CHAPTER 9

Conclusions

Fruits of Aegle marmelos (L.) Cornea being sold in the local markets.
9. Conclusions

Medicinal plants have paved way in international and national trade due to its multi-centric usage for phytochemicals in the form of plant extracts, herbal/natural/traditional medicinal health care products, nutraceuticals, cosmetics. This has resulted in threats of several of the medicinal plants species existence in wild (forest and non-forest areas) considerably. There are issues pertaining to QA, GMPs, consumer awareness, backward linkages of botanical sources, availability of authentic botanicals, regulatory norms, stake holders’ attitudes towards sustenance of resources.

The study enabled to deepen the understanding of botanical trade at select markets in southern India with regard to trade dynamism. The following conclusions have emerged from the present study:

9.1. Enabling ‘Market Information System (MIS) of botanicals’:

The present study is at micro-level concentrating on the prioritized plant raw drug markets and hence throws light at local level. Through this study, an effort was made to develop a ‘Medicinal Plants Raw Drugs Catalogue’ which forms part of the Market Information System (MIS) of botanicals traded in a specific market. Moreover the catalogue connects to the voucher specimen deposited at FRLH Herbarium, Bangalore. This serves as a ready reckoner for the trading communities to authenticate their traded plant materials. Such efforts need to be encouraged for all the markets at regional and local levels. Periodical assessment of locally available species has to be undertaken to understand the market fluxes and changing trends in the use of botanicals, new entrants, correlation of botanical names (controlled vocabulary) and trade names as in the Medicinal Plants Nomenclature Services, RBGKEW( Willis, 2017), rarity of the species, botanical sources, price fluctuations.

9.2. Local markets are potential ‘Traditional Medicine Health Care Service Points’:

As an inseparable and integral part of the trade study, one of the well-known local shanties, the Tilagar tidal market, in the Madurai was taken up as a case study. This
market has a few shops managed by herbalist-cum-traders, belonging to Valaiyar communities, who are committed to provide cost effective and adaptable ‘Traditional Medicine Health Care Service’. They are dispensing ‘fresh green herbs’ for local populations. It co-exists with other medical health care systems in the city. Such Traditional Ecological Knowledge and Services, have to be fostered thus addressing Sustainable Development Goal 3 with focus on ‘health for all’.

9.3. Commodities in Botanical Trade:

The study attempted to understand the factors that affect the commoditization of plant drugs in the market with regard to regional manifestations, sourcing issues, pharmacological or biological similarities or neutral additions. There are 65 different complexes recorded and categorized based on the biological compositions and perceived utility (Figure 9.1).
9.4. Matrix showing the commodity value:

For select commodities listed in the study (Figure 9.1), a scale was visualized to understand the underlying factors that influence in making of a plant drug. Score 1 is lowest (morpho-variants) and 10 is presumed to be highest with pharmacological actions of its kind, from 7 to 1, morphological features are given more prominence than its action. This matrix is similar to gold standard matrix (Krepe et al. 2004). Further studies can be taken up to validate the commodities and its biological actions depending on the rank given.

9.5. Potential Geographical Indicators (GI) from Economic-Sensitive-Zone:

While understanding the complexities in trade, a few of the commodities representing 23 species were identified as ‘Potential Geographical Indicators (GI)’ based on the choice of the traders and manufacturers. These are valued as the premium quality material and priced high from the specific regions (Economic-Sensitive-Zone). Such potential GI commodities can be further studied for its value chain and encouraged in the agricultural crop improvement programs.

9.6. Establishing backward linkages to sources:

Botanicals in the market come from several different sources. Analysis showed that 68% of the resources recorded are obtained from wild, 10% come from cultivated and remaining either from wild/cultivated/planted sources. These represent different vegetation types and geography. Backward linkages studies are absolutely essential to understand the distribution pattern of the species traded visualize the trade route of species; estimate the supply capacity from a particular place, deficit assessment and resource supply from alternate sources, regional variants, establish identity of the botanicals linking to specific markets.

9.7. Specialties of the trade route:

In the study, it was observed that traditionally certain popular drugs are sold in select markets in bulk, which is like ‘hot spots’ for the traders/industries. For example, *Mollugo ceruviana* (parpatakam) from Tamil Nadu is sold for domestic and
international markets; from North India, *Fumaria indica* is sold as *Shahtara* or *Parpata*; *Cryptocoryne spiralis* from southern India, *Gloriosa superba* from south Tamil Nadu. These places are known for supply of genuine quality materials. Such points have to be encouraged as trade hot spots for premier products and produces.

9.8. **A better alternative for a substitute:**

TSM industry is constantly evolving and trying to face every day challenges of resource availability. For instance, during the study, it was observed that in Kerala state, Varadarpally region, *Kodiveli (Plumbago zeylanica L.)* is being grown by marginal farmers in more than 50 acres land. These are on contractual basis to local Ayurveda industries. *Kodiveli* is used as a substitute for *Bhallataka (Semecarpus anacardium L.f.)* in various skin care products. This is now being replaced by *Plumbago indica*, for its viable cultivation and handling. Such practices have now been accepted widely by the industries. Validation and quantity of Plumbagin in the product has to be standardized through pharmacological studies to ensure better quality products. Such case studies have to be investigated to learn about the innovative approaches of the industries to adapt alternatives and resource management measures.

