

Conservation & Consumption:

**A Study on the Crude Drug Trade in Threatened
Medicinal Plants in Thiruvananthapuram District,
Kerala.**



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Foreword

The 21st century has ushered in a new age of conservation. Though belated, world has recognized the importance of conservation of natural resources and its judicious exploitation. Man has always depended on nature for all of his requirements, but never before has been the need for a balanced approach to the utilization of nature's wealth more important than now.

As our dependence on nature increases, it is vital that we understand the pitfalls of indiscriminate exploitation and take immediate remedial measures. As plant-based drugs are used extensively for our healthcare, care should be taken to ensure that its extraction is sustainable so that the future generations may continue to benefit from nature.

This study on the trade and collection of crude drugs based on threatened plant species in Thiruvananthapuram district is an important work in the direction of the sustainable use of natural resources. By understanding the market and source of such species, effective conservation management measures can be taken up. The study of adulteration of crude drugs provides valuable information on substitution and adulteration of crude drugs, which practice could be one of the reasons for the suspect efficacy of some medicinal preparations.

Ms. Parvati Menon of this institution have done a laudable job by undertaking this study that sheds light on hitherto less understood area. I am sure this study will be a landmark contribution to the vision of a harmonious relation between humanity and the rest of life on this planet.

It is my pleasure and privilege to wish her all success in her future efforts.

Sd/-

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Conservation & Consumption: A Study on the Crude Drug Trade in Threatened Plants in Thiruvananthapuram District, Kerala.
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Abstract

The recent upswing in the popularity of herbal products and traditional systems of medicine is one of the major reasons for the depletion of medicinal plants in the wild; many species have become rare, endangered or even extinct. The rising demand for crude drugs in the market has also led to widespread adulteration of the plant based crude drugs with dubious effect on the consumer. Also, an equitable share of monetary benefits from the trade do not reach the indigenous communities who live in forests who are the primary collectors of medicinal plants, which is a disincentive for the protection and preservation of the plants and its habitats.

Various studies have identified certain plants as becoming rare and endangered in the wild. This study investigates certain aspects of the collection, trade and adulteration practices in such threatened plant based crude drug trade in Thiruvananthapuram district, Kerala, India. The enquiry begins from the trade outlets; from the traders through suppliers to the collectors and to the sources of extraction so as to recommend conservation of such ecologically important areas; and also to identify other plant species that are reportedly becoming scarce. The instances of the prevalent drug adulteration practices are investigated. An effort has been made to understand the pattern of price distribution of the trade with a view to learn the share earned by the collectors.

Detailed interviews and field observations were conducted among the traders to get an overall idea of the medicinal plant trade in the district with focus on threatened species. The suppliers were traced and from them, the collectors. Extensive survey of forest and non-forest land in the study area brought out data on major collection locations, species and their quantity. Adulteration of raw drug occurs at all stages, from collector to the retail trader. Major substitutes/adulterants were identified from samples collected and a list of original and substitute/adulterants was prepared.

Medicinal plants have become scarce even in rural and suburban areas. The severely affected forest areas in the district were located. Field visits were made to the exact locations. Checklist of plants and estimates of extraction were prepared. It was found that several species other than the official list of threatened species were becoming scarce. It is recommended that population studies of such species should be undertaken to confirm their status in the wild. On the basis of quantity of extraction and habitats of threatened species, possible Germplasm Conservation Areas in the forests of the study area were identified. Recommendations have been made for an equitable distribution of income through an improved retailing system and value-addition.

Chapter 1.

Introduction

This study on the crude drug trade in threatened medicinal plants is based on certain basic stances, viz., i) the trade in medicinal plants is on the rise; ii.) adulteration of crude drug is prevalent; iii) primary collectors such as tribals are not getting a fair share of the income generated in the trade; iv) substantial part of the raw materials are sourced from the forest and non-forest areas of Thiruvananthapuram district; v) unless the species and their habitats are brought into the conservation priorities of the state, the biodiversity of the land might be irretrievably lost.

1. 1. The Urgency of Conservation

Infinity exists only in outer space and in mathematical jungles. Natural resources are finite. But judicious consumption and careful conservation can extend natural resources for generations to come. Survival of our species rests precariously on this truth. Today the world faces the prospects of mass extinction, as species disappear at a rate faster than at any previous time in earth's history. Indiscriminate and imprudent exploitation of the natural resources by mankind has been cited as the major cause for this critical situation. Roughly 68000 of the 250,000 plant species of the world border on extinction. Many hardwoods and medicinal plants are overexploited and their populations exhausted. (Namboodiri A.N, 1994). Finding ways to preserve the planet's rich variety of species is the challenge taken up by scientists of different disciplines.

Forests have been long considered as an perennial source of resources for mankind: man has been overtly dependent on forests for fuel, timber and medicine. However, a variety of reasons ranging from increase in human population, deforestation caused by developmental activities, mono-agriculture, pollution, alien invasive species, etc., have put severe pressure on forests. Depletion of certain species in their natural habitat lead to loss of genetic pools and ultimately to their extinction. Therefore immediate measures have to be taken to conserve the biodiversity of our planet. According to IUCN, the broad categories of threats to the natural flora are as follows:

- Destruction or modification of habitats and ranges.

- Over-exploitation for commercial, scientific and educational purposes.
- Disease and pest attacks.
- Inadequacy of existing regulative mechanisms.
- Other natural and man-made factors. (Nair, 2000)

Plants are important source of medicine – they are key ingredients in everything from aspirin to contraceptive pills and are the foundation of health care systems all over the world. One of the major causes for the depletion of plant life is the excessive extraction of plants for medicinal purposes. Considering the fact that not even 1/5th of all the plant life in the world has been documented, the very loss of the known plant species valuable for human survival can have catastrophic effects in the future. Around 119 pure chemical substances extracted from some 90 species of higher plants are used in medicines throughout the world. In the regional, traditional medicine systems, a wide range of plant species are used medicinally. The World Health Organisation has listed over 21,000 plant names that have reported medicinal uses around the world. Very few of these have been subjected to scientific scrutiny. Around 80% of people in the developing countries rely on traditional medicines. (WCMC, 1992). According to WWF, about 35,000 to 70,000 species, or more than 1 in 10 of the world's known flora are used in traditional medicine. Of all the things people use from nature - from timber to coral - medicinal plants form by far the largest category on a species-specific basis (WWF, 1996).

India has several traditional medical systems, such as Ayurveda and Unani, which has survived through more than 3000 years, mainly using plant-based drugs. The *materia medica* of these systems contains a rich heritage of indigenous herbal practices that have helped to sustain the health of most rural people of India. The ancient texts like Rg Veda (4500-1600 BC) and Atharva Veda mention the use of several plants as medicine. The books on ayurvedic medicine such as Charaka Samhita and Susruta Samhita refer to the use of more than 700 herbs (Jain, 1968).

Ayurvedic medicines with a wide range of plant-based compounds have regained popularity in the last few decades. This increase in demand for medicines, their consequent mass production, the rapid depletion of wild sources and the absence of large -scale cultivation of medicinal plants have pushed many of the plants in the wild to a critical level. Several are on

the threatened list and some have already become extinct. According to World Bank, during the past decade, India's exports of medicinal plants have trebled. Overharvesting, unsustainable collection techniques and conversion of habitats to crop-based agriculture now threaten hundreds of species with extinction. (World Bank, 1998)

Kerala has a long tradition of Ayurveda. Richly endowed with plant life, the Western Ghats has been a perennial source for medicinal plants. In the past, pressure on the hills was less since the local sacred groves and common lands served as resource base for medicinal plants. But the shift from local healthcare practices to large-scale commercialization and the clearing of sacred groves and common lands turned the heat on to the wild resources of the forests.

1.2. Depletion of medicinal plants in their natural habitat.

There is clearly a great range of higher plants (est. 25,000) from which to draw, and a great repository of traditional knowledge in the various cultures of people using medicinal plants. A major challenge is to identify the species that merit priority for conservation. The 'risk of extinction totally or locally' (Heywood, 1991) is one among the many criteria to consider; others being value, actual and potential usage, cultural importance and uniqueness (Frankel, et.al.1995). The species that are high in demand and as well as scarce, require a pre-eminent attention of research.

Plants such as Maramanjil (*Coscinium fenestratum*), Aarogyapacha (*Trichopus zeylanicus*), Chakkara kolli (*Gymnema sylvestre*), Kosuvetty Pullu (*Drosera peltata*) and scores of others that are endemic to our forests have become rare, endangered or threatened. This is due to uncontrolled extraction for feeding an ever-growing market. *In situ* conservation (conserving species in their natural habitat) as well as *ex situ* conservation (cultivation of species in controlled conditions) is the only remedial measure. Too little is known about the ecology of endangered species to develop a strategy for their *in situ* conservation. (Namboodiri, 1994). Ecological niches suitable for their existence have to be identified and appropriate biotypes have to be prepared. In addition to the many risks that medicinal plants face, if their extinction through oversight is to be avoided, it has to be carefully surveyed to determine which species are at risk and areas should be set aside *in situ*.

Medicinal plants are found in the wild both in forests and non-forest areas. Conservationists often equate conservation of habitats with forests alone. Substantial numbers of plants are found in other ecosystems such as coastal, riverine, wetlands, homesteads, common lands etc. These natural regions should also be subjected to investigation and important areas should be marked out for protection.

This study adopts an approach that begins from investigating the trade and marketing of medicinal plants and retracing the distribution system through the trader – supplier – collector route to the source or area from where such plants are extracted. This could provide clues to the status of such plant species and identification of the area, and help in evolving immediate, concrete and effective conservation measures.

1.3. Adulteration/ substitution in Crude Drugs.

Crude drugs are either mixed with adulterants or substituted with other species. Basically, change in the constitution of crude drugs can be of two ways. One is the authorised or accepted substitution by the classical texts of Ayurveda, of one medicinal plant with another equally potent one. *Yogaratanakara*, *Bhaishajyarthanavali* and *Bhavaprakasha* – the ayurvedic classics of 13th century describe substitutes for certain herbs. Due to the geographical and biological diversity, the land plants available in one part of the country may not be available in another part. Therefore the sages who taught Ayurveda directed students to look for alternative plants, which would be available elsewhere and with more or less the same efficacy as that of the original. Such practices of substitution, which has the sanction of the classical texts of Ayurveda, may be categorized as substitution (Per.Comm. Dr.V.Velayudhan Nair). The second category is adulteration, which includes substitution of drug not sanctioned by the classical texts and is practiced by collectors and traders. The increasing demand of herbs for medicinal and cosmetic purposes and the extinction or rarity of medicinal plants due to overexploitation and habitat destruction has further increased the crisis. According to the Prevention of Food Adulteration Act, 1954, substitute also falls under the definition of adulterant. Usually adulteration occurs wherever the availability of the material becomes scarce or the price of original material is very high, i.e., the adulterant/substitute should be cheap and available in large quantity. Plant samples in the market are stored under bad conditions over a long period and often contain multiple species mixture thus affecting their bio-efficacies (Gupta et al., 1998). Adulteration is done in several

ways, mainly similarity in morphological features like physical appearance, colour, smell, taste, etc. Products are either mixed with or entirely replaced by another.

Efficacy, toxicity etc., of herbs varies according to their habitat. Since specific plants cannot be grown and made available everywhere because of ecological variations and hence different substitutions are used in different parts of the country (Shanbhag & Dubey, 2000). This is the major problem in standardization of ayurvedic drugs. In the present scenario where pharmacological validation of traditional medicines is by and large few, this acquires different dimensions and sets off a distinct set of related social issues on human health. Adulteration thus creates doubts and disbelief in the curative capability of traditional systems. Therefore, it is essential that the practices of adulteration at different stages between the collection and consumption of the plant-based drugs be understood and preventive measures adopted. The combination of lack of adequate hospitals and western medical practitioners especially in the rural areas along with destruction of forests will totally destroy the primary health care network involving plants and traditional healers (Balick, 1990).

The solution lies in ensuring the availability of the crude drugs. Studies on adulteration practices will have to be taken up alongwith identification of the scarce drugs. Conservation measures of their natural habitat and *ex situ* medicinal plant cultivation may have to be taken up in a large scale. This study has been able to amass details on adulteration of crude drugs in the study area.

1.4. Trade in crude drugs.

A major aspect of conservation of medicinal plants is their considerable economic and social value (Farnsworth 1988). To highlight the monetary loss from the extinction of medicinal species, Principe (1991) estimated that the potential annual market value in OECD countries of the species likely to vanish before the year 2050 is \$60 million. This figure is about 0.15% of the amount spent on plant-based drugs. It represents a benefit foregone rather than an actual loss. It is, however, only a market value and excludes other components of the total economic worth of the drugs, such as the cost to society of not having them and the benefits of good health. The total economic value could be 5 to 50-fold higher (Principe, 1991).

Demand for medicinal plants, both within South Asia and internationally, has been growing very rapidly for over a decade. Conservative estimates have put the monetary value of medicinal plant-related trade globally at over US \$68 billion (USD) with an expected growth to US \$5 trillion by the year 2050 (IDRC, 1998).

India is the centre of South Asia's export trade in traditional medicine (Ayurvedic, Siddha and Unani). In 1996/97, India exported refined Ayurvedic and other drugs worth CAD 52 million and crude drugs worth US \$76 million. The products reached 123 countries. (IDRC, 1998) The herbal medicine business in European Union countries is worth US\$4 billion a year. The trade's centre is Hamburg, Germany, and main suppliers are in the Indian subcontinent and Eastern Europe. Medicinal plants are also over collected from the wild in Asian areas such as the Himalayas and China. But China is now promoting cultivation of medicinal plants, and has a total area of 330,000 hectares under production. A survey of the ayurvedic medicine industry in India reveals the following facts:

According to secondary sources, there are about 5000 licensed units and an equal number of unlicensed units in India engaged in the manufacture and sale of ayurvedic drugs. The total annual turnover in the herbal industry in 1993 was Rs.600 crores. In 1998 the turnover was Rs.2300 crores and is projected to reach Rs.4000 crores by the turn of the century. The break-up of a few major companies are given below:

| | |
|-----------------------------|------------------|
| Dabur India | Rs.261.00 crores |
| Zandu Pharmaceuticals | Rs. 39.00 |
| Himalaya Drug Co. | Rs. 31.00 |
| Ajanta Pharmaceuticals | Rs. 17.00 |
| Arya Vaidya Salai, Kottakal | Rs. 40.00 crores |

Estimated demand for ayurvedic medicine (annual growth of 20%)

| Year | Estimated Demand(Rs. in Crores) |
|---------|---------------------------------|
| 1993-94 | 600 |
| 94-95 | 720 |
| 95-96 | 865 |
| 96-97 | 1040 |
| 97-98 | 1245 |
| 98-99 | 1490 |
| 99-2000 | 1790 |

There are about 1650 herbal formulations in Indian market and the major number of plants involved in the formulation is around 540. According to 1992 statistics, 42 lakh people in Kerala resort to ayurvedic treatment. The market size is worth about Rs.100 crores and by 1999- 2000 this is expected to go up to Rs.600 crores. (World Ayurvedic Congress, 2002)

Medicinal plants provide accessible and culturally relevant sources of primary health care to a majority of the population in Asia. Marginalized peoples, who are unable to financially or logistically access formal health systems, are especially dependent on herbal medicines. As many of the governments find it increasingly difficult to meet the costs of pharmaceutical-based health care, there is increased interest in the value and efficacy of medicinal plants and local health systems as a means of meeting current and future health care needs. Medicinal plants are critically important in supporting livelihood options for millions of rural people who are fully or partially dependent on these plants as a source of income. The following figures indicate the economic value of medicinal plants.

Table. 1.2. Medicinal Products of plant origin exported from India.

| 1970-71 | | 1980-81 | | 1990-91 | |
|----------------|------------------------|----------------|------------------------|----------------|------------------------|
| Qty. in tonnes | Value in Million (Rs.) | Qty. in tonnes | Value in Million (Rs.) | Qty. in tonnes | Value in Million (Rs.) |
| 15057.21 | 55.23 | 68673.10 | 545.27 | 71485.21 | 1875.60 |

(Adapted from - Shiva et.al.1996 in Nair, KKN. 2000)

The above table does not include other forest products such as edible, spices, essential oils, gums/resins, tanins/dyes, fibres, bamboos etc.

In India alone, it is estimated that collection and processing of medicinal plants contribute to at least 35 million workdays of employment annually to the poor and underemployed workforce, majority of whom are women, tribals and the very poor. (IDRC, 1998).

