Linking Tribal Medicinal Plant Co-operatives and Ayurvedic Manufacturing Firms for Better Rural Livelihood and Sustainable Use of Resources

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The analysis brings forth the major issues in medicinal plant sector, taking Kerala as a case. The analysis, basically use the supply chain framework, focuses on the Southern Western Ghats part of Kerala, gives the picture of the lopsided sharing of income and hence the side-streamed tribal collectors in the medicinal plant chain. In the existing two types of chains, first one dominated by largely unequal distribution of income because of the existence of a large number of mediators while the second supply chain network, where the major player is tribal co-operatives and include less number of players, seems relatively efficient. The latter is less visible in Kerala because of some specific internal and external factors. The study proposes the need for a move towards the second type of chain and initiation of more and more tribal medicinal plant co-operatives. This will lead to better linkage with co-operatives and Ayurvedic manufacturing firms, and a well defined contract to be enforced for both environmentally sustainable collection through avoiding the information asymmetry, high bargaining power. This can work as a better economic incentive structure and hence can bring more efficiency from the view of both firms and rural collectors.

Key words: Rural Livelihood, Tribal Co-operatives, Supply Chain, Medicinal Plants, Sustainable Development.

JEL: O17, Q01, Q13, Q28

1: Background

Medicinal plant sector is often projected as one of the potential sectors of employment promotion, especially in the current context of growing herbal product market and increasing relevance of indigenous medicines in healthcare. It has importance of two fold; one from an industrial and health care perspective and another importantly from a livelihood perspective. While the medicinal plants form the major raw material for the growing herbal industry, it is a source of livelihood for a large chunk of tribal population who make an earning by collecting it from the wild. The growth of medicinal plant sector's importance cannot be alienated from the growth of ayurvedic sector, since the demand for medicinal plants is a derived demand of the latter. In that sense, a brief look into the world market for ayurveda and other herbal systems is pertinent.

During the past two three decades, prima-facie there has been an increasing demand for more and more drugs from plant sources[1] especially from developed countries. World demand for herbal

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[1] Cited in WHO Strategy on Traditional Medicine 2002-2005.

products including natural products of medicinal value, pharmaceuticals, food supplements and cosmetics has been growing steadily at the rate of 10% to 15% per annum in the last decade (WHO, 2002). This revival of interest in plant-derived drugs can be mainly due to the growing belief that green medicine is safe and more dependable than the synthetic drug, of which many have adverse side effects. This seems to be supplemented by the '*back to nature'* attitude of consumerism. According to WHO, about 80% of the world population depends on one or another form of indigenous medicine[2]. Currently, the global market for herbal products, which includes medicines, food supplements, herbal beauty and toiletry products is estimated at around US$ 62 billion. Out of this, the market for herbal medicine alone is estimated at US$5 billion and is expected to reach US$16 billion by 2005(EXIM Bank, 2002). In India there is inadequate information about the medicinal plant and Ayurvedic drug market. According to a rough estimate, in the total market for the herbal products, India's share is less than 2% i.e., about Rs.2000-2500 crores considering the formulations, beauty and toiletry products made by the emerging companies like Zandu, Dabur, Himalaya etc (ibid). Out of this, Kerala provides around Rs.230 crores. The structure of the Ayurvedic market is of oligopolistic nature with a high concentration[3] and they are mainly aiming at export market than the domestic market.

In the new consumer culture, the commodity side of the herbal systems are getting more popularity than the curative side of it. This opens additional possibilities for Ayurvedic market. About 84 percent of the market for indigenous medicine market is occupied by the ayurvedic system. The three states viz. Uttar Pradesh, Kerala and Gujarat together constitutes more than half of the ayurvedic manufacturing units. According to the Department of Indian Systems of Medicine and Homeopathy (ISM&H web site, 2000), there are 8405 licensed manufacturing units and a large number of small scale processing houses to meet the requirement of 4.6 Lakh registered practitioners of ISM&H and other users in the country. As mentioned earlier, this necessarily points to the large chunk of raw material used up by ayurvedic sector and medicinal plant trade in the world is estimated as high as $16billion per annum (Lambert, 1997) and in India it is roughly calculated as Rs.1000 crores.

Here the study is mainly focusing on Kerala, looking into the dynamics of medicinal plant market and try to bring out some of the concerned issues. The section follows describes the linkage and income generation from Ayurvedic sector and then describes the supply chain analysis. This analysis basically helps us to understand the relations in production and distribution, available incentive structure, if any information asymmetry and need for further up gradation in the chain, which help to bring more overall efficiency. It finally analyses the issues relating sustainable collection and how an economic incentive structure can be created for collectors with an overall efficiency and concludes with some major suggestions.

