

Sustainable Development and Utilization of Ayurvedic Medicinal Plants- An Integrated Approach

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Introduction

Ayurvedic system of medicine has been integral to healthcare services in India. The system took its origins in our country dating back to pre-historical periods. Since the times of its origins the system passed through many scientific and political upheavals. Today, the system enjoys governmental patronage both for its scientific and heritage values.

From Biological Diversity point of view, the system needs to be appreciated through its pharmaceutical practices:

- The system uses both botanical and zoological entities as a part of its pharmacopoeia. However, larger part of the animal derivatives is derived from animal wastes like horns, eggshells and shells of molluscan species though other derivatives are not ruled out.
- It's pharmacopoeia is relatively wide and complex. Classical Ayurvedic treatises enumerated over 2500 botanical species. In today's context over 1100 species are known to be available and considered be in use.
- The system harps upon a concept of poly pharmacy. Each formulation contains multiple herbs- sometimes exceeding 60 ingredients. Also each herb goes into multiple formulations. Invariably, these botanical entities need to be drawn from different eco-systems.
- On further analysis, it becomes evident that-most of the medicinal plants are used in small quantities. Each product has one or two herbs used as main ingredients and rest of them being

used in small concentrations.

- A market study indicates that out of 960 traded medicinal plants in India- only 176 species are demanded in quantities exceeding 100 MT per annum (Ved *et al.*, 2008).

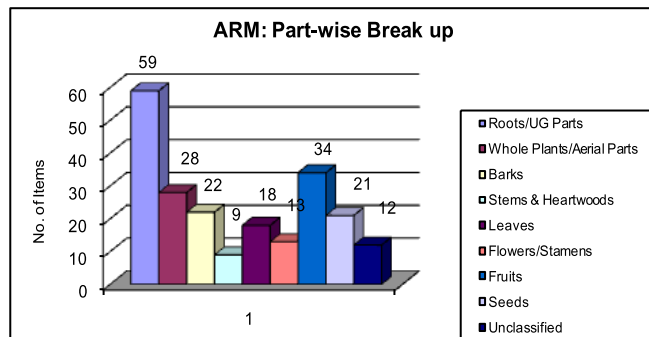
Sustainability Concerns

Considering the complexity of Ayurvedic pharmacopoeia, the system invariably depends to a large extent, on wild sources of medicinal plants. Wild sources need not be essentially from forests. Ayurvedic medicinal plants include a significant number of Agricultural weeds and Wasteland species. The following table summarizes the sources of 176 species which are in high-volume trades as an illustration.

Table I : Sources of Medicinal Plants

Source	No. of Species	% age
Cultivation	35	20%
Wastelands incl. Agricultural Weeds	44	25%
Tropical Forests	71	40%
Temperate Forests	21	12%
Imports	5	3%
Totals	176	

Ayurvedic practices of selecting a plant also are known to be methodical and are based on scientific foundations. The following representation shows the distribution of plant parts for 260 species chosen at random from one Bhavaprakash Nighantu:



Graph Showing the Patterns of Plants Part Usage

As seen from the above illustration, it is evident that collection of medicinal plants requires destructive procedures because of usage needs like roots, rhizomes, whole plants, tree bark and heartwoods. In general, the collection of flowers and fruits is assumed to be a sustainable practice (since they constitute renewable plant parts). Nonetheless, the practice is associated with the risk of interference in the natural regeneration of the species and may deplete the source on long run.

Need for Strategic Developmental Plan

Going by these practices- it becomes evident that the future sojourn of the system depends on sustainability of biological diversity as whole but not of few selected species. Further, the importance of sustaining biological diversity needs to be appreciated from a fact that the market demand for various Ayurvedic formulation is registering 15-20% growth rate year-over-year and so is the demand for medicinal plants. This kind of growth rate invariably brings tremendous pressures on the existing stock of biological resources.

Sustainable development of Ayurvedic medicinal plants therefore, logically needs an integrated approach. Cultivation of a handful of species outside the forest areas will not enough to sustain the entire gamut of medicinal plant species used by the system. Considering the overall pressures on our ecosystems and in turn on the biological diversity it is critical that, an integrated approach is adopted. More importantly, such integrated developmental plan cannot be implemented in absence of networking among the stakeholders.

