao R, Ms. Rajashree G. Mavinkurve, Ms. Deepa G. B.

20. **Generation of Livelihood Opportunities for the Local Communities in Savanadurga by Sustainably Utilizing the Natural Resources.** Funded by National Medicinal Plants Board (NMPB) through Karnataka Forest Department

Relevance: The project attempted to provide livelihood options using medicinal plants for 4 fringe villages of Savanadurga Medicinal Plants Conservation Area (MPCA), Ramanagara Forest Division, Karnataka. The main purpose of this project is to involve the local community in long term conservation of Medicinal Plants Conservation Area (MPCA) by providing alternative livelihood programmes. The 4 villages selected were Dabbaguli, K.V. Matha, NayakanaPalya and Polohalli.

Highlights of the progress:

Coordinated the mid-term project review conducted by Ministry of AYUSH, Govt. of India, New Delhi.

Organized a meeting with Deputy Conservator of Forests, Ramanagara Forest Division and Aditi Organic Certification Pvt. Ltd., to understand the process of organic certification of wild collection areas and produces. Compilation of documents for organic certification is under progress.

Team Members: Ms. Deepa GB and Mr. Jagannatha Rao R.

21. **Capacity building of MFP collectors of Chhattisgarh Minor Forest Produce Federation (CGMFPF) on good collection practices of nationalized and non-nationalized MFPs in Chhattisgarh.** Funded by Chhattisgarh Minor Forest Produce Federation Cooperative Limited, Raipur.

Relevance: The **Chhattisgarh State Minor Forest Produce Federation** has registered 915 primary cooperatives, whose primary members collect nationalized and non-nationalized Non-Timber Forest Produces (NTFPs) including medicinal plants. The main aim of this project is to train these primary collectors on sustainable harvesting of identified NTFPs so that the resource is available for the generations to come and the collectors earn better employment and livelihood.

Highlights of the progress:

Organised six training programs covering NTFP collectors from six forest divisions. A total of 360 collectors were trained on sustainable harvesting of NTFPs during 2018-19.

A detailed report along with analysed feedback was prepared and submitted to the funding agency.

Demonstration of concept of sustainable harvesting through game

Team Members: Mr. Jagannatha Rao R. and Ms. Deepa G.B.

22. **Sustainable harvesting, value addition, warehousing and marketing of selected RET and high traded species in Peechi and Silent Valley Wildlife Divisions, Kerala,** funded by NMPB, New Delhi, through Kerala Forest and Wildlife department, Government of Kerala.

Relevance: This project aims to 'implement the good collection practices' for medicinal plants especially conservation concern and high traded species collected from nine Eco-Development Committee (EDC) areas, through regular training and capacity building activities targeting the local collectors. Besides, in this project, collectors are provided support to perform value additions locally, and are also given market linkage to trade their collections for a good price. In this project, TDU offers technical support to implementing agency i.e. Kerala Forests and Wildlife Department.

Highlights of the progress:

Coordinated the mid-term project review conducted by NMPB, New Delhi.

Conducted field motivation programmes to implement sustainable wild collection practices prior to collection season at EDCs

Held consultative meetings with forest department and herbal industries who had already signed a MoU with FDA on marketing the sustainably collected plant produces

Prepared and submitted the progress report to forest department

Field demonstration of implementing good field collection practices

Team members: Mr. Jagannatha Rao R., Dr. Arthur Selwyn Mark and Mr. A.K. Pramod, Field Coordinator, Kerala

Invited talk: Invited talk by Jagannatha Rao R, Arthur Selwyn Mark and A.K. Pramod on Sustainable harvesting, value addition and marketing of wild medicinal plants: designing participatory methods and

the process of field implementation – case study from Silent Valley and Peechi Wildlife Divisions in Kerala, during one-week training programmes organized at KSCSTE-KFRI on 'Conservation and Development of Medicinal Plants and Benefit Sharing with Local Communities' for the senior officers of the Indian Forest Service during 22-26 October, 2018

23. **Development of sustainable harvesting methodologies for selected medicinal plant species in Medicinal Plants Conservation Areas (MPCAs), Chhattisgarh**. Funded by Chhattisgarh Medicinal Plants Board, Raipur

Relevance: In Chhattisgarh, tribes depend on medicinal plants for their livelihood. Chhattisgarh Medicinal Plants Board has established 21 MPCAs in the state. To conserve medicinal plants and secure tribal livelihoods, creating awareness and training the tribes on sustainable harvesting techniques was undertaken in two MPCA sites viz., Keshkal and Katghora.

Highlights of the progress:

Undertook field work to identify the medicinal plant species that are highly traded, and whose populations are threatened in the wild.

Short listed and finalized the species for development of sustainable harvesting techniques.

Developed sustainable harvesting techniques for 13 species.

Organised a training program in Katghora MPCA on 14th and 15th March 2019, where 77 stakeholders, including collectors, folk healers, women self-help group members had attended.

A detailed report with feedback analyses was prepared and submitted to the funding agency.

Class room session during the training program

Team Members: Mr. Jagannatha Rao R. and Ms. Deepa G.B.

24. Development and standardization of semi-processing technology to enhance the quality and market value of selected medicinal plants in Peechi Wildlife Sanctuary and Silent Valley National Park, Kerala (NMPB-RCFC(SR)/STRP/03)

Relevance: This project is aimed to explore the opportunities for conducting field level semi-processing and value addition exercises for prioritized medicinal plant species, and also to develop and standardize semi-processing and packaging methods for prioritized medicinal plant species considering the industry requirements to improve the quality of herbal collections.

Highlights of progress:

Following were the achievements made in this project during the period (2018-19):

Prepared the action plan for the implementation of activities during the project period

Prioritised the medicinal plant species for the development of semi-processing techniques

Identified the study sites and EDCs for the implementation of field activities and also identified the herbal industries and industry representatives to have consultations to explore relevant and simple semi-processing practices.

Team Members: Mr. Jagannatha Rao R., Dr. Arthur Selwyn Mark and Mr. A.K. Pramod, Field Coordinator, Kerala

Publications:

Deepa G.B., Arthur Mark Selwyn and Jagannatha Rao R. 2018. "Sustainable harvesting of NTFPs and Medicinal Plants: A Participatory Process". In: Prospects in conservation of Medicinal Plants. Raghu AV., Amruth M., Md. Kunhi KV., Raveendran VP and Viswanath S. (eds.). KSCSTE-Kerala Forest Research Institute, Peechi. ISBN: 81-85041-99-7

Deepa G.B., Jagannatha Rao R., Suresh H.M., Arthur Mark Selwyn and Balakrishna Pisupati. 2018. "Principles and practices of sustainable use and sustainable harvesting". The University of Trans-Disciplinary Health Sciences and Technology (TDU), India and Forum for Law, Environment, Development and Governance (FLEDGE), India.

25. Environmental Education initiatives in Govt High Schools of H D Kote

Relevance: The Environmental Education initiatives are an important activity under H D Kote Taluk Pharmacopoeia project. The Science teachers and students of 8^{th}, 9^{th} and 10^{th} class from 35 Govt. schools of h D Kote are addressed in this activity. Four participatory learning modules, covering the important topics from H D Kote Pharmacopoeia project theme (such as Medicinal Plant diversity of H D Kote, Medicinal plants for Primary Healthcare and Local Health Traditions, Conservation of Medicinal Plants) are introduced, with the aim of exposing the students to the uniqueness of H D Kote medicinal plant diversity and supplementing the class room science learning with field activities -outdoor learning.

The Environmental Education (EE) team of the HD Kote project team at TDU successfully completed the following activities related to Environmental Education initiatives in the Schools of H D Kote taluk, during the year 2018-19.

Highlights of the Progress:

a) Orientation training program of Science Teachers from the Schools of H D Kote

In order to consolidate the actual learning needs of the Science teachers and to discuss the modalities of their involvement, an orientation training program for science teachers from selected high schools of HD Kote was organized on 10th July 2018 at Saragur, in collaboration with Swamy Vivekananda Youth Movement (SVYM), Saragur, Mysore District.

Twenty-six teachers attended the program. Through its participatory sessions, the program introduced and discussed, selected focal issues related to biodiversity conservation, by keeping medicinal plants of H D Kote as the focus. The program brought out the learning needs of students from 8, 9 and 10th classes, in the light of their school curriculum. Teachers pointed that, certain lessons in the school text books have identical topics with the focal themes of HD Kote project, and it would be good to review the text books, to identify such lessons, in order to tag the focal themes from the pharma project.

Brainstorming session during Teachers Orientation program 1

The team subsequently did a review of the text books of 8, 9, 10th class. It found out that about 10 lessons (on generic themes such as Our Earth, Natural resources, Water, Forests, Our Environment, Pollution), have certain identical elements with that of the focal themes of the EE initiatives.

b) Preparation of Environmental Education Modules:

The team, during the year developed 4 learning modules. Taking cues from the learning need assessment, the team held discussions with the officials of Karnataka State Primary Education department, at Mysore and H D Kote, and with experts in the field of environmental education and community education, to identify the appropriate contents for the modules. Accordingly, four illustrated training modules were developed. These modules introduce the focal topic under consideration through simple lessons, activities and participatory sessions. These are:

1. *Medicinal Plant resources of H D Kote*
2. *Medicinal Plants for Primary health care and Local Healthcare Traditions*
3. *Strategies for Medicinal plants Conservation*
4. *Field Learning Activities*

Additionally, a **Teacher support study material volume** was developed in Kannada to serve as the reference tool for the teachers. These modules were subsequently sent for peer review and translation and were ready for use.

c) Approval by the State Education Department for conducting Environmental Education activities

The EE team subsequently held discussions with the Block Education Officer of H D Kote, and obtained a formal approval to conduct the environmental education activities in the govt high schools of H D Kote taluk.

Team members involved: Somashekhar B S., Mohan Kumar Thambad, Kollegala Sharma and S Tukaram

26. Climate Change Impact Study - I: Impact of Climate Change on wild populations of Medicinal plants of Conservation Concern (Endemic, Niche-specific & Red listed): A Futuristic Scenario

Relevance:

Climate change, which has emerged as a global challenge to the scientific fraternity has sparked a recent surge of interest for investigating its impact on forests and biodiversity. However, as is known, much of climate change research is centred in the temperate world than in the tropics and has focused on temperate species as against the tropical species.

Understanding the effects of climate change on medicinal plants in India will become a priority issue for the herbal sector, since majority of highly traded medicinal plants in India are sourced from tropical landscapes, which are vulnerable to climate change as per the projected climate scenarios. However our current understanding of the impact of climate change on the medicinal plant populations in India is quite sketchy.

This study is thus an attempt to fill this gap by way of developing an overview on the impact of climate change on wild populations of medicinal plants, based on published research literature and data from climate change studies in India. This synthesis is hoped to contribute to overcome the dearth of information in this regard.

Highlights of the Progress:

The Climate Change research group within the Conservation team, during the year was engaged in the following activities and successfully completed them.

a) Literature review of the impact of climate change

Two focal themes were identified for the systematic literature viz., **a) Climate change impact on the threatened medicinal plants** (phenology, growth & productivity, regeneration, and range shift), **b) Climate change impact on habitats and landscapes** (structure, composition, distribution range).

In order to align the focus of literature review, the following species were prioritized for the study.

Medicinal plant Species	***Niche specificity***	***Whether NTFP***	***Trade***	***Red list status***
Artocarpus lakoocha	*Riparian spp.*	*NTFP*	*Regional*	
Artocarpus gomezianus	*Evergreen spp.*	*NTFP*	*Regional*	

Calophyllum apetalum	*Riparian, swamp*	*NTFP*	*Local*	*Vulnerable*
Calophyllum ionophyllum	*Riparian, swamp*	*NTFP*	*Local*	
Cinnamomum macrocarpum	*Evergreen sp.*	*NTFP*	*High volume trade*	*Vulnerable*
Cinnamomum riparium	*Riparian spp.*	*NTFP*	*High volume trade*	*Endangered*
Garcinia gummi-gutta	*Evergreen sp.*	*NTFP*	*High volume trade*	*Near Threatened*
Garcinia indica	*Evergreen sp.*	*NTFP*	*High volume trade*	*Vulnerable*
Garcinia morella	*Riparian, Swamp*	*NTFP*	*regional*	*Vulnerable*
Garcinia xanthochymus	*Evergreen sp.*	*NTFP*	*regional*	
Holigarna arnottiana	*Riparian, Swamp*	*NTFP*	*High volume trade*	
Hydnocarpus macrocarpum	*Riparian spp.*	*NTFP*	*High volume trade*	*Vulnerable*
Hydnocarpus pentandra	*Riparian spp.*	*NTFP*	*High volume trade*	*Vulnerable*
Mesua nagassaricum	*Evergreen sp.*	*NTFP*	*High volume trade*	
Myristica malabarica	*Swamp*	*NTFP*	*High volume trade*	*Vulnerable*
Myristica fatua magnifica	*Swamp*	*NTFP*	*High volume trade*	*Endangered*
Saraca asoca	*Riparian spp.*	*NTFP*	*High volume trade*	*Endangered*
Vateria indica	*Evergreen sp.*	*NTFP*	*regional*	*Vulnerable*

Subsequently, the team did a thorough online and offline library search, data-mining and gathered >250 quality research papers/ study reports/ chapters/references related to the focal themes and the focal species as above, from different information repositories and data banks.

These datasets thus gathered were processed and “annotated data digests” were prepared. These digests are the “research briefs” of these publications, which highlight the key findings, and will serve as the notes for developing the overviews under different focal themes.

The team subsequently prepared a bibliography of 200 climate change references. An interim progress report was prepared and sent to the Director, NATCOM, MoEF & CC.

b) Gather relevant field /unpublished data from institutions and research scholars engaged in climate change research

The team attempted to consult different research institutes and individuals engaged in climate change research in India. In this regard, it interacted with the researchers from Forestry College, Sirsi, and Life Trust, Sirsi and requested them to share phenology data from their research studies. Accordingly, two unpublished datasets from the projects were gathered:

"Restoration of Fresh water Myristica Swamps in Central Western Ghats" of LIFE Trust, Sirsi (funded by CEPF)- relevant data on phenology of Myristica species (focal group of species of the present study) from 40 different swamp sites along the Western Ghats in Karnataka.

"DST GoI project on threatened species of Western Ghats", housed at Forestry College, Sirsi - relevant data on phenology of select threatened medicinal trees (focal species of our study) from 60 transects from different localities in the central Western Ghats in Karnataka.

Inside the swamp; Note the profuse formation of stilt roots and arc

The search will be continued to obtain additional datasets from other researchers/ institutes too.

Team members involved: Somashekhar B S., Noorunnisa Begum, Manjunatha Naik

27. Climate Change Impact Study- II: Study on Phenological Response of Endemic Plants of Western Ghats to Climate Change: Based on Herbarium records, Historical datasets & Ground truthing

Relevance: Phenological datasets have become extremely important for understanding the variations in flowering patterns, due to climate change. However, there is a dearth of long-term monitoring data related to flowering of medicinal plants, especially the perennials, in India.

This study is thus an attempt to strengthen the understanding of the impact of climate change on medicinal plants in the tropics. In the absence of sufficient scope for generating long term data, this study aims to examine the trends in phenological response of select endemic medicinal plants of the Western Ghats, by relying on historical data sets, viz., a) herbarium sheets collected over the last century and housed at different herbaria, b) published research literature and research reports, c) forest working plans and other forest records from the previous decades, d) anecdotal and qualitative data from the reflections/recollections by NTFP collectors and community groups, about changes in harvest cycles and flowering patterns of the focal medicinal plant species during the previous decades.

Highlights of the Progress:

Accordingly, the Climate Change research group was engaged in the following activities during the year, and successfully completed them.

a) Gather historical data on phenology of focal plant species

The team finalized the following species as its focal candidates.

Medicinal plant Species	***Niche specificity***	***Whether NTFP***	***Trade***	***Red list status***
Calophyllum apetalum	*Riparian, swamp*	*NTFP*	*Local*	*Vulnerable*
Cinnamomum macrocarpum	*Evergreen sp.*	*NTFP*	*High volume trade*	*Vulnerable*
Garcinia indica	*Evergreen sp.*	*NTFP*	*High volume trade*	*Vulnerable*
Myristica malabarica	*Swamp*	*NTFP*	*High volume trade*	*Vulnerable*
Saraca asoca	*Riparian spp.*	*NTFP*	*High volume trade*	*Endangered*
Vateria indica	*Evergreen sp.*	*NTFP*	*regional*	*Vulnerable*
Dysoxylum malabaricum	*Evergreen sp.*	*NTFP*		
Kingiodendron pinnatum	*Evergreen sp.*			
Mammea suriga	*Evergreen sp.*	*NTFP*		
Shorea roxburghii	*Deciduous*			

The team subsequently attempted to gather the historical data related to flowering phenology of these species from different herbarium records in the country. In this regard, the team visited the herbaria located at Botanical Survey of India, Coimbatore; French Institute, Pondicherry; IFGTB, Coimbatore; TBGRI, Trivandrum; KFRI, Peechi and Shivaji University, Kolhapur. The team examined the herbarium sheets (pertaining to the focal species) collected during the previous decades, and subsequently gathered the phenology data of 23 focal species from 1020 herbarium sheets.

Subsequently, the unpublished phenology data corresponding to 15 focal species from 21 sites along the Western Ghats, from 3 research projects carried out by the researchers at Forestry College, Sirsi and Life Trust, Sirsi were gathered.

b) Literature search for phenological data of threatened medicinal plants, from published and unpublished research literature

The team gathered >100 quality research papers/ study reports/ chapters/references related to phenological response of plants from different information repositories & data banks of research institutes and individuals.

c) 'Ground truth' studies to document the phenology of select focal species

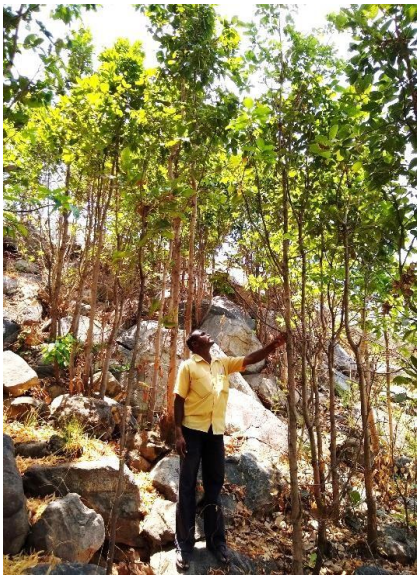
The team carried out on-the-ground studies for phenology of the focal species at select locations in the Western Ghats. It focused on 6 Myristica Swamps, in Uttara Kannada district, 14 single-species stands of *Mammea suriga,* 2 populations of *Vateria indica* in Uttara Kannada district and the natural groves of *Shorea talura* from 9 sites in Tumkur and Mandya districts. Altogether phenology data on 17 focal species from 28 sites were gathered.