9.9. **Application of modern techniques to aide in Authentication of botanicals:**

In the study, Pharmcognosy tools and DNA finger printing studies facilitated the process of to verify the presence of the plant drug *Balaa* and its botanical sources in the traditional formulations. The complete gene sequencing of the well-known trade names and accepted botanical entities is recommended for Pharmacovigilance and QA besides the conventional application of taxonomy thus hastening the process of procurement, manufacturing to meet the regulatory norms nationally and internationally. This is to ensure of safety of TM formulations.

9.10. **Encourage sustainable collection practices:**

From the study, it was observed that 68% of the traded botanicals are leafy twigs and non-reproductive parts of the plant (Fig.9.2). Use of reproductive parts and propagation parts is alarming as it indicates that the traded botanicals are facing high
threat and have concern with its future generation. Therefore, adaptive management and sustainable harvest protocols specific to species needs to be evolved.

9.11. Promote preparation of micro plans for cultivation:

In the study, 32 species were found under cultivation which has ‘Packages of Practices (PoP)’ ready to be shared. Further, cultivation of herbs has to be state and region specific and promoted by National Medicinal Plant Board (NMPB) schemes for entrepreneurs farmers. Micro-plan considering microclimatic parameters, regional list of species has to be prepared and subsidizes provided for cultivation. Frequent revision of the list of priority species is also important from the cultivation viability perspective and keeping pace with market trends. These schemes may also be linked to marginal farmers, industries and community owned enterprises for better management through buy-back schemes.

9.12. Industries and resource augmentation:

In the study, it was noted that certain industries have been utilizing the raw drugs obtained from cultivated origin though it is available from wild sources. For instance: *Vasambu (Acorus calamus L.)* from Tanjore and *Gloriosa (Gloriosa superba L.)*
from Dindigul and Erode (Export quality) are obtained from cultivated sources. Such initiatives have to be identified and incentivized for industries conscious effort to reduce use of wild sources and contribute in the resource augmentation measures.

9.13. Documentation of Non-Forest weeds:

Presently, more emphasis has been laid for forest sources and its regulatory measures. However, there is scattered information on supply chain of non-forest weeds (self-grown). Systematic documentation of weeds in botanical trade periodically can help in local management of the resources including setting up of decentralized collection points and marketing. Further, it can help in development of ‘PoP’ for commercial cultivation and QA on long term.

9.14. Control on cultivation anomalies as a safety measure:

During the study, there are anomalies reported on cultivation of unofficial plant species as original drugs, which misleads the users and affects the quality. Measures may be taken by NMPB to check the spurious materials under cultivation. Also promote incentive driven need based crop improvement and commercial production of genuine and authenticated material. Further, fine may be imposed for the defaulters provided there is a log of medicinal plants species cultivated locally is maintained by Competent Authorities like SMPB, Agriculture or Horticulture department.

9.15. Value addition and pricing:

In the study, it was observed that a few of the traders including exporters supplying to industries adhere to minimum quality control norms as agreed for supplying quality material. This process begins with wastage assessment at ocular levels, semi-processing and shelf life procedures etc., This defines the price of the collected material/produce and guides the semi-processing steps, storage, transit time, packing etc. Like in the recent times, ‘Minimum Support Price Scheme’ has been launched for Agricultural sector for the produce and TRIFED(Tribal Cooperative Marketing Development Federation of India) for collection of NTFPs. Similar logic may be
extended for the medicinal plants collectors and producers for their effort and better living.

9.16. Promotion of common collection points for storage/ semi processing facilities:

In the study, perceptions from grass root stake holders involved in collection of medicinal plants for their livelihood expressed need for common collection points in decentralized way at local level. The local communities who sell their collections made in smaller quantities at their points and reduce on transit losses and save the penny earned. Adapting Milk Union /GMCL model, at local level will be ideal as it is owned by Community Based Organisation on profit basis. Similar efforts under the leadership of AVP, Kozhikode along with network of industries have led to establish AHEAD centre in Palakkad. At AHEAD, botanicals are collected from local communities for network of industries.