Policy Interventions in the Sector

Formation of National Medicinal Plants Board under the department of AYUSH, Ministry of Health and Family Welfare is an important milestone in the direction of ensuring sustainability. The board was given a mandate to serve as a nodal agency to design and finance specific interventions to ensure conservation and sustainable utilization of medicinal plants as a sub-set of biological diversity. At present, NMPB supports a variety of programmes to both governmental and non-governmental stakeholders which include but not limited to:

- Domestication and cultivation of commercially important medicinal plants- including research projects to develop package of practices
- Survey, inventorization, conservation and resource augmentation of medicinal species in their natural habitats
- Development of peripheral infrastructure like storage, post harvesting facilities to serve the needs of farmers and collectors
- Training and capacity building activities for stakeholders more specifically the communities
- Research projects centred on the medicinal plants sector as a whole

The board takes credit for successful implementation of important projects touching upon the species like Guggulu (*Commiphora wightii*), Ashoka (*Saraca indica*), Dashmool group, etc. Further, the board succeeded to include cultivation of medicinal plants as an integral part of National Horticultural Mission.

Integrated Model for Sustainable Development

Considering the pharmaceutical practices of Ayurveda- there is a visible need for a strategic developmental plan concerning the category. The suggested developmental plan for this purpose follows a three-dimensional model comprising of:

- Domestication and Cultivation
- Value chain interventions linked to resource management



- Development of substitutions using sophisticated tools of investigation

The integrated model suggested above differ much from the mandates or programmes of National Medicinal Plants Board. Nor the model has any new component to offer for the intended purpose. However, the suggested model seeks to promote the concept at institutional level and to make use of its components in a rationalistic manner. Further, the model emphasizes upon the need for partnerships among the stakeholders- the resource owners, the resource managers and the resource users.

I. Domestication and Cultivation

Herbaceous species traded in high-volumes are the right candidates for this type of intervention. Obviously, the wild resource of any medicinal plant faces high-degree conservation concerns when it goes into high-volume trading. Herbaceous species in this context may have a life-cycle ranging between 6 months to 3 years. On this front, many institutions have been working to develop agronomic practices, seed banks and nursery facilities. Also, many wild species of high-commercial value have been introduced into farming conditions. However, the following factors need the attention of these interventions.

- The success rate of any cultivation project is essentially dependent on economic feasibility to the farmer and reliable market linkages.
- While developing agronomic package, it is important to identify and promote the most appropriate source of mother stocks. While deciding the source of mother stocks, quality profile/ phyto-chemical profile is taken into consideration adequately.
- When a species is introduced into cultivation- the supplies from wild sources need to phase out proportionately. So long the supplies from wild continue to flow into the markets- the economic feasibility of cultivation is nullified.

It is equally important to assess the effect of this intervention on the health of natural populations. In most of the cases, this aspect remained un-addressed.

The Cases of Prishniparni & Salparni

Uraria picta (Jacq) DC. (family: Fabaceae) used as constituent of Dashmoola is now classified under “vulnerable” category in terms of conservation status. With an objective of reducing pressures on wild sources, a project was initiated under financial support from National Medicinal Plants Board. Under the project:

1. The sodium tolerance pattern of the studies was evaluated in 4 different accessions.
2. To assess the qualitative profile of the species, rhoifolin estimation was carried out to choose the right kind of mother stocks.
3. A pilot demonstration plot was developed and the farmers were exposed through repeated orientation programme.
4. Under buy back warrantees from the sponsoring company, today 35 acres of land was brought under cultivation during last 3 years. Plans are on anvil to increase the production to 90 MT p.a in next two years.
5. Under the same project, cultivation of Saliparni [*Desmodium gangeticum* (L.) DC, Fam: Fabaceae] was also introduced in cultivation. Its cultivation under mango orchards has become more acceptable to the farming communities.