Phenology data of *Shorea talura* populations

Site	Popu. size	GBH (cm)	Height (ft)	Phenology						Remarks
				V	FLB	FL	FLS	FRS	FR	
Bukkapattana, Tumkur	>40 trees	80-145	15-25	----	----					Degraded scrub; stunted trees; very dense clusters; no seedlings
Oordigere, Tumkur	~50 trees	75-150	20-45	----	----					Mixed dry deciduous; solitary trees on crop land bunds; lopping
Basavapattana, Malavalli	~50 trees	60-130	20-35	----	----					Degraded dry deciduous severe lopping of main stems and stumps
Bhimana Kindi, Malavalli	~50 trees	55-140	20-35	----	----					
Malleswara hill-1 Tumkur	>70 trees	15-45	12-25	----	----					Single species stand secondary growth from coppice; severe lopping; profuse flowering in old trees, scanty in mid aged
Malleswara hill-2 Tumkur	>100 trees	15-75, 330	12-40, 50	----	----					
Hemagiri-1 Tumkur	>50 trees	60-150	15-40	----	----					Mixed dry deciduous; sparsely distributed along foot hills; profuse fruiting
V-Vegetative, FLB-Floral buds emerging, FL-Flowering, FLS-Flower shedding, FRS-Fruit set; FR-Fruiting										

Team members involved: Somashekhar B S., Ravikumar K, Manjunatha Naik

Dense flower clusters of Jalari



Population of Jalari at Hemagiri

28. **SECURE Himalaya Project-Sikkim-** ***"Assessment of Medicinal and Aromatic Plant (MAP) species including their collection, usage, demand, markets, price trends and life cycle, focusing on landscapes in Sikkim under SECURE Himalaya Project"***

Relevance: The Ministry of Environment, Forest and Climate Change (MoEF & CC), Government of India, along with UNDP is implementing a new GEF funded project: SECURE Himalaya (Securing livelihoods, conservation, sustainable use and restoration of high range Himalayan ecosystems) in the states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand and Sikkim, which aims to support the Government of India to effectively promote sustainable land and forest management in alpine pastures and forests in high range Indian Himalayan ecosystems.

In this context, to contribute to the overall conservation of threatened species in the Himalayan Landscapes, the present study focuses on conducting a detailed assessment of Medicinal and Aromatic Plant (MAP) species in the project landscapes of Kanchenjunga National Park in Sikkim, with a focus on ensuring sustainable cultivation and harvesting by identifying usage patterns, and, studying existing value chains.

Highlights of the Progress:

Under this project, the conservation team was collectively involved in the following key activities and successfully completed them during the year.

Developing an Overview of projects and schemes on MAPs by consulting reports, and other documents available with SFD, govt agencies, NGOs and research Institutes.

Prepared a prioritised list of 25 species of medicinal plants, which are perceived to be highly threatened and which are in high volume trade, based on secondary literature. The list was submitted to Forest department, Sikkim and UNDP for their approval. This list would serve as the focal priority species around which the key project activities in the field would be focused.

Reviewed the Distribution data of these focal species from secondary literature and prepared a primary overview picture. This would help the team for initiating the necessary botanical studies. The overview was shared with Sikkim FD.

The team **prepared the project implementation strategy** and presented to the State Review Committee at the Project inception workshop organised by UNDP and Sikkim forest department at Gangtok in January 2019.

Subsequently, the team also prepared the project gap analysis and submitted to UNDP.

Team members involved: M. Abdul Kareem, Somashekhar B S., Dr. Ravi Kumar, Mr. Jaganath Rao, Dr. Noorunnisa Begum, Dr. Suma T, Ms. Deepa G. B., Ms. Sathya Sangeetha, Dr. Chetan H. C., Ms. Nandini D, Ms. Amrita G. Dr. Arthur Selwyn

Center for Ethno Veterinary Science and Practice

Project/program title: "Training of small dairy farmers in Kerala, Karnataka and Tamilnadu on ethno-veterinary practices to reduce the antibiotic residue in the milk

Relevance (scientific/social) of the project:

The excessive and indiscriminate use of antibiotics in human, agriculture and animal health care, has resulted in the creation of antimicrobial resistance. One of the immediate demands by those working on antimicrobial resistance is to reduce the use of antibiotics in animal production. There is nearly 67% increase in global consumption of antibiotics for livestock production that has direct impact on human beings and the environment. In India in the past 5 years the annual rate of use of antibiotics is rising by 6-7 %. About 90% of the antibiotics given to humans, crops and the livestock end up in the environment. It is estimated that by 2050 the antimicrobial resistance (AMR) will cause globally 10 million deaths per year.

Highlights of progress/ achievements:

An intervention impact study by TDU involving 220 farmers (80 controls, 140 study group) indicates there is no significant change in KAP in EVP, antibiotic residue in the milk and AMR among farmers in Karnataka. There is suggestive significance in change in knowledge on EVP, antibiotic residue in the milk and AMR, but no change in the attitude but strongly significant change in the practices of EVP in Kerala and TN among the farmers who were selected for the study. After one year training and monitoring 140 farmers to use EVP instead of antimicrobial for infectious diseases, 123 (87.86%) farmers milk was without any antimicrobial residue, 11 (785%) farmers has Low positive of Beta lactams or sulphonamides and 6 (4.29%) farmers milk has positive to antimicrobial residue (Beta lactams and or sulphonamides). The farmers agreed that they have used antimicrobial along with EVP. Adopting Ethno-veterinary Practices (diverse traditional knowledge based practices including natural products) to combat infectious diseases in livestock has been identified and tested as a key game changer in reducing the use of antibiotics in veterinary practice.

The expenditure on treatment of diseases in cattle using both conventional veterinary medicine & EVP are shown in table below

No	Disease conditions	Number of animal treated	Expenditure for allopathic treatment	Expenditure for herbal medicine treatment	Amount saved in Rs
1.	Mastitis	35	3000	120	2880
2.	Maggot wound	28	962	60	881
3.	Bloat & Indigestion	34	719	224	495
4.	Repeat breeding	23	3060	430	2630
5.	Cow pox	18	583	335	250

6.	FMD	22	3165	1640	1525
7.	Diarrhoea	3	500	166	334

Quantity of milk in litres before and after treatment of various clinical conditions in cattle with veterinary drugs

Disease conditions	n	Before treatment (lit)	After treatment	Loss of milk In litres per day	Loss for 6 days in litres	Financial loss in Rs
Mastitis	35	12.8	10.5	2.5	15.0	390
Maggot wound	28	13.1	10.6	2.5	15.0	390
Bloat & Indigestion	34	14.0	10.5	3.5	21.0	546
Repeat breeding	23	16.0	13.2	2.8	16.8	437
Cow pox	18	14.9	11.8	3.1	18.6	484
FMD	22	9.71	06.0	3.7	22.2	577
(Rs 26 per litre)						

Project/program title-Training on EVP and Veterinary Ayurveda for the field veterinarians

Relevance (scientific/social) of the project

Issues

1. High disease incidence in cross-bred animals and high treatment costs.
2. Indiscriminate use of antibiotics and other veterinary drugs in dairy animals leading to high veterinary drug residues in the animal products.
3. Threats to human health due to microbial resistance to antibiotics.
4. Loss of local breeds which have resistance to many diseases.
5. Weak animal / poor farm management in many farms.
6. Reduced Milk quality.

This programme is to provide training vets on ethno-veterinary practices to manage health conditions in cattle. The natural herbal formulations can reduce the use of antibiotic and the other chemical veterinary drug in animal health management and thereby minimize the antibiotic and veterinary drug residues in the milk and other animal products.

126 Veterinarians and faculties from AHLFVS, Govt of Sikkim, Gokul dairy Kolhapur, NDDB Mastitis control popularization project (Vets from States of Gujarat, Punjab, Maharashtra, Goa, Karnataka, Tamilnadu, Andhra Pradesh and Kerala), Goat Trust, officers of Abbott and Abbott Business Partners were trained to use EVP for clinical conditions like Mastitis, Udder edema, Udder pox, Enteritis, Indigestion, Bloat, Repeat breeding, Downer syndrome, Wounds and Ticks.

Highlights of progress/ achievements 126 vets and faculty members are trained to use EVP for clinical conditions in animal and also prevent these disease conditions reducing the use of antibiotic and other veterinary drugs. This will ensure reduction of antibiotic and other chemical drug residue in the milk and other animal products consumed by the public.

We also work with NLF Ethiopiia, Uganda and Netherlands.

Project/program title: Diploma and certificate program on Hasthyadyayurveda

Relevance (scientific/social) of the project:

Program highlights:

- Pathobiology and diagnosis of diseases in Elephants and other animals – Traditional verses Modern perspectives.
- Basics of Sanskrit language for better understanding of Hastyayurveda, Gajasastra, Mathangaleela etc.
- Anatomy, physiology and morphometry of animals especially elephants - Veterinary Science.
- Management of diseases in Elephants and other animals and Hasthyadyayurveda practices in Kerala.
- Pharmacological basis of Ethnoveterinary medicine.
- Functional herbal remedies for primary health care of livestock.
- Traditional Medicine system (TMS) and Local Health Traditions.

The first contact class conducted in the month of June 2018. Totally 15 students have enrolled 12 for Diploma and 3 for certificate program.

Highlights of progress/ achievements: The first batch of Ayurveda doctors for healing of animals particularly Elephants

Publications

1 Suresh B, Puniamurthy N, Nair MNB. DhanwantharamKashayam for Preventing Post-Partum Complications in Cross-Bred Cows. Dairy and Vet Sci J. 2018; 5(4): 555666. DOI: 10.19080/JDVS.2018.05.555666004

2. Kumar S K[1], Deepa P M[2], Punnimurthy N[3], MNB Nair[4] 2018. Prevention of mastitis in cattle during dry period using herbal formulation. RRJVS | Volume 4 | Issue 1 | June, e-ISSN:2581-3897

Team Members: Dr M N Balakrishnan Nair, Dr Punnimurthy N, Dr. Sateesh, Dr Kumar S K, Mr. Abhilash and Ms. Anitha N

Centre for Traditional Knowledge Informatics

Project/program title: Network Pharmacology approach in Ayurvedic plant-based drug discovery

Relevance (scientific/social) of the project:

This project explains the scientific rationale and mechanism of Ayurvedic drugs. The effort here (supported by Infosys) is to study the network pharmacology of the given medicinal plants to be able to explain the rationale behind their efficacy. Network pharmacology is effective for establishing "compound-protein/gene-disease" network and revealing the regulation principles of small molecules in a high-throughput manner.

Highlights of progress/ achievements:

The network pharmacology analysis of medicinal plants like *Tinospora cordifolia*, *Azadirachta indica, Piper* species, has offered new relationships among bioactive, targets and putative applications of disease etiology. This research work on network pharmacology is a pioneering effort which would help to open new possibilities for known pharmacodynamics of Ayurvedic drugs and also help in the discovery of new leads and targets for various diseases.

In the current project, the structural information of bioactive was retrieved from universal Natural Products database (UNPD) and Dr.Duke's phytochemical and Ethnobotanical database. The bioactive were then queried for identifying their targets using special tool find My Compound target. The binding database is a web-based free database that covers protein interactions with small-drug-like molecules. To improve the accuracy the targets of those bioactive having a score equal to one were selected. The targets of the bioactive were further searched in Kegg pathway database. Further visualization was carried out using software Cytoscape. The computational analysis shows *Tinospora cordifolia*: Bioactives: 69; Targets: 164, Ayurvedic synergy with disease 11; *Azadirachta indica*: Bioactives: 308, Target: 750. The network depicts the synergy of bioactive with molecular targets and their synergy with diseases and Dravyaguna profile of the drug which is one of the unique features of this current research.

Publications/Research papers/ invited talks:

Nair. SN.V., 2018. Network Pharmacology as an Appropriate Bioinformatics Tool, Bioinformatics and Proteomics Open Access Journal, Medwin Publishers, Vol 2, Issue 1

Team members involved: Dr.Venu Gopalan Nair, Dr.Tabassum Ishrath Fathima, Dr.Shilpa Naveen, Mr.Nadanavinayakan

Centre for Ayurveda Biology & Holistic Nutrition

Project/program title: Holistic Nutrition **RIST** (Rural India Supporting Trust)

Relevance (scientific/social) of the project:

The Holistic Nutrition Research and Education Center being established in Trans-Disciplinary University engages in translation research that brings together molecular understanding of nutrition with Ayurvedic principles and insights in order to

- Generate new scientific knowledge about the ingredients, nutrition processing technology, flavours, biology of nutritious foods inspired by principles of Ayurveda and modern biology.
- Create prototypes of high impact nutritious foods for the masses
- Share findings about health foods and nutrition with both professionals and laypersons

The specific deliverables of the Centre over the next 3 years are:

- **Deliverable 1**: Establish an advanced Nutrition Research Lab with capability to do work in food chemistry, nutrition science and food processing.
- **Deliverable 2**: Design and establish a unique in silico integrative database on nutritive values, therapeutic diets, pharmacology, chronobiology and processing techniques of Indian foods derived from both modern and Ayurveda knowledge systems.
- **Deliverable 3**: Conceive and develop prototypes of 3 carefully selected, well-researched, high priority health foods and drinks that can impact public health and be consumed by masses.
- **Deliverable 4**. Design and execute pilots of innovative educational programs & workshops for professionals and lay persons on holistic nutrition.

Highlights of progress/ achievements:

Through the Holistic Nutrition Project, a world class program is being built that delivers (1) an integrative database on holistic food that combines Ayurveda and modern nutrition (2) three well researched nutritious foods (3) pilots to demonstrate socially impactful education and outreach programs.

Three benefit platforms have been created under the program to develop well researched products

- Brain Health : Cognitive impairment – global aging population
- Metabolic Health : Type 2 diabetes and obesity – global pre-diabetics population
- Bio-assimilation & Rasayana : Enhanced bio-assimilation of iron and/or vitamins – women and children population with iron and vitamin deficiency

The program is being operationalized through 14 laboratories and pilot plants.

The 14 laboratories and pilot plants of the Holistic Nutrition program are in various stages of growth.

Sl.No	Laboratory/Pilot Plant	Key equipment	Purpose
1	Kitchen & Sensory Laboratory	Multi kitchen stations. Cooking Hobs, Traditional Hobs, Wet & Dry Grinding section, Blender, Juicer, Slicer, Kneader, Oven, Precision Bath, Microwave, Refrigerator, Freezer, Pantry	Rapid prototyping, training & workshops, video recording for nutritional videos.
2	Food & Dravya Analytical Laboratory	HPTLC, HPLC with PDA & RI detectors, LC-MS, GC-FID, GC-MS, UV spectrophotometer	Volatile and non-volatile molecular analysis.
3	Food & Phyto Chemistry Laboratory	Weighing balance, pH & Conductivity meter, Colorimeter, Rotary water bath, circulating chiller, Soxhlet, proximate analysis set-up, wet chemistry set-up, extraction columns, distillation columns, glass ware, chemicals	Food chemistry, proximate analysis, separations and fractionations, phytochemical analysis of ingredients
4	Microbiology Laboratory	Incubators, Laminar flow hoods, microscope, workbench for media preparation, autoclave	Microbial analysis, microbials safety testing of foods
5	Multi-omics Laboratory	RT PCR, thermocyclers, ice machine, lyophilizer, bench top centrifuge, probe sonicator, gel doc system	Markers for inflammation, obesity etc.
6	Cell Biology Laboratory	Incubators, Shaker tables, media preparation room, autoclave, laminar flow hoods	Cell models for bioavailability, inflammation, glucose metabolism etc.
7	Microscopy Room	Upright and inverted microscopes, microtome, slide preparation table, digital camera	Support for microbiology, cell cultures and food structuring
8	Drosophila Laboratory	Microscope, Racks for culture bottles, culture bottles	Drosophila model system for nutrition studies on obesity, rejuvenation
9	*C. elegans* room	Laminar flow hood, racks, glassware, microscope	Nematod model system for brain health and nootropics
10	Botanical Post Harvest	Withering trough, carding machine, panning machine, tray dryer, crush tear	Raw material 'Post-harvest' processing

	Processing Pilot Plant	curl machine, fluid bed dryer	pilot plant including moisture reduction, shaping and drying
11	Dry Pilot Pant	Cuter, Coarse grinder, fine grinder, sorting machine	Raw material preparation pilot plant - Size reduction and sorting of raw material
12	Wet Pilot Plant	Extractor, Cooking Pan, Vacuum cooking vessel, thin film evaporator, juicer and pulper, extruder, steam boiler, baby boiler, chiller, water softener, vacuum pump, air pump, hot water generator, spray dryer, oil expeller with drive	Wet pilot plant for preparing foods from prepared raw materials
13	Fermented Foods Pilot Plant	Autoclave, incubating chambers, laminar flow hood, fermentation tanks	Fermented foods like curd, gruels, asava, arishta, kombucha
14	Product Design Laboratory	Kneaders with high power drives, wet grinders, mixing tank, dissolution test, disintegration test, penetration test machine, water activity meter	Grinding, mixing, kneading, tableting laboratory (non-heat operations). Testing of products including dissolution, disintegration, hardness, water activity

Invited talks

a. Singh, G, In Silico Design Principles for Foods – Ayurveda Algorithms to Network Pharmacology, Computational Gastronomy Symposium, IIIT Delhi, December 2018

b. Singh G., Ayurveda Nutrition & Microbiome, Symposium on Prebiotics & Microbiome, ILSI, Meridian Hotel, New Delhi, December 2018

c. New Product Development – Innovation Journey of Tea: Tea Tasters Certification Short-Course at Indian Institute of Plantation Management, Bangalore, June 2019

d. Branding Agri Products – Sharing Value Across the Supply Chain, Indian Institute of Plantation Management, July 2019

Event/Visitors:

- Food and Beverages Proto typing Day was organized on 19th March 2019

Products like Nisamalaki spice mix, Turmeric Latte, Nithya sevinia drink, Congnitive enhancer, Ghee prototypes, Kombucha, Sleepy bars and Shakes, Iron rich snack bar, Iron fortified chikki, Amlx candy etc. was displayed for sensory evaluation

Food and Beverage Prototyping Day 19th March 2019

Sleepy Bars and Shakes

Nitrya Sevinia Drink

Iron Fortified Chikki

Kombucha –Fermented Tea

Cognitive Enhancer

Turmeric Latte

Chef Manjit Gill is an Indian chef. He is currently serving as the President of the Indian Federation of Culinary Associations. He visited FRLHT – CABHN for sensory analysis based on ghee and ghee products. He discussed the importance of ghee products and its role as a traditional Food in India.

Team members involved

- Dr. Gurmeet Singh
- Dr. Subrahmanya Kumar
- Dr. Vishnu Prasad
- Dr. Ashwini Godbole
- Dr. Mohana Kumara Patel
- Dr. Bhagya V Rao
- Dr. Shridevi Gothe
- Dr. Sriram Padmanabhan
- Mrs. Suganthi Fathima J
- Mr. Kumaraswamy, Mr Eshwarappa
- Prof. Shobha Udipi
- Dr. Malali Gowda, Dr. Sheeba Ganesan
- Mr. Nadana Vinayagan
- Ms. Prakruthi
- Ms. Sushmita HS
- Mr. Abdul Mateen
- Ms. Deepshikha Kataria (Ph.D Student)
- Ms. Prathima CL (Ph.D Student)
- Mr. Shubham Barman
- Ms. Shireen D' Souza
- Ms. Glenita D'Souza
- Mr. Venkata Subramanian
- Dr. Arun B, Dr Satish Rao
- Dr. Venugopalan, Dr. Shilpa Naveen

Project/program title: Ayurveda based approaches for prevention and management of Diabetes & Obesity

Relevance (scientific/social) of the project:

The socio-economic and health burden of diabetes is increasing across the globe. There is an increasing interest in opting for complementary and alternative medicines for managing life style diseases like diabetes and obesity. Diabetes research in TDU focuses on understanding the concepts of diabetes management in Ayurveda and develops innovative holistic strategies for diabetes management.