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[2] The term *Traditional Medicine* (indigenous medicine) refers to ways of protecting and restoring the health that existed before the arrival of modern medicine. According to WHO traditional medicine is "the sum total of the knowledge, skills, and practices based on the theories, beliefs and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illnesses".

[3] Around 2% of herbal firms constitute more than 70% of the market share in terms of annual sales value.

2. Medicinal Plant Sector and Linkage with Ayurvedic Industry

Easy and continuous availability of medicinal and aromatic plants is one of the major factors, which determines the growth of ayurvedic industry. Hence an analysis of the working of medicinal plant market is important, since Kerala possessing large variety of flora and fauna with manufacturers in equal measure. The medicinal plant market in Kerala is well developed over the last few years as a result of the increase in the number of manufacturers. This is evident from the large number of traders and middlemen who provide an uninterrupted supply of raw material to the major Ayurvedic manufacturing units. The ayurvedic pharmacies of Kerala use around 500 plant species for the manufacture of medicinal formulations. Around 95 percent of these medicinal plants, which are in use by the Ayurvedic industry, are directly collected from the wild. Less than 20 species are under commercial cultivation. There has been an increasing demand for the major medicinal plants in Kerala over the last decade (Suneetha and Chandrakanth, 2001). Secondary data shows that price elasticity is positive in all the major medicinal plants demanded by the manufacturing firms of Kerala (Devi and Joby 2003). This is true for plants endemic (the plants, which cannot be found any other parts of the world) to Kerala also, shows the unhindered growth in the demand for medicinal plants in Kerala.

Though ayurvedic medicines, do contain the food items like jaggery, spices, cardamom, oils, sugar, salt, milk, ghee, animal products, preservatives, animal products, honey, fresh and dry fruits, around 80-85 percent of the total raw materials are plant based or in one or the other way related to plant materials. Adequate and timely provision of raw materials, quality of the same are most important for the manufacturing units, as the nature of the industry is concerned. Table 1 gives the backward linkage ratio for the ayurvedic industry[4] and its change over the period 1993-2002, which shows the relation between the ayurvedic industry and medicinal plant sector. Since more than 90 percent of the raw material used in the sample units consists of medicinal plants, the simple ratio of raw material expenditure to the value of total output is calculated can be used, as a proxy for interdependence.

(Insert Table: 1 here)

Until 1998 the share of raw material expenditure in total output is almost stagnant. Since then ratio has been declining, yet, it still accounts to a high proportion of almost 37percent. One possible reason for this decline could be the increase in the price of Ayurvedic medicine by 3 percent and 9 percent respectively in 1998 and 2000, while a similar increase did not occur in the case of medicinal plants though there was slight change[5]. In short, the growth of nominal value of output was higher than that of raw materials. Here the noted point is that around 40 percent of the income in ayurvedic industry is trickling down to the medicinal plant sector.

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[4] The sampled ayurvedic manufacturing firms include nine firms, i.e. Kottakkal Arya Vaidya Sala (Malappuram), Vaidyaratnam Oushadha Sala (Thrissur), Nagarjuna Herbal Concentrates (Ernakulam), Kerala Ayurvedic Pharmaceuticals (Alwey), Pharmaceutical Corporation (Thrissur), Pankaja Kasturi Herbal Concentrates (Thiruvanthapuram), Santhigiri Oushadhasala (Thiruvanthapuram), SD pharmacy (Alappuzha) and Sitaram ayurveda Pharmacy (Thrissur) which constitute 72% of the total ayurvedic market of Kerala.

[5] Information collected from the major medicinal plant shops of Thiruvananthapuram. Although there are some individual studies, regarding the demand for medicinal plants by different pharmacies of Kerala, the detailed data regarding price change is not available.

In Kerala the major market for medicinal plants exists in Thrissur, while Thiruvananthapuram, Palakkad and Ernakulam are considered to be the minor markets. For Pankaja Kasturi and other South Kerala -based manufacturing units, the tribal belt of the southern parts of the Western Ghats is the major providers of medicinal plants, particularly from areas like Palode and Kottur. Primary information collected from Kottakkal Arya Vaidya Sala (AVS) and Pankaja Kasturi shows that different sections of suppliers of raw materials exist in this field. Arya Vaidya Sala mostly depends on conventional suppliers i.e. the age-old suppliers (contractors) who have been supplying herbal raw materials for the past few decades. But of late, the conventional suppliers have not been able to meet the increased requirements because of the bulkiness of the quantity required and the non-availability/extinction of some of the medicinal plants that they used to supply. In the case of AVS, NAFED (National Agricultural Federation of India) is one of the major sources of medicinal plants like Chukku, kurumulaku (pepper) etc. Now suppliers from other states increasingly interfearing in the Kerala market with their raw material supply potential.