Pilot Scale Cultivation of *Desmodium gangeticum* in Dist. Hardoi (UP)

II. Supply Chain Interventions Linked to Resource Management

At present, the supply channels for medicinal plants have been very traditional, unorganized and un-regulated. As generally appreciated, the supply chain is long with multiple stakeholders playing between the tribal collectors and the end user the industry.

A major complaint about this process has been the wide gaps between the final sale price and the returns to the collectors working at the grassroots level. In this prevailing scenario- the communities



Cultivation of *Uraria picta* in Dist. Kushinagar (UP)



Pilot Scale Cultivation of *Desmodium gangeticum* in Dist. Hardoi (UP)

are losing basic interests in the sustainable resource management. Neither, they deploy any traditional skills in this direction.

This direction of supply chains needs to be altered to establish a direct market linkage between the forests based collector's communities and the user industry. This kind of intervention may bring in the following advantages:

- The post harvesting processes/ primary value addition by the collectors community shall improve substantially. As a result of such improvement, on account of wastage of precious bio-resources on account of quality rejection will be minimized. On an average, 10-12% delivered volumes to the end users are prone to the risk of quality based rejections
- The economic returns to the communities from the resource will improve substantially. More specifically, the supply terms shall be transparent and on shall be based on the principle of prior informed consent.
- It provides specific opportunities for resource management priorities. Over a period of time, the annual micro-planning of forest management prioritize those species which are important sector.

owners of forest wealth. At present, there is a glaring lack of positive relations between the resource owners and the end-users. Unless this scenario is not changed-value chain interventions can't be established effectively.

The Partnership between Dabur & OFSDP

In 2011-12 a formalized collaboration was established between Dabur India Ltd and Orissa Forestry Sector Development Project (OFSDP funded by JICA)- in this direction. Since then, the VSS groups under the project areas are involved in collection, primary value addition and supplies of selected medicinal plants from the project areas. Initially, the collaboration was limited to two forest divisions. Today, the programme is expanded to eight forest divisions and covers 180 Van Samrakshan Samities. The collaboration envisages that;

- Scientists & technical resources shall impart necessary training on sustainable collection, post harvest treatments and primary value addition techniques to the collectors of medicinal plants.
- The materials so collected, shall be procured directly by Dabur under negotiated prices and exceeding the purchase prices of local vendors/ village markets.
- The procurement plans shall not include any





An Interaction Programme in OFSDP Project Site

species known to face conservation concerns. Hence, it covers only 6 species.

- Resource augmentation/ ANR for these species shall be included in the project areas of OFSDP.
- OFSDP and Dabur shall work together in resource augmentation plans for important medicinal plants even though they are not included in the procurement plan.

The overall outcomes of this collaboration have been encouraging in many respects. While communities are satisfied with the economic opportunity created under the scheme, medicinal species like *Operculina turpethum*, *Oroxylum indicum* and *Messua ferrea* entered in the list of resource augmentation plans in the project areas.

The provisions of Biological Diversity Act 2002 also create unexpected opportunities through 3-tier institutional mechanism for such collaborations. Hopefully, the future will see more active collaborations in this direction.

- However, the effectiveness of such interventions is multiplied when the collectors/ are converged into producers' companies. While this process is relatively simple under present schemes-infusing managerial skills into these producers' companies and ensuring working

capitals seem to be uphill task.

III. Substitutions Development

The third component of this integrated approach is to initiate research projects to identify alternative plant parts (or plant species) to replace the use of unsustainable plant parts - seeking destructive collection or for those species classified under 'endangered' category.

Under the existing provisions of Drugs and Cosmetics act- there is no explicit provisions for substitution of plant parts or unsustainable species. However, the ancient sages and Ayurvedic scholars have foreseen the need for development of substitutions (termed as *Abhava pratidinhi dravyas*) and laid down guidelines for the purpose.