1.5. Inequitable trade relations

The indirect beneficiaries of innovative policies on conservation of biodiversity are the indigenous peoples of the forests who constitute the majority of the collectors and who are the most deprived class in human civilizations. With the innate and intimate knowledge of their environment, they can very well be the protectors and the propagators of natural wealth. As collectors of non-wood forest produce (NWFP), the tribals however have been at the poorer end in receiving the benefits of the trade in crude drugs. In comparison to the collectors, the traders are excessively benefited from the trade. Even the interventions of governmental agencies by constituting marketing co-operatives or participatory forest management (PFM) have not been able to assure them of an equitable share in the profits of such transactions. There is substantial difference between the collection charges paid to the primary collectors and price paid by the end consumer. This price spread is worked out for various items including threatened species. Such investigations into the existing trade relations among the collector-supplier-trader channel could be used to protect the interests of the most economically backward section of our society, the tribals. As earnings from collection of NWFP forms a substantial part of their income, it is highly imperative that this aspect is given due importance.

1.6. Explanation of Concepts:

- a. **Conservation.** Conservation as defined as *'the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet the needs and aspirations of future generation. Thus, conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration, and enhancement of the natural environment (IUCN 1980).*
- b. **Consumption.** Consumption is the use of a resource so that it will not, in the foreseeable future, be available again. It involves destruction of habitats, decimating plants and wildlife and destroying indigenous cultures (Given, 1994). Therefore the concept of conservation has to be inclusive of not only plants and wildlife but also the marginalized tribal communities.

- c. **Non-Wood Forest Produce (NWFP).** ‘Non-Wood Forest Produce includes all goods of biological origin other than wood, in all its forms, as well as services derived from forests or any land under similar use. They may be of plant or animal origin’ (Chandrasekharan, 1996). Medicinal plant collection, marketing and trade is part of the wider NWFP.
- d. **Medicinal plants.** Whole plants or plant parts, fresh or dried, used directly or as part of medicinal preparations in Ayurvedic, Yunani and Siddha systems of medicine are called medicinal plants.
- e. **Crude Drug.** Any raw or unrefined medicinal compound in its natural form, especially one taken from a plant. In this study the term is used at par with ‘Medicinal plants’ and specifically excludes animal parts and minerals.
- f. **Threatened species.** In the Red Data Books, International Union for Conservation of Nature (IUCN) and Botanical research institutions have prepared lists of rare, endangered, endemic and vulnerable species based on their herbarium collections from the study area.

Rare: taxa with small world populations that are not at present endangered, but are at risk. These are localised with limited spread.

Endangered: taxa in dangers of extinction and whose survival is unlikely if the causal factors continue operating; they are down to a critical level or whose habitats are drastically reduced. (Given, 1994).

Endemic: taxa confined in distribution to particular region, eg., Southern Western Ghats/ Agasthyamalai.

Vulnerable: taxa for which most or all the population are decreasing because of over-exploitation or other environmental disturbance. (Ravikumar & Ved, 2000).

- g. **Adulteration & Substitution.** As already mentioned in the introduction, adulteration occurs by way of mixing the original drug either in a form from which they cannot be separated (dissolved solutions or extracts, powder, etc.), by mixing partly with substitutes or by replacing entirely with another product, whereas substitution indicates the pharmaceutically sanctioned practice. In this study, both the terms adulteration and substitution are used as and when appropriate.

1.7. Rationale.

Biological diversity relates to most facets of peoples' lives. Conservation of medicinal plants and their habitats is primarily an anthropocentric approach to conservation. This approach is needed to impress the importance of conservation. Indirectly, it benefits other species and their habitats since those which have human-interest values and otherwise, co-exist in the wild. Thus economic value of conservation is projected while cultural and other intangible values are implied.

The Western Ghats mountain range is well known for its biodiversity. Kerala, in the southern Western Ghats has a long tradition in plant-based medicinal practices. The Agasthyamalai and its environs, which is part of the Thiruvananthapuram district is recognised for its abundance of medicinal plants and indigenous communities like the Kani, whose culture has a rich repertoire of plant-based healthcare.

1.8. Literature Review.

Literature on the four aspects of the study is briefly reviewed here: Studies on (i.) Flora of Thiruvananthapuram, (ii.) Medicinal Plants, (iii.) Adulteration and (iv.) Studies on the crude drug trade.

There are several studies on the flora of Thiruvananthapuram district. These works have been referred for the botanical nomenclature, confirmation of their report in the study area, etc. *Flora of Thiruvananthapuram Kerala* (Mohanani, N. & Henry, A.N.) is a floristic survey report of the Botanical Survey of India. It is very useful for the purpose of plant identification and location and distribution of their habitats. Another valuable work is the *Floristic Study of Agasthyamalai, Western Ghats* (Mohanani, M. 1995). This Ph.D. thesis has comprehensive details on the species composition, distribution patterns and abundance. The Agasthyamalai region which is included in the study area of this project is well known as a centre of high biodiversity. This area is identified by the International Union for Conservation of Nature (IUCN) in 1987 as one of the three centres of plant diversity in India which needs immediate conservation action. Earlier studies by T.F. Bourdillon, such as *Report on the Forests of Travancore* (1892), *The Forest Trees of Travancore* (1908) and *Flowering Trees of Travancore* by Rao Saheb M. Rama Rao (1914) shed light into the vegetational history of

Travancore. *Flora of the Presidency of Madras* (Vol. 1-3) by J.S.Gamble (1935) still remains the basic reference for any study on flora of South India.

Studies on medicinal plants of Kerala abound. In addition to works with a botanical perspective, there are several with focus on the medicinal aspects. *Oushadhasasyangal* (Vol.1 &2 , 1985, 1988) by Dr. S.Nesamoni is by far the most popular of its kind. It describes about 310 medicinal plants used in India. The distribution, description, chemical and medicinal properties, medicinal usage, etc., are given for each specie. *Medicinal Plants of India with Special Reference to Ayurveda* by C.K.N.Nair and N.Mohanan (1998) is an illustrated work, which gives references to Ayurvedic texts for each plant and medicinal usage. Another recent work is *A Multilingual Dictionary of Medicinal Plants* by S.C.S.Nair (2003).For the more specific studies on diminishing medicinal flora, the *100 Red-Listed Medicinal Plants of Conservation Concern in Southern India* by K.Ravikumar and D.K.Ved (2000) provides the best reference available. Other than details on distribution, description and Phenology, the book has information on the medicinal uses and trade of most of the species. *The Proceedings of the Symposium on Rare Endangered and Endemic Plants of the Western Ghats* held in 1991 at Thiruvananthapuram has several papers, which go into the detailed status of flora in the area.

There seems to be a dearth on studies on Adulteration/ substitution. A series of papers, *Studies on Some South Indian Market Samples of Ayurvedic Drugs* (Nair, K.V. et al 1984) published in *Ancient Science of Life* (Vol. II –VI) evaluate several crude drugs available in the market on the basis of its botanical description and pharmacological properties and also look at the substitute drugs available. The issue of adulteration gains importance in relation to standardization of drugs. Modern clinical and phramcological tests on alkaloids extracted from medicinal herbs some time show negative results (Jain, 1968). The efficacy of the herb is dependant on the total effect of plant contents rather than a chemical fraction. Similarly the use of substitute drugs is confusing to the standardization issue. Most of the data on adulteration in the study has been collected from the field and the medicinal aspects verified with the assistance of ayurvedic specialists.

Trade in Non-wood Forest Produce (NWFP) is a branch of study that has gained prominence in the recent decades. The Centre for Minor Forest Produce, Dehra Dun has brought out numerous studies on NWFP trade. Harvesting and marketing of NWFP, income generation for the primary collectors like tribals, conservation of wild habitats of NWFP, status studies

of many species, etc., are the different aspects that have undergone extensive scrutiny. The Kerala Forest Research Institute has conducted several studies in these issues. Sustainable use of NWFP, its collection, marketing and trade form the subject of study in the reports (KFRI Research Reports Nos.133, 162. Muraleedharan P.K. et al). These studies focus on areas such as Wynad, Nilambur and Attappadi. *A Preliminary Survey on the Commercial Exploitation of Medicinal Plants in the Drug industry of Southern Kerala* by Dr.Rajasekharan Nair of TBGRI (1996) looks at the trade in medicinal plants. *Management of Minor Forest Produce for Sustainability* (Eds. M.P. Shiva & R.B.Mathur) has articles on NWFP marketing in Kerala and by the Kani Tribals. *The Manual of Non-Wood Forest Produce of Kerala* by Dr.K.K.N.Nair (KFRI Report no.185,2000) give information on various aspects of NWFP such as identity, distribution, products and their uses, present level of production and methods of regeneration of 160 plant species. The studies by Dr.Philip Thomas on the various aspects of collection and marketing of NWFP in Kerala deserve special mention. The Market structure of NWFP has been an important part of studies by KFRI teams and others. The main parties in the structure are tribal collectors, Societies, Federation and Dealers forming one chain and another that linking collectors, middlemen, traders and consumers. In this study this market structure in the study area is closely looked at to learn the characteristics of the trade. The survey by TBGRI on the trade in medicinal plants in southern Kerala (Pushpangadan et.al, 1997) lists 35 plants, which are 'rarely available in the market due to over-exploitation'.

The Threatened Species Recovery Research Programme launched by FRLHT in association with TBGRI and ATREE in 2000 have developed Medicinal Plants Conservation Areas (MPCAs) in various parts of the Western Ghats including Agasthyamalai. Their studies have produced following results: (a). Documentation on basic reproductive biology parameters of 20 species, (b). Mapping of adult population distribution of threatened species across MPCAs. (c). Future monitoring system for these populations across MPCAs. (d). Threatened species recovery research protocol. (e). Seed storage, treatment & propagation protocols for 20 species. (f). Identification of threats to be addressed in future research/ conservation for 5-6 species, in collaboration of Forest Department and local community, if any, in minimising threats, nursery raising, enrichment planting etc. (FRLHT,2003) The 7 MPCAs host 45 medicinal plant species threatened with some degree of extinction. The findings of our study

could be of valuable support to broader and efficient implementation of the programmes such as taken by the FRLHT.

What has been attempted in the present study is to bring together the above elements on the study area. Focus is on the Rare, Endemic, Endangered and Threatened medicinal plants of Thiruvananthapuram. It investigates the medicinal plant trade in Thiruvananthapuram, tries to establish the links between the traders and collectors, identifies the exact locations from where the above plants are collected and also unearths the adulteration practices prevalent here. Thus the study attempts to give a comprehensive, holistic picture of one of the major causes of depletion of flora in order to formulate plans for conservation.

Chapter 2

Objectives & Methodology

2.1 Objectives

1. To study the trade in crude drugs in general with emphasis on threatened plant species in Thiruvananthapuram district.
2. To study the adulteration practices related to the threatened species.
3. To locate the sources of such medicinal plants.
4. To make appropriate recommendations regarding conservation of medicinal plants and its habitats in Thiruvananthapuram district and on the trade inequities.

2.2. Study area

The study area is the revenue district of Thiruvananthapuram (Thiruvananthapuram). Kulathupuzha reserve, lies both in Kollam and Thiruvananthapuram districts, and is contiguous to forests in Thiruvananthapuram district and also due to the fact that most of the collection from Kulathupuzha come to the markets in Thiruvananthapuram district. The study area is further classified into forest and non-forest areas. The forest areas under study are:

1. Peppara Wildlife Sanctuary
2. Neyyar Wildlife Sanctuary
3. Agasthyavanam Biological Park and
4. Reserve forest ranges of Paruthippilly, Palode and Kulathupuzha.

The tea/coffee/rubber estates lying scattered among these forest areas were not included for the study.

The non-forest area consists of common lands, suburbs and rural areas in the district, from where Study of the trade/market survey is done at the following trade centres such as Neyyattinkara, Kattakada, Nedumangad, Kadakkavoor, Attingal and Thiruvananthapuram City.

2.3. Methodology:

Methodology and data sources are shown below in relation to the objectives of the study.

1. Trade in threatened medicinal plants
 - Drug manufacturers Interview Schedule &
 - Wholesale & retail traders Semi-structured interview
 - Suppliers & Agents & Collectors

2. Adulteration in medicinal plants
 - Secondary sources Sample Collection &
 - Different outlets Morphological analysis

3. Collection of threatened medicinal plants.
 - Tribal & non-tribal collectors in the forest and collectors from the non-forest area. Questionnaire, Semi-structured Interview & Field observation & survey
 - Depot of Tribal Co-op Federation
 - Traders & drug manufacturers

4. Evaluation of status of medicinal plants
 - Plant habitats in the study area
 - Detailed Survey & Field visits, semi-structured interviews of the traders and collectors.

From the initial survey, a list of traders in the aforesaid study area was prepared. From the traders, list of medicinal plants in trade, list of the threatened species in trade and list of suppliers of medicinal plants were procured. Drug manufacturers, wholesale dealers of medicinal plants and tribal and non-tribal plant collectors were interviewed. To know about the flow of commodities, information on the trade channel was collected from the traders. The pattern of trade relations among collector, supplier and trader is brought out in order to ascertain the benefits that the collector accrues out of the entire transaction.

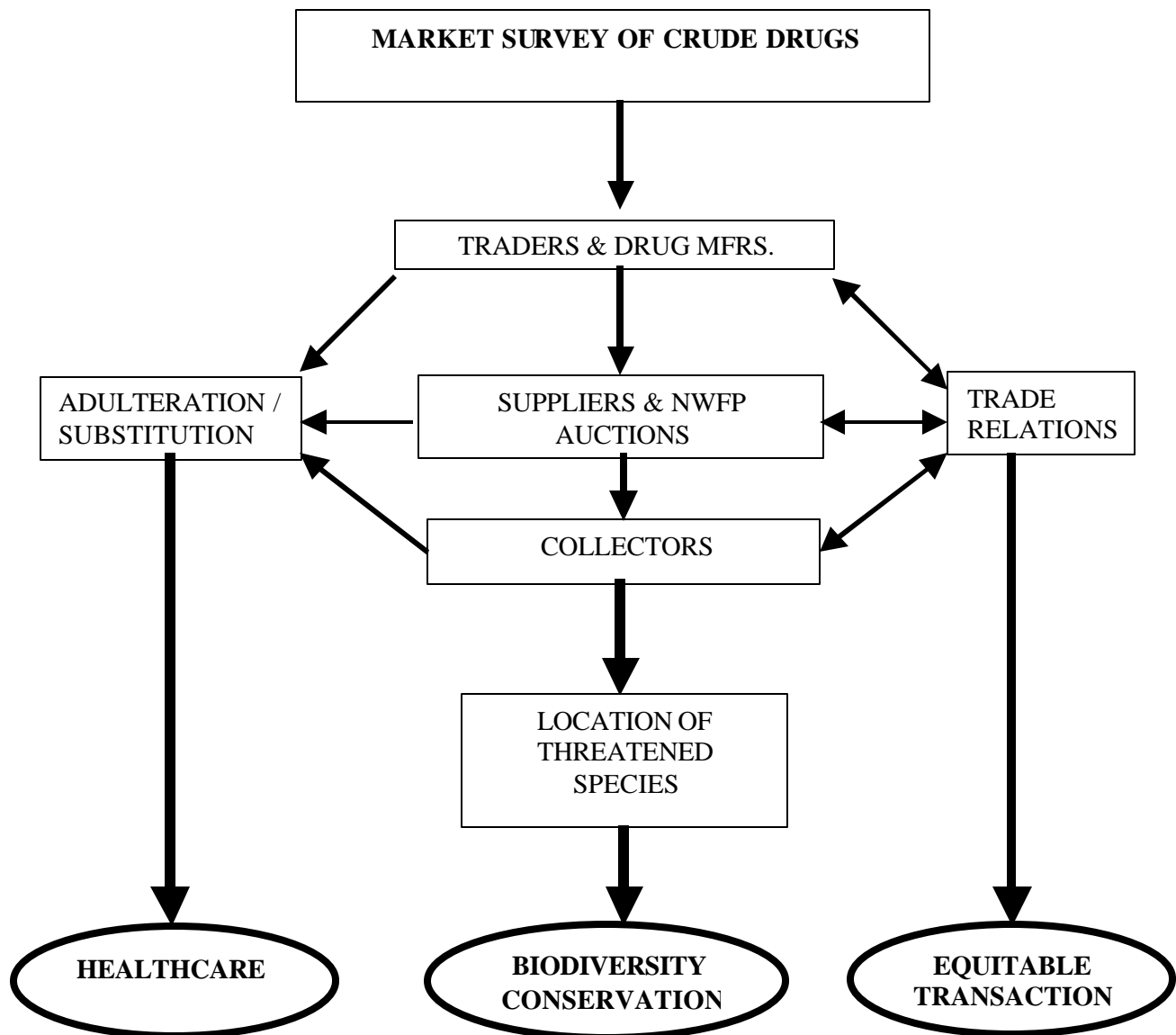
Information on the locations of medicinal plants was obtained from the latter. Medicinal plant collection in Thiruvananthapuram district occurs in forest and non-forest areas, by tribal and non-tribal collectors. A detailed survey of the study area elicited information on the location of medicinal plants, collectors and the quantity collected. Medicinal plant collection is part of the larger non-timber forest produce (NWFP) collection, which includes fuelwood, plants for commercial, edible purposes etc. The strategy was to identify the routes and exit points of the NWFP from the sanctuaries and take observations before and at the time of exchange of goods. Data was collected from the collectors and traders at the Pottamavu and Njaraneeli tribal co-operative societies and its sub-depots at Adiparambu and Kottur. The markets held at various villages in the periphery were also visited for data collection. Collectors, traders and forest department staff were informally interviewed and direct observations were made at the trade/auction centres. Field visits were made to some areas from where NWFP were being collected to observe the collection techniques. Discreet observation posts were maintained at various points of the collectors' routes to assess the quantity, variety and techniques adopted in NWFP collection. Information about the source of the plants, method of collection, and the plant parts used forms the basic data.