3. Supply Channels, Power Relations and Governance

The tribal belt of Kerala is richly endowed with medicinal plants and most of the tribes are dependent on the collection of medicinal plants and their sale to the traders, community groups or directly to the small and large industrial units. So in the medicinal industry, it is very pertinent to understand the relations exist in the supply chain[6] of the medicinal plants and if necessary to rearrange the relations as a part of better livelihood strategy.

In Kerala medicinal plant market, there are mainly two types of supply channels. One, which involves a large number of agents (chain 1) and the other mainly, constitutes the tribal co-operatives or their federations (chain 2). Fig: 1 gives an idea about the various intermediaries in different chains in detail. This is mainly a buyer driven supply chain and many intermediaries are involved and influence the market decisions and the final price. The second type of chain involves the co-operatives, which collect the medicinal, and aromatic plants, sell it to the co-operatives and then co-operatives, which in turn supplies it to NAFED. Pharmacies obtain the raw material from NAFED.

(Insert Figure 1 here)

A discussion of the intermediaries in the different chains will give us an idea of who controls the major transfers (i.e. power relations in the chain) in the industry. This gives us the option for better governance of the same. The major agents[7] in the first chain are one; ***the collectors*** are usually tribals or the rural poor; depend on the forests for their basic needs like fuel and fodder. Collection from the wild is a labour-intensive activity often involving entire families. There is no correlation between the payment given to these collectors and the market price of the commodities. The rates paid to the collectors of the herbs are extremely low, often just a fraction of the price paid by the final consumer. It is very much evident that it is mainly because of the large number of tiers in the supply chain. Two; ***the local agent or traders***, who buy the raw material from the collectors, form the next tier in the supply chain. They often operate in different villages simultaneously, usually in

[6] Supply chain management usually focuses on only a single aspect of the commodity chain.i.e. it examines a value chain only in one direction from midway along the value chain. Supply chain management often helps a manufacturer to examine how to secure all the materials required (their supply) to operate efficiently and profitably.

[7] Here the information is collected from the medicinal plant collectors from Attappady (Palakkad) and Palode (Thiruvananthapuram) and the suppliers of the major manufacturing units like Pankajakasthuri and AVS.

groups and collect medicinal plants at a cheaper rate and transport and sell it to the district based traders at higher rates. The margin they get is invested in further purchase of herbs from the rural people. With the growth of the ayurvedic pharmaceuticals the strength of these agencies have increased, which in turn, increases the stress on primary collectors. The traders have two ways of increasing their profit margin, either reduce the purchasing cost or increase the selling cost. Traders usually select the first method to gain more profit. This is because of the less bargaining ability and ignorance of the collectors regarding market dimensions. So the traders opt the way of exploiting the primary collectors to increase the profit margin. This will ultimately end up in further exploitation of natural resources but less money benefits to the collectors. Some of the plant collectors interviewed mentioned[8] that, some times they travel all the way to the towns in bicycles to sell the herbs that they collected, since what they get from the traders is not at all sufficient to cover the physical and social cost they put. But it is a cumbersome effort to go to the cities and sell their herbs, especially when the collection is not large enough to cover the daily expenses.

The third tier of the chain is mostly concentrated in the cities. They are generally ***big business men*** (bulk traders). The urge for high profit starts here. In fact they are the initiators of the business in the sense that they place the orders with the commission agents or the manufacturing units and this result in the backward chain, which extends till the collectors. Some times value addition also takes place at this stage, because there are some commission agents or traders, who collect herbs in a raw form but convert it into the semi-finished form and then sell it to the pharmaceutical companies. These traders own machines and integrated factories, which convert the raw material into the exact form, which the company demands. They simultaneously sell their raw herbs to the districts outlets. In a chain these tiers may or may not exist all of the tiers. But the general working of the supply chain in the medicinal plant sector in the major towns of Kerala follows this pattern.