Highlights of progress/ achievements:

A trans-disciplinary and integrative medicine approach, focusing on holistic perspectives of lifestyle, wellness, diet and energy homeostasis, would be more appropriate in the management of diabetes. Increasing evidences from global research suggest that gastro-intestinal tract (GIT) plays a vital role in whole body glucose homeostasis and diabetes. Gastro Intestinal mediated Glucose Disposal (GIGD), an orchestrated event regulated by various gut derived factors, is emerging as a systemic strategy in diabetes management. A deeper understanding of GIGD and its multi-targeted mode of action could open up novel holistic strategies for maintaining whole body glucose homeostasis and management of diabetes. The team studied 5 important Ayurveda formulations (*Nishamalaki, Chandraprabhavati, Vasanthakusumakara rasa, Nishakathakadi Kashaya, Varanadi Kashaya*) for their possible mode of action, with a focus on GIGD. These formulations are shown to inhibit key digestive enzymes (viz. alpha amylase and alpha glucosidase) and adipogenesis in *in-vitro* model system. In addition, these formulations are also shown to inhibit one of the key enzymes in GIGD, ie DPP-4.

As the team is working on various Ayurveda formulations, the team had highlighted need for comprehensive standardization strategies for marketed *Ayurveda* formulations taking *Lodhrasavam,* a classical Ayurvedic preparation, as an example. *Lodhrasavam* procured from six reputed Ayurvedic drug manufacturers showed significant variations in their sensorial, physico-chemical, chromatographic as well as biological properties. The team has suggested that, in the era of globalization of *Ayurveda*, it is necessary to have utmost attention on the quality control parameters for the therapeutic formulations.

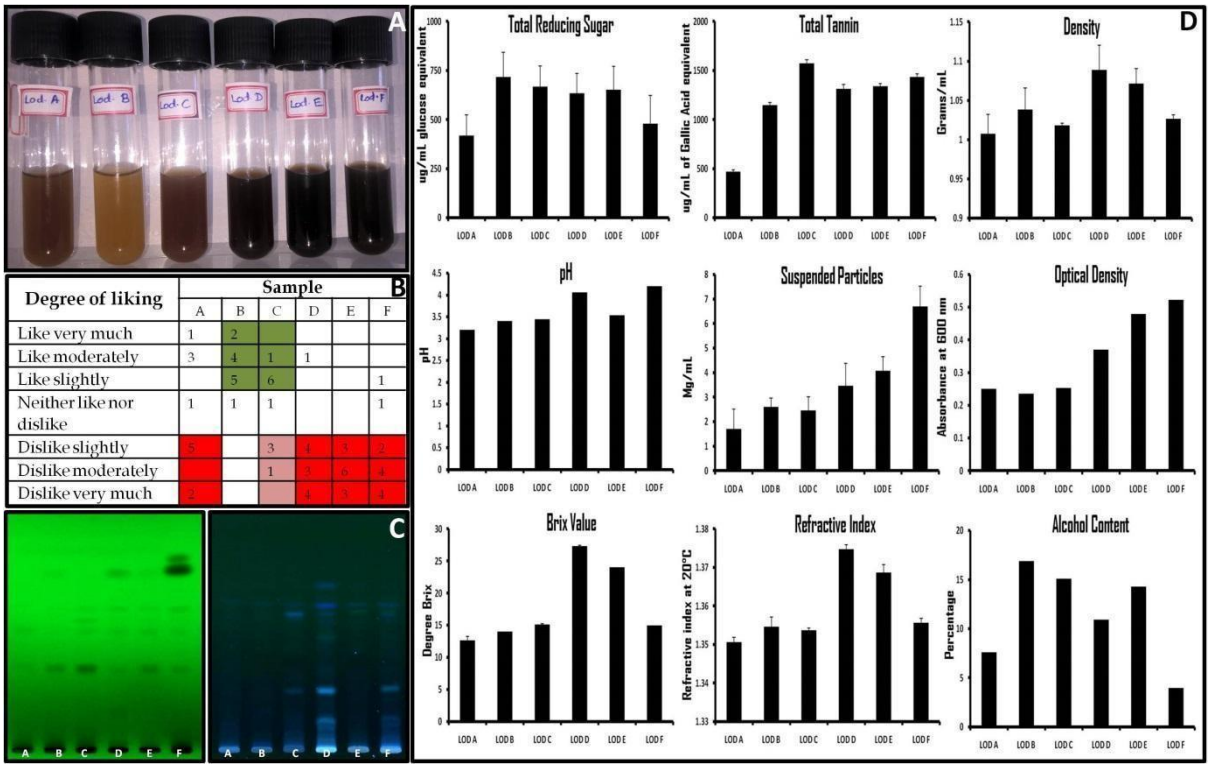


Figure: Physicochemical and hedonisity comparison of Lodhrasavam samples: Marketed samples of Lodhrasavam (Lod A-F) are compared for (A) - visual appearance; (B) – hedonicity properties; (C) – Thin Layer Chromatography pattern and (D) – physicochemical properties.

Publications/Research papers/ invited talks.

- Vaidya VN, Tatiya AU, Elango A, Kukkupuni SK, Vishnuprasad CN (2018). Need for comprehensive standardization strategies for marketed Ayurveda formulations. J. Ayurveda Integr. Med. 9(4): 312-315.
- Dr. C. N. Vishnuprasad has been invited as a resource person for a Two Day National Workshop and Hand's on Training on "Western Blotting Technique" held at The Department of Biochemistry, PSG College of Arts & Science, Coimbatore on February 15 & 16, 2019.
- Dr. C. N. Vishnuprasad has been invited to deliver a lecture on two days seminar on Limitations of Animal Experimentation & Alternate Animal Models in Research held at Department of Pharmacology Acharya & B.M. Reddy College of Pharmacy on 6-7th December 2018.

Team members involved Dr. C. N. Vishnuprasad, Principle Investigator, Dr. Subramanya Kumar, Ms. Anjana. T, PhD student.

Project/program title: Scientific evaluation of marketed substitutes for medicinal plants facing conservation threat

Relevance (scientific/social) of the project:

In the 15th Century CE, Ayurvedic practices had identified substitutes (*Abhava Pratinidhi Dravya*) with similar pharmacological properties to meet the needs of the users. Systematic R&D on the bio-equivalence of *Abhava Pratinidhi Dravya* can establish authentic substitutes for rare, and highly demanded medicinal plants of

contemporary relevance. TDU is researching on several such *Abhava Pratinidhi Dravyas* using appropriate tools of pharmacognosy, phytochemistry, molecular biology and pharmacology.

Highlights of progress/ achievements:

Ashoka is one of the highly demanded medicinal plants of Ayurveda. The authentic botanical source of Ashoka is tree bark of *Saraca asoca* (Roxb.) Willd., which is an endangered species. Ashokarishta, one of the Ayurvedic products prepared with bark of Ashoka is used to treat the diseases of female reproductive system that are associated with estrogen. The Arishtas prepared using the substitutes of Ashoka, including the bark of commonly available *Shorea robusta* Roth showed varying degrees of estrogenic activities on preclinical, small animal and *in vitro* cell based pharmacology models (Figures 1&2).

Seeds of Vidanga are used in Indian traditional medicine to treat helminthiasis, obesity and benign tumours. Seeds of the *Embelia tsjeriam-cottam* (Roem. *&* Schult.) A. DC. are used instead of *Embelia ribes* Burm.f. - the authentic, but rare source for Vidanga. Current studies show that, Vidangarishta prepared with *E. tsjeriam-cottam* is on par with the Arishta prepared with *E. ribes* W.R.T anthelmintic activity in the pharmacology model of *Caenorhabditis elegans (Figure 3) and* anti-adipogenic activity in *in vitro* 3T3-L1 pre-adipocyte models (Figure 4).

These bio-equivalence studies show the possibility of establishing commonly available plants as well-researched substitutes for the rare and endangered plant drugs.

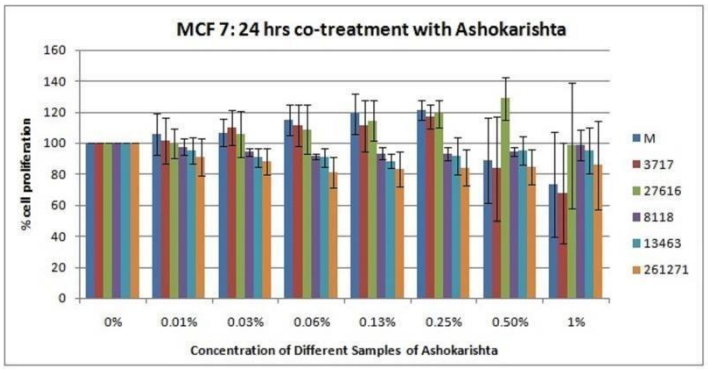


Figure 1: Effect of different samples of Asokarishta co-treatment for 24 hours on proliferation of MCF 7 cells

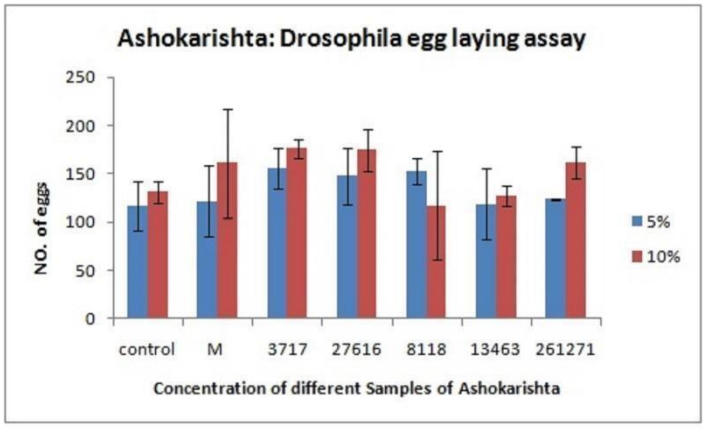


Figure 2: Effect of different samples of Ashokarishta on the fecundity of *Drosophila melanogaster*

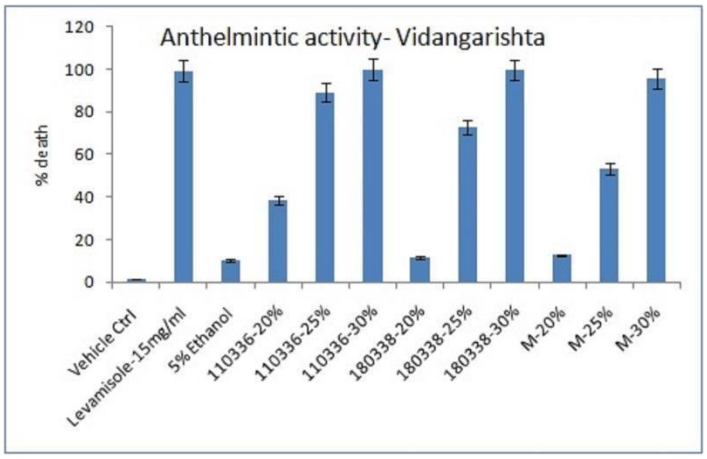


Figure 3: Relative anthelmintic activity of different samples of Vidangarishta in *Caenorhabditis elegans*

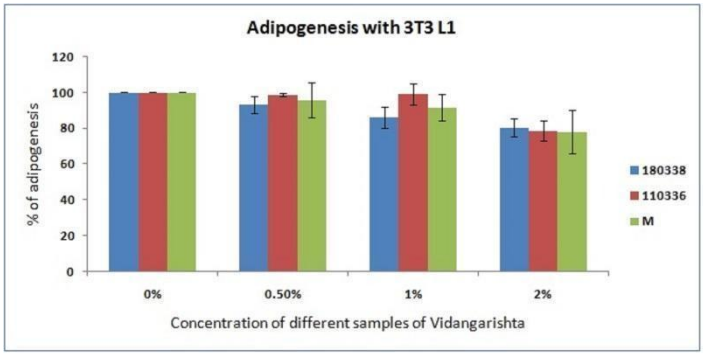


Figure 4: Effect of Vidangarishta samples on MDI induced differentiation of 3T3-L1 fibroblasts

Publications/Research papers/ invited talks related to the activity during the year.

1) A poster, "*In vitro* cell model for the scientific evaluation of estrogenic potential of Ashokarishta" was presented in the 1st International Conference on Healthcare and Technical Research conducted by the *Manipal* Academy of Higher Education, Manipal.

Team members involved Dr. Subrahmanya Kumar KDr. Vishnu Prasad, Dr. Ashwini Godbole, Ms. Kallolika Mondal, Ms. Ashwini Elango, Ms. Seema VG, Mr. Arunava Choudhary

Project/program title: DESI-MS/ MALDI-MS tissue metabolite imaging of key medicinal plant *Dysoxylum binecteriferum*: from metabolite imaging to gene discovery

Relevance (scientific/social) of the project:

Diverse plant species worldwide produce important medicinal compounds used extensively in curing major human diseases, e.g. cancer. Often, availability is limited, due to low levels *in planta* and/or coming from biodiversity hotspots. Furthermore, their commercial chemical production is frequently difficult because a) syntheses of their complex skeletal structures are not economic and b) metabolic pathway engineering is currently not feasible because of lack of information on biosynthetic machinery involved. A new approach is urgently needed to overcome these longstanding biotechnological bottlenecks and ultimately gain sustainable production of such key medicinals. In this current program I have used the cutting edge technologies and approaches to determine cellular "phytochemical factory" location(s) of key medicinal pathway metabolites using DESI-MS/MALDI-MS tissue imaging

and for identification of the remaining missing pathway genes in order to have new means for their production, including use of synthetic biology.

Highlights of progress/ achievements:

DESI MS imaging of different seed developmental stages of *D. binectariferum* was done. Rohitukine accumulation increased with seed development and its distribution was largely restricted to cotyledonary tissue. Rohitukine acetate, glycosylated rohitukine and rohitukine methoxylated are reported for the first time. Identified tissue specific localization of metabolites during different developmental stages of seedling growth. *De novo* transcriptome analysis of *D. binectariferum* leaf and root samples revealed 5 partial genes could be involved in the biosynthesis of chromone alkaloid, rohitukine.

Publications/Research papers

- **Mohana Kumara P** Uma Shaanker R and Pradeep T 2019. "UPLC and ESI-MS analysis of metabolites of Rauvolfia tetraphylla L. and their spatial localization using desorption electrospray ionization (DESI) mass spectrometric imaging Mass spectrometry imaging; metabolic pathways" Phytochemistry Vol. 159, March 2019, 20-29 . Corresponding author
- Soujanya K.N, Siva R, **Mohana Kumara P,** Amitava Srimany, Ravikanth G, Pradeep T, Thulasiram H.V, Santhoshkumar T.R and Uma Shaanker R 2018 "Isolation and characterization of camptothecin-producing endophytic bacteria from *Pyrenacantha volubilis* Hook. (Icacinaceae): Role of plasmid in the production of camptothecin" Phytomedicine 1;36:160-167.

Team members involved: Dr. Mohana Kumara P, Dr. Amitava Srimany, IIT Madras, Mr. Ravikanth G, ATREE, Prof. Uma Shaanker R, GKVK , Prof. Pradeep T , IIT Madras

Project/program title: Functional molecules in honey for the management of diabetes

Relevance (scientific/social) of the project:

Honey is a natural product obtained from the nectar of flowers, collected by bees. It is considered as a functional food and one of the finest sources of heat and energy. Honey is rich in sugars, minerals, enzymes and functional phytochemicals. Among these, the major constituents are glucose (30%), fructose (40%) and water (17%). The nature and composition of the minor components like functional molecules (flavonoids, terpenes, enzymes, peptides, rare sugars etc.) are basically determined by the floral diversity and the nectar source from which it is collected. Biological effects, composition and acceptability of honey are largely determined by the local floral diversity, geographical locations and the species of *Apis*, which collects the honey. While the major components of honey like sugars and water remain constant, the functional molecules in honey will vary depending on the quality determining factors. In order to overcome the variability, the present study intends to use honey obtained from single plant species like, Jamun, Eucalyptus, Ficus, etc (monofloral honey). The study focuses on identifying the chemical constituents of the monofloral and multifloral honey using advanced analytical tools and elucidate the biological properties (anti-diabetic and anti-obesity) using various in-vitro model systems.

Highlights of progress/ achievements: Multifloral and monofloral honey was collected from authentic sources. Multifloral honey showed higher percentage of inhibition of enzymes (Alpha-Amylase and Alpha-Glucosidase) than monofloral honey. This could be because of possible synergistic effect of phyto-constituent's present in the honey which was collected from many floral plants. Studies have also shown that upon heating of honey reduces the biological activity. This indicates that heating of honey could result in to negative effect. Phytochemical analysis of honey using GCMS showed the presence of more than 30 different metabolites.

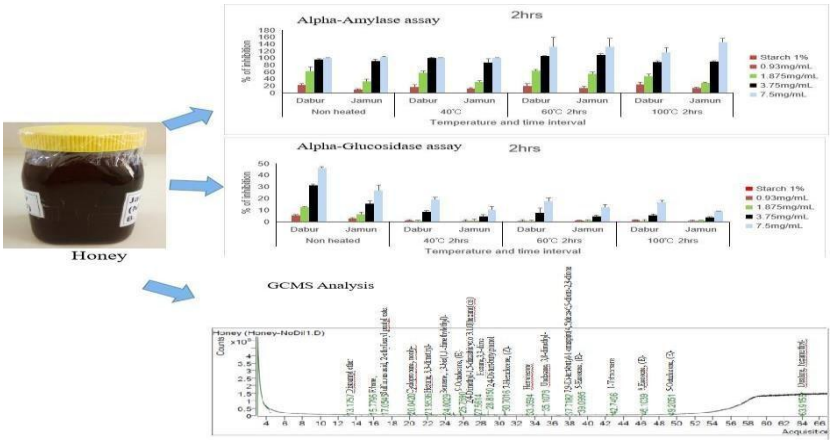


Figure 1: Effect of honey on alpha- amylase and alpha glucosidase enzymes and

GCMS chromatogram showing presence of different metabolites.

Team members involved: Dr. Mohana Kumara P, Dr. Vishnuprasad C N

Invited talks given

- Tissue metabolite imaging: Mass spectrometry and its application in medicinal plant research, Refresher Course on Multi-omic application in medicinal plant research from 11-23 Feb, 2019.
- Molecular markers and genetic diversity analysis of endangered medicinal plants Biotechnological approaches for conservation of endemic and endangered medicinal plants of India, Tumkur University, 30 Nov, 2018

Academic activities:

- Two Week Academy Refresher course on "**Multiomic application in medicinal plant research**" from 19 Feb, 2018 to 3 March 2018 held at Centre Head for Ayurveda Biology and Holistic Nutrition, TDU.