Other than such species in the official classification, we also look at the reports of the traders and the collectors to investigate if there are other species, which are becoming less in the market as well in the collection area.

Information regarding adulteration throughout the stages from procurement to retail sale was gathered. Traders were not willing reveal the details of adulteration. Therefore, samples were bought from different traders. These were analysed for morphological variations to find out the nature of adulteration and adulterants. Substitution was found to be practised in many instances. Field visits to the locations of plant extraction were made to evaluate the extent of extraction and the status of the plants in the area. Observations also produced other information on the local environment. Secondary sources such as the regional botanical research institutions and other reports were consulted to verify the threatened status of the plants.

Chart No.2.1.

Conservation & Consumption: a study on the crude drug trade in Threatened plants in Thiruvananthapuram district



Chapter 3.

Trade in Crude Drug

3.1. Marketing Channels of medicinal plants

A list of ayurvedic drug manufacturers/pharmacies in Thiruvananthapuram district was collected from the office of the Deputy Drug Controller. 15 out of the 81 registered firms were defunct and 20 could not be located. From the rest, excluding those who could not be met due to several reasons, data was collected from 29 concerns.

Many of those who were interviewed were not willing to divulge many aspects of the trade, either because they did not keep accurate figures or because they were not keen to discuss trade secrets. Detailed information on quantity, source, purchase price, adulteration etc., could not be collected from all.

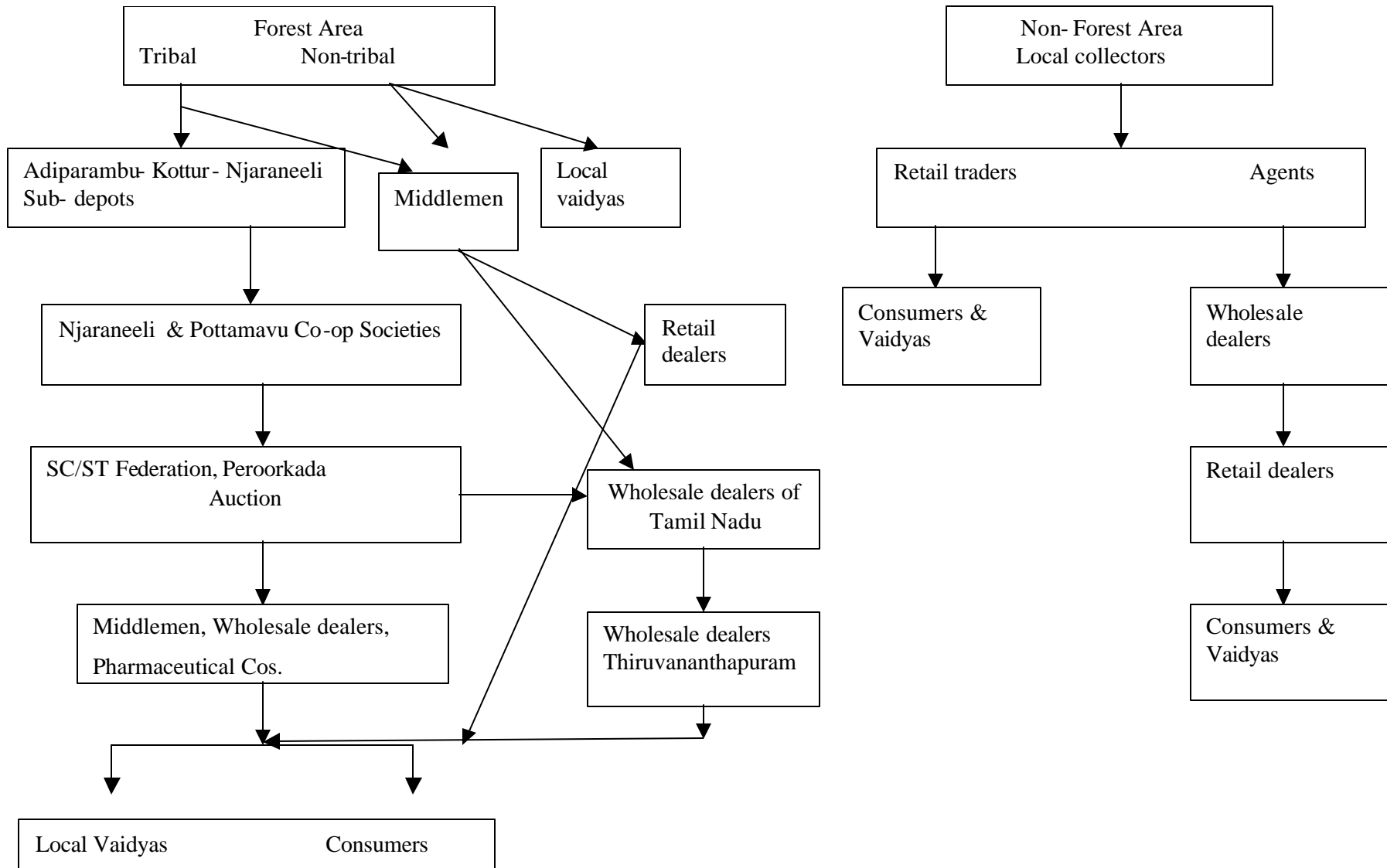
Table No. 3.1. List of Pharmacies/ Manufacturers

| Sr.No. | Name | Area |
|--------|---|--------------------|
| 1. | S K V Vaidyasala | Attingal |
| 2. | Dharma Mission Ayurveda & Siddha Vaidyasala | Ayiroorpara |
| 3. | Mukti Pharma | Chirayinkizhu |
| 4. | R R Hospital | Kadakkavoor |
| 5. | Apsara Pharmaceuticals | Kadakkavoor |
| 6. | Brahma Pharma | Kilimanoor |
| 7. | Bhaskara Vilasom Vaidyasala | Nedumangad |
| 8. | Prakrithi Ayurvedics | Nedumangadu |
| 9. | Herbal Remedies India | Neyyatinkara |
| 10. | Padmavilasom Ayurveda | Perumpazhathoor |
| 11. | Sigi Ayurveda Pharmacy | Peyad |
| 12. | Sathavilasom Vaidyasala | Poovachal |
| 13. | Pankaja Kasturi Herbals India | Poovachal |
| 14. | Santhigiri Ayurveda Vaidyasala | Pothencode |
| 15. | Santhigiri Siddha Vaidyasala | Pothencode |
| 16. | Dr.T N Internationa Institute of Medico-Sc.Research | Sreekariyam |
| 17. | Hindustan Pharmacy | Thiruvananthapuram |
| 18. | Arshik Herbal Remedies | Thiruvananthapuram |
| 19. | Sree Narayana Vilasom Vaidyasala | Thiruvananthapuram |
| 20. | Saroja Pharmacy | Thiruvananthapuram |
| 21. | Sukumara Vilasom Vaidyasala | Thiruvananthapuram |
| 22. | C V N Kalari | Thiruvananthapuram |
| 23. | Vasudev Herbal Concentrates | Thiruvananthapuram |
| 24. | Agasthya Pharmacy | Thiruvananthapuram |
| 25. | Rasma Pharmaceuticals | Thiruvananthapuram |
| 26. | Sree Dhanwanthari Madom | Thiruvananthapuram |
| 27. | Sri Udayannor Ayurvedics | Thiruvananthapuram |
| 28. | Indigenous Medical Stores | Vakkom |
| 29. | Anugraha Ayurvedic Pharmacy | Veli |

Several crude drug traders in the City as well as the other towns in the district were interviewed.

Most of the green, fresh medicinal plants are supplied from local sources or agents brought it from collectors in the forest or rural areas. From the preliminary survey of the traders a list of 933 materials in trade were obtained. These included plant and animal parts as well as minerals. Different parts of the same plant like Kurumulaku valli (Pepper vine) and Kurumulaku (Black Pepper) are considered separately. Traders are of the opinion that only about 201 plants are from Kerala. 2 from Kashmir, 7 from North India, 2 from Rajasthan, 4 from Punjab, one each from Andhra Pradesh and Assam and 33 from Tamil Nadu come to the trade centres here. 18 of them are from both Kerala and Tamil Nadu. Medicinal plants are also imported from Africa, Burma, and other Asian countries. The wholesale dealers often get their materials from Nagercoil, Madurai and Tenkasi in Tamil Nadu. Materials are also obtained from Sri Lanka, Malaysia, Burma, Afghanistan and Arab countries. In this study we confine ourselves to the plants from the study area, with focus on the rare, endangered, endemic, and threatened species among them.

Chart No.3.1. Marketing Channels of Medicinal Plants in Thiruvananthapuram



In the past, marketing of NWFP was directly between the tribal collectors and traders or settlers through barter system. After independence, the Forest Department took over the management of forests and they leased out the forest ranges to private traders and contractors to collect the NWFP. As the collectors were marginalized in the transaction, the government set up Tribal cooperative Societies in 1978. For effective marketing of NWFP, in 1982 a network was created with 'The Kerala State Federation of SC&ST Development Corporation' (Federation) as an apex body of Tribal Cooperative Societies. The Federation has the monopoly right to procure and market all the NWFPs collected by the tribal societies (Shanker & Muraleedharan, 1996). The Societies have collection depots to facilitate collection, which are managed mainly by tribals. The Federation fixes procurement prices for each item every year. Most of the items are sold by auction at the Federation premises. Some items are sold by quotation also. For perishable medicinal plant items like Kurunthotti (*Sida rombifolia*), Orila (*Desmodium gangeticum*), Moovila (*Pseudarthria viscida*) and Karimkurinji (*Nilgiranthus ciliatus*), etc., a marketing practice called 'Negotiation' is adopted in which the Federation and buyers agree to a price and items are supplied without any delay. In spite of this network, it is reported that 60-70% of the NWFPs are marketed by private traders (.ibid.). This is due to the non-trade relations that exist between the collectors and traders. The latter advances the former money and goods during exigencies in return for the collected items. This connection is not easily broken and many of the tribals are permanently indebted to the traders.

In the forest area, most of the perishable, short-shelf life items are directly sold by the collectors to the middlemen who in turn either sell to the retail dealers, wholesale dealers from nearby districts of Tamil Nadu or wholesale dealers of Thiruvananthapuram. The tribal collectors also directly auction the produce at Kottur market, known as 'Kani Chantha', under the supervision of Forest Department officials. Tribal collectors sold other items to the Sub-depots of the SC/ST Federation and also in the local markets. Local vaidyas mostly bought their crude drug from the non-tribals. Sometimes wholesale dealers from Tamil Nadu bought goods at the auctions of the Federation later sold the same to the wholesale dealers of Thiruvananthapuram at a margin.

Collections from the non-forest areas were either sold directly to the local vaidyas or the agents who are suppliers to the Wholesale dealers. The institutional chain involving the Societies and Federation is less lucrative to the collectors, who get a better deal in trading directly with the

middlemen and traders. The reasons for better prices from the private traders could be due to the facts that overhead charges are less in comparison with the institutional set-up and also due to the competition that the traders have to face from the Societies – Federation system (Shanker 1999). But what is overlooked here is the extra-trade relations that the collectors have with the traders. Money lending, personal relations over a long period, assurance of payment etc., are the reasons that the tribal collectors cited for preferring direct deal with the traders. Also the Societies have a restricted list of items; therefore the collectors will have to go the traders anyway for selling other items. Poor pricing policies, formal and distant relationship of the institutional staff, the inability of such institutions to disable exploitative middlemen marketing, etc., are cited as other reasons for failure of the Society-Federation institutional system (Muraleedharan, 2003).

3.2. Price Spread

Price spread is the difference between the price paid by the consumer and the price received by the producer for an equivalent quantity of produce (Acharya & Agarwal, 1987). In the context of Medicinal plant trade, there are intermediate stages between the primary collector and the end consumer, such as agents, middlemen, wholesale dealers and retailers.

Two tables (3.2. & 3.3.) are given below. Table 3.2. shows the price spread of collections from non-forest areas. The Percentage Increase is the margin between charges paid to the primary collector and the final retailer's price. Items like *Chittadalodakam*, *Vella Akil* have margin of more than 500%, while *Kaippan padavalam* and *Kattuzhunthu* have margins of above 300%. Of the 79 items shown below, 43 are sold at 100% or more margins. Generally, such plants are either rare or have high demand in the market. *Chittadalodakam* (Adhathoda beddome) has a high market demand. *Vella Akil* (Dysoxylum malabaricum) is collected and sold as adulterant of *Akil* (Aquilaria agalocha), an evergreen tree found only in Assam and Bengal. Fungal infected part of this tree is considered to be highly medicinal. This infected wood when lit is luminant and emits fragrance. The price margin is high because of its rarity. The combination plants for Dasamoolam and Nalpamara also fetch high margin because of the great market demand. Prices at certain stages could not be gathered for some items, because it was not either divulged or found to be very inconsistent

Table. 3.2. Price spread of medicinal plants of non-forest areas.