One of the major concerns associated with Ayurvedic medicinal plants is the usage of tree barks and heartwoods. In selected cases, the textual recommendations also included the use of root bark as well. This practice is associated with high-degree conservation concerns. Use of stem bark from species like *Oroxylum indicum*, *Stereospermum chelenoides* and *Symplocos racemosa* is fought with the risk of losing these species forever. Thus, there is a pressing need to:

- Identify alternative plant parts through a systematic investigation.
- Incorporate these alternative plants in the Ayurvedic pharmacopoeia.
- Promote the supply base for alternative plant parts.

Substitution for Bark Usage: An Illustration

In one of major attempts, a networked research project was initiated in 2010 and concluded during 2014. The primary objective of this project was to replace the use of bark in 5 tree species- widely used in Ayurvedic formulations. A summary of observation is presented in the following table.



Name in Sanskrit, Botanical Name & (Family)	Plant Part	Summary of Observations
Bilva <i>Aegle marmelos</i> (L.) Correa (Rutaceae)	Root Bark	Selectively inhibited COX-2
		But No Effect on Cytokines
	Stem Bark	Desirable effects on COX-2
		Better effect on cytokines in comparison to Root Bark
Young Roots-2 years	Selective COX-2 inhibition activity coupled with cytokine modulation	
Agnimantha <i>Premna serratifolia</i> L. (Syn. <i>P. Integrifolia</i> L.) (Verbenaceae)	Mature Roots	No effect on COX-2
	Young Roots-1 year	Inhibits COX-2 with optimal degree of cytokine modulation
	Young Roots-1.5 Yrs	Inhibited LOX-2 coupled with cytokine modulation
Syonaka <i>Oroxylum indicum</i> (L.) Benth.ex. Kurz. (Bignoniaceae)	Root Bark	Inhibited COX-2 activity effectively
		Bit no effect on Cytokines
	Stem Bark	Inhibited COX-2 activity
		Shows signs of cytotoxicity
Young roots-6 months	Desirable effect on both COX-2 and all cytokines	
Pathala <i>Stereospermum chelonoides</i> (L.f.) DC [Syn. <i>S. suaveolens</i> (Roxb.) DC.] (Bignoniaceae)	Root Bark	Dual inhibitor of COX-1 & 2
		Modulating effect on only 3 cytokines as against 4
	Stem Bark	Selective Inhibitor of COX-2
		Modulating effect on 2 cytokines as against 4
Young Roots 1.5 Yrs	Effect on COX-2 & cytokines at par with root Bark & no visible difference.	
Gambhari <i>Gmelina arborea</i> Roxb. (Verbenaceae)	Root Bark	Inhibited COX-2 and modulates Cytokines expression.
	Stem bark	Almost similar effects and comparable to root bark
	Young Roots - 0.5 Yrs	Effects at par with root bark





HDST Plantation of *Premna integrifolia* in Dist. Chittoor (AP)



Nursery Phase for *Oroxylum indicum* plantations in Dist East Godavari (AP)

Sustainability of Young Roots

The project was designed with hypothesis that, production and utilization of Young Roots would prevent destructive utilization of medicinal tree species. In order to produce young roots of desirable age- protocols were developed for High Density Short Term schemes for the species evaluated under the project. Such production activities can be launched in private lands or even in the degraded forest lands involving the forest dependent communities. Pilot scale production projects were set-up in different locations as soon as the scientific studies on safety and efficacy were concluded.

As seen from the above observations- it is technically possible to develop alternatives to the usage of Stem, root bark or heartwoods of medicinal trees and develop sustainable sources supply without pressurizing the tree populations.

References

Ved DK & Goraya GS: demand & Supply of Medicinal Plants in India, NMPB & FRLHT, Publishers: Bishen Singh & Mahendrapal Singh, Dehradun- 2008.)

Conclusions

- The future of Ayurveda is essentially dependent on the sustainability of medicinal plants diversity. The emphasis is on the biological diversity and not just on few species.
- In order to cover the diverse species used in the system, there is an increasing need to evolve and implement an integrated plan. The suggested model for this purpose includes three specific dimensions.
- Implementation of suggested 3-dimensional programme seeks partnership with all the stakeholders' viz. Resource owners, resource managers and the end users. In addition, the involvement of researchers from various disciplines is always called for in this network is always sought for.