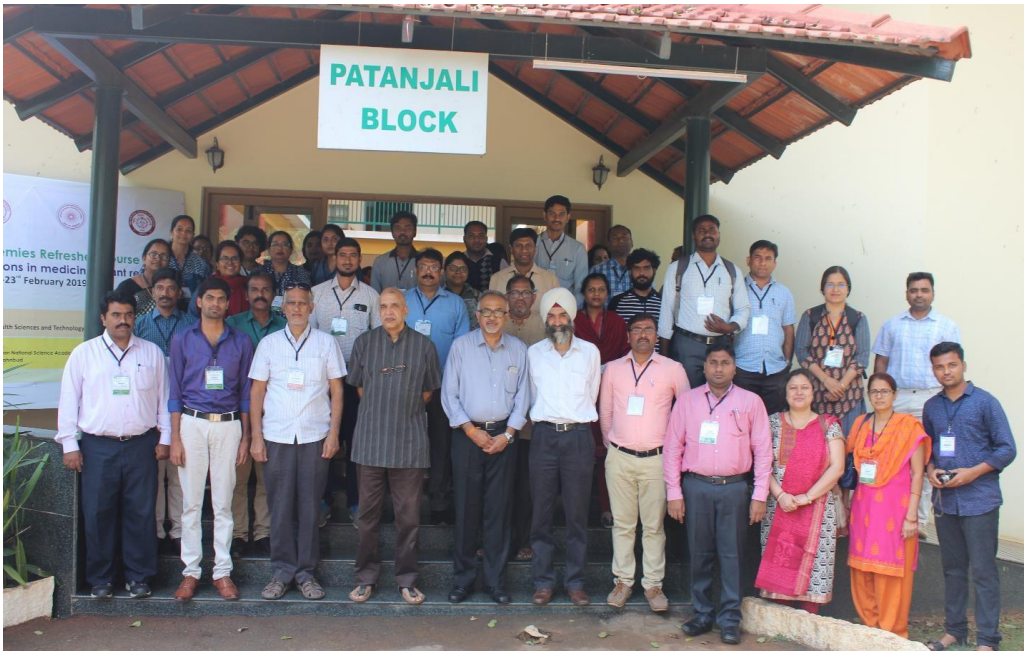


Figure: Two-week Science Academy Refresher course on "**Multiomic application in medicinal plant research**" from 19 Feb, 2018 to 3 March 2018 held at Centre Head for Ayurveda Biology and Holistic Nutrition, TDU. Group photograph of 35 participants along with Prof. Darshan Shankar, Vice Chancellor, TDU, Prof. Uma Shaanker, R, Course Director, Dr. Navin Sharma, Dean Research, TDU, Dr. Gurmeet Singh, Centre Head for Ayurveda Biology and Holistic Nutrition, TDU and Dr. Mohana Kumara P, Course Coordinator, TDU.

Project Name/Title: Understanding biological effect of Ayurvedic Nootropics

Mode of Action studies: *Caenorhabditis elegans* models

1. Effect of different dosage forms of Brahmi on neuronal health and Disease
2. Mode of action of Ayurvedic Nootropic herbs used in treatment of PD
3. Study of mode of action of Ayurvedic Nootropic formulation on AD phenotypes

Clinical studies: Effect of Brahmi ghrita on memory

(In collaboration with Centre for Clinical Research, TDU)

1. Age-related Mild Cognitive Impairment (MCI)
2. Chemotherapy Induced Cognitive Impairment (CICI) in breast cancer patients

Relevance (scientific/social) of the project:

Global increase in human lifespan and lack of concomitant increase in health span has led to a sharp increase in age related health problems like neurodegenerative disorders. Unfortunately, currently available healthcare solutions or management strategy to tackle the age-related diseases are not very effective. On the other hand, traditional medicine suggest many holistic solutions for age-related health problems like Alzheimer's and Parkinson's Disease, but paucity of scientific evidence about the efficacy and mode of action of traditional Ayurvedic nootropics, such as Brahmi, Kapicatchhu, Ashwagandha and Shankhapushpi. Thus it is important to undertake research on efficacy and

mode of action of the traditional solutions, which in turn will lead to development of effective and safe integrative healthcare solutions.

Highlights of progress/ achievements:

Neuro protective effect of clinically prescribed Ayurvedic nootropics like *Bacopa monnieri* (Brahmi), *Sida cordifolia* (Bala) and Ksheera (milk) has been evaluated on Parkinson's and Alzheimer's disease models of *C. elegans.*

- Bala in the form of Ksheerabala 101 protects PD models of *C. elegans* against MPP+ iodide induced neurodegeneration (Figure 1 attached).
- Brahmi Ghrita reduces percentage of Amyloid beta protein induced paralysis in AD models of *C. elegans* (Figure 2 attached)
- Milk supplementation of food increases life span of *C. elegans* (Figure 3 attached)

Publications/Research papers/ invited talks related to the activity during the year.

- Study of differential mode of action of Ayurvedic nootropic extracts in PD models of *C. elegans*- submitted in Journal for Ayurveda and Integrative medicine (JAIM).
- Attended *C. elegans* Principal investigator Meeting in April 2019, at Department of Biological Sciences, TIFR, Mumbai.

Team members involved Dr. Ashwini Godbole, Anjaneyulu Jalagam, Dr. Varghese Thomas, Mr. Prasanna K Simha, Ms. Ashwini Thakare, Dr. Swathi G H, Mr. Arman Deep Singh

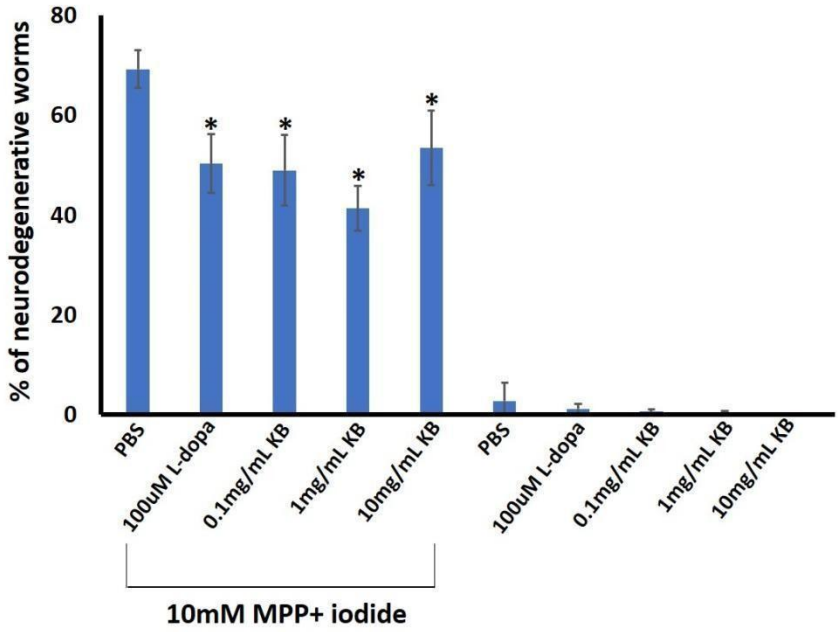


Figure 1: Neuroprotective effect of *Sida cordifolia* in the form of Ksheerabala 101 in PD models of *C. elegans*

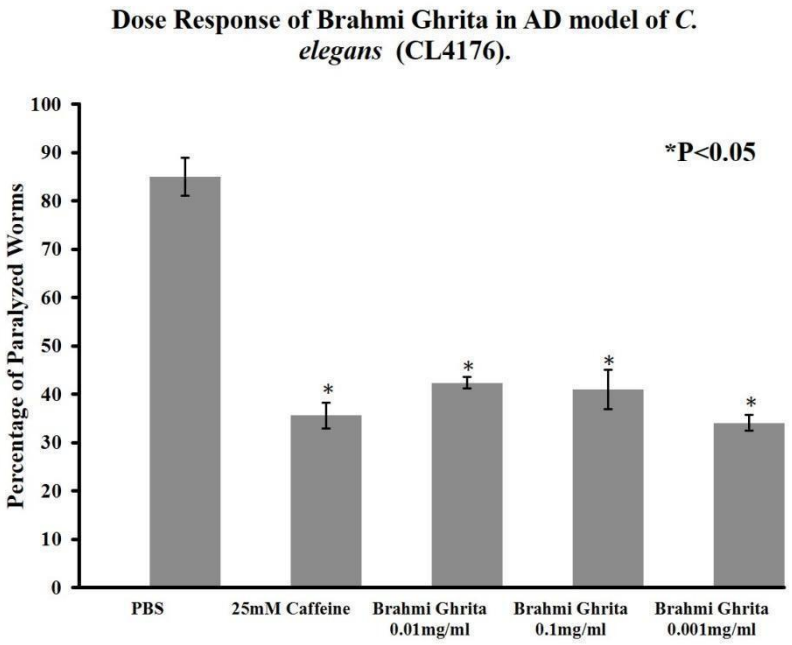


Figure 2: Brahmi Ghrita reduces amyloid beta induced paralysis in Alzheimer's Disease models of *C. elegans*.

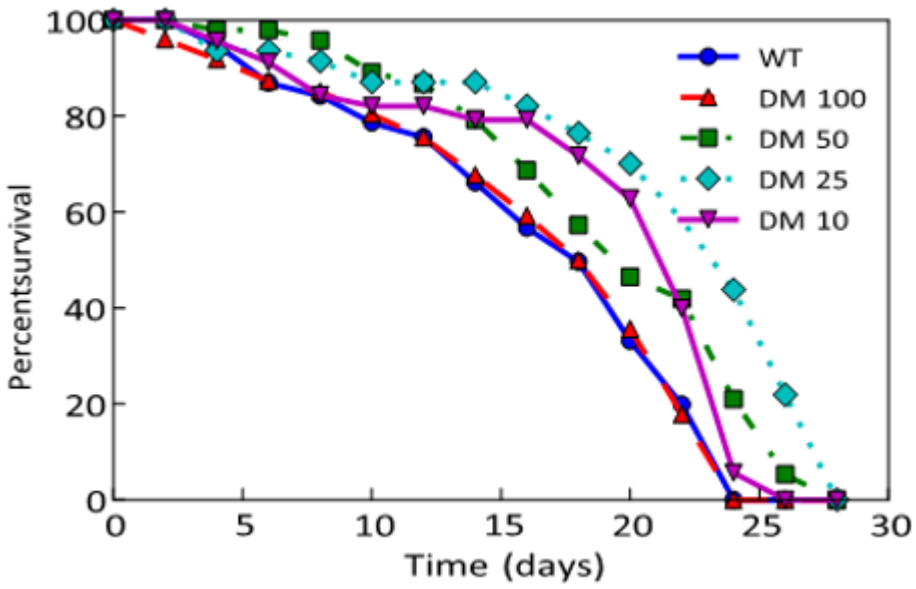


Figure 3: Effect of different concentration of Indian breed cow milk on life span of *C. elegans* treated with milk

Project/program title: Poly-herbal formulation using traditional herbal plants

Relevance of the project:

Polyherbal formulation is an Ayurvedic health supplement which is made up of a blend of 50 medicinal herbs with different proportions. Due to lack of suitable quality control standards of Ayurvedic drugs, it is difficult to ensure uniformity of their composition and consequently the efficacy of the final product. Ayurvedic text describes a multistep procedure for the preparation of polyherbal formulation. In the absence of standard operating procedure in classical text, the method of preparation varies from place to place. Also, at industrial level, it is time consuming, energy intensive step, difficult to adopt on a large scale. Hence, it is the need of the hour to standardize the raw

materials to obtain consistency in the final product and to develop standard operating procedure for the preparation of polyherbal formulation.

Highlights of progress/ achievements:

Extensive comprehensive assessment of traceability, sustainability of the herbs for the poly-herbal formulation has been documented. A set of herbs are replaced with accepted substitutes as per classical texts or rasa-guna analysis. Established monograph of each herb which are part of poly-herbal formulation, each monograph follows a standard format with information presented in section followed by a reference list. The monograph presents geographical distribution, macroscopic and microscopic identification of each herb, HPTLC fingerprinting, DNA barcoding profile, Ayurvedic explanation of each herb (dravya), followed by scientific literature. Extensive scientific evaluation of the process development of the ploy-herbal Rasayana formulation has been documented. In order to assess reproducibility of batch yields and control quality parameters, the preparation process has been sub-divided into unit operations. Also, critical quality attributes at each stage of preparation has been developed.

Team: Dr. Gurmeet Singh, Dr. Bhagya V Rao, Dr. Shridevi Gothe, Ms. Anuja T, Mr. Subham B

Project/program title: Role of different post-harvest processed turmeric in maintaining bone health- A comprehensive study

Relevance of the project

Osteoporosis is a chronic epidemic condition which leads to increased bone fragility with higher chance of fracture. It is characterized by low bone mass and micro-architectural deterioration of bone tissues. More than 200 million people suffer from osteoporosis worldwide. Treatment strategy includes pharmacotherapy and life style measures, which includes dietary changes, mineral supplementation and exercise. Drugs should be used on long term basis to treat osteoporosis condition. However, due to their adverse effects, their usage is limited. Turmeric, *Curcuma longa* an Ayurvedic herb, has been used for centuries as a dietary spice and as a traditional Indian medicine. Turmeric has showed anti-inflammatory, antioxidant, antiviral, antibacterial, antifungal and anticancer activities in experimental conditions. Curcumin, a chemical moiety present in turmeric, targets proteins like NF-kB, activating protein-1, β-catenin, and peroxisome proliferator activated receptor-γ, cyclooxygenase-2, nitric oxide synthase, cyclin D1, cytokines TNF-α, IL-1 and IL-6. Also, previous studies demonstrated that curcumin regulates bone remodeling by acting on osteoblasts and osteoclasts. The aim of the present study is to investigate the effects of turmeric, subject to different post-harvest treatments, (one with lime and other without lime) on bone health of ovariectomized rat model of postmenopausal osteoporosis. Also, we will be estimating complete chemical profile of different processed turmeric for curcuminoids, the essential oil present in Turmeric.

Highlights of progress/ achievements

Fresh turmeric rhizomes were procured from the market, washed and cleaned thoroughly with water. Half of the quantity of turmeric rhizome was mixed with equal amount of quick lime water (calcium hydroxide) in air-tight earthen pot for 90 days. After 90 days, turmeric was removed from the pot, washed thoroughly with water to remove lime, and dried. Other half of the quantity was dried in dryer. 12-14-week-old female Wistar rats were subjected to bilateral ovariectomy. The rats were allowed to recover from surgery for one week and randomly divided into 7 groups to receive standard and turmeric treatment for 12 weeks.

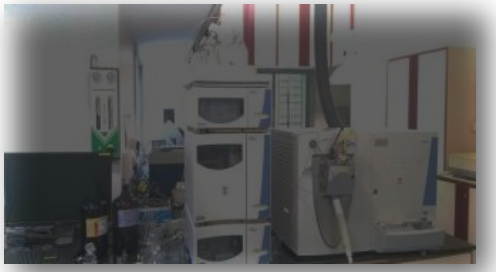
Team members involved: Dr. Gurmeet Singh, Dr. Bhagya V Rao

List of Instruments purchased during 2018-19 and located in different labs of CABHN

Built full furnished Food & Formulations Analytical Laboratory lab

HPTLC

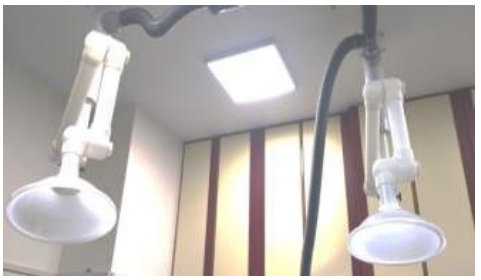
HPLC



LC-MS

GC-MS

Water activity



Spot exhaust

Instrumentation facilities established at Food & Formulations Analytical Laboratory lab

Single batch Evaporator

Deep Freezer (-20 C)

Polarimeter

Electromagnetic sieve shaker

Carbonation machine

Spray dryer

Instrumentation facilities established at Wet Pilot Plant

Dehydrator

Carding machine

Double Cauldron machine

Automatic flat Tea Frying machine

Roller Table

Instrumentation facilities established at Post-Harvest Processing Pilot Plant

Real-time PCR: QuantStudio 3,
Applied biosystems

Gel doc: G:BOX F3, Syngene

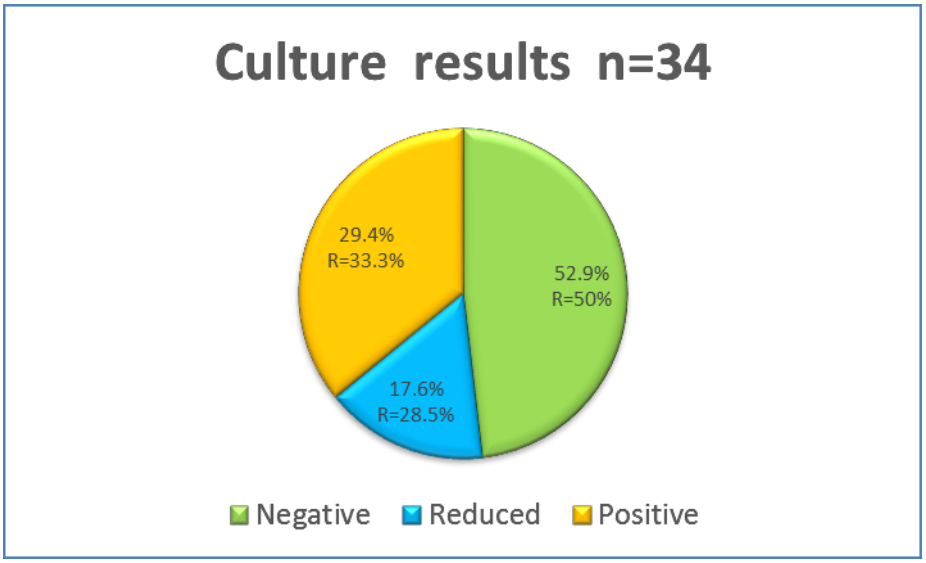
Instrumentation facilities established at Multi-omics lab

Center for Clinical Research and Education

Project/program title: Evaluation of Ayurvedic Management of uncomplicated urinary tract infections (UTI) in adult females-using modern biochemical tests– A Pre-post, Pragmatic Clinical Study.

Relevance (scientific/social) of the project: Bacteria causing UTIs are becoming resistant even against highly potent antibiotics. Hence, there is a requirement for alternative treatments to address UTIs that would benefit patients as well as the healthcare system. Ayurvedic treatment appears to be effective in treating UTIs without using antibiotics. This preliminary observation underlies the need for a defined clinical study on Ayurvedic management for UTI. If Ayurvedic treatments are proven to be effective, they may be promoted for recurrent as well as antibiotic resistant cases of UTI

Highlights of progress/ achievements: After IEC approval, around 590 female patients with urinary complaints were screened, 46 patients of uncomplicated UTI were recruited based on clinical signs and symptoms along with urine culture positive results for presence of bacteria. They were administered Ayurveda whole systems management for 15 days to 3 months. All the patients became asymptomatic during the course of treatment with 55% showing negative culture results in urine, 21% showing reduction in the organism count and remaining 24% showed culture positive in spite of being asymptomatic.



Several reports have shown that there is a change is resistance bacterial phenotype to sensitive phenotype for various antibiotics after Ayurveda treatment. We hypothesize that, in patients with culture positive results in spite of being asymptomatic, mostly pathogenic bacteria is reverted to colonization stage or biofilm stage from infection stage, hence the patients are not experiencing the symptoms. This may be due to improvement in host immune response also. Additional work on delineating which microbes are responsible for causing UTI in different individuals, the specificity of their susceptibilities to different treatment regimen before and after Ayurveda management, as well as their quantification is under progress.

The urinary exosome biomarkers of UTI also are planned to be investigated in the period April 2019 – March 2020.

Team members: Dr Neelambika, Dr Poornima , Dr Rashel, Dr Sanjeev Tonshal, Dr Flavia Shankar, Ms. Bhavya, Dr Satish Rao

Talks: Dr. Poornima gave an instructive presentation on personal hygiene and how to prevent UTI at a local high-school in Siluvepura.

Project/program title: Evaluation of biomarkers in patients undergoing Ayurvedic Management of uncomplicated urinary tract infections in adult females

Relevance (scientific/social) of the project: This project is a systematic study to explore the suggested 'Immune-modulation' pathway of Ayurveda treatment against uncomplicated UTI. The molecular and supra-molecular changes in the bio markers in the patients receiving Ayurvedic treatment will be quantified to map the molecular pathway of recovery.

Highlights of progress/ achievements:

a. IEC approval obtained to conduct the study

b. Introduction and preliminary training to the laboratory staff regarding importance and procedure of samples handling for storage.