| Sl. No | Name of the medicinal plant. | Botanical name | Average collection charges | Average cost price of whole traders | Average selling price of whole traders | Average selling price of retailer | Difference | Increase in Percentage |
|--------|------------------------------|------------------------|----------------------------|-------------------------------------|--|-----------------------------------|------------|------------------------|
| 1 | Aal | Ficus benghalensis | 7.00 | 10.67 | 12.00 | 20.00 | 13.00 | 185.71 |
| 2 | Adalodakam | Adhathoda vasica | 7.00 | 10.67 | 12.00 | 25.00 | 18.00 | 257.14 |
| 3 | Adavikacholam | | 50.00 | 55.00 | 70.00 | 75.00 | 25.00 | 50.00 |
| 4 | Amukkuram | Withania somnifera | | 96.00 | 108.00 | 140.00 | 44.00 | 45.83 |
| 5 | Anakurumthotty | Sida spp. | 10.00 | | | 40.00 | 30.00 | 300.00 |
| 6 | Arashu | Ficus religiosa | 7.00 | 10.67 | 12.00 | 20.00 | 13.00 | 185.71 |
| 7 | Asokam bark | Saraca asoca | 25.00 | 42.67 | 48.00 | 35.00 | 10.00 | 40.00 |
| 8 | Asokam flower | Saraca asoca | 30.00 | 40.00 | 48.00 | 90.00 | 60.00 | 200.00 |
| 9 | Athithippali | Raphidophora retusa | | 75.00 | 90.00 | 95.00 | 20.00 | 26.67 |
| 10 | Athy | Ficus glomerata | 10.00 | 10.67 | 12.00 | 22.50 | 12.50 | 125.00 |
| 11 | Attilippa | Madhuca nerifolia | | 21.00 | 27.00 | 28.00 | 11.00 | 52.38 |
| 12 | Bhrami | Baccopa monnerii | 10.00 | 11.00 | 15.00 | 15.00 | 5.00 | 50.00 |
| 13 | Chakkarakkolli | Gymnema sylvestre | 35.00 | 35.33 | 42.00 | 60.00 | 25.00 | 71.43 |
| 14 | Chamatha (bark) | Butea parviflora | 20.00 | 17.33 | 24.00 | 25.00 | 5.00 | 25.00 |
| 15 | Chamatha (stem) | Butea parviflora | 20.00 | 10.00 | 12.00 | 30.00 | 10.00 | 50.00 |
| 16 | Chandanam (medium quality) | Santalum album | | 330.00 | 380.00 | 400.00 | 70.00 | 21.21 |
| 17 | Cheruchunda | Solanum indicum | 18.00 | 21.33 | 24.00 | 40.00 | 22.00 | 122.22 |
| 18 | Cherunjara | | 10.00 | 12.00 | 15.00 | | 5.00 | 50.00 |
| 19 | Cherupunna | Calophyllum inophyllum | | 54.00 | 54.00 | 95.00 | 41.00 | 75.93 |
| 20 | Cheruthekkku | Clerodendrum serratum | | 35.67 | 39.00 | 60.00 | 24.33 | 68.22 |
| 21 | Chillarikizhangu | Kaemphaeria rotunda | | 15.00 | 18.00 | | 3.00 | 20.00 |
| 22 | Chitta amrithu | Tinospora cordifolia | 5.00 | 9.33 | 9.60 | 13.50 | 8.50 | 170.00 |
| 23 | Chittadalodakam | Adhathoda beddomei | | 5.00 | 6.00 | 32.50 | 27.50 | 550.00 |
| 24 | Choriyanam | Tragia involucrata | 15.00 | 25.00 | 30.00 | | 15.00 | 100.00 |
| 25 | Chunnamukki | Cassis augustifolia | | 28.67 | 30.00 | 45.00 | 16.33 | 56.98 |
| 26 | Chuvanna kadaladi | Achyranthus sp. | 10.00 | 43.33 | 42.00 | 25.00 | 15.00 | 150.00 |

| | | | | | | | | |
|----|---------------------|---------------------------|-------|--------|--------|--------|--------|--------|
| 27 | Chuvanna koduveli | Plumbago indica | 40.00 | 43.00 | 45.00 | 60.00 | 20.00 | 50.00 |
| 28 | Ithy | Ficus gibbosa | 7.00 | 10.67 | 12.00 | 22.50 | 15.50 | 221.43 |
| 29 | Kadambu | Neolamarkia kadamba | | 22.00 | 25.00 | | 3.00 | 13.64 |
| 30 | Kaippan cheera | Mullugo oppositifolia | 20.00 | 22.00 | 25.00 | | 5.00 | 25.00 |
| 31 | Kaithonni | Ecipta alba | 10.00 | 11.00 | 6.00 | 12.50 | 2.50 | 25.00 |
| 32 | Kakka thondy | Torrenia bicolor | 15.00 | 24.67 | 30.00 | 35.00 | 20.00 | 133.33 |
| 33 | Kallal | Ficus mysorensis | 30.00 | 32.67 | 35.00 | | 5.00 | 16.67 |
| 34 | Kandakarichunda | Solanum xanthocarpum | 15.00 | 28.67 | 30.00 | 50.00 | 35.00 | 233.33 |
| 35 | Kanikonna (Bark) | Cassia fistula | 15.00 | 17.67 | 21.00 | 30.00 | 15.00 | 100.00 |
| 36 | Karimkoovalam | Monochorea hastaefolia | 15.00 | 11.00 | 6.00 | 40.00 | 25.00 | 166.67 |
| 37 | Karimkurinji | Nilagirianthus ciliatus | 15.00 | 14.80 | 18.00 | 30.00 | 15.00 | 100.00 |
| 38 | Karimthumba | Anisochilus carnosus | 12.00 | 22.00 | 30.00 | | 18.00 | 150.00 |
| 39 | Kariyilanchi | Smilax zeylanica | | 46.00 | 54.00 | 55.00 | 9.00 | 19.57 |
| 40 | Karutha kodangal | Geophila sp. | | 56.67 | 66.00 | | 9.33 | 14.14 |
| 41 | Kattu karuva pattah | Myristica spp. bark | | | | 150.00 | | |
| 42 | Kaippan padavalam | Trichosanthes cucumerina | 20.00 | 152.67 | 174.00 | 130.00 | 110.00 | 550.00 |
| 43 | Kattu panchi | | 10.00 | 12.00 | 22.00 | | 12.00 | 120.00 |
| 44 | Kattu uzhunnu | Vigna vexillata | 10.00 | 32.00 | 36.00 | 40.00 | 30.00 | 300.00 |
| 45 | Kattuchena | Amorphophallus commutatus | 20.00 | 22.00 | 25.00 | 30.00 | 10.00 | 50.00 |
| 46 | Kattumuthira | Atylosia scarabaeoids | 15.00 | 24.67 | 30.00 | 35.00 | 20.00 | 133.33 |
| 47 | Kattuvellari | Melothria indica | | 78.67 | 84.00 | 85.00 | 6.33 | 8.05 |
| 48 | Kazhanji | Caesalpinia bonducella | 25.00 | 20.67 | 30.00 | 45.00 | 20.00 | 80.00 |
| 49 | Kodangal | Centella asiatica | 10.00 | 27.67 | 39.00 | | 29.00 | 290.00 |
| 50 | Koovalam | Aegle marmalos | 10.00 | 19.33 | 24.00 | 35.00 | 25.00 | 250.00 |
| 51 | Kurumthotty | Sida cordifolia | 15.00 | | | 40.00 | 25.00 | 166.67 |
| 52 | M aenthonni | Gloriosa superba | 25.00 | 55.00 | 30.00 | 60.00 | 35.00 | 140.00 |
| 53 | Manjal | Curcuma longa | 20.00 | 42.67 | 48.00 | 45.00 | 25.00 | 125.00 |
| 54 | Munja | Premna integrifolia | 18.00 | 17.67 | 21.00 | 30.00 | 12.33 | 69.81 |
| 55 | Nagadhanthy | Baliospermum montanum | | 74.33 | 87.00 | 90.00 | 15.67 | 21.08 |
| 56 | Neela amari | Indigofera tinctoria | 40.00 | 28.00 | 36.00 | 45.00 | 5.00 | 12.50 |
| 57 | Neer maruthu | Terminalia arjuna | 15.00 | 28.67 | 30.00 | 32.50 | 17.50 | 116.67 |
| 58 | Ooravu | Persea macrantha | | 28.67 | 35.00 | | 6.33 | 22.09 |
| 59 | Orila thamara | Nervalia araguana | 25.00 | | | | | |

| | | | | | | | | |
|----|----------------------|---------------------------------|-------|-------|--------|--------|--------|--------|
| 60 | Padarchunda | | 10.00 | 10.00 | 12.00 | 50.00 | 40.00 | 400.00 |
| 61 | Pal Modakku | <i>Ipomoea mauritiana</i> | 3.00 | 10.00 | 10.80 | 12.50 | 9.50 | 316.67 |
| 62 | Palakappayani | <i>Stereospermum suaveolens</i> | 20.00 | 18.00 | 18.00 | 45.00 | 25.00 | 125.00 |
| 63 | Panchy | <i>Glycosmis pentaphylla</i> | | 11.00 | 6.00 | 30.00 | 19.00 | 172.73 |
| 64 | Parppadakappullu | <i>Oldenlandia corymbosa</i> | 20.00 | 28.00 | 28.80 | 50.00 | 30.00 | 150.00 |
| 65 | Pokkanamthooki | <i>Aristolochia tagala</i> | 25.00 | 30.00 | 36.00 | | 11.00 | 44.00 |
| 66 | Ponkorandy | <i>Salacia fruticosa</i> | 70.00 | 73.33 | 78.00 | 80.00 | 10.00 | 14.29 |
| 67 | Poovamkurunnila | <i>Vernonia cineria</i> | 15.00 | 11.00 | 16.00 | 20.00 | 5.00 | 33.33 |
| 68 | Sarpagandhi (manja) | <i>Rauvolfia serpentina</i> | | 40.00 | 48.00 | | 8.00 | 20.00 |
| 69 | Sarpagandhi (Vella) | <i>Rauvolfia serpentina</i> | | 86.67 | 84.00 | 250.00 | 163.33 | 188.46 |
| 70 | Thippali | <i>Piper longum</i> | | 75.33 | 114.00 | 150.00 | 74.67 | 99.12 |
| 71 | Valiyanarunandi | <i>Decalepis hamiltoni</i> | | 33.67 | 39.00 | 47.50 | 13.83 | 41.09 |
| 72 | Vayambu | <i>Acorus calamus</i> | | 30.33 | 33.00 | 45.00 | 14.67 | 48.35 |
| 73 | Vella akil | <i>Dysoxylum malabaricum</i> | | 43.33 | 42.00 | 300.00 | 256.67 | 592.31 |
| 74 | Vellaruku | <i>Mussaenda frontosa</i> | | 24.67 | 30.00 | 35.00 | 10.00 | 40.54 |
| 75 | Vettupala | <i>Wrightia tinctoria</i> | 20.00 | 22.00 | 25.00 | | 5.00 | 25.00 |
| 76 | Vizhal | <i>Embelia ribes</i> | | 72.00 | 72.00 | 120.00 | 48.00 | 66.67 |
| 77 | Arashu | <i>Ficus religiosa</i> | 7.00 | 10.67 | 12.00 | 20.00 | 13.00 | 185.71 |
| 78 | Athy | <i>Ficus glomerata</i> | 7.00 | 10.67 | 12.00 | 20.00 | 13.00 | 185.71 |
| 79 | Ithy | <i>Ficus gibbosa</i> | 7.00 | 10.67 | 12.00 | 20.00 | 13.00 | 185.71 |

* Certain medicinal plants are rare and hence are not collected by the medicinal plant collectors. But these plants are reported in various floras pertaining to Thiruvananthapuram.

Chart 3.2. Market margin of selected Medicinal Plants collected from Non-Forest Area.

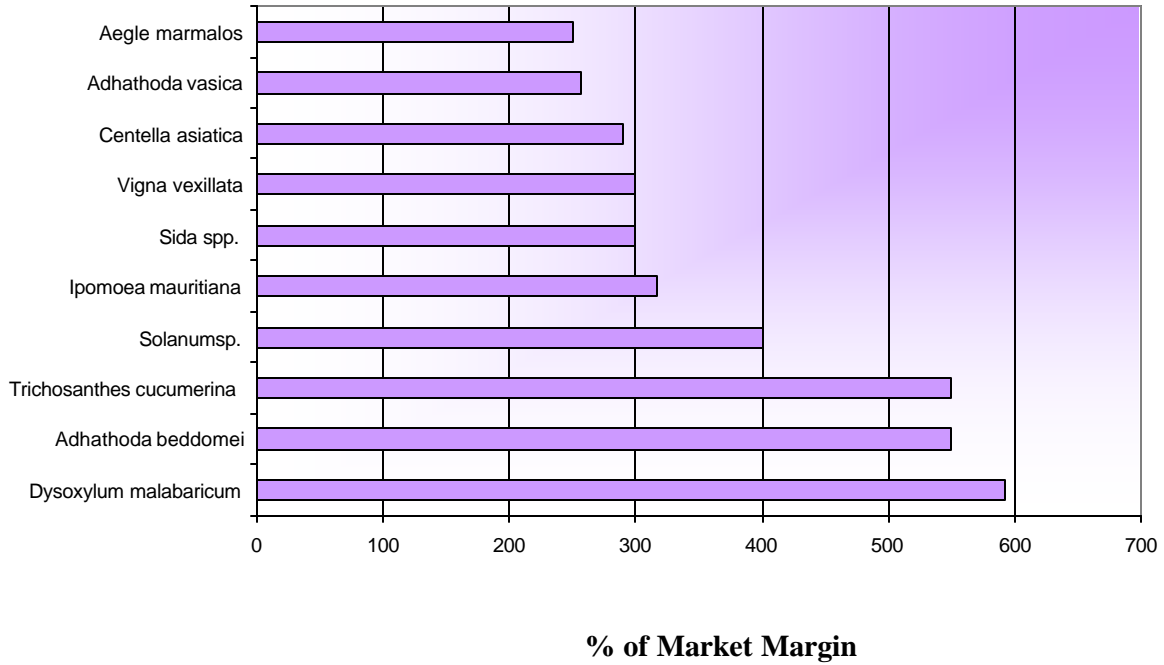


Chart No. 3.3. Market Margin of Selected Medicinal Plants from forests

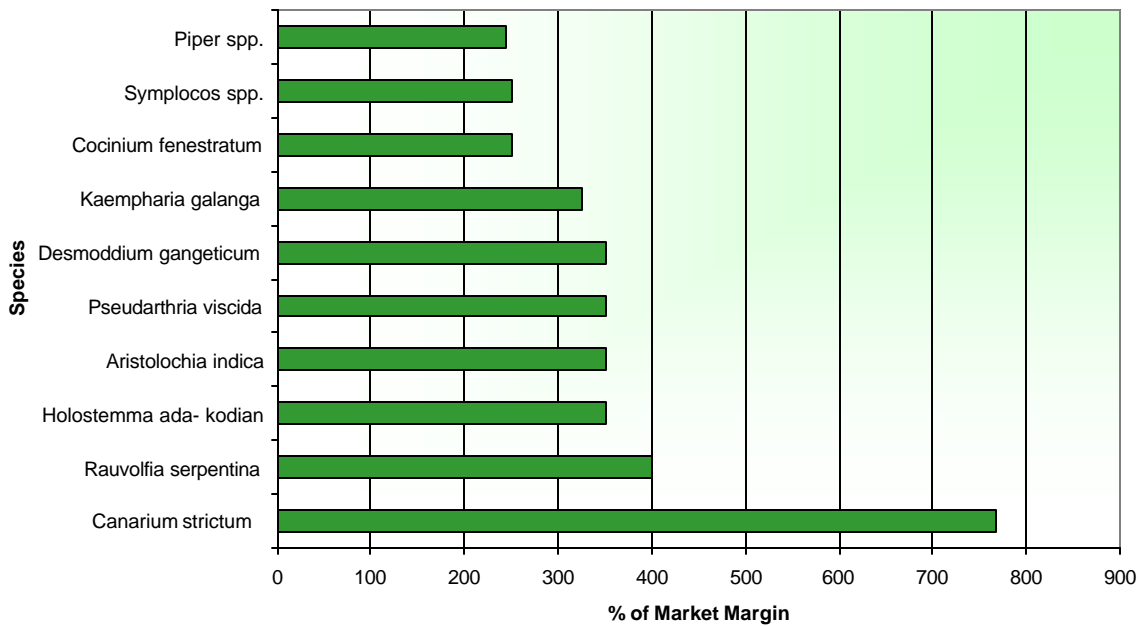


Table 3.3. Price spread of medicinal plants from forests

| Sl. No | Name of the medicinal plant. | Botanical name | Average collection charges paid | Av. cost price of wholesaler | Av. selling price of wholesaler | Av. selling price of retailer | Difference | Increase in Percentage |
|--------|------------------------------|------------------------------|---------------------------------|------------------------------|---------------------------------|-------------------------------|------------|------------------------|
| 1 | Adapathiyam | <i>Holostemma kodian</i> | 50.00 | 128.00 | 144.00 | 225.00 | 175.00 | 350 |
| 2 | Amalpori | <i>Rauvolfia serpentina</i> | 50.00 | 100.00 | 150 | 250.00 | 200.00 | 400 |
| 3 | Cheriyam narunandi | <i>Hemidesmus indicus</i> | 40 | 75 | 78 | 100 | 60 | 150 |
| 4 | Garudakkodi | <i>Aristolochia indica</i> | 10.00 | 19.67 | 21.00 | 45.00 | 35.00 | 350 |
| 5 | Kacholam | <i>Kaempferia galanga</i> | 20.00 | 39.00 | 45.00 | 85.00 | 65.00 | 325 |
| 6 | Kattu manjal | <i>Curcuma spp.</i> | 20.00 | 24.00 | 44.00 | 48.00 | 28.00 | 140 |
| 7 | Kattukurumulaku | <i>Piper spp.</i> | 40.00 | 51.00 | 55.00 | | 15.00 | 38 |
| 8 | Kattukurumulaku valli | <i>Piper spp.</i> | 8.00 | 11.00 | 6.00 | 27.50 | 19.50 | 244 |
| 9 | Kolinji | <i>Alpinia calcarata</i> | 10.00 | 19.67 | 21.00 | 25.00 | 15.00 | 150 |
| 10 | Kudampuli | <i>Garcinia gummi gutta</i> | 35.00 | 49.33 | 60.00 | 60.00 | 25.00 | 71 |
| 11 | Kunthirikkam (Karuppu) * | <i>Vateria indica</i> | 45.00 | 74.00 | 90.00 | 100.00 | 55.00 | 122 |
| 12 | Kunthirikkam (Veluppu) * | <i>Canarium strictum</i> | 15.00 | 110.00 | 126.00 | 130.00 | 115.00 | 767 |
| 13 | Maramanjil | <i>Cocinium fenestratum</i> | 10.00 | 24.67 | 30.00 | 35.00 | 25.00 | 250 |
| 14 | Marotty enna | <i>Hydnocarpus spp.</i> | # | 235.33 | 258.00 | 280.00 | 44.67 | 19 |
| 15 | Moovila | <i>Pseuderthria viscida</i> | 10.00 | 21.33 | 24.00 | 45.00 | 35.00 | 350 |
| 16 | Orila | <i>Desmoddium gangeticum</i> | 10.00 | 21.33 | 24.00 | 45.00 | 35.00 | 350 |
| 17 | Pachotty | <i>Symplocos spp.</i> | 10.00 | | 35.00 | | 25.00 | 250 |
| 18 | Padathaly | <i>Cyclea peltata</i> | 55.00 | | 100.00 | | 45.00 | 82 |
| 19 | Ponnampooovu | <i>Myristica spp.</i> | 130.00 | 99.33 | 114.00 | 250.00 | 120.00 | 92 |

* Collector gets charges for collection of *Kunthirikkam* depending on its quality.