There is another chain (chain two), which follows from tribal collectors to tribal co-operatives. Many of the tiers that constitute the earlier chain do not prevail here. In this case, the tribal co-operatives some times supply to the SC/ST co-operatives at the state level and some times to the pharmaceutical units directly. One study has pointed out that the tribal co-operatives of Kerala provide only a very small percentage of the total requirement of Kerala manufacturing units (Meerabai, 2001, emphasis mine). In Kerala the marketing is taken in a relatively organised manner, though a large number (34) of tribal co-operatives operates in different districts through Medicinal Plant Society's four branches in Thiruvananthapuram, Adimali, Thrissur and kalpetta. But the private traders still do most of the trade. Some of the tribal societies have established collection depots but inadequate storage facilities form a major hurdle. In spite of the efforts made by this federation, the private traders' control 60 to 70 percent of the medicinal plant trade. These private traders will offer the collectors a higher return for their product to compete with the federation, but still less than their subsistence needs. In places like Kottur and Bonakkad, these tribal communities sell their products through direct auction in the market. Although the chain working through the federation is more beneficial to the collectors and the pharmacies, either the lack of tribal co-operatives or the under functioning of the co-operatives remains a major hurdle for this medicinal plant market chain. The survey of three pharmacies[9] shows that most of them have very little connection with the tribal co-operatives. While, AVS depends on the conventional suppliers and buy-back arrangements, Pankajakasthuri gets its medicinal plants mainly from traders.

[8] Maniappan, a collector from *Vithura*, Thiruvananthapuram.

[9] Arya Vaidya Sala, Pharmaceutical Corporation of Kerala (Oushadhi) and Pankajakasthuri Herbal India Limited.

Many officials in the sampled manufacturing firms have pointed out that they prefer private traders than co-operatives mainly due to the factors like easy and timely availability, complete information about the stocks, age-old relations with the suppliers etc. There is a lack of linkage between the tribals and the pharmacies and especially the co-operatives and the pharmacies. This asymmetry of information puts the tribals in the lowest tip of gainers. Table: 2 show the difference between the selling prices through two chains. A large price difference is evident here. In most of the medicinal plant items, the purchasing cost of the firms is double of selling price of federations. This alone shows the loss of benefits (high cost) due to the lack of linkages. This co-ordination problem between the manufacturing units and the potential suppliers affects the companies and the consumers equally adverse. The structure of relationships between collectors, middle men, traders and wholesalers can be highly complex, involving various elements of exploitation, risk, co-operation, collusion and resistance... the character of these relationships can shift through time, from locale to locale and at different points along the marketing chain. Lack of access to information, transport and credit and storage facilities combine to keep collectors at a lower tip of advantage in the market place. And these conditions provide plenty of opportunities for intermediaries to position themselves as almost unavoidable links in the marketing. Extension of the chain through more tiers may either distribute the benefits unevenly by keeping the sum of the benefits same, or in some cases can lead to an increase in the raw material cost also.

(Insert Table 2 Here)

4. Medicinal Plant Market and Incentive Structure

Both in supply and demand side, the market imperfections are apparent in the case of medicinal plant trade. There is an *asset specificity* character attached to the supply side, because full information about the supply function is not possible. Here asset specificity is in the form of the difference in the quality and the form in which they prefer raw materials (whether in semi finished form or fresh form) etc. Another problem is *information asymmetry*. The information about the right quality material, right maturity and availability of the plants and about the final demand and price will not be available with all the suppliers or gatherers, but only with some (Chandrakanth and Suneetha, 2001). This works as an entry barrier for new agents in the tiers of the market and firms will prefer their conventional suppliers. In a way, this helps the traders as well, because they are forced to be very careful in the selection of the agents. In the second chain, this problem will be sorted out with effective monitoring mechanism through co-operatives.

The major problem in the medicinal plant trade is that the price is determined not by the receiver, but by the player of the next tier and is characterised by exploitation. This is somewhat different from what is expected, because the major advantage of linkages is considered to be the '*trickling down*' of benefits. Our analysis suggests that 'percolation' of the benefits of the booming industry is not occurring to a large extent, but only a '*drizzling down'* is taking place. The price of the producer (collector) is determined by the trader who gets it from him, and the price of the trader is determined by the wholesale dealer and not of themselves. A relatively rich producer can bargain for a better price but as most of the collectors come mainly from a tribal community, he will not be in a position to bargain. This can be clearly seen from the table 3 given below:

(Insert Table 3 Here)

Table shows share of the final price that the medicinal gatherer's get by trading different medicinal plants, which have high demand among ayurvedic manufacturing units. In most cases, the gatherers do not get even half of the final price (see column 6). If we compare with the price charged at the open outlets, the share becomes even less, indicating that the traders corner the rest of the share. Most of the times, the wholesale traders intercept these gatherers and collect the materials before they reach the pharmacies and offer them a reasonably satisfactory price and promise them more business. Since the material collected individually, the quantities with them at a particular time will be very little. This deters them from approaching pharmacies, since they believe that these pharmacies require bulk amounts. Generally, the manufacturing units get the medicinal plants at a lower rate because they purchase it in bulk. Being unaware of the exact price, the tribals sell their collection at a lower price. Wholesale traders put together the material obtained from different gatherers and sell it to the pharmacies in bulk at a higher price and obtain a large share of the final price (see column 8).