Team members: Dr. Satish Rao,Dr. Poornima H V R, Dr. Neelambika G B, Dr. Rashel, Ms. Bhavya

Project/program title: The effect of Ayurvedic enema (*Lekhana basti*) on obese adult human w.s.r to Intestinal permeability- Open labeled prospective single group clinical study.

Relevance (scientific/social) of the project: Obesity and its metabolic complications are major health problems worldwide, and increasing evidence implicates the microbiota in these important health issues. Moreover, alterations in gut microbiota, increased intestinal permeability, and metabolic endotoxemia likely play a role in the development of a chronic low-grade inflammatory state in the host that contributes to the development of obesity and associated chronic metabolic diseases. Ayurveda suggests various diet and life advices along with medicaments and therapeutic measures for obesity. Medicated enema is one of the prime recommendations for reduction of obesity. This study was planned to evaluate the effect of medicated enema (lekhanabasti) in obesity w.s.r Intestinal permeability.

Highlights of progress/ achievements: 20 obese people adults, both male and female, were recruited based on BMI≥30, who were devoid of other serious illnesses. Participants were administered 9 days of medicated enema known as *Lekhana basti.*

Multi sugar whole Gut permeability assay was done through urine analysis by Liquid Chromatography – Mass spectrometry (LC_MS) before and after treatment along with one more assay after 15 days of resting period.

Clinical parameters like BMI, lipid profile and anthropometric measurements were done before and after treatment.

Major alterations in intestinal permeability through LCMS were not observed but there was reduction in the endotoxins. Endotoxin is one of the most important bacterial components contributing to the inflammatory process. It is postulated that the presence of endotoxin in the blood in conditions other than gram negative sepsis like in obesity is related to altered gut permeability. There was highly significant reduction in weight, BMI, total cholesterol, triglycerides, LDL, VLDL along with significant reduction in chest and hip circumference. This study is first of its kind documenting the effect of Ayurvedic medicated enema on intestinal permeability and endotoxin assay. Proteomic analysis of exosome is planned and will be presented as part of next year's annual report.

Team members: Dr Poornima H V R, Ms. Bhavya, Dr. Satish P Ramachandra Rao.

Financial support: Project was supported by TDU and partially by La Trobe University, Australia.

Project/program title: Efficacy of Chandraprabha Vati and Punarnava in the Chronic Kidney Nephropathy (CKD) model in Mice.

Relevance (scientific/social) of the project: Chronic Kidney Disease (CKD) is a global healthcare issue that is increasing at an alarming rate in India. The renal replacement therapies in the form of dialysis and / or transplantation are highly invasive and expensive, necessitating an alternative.

Ayurveda has shown to manage CKD with herbal and herbo mineral formulations along with some therapies. Chandraprabha vati and Punarnava tops the list of medications used for CKD in Ayurveda. This study was planned to evaluate the synergetic effect of these medications as they are usually prescribed together in Ayurveda. This study also plans at evaluating organ and molecular level alterations/changes before and after treatment with these formulations. . This study will throw some light on mechanism of selected Ayurveda formulations that are commonly used in the Ayurveda practice. The synergistic effect of Chandraprabha vati and Punarnava is evaluated for the first time in this study.

Highlights of progress/ achievements: Nephropathy was induced in BALB/c mice with Adriamycin and test formulations along with standard was administered.

The results of this study are being collected and will be collated as data. Additionally, we are planning to conduct exosome analysis and gut microbiome analysis of the animals before and after treatment.

Team members: Dr Satish P Ramachandra Rao, Dr. Poornima H V R, Ms. Bhavya V

Project/program title: Whole systems management of Parkinson's disease, an observational pilot study.

Relevance (scientific/social) of the project: Parkinson's disease (PD) is a chronic, progressive degenerative disorder of the central nervous system, characterized by tremor, rigidity, bradykinesia and postural instability as major symptoms. Though PD is designated as movement disorder, it is associated with range of non-motor symptoms, like problems in speech, swallowing, constipation, incontinence, sexual dysfunction, sleep disturbance and social isolation. Although there have been landmark advancement in contemporary understanding of PD in terms of

pathogenesis and clinical symptoms, still there are lacunae in current management. Indian traditional medicine, Ayurveda, describes conditions very similar to Parkinson's disease and suggests a holistic approach for its management. Ayurvedic textual information, practice and few scientific studies together indicate its potential in treatment of various aspects of PD. However, detailed trans-disciplinary research is warranted for gaining deeper understanding and developing contemporary scientific data (clinical and preclinical) for effective use of Ayurveda for treatment of PD. Systematic documentation of PD patients undergoing whole systems Ayurveda on internationally accepted tools like Unified Parkinson's Disease Rating Scale (UPDRS) was initiated through this project.

Highlights of progress/ achievements:

Ayurveda doctors at IAIM were trained under Movement disorder specialist for documentation on UPDRS

18 cases of PD have been documented with three or more follow-ups. 12 out 18 show trends of improvement.

Overall improvement especially in case of idiopathic PD and Parkinson's plus syndrome are variable. Broadly we have seen following trends

A. Idiopathic Parkinson's –

Improvement in motor functions

Drug naive can be maintained and managed without modern drugs in early stages

Improved quality of life

B Parkinson's plus syndromes

Better ability to walk

Improved gait

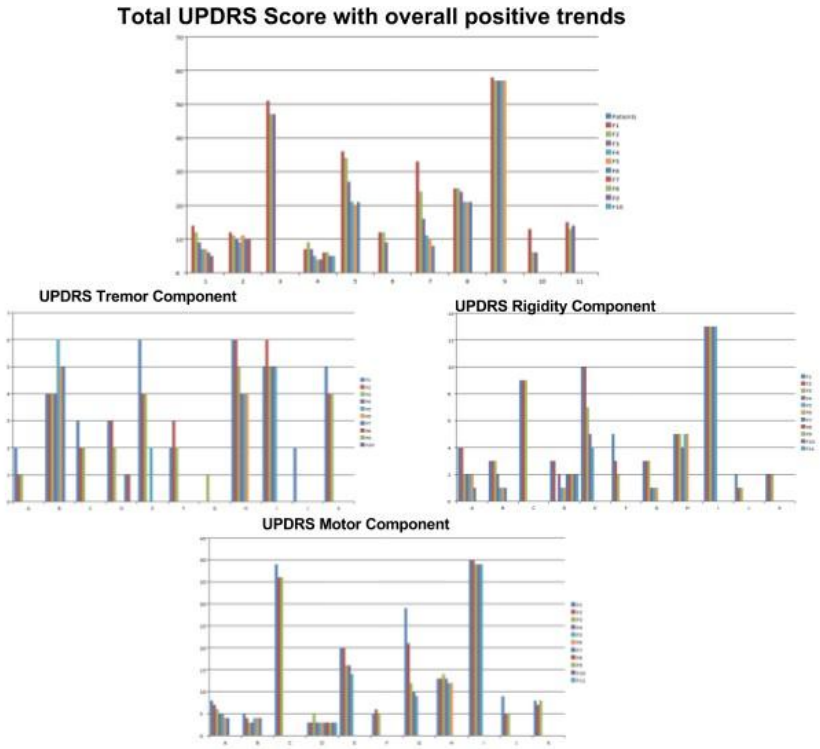
Sleep improvement

Bowel improvement

Speech improvement

Out of the 18 patients treated, 12 patients (6 each on OPD and IPD treatments) showed a positive trend and 1 was stable. Amongst the patients who have improved 2 patient were drug naive, 5 patient were able to reduce their dose of allopathy medications and 3 patients continued to take their Allopathy medications without any change. One patient had to add an Allopathic medication.

Preliminary analysis indicates that out of the 12 patients, total UPDRS Motor score analysis has shown mean decrease of 8.02 units, tremor component mean decrease was 1.12 units and Rigidity component mean decrease was 1.64 units and functional component mean decrease was 3.64 units. Only the patients with more than 3 follow ups are included in the analysis. [Note: UPDRS M was divided into tremor, rigidity, functional component and total UPDRS M]



Team members: Dr Prashanth, Dr Prasan Shankar, Dr Poornima, Dr Ashwini Godbole

Project/program title: Development of Wellness score

Relevance (scientific/social) of the project: The awareness about health and wellness is increasing with rising challenges of diseases. Wellness refers mainly to the individual feeling of one's body/mind/spirit. Currently, practical interventions of wellness SPA industry generally comprise specialized massage, sauna, health foods, fragrances, Yoga and so on. Such interventions undoubtedly provide relaxation and contribute to wellbeing particularly if they are delivered with grace and high quality of service. However such interventions from a "Wellness Science" perspective are generalized and arbitrary because they are not founded on a sound concept of wellness. This study was taken up to develop a wellness score based on the concepts of Ayurveda concept of health depicted by

- *Sama Dosha* (physiological equilibrium normal functions)
- *Sama Agni* (proper functions of digestive fire and metabolism)
- *Sama Dhatu* (physiological equilibrium of tissues)
- *Sama Malakriya* (proper evacuation of wastes, such as feces, urine and sweat)
- *Prasanna Indriya* (efficient working of sense organs)
- *Prasanna Mana* (cheerful mind)
- *Prasanna Atma* (peaceful soul).

Highlights of progress/ achievements:

With the objective of developing a comprehensive tool for wellness assessment, a workshop was conducted on August 2018 to get insights and inputs from experts in the field of Ayurveda on the various parameters to be included for the assessment of the overall Wellness score in a Healthy individual.

A field study was done for 200 healthy volunteers at I-AIM and Pune centers to test the wellness questionnaire.

In collaboration with eRx solutions, a field testable version of the wellness assessment software was developed.

Currently the field trial of software is in progress. After review of the results of the field trial the final version of the wellness software will be released. This is a unique initiative and has been a long-term goal of IAIM to create a comprehensive tool to assess an individual's wellness score.

Team members: Dr Prasanna Kulkarni, Dr Prasan Shankar, Dr Yashaswini Gowda, Dr Narendra Pendse, Dr Girish Tillu, Dr Ganesh

Financial support: This study is sponsored by Anand Spa IHHR Hospitality Pvt. Ltd, I-AIM Healthcare Centre, eRx Solutions Private limited.

Project/program title: Effect of Brahmi ghrita and Brahmi extract on cognitive functions in mild cognitively impaired (mci) population - a randomized controlled study

Relevance (scientific/social) of the project: The ability to maintain high levels of cognition is considered to be an indicator of a healthy nervous system and a protective factor for neurodegeneration. Thus, promotion of cognition, prevention, and reversal of its decline is of great bio-medical interest. Mild Cognitive Impairment (MCI) is one of the most common clinical manifestations affecting the elderly population. It defines a transitional stage between normal ageing and dementia. Around 46% of people with MCI develop dementia within 3 years compared to 3% of the population of the same age without MCI. Timely intervention is extremely important in these cases. Limitations and adverse effects of modern medications for MCI suggest the need for alternative medications for the same. Ayurveda has detailed about ***medhya rasayana*** which are specific to brain and nervous system. Bramhi is one of the herbs that is being used as *medya rasayana*. It is suggested to be taken in ghee form in Ayurveda. Hence this study was planned to evaluate the effect of Bramhi ghee in MCI patients.

Highlights of progress/ achievements: After IEC approval, Screening of elderly population is being done and the status till now: No. of participants screened – 60 No. of MCI cases identified -5 No. of cases who completed the trial – 2 No. of cases undergoing the trial - 2

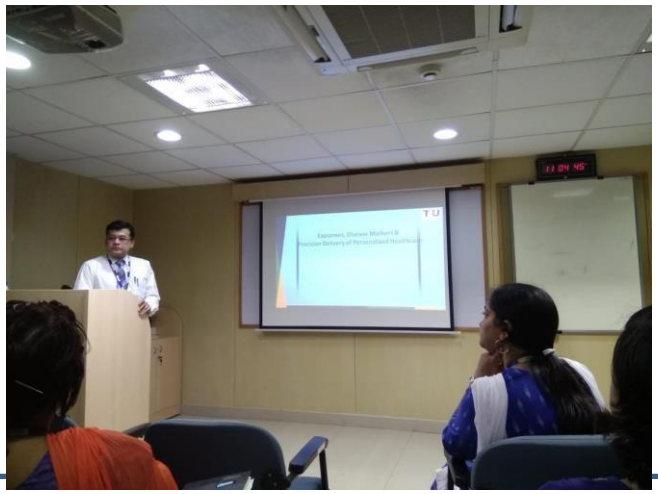
Preliminary observations: Brahmi ghee enhanced spatial memory and auditory verbal memory in one participant. For the second participant improvement in information processing and verbal fluency was observed. It also enhanced the quality of sleep and lower the levels of irritability in both cases who completed the trail. This study is ongoing.

Team members: Dr Vivekanand, Dr Bhaktee , Dr Poornima Devakumar, Dr Gowripriya, Dr Ashiwni Godbole

Presentations: Poster presentation at International symposium on dementia at IISC from 14-16th November 2018 to create awareness regarding Mild Cognition Impairment (MCI) and its treatment available in Ayurveda was done to elderly people. Presented by Dr. Poornima, Dr. Vivekananda and Dr. Gowripriya

Presentations from CCRE team:

1. Dr. Satish P Ramachandra Rao presentation on Exosome, disease markers and precision delivery of personalized healthcare. At GangaGen on 25th July 2018



2. **Dr Poornima delivering** an invited talk **"Herbs for health and healing"** for general public and botany students of Mount Carmel college on 2.7.18

3. Dr. Poornima presented **"Guidelines to publish case reports"** for Ayurveda doctors at Agnivesha Ayurveda Pratishtana, Bangalore 5.11.18

Dr. Poornima delivering a talk at Agnivesha Ayurveda pratishtana on the topic of Guidelines to publish case reports

Dr. Poornima getting felicitated at Agnivesha Ayurveda Pratishtana - Guidelines to publish case reports

Publications from CCRE:

1. Singal AK, Jackson B, Pereira GB, Russ KB, Fitzmorris PS, Kakati D, Axley P, Ravi S, Seay T, **Ramachandra Rao SP**, Mehta R, Kuo YF, Singh KP, Agarwal A. Biomarkers of Renal Injury in Cirrhosis: Association with Acute Kidney Injury and Recovery after Liver Transplantation, Nephron. 2018; 138(1):1-12. doi: 10.1159/000479074

2. Linda Awdishu, Shirley Tsunoda, Michelle Pearlman, Chanthel Kokoy-Mondragon, Majid Ghassemian, Robert K. Naviaux, Heather M. Patton, Ravindra L. Mehta, **Bhavya Vijay**, and **Satish P. RamachandraRao,** Identification of Maltase Glucoamylase as a Biomarker of Acute Kidney Injury in Patients with Cirrhosis, Critical Care Research and Practice, Volume 2019, Article ID 5912804, 8 pages https://doi.org/10.1155/2019/5912804

Education at CCRE:

Person in charge: Dr Girish Kumar

Project/program title: Panchakarma Therapist training

Relevance (scientific/social) of the project:

The program is aimed at providing skilled training and employment, to rural youth who have passed 10th grade and are interested in paramedical work. They are trained on Panchakarma therapy for 6 months, after which they find gainful employment in various Ayurvedic establishments across the country.

Highlights of progress/ achievements:

Trained 71 (28+13+15+15) students from more than 7 states across the country.

100% placement achieved.

Effective evaluation of the training which includes assessment of awareness, knowledge and skills by various methodologies has been developed and implemented.

Systematic selection process which follows Qualitative parameters to grade/score the potential candidate's eligibility to enter the training was practiced.

Financial self-reliance of the training program was achieved.

Project/program title: **Developing Innovative educational programs for Students from Abroad**

Relevance (scientific/social) of the project:

Development of innovative educational programs for professionals residing abroad with interests in the area of Ayurveda and allied integrative medical sciences

Highlights of progress/ achievements:

Developed and conducted an International workshop on "Recent Advances of Research in Ayurveda" for Ayurveda PG Scholars from Sri Lanka (42 doctors trained). Through this program TDU had an opportunity to develop collaboration with GAMPAHA WICKRAMARACHCHI AYURVEDA INSTITUTE, UNIVERSITY OF KELANIYA.

Two students from abroad (one from UK & another from US) underwent internship training programs

Short training on "Introduction to Ayurveda" was delivered for International patients/customers at I-AIM-Inpatients.

Project/program title: **Medicinal Plants & Primary Health Care**

Relevance (scientific/social) of the project:

The program is ongoing from the past 10yrs at various public and community centers. Participants are sensitized on developing self-reliance in primary health care management. They are taught about using medicinal plants grown in their backyard and commonly found in their kitchens that are useful as as home remedies for early management of common ailments.

Highlights of progress/ achievements:

Delivered more than 5 – public talks at various platforms & institutions (Pollution control board, Doordarshan Kendra, Rail wheel factory, Mysore sandal soap factory, etc.)

Delivered series of guest lectures on MP-PHC for Degree students at Mount Carmel College.

Invited talks: Public talks at various platforms & institutions (Pollution control board, Doordarshan Kendra, Rail wheel factory, Mysore sandal soap factory) to create awareness about Ayurveda and positive health.

Team members involved Dr. Girish kumar V., Dr. Sreeja, Dr. Aayush, Dr. MNB Nair, Dr. Yashaswini, Dr. Rashmi, Dr. Uday kumar, Ms. Tarika, Senior Therapist

Dr Girishkumar, presenting at Doordarshan head office Bangalore on Ayurveda and positive health.

Centre for Local Health Traditions and Policy

Project/Program Title: Voluntary Certification Scheme for Traditional Community Healthcare Providers (VCSTCHP)

Relevance (scientific/social) of the project: Traditional Community Healthcare Providers (TCHPs) numbering 1 million, constitute the largest community supported healthcare workers spread across the country. They provide healthcare to local populations in their neighborhood mostly in the rural areas, in the management of common health conditions. Foundation for Revitalisation of Local Health Traditions (FRLHT), Bengaluru and the Quality Council of India (QCI), New Delhi have jointly launched a competency based third party Voluntary Certification Scheme for TCHPs, based on a set of Minimum Standards of Competence (MSC) following the Personnel Certification guidelines of ISO 17024.

Highlights of progress/ achievements:

- The pilot certification program was implemented by FRLHT in six states namely Chhattisgarh, Odisha, Rajasthan, Gujarat, Tamil Nadu and Karnataka, in collaboration with Quality Council of India, IGNOU and certified 517 TCHPs. Based on this experience, MSC documents were revised for the six health conditions namely Common ailments, Jaundice, Arthritis, Poisonous bites, Traditional Bone Setting, Traditional Birth Attendant.
- First Technical Committee and Technical Sub-Committee meeting meetings were held on 9th May 2018 and 11th June 2018 respectively, in TDU campus, to discuss various aspects of VCSTCHP scheme such as role of TCHPs, format of certificate & logo, evaluation criteria, constitution of the assessment committee, drafts of various scheme documents such as code of conduct, Self-declaration form, Free Prior Informed Consent form, Scope of TCHPs and Multiple Choice Question (MCQ) based knowledge evaluation of TCHPs.
- Draft documents such as MSC, MCQ, and question bank for 6 streams were developed as per the scheme document.
- Training of Personnel Certification Bodies (PrCBs): CLHT&P team trained the staff of Etica Clinpharm Pvt. Ltd., Raipur from 10 - 12, July 2018 and the North Eastern Christian University, Dimapur.
- Operations and Quality Manual: We prepared a standard operations and quality manual as per the Scheme document and submitted an application in December 2018, to QCI, to be recognized as PrCB.
- Assessment by QCI team: A team of three Assessors led by Shri. Krishnamurthy S. visited the Centre on 29th January 2019 for assessment of VCSTCHP Requirements for Provisional approval as a Personnel Certification Body.