Tribals collect the seeds of *Hydnocarpus spp.* and the oil from it is sold in the market.

3.3.Collectors' share in income.

The objective of looking at the Price Spread in this study is to understand the share of income earned by the tribal and other primary collectors from the trade. The tribal collectors have virtually no way of collective bargaining. The unscientific harvesting and poor marketing strategies of the Federation are among the reasons due to which the real income of the collectors decline. Lack of alternative employment therefore forces the tribal to collect excessively, which leads to the decline of regeneration potential of NWFP species. (Muraleedharan *et al.*, 1997)

From the above chart, it is obvious that the middlemen and traders pocket the lion's share of the market value of medicinal plants. The collectors, mostly tribals are paid a pittance, which is totally unjustified in relation to their efforts to procure the same. This lopsided sharing has a major detrimental effect. The collectors might be tempted to resort to exaggerated extraction of species that fetch better price which again lead to their rarity or extinction in the wild.

Chapter 4

Adulteration & Substitution of Crude Drugs

Adulteration or substitution occurs due to various factors. Usually a cheaper, abundant and in most cases, less effective material is either mixed or totally substituted for the original. The ordinary consumer cannot detect the subtle morphological differences. In instances where root of a species is the crude drug, stem is cut and mixed along with, which would increase the weight of the material.

Certain adulteration/substitution practices detected in the course of the study are given below.

4.1. Same plant substitution

Different parts of the same species are available as substitutes. In most of the cases stem is used instead of roots. Stem of Rubia cordifolia is mixed along with with its roots. Stem of Sida species is substituted for Sida roots. Entire wood is sold instead of the bark of Coscinium fenestratum.

4.2. Same genera substitution

Most of the adulterants have some of the qualities of the original plant material. This may be because both of them are of the same genus or of the same family.

Phyllanthus amarus (*Keezharnelli*) is adulterated with the species of the same genus – P.fraternus and P.maderaspatensis (Joseph GVR, 2000). Roots of Caesalpinia sappan (*Pathimugham*) are adulterated with that of C. pulcherrima. Roots of Tinospora sinensis (*Kattamrthu*) is used in place of T. cordifolia (*Chittamrthu*). Roots of several species of Solanum are available instead of Solanum melongena. Seeds of Mucuna puriens are replaced by that M.gigantia and M.hirsute. In the place of Sida cordifolia, roots of other Sida species (S.acuta, S.rhombifolia) are used. Hedychium coronarium is an adulterant of H. spicatum, the rhizomes of which are traded under the name *Kapur Kachari* (Ravikumar & Ved, 2000). Adhathoda vasica (*Adalodakam*) roots are adulterated with that A.beddomei (*Chittadalodakam*), or vice-versa though the latter is an endangered plant. However, there is a difference of opinion as to which is the substitute, since a school of thought holds that A.beddomei is more potent than the former. The leaf galls of Terminalia chebula (*kadukka*) are substituted by that of T.arjuna (*neermaruthu*).

The dried flower bud of Syzygium aromaticum (Clove), a well-known spice is substituted by that of *Vayana*. Fruits of Piper barberi (*Kattu kurumulagu*) and P. triviale are mixed with P. nigrum (Black Pepper), whereas the stem of Piper nigrum is the adulterant of Piper barberi (*Kattu kurumulakin thandu*). The aril (mace) of Myristica malabarica (*Ponnampoo*) is substituted for that of M. fragrans (*Jati patri*).

4.3. Same family substitution

Costus speciosus and Hedichium coronarium belong to the same family of Zingiberaceae. The latter is an adulterant of the former.

4.4. Different Plants substitution

Tubers of Mirabilis jalapa (*Nalumani*) are used as an adulterant of Smilax china (*Cheenappavu*). The wood of Pterocarpus marsupium is sold in the place of Caesalpinia sappan Oxalis cornicularis (*Puliyaral*), a flowering plant is substituted by similar looking Marselia quadriflora, which is a Pteridophyte (non-flowering).

Another interesting substitution is that of an animal product by plant material. A plant, Illicium verum is substituted in place of *Kasturi*, musk gland of Musk Deer (Moschus moschiferus).

In certain cases, the original material even though available is not marketed or less in the market and ironically, an endangered species is supplied. e.g., Hemidesmus indicus (*Sarasaparilla*) is substituted by Decalepis hamiltonii, a globally endangered plant, endemic to peninsular India. In the markets of Thiruvananthapuram its roots are available in plenty compared to the original. Both have the same smell and hence are not distinguishable except for its size. The roots of Abrus precatorius (*Vella kunnii*) are used instead of the roots of Glycyrrhiza glabra (*Iratti madhuram*). Both are sweet to taste. Cycas circinalis, a critically endangered gymnosperm seen in the deciduous to semi-evergreen forests or in tall grasslands and woodland savannahs is used as an adulterant of Puraria tuberosa.

Table No.4.1. Adulterants of Threatened Medicinal Plants of Thiruvananthapuram

| Sl. No | Threatened Species | Local name | Part | Adulterant | Local name | Part |
|--------|----------------------------------|----------------------|---------------|--|----------------------|---------------|
| 1 | <i>Adenia hondala</i> | Mothakku | Tuber | <i>Adenia wightiana</i> | | Tuber |
| 2 | <i>Adhathoda beddomei</i> | Chittaratha | Roots | <i>Adhathoda vasica</i> | Adalodakam | Roots |
| 3 | <i>Aegle marmalos</i> | Koovalam | Roots | <i>Atlantia bengalensis</i> | Kattunarakam | Plathyveru |
| 4 | <i>Aerva wightii</i> | Kattu cherula | Roots | <i>Aerva lanata</i> | Cherula | Roots |
| 5 | <i>Amorphophallus commutatus</i> | Kattu chena | Rhizome | <i>A.companulatus</i> | Nadan Chena | Rhizome |
| 6 | <i>Aristolochia indica</i> | garuda kody | Roots | <i>Aristolochia tagala</i> | garudakody | roots |
| 7 | <i>Calophyllum apetalum</i> | Cherupunna | Seeds | <i>Celastrus paniculatus</i> | | |
| 8 | <i>Canarium strictum</i> | Kunthirikkam, Thelly | Resin | <i>Vateria indica</i> | Velutha kunthirikkam | Resin |
| 9 | <i>Cinnamomum veerum</i> | Karuva, Vazhana | Bark | <i>Cinnamomum macrocarpum</i> | Kattukaruva | Bark |
| 10 | <i>Cocinium fenestratum</i> | Maramanjil | stem | <i>Mahonia leishnaulti</i> | | Stem |
| 11 | <i>Garcinia gummigutta</i> | Kodam puli | Fruits | <i>Garcinia travancorica</i> | | Fruits |
| 12 | <i>Hemidesmus indicus</i> | Narunandy | Roots | <i>Decalepis hamiltoni</i> | Valiyanarunandi | Roots |
| 13 | <i>Oroxylum malabraicum</i> | Palakapayyani | Roots | <i>Ailanthus exelsa</i> | Aazhantha | Roots |
| 14 | <i>Pseudarthria</i> | Moovila | Roots | <i>Desmodium gangeticum</i> | Orila | Roots |
| 15 | <i>Purera tuberosa</i> | Mothakku | | <i>Adenia hondala</i> | Mothakku | |
| 16 | <i>Salacia pronoides</i> | Ponkorandy | Roots | <i>Salacia oblonga</i> | | Roots |
| 17 | <i>Salacia pronoides</i> | Ponkorandy | Roots | <i>Salacia reticulata</i> | Korandy | Roots |
| 18 | <i>Gloriosa superba</i> | Menthonni | Rhizome | <i>Costus speciosus</i> | Chenthy | Rhizome |
| 19 | <i>Hedychium spicatum</i> | Karppora kacheri | Rhizome | <i>Hedichium coronarium</i> | Kalyana sougandhikam | Rhizome |
| 20 | <i>Aquileria malaccanses</i> | Akil | Heart wood | <i>Dysoxylum malabaricum</i> | Vella akil | Heart wood |
| 21 | <i>Hydnocarpus pentandra</i> | Marotty | Seeds | <i>Hydnocarpus macrocarpa</i> | Malamarotty | Seeds |
| 22 | <i>Myristica fragrans</i> | Jathy | Aril | <i>Myristica malabarica</i> | Pooam paanu | Aril |
| 23 | <i>Myristica fragrans</i> | Jathy | Aril | <i>Myristica dactyloides</i> | Paanu | Aril |
| 24 | <i>Nervelia araguana</i> | Orila thamara | Tubers | <i>Other Nervelia spp.</i> | | Tubers |
| 25 | <i>Piper barberi</i> | Kattu kurumulaku | Stem & leaves | <i>Piper nigrum</i> | Kurumulaku | Stem & leaves |
| 26 | <i>Piper nigrum</i> | Kurumulaku | Seeds | <i>Piper barberi</i> | Kattu kurumulaku | Seeds |
| 27 | <i>Piper nigrum</i> | Kurumulaku | Seeds | <i>Piper mullesua</i> | Kattu kurumulaku | Seeds |
| 28 | <i>Piper longum</i> | Thippali | Roots | <i>Piper longum</i> | Thippali | Roots |
| 29 | <i>Saraca asoka</i> | Ashokam | Bark | <i>Polyalthia longifolia</i> | Weeping Ashoka | Bark |
| 30 | <i>Santalum album</i> | Chandanam | Heart Wood | <i>Any other wood on which sandal perfume is applied</i> | | |
| 31 | <i>Semicarpus anacardium</i> | Cherkkuru | Seeds | <i>Semicarpus travancoricum</i> | Amukkuram | Seeds |
| 32 | <i>Symplocos cochinchinensis</i> | Pachotty | Bark | <i>Symplocos racemosa</i> | Malam parala | Bark |
| 33 | <i>Syzygium aromaticum</i> | Clove | Flower bud | <i>Cinnamomum veerum</i> | Vazhana | Flower bud |
| 34 | <i>Syzygium aromaticum</i> | Clove | Flower bud | <i>Syzygium cumini</i> | | Flower bud |

4.5 Adulteration in Combination Drugs

a. Dasamoola

'Dasamoola' - 10 roots (Cheru pancha moolam & Valiya Pancha moolam) is a medicine in great demand. In the following table the first 5 are cheru panchamoolam & the last 5 are valiya Pancha moolam. Cherupanchamoolam is the root of shrubs and the Valiya Panchamoolam is that of trees. All the traders & collectors agree that they do not get enough quantity of these roots. Hence always the stems are also added. Apart from this parts of other species are seen in the market.

Table:4.2 Adulteration in Dasamoola

| Sl. No | Local Name | Botanical name | Local name of the adulterant | Botanical Name of the adulterant |
|--------|------------------|---------------------------------------|---------------------------------|--|
| 1 | Orila | <i>Desmodium gangeticum</i> | Pothorila Valli orila | <i>D. triquiterum</i> , <i>D. pulchellum</i> & other <i>Desmodium spp.</i> |
| 2 | Moovila | <i>Pseudarthria viscida</i> | Orila, Valli orila | <i>Desmodium gangeticum</i> & <i>D. triquiterum</i> , <i>D. pulchellum</i> & other <i>Desmodium spp.</i> |
| 3 | Cheru vazhuthana | <i>Solanum indicum</i> | Vazhuthana Chunda etc | <i>Solanum melongena</i> , <i>solanum torvum</i> & other <i>Solanum spp.</i> |
| 4 | Ven vazhuthana | <i>Solanum melongena var. insanum</i> | Vazhuthana Chunda etc | <i>Solanum melongena</i> , <i>solanum torvum</i> & other <i>Solanum spp.</i> |
| 5 | Njerinjil | <i>Tribulus terrestris</i> | | <i>Pedaliium murex</i> |
| 6 | Pathiri | <i>Stereospermum suaveolens</i> | | <i>Rhododendrum macrophyllum</i> |
| 7 | Palakappayani | <i>Oroxylum indicum</i> | Azhantha | <i>Ailanthus exelsa</i> |
| 8 | Munja | | Kozhi munja | <i>Clerodendrum phlemedis</i> |
| 9 | Koovalam | <i>Aegle marmalos</i> | 1.Kattunarakam 2.Nilanarakam | 1. <i>Atlantia bengalensis</i> 2. <i>Toddalia asiatica</i> |
| 10 | Kumbil | <i>Gmeligna arborea</i> | Ilipooovu | <i>Bassia longifolia</i> |

b. Chathur Jat ham

In ayurvedic medicine 4 plants are used as flavouring agents. They are called Chathur jatham.

| Sl. No | Local Name | Botanical name | Part used | Botanical Name of the adulterant | Part used |
|--------|------------|---|------------|--|------------------|
| 1 | Ealakka | <i>Elettaria cardamomum</i> | Fruit | Valiya Ealam | Amomum subulatum |
| 2 | Ilavargam | <i>Cinnmomum zeylanicum</i> | Bark | Cinnamomum tamala | Bark |
| 3 | Pachila | <i>Cinnamomum tamala/Pogostemon heyneanum</i> | Dried Leaf | 1. <i>Anisomeles ovata</i> , 2. <i>Hyptis suaveolens</i> | Dried Leaf |
| 4 | Nagappoo | <i>Mesua ferrea</i> | Stamen | 1. <i>Calophyllum inophyllum</i> 2. <i>Cinnamomum inermis</i> | Bud 2.Bud |

c. Triphala

Triphala is a drug used for rejuvenation. It is a combination of the fruit of three tree species. But the tribhala powder sold in the market contains fruits as well as seeds. The seeds especially that of Thannikka is not advisable for intake as it causes drowsiness.

| Sl. No | Local name | Botanical Name |
|--------|------------|-----------------------------|
| 1 | Kadukka | <i>Terminalia chebula</i> |
| 2 | Nellikka | <i>Phyllanthus emblica</i> |
| 3 | Thannikka | <i>Terminalia bellerica</i> |

d. Thrikadu

Thrikadu is a combination of three pungent medicinal plants.

| Sl. No | Local name | Botanical name | Part used | Local Name of Adulterant | Botanical name of Adulterant |
|--------|------------|-----------------------------|---------------|---------------------------------|---|
| 1 | Chukku | <i>Zingiber officinalis</i> | Dried Rhizome | | |
| 2 | Mulaku | <i>Piper nigrum</i> | Fruits | 1.Kattukurumulaku 2.Poochedi | 1. <i>Piper barberi</i> 2. <i>Lantana camara</i> |
| 3 | Thippali | <i>Piper longum</i> | Fruits | Piper mullesua | Kattu thippali |

4.6 Incomplete combinations of crude drugs

Apart from substitution and adulteration in many cases all the ingredients are not supplied, in cases where crude drugs are sold in a combination: for example, Dasamoola – instead of the 10 different types of roots required, several samples taken from tradres contained only 5 to 6. Another example is Naalpamaram, in which bark of 4 *Ficus* species are used, viz., *Ficus glomerata* (Athi), *F. tinctoria* (Iththi), *F.bengalensis* (Arayal), and *F.religiosa* (Peraal). Samples collected from different outlets contained barks of only one or two species. *F.tinctoria* was absent in most samples, obviously due to its rarity.