Organisation and control of production may also be encouraged if consumers or retail buyers express preference for supplies that come from socially and environmentally sustainable production. For sustaining production and ensuring better returns, a number of issues need to be addressed like; a) Better information about the current status and potential of production of medicinal plants, which would provide a baseline from which a strategy for sustainable production could be developed, b) More transparent supply chain information in order to improve the bargaining power of those near the start of the chain, and to help ensure good quality raw materials and c) Organization of collectors at the local level help to put in place mutually enforced codes of collection and sharing of market benefits.

These three points are very well enforced through the Tribal co-operatives. But the fact is that, unfortunately such efforts are lacking from both firms and government side. Training for collection, information on existing market price and better demanded varieties can be easily provided through these co-operatives. An immediate need of restructuring the chain towards the second chain seems to be necessary. From the point of view of profitability of the firm also, the restructuring of the value chain needs attention and should be a matter of primary concern, because the data obtained from the firms shows that a major expenditure item is on the raw material and in most of the firms it constitutes more than half of the total expenditure (Harilal, 2004). It is evident that it can be reduced to a larger extent if the chain is restructured. But there is not much effort from the part of the firms towards this, mainly because of the disadvantage in terms of procedures and transaction costs. In short, if the local gatherers are to secure a fair price for their work and participate willingly in sustainable harvesting and local cultivation, new models of trade are called for which will shorten the supply chains. The link between Co-operatives of gatherers and bio-enterprises might offer new possibilities. This could offer enhanced levels of returns to local communities and at the same time a sounder basis for the sustainable use of the resources. The present picture of dependence of firm on major suppliers and co-operatives is shown in Table 4. There is employment creation in each tier of the supply chain through many tribal collectors, traders, loaders and co-operative employees.

(Insert Table 4 Here)

Table gives a better picture of the backward linkage of the manufacturing units with the raw material suppliers. Column 3 explains the number of major suppliers of medicinal plants. There are

20 major private medicinal plant suppliers (mostly collective traders) from the state. Though manufacturing units depend on the suppliers from outside as well, the major dependence is still on the suppliers within Kerala. 45 pharmaceutical units are linked to the private suppliers. Another point to be noted here is an increasing interference by suppliers from outside the state. But the number of the tribal co-operatives is relatively less in number. They connected with only six manufacturing units and point the need for increasing the linkage with the tribal federations.

5. Upgrading Supply Chain and Sustainable Use of Resources

The neo classical demand curve (i.e. higher the price, lower the demand) is not applicable in the case of medicinal plants. The huge demand for medicinal plants is unresponsive to the price change. So to reduce the cost of production, firms adopt the strategy of *vertical integration* of raw material. Thus only it is a substitution of the source that occurs, while the total demand moves up. But at the same time there is no increase in the natural supply. The reason for increase in the demand for medicinal plants is the same as that for ayurvedic medicines, since the demand for medicinal plants being derived from the earlier as mentioned. In other words, increased demand for medicinal plants are a corollary to the increasing number of patients opting for ayurvedic treatment and the ineffectiveness of allopathic medicines in alleviating certain chronic diseases like diabetes, blood pressure etc.

(Insert Table 5 Here)

Table 5 gives an exact picture of the direct relation between price and quantity demanded portrayed by Devi and Joseph (2003). All figures in the price elasticity column are positive. This aspect has led to the non-availability of many of the medicinal plants. Unscientific collection in many places and encroachments in to the forests are leading to the extinction of many rare species. The same table shows the scarcity ratio of the respective medicinal plants. Except *Sida spp* (Kurunthotty) and *Tinospora Cordifolia* (chittamruthu), all the plants are highly scarce. Scarcity of different plants leads to substitution by other parts of the same plant instead of the right parts, adulteration with the plant that has the same organoleptic properties or same vernacular name, use of exhausted plants etc. To get a day-to-day remuneration the collectors may opt for next best of the plant demanded, since they are getting very less amount from the sale of plants. So ensuring the high remuneration at the initial phase as mentioned earlier ensures the sustainable gathering of the medicinal plants. Another way of promoting the rural livelihood is contracting out the cultivation of medicinal plants.

In the case of collection, a permanent system of informing the state tribal co-operatives about the exact monthly requirement for the medicinal plants by the firms can be done. A well defined contract, where the quantity demanded, type of raw material, quality specified, timing, price etc. should be clearly written can be exercised. This should be directly entrusted to the state co-operatives or the respective near by district co-operatives or it can be through a nodal agency like medicinal plant board or the private agencies *like CARe Keralam*[10]. Cultivation can also be done in a similar manner with long term contract, by which the demand for the cultivated plants is ensured.