Publications/Research papers/ invited talks related to the activity during the year.

Publication:

- Unnikrishnan PM, Hariramamurthi G, Sarin NS, Debjani R, 2018. Accreditation, Certification and Self-Regulation: An Innovative Approach for Strengthening and Reintegrating Traditional Community Healthcare Providers. In: Arima M, editor. Local Health Traditions: Plurality and Marginality in South Asia accepted.

Invited talk:

- Hariramamurthi G. A Trans-disciplinary Approach to Documenting and Promoting Traditional Community Health Practices – A Case Study. A 2-day International Conclave on “Ethnopharmacology, Ethno-medicine and

Traditional Health Practices-Global Scenario", was organised jointly by Society for Ethnopharmacology and TransDisciplinary University at V Bapalal Hall, Gujarat University, Ahmedabad, Gujarat, India, from 16th to 17th December, 2018.

- Hariramamurthi G. VCSTCHP in Meghalaya - A traditional healers training workshop was organized in collaboration with QCI, by the Bio Resources Development Centre (BRDC), a Government of Meghalaya Institution under Science & Technology Cell, Planning Department on 6th and 7th December 2018.

- Thematic Session on "Traditional Medicine as Resistance and Resilience" chaired by Prof. Hariramamurthi from TDU and Was organized by TDU, Lok Swasthya Abhiyaan (Traditional Health Campaign), Biodiversity & Community Health Initiative; SOCHARA; Centre of Social Medicine and Community Health, JNU, Health Swaraaj Samvaad and South Asian Dialogues on Ecological Democracy (SADED), as a part of the Fourth People's Health Assembly held on 18th November 2018, at Savar in Bangladesh.

- An Invited Talk on the theme of "Health Policy and Systems Research (HPSR) – the importance of values" was delivered by Dr John Porter, Professor Emeritus at TDU and Professor of International Health, Faculty of Infectious and Tropical Diseases and Public Health and Policy, London School of Hygiene and Tropical Medicine, United Kingdom on 4th October 2018 at TDU Campus, Bengaluru.

- Prof. G. Hariramamurthi visited North Eastern Christian University (NECU) as a Technical Expert for its Office assessment by a two member QCI Assessors Team in NECU in its Dimapur Campus on 22nd September, 2018. He also participated in training for the officials of the Department of Health and Family Welfare on the VCSTCHP Scheme in Kohima, Nagaland on 24th September, 2018.

- Folk Healers organize a thematic session under the banner of Jan Swasthya Abhiyan in the Third National Health Assembly, Raipur on 23rd September 2018. More than 200 traditional healers from different districts of Chhattisgarh participated in the National Health Assembly.

- Prof. G. Hariramamurthi participated as a Resource Person at the Community-to-Community Exchange on ABS and Traditional Knowledge Pretoria, South Africa from 3rd to 8th September 2018.

Community knowledge exchange program:

- A one week Community Knowledge Exchange was organized for a team of 10 traditional healers from Africa sponsored by the Tata Steel Rural Development Society to Jamshedpur to attend the Tribal Samvaad-2018 from 15th to 19th November 2018 and followed by a two day visit to TDU from 21st to 22nd November 2018. (Photo-1)

Team members involved Mr. Hariramamurthi G, Dr. Prakash BN, Dr. Girish Kumar

Project/Program Title: Develop a Replicable Knowledge Resource for One Taluk in Karnataka (HD Kote) in the form of Geospatial Database of Populations, Distribution of Local Medicinal Plants and a Taluk Specific Herbal Pharmacopeia, on an ICT Platform

Component: Health

Relevance (scientific/social) of the project:

Rural communities traditionally manage primary healthcare conditions first at the household level. In this project , the aim is to empower taluka level households and local institutions to self-manage primary healthcare problems using ecosystem specific plants.

Highlights of progress/ achievements:

- **Baseline health survey:** Survey was conducted in 650 households in 30 selected villages of HD Kote. The quantitative data on demography, socio-economic status, disease morbidity, health seeking behavior and healthcare expenditure were analyzed using Epi-info software and SPSS. MS-Excel interactive dashboards were created for better visualization of data. The qualitative data from focus group discussion, in-depth-interview analyzed based on Themes.

- Ten traditional healers were documented using DALHT format and selected traditional practices were adopted in the training material developed to create awareness among the rural households of HD Kote.

- Health education material: 30 brochures, 6 ToT modules (having 5 health conditions each) and 9 videos on use of locally available medicinal plants for primary healthcare were developed. (Photo-2)

- A team from Swami Vivekananda Youth Movement (SVYM), Sarguru, Mysuru provided the health education training to health workers, Aganwadi workers and selected households of HD Kote.

Publications/Research papers/ invited talks related to the activity during the year.

- 30 Brochures on Primary Health care practices

- 6 Training of Trainers module

Team members involved Dr. Prakash BN, Mr. Shivanand Savatagi, Dr. Sarin NS, Dr. Mohan Kumar B.Thambad and his team from SVYM, Dr. PS Sundar Rao, Senior Biostatistician, Dr. Nirmala Murthy, Public Health Expert, Foundation for Research in Health Systems (FRHS), Bengaluru.

Program Title: Pharm-Bio Technology and Traditional Medicine Centre (PHARMBIOTRAC)

Relevance (scientific/social) of the project:

Pham-Bio Technology and Traditional Medicine Centre is established under the Africa Centre of Excellence program (Eastern and South Africa Higher Education Centres of Excellence Project), based at the Mbarara University of Science and Technology (MUST), Western Uganda. The vision of this project is to be a leading African centre of excellence for training and research in traditional medicine and pharm-biotechnology. TDU has signed a MoU with MUST to provide technical support for the effective implementation of PHARMBIOTRAC project.

Highlights of progress/ achievements:

- A team of 3 members (Dr. Prakash BN, Dr. Vishnu Prasad, Dr. Ganesh Babu) from TDU participated in the project launch program and project planning meeting held in Mbarara University.

- Two faculties from TDU (Dr. Prakash BN and Dr. Vishnu Prasad) guiding 3 PhD students as Co-Supervisors.

- TDU provided technical support in the implementation of traditional medicine research and outreach activities.

- Dr. Eunice A. Olet from Dept. of Biology, Faculty of Science, MUST visited TDU from 18th February to 3rd March 2018, to undergo training on herbal garden landscape techniques.

- Eng. Anke Weisheit, Chair, Innovation & Business Management, PHARMBIOTRAC, MUST visited TDU 25th February to 3rd March 2018 to understand activities of TDU and to explore collaborative projects.

Publications/Research papers/ invited talks.

Peer-review Publications

A) Peter EL, Kasali FM, Deyno S, Mtewa A, **Prakash BN**, Tolo CU, Ogwang PE, Sesaazi D. Momordica charantia L. lowers elevated glycaemia in Type 2 Diabetes Mellitus Patients: Systematic review and Meta-analysis. J Ethnopharmacol. 2018 Oct 29. pii: S0378-8741(18)31750-1. doi: 10.1016/j.jep.2018.10.033. [Epub ahead of print]

B) Peter EL, Deyno S, Mtewa A, Kasali FM, **Prakash BN**, Sesaazi D, Tolo CU, Ogwang PE. Safety and efficacy of Momordica charantia Linnaeus in pre-diabetes and type 2 diabetes mellitus patients: a systematic review and meta-analysis protocol. Syst Rev. 2018 Nov 15;7(1):192. doi: 10.1186/s13643-018-0847-x.

Program Title: Documentation and Rapid Assessment of Local Health Traditions (D-RALHT) training program

Relevance program:

Many local health traditions are sound, some are incomplete and a few may be distorted. One of the major challenges in advocating local health practices is to have clear documentation on the efficacy and safety of these practices. Finding out effective practices through elaborate pharmacological and clinical trials is a huge task. In order to systematize and assess various traditional practices in a rapid and cost effective way a participatory method called Documentation and Rapid Assessment of Local Health Traditions (D-RALHT) was applied. This method has been found effective earlier in primary health care conditions in a number of locations in India. It is primarily community based and uses dialogue and building consensus for assessing traditional health practices as their strategy. CLHT&P is promoting this methodology through training programs to encourage local institutions (NGO/CBOs) and traditional healers to document the local traditional healthcare practices.

Highlights of progress/ achievements:

- A two training program was organized from 6th to 8th August, 2018 for Village Health Organisers in Documentation of Local Health Traditions, Massage Techniques and use of Medicinal Plants for Primary Healthcare, sponsored by Friends of Hope, United Kingdom.
- A team from TDU visited Kothagiri, Tamil Nadu from 21st to 23rd January, 2019 to train field staff of Nilgiris Adivasi Welfare Association, in Documentation and Assessment of local Health Traditions (DALHT) methodology, sponsored by Friends of Hope, United Kingdom.
- NAWA is actively involved in the selected villages of Kothagiri to document traditional knowledge on specific health conditions like Anaemia.

Other publications

Darshan Shankar, Unnikrishnan Payyappallimana, Sarin NS, Prakash B N, Hariramamurthi G, 2018. Fostering and Mainstreaming Grass Root Innovations: Local Health Traditions (Under publication)

Academic activities: PhD study titled “Self-reliance for Primary Healthcare using Integrative Healthcare Approaches-Analytical study based on Health Systems Framework” (Mr. Shivanand Savatagi)

Photo-1: Traditional healers from Africa discussing with Vice-Chancellor, TDU

Photo-2: Brochure having information on medicinal plants used for fever. Brochures were used in the training program conducted in 30 villages of HD Kote.

Center for Functional Genomics and Bioinformatics

Project/program title: "**Integrated Genomics-Assisted Breeding for Efficient Development of Superior Finger Millet Varieties for Karnataka".**

Relevance (scientific/social) of the project: In India, Karnataka has the largest area producing finger millet (*Eleusine coracana* L.) production. The major constraints to the finger millet production include blast disease and abiotic stress such as drought and temperature. Hence developing more resilient and drought tolerant varieties that are adapted to the changing climate as well as blast disease through innovative biological system is the need of hour to sustain the finger millet cultivation in Karnataka State.

Considering the complexity of Finger millet genome (tetraploid nature) and big genome size, polyploidy genome the genome, assembly will not be sufficient, but it will require re- sequencing and genetic mapping to undertake molecular breeding activities for development of superior traits. With this background development and identification of superior breeding lines through integrated breeding, re-sequencing of 1000 finger millet varieties for further utilization in molecular breeding for finger millet development.

Highlights of progress/ achievements:

- The Finger Millet germplasm of released (superior commercially available finger millet varieties), blast resistant, blast susceptible varieties were collected from GKVK, seeds were sown, grown for the DNA isolation for whole Genome sequencing. 88 Finger Millet germplasm were re-sequenced and the Bioinformatics analysis for selecting superior traits is in progress.

- The pipeline used for the analysis involved the FastQC, TrimGalore, and GATK for analyzing the SNPs and insertions & deletions.

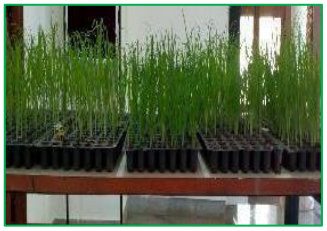
- Validation of the pipeline: To validate the pipeline used for the prediction of SNPs, we took data and prediction parameters from already published work [Anon, 2014]. The prediction was carried out on one sample *indica* rice variety with both our pipeline and the pipeline from the 3000 rice genomes project [Anon, 2014]. We observed that both the pipelines shared ~88% of the SNPs positions. Hence the pipeline developed for this project is significant.

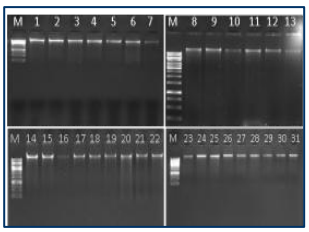
- After the validation the developed pipeline was used to analyze 63 Finger millet samples from Karnataka, for SNPs and InDels identification. This would help in identifying the superior traits, blast resistance, temperature tolerant and drought tolerant Finger Millet germplasm. Further this would help in Marker assisted selection of Finger Millet germplasm with superior traits.

- In addition to this, the pedigree analysis for few Ragi germplasm was initiated. One example of this is parent 1: Indaf 5, parent 2: PR202 and child: MR-2, were mapped to the ML365 reference using the GATK pipeline. The family pedigree depiction and the number of SNPs in the family members were defined. In this 61,671 SNPs were shared between two parents and 64,420 were from parent 1 and 1, 09,204 were from parent 2.

Team members: Prof. Malali Gowda, Dr. Venu Seenappa, Dr. Lavanya Devi K

DNA ISOLATION & SEQUENCING





Project/program title: Elucidation of molecular mechanisms involved in *Pistacia*-aphid gall development

Relevance (scientific/social) of the project: *Pistacia integerrima* belongs to family *Anacardiaceae* widely distributed in North-West and Western Himalayas and called by different names such as kakroi, kakarsinghi and kakarsinghi. *Pistacia chinensis* subsp. *Integerrima* is well-known for formation of galls on leaves and petioles. These galls are horn shaped, formed due to insect attack of *Pemphigus species.* Need for this study was felt because of the high demand (estimated annual trade: 200-500MT., increased during past two decades), but fluctuation and constant decrease in the supply of Karkatashringi. Till date, no studies were taken up on production of galls, interaction of plant & insect as well as bottleneck in gall production.

Highlights of progress/ achievements:

- Identification of specific genes, differentially expressed genes, plant growth regulator genes and transcription factors of gall and leaf
- Identification of Simple Sequence Repeats (SSR) distribution in gall and leaf
- Identification of 21 proteins against *Cajanus cajan*, 10 proteins against *Arabidopsis thaliana* and 14 proteins against *Drosophila melanogaster*
- Manuscript titled "Elucidation of *Pistacia chinensis subsp. integerrima* (J. L. Stewart ex Brandis) Rech. f. - Aphid Gall Development Using Transcriptome and Proteome analysis" ready to communicate
- A total of 24 endophytic fungi and 6 endophytic bacteria have been isolated.
- Endophytic fungi identified by molecular method were found to be *Nigrospora, Diaporthe, Cladosporium and Phomposis sp.*
- Optimization of soil media for isolation of soil microbes

Publications/Research papers/ invited talks related to the activity during the year.

Manuscript titled "Elucidation of *Pistacia chinensis subsp. integerrima* (J. L. Stewart ex Brandis) Rech. f. - Aphid Gall Development Using Transcriptome and Proteome analysis" communicated to Frontiers in Plant Science. Received comments (in revision)

Team members: Dr. Malali Gowda, Dr. Pavithra N, Dr. Noorunnisa Begum

Project/program title: Authentication of Medicinal Plants Using DNA Fingerprinting Technique

Relevance (scientific/social) of the project:

Medicinal plants have gained popularity worldwide for treatment of diseases and maintenance of health. According to WHO reports, 80 % of world population depend on botanical drugs and therefore the international trade for herbal medicine is a force in global economy. From the literature survey it has been found that worldwide more than 1,000 companies are involved in the production of herbal products with the annual revenues in excess of US$60 billion and India ranking third herbal medicine holds the value for botanical related trade of about US$10 billion per annum with the annual export of US$1.1 billion. Since there is a huge demand at the national as well as international level for herbal drugs, there is a need to maintain the quality and purity of plant material. But the adulteration and use of substitutes has become a major concern for the users as well as industry. Henceforth the authentication of medicinal plants is of utmost importance for safety and efficacy of herbal drugs. Sequencing a

standard region of DNA known as DNA barcoding can be used as an efficient tool for species identification as these DNA markers are not age dependent, tissue specific and also have a high discriminating power. Chloroplast genes can be used for DNA barcoding.

Highlights of progress/ achievements:

1. Genomic DNA from fresh plant samples (14) as well as dry samples (12) has been successful using Cetyl Trimethyl Ammonium Bromide (CTAB) as well as commercially available kits

2. Universal primers such as matK, rpo B &C, ndhG did not work for few samples tested

3. rbCL , ITS 1 &2 , psb A trn H has been successful for most of the plant samples.

4. Reamplification of these genes has also not worked for dry samples

Team members: Dr. Malali Gowda, Dr. Pavithra N, Dr. Lavanya D K

Project/program title: Study of Transposons in rice (*Oryza sativa* L.) and their association in host resistance

Relevance (scientific/social) of the project:

Transposable elements (TEs) are mobile DNA elements which exist in almost all eukaryotic genomes as they have regulatory or coding sequences and often occur in large copy numbers. TEs can cause the transcription or methylation of nearby genes and significantly promote structural variation or genome size expansion. However, TEs are rapidly evolving due to the arms races with their host genomes. In the present work, we investigated the TEs in Rice (Oryza sativa L.) as it is a staple food for more than half of the world's population and it is model organism for genomic research; but can be attacked by most devastating pathogen *Magnaporthe oryzae* causes Rice Blast disease, which significantly reduces yield up to 65% in susceptible cultivars and grain quality worldwide. Plant disease resistance (R) genes can detect a pathogen attack and facilitate a counter-attack against the pathogen, but TEs can affect the expression of these R - genes. To understand TE role in host pathogen interactions, we analyze 29 different rice species by using RepeatModeler and RepeatMasker. The data indicates the average TE content of rice genome assemblies is 38.79%, and 66 different TEs are associated with-in different 66 R - genes of O. sativa Nipponbare in 113 copies.

Highlights of progress/ achievements:

The average TE content in genome after study of 29 rice assemblies is **38.79 %**

It is observed that TE content in wild rice *O. brachyantha* is low as **20.47%** and in *O. punctate* it is high as **48.55 %**

The fraction of Long Terminal Repeats (**LTR elements) are** more compare to other elements in rice genome

Two classes of LTR elements (**Ty1/Copia** and **Gypsy/DIRS1**) account for a significant portion of the genome size variations present in the Oryza genus

It is observed that the different **69 TEs** are located within various **151 disease resistance (*R)* - genes** of *O. sativa* Nipponbare

19 types of Rice disease resistance protein (R) are associated with **11** different subclasses of TEs

Team members: Dr. Malali Gowda, Dr. Subhankar Roy Barman, Mr. Ravindra Raut

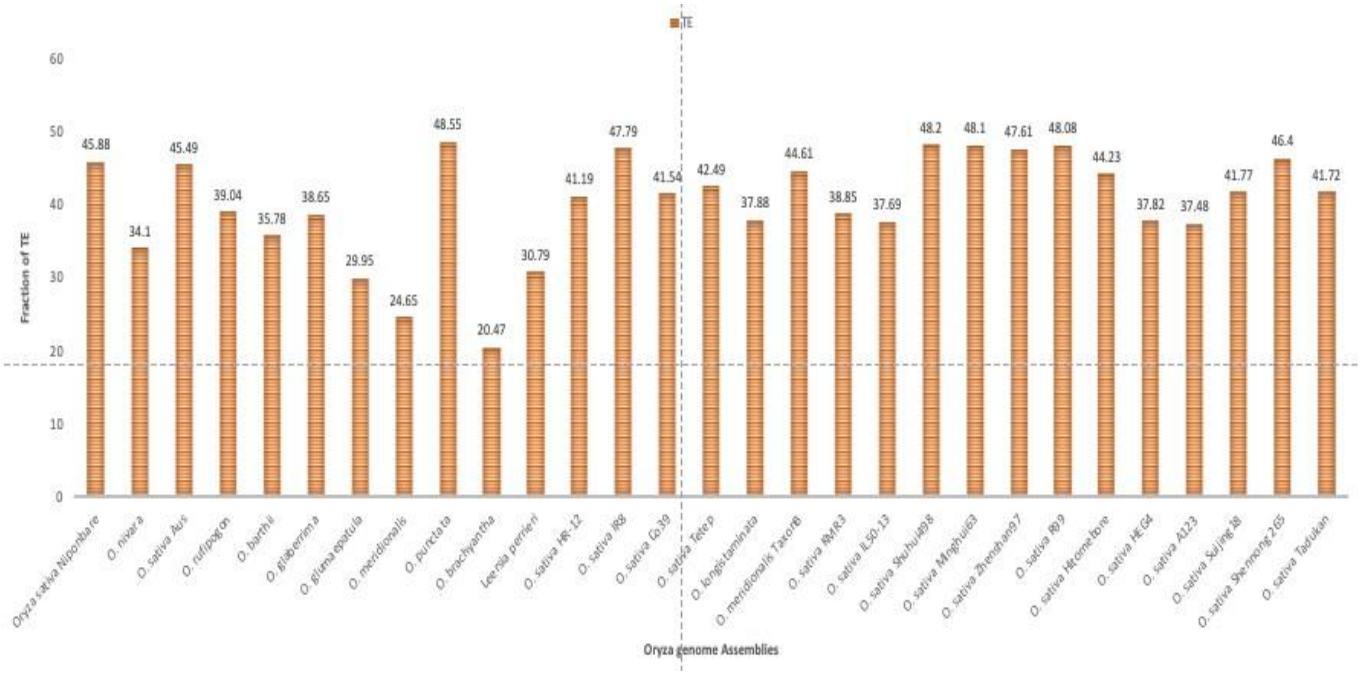


Figure 1. TE content in various rice genomes.