During the study it was found that adulteration occurs at all stages. The collectors knowingly and unknowingly mix the items, with or without the knowledge of the traders. The traders also indulge in mixture and substitution of the crude drugs.

Table: 4.3. Incomplete combinations of crude drugs

| Common name | Scientific name | Part used | Remarks |
|--|------------------------------|---------------------|---|
| Orila, Moovila | <i>Desmodium gangeticum</i> | Roots | Usually only <i>Desmodium gangeticum</i> is seen |
| | <i>Pseudarthrida viscida</i> | Roots | |
| Jeevakam, Edavakam (First Quality) | <i>Microstylis wallichii</i> | Tubers | <i>Ipomoea paniculata</i> or <i>Asparagus racemosus</i> singly (Palmuthakku or Sathavary) Edampiri Valmapiri (<i>Helecteres isora</i>) |
| Jeevakam, Edavakam (First Quality) | <i>Microstylis mucifera</i> | Tubers | |
| Naalpamaram (Atthi, Itthi, Arayal, Peraal) | <i>Ficus sp.</i> | Stem bark | Only 1 or 2 species will be present |
| Dasamoolam | | Roots of 10 species | All the 10 ingredients are not sold |

Usually *Pseudarthrida viscida* (*Moovila*) is not collected or sold in the name of Moovila. It is sold as Orila-moovila and it mostly contains Orila. In Ayurveda, substitution of one drug with another is acceptable in certain cases. For example, *Coscinium fenestratum* is accepted as a substitute for *Berberis aristata*. Both are known as *Maramanjala*.

While most of the adulteration/substitution practices noted above would not have any harmful effect on the consumer, it may just be ineffective and this would shake the faith of the consumer in the traditional healthcare system. Lack of standardization in most traditional drugs also let the culprits get away with such instances of unethical practices.

4.7 Controversial Substitution

In certain cases there are controversies regarding the correct identity of a medicinal plant. Certain plants like *Brahmi*, *Kurumthotty*, *Paluluvam* etc., used in North India are not the same plants used in Kerala. i.e., they have the same common name but are different species.

| Sl. No | Used in Kerala | Used in N. India | Part used |
|--------|--|--|-----------|
| 1 | <i>Sida cordifolia</i> (Kurumthotti) | <i>Sida retusa</i> | Roots |
| 2 | <i>Calophyllum apetalum</i> (Cherupunna) | <i>Celastrus paniculatus</i> (Paluluvam) | Seeds |
| 3 | <i>Baccopa monnerii</i> (Neer brahmi) | <i>Centella asiatica</i> (Kodangal) | Plant |

Chapter.5

Medicinal plant Collection

The major areas of collection in Thiruvananthapuram District are divided into Forest areas and non-forest areas.

5.1. Collection from Forests

Majority of the threatened medicinal plants are from forests; hence a detailed survey was conducted in Peppara & Neyyar Wildlife Sanctuaries, Agasthyavanam Biological Park, and the forest reserves such as Palode, Paruthipalli, & Kulathupuzha (Kulathupuzha Reserve fall under Kollam district; however, it is part of Thiruvananthapuram forest division and contiguous to other ranges in Tiruvananthapuram district and most of the forest produce come to the market in Thiruvananthapuram. Therefore collection from Kulathupuzha reserve is also included in this study).

5.1. 1. Collectors

The medicinal plant collectors from the forest areas include tribals, settlers and the estate workers residing in the periphery of the forests. The right to collect from forests is exclusively allotted to the members of tribals' co-operatives. Studies show that this rule is openly flouted (Christopher & Jayson, 1996). It was observed that practitioners of traditional medicine and their agents from the neighbourhood as well as distant places are directly engaged in collection. Traders from Tamil Nadu also directly engage tribals and other collectors for the supply of medicinal plants. A survey was conducted in the study area. 1366 households from 81 settlements were surveyed. Of these, 851 families engage in NWFP collection which includes medicinal plants.(Table no.5.1.)

Table No.5.1. Medicinal Plant Collectors of forests areas in Thiruvananthapuram

| | Peppara | Neyyar | Agasthyavana m Biological Park | Paruthippilly | Palode | Kulathu -puzha | Total |
|--|---------|--------|--------------------------------------|---------------|--------|-------------------|-------|
| No. of houses surveyed | 196 | 396 | 77 | 273 | 220 | 204 | 1366 |
| No. of families engaged in NWFP collection | 175 | 110 | 52 | 233 | 178 | 103 | 851 |

The Kani tribals who live in an around the forests are actively engaged in NWFP collection, of which medicinal plants form a substantial part. The estate workers at Bonnacord, Merchinston, etc, most of whom are presently either unemployed or underemployed also forage in the forest mainly for fuelwood and fodder. Settlers in the periphery of the sanctuaries and forest reserve access the forests in spite of the fact that it is forbidden.

5.1.2 Methods of collection

The collection methods were noted to be totally unscientific and ecologically disastrous. This is especially so in the case of non-tribals who collect fuelwood and other NWFP. Fruits and seeds are often collected by felling the tree or lopping large branches or cutting off an entire unit (eg. Myristica sp, Terminalia chebula, Cinnamomum malabattrum, Phyllanthus emblica, Calamus sp etc). Collection of commercial quantities of fruits and seeds can cause notable changes in the structure and dynamics of a tree population (Peters, 1994). Large-scale collection of oil from Kingiodendron pinnatum (Kulavu enna), though banned, has resulted in its depletion in the forests. Black Damar (Canarium strictum) is collected by peeling off the bark of the tree and then setting fire to it for increased exudation of the resin. According to the collectors, C.strictum has become very rare in Peppara & Neyyar Sanctuaries now. The endangered plant Manjavalli (vine of Coscinium fenestratum) is near extinction due to its collection by cutting it off at the base. The illegal extraction of Arogyya paccha (Trichopus zeylanicus) is done by pulling out the entire plant. Vayanapoo & Thalipoo are flower buds used as adulterants for clove. They are extracted by cutting off the branches. The collection of the flower buds before they are allowed to reproduce, results in the arrest of the growth of the next generation. Harvest of medicinal plants is very

much influenced by market demand. When there is a high demand for a particular item, it is harvested without any ecological consideration.

5.1.3 Quantity and No. of Species collected from the forests.

38 medicinal plants/ parts are collected from the forests. Of these 22 come under threatened category (Table No: 5.2.). The data can be used in prioritising conservation measures in the forests on the basis of extent of extraction and the status of the species. The collection of *Arogyya paccha* (*Trichopus zeylanicus*) is banned; though it is still being collected illegally.

5.1.4. Locations of collections in forest areas

The locations of threatened medicinal plants collection were identified through detailed survey and field visits. The identification of location of major collection in each sanctuary/ range can be of use in notifying such areas for gene pool conservation. The variations in collection among the areas can be due to many reasons such as species- richness, size, extent of extraction, disturbance and protection, ecological landscape etc. What is evident is the fact that there is substantial extraction of medicinal plants from these forests. Long-term studies on the extraction could help in understanding the dynamics of vegetational changes and design strategies for improved management of the forest.

Table No.5.2. Threatened medicinal plants collected from the forests

| No | Botanical name | Item | Part collected |
|----|--------------------------------|------------------------|----------------|
| 1 | <i>Holostemma adakodian</i> | Adapathiyan | Tuber |
| 2 | <i>Rauvolfia serpentina</i> | Amalpory | Plant |
| 3 | <i>Pterospermum rubignosum</i> | Elluttyppattah | Bark |
| 4, | <i>Aristolochia indica</i> | Garudakkodi | Stem & leaves |
| 5 | <i>Aristolochia tagala</i> | -Do- | -do- |
| 6 | <i>Kaemferia galanga</i> | Kacholam | Rhizome |
| 7 | <i>Piper barberi</i> | Kattukurumulaku/ vally | Fruits |
| 8 | <i>P. mullesua</i> | Kattukurumulaku/ vally | Stem & leaves |
| 9 | <i>Garcinia gummigutta</i> | Kodampuli | Fruit |
| 10 | <i>Canarium strictum</i> & | Kunthirakkam | Resin |
| 11 | <i>Vateria indica</i> | -do- | -do- |

| | | | |
|----|----------------------------------|--------------------|--------------|
| 12 | <i>Sida spp.</i> | Kurumthotty | Root |
| 13 | <i>Cocinium fenestratum</i> | Manjavally | Stem |
| 14 | <i>Hydnocarpus pentandra</i> | Marottykkuru | Seeds |
| 15 | <i>Pseudarthida viscida</i> | Moovila | Plant |
| 16 | <i>Symplocos cochinchinensis</i> | Pachottypattah | Stem bark |
| 17 | <i>S.racemosa</i> | -do- | -do- |
| 18 | <i>Myristica malabarica</i> | Panam poovu | Aril (Mace) |
| 19 | <i>M.dactyloides</i> | -do- | -do- |
| 20 | <i>Stereospermum suaveolens</i> | Pathiri veru | Root |
| 21 | <i>Oroxylum indicum</i> | Vaiyyazhantha veru | Root |
| 22 | <i>Cinnamomum spp.</i> | Vayanappoovu | Flower bud |

For each area, the following data are provided:

1. Total medicinal plant collection – Names of all the species collected, the total quantity of collection in a year (in Kg.), average number of days of collection in a year, and average number of collectors in each area.
2. Quantity of major threatened species collected. (in Kg.)
3. Specific location of threatened species within that area.

5.2.Collection from Peppara Wildlife Sanctuary

Peppara Wildlife Sanctuary is situated on the western slopes of the Western Ghats in its southern part in the Nedumangad Taluk in Thiruvananthapuram district. It has an area of 76 km² and lies between 8°34'30" to 8°41'25" N and 77°6'50" to 77°14'5" E. On the northeast side lies the Mundanturai Tiger Reserve of Tamil Nadu, Palode Reserve Forest on the north, and Neyyar Wildlife Sanctuary on the south and Agasthyavanam Biological Park on the southwest. The altitudinal range varies from 89m to 1717m above m.s.l. (Chemmunji peak). Mean temperature varies from 16°C to 35°C and the average annual rainfall is about 3200mm.

Majority of the area belongs to the Southern tropical moist deciduous forests. Other vegetation types range from montane sub-tropical to tropical evergreen forests. Peppara sanctuary has about 20km² of intact southern hilltop evergreen forest along the crest-line continuous with that of the Neyyar sanctuary. Tropical fresh water swamp forests like the *Myristica* swamp forests, large

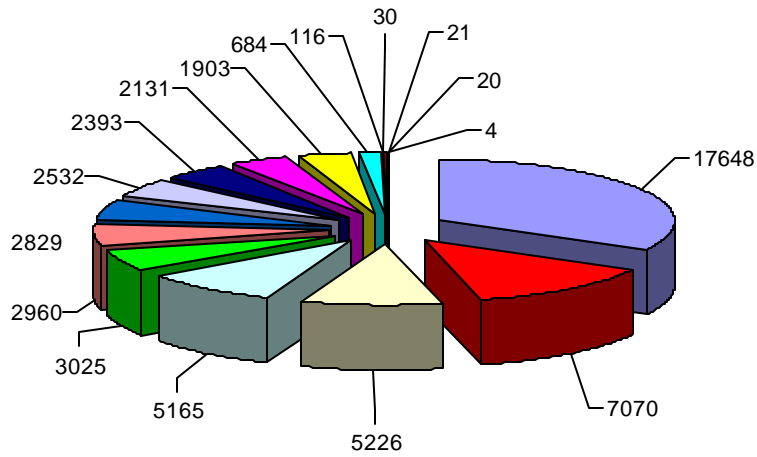
patches of *Ochlandra* (Reed) brakes and small patches of *Bentinckia condapanna* are found here. The sanctuary suffers degradation by way of large scale illicit felling of wood, annual fire damage, the presence of the tea estate in the margin of the sanctuary and the presence of several tribal hamlets scattered throughout the area (Nair, S C. 1991) Social forestry plantation and the 'pilgrimage' to Agasthyarkoodam have also had its adverse impact on the sanctuary.

Table No.5.3. Medicinal Plant collection - Peppara Wildlife Sanctuary

| Sl. | Item | Botanical name | Total Quantity of collection (K.g.) | Average no. of days of collection/yr. | Average no. of collectors/yr. |
|-----|--------------------------------|---|-------------------------------------|---------------------------------------|-------------------------------|
| 1 | Adapathiyam * | <i>Holostemma adakodian</i> | 684 | 28 | 76 |
| 2 | Amalpory * | <i>Rauwolfia serpentina</i> | 21 | 30 | 4 |
| 3 | Cheevakka | <i>Acacia concinna</i> | 211 | 5 | 41 |
| 4 | Chittaratha | <i>Alpinia calacarata</i> | 165 | 15 | 10 |
| 5 | Ealakka | <i>Elettaria cardamomum</i> | 126 | 6 | 22 |
| 6 | Edampiri Valampiri | <i>Helecteris isora</i> | 194 | 7 | 43 |
| 7 | Garudakkodi * | <i>Aristolochia indica</i> | 5165 | 30 | 573 |
| 8 | Kacholam * | <i>Kaemphaeraia galanga</i> | 116 | 8 | 25 |
| 9 | Kadukkakkai | <i>Terminlia chebula</i> | 100 | 20 | 2 |
| 10 | Kadukkappoovu | <i>Terminlia chebula</i> | 7965 | 28 | 209 |
| 11 | Karakkai | <i>Elaeocarpus serratus</i> | 1055 | 5 | 11 |
| 12 | Kasthurimanjal | <i>Curcuma aromatica</i> | 4331 | 6 | 143 |
| 13 | Kattukurumulaku * | <i>Piper spp.</i> | 2829 | 5 | 364 |
| 14 | Kodampuli * | <i>Garcinia gummi gutta</i> | 17648 | 15 | 269 |
| 15 | Kolinji | <i>Alpinia galanga</i> | 180 | 15 | 3 |
| 16 | Kunthirakkam * | <i>Canarium strictum & Vateria indica</i> | 2131 | 13 | 83 |
| 17 | Kurumthotty * | <i>Sida spp.</i> | 20 | 10 | 4 |
| 18 | Manjal | <i>Cucuma longa</i> | 630 | 4 | 64 |
| 19 | Manjavally * | <i>Coscinium fenestratum</i> | 2960 | 10 | 32 |
| 20 | Moovila * | <i>Pseudarthria viscida</i> | 4 | 4 | 4 |
| 21 | Narunandi | <i>Hemidesmes indicus</i> | 4053 | 32 | 555 |
| 22 | Nellikka | <i>Phyllanthus emblica</i> | 27110 | 10 | 233 |
| 23 | Orila | <i>Desmodium gangeticum</i> | 3200 | 39 | 183 |
| 24 | Pachottypattah * | <i>Symplocos cochinchinensis & Symplocos racemosa</i> | 7070 | 11 | 123 |
| 25 | Padathali | <i>Cyclea peltata</i> | 2393 | 30 | 587 |
| 26 | Panampoovu * | <i>Myristica spp</i> | 1903 | 15 | 382 |
| 27 | Thaen | Honey | 2532 | 22 | 728 |
| 28 | Sathavary | <i>Asparagus racemosus</i> | 5226 | 34 | 572 |
| 29 | Thalippoovu, Viringa, Moongali | | 30 | 10 | 7 |
| 30 | Vaiyyazhantha veru * | <i>Oroxylum indicum</i> | | | |
| 31 | Vayanappoovu * | <i>Cinnamomum Spp.</i> | 3025 | 14 | 199 |

(* - Threatened Species)

Chart 5.1. Quantity of Major Threatened Medicinal Plants Collected from Peppara Wildlife Sanctuary



- *Garcinia gummi gutta*
- *Symplocos cochinchinensis & Symplocos racemosa*
- *Asparagus racemosus*
- *Aristolochia indica*,
- *Cinnamomum Spp.*
- *Coscinium fenestratum*
- *Piper spp.*
- Honey
- *Cyclea peltata*
- *Canarium strictum & Vateria indica*
- *Myristica spp*
- *Holostemma adakodian*
- *Kaemphaeraia galanga*
- *Rauvolfia serpentina*
- *Sida spp.*
- *Pseudarthria viscida*