[10] *CARe Keralam* is an organization recently formed in Kerala by major manufacturing firms to work as a nodal agency for the industry related problems like availability of raw materials, intellectual property right issues, standardization and to over come the economies of scale issues. This is yet to be commissioned.

In the case of the ayurvedic industry, there is a constraint regarding the complete vertical integration unlike the other industries because of the specific character of the plants. Tropical Botanical Garden and Research Institute (TBGRI)[11] of Palode in Kerala is making an excellent effort in cultivation through combining *ex-situ*[12] and *in-situ* preservation, gene banks etc. This effort has found expression through contracts and fallback arrangement they have made with the major pharmacies like AVS and Pankajakasthuri etc.

In addition to this, alternatives for an economically efficient and sustainable way of cultivation, conservation and utilization can be framed. There are many approaches like, *Eco-system Approach*[13]*; Sociological Approach*[14]*, Technological Approach*[15]*, Economic Approach*[16]*,* and some *Holistic Resource Approaches*[17] for better conservation (Wilder,2000). But a bio-partnership approach is becoming very important in recent years. This is a sustainable and efficient way of sharing the benefits through the partnership of two/multiple agents, here, tribal community, co-operatives and the herbal drug industry. To make sense of this approach in the context of the ayurvedic drug industry, it is necessary for the firms involved to follow certain practices regarding collection and harvesting of medicinal plants. In fact, the development of `social contracts' with local communities could address not only the basic problem of supply of medicinal plants raw materials but could also assist the industry in lifting the ceilings of growth potential identified earlier. A closer involvement with local communities and a clearer indication that these target groups started to benefit from a more productive sector can attract increased public investment in R&D as well as technology transfer, marketing and employment opportunities via development of primary processing units in rural areas and hence a sense of sustainable use of resources too.

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[11] India has a net work of about 140 botanical gardens, which include 33 botanical gardens attached to 33 universities botany departments. But hardly 30 botanical gardens have any programme on conservation. TBGRI is one among the most successful botanical gardens in India that promote conservation activity. The field gene bank programme launched by TBGRI from 1992-99 is now well acclaimed as a very effective method of conservation of medicinal and aromatic plants.

[12] ***In-situ*** cultivation is the cost-effective way of protecting the biological and genetic diversity on the site itself wherein a wild species or stock of a biological community is protected and preserved in its natural habitat. ***Ex-situ*** cultivation is conservation of medicinal plants out of their natural habitat in botanical garden parks, other natural sites, gene banks etc.

[13] It recognizes the dynamics of the ecosystem as the basis for resource management. These approach aims at the rational allocation and management of resources based on ecological characteristics, component behavior, change processes and functional relationships among different components within ecosystems.

[14] The sociological approach emphasizes the significance of culture, ecological and social ethics, indigenous knowledge, the role of local people and social institutional arrangements in resource management.

[15] It aims to monitor and mitigate environmental change using physical tools and modern technologies such as mapping, Geographical Information Systems (GIS), remote sensing, etc, environmental impact techniques, soil management, biotechnology and other techniques.