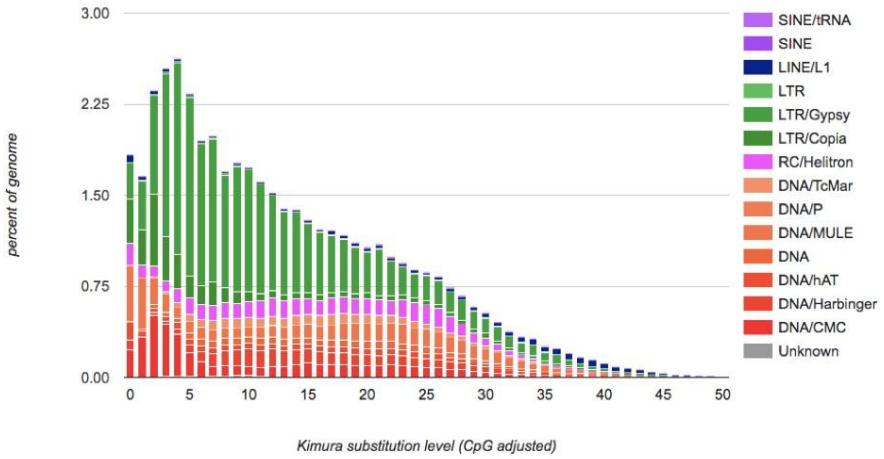


Figure 2. a) TE fraction in *O. sativa* Japonica Nipponbare

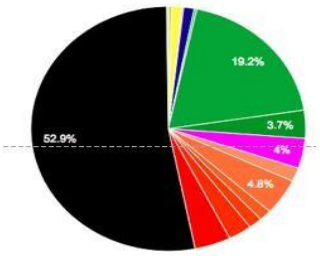


Fig 1. b) Genome fraction for TEs in *O. sativa* Japonica Nipponbare

Project title: To study the molecular basis of *Ficus religiosa* and its effect on human diseases and health

Relevance (scientific) of the project: *Ficus religiosa* is been used for treating several disease in traditional medicines. But relatively less studied and also it lacks the information in molecular level. Our hypothesis is to understand the medicinal plants with scientific and molecular level evidences. In this study, we will be looking into the molecular aspects of *F. religiosa* and its metabolic pathways in relation to human disease

Highlights of progress:

1. Estimated the Genome size, sequenced and assembled whole genome of *F. religiosa*

2. Sequenced and analyzed transcriptome of *F. religiosa* leaf tissues

3. Data submitted to NCBI SRA

4. Isolated Proteins and metabolites from *F. religiosa*

5. Annotated the genes from assembled genome

6. Cultured endophytes from *F. religiosa*

Team members: Prof. Malali Gowda, Collaborated with Dr. Keshav Prasad, Yenepoya deemed to be University for Protein and metabolome part of the work, Ms. Ashalatha K L

Project/program title: Training on Next generation Sequencing Technology and Bioinformatics and MSc in Biological Sciences (Bioinformatics and Functional Genomics by Research)

Relevance (scientific/social) of the project

- Next Generation Sequencing (NGS) is a recent technological revolution in life science that transformed our understanding of life's genome landscape
- Present training helps to get a deeper understanding in NGS technology with a special focus on RNA world and transcriptome analysis
- Teach the fundamentals of NGS workflow from sample preparation to sequencing
- Globally huge demand and opportunities in genomics and industry

Objectives

- Training and capitalizing human resources to carry out NGS and transcriptome analysis.
- Carry out high throughput research using genomic tools to foster trans-disciplinary dialogues in functional genomics.

Highlights of progress/ achievements

Created "Genomics Training Ecosystem" in the country by conducting 13 training programs.

Trained > 500 Scientists (Streams of Biology, Engineering, Technology). Achieved 100% literacy by participants in the areas of Genomics and Bioinformatics

Team members involved: Dr Malali Gowda, Dr Sheethal A, Dr Pavithra N, Dr. Santhosh, Dr. Venu Seenappa, Dr. Lavanya Devi K, Dr. Niranjan, Ms. Ashalatha, Mr. Santhosh, Mr. Ravindra Raut, Ms. Puja, Ms. Divyarani Basappa

Figure 1: Training Programme on Next Generation Sequencing and Bioinformatics organized by Centre for Functional Genomics and Bioinformatics at TDU

Figure 2: Over-all representation of the participants of NGS Training Programme

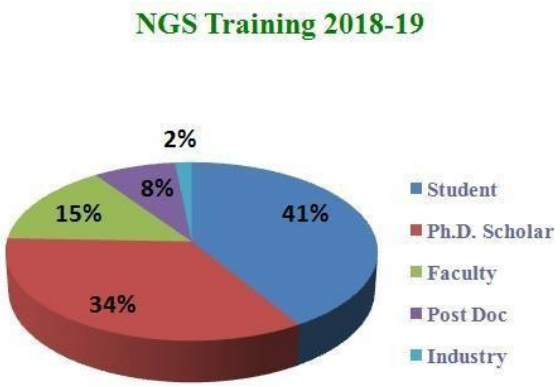


Table 1: Training Programs held at CFGB, TDU during April 2018 - April 2019

Theme	Time
Transcriptome Sequencing and Analysis	April 2018
Next Generation Genomic Technologies	June 2018
Next Generation Sequencing and Analysis (Genome, RNA Seq and Meta Genome)	September 2018
Next Generation Sequencing and Analysis (Genomics, Transcriptome and Transposons)	November-December 2018
Next Generation Sequencing and Analysis (Whole Genome Sequencing)	January-2019
Next Generation Sequencing and Analysis (Genomics, Transcriptome and Transposons)	February 2019

I-AIM Healthcare Center

In 2011, on the Trans-disciplinary University campus, Ratan Tata inaugurated a futuristic healthcare facility called the Institute of Ayurveda and Integrative medicine (I-AIM). The center is located in North Bangalore, Yelahanka district and is steadily gaining popularity among health-conscious individuals, across all sections of the society. The 100-bed integrative healthcare center has a footfall of ~43,000 annually.

Customer testimonials suggest that IAIM is a popular destination for the management of several non-communicable diseases: muscular - skeletal diseases such as cervical spondylosis, lumbar spondylosis, diseases of the elderly like Parkinson's, strokes, metabolic diseases like diabetes and obesity, developmental disorders in children like autism and cerebral palsy, women health issues like PCOS, infertility, pregnancy care during antenatal and postnatal period, respiratory disorders, eye diseases of non-surgical nature, skin conditions, non-healing diabetic wounds and ano-rectal diseases.

I-AIM has 12 specialty units each managed by expert clinicians. The 100-bed hospital is equipped with accommodation facility suitable for all strata of society (starting from general ward, triple sharing rooms, Semi-Private, Private single rooms, Semi-deluxe, Deluxe and Suite). The center has 24 spacious, well equipped, state of the art Panchakarma theaters and around 40 well-trained Panchakarma therapists.

Under one roof, IAIM provides Ayurveda, Yoga, Acupuncture, Physiotherapy and modern diagnostics. To enhance our yoga services, I-AIM has collaborated with esteemed yoga centre: Krishnamachari Yoga Mandiram.

The healthcare facility offers services to economically **weaker sections at subsidized rates**. It conducts regular camps in rural and urban settings serving several thousand patients.

The I-AIM Healthcare Centre campus is uniquely landscaped with over 1200 species of medicinal plants and a nursery, which provides medicinal plants for home gardens.

Although IAIM focuses on traditional knowledge, it believes in contemporizing Ayurveda for healthcare in India. Its vision is "**To provide innovative integrative healthcare for homes, communities and institutions."**

I-AIM celebrated its 9th anniversary in the year 2018-19. As an organization, which set out to provide integrative healthcare to society, we have come a long way!!





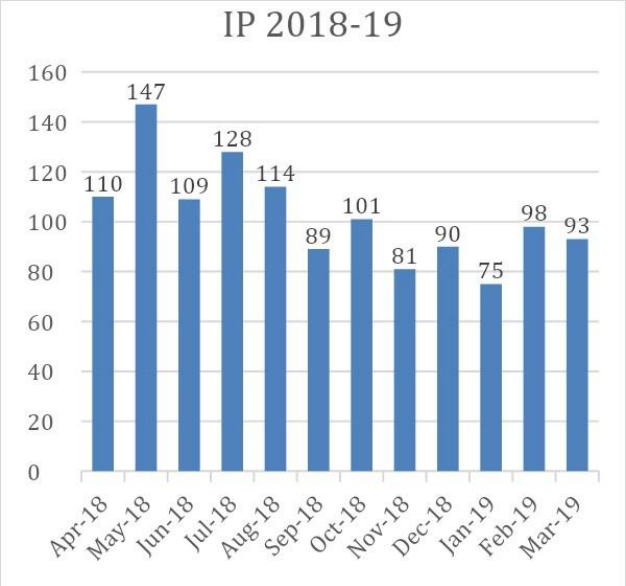


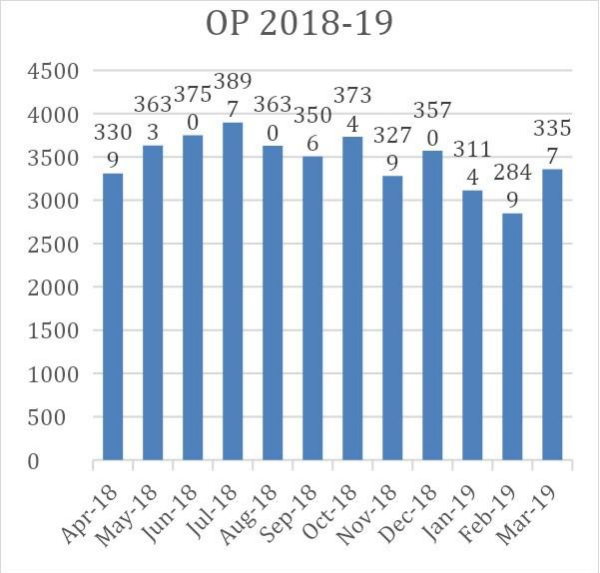
100 bed Multi-specialty Ayurveda Services

10 Full-time Senior Physicians + 4 Specialists + 18 Duty Doctors

Annual footfalls:

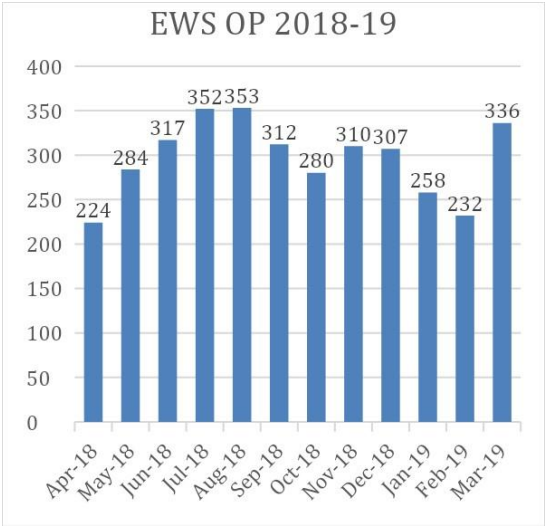
IP admission: 1235 OP visits: 41628

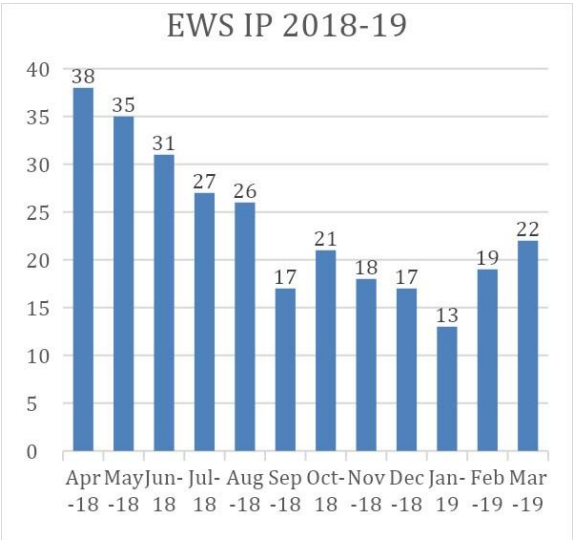




Support to Economically weaker sections of society

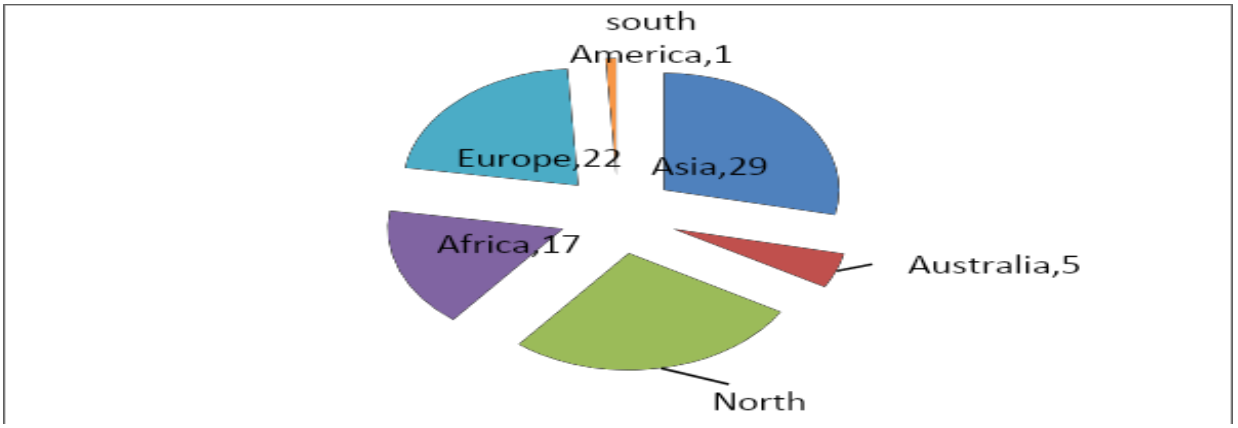
IP EWS admission: 284 OP visits: 3565





International Patient footfalls:

OP visits:102 International IP admission: 65



Wellness Retreat at IAIM:

To provide the best of Ayurveda wellness (Wellness science), Yoga, Nutrition, I-AIM has successfully being conducting wellness retreat over the last 4 years.

A. Awareness talks

How to write the case reports for publications" for Ayurveda doctors at Agnivesha Ayurveda Pratishtana, Bangalore by Dr. Poornima

B. Conference participated:

1. Indo-UK summit on emerging innovations in anti-microbial resistance (Current UTI study preliminary results, further study possibilities and funding opportunities) by Dr. Neelambika GB

2. Paper presentation at IDA - Indore from 30th Sept to 2 Oct 2018, titled Geriatric Nutrition and Ayurveda, Learnings from a living tradition by Dr. Prasan Shankar

C. Paper publication-

Integrative approach in the management of Diabetic Foot - A case report, JAIM

D. Research:

1. Ongoing clinical study on Urinary Tract Infection cases:

A clinical study to evaluate the effect of Ayurveda management of uncomplicated UTI in adult females conducted at Institute of Ayurveda and Integrative Management, Bangalore. Around 47 UTI diagnosed adult females after confirming through symptoms and culture positive results, were treated with whole systems Ayurveda for 7 days to 60 days based on the severity (No antibiotics were used in this study).

All the patients had significant reduction in the symptoms along with supporting culture results that showed negative growth of bacteria. Few of the patients despite the presence of bacteria became asymptomatic after Ayurveda treatment! Interestingly some bacteria phenotype was changed from resistant to sensitive pattern. This suggests that Ayurveda might be acting thorough not only anti-bacterial route but also improves host immunity. The relapse rate was also significantly reduced after Ayurveda treatment that indicates long term effect of Ayurveda management.

2. Ongoing study for the Development of Wellness score:

With the objective of developing a comprehensive tool for wellness assessment, a workshop was conducted on August 2018 to get insights and inputs from experts in the field of Ayurveda on the various parameters to be included for the assessment of the overall Wellness score in a Healthy individual. A field test was done for 200 healthy volunteers at I-AIM and Pune centers to test the wellness questionnaire. In collaboration with eRx solutions, a field testable version of the wellness assessment software was developed. Currently the field trial of software is in progress. After review of the results of the field trial the final version of the wellness software will be released. This is a unique initiative and has been a long-term goal of IAIM to create a comprehensive tool to assess an individual's wellness score!!

E. Success stories:

Institute of Ayurveda and Integrative healthcare center deals primarily with NCD's, chronic disorders, musculoskeletal diseases, metabolic and life-style disorders, infertility, POCS, developmental disorders, skin diseases, respiratory diseases, supportive care for oncology and so on. Below we give you a glimpse of some of the interesting success stories and testimonials that were seen in the year 2018-19!!

Individual staff-driven projects: Dr. Manjunath (Pediatrics)

Kaumara brithya Unit

A] ***Kushtha-charmadala -Dry skin Eczema***

Name:-ABC , MRNo - 059429 , Age - 6y / Male

Complaints Dry skin lesions under eyelids, on different parts of the body and on the genitals since 4 years

Treatment Outcome

Patient of 6y/Male came to IAIM Pediatric OPD with complaints of dry skin lesions under eyelids, other parts of the body and in the genitals since 4 years on 08-10-2018.

Child was on Ayurveda treatment at IAIM Pediatric Unit for duration of 3 months! Reduction in symptoms was observed within 3 months of initiating treatment at IAIM. Dryness of skin in different body parts had reduced along with gradual reduction in whitish patches.

B] Testimonial of Shvitra – Leukoderma

MRNo - 054351, Age -15y 3m (DOB 27-03-2004) , Sex - Female

Complaints :-

White patches over skin of forearm (L), knee(R), ankle(R), and eyelid (R) since 5 years

Treatment outcome:-

Reported to IAIM Pediatric Unit on 27-02-2018 to our OPD with complaint of white patches over skin of forearm (L), Knee(R), ankle(R), eyelid(R) since 5 years which initially started as a small lesion over eyelashes and later spread to other body parts. She had taken Allopathic medications for 2 years but did not get any relief. The patient came to I-AIM seeking Ayurvedic management of this condition.