Table 5.4. Peppara – Location of major threatened medicinal plants

| Area | Item | No. of Collectors | Total annual collection (Kg) |
|---------------------------|------------------------|-------------------|-------------------------------|
| Athirumala | <i>Kodampuli</i> | 50 | 4900.000 |
| Athirumala | <i>Pachottypattah</i> | 42 | 2670.000 |
| Athirumala | <i>Manjavally</i> | 13 | 1525.000 |
| Athirumala | <i>Kunthirikkam</i> | 24 | 927.500 |
| Athirumala | <i>Panampoovu</i> | 9 | 195.000 |
| Athirumala | <i>Kattukurumulaku</i> | 12 | 110.000 |
| Athirumala | <i>Garudakkodi</i> | 1 | 90.000 |
| Athirumala | <i>Kacholam</i> | 19 | 80.000 |
| Athirumala | <i>Adapathiyam</i> | 2 | 21.000 |
| Athirumala | <i>Vayanappoovu</i> | 2 | 20.000 |
| Atta Ar | <i>Kodampuli</i> | 28 | 2485.000 |
| Atta Ar | <i>Manjavally</i> | 10 | 655.000 |
| Atta Ar | <i>Kunthirikkam</i> | 9 | 235.000 |
| Atta Ar | <i>Pachottypattah</i> | 6 | 225.000 |
| Atta Ar | <i>Vayanappoovu</i> | 3 | 75.000 |
| Atta Ar | <i>Garudakkodi</i> | 4 | 60.000 |
| Atta Ar | <i>Amalpory</i> | 3 | 18.000 |
| Atta Ar | <i>Panampoovu</i> | 4 | 11.500 |
| Atta Ar | <i>Kattukurumulaku</i> | 1 | 2.500 |
| Bhagavathyppara | <i>Kattukurumulaku</i> | 170 | 1088.500 |
| Bhagavathyppara | <i>Kodampuli</i> | 9 | 625.000 |
| Chenkottappara karikkakam | <i>Kodumpuli</i> | 6 | 300.000 |
| Chenkottappara karikkakam | <i>Panampooovu</i> | 10 | 6.000 |
| Dravya Mottai | <i>Kodampuli</i> | 1 | 100.000 |
| Dravya mottai | <i>Manjavally</i> | 1 | 80.000 |
| Dravyamottai | <i>Adapathiyam</i> | 1 | 6.000 |
| Eazhumadakkan | <i>Garudakkodi</i> | 4 | 60.000 |
| Eazhumadakkan | <i>Adapathiyam</i> | 4 | 30.000 |
| Eazhumadakkan | <i>Kodumpuli</i> | 1 | 9.090 |
| Karalakkodu | <i>Vayanappoovu</i> | 1 | 30.000 |
| Karalakkodu | <i>Kattukurumulaku</i> | 2 | 7.500 |
| Karamana Ar | <i>Kodampuli</i> | 4 | 260.000 |
| Karamana Ar | <i>Pachottypattah</i> | 5 | 250.000 |
| Karamana Ar | <i>Garudakkodi</i> | 1 | 180.000 |
| Karamana Ar | <i>Panampoovu</i> | 10 | 84.600 |
| Karamana Ar | <i>Kunthirikkam</i> | 3 | 55.000 |
| Karamana Ar | <i>Vayanappoovu</i> | 3 | 45.000 |
| Karamana Ar | <i>Kattukurumulaku</i> | 1 | 10.000 |
| Karikkalathu kavu | <i>Manjavally</i> | 2 | 130.000 |
| Karikkalathu kavu | <i>Adapathiyam</i> | 4 | 31.500 |
| Karikkalthukavu | <i>Panampoovu</i> | 4 | 85.000 |
| Kattupacha | <i>Garudakkodi</i> | 8 | 480.000 |
| Kattupacha | <i>Kattukurumulaku</i> | 8 | 110.000 |
| Kattupacha | <i>Adapathiyam</i> | 3 | 45.000 |

| | | | |
|------------------------|------------------------|----|----------|
| Kattupacha | <i>Kacholam</i> | 6 | 36.000 |
| Kattupacha | <i>Panampoovu</i> | 1 | 20.000 |
| Kavi Ar | <i>Vayanappoovu</i> | 15 | 335.000 |
| Kavi Ar | <i>Kodampuli</i> | 1 | 150.000 |
| Kavi Ar | <i>Pachottypattah</i> | 2 | 125.000 |
| Kavi Ar | <i>Garudakkodi</i> | 7 | 105.000 |
| Kavi Ar | <i>Panampoovu</i> | 10 | 52.100 |
| Kavi Ar | <i>Kattukurumulaku</i> | 3 | 15.000 |
| Maruthum P ara | <i>Vayanappoovu</i> | 11 | 330.000 |
| Maruthyppara | <i>Kodumpuli</i> | 1 | 9.090 |
| Maruthyppara | <i>Panampoovu</i> | 1 | 3.330 |
| Mlavila | <i>Pachottypattah</i> | 1 | 50.000 |
| Mlavila | <i>Garudakkodi</i> | 2 | 110.000 |
| Mookalavally | <i>Garudakkodi</i> | 20 | 63.740 |
| Mookkalykkunnu | <i>Vayanappoovu</i> | 7 | 210.000 |
| Muthumara | <i>Garudakkodi</i> | 7 | 105.000 |
| Muthumara | <i>Vayanappoovu</i> | 2 | 60.000 |
| Muthykkavu | <i>Garudakkodi</i> | 13 | 80.000 |
| Muthyppara | <i>Vayanappoovu</i> | 8 | 240.000 |
| Nakkalippara | <i>Pachottypattah</i> | 2 | 250.000 |
| Nakkalippara | <i>Vayanappoovu</i> | 7 | 181.250 |
| Nellikathara | <i>Kodumpuli</i> | 23 | 1725.000 |
| Nellikunnu | <i>Garudakkodi</i> | 3 | 6.000 |
| Nellimodu | <i>Adapathiyam</i> | 11 | 27.500 |
| Paekkalu Kav u | <i>Garudakkodi</i> | 21 | 540.000 |
| Patampara | <i>Vayanappoovu</i> | 3 | 85.000 |
| Pattampara | <i>Manjavally</i> | 1 | 70.000 |
| Pekkallukavu | <i>Vayanappoovu</i> | 1 | 30.000 |
| Perumpara | <i>Kodumpuli</i> | 20 | 708.270 |
| Perumpara | <i>Kunthirikkam</i> | 1 | 25.000 |
| Seethanganpara | <i>Panampoovu</i> | 22 | 553.000 |
| Seethanganpara | <i>Kodampuli</i> | 8 | 459.090 |
| Seethanganpara | <i>Adapathiyam</i> | 28 | 355.000 |
| Seethanganpara | <i>Garudakkodi</i> | 3 | 210.000 |
| Seethanganpara | <i>Manjavally</i> | 2 | 200.000 |
| Seethanganpara | <i>Kunthirikkam</i> | 2 | 125.000 |
| Seethanganpara | <i>Kattukurumulaku</i> | 5 | 45.000 |
| Vaz hapayanth y | <i>Kodumpuli</i> | 1 | 9.090 |
| Vazhapazhanthy Ar | <i>Manjavally</i> | 2 | 175.000 |
| Vazhapazhanthy Ar | <i>Kunthirikkam</i> | 7 | 92.500 |
| Vellamala | <i>Panampoovu</i> | 41 | 101.000 |
| Vellamalakkari k k a m | <i>Kodampuli</i> | 21 | 1050.000 |
| Vellamalakkari k k a m | <i>Kattukurumulaku</i> | 26 | 205.000 |

5.3. Collection from Neyyar Wildlife Sanctuary

Neyyar Wildlife Sanctuary came into being in 1958. It includes the catchment area of Neyyar River. A dam was built in this river for irrigation purpose in Thiruvananthapuram and Kanyakumari Districts and a large area was submerged in the reservoir. This is the southernmost wildlife sanctuary in Kerala State. It spreads over an area of 128 Km² in Thiruvananthapuram district, and is located between 8°30' to 8° 37'N latitude and 77°8'–77°17'E longitude. The peak Agasthyarkoodam (1866m), lies within the Sanctuary. Even though the Sanctuary is well known for its biodiversity, not many studies have been conducted here. Neyyar sanctuary is contiguous with Peppara Sanctuary to the north and with Kalakkad Sanctuary and reserved forests of Tamil Nadu in the east. Moderately heavy rainfall (1800mm –3000mm) is experienced here. Majority of the area belongs to the Southern tropical moist deciduous forests. Other vegetation types range from montane sub-tropical to tropical evergreen forests. Large patches of *Ochlandra* (Reed) brakes and small patches of *Bentinckia condapanna* are found here. There is an abandoned tea estate near Athirumala. The tribal community, Kanikkar, have 18 settlements in the sanctuary area with a total population of 1474. Their main sources of income are NWFP gathering, agriculture, and manual labour. The Sanctuary suffers from a variety of threats such as forest fire, bootlegging, poaching, pilgrimage to Agasthyarkoodam, encroachment, unscientific collection of NWFP, etc.

Table No.5.5. Medicinal Plant Collection - Neyyar Wildlife Sanctuary

| Sl. | Item | Botanical name | Total Qty. of collection (kg.) | Av. no. of days of collection/yr. | Av.no.of collectors/yr. |
|-----|--------------------|---|--------------------------------|-----------------------------------|-------------------------|
| 1 | Adapathiyan | <i>Holostemma adakodian</i> | 55 | 35 | 4 |
| 2 | Amalpory * | <i>Rauwolfia serpentina</i> | 270 | 23 | 24 |
| 3 | Chittaratha | <i>Alpina calacarata</i> | 90 | 15 | 3 |
| 4 | Ealakka | <i>Elettaria cardamomum</i> | 55 | 6 | 24 |
| 5 | Edampiri Valampiri | <i>Helecteris isora</i> | 75 | 14 | 11 |
| 6 | Garudakkodi * | <i>Aristolochia indica</i> | 883 | 20 | 122 |
| 8 | Kadukkappoovu | <i>Terminlia chebula</i> | 1500 | 26 | 53 |
| 9 | Karakkai | <i>Elaeocarpus serratus</i> | 800 | 6 | 7 |
| 10 | Kasthurimanjal | <i>Curcuma aromatica</i> | 902 | 8 | 36 |
| 11 | Kattukurumulaku * | <i>Piper spp.</i> | 30 | 5 | 3 |
| 12 | Kodampuli * | <i>Garcinia gummi gutta</i> | 12786 | 18 | 163 |
| 13 | Kolinji | <i>Alpinia galanga</i> | 10 | 2 | 1 |
| 14 | Kumbil veru | <i>Gmelina arborea</i> | 4200 | 10 | 14 |
| 15 | Kunthirakkam * | <i>Canarium strictum & Vateria indica</i> | 1185 | 11 | 37 |

| | | | | | |
|----|------------------|---|------|----|-----|
| 16 | Marottykkuru * | <i>Hydnocarpus pentandrus</i> | 202 | 5 | 41 |
| 17 | Moovila * | <i>Pseudarthria viscida</i> | 1 | 1 | 0 |
| 18 | Narunandi | <i>Hemidesmes indicus</i> | 943 | 33 | 150 |
| 19 | Nellikka | <i>Phyllanthus emblica</i> | 6362 | 11 | 67 |
| 20 | Orila | <i>Desmodium gangeticum</i> | 1199 | 59 | 47 |
| 21 | Pachottypattah * | <i>Symplocos cochinchinensis</i> & <i>Symplocos racemosa</i> | 835 | 8 | 15 |
| 22 | Padathali | <i>Cyclea peltata</i> | 689 | 36 | 164 |
| 23 | Panampoovu * | <i>Myristica spp</i> | 446 | 14 | 98 |
| 24 | Thaen | <i>Honey</i> | 946 | 27 | 200 |
| 25 | Sathavary | <i>Asparagus racemosus</i> | 2370 | 36 | 179 |
| 26 | Vayanappoovu * | <i>Cinnamomum Spp.</i> | 1613 | 12 | 128 |

(* - Threatened Species)

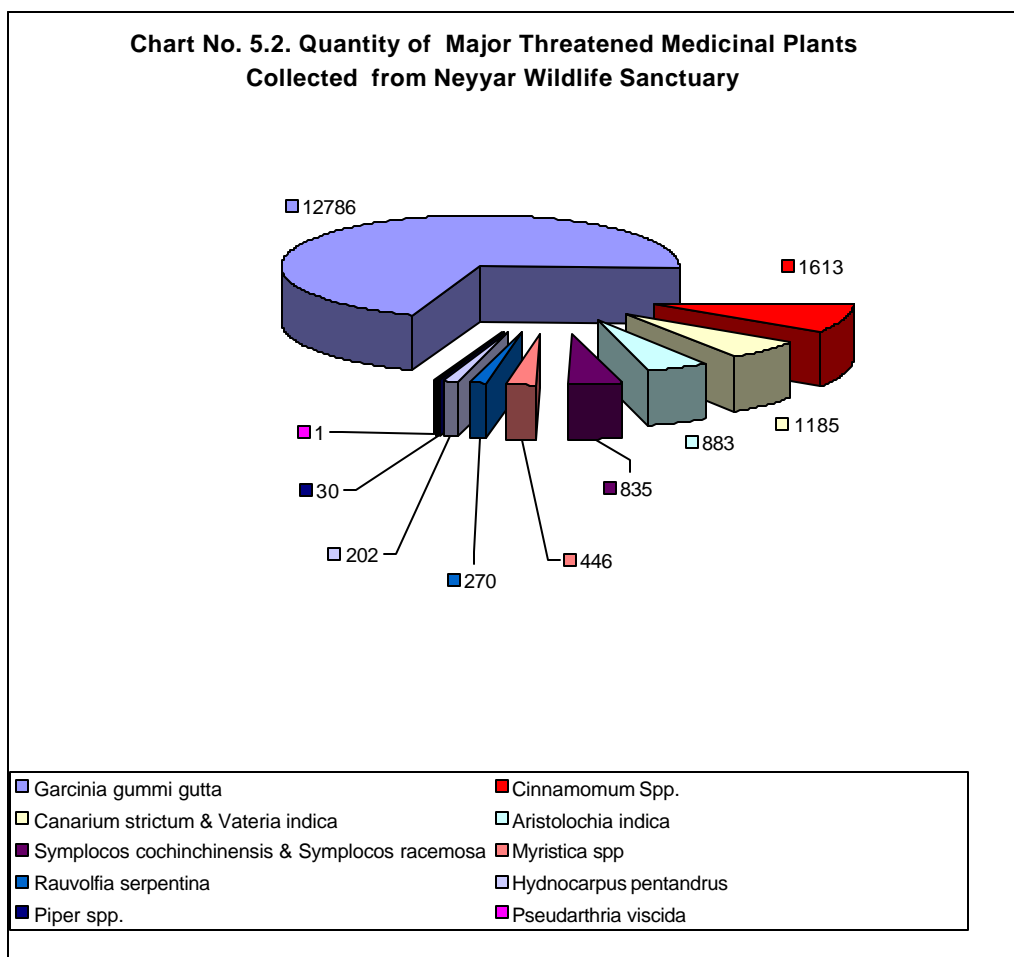


Table No.5.6. Neyyar – Location of Major Threatened Medicinal Plants

| Sl. No | Area | Item | Collector | Total annual collection (Kg) |
|--------|------------------|-----------------|-----------|-------------------------------|
| 1 | Agasthyakoodam | Kodampuli | 9 | 675 |
| 2 | Agasthyakoodam | Kattukurumulaku | 3 | 30 |
| 1 | Bhoothaka | Kodampuli | 9 | 900 |
| 2 | Bhoothaka | Vayanappoovu | 1 | 1 |
| 1 | Elam plathu | Vayanappoovu | 18 | 442 |
| 2 | Elam plathu | Pachottypattah | 2 | 50 |
| 3 | Elam plathu | Panampoovu | 1 | 4 |
| 1 | Elamkodu | Adapathiyar | 4 | 55 |
| 1 | Kaduvappara | Garudakkodi | 13 | 43 |
| 2 | Kaduvappara | Vayanappoovu | 1 | 3 |
| 1 | Kallar (Neyyar) | Panampoovu | 8 | 80 |
| 2 | Kallar (Neyyar) | Kunthirikkam | 2 | 100 |
| 3 | Kallar (Neyyar) | Pachottypattah | 1 | 50 |
| 4 | Kallar (Neyyar) | Kodampuli | 10 | 690 |
| 6 | Kallar (Neyyar) | Panampoovu | 1 | 10 |
| 1 | Mulla Ar | Kodampuli | 22 | 1333 |
| 2 | Mulla Ar | Pachottypattah | 2 | 125 |
| 4 | Mulla Ar | Kunthirikkam | 1 | 25 |
| 5 | Mulla Ar | Panampoovu | 2 | 20 |
| 1 | Mylammoodu | Vayanappoovu | 2 | 30 |
| 2 | Mylammoodu | Panampoovu | 3 | 15 |
| 1 | Narayappu | Vayanappoovu | 1 | 1 |
| 2 | Narayappu | Panampoovu | 1 | 1 |
| 1 | Njarakkavu | Kodampuli | 5 | 333 |
| 2 | Njarakkavu | Panampoovu | 5 | 13 |
| 1 | Ompathintekonu | Kodampuli | 5 | 333 |
| 2 | Ompathintekonu | Vayanappoovu | 5 | 25 |
| 1 | Thalamutty | Kodampuli | 7 | 700 |
| 2 | Thalamutty | Amalpory | 12 | 91 |
| 1 | Thallakkavu | Amalpory | 12 | 180 |
| 2 | Thallakkavu | Kodampuli | 1 | 20 |
| 3 | Thallakkavu | Panampoovu | 1 | 3 |
| 1 | Vaemala | Kodampuli | 13 | 1000 |
| 2 | Vaemala | Panampoovu | 10 | 6 |
| 1 | Valli Ar | Kodampuli | 37 | 3820 |
| 3 | Valli Ar | Kunthirikkam | 14 | 370 |
| 4 | Valli Ar | Panampoovu | 15 | 180 |
| 1 | Varayattu mottai | Kunthirikkam | 6 | 145 |
| 1 | Veyilam Chathy | Panampoovu | 2 | 55 |
| 2 | Veyilam Chathy | Vayanappoovu | 3 | 33 |