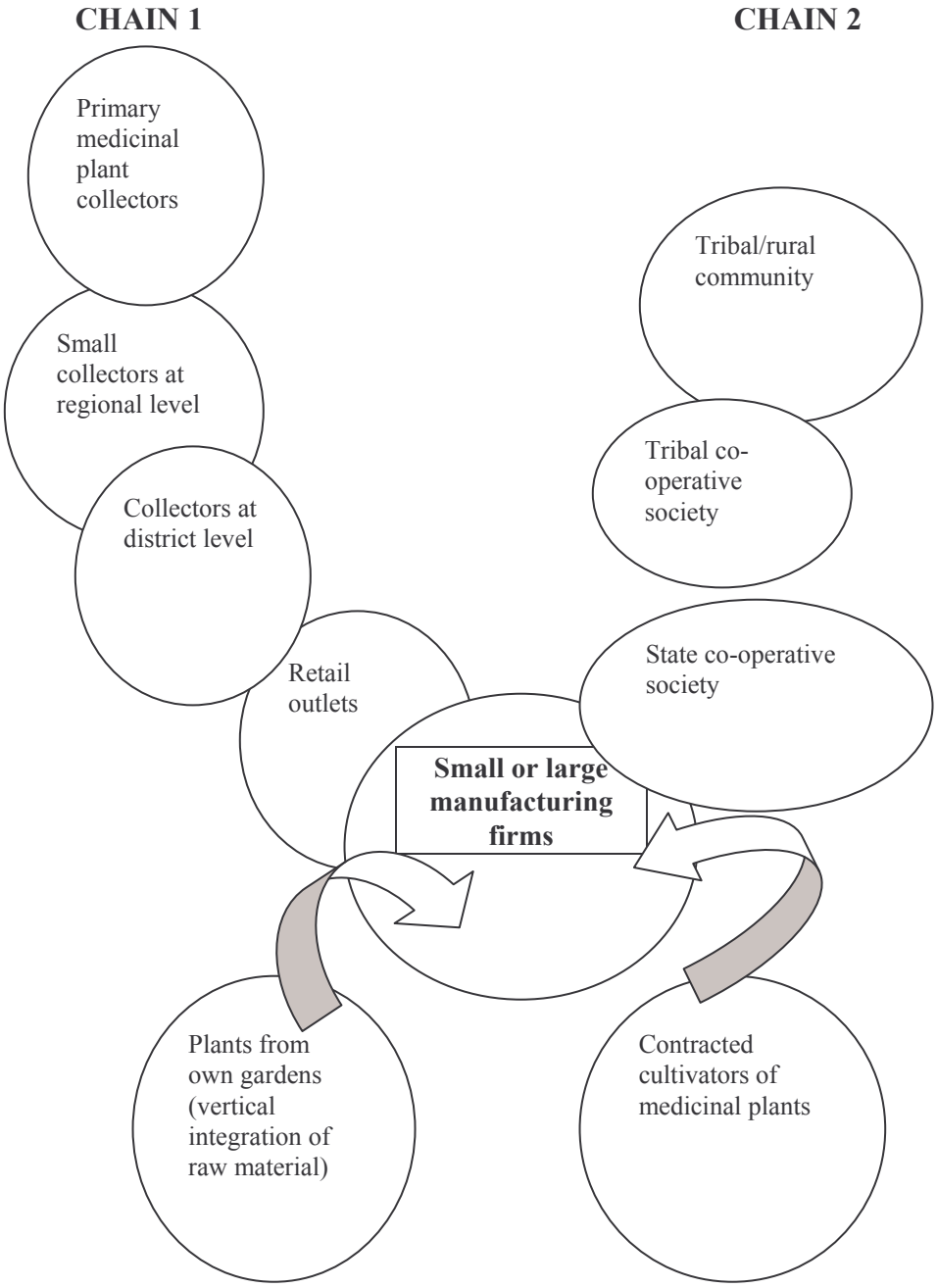
[16] An economic approach to resource management is based on the premise that there is a need to rationalize the allocation of natural resources and optimize their use through competitive market economies to achieve maximum economic efficiency. This approach has dominated the resource use policies in many developing countries using cost benefit analysis (CBA) as the yardstick against which resource allocation and use decisions are evaluated.

[17] A holistic resource management (HRM) refers to a management strategy that endeavors to recognize the interrelationships among a wide range of resource management activities and bring together a variety of needs and values into the decision making process. This approach recognizes that management and use of anyone resource inevitably affects the management of other resources and emphasizes on participation, consultation before action, cooperation, communication, coordination, comprehensives and shared decision making.

7. In lieu of conclusion

The study here tried to draw some preliminary understanding of the medicinal plant sector of Kerala and to understand how a better economic incentive structure can be created to sustainably utilize the resources with the help of the supply chain relations. The major conclusion from the analysis are one, the demand and growth of the sector is largely determined by the Ayurvedic industry growth second, there is a lopsided sharing of income in the medicinal plant sector which is designed mostly in favour of the middle men, third there is a huge price difference between the selling price of co-operatives and of the private agencies (in other words between both the chains) and fourth there is a lack of linkage between firms and co-operatives and finally this might be one of the major reasons for the unsustainable collection. It is evident from the analysis that a better linkage between firms and co-operatives will be beneficial for both the actors of the game, the tribal community and the firms, by increasing the earning for the former and reducing the transaction cost in the case of latter. So a restructuring of the supply chain should favorably towards the latter. And it also added to the relevance from the point of view of sustainable cultivation of the medicinal plants and a solution for the increasing adulteration, which in turn promotes the long-term growth of the ayurvedic industry. The paper portraits the supply relations in the medicinal plant market and suggest two pronged approach. In the case of medicinal plants collected from the wild better linkage is needed with medicinal plant co-operatives, while contracting out to the tribal farmers is better if *in-situ* cultivation is possible. In both the cases, raw material cost can be considerably reduced, which necessary for the industry and at the same time is creating employment for many especially those depend on the forest produces. And at the same time a well defined contract should be ensured between the actors in both the above cases.