She underwent external therapies as well as internal medications during her OPD (27-02-2018 to 05-12-2018) and IPD (26-03-2018 to 04-04-2018) treatments. After the treatment, white skin patches have reduced and affected areas have shown improved pigmentation (dark & pink) turning towards natural skin color.

Before Treatment

After Treatment

Pediatric Neuro Case Summary

Child with MR No 048366, Age, 4y 1m , Gender- Female , with history of fall from height (of 3rd floor), severe head injury & was initially treated in the Pediatric Intensive Care Unit.

She approached IAIM Pediatric unit with complaints of loss of speech, unable to sit / stand, walk since 20 days.

Was Diagnosed with:

Traumatic intraventricular hemorrhage with hydrocephalus and diffuse cerebral edema

Condition before admission at IAIM

Examination before treatment suggested that she had neurological deficits viz low on alertness, not responding to oral commands, slowness is response, was unable to speak, eye to eye contact was poor. Further-more patient was unable to sit, stand or walk, hand-grip was poor.

Condition after 1 month IP treatment at IAIM KB / Pediatric unit

Consciousness levels improved, she was more alert, improved orientation, responding well to verbal commands. Speech was established and was gradually able to talk fluently. Eye to eye contact improved, Gross motor movements like- ability to sit /stand/walk were seen, Fine motor - Motor changes like pincer /palmar grip were established & good.

Child at PICU - few days before

Admission at IAIM

Child at IAIM few days after admission

Child after 21 days during treatment

Child after 1 month of treatment at IAIM

Individual staff-driven projects: Dr. Sahana Kumar (Dermatology)

Skin Unit:

1. Psoriasis is a chronic autoimmune condition that causes the rapid build-up of skin cells and can be correlated with *kitibha, ekakushta* in Ayurveda. I-AIM has treated more than 1500 patients of psoriasis based on Ayurveda principle that follows detoxification, (vamana, virechana) Raktamokshana (blood letting) Rakta shodhana (blood purifiers) and rasayana 's like Gandhaka rasayana , madhusnuhi rasayana , tuvaraka rasayana etc . This approach has given successful outcomes.

Some photographic evidence for the same. Reduction in the psoriasis lesion can be observed in the photograph that is also quantified in PASI score (Psoriasis Area Severity Index score).

First visit ; PASI Score- 24 (Out of 72)

After 6 months; PASI Score- 2

2. A case of Palmar psoriasis (Kushta-Kitibha).

Patient aged 50 years / female; came to our hospital with complaints of dryness with deep sores and fissures with severe itching and pain in both the palms since 1 year. Initially consulted a skin specialist and used some allopathy medications with not much relief. Has been under treatment from last 6 months. There is remarkable reduction in dryness, fissures, sores and itching.

Before Treatment

After Treatment

3. A case of Psoriasis(Kushta-Kitibha)

Patient aged 63 years/male came to our hospital in July 2019 with complaints of scaly thick lesions with deep sores, fissures, oozing and severe burning over both the hands, palms and face with difficulty and painful movements of hands associated with fever since 10 days. He had been suffering from Psoriasis since over 20 years. He was treated as inpatient at IAIM Healthcare Center for 10 days with panchakarma therapies. Patient came for follow up after 20 days with 90 % reduction in fissures, sores and burning, oozing absent.

Before Treatment

After Treatment

4. A case of Vitiligo (Shvithra)

A child aged 6 years/ female consulted at I-AIM in the month of October 2018 with complaints of whitish patches over the right foot and toes and over the right knee since 4 months. She has been under Ayurveda treatment for same for the last 10 months. She has been responding well. Patch over the knee had completely reduced. The patches over the foot and toes had reduced to a great extent. No new patches were noticed in the last 10 months.

Before Treatment

After Treatment

5. A case of Vitiligo (Shvithra)

Patient aged 26years/male came to our hospital in January of 2019 with complaints of whitish patches over the neck and back since last 6 months. He is under treatment on OPD basis for the last 6 months. The patches over the neck have completely reduced. The patches over the upper back have reduced by about 70%. No new patches have been noticed for the last 6 months.

Before Treatment **After Treatment**

Testimonials:

Surprisingly amazing hospital! Though the treatment is traditional the overall approach is best of both worlds. The hospital itself is very well maintained and has beautiful surroundings.

Mr. Ashok Sharma

The experienced doctors could help me with the long-term illness. Extremely good place for holistic treatment.

Miss Vijayshree PS

Patient named Seema (name changed upon request) having symptoms of irregular periods was diagnosed with PCOD in the year 2016 and had already undergone 6 cycles of ovulation induction and 2 cycles of IUI, before approaching I-AIM Healthcare in 2017. Her cycles were corrected by our specialized treatments like Bastis (Uttar basti, etc) with combination of Yoga and proper lifestyle advice. After correction of her cycles she was able to conceive naturally and is 17 weeks pregnant at present.

Name Anonymized

After going through one induction cycle with the allopathic gynecologist for conception, I decided to start with ayurvedic treatment instead... Believe me ayurveda takes time but works wonders on your body. What I really like about the gynaecs here is that they make your body capable to do its own activities rather than inducing some hormone and making the case go worse. I am very happy with the treatment and it took me 10 months on the treatment to my body shed the extra weight, I was physically active and conceived naturally. Wishing everyone opting for the treatments and medicines which the doctors give here for a holistic well-being... Happy and healthy living to you all!!

Sujatha Verma

“It was a pleasure being a patient at this hospital. Everybody without exception have been given their best in performing their duties as Doctors, Nurses, Panchakarma personal, Therapist, Housekeeping, Reception and

especially the food section who pampered me with even smiling face from enthusiastic young boys in them white caps. Thank you all for all your help, and keep up the good work."

Name Anonymized

Geriatric Unit

Admitted my wife (suffering from acute osteoarthritis) at I-AIM for Ayurvedic therapies and treatment under the expert care of Dr. Prashant. Wife was initially recommended surgery by a leading expert (Orthopedist from a reputable Hospital) and had great difficulty in walking. After admission into I-AIM and 12 days of treatment/ procedures using herbal/ natural oils / medication under Dr. Prashant, she is now able to move about freely.

Even my brother was successfully treated for multiple rib injuries after a fall in 2018 by Dr. Prashant. He is an expert in geriatrics who had incidentally treated my dad, then aged 86. He is affectionate and offers the best advice and treatment after taking into consideration the entire medical history of the individual, also is open to valid opinions from other medical experts who you have approached previously. Highly recommend this doctor and also the medical-resort, the I-AIM Health Care Center, one of its kind in Bangalore, India.

Mr. S Suresh

Wellness and Metabolic disease (Diabetes Unit):

Experience has been great very methodical and gets you out of allopathy over a period of time. He is great to talk too and gives great advice!!

Mr. Rajaram Natarajan

Musculoskeletal Diseases Unit:

Dr. Vivekananda studied the MRI and advised low cost medicine and simple treatments for my low back pain. I strongly recommend getting advice from this doctor before going for surgery. Thank GOD, I am doing good and leading my happy and normal life. I have saved lot of money and avoided the big suffering.

Mr. Kumar

Pediatric Disease Unit:

As a pediatrician Dr.Manjunath is awesome, his suggestions and advices are really helpful for me as parent and my baby's health.

Mr. August Biswas

THE UNIVERSITY OF TRANSDISCIPLINARY HEALTH SCIENCES & TECHNOLOGY
74/2, Jarakabande Kaval, Post Attur, Yelahanka, Bangalore 560 064

BALANCE SHEET AS AT MARCH 31, 2019

Corpus & Liabilities	SCH REF	As at 31st Mar 2019	As at 31st Mar 2018	Assets	SCH REF	As at 31st Mar 2019	As at 31st Mar 2018
		Rs.	Rs.			Rs.	Rs.
General Fund	A	1,15,23,526	(8,56,72,743)	Property, Plant & Equipments	E	1,03,48,797	80,01,259
Reserve for Fixed Assets	B	29,82,431	23,45,211	Investments			
				Fixed deposits / Bonds	F	2,03,41,000	1,35,53,000
Project Grants	C	3,16,86,469	4,32,40,998				
				Assets, Loans and Advances			
Current Liabilities	D	20,42,317	8,70,46,892	Cash on hand	-	30,968	57,368
				Bank balances	G	1,52,76,502	2,24,33,846
				Non-Current Assets	H	-	1,00,000
				Other Current Assets	I	12,23,479	21,44,540
				Loans and Advances	J	10,13,997	6,70,345
Total		4,82,34,743	4,69,60,358	Total		4,82,34,743	4,69,60,358

Schedules A) to J) referred to above and Notes to the accounts (Schedule O) form an integral part of this Balance Sheet

For University of Transdisciplinary Health Sciences & Technology

Place: Bangalore
Date : 29/08/2019

(Professor Darshan Shankar)
Vice-Chancellor

(R Giridharan)
Registrar

(Suresh Hegde)
Joint Registrar - Finance & Accounts

As per our report of even date attached

For LAWRENCE TELLIS & ASSOCIATES
CHARTERED ACCOUNTANTS
(FIRM REGISTRATION NO. 001857S)

(Rohan Miranda)
Partner
ICAI M. No. 022772
ICAI UDIN No. 19022772AAAACY1433

Place: Bangalore
Date : 29/08/2019

THE UNIVERSITY OF TRANSDISCIPLINARY HEALTH SCIENCES & TECHNOLOGY
74/2, Jarakabande Kavai, Post Attur, Yelahanka, Bangalore 560 064

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2019

(Amount in Rs.)

Income	Grants/Project Income (Schedule K)	University Income (Schedule L)	Total Income
Consultancy Income	1,00,59,626	19,64,375	**1,20,24,001**
Donations	-	11,87,41,793	**11,87,41,793**
University Course Fees	-	33,44,251	**33,44,251**
Training Income	25,25,986	54,19,999	**79,45,985**
INCOME FROM OTHER SOURCES			
-Hostel & Guest House Charges	-	23,74,125	**23,74,125**
-Miscellaneous Income	-	1,32,347	**1,32,347**
-Transport & Other Recoveries	-	9,55,521	**9,55,521**
INTEREST EARNED	-	-	**-**
-Interest on Fixed Deposits	-	10,54,261	**10,54,261**
-Interest on Savings Bank Accounts	92,694	4,10,835	**5,03,529**
Fees on Projects (Contra)	-	50,10,728	**50,10,728**
Project Income recognised (to the extent of project funds / grants utilised as in **Schedule K**)	3,43,41,783	-	**3,43,41,783**
TOTAL INCOME A]	**4,70,20,089**	**13,94,08,235**	**18,64,28,324**

Expenditure	Grants/Project Expenses (Schedule M)	University Expenses (Schedule N)	Total Expenditure
Books, Periodicals & Other Literature	31,790	36,343	**68,133**
Communication Costs	26,161	7,15,732	**7,41,893**
Consultants & Outsources Services	90,69,079	17,06,639	**1,07,75,718**
Consumables	24,82,890	54,355	**25,37,245**
Field Work & Trials	1,52,321	1,295	**1,53,616**
IT, Hardware, Software & Services	51,027	1,67,830	**2,18,857**
Maintenance, Utilities, Repairs & Improvements	-	1,13,53,069	**1,13,53,069**
Meeting, Conferences & Workshops	92,398	13,31,362	**14,23,760**
Other Overheads & Contingencies	4,24,577	11,57,929	**15,82,506**
Printing & Stationery	1,92,304	2,48,013	**4,40,317**
Salaries Including Fellowships	1,50,25,615	2,19,05,938	**3,69,31,553**
Travel & Conveyance	27,35,645	9,18,714	**36,54,359**
Fees on Projects (Contra)	40,57,976	9,52,752	**50,10,728**
Depreciation (**Schedule E**)	-	23,17,718	**23,17,718**
TOTAL EXPENDITURE B]	**3,43,41,783**	**4,28,67,689**	**7,72,09,472**

EXCESS OF INCOME OVER EXPENDITURE FOR THE YEAR C] = A] - B]	**1,26,78,306**	**9,65,40,546**	**10,92,18,852**

LAWRENCE TELLIS & ASSOCIATES * CHARTERED ACCOUNTANTS * BANGALORE FRN : 001857S

THE UNIVERSITY OF TRANSDISCIPLINARY HEALTH SCIENCES & TECHNOLOGY
74/2, Jarakabande Kaval, Post Attur, Yelahanka, Bangalore 560 064

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2019

(Amount in Rs.)

Income	Grants/Project Income	University Income	Total Income
Excess of Income over Expenditure for the year b/d	1,26,78,306	9,65,40,546	**10,92,18,852**
Appropriations:			
Project income transferred to the respective **Project (Grants) Funds (Schedule C)**	1,26,78,306	-	**1,26,78,306**
Depreciation for the year on assets acquired through project funds transferred to **Reserves for Fixed Assets (Schedule B)**	-	(6,55,723)	**(6,55,723)**
Excess of Income over Expenditure (after appropriations) for the year transferred to **General Fund (Schedule A)**	-	9,71,96,269	**9,71,96,269**
TOTAL	**1,26,78,306**	**9,65,40,546**	**10,92,18,852**

Schedules `E', `K', `L', `M' & `N' and Schedules `A', `B' & `C' referred to above and Notes to the Accounts (Schedule `O') form an integral part of this Income and Expenditure account.

For The University of Trans-Disciplinary Health Sciences & Technology

Place: Bangalore
Date: 29/08/2019

(Professor Darshan Shankar)
Vice-Chancellor

(R. Giridharan)
Registrar

(Suresh Hegde)
Joint Registrar - Finance & Accounts

THE UNIVERSITY OF TRANS-DICIPLINARY HEALTH SCIENCES AND TECHNOLOGY
Bengaluru - 64

As per our report of even date attached
For LAWRENCE TELLIS & ASSOCIATES
CHARTERED ACCOUNTANTS
(FIRM REGISTRATION NO. 001857S)

LAWRENCE TELLIS & ASSOCIATES * CHARTERED ACCOUNTANTS * BANGALORE FRN : 001857S

(Rohan Miranda)
Partner
ICAI M. No 022772
ICAI UDIN No. 19022772AAAACY1433

Place: Bangalore
Date : 29/08/2019

END OF I & E A/C (PAGE .....2)

LAWRENCE TELLIS & ASSOCIATES
Chartered Accountants
No. 44/45, 2nd Floor, Vinayaka Complex
Residency Cross Road, Bangalore - 560 025
Ph.: 41514791/92/93
(FIRM ICAI REGN. No. 001857S)

THE UNIVERSITY OF TRANSDISCIPLINARY HEALTH SCIENCES & TECHNOLOGY
74/2, Jarakabande Kaval, Post Attur, Yelahanka, Bangalore 560 064

RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2019

(Amount in Rs.)

Receipts	Grants/Project Receipts	University Receipts	Total Receipts
OPENING BALANCES AS ON 01/04/2018			-
Bank Balances (Schedule G)	-	2,24,33,846	2,24,33,846
Cash Balances	-	57,368	57,368
RECEIPTS DURING THE YEAR			
Consultancy Income	1,00,59,626	19,64,375	1,20,24,001
Donations	-	3,63,62,290	3,63,62,290
University Course Fees	-	33,44,251	33,44,251
Training Income	25,25,986	53,49,935	78,75,921
INCOME FROM OTHER SOURCES			
-Hostel & Guest House Charges	-	23,74,125	23,74,125
-Miscellaneous Income	-	1,21,097	1,21,097
-Transport & Other Recoveries	-	9,55,521	9,55,521
INTEREST EARNED			
-Interest on Fixed Deposits	-	10,59,222	10,59,222
-Interest on Savings Bank Accounts	92,694	4,10,835	5,03,529
Project Grants received	1,28,50,691	-	1,28,50,691
OTHER RECEIPTS DURING THE YEAR			
Refundable Credits received	-	2,22,222	2,22,222
Refund of Deposits paid	-	52,000	52,000
Refund/Settlement of Advances	-	6,65,346	6,65,346
GST collected and to be remitted	1,64,914	3,67,674	5,32,588
Fees on Projects (Contra)	-	50,10,728	50,10,728
Inter-Unit Transfers (Contra)	1,49,46,095	-	1,49,46,095
TOTAL A)	4,06,40,006	8,07,50,835	12,13,90,841

Payments	Grants/Project Payments	University Payments	Total Payments
PAYMENTS DURING THE YEAR			
Books, Periodicals & Other Literature	31,790	38,223	70,013
Communication Costs	26,161	7,28,341	7,54,502
Consultants & Outsources Services	90,69,079	17,06,639	1,07,75,718
Consumables	24,82,890	54,355	25,37,245
Field Work & Trials	1,52,321	1,295	1,53,616
IT, Hardware, Software & Services	51,027	2,50,418	3,01,445
Maintenance, Utilities, Repairs & Improvements	-	1,10,96,070	1,10,96,070
Meeting, Conferences & Workshops	92,398	13,31,362	14,23,760
Other Overheads & Contingencies	4,29,297	10,77,649	15,06,946
Printing & Stationery	1,92,304	2,48,013	4,40,317
Salaries Including Fellowships	1,50,25,615	2,52,11,870	4,02,37,485
Travel & Conveyance	27,35,645	9,18,714	36,54,359
Advances for Purchases	9,45,556	59,119	10,04,675
Refund of un-utilised Project Grants	95,004	-	95,004
Purchase of Fixed Assets	12,92,943	33,72,313	46,65,256
c/fd	3,26,22,030	4,60,94,381	7,87,16,411

LAWRENCE TELLIS & ASSOCIATES * CHARTERED ACCOUNTANTS * BANGALORE FRN : 001857S

R & P A/C (PAGE .....1)

THE UNIVERSITY OF TRANSDISCIPLINARY HEALTH SCIENCES & TECHNOLOGY
74/2, Jarakabande Kaval, Post Attur, Yelahanka, Bangalore 560 064

RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2019

(Amount in Rs.)

Payments	Grants/Project Payments	University Payments	Total Payments
b/fd	3,26,22,030	4,60,94,381	7,87,16,411
OTHER PAYMENTS DURING THE YEAR			
Loans & Staff Advances	-	4,323	**4,323**
Refund of Caution Deposits received	-	1,50,000	**1,50,000**
TDS/TCS recovered during the year	-	4,66,940	**4,66,940**
Excess GST paid	-	874	**874**
Investments during the year	-	67,88,000	**67,88,000**
	-	-	**-**
Fees on Projects (Contra)	40,57,976	9,52,752	**50,10,728**
Inter-Unit Transfers (Contra)	-	1,49,46,095	**1,49,46,095**
CLOSING BALANCES AS ON 31/03/2019			
Bank Balances **(Schedule G)**	39,60,000	1,13,16,502	**1,52,76,502**
Cash Balances	-	30,968	**30,968**
TOTAL B)	4,06,40,006	8,07,50,835	12,13,90,841

For The University of Trans-Disciplinary Health Sciences & Technology

Place: Bangalore
Date: 29/08/2019

(Professor Darshan Shankar)
Vice-Chancellor

(R. Giridharan)
Registrar

(Suresh Hegde)
Joint Registrar - Finance & Accounts

THE UNIVERSITY OF TRANS-DICIPLINARY HEALTH SCIENCES AND TECHNOLOGY
TDU
Bengaluru - 64

As per our report of even date attached
For LAWRENCE TELLIS & ASSOCIATES
CHARTERED ACCOUNTANTS
(FIRM REGISTRATION NO. 001857S)

LAWRENCE TELLIS & ASSOCIATES * CHARTERED ACCOUNTANTS * BANGALORE FRN : 001857S

(Rohan Miranda)
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Place: Bangalore
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Chartered Accountants
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