5.4. Collection from Agasthyavanam Biological Park

Agasthyavanam Biological Park is located in the Kottur Forest Reserve in Paruthipally Range, Nedemangadu Taluk of Thiruvananthapuram district, adjacent to the Peppara and Neyyar Wildlife sanctuaries. It lies between 8⁰30' and 8⁰40' North latitude and between 77⁰5' and 77⁰10' east longitude. It is bounded on the north by Peppara Wildlife Sanctuary, on the east by Neyyar Wildlife Sanctuary, private lands on the south and Paruthipally range on the west. The altitude varies from 90 m to 720 m above MSL. It is a degraded natural forest area, a mixture of evergreen forests, Albezzia, Eucalyptus and Teak plantations and Kani tribal hamlets with around 51 families. The Park has been set up with the objectives of ecorestoration of the degraded forests, conservation of the flora and fauna and to develop nature education and ecotourism.

Table No.5.7. Medicinal Plant Collection - Agasthyavanam Biological Park

| Sl. | Item | Botanical name | Total Quantity of collection | Average no. of days of collection/yr. | Average no. of collectors/yr. |
|-----|--------------------------------|--|------------------------------|---------------------------------------|-------------------------------|
| 1 | Adapathiyam * | <i>Holostemma adakodian</i> | 126 | 11 | 40 |
| 2 | Amalpory * | <i>Rauvolfia serpentina</i> | 278 | 10 | 29 |
| 3 | Garudakkodi * | <i>Aristolochia indica</i> | 475 | 13 | 86 |
| 4 | Kadukkappoovu | <i>Terminlia chebula</i> | 1735 | 27 | 43 |
| 5 | Karakkai | <i>Elaeocarpus serratus</i> | 75 | 5 | 1 |
| 6 | Kasthurimanjal | <i>Curcuma aromatica</i> | 380 | 5 | 15 |
| 7 | Kattukurumulaku * | <i>Piper spp.</i> | 23 | 5 | 3 |
| 8 | Kattumanjal | <i>Curcuma spp.</i> | 450 | 5 | 18 |
| 9 | Kodampuli * | <i>Garcinia gummi gutta</i> | 990 | 7 | 8 |
| 10 | Kolinji | <i>Alpinia galanga</i> | 140 | 5 | 14 |
| 11 | Manjavally * | <i>Coscinium fenestratum</i> | 150 | 10 | 1 |
| 12 | Moovila * | <i>Pseudarthria viscida</i> | 4 | 11 | 1 |
| 13 | Narunandi | <i>Hemidesmes indicus</i> | 359 | 18 | 64 |
| 14 | Nellikka | <i>Phyllanthus emblica</i> | 5625 | 7 | 31 |
| 15 | Orila | <i>Desmodium gangeticum</i> | 262 | 13 | 42 |
| 16 | Pachottypattah * | <i>Symplocos cochinchinensis</i> & <i>Symplocos racemosa</i> | 230 | 12 | 6 |
| 17 | Padathali | <i>Cyclea peltata</i> | 237 | 19 | 64 |
| 18 | Panampoovu * | <i>Myristica spp</i> | 84 | 8 | 33 |
| 19 | Thaen | Honey | 452 | 15 | 87 |
| 20 | Sathavary | <i>Asparagus racemosus</i> | 638 | 14 | 82 |
| 21 | Thalippoovu, Viringa, Moongali | | 3 | 5 | 1 |
| 22 | Vayanappoovu * | <i>Cinnamomum Spp.</i> | 647 | 13 | 41 |

(* - Threatened Species)

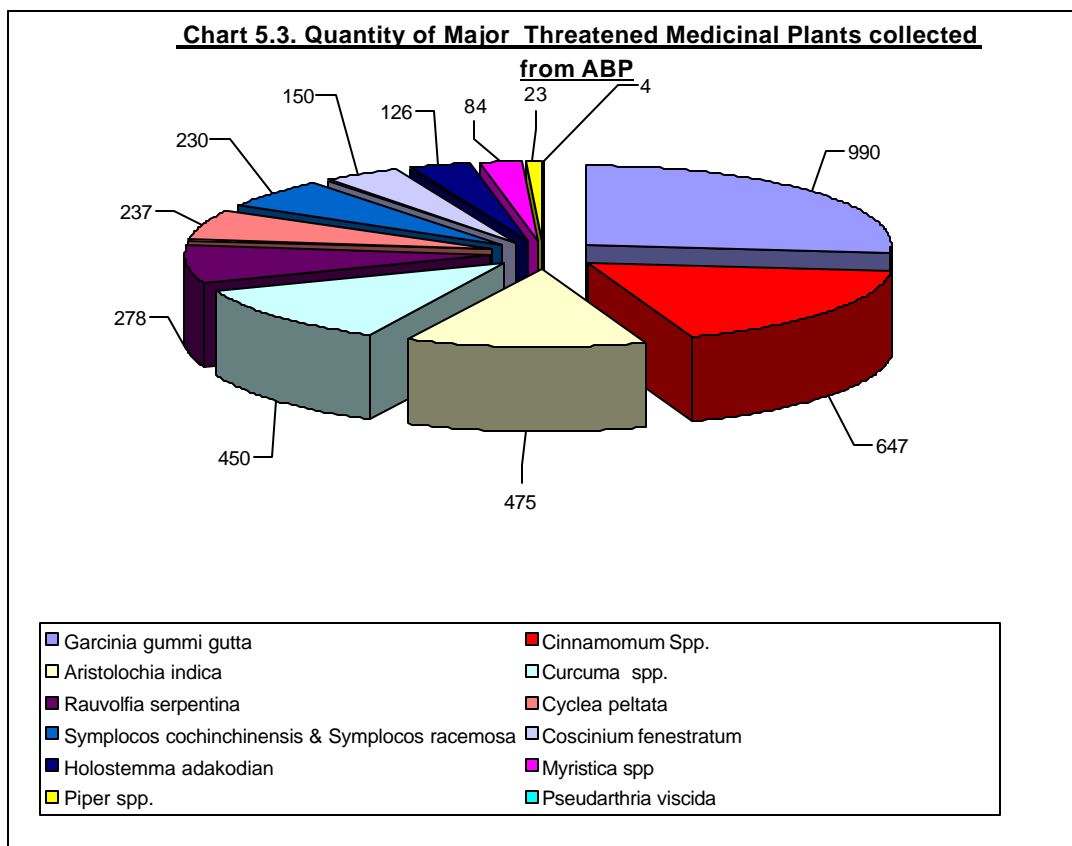


Table No.5.8. ABP – Location of Major Threatened Medicinal Plants

| Sl. No | Area | Item | Collector | Total annual collection (Kg) |
|--------|-------------|-----------------|-----------|-------------------------------|
| 1 | Aalikkavu | Garudakkodi | 10 | 70 |
| 2 | Aalikkavu | Amalpory | 9 | 57 |
| 3 | Aalikkavu | Adapathiyan | 9 | 22 |
| 4 | Aalikkavu | Moovila | 1 | 3 |
| 1 | Thalamala | Vayanappoovu | 14 | 420 |
| 2 | Thalamala | Amalpory | 20 | 222 |
| 3 | Thalamala | Manjavally | 1 | 150 |
| 4 | Thalamala | Garudakkodi | 11 | 48 |
| 5 | Thalamala | Pachottypattah | 1 | 30 |
| 6 | Thalamala | Adapathiyan | 9 | 22 |
| 7 | Thalamala | Panampoovu | 1 | 4 |
| 1 | Thindivanam | Pachottypattah | 5 | 200 |
| 2 | Thindivanam | Vayanappoovu | 3 | 48 |
| 1 | Vellakkuzhy | Vayanappoovu | 10 | 156 |
| 2 | Vellakkuzhy | Kattukurumulaku | 2 | 20 |
| 3 | Vellakkuzhy | Kodampuli | 1 | 20 |
| 4 | Vellakkuzhy | Panampoovu | 2 | 5 |

5.5. Collection from Paruthippilly Range

Paruthippilly Range is adjacent to Agasthyavanam Biological Park. It has an extent of 42.690 sq.km. Aryanad, Kottur, Choolayamala, Valiamala, Vithura and Aryanad –Palode are the sections in Paruthippilly Range. There are comparatively more plantations belonging to Kerala Forest Development Corporation (KFDC) in this range. Social forestry plantation and the ‘pilgrimage’ to Agasthyarkoodam & Kurishumalai have also had its adverse impact on the forests of this range.

Table No.5.9. Medicinal Plant collection - Paruthippilly Range

| Sl. | Item | Botanical name | Total Quantity of collection | Average no. of days of collection | Average no. of collectors in a year |
|-----|-------------------|-----------------------------|------------------------------|-----------------------------------|-------------------------------------|
| 1 | Garudakkodi * | <i>Aristolochia indica</i> | 881 | 17 | 236 |
| 2 | Kadukkappoovu | <i>Terminlia chebula</i> | 870 | 14 | 32 |
| 3 | Kasthurimanjal | <i>Curcuma aromatica</i> | 778 | 5 | 36 |
| 4 | Kattukurumulaku * | <i>Piper spp.</i> | 234 | 4 | 25 |
| 5 | Kattumanjal | <i>Curcuma spp.</i> | 935 | 5 | 14 |
| 6 | Kodampuli * | <i>Garcinia gummi gutta</i> | 4825 | 5 | 49 |
| 7 | Moovila * | <i>Pseudarthria viscida</i> | 1 | 1 | 1 |
| 8 | Narunandi | <i>Hemidesmes indicus</i> | 1131 | 20 | 292 |
| 9 | Nellikka | <i>Phyllanthus emblica</i> | 8380 | 7 | 169 |
| 10 | Orila | <i>Desmodium gangeticum</i> | 277 | 29 | 20 |
| 11 | Padathali | <i>Cyclea peltata</i> | 550 | 22 | 236 |
| 12 | Panampoovu * | <i>Myristica spp</i> | 50 | 15 | 13 |
| 13 | Thaen | Honey | 764 | 13 | 221 |
| 14 | Sathavary | <i>Asparagus racemosus</i> | 1699 | 19 | 257 |
| 15 | Vayanappoovu * | <i>Cinnamomum Spp.</i> | 255 | 11 | 17 |

(*- Threatened Species)

Chart No. 5.4. Quantity of Major Threatened Medicinal Plants collected from Paruthippilly Range

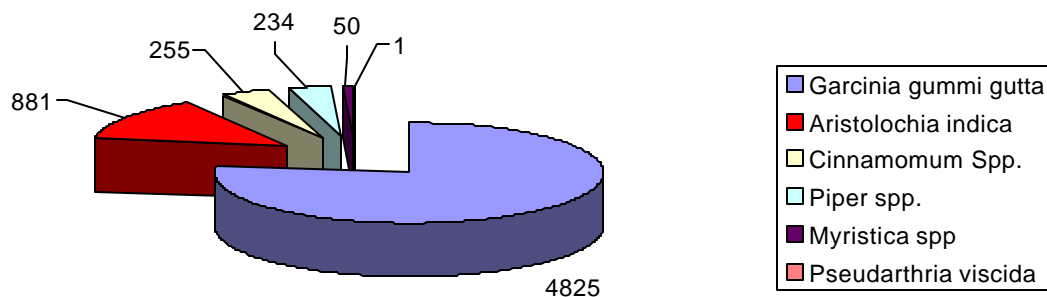


Table No.5.10.

Paruthippilly – Location of Major Threatened Medicinal Plants

| Sl. No | Area | Item | Collector | TotalCollection |
|--------|--------------------|-----------------|-----------|-----------------|
| 1 | Kappithottam | Kodampuli | 46 | 4600.000 |
| 2 | Kappithottam | Garudakkodi | 3 | 6.000 |
| 1 | Karichatty Mottai | Kodampuli | 3 | 225.000 |
| 2 | Karichatty Mottai | Vayanappoovu | 11 | 135.000 |
| 3 | Karichatty Mottai | Garudakkodi | 21 | 35.070 |
| 4 | Karichatty Mottai | Panampoovu | 1 | 10.000 |
| 5 | Karichatty Mottai | Kattukurumulaku | 1 | 5.000 |
| 1 | Makki Kadu | Garudakkodi | 20 | 100.000 |
| 1 | Mappi mala | Vayanappoovu | 6 | 120.000 |
| 2 | Mappi mala | Garudakkodi | 6 | 180.000 |
| 3 | Mappimala | Kattukurumulaku | 22 | 220.000 |
| 1 | Panniyottu Kadavu | Garudakkodi | 18 | 60.000 |
| 1 | Valiya Manithookki | Garudakkodi | 13 | 28.500 |

5.6. Collection from Palode Range

Table No.5.11. Medicinal Plant collection – Palode Range

| Sl. | Item | Botanical name | Total Quantity of collection | Av. no. of days collection/yr. | Average no. collectors/yr. |
|-----|------------------------|--|------------------------------|--------------------------------|----------------------------|
| 1 | Amalpory * | <i>Rauvolfia serpentina</i> | 90 | 30 | 12 |
| 2 | Edampiri Valampiri | <i>Helecteris isora</i> | 120 | 5 | 44 |
| 3 | Elluttyppattah * | <i>Pterospermum rubignosum</i> | 270 | 4 | 7 |
| 4 | Garudakkodi * | <i>Aristolochia indica</i> | 1160 | 14 | 244 |
| 5 | Kacholam * | <i>Kaemphaeraia galanga</i> | 1 | 6 | 1 |
| 6 | Kadukkappoovu | <i>Terminlia chebula</i> | 3620 | 12 | 300 |
| 7 | Kasthurimanjal | <i>Curcuma aromatica</i> | 1960 | 7 | 95 |
| 8 | Kattukurumulakuvally * | <i>Piper spp.</i> | 125 | 5 | 25 |
| 9 | Kodampuli * | <i>Garcinia gummi gutta</i> | 18376 | 12 | 198 |
| 10 | Kumbil veru | <i>Gmelina arborea</i> | 40450 | 12 | 134 |
| 12 | Kunthirakkam * | <i>Canarium strictum & Vateria indica</i> | 1623 | 5 | 153 |
| 13 | Kurumthotty * | <i>Sida spp.</i> | 355 | 11 | 46 |
| 14 | Manjavally * | <i>Coscinium fenestratum</i> | 263 | 5 | 7 |
| 15 | Moovila * | <i>Pseudarthria viscida</i> | 3 | 3 | 1 |
| 16 | Narunandi | <i>Hemidesmes indicus</i> | 3480 | 26 | 340 |
| 17 | Nellikka | <i>Phyllanthus emblica</i> | 42575 | 10 | 315 |
| 18 | Orila | <i>Desmodium gangeticum</i> | 2658 | 45 | 141 |
| 19 | Pachottypattah * | <i>Symplocos cochinchinensis & S. racemosa</i> | 663 | 7 | 20 |
| 20 | Padathali | <i>Cyclea peltata</i> | 1389