APPENDIX:
Fig: 1 supply chain in the medicinal plant market



Tables

Table 1: Backward Linkage ratio of the Ayurvedic industry in Kerala

Year	Value of output (value in lakhs)	raw material expenditure (in lakhs)	share of raw material to total output (in percent)
1992-93	3789.43	1719.22	45.37
1994-95	5605.70	2621.17	46.76
1997-98	8564.90	3887.12	45.38
1999-00	12275.33	5256.40	42.82
2001-02	13848.76	5097.04	36.80

Source: compiled from the annual reports of the Ayurvedic manufacturing units.

Table 2: Purchase Rates (Rs/Kg) of Medicinal Items by the Ayurvedic Medicinal Manufacturing Units and Selling Price of the same by Co-operatives- a Comparison

Sl.No.	medicinal items	X	Y	Z	R
1	Tuber Crops	57.6	24.55	33.05	134.62
2	Root items	13.5	6.33	7.17	113.27
3	Fruits	10.6	3.3	7.3	221.21
4	Barks	92.7	5.66	87.04	1537.81
5	Bushes and Creepers	19.3	7.07	12.23	172.98
6	Liquids	52.1	38.61	13.49	34.94
7	Seeds	17.3	9	8.3	92.22
8	Flowers	50	35.56	14.44	40.61
9	Oil seeds	9	4.02	4.98	123.88
10	Kundirikkam	76	31.24	44.76	143.28
11	Spices	428	128.16	299.84	233.96
12	Miscellaneous	82	54.86	27.14	49.47

Source: Meerabai (2002)

***Note**: 'X' denotes the average purchase rate of medicinal items by the Ayurvedic manufacturing units of Kerala from 1990-91 to 1993-94,'Y' denotes the average sales rate of the medicinal items by the SC/ST federation from 1990-91 to 1993-94,'Z' denotes the price difference* and '*R' denotes the percentage of difference.*

Table 3: Gatherer's Share in the Final price of the Medicinal Plant Trade *(prices are in Rs/ Kg)*

No.	Scientific name of med. Plants (1)	Malayalam name (2)	Avg.Price in firms (3)	Price in private outlets[18] (4)	Gatherer's (collectors) price (5)	% to firm's price (6)	% share of gatherrs to private outlets (7)	Traders margin* who supplies to firms (8)
1	Withania Somnifera	Amukkuram	30	135	23.5	78.33	17.41	21.67
2	Adatoda Vassica	adalotakam	22	60	13.5	61.36	22.50	38.64
3	Sidda spp	kurunthotti	21	35	4.5	21.43	12.86	78.57
4	Tinospora cordifolio	amruthu	6	15	3.5	58.33	23.33	41.67
5	Phyllanthesus emblica	nelli	24	75	19	79.17	25.33	20.83
6	piper longum	thippali	115	165	57	49.57	34.55	50.43
7	Tragia involucrata	kodithuva	15	60	8.5	56.67	14.17	43.33
8	Comnifora Mukul	guggulu	180	325	75	41.67	23.08	58.33
9	Tricosanthes cucumerina	Kattu padavalam	120	150	45.5	37.92	30.33	62.08

Source: Primary survey, 2003, * column 8 is calculated as (100- column 6)

Table 4: Indication of the Backward Linkage: Major Suppliers of Raw-materials to the Ayurvedic Medicine-Manufacturing Units of Kerala.

State (1)	Location (2)	Number of major suppliers (3)	NO. of manufacturing units in Kerala having linkage (4)	Major items supplied (5)
Kerala	Thrissur, Kozhikkod, Thiruvananthapuram	20	45	All materials
Tamil Nadu	Coimabatore, Salem, Madras, Kunnathoor	7	40	Root items, gur, oils, ghee, and fruits.

[18] The private medicinal plant selling shops are included in the category of private outlets. This information is the average price of the sample units. We have taken three private outlets for the analysis.

Punjab	Ludhiana, jalandhar, Chandigarh	6	23	Gulgulu, Amukkuram, Kottam, Karpooram, Saffron, Kunthirikkam
Kerala SC/ST federation	Thiruvananthapuram	1	6	Root items, tuber items.

Source: Abraham (2003)

Table 5: Market Analysis of the Major Medicinal Plants

Name of the plant	Quantity demanded (in tons)	Price elasticity of demand	Scarcity ratio (ratio of availability to needed)
Sida spp.	608	0.54	2.79
Tinospora cordifolia	282	0.35	0.00
Terminalia chibula	164	3.31	-3.20
Withania somnifera	149	0.60	-4.02
Adathoda sp	141	1.46	-1.60
Cedrus deodara	138	1.98	-3.80
Woodfordia frutisoca	123	0.42	-5.16

Source: Devi and Joseph (2003)

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