9.17. Adaptability to socio-economic changes:

In the study, it is evident that there are socio-economic changes which influence this medicinal plants sector. Especially at grass root level, the local communities traditionally known for community specific practices, which were part of their livelihood activity does shift by capitalizing on their acquired knowledge for their substance. A case study on the Valiyayar community, originally snake and rat catchers community has adapted to the social changes and confidently been practicing Traditional Medicine for city dwellers by dispensing medicinal plants in ‘Tilagar Tidal’ market. They charge nominally. This case study reveals the significance of the tribals/ local communities in managing their ecosystem services. Some of them have thrived with changing time and continuing practicing. Similar case studies should be taken up in different tribal centred markets across the country for documentation of TK and sustenance. Tribal markets that periodically occur in Trichy, Nagarkoil, Thrissur, Trivandrum, Palakkad have to be promoted.
9.18. Livelihood opportunities and community engagement:

Medicinal plants trade provides livelihood avenues for these community members from time immemorial for their sustenance. For example: One contractor / wholesaler, engages more than 100 villages around business locations, either for collections /processing/semi-processing the produces. In the study, it was recorded that 80% of the rural households attached to the traders are women beneficiaries, thus indicating the livelihood opportunity for the local communities. Rural development mission, MGREGA, MOEF&CC, State Forest Department Joint Forest Management Committee (JFMC), Ministry of Health and Rural Development (MHRD), should converge together to provide ‘Green Skill Development Program (GSDP)’ employability schemes on long term basis. Skill development programs can be offered for sustainable collection of medicinal plants resources, value addition and marketing medicinal plants produce at local/regional level. This will help in improving Human Development Index (HDI), National Happiness Index (NHI), and Gender equality. This will also address Sustainable Development Goals (SDGs) goals such as 1 (No poverty), 3 (Good Health and Well being), 5 (Gender equity), 8 (Decent work and economic growth ), 13 (Climate Action) and 15 (Life on land).

9.19. Non-availability of rare and threatened resources:

Due to resource crunches, reduction of forest, urbanization, sourcing raw materials is becoming difficult except for common self-proliferating species seasonally. Periodically assessment of locally available species has to be undertaken. This is to understand the trade dynamism at regional level with regard to the changing scenario in the use of botanicals or new entrants or rarity of a species. Through this study, nearing 75 short fall species were identified, which are rare and also of conservation concern through interactions with various stakeholders in different forums. Further, resource augmentation measures can be developed based on the shortfall analysis to meet the demand from the industries.
9.20. Cultural practices associated with the harvest protocol:

In the study, it was noted that some trading communities religiously follow rituals while collecting certain plant parts from a plant which is most revered and believed to have conservation measures. Such Traditional Ecological Knowledge (TEK) is relevant for community based medicinal plants conservation programs.

9.21. Para taxonomist and Traditional Quality Standards:

The community members can be called as ‘Para-taxonomists’, as they easily identify plant resources through close observation of external and organoleptic characters as confirmatory tests. This aspect of traditional know-how needs to be documented in future, as it would lead to practical key for identification of resources. Their ecological understanding and sustainable collection practices will help in adaptive management of medicinal plants and development of Traditional Quality Standards (TQS).

9.22. Strengthening pharmacopeia, herbarium and repositories at regional level:

Simultaneously, every 10 years, the API/AFI has to be revised by including the commonly available species of the same genus, family or allied families. These species have to be validated with the help of experienced and competent field taxonomist. Additionally, to support this initiative, the voucher specimens of the validated species including the herbarium specimen and plant raw drugs should be made available in the nationally recognized herbaria. Besides this exo-morphic confirmation of the species, a plant profile comprising pharmacognostic properties, chemical and DNA finger printing have be made available in the repository and API thus ensuring safety of the traditional formulations. All the regional laboratories and herbaria have to be linked for serving the herbal sector and address the regional needs of authentication of botanicals. Thus, the resulting information in the form of a ‘diagnostic kit’ to be made available to the various stakeholders on the species of high volume trade.
To train and educate the various stakeholders with regard to botanical identification, differentiation of original, adulterant, alternatives, sourcing, value addition, pricing to ensure Quality Assurance and sustenance of the herbal sector.

9.23. **Future directions:**

1. There is no comprehensive authorized list of species (with controlled vocabulary of scientific names and trade names) for a specific market due to dynamic nature of the trade. Specific catalogue of botanicals traded at local /regional levels generated based on the interactions with cooperative Knowledge Partners (KP) is needed for resource planning of medicinal plants species for meeting the demand and supply chain.

2. The study is qualitative study and hence has no quantitative information.

3. There is immense potential for NGS catalogue development for single drugs used in traditional medicine and help in pharmacovigilance and QA.

4. The pharmacognosy study for selected plant species falling under Balaa group of Ayurvedic drugs was undertaken due to the popularity it commands in the market. Trichome studies were done to develop a practical key to distinguish the entities easily. Further keys can be developed based on anatomical features and characters.

5. A comprehensive documentation of good practices and value addition processes will help in the growth of the sector.

Regional market studies on botanical trade are relevant as it shows the local level trade dynamism, complexities and regional manifestations which are less visible at national level. The dynamic data from regional level will certainly help in management systems for wild (forest/ non forest) populations of medicinal species of high consumption. A regional study will help in rationalizing schemes for promotion of commercial cultivation of medicinal plants based on supply chain. Besides these, all the stakeholders involved in the botanical trade and herbal industry should be encouraged to have an attitude and principle of “Economically Motivated Integrity” to provide safe and effective, affordable health care solutions. This attitude and action should aim to create a brand for authentic traditional formulations from India similar to Traditional Chinese Medicine by following Good Manufacturing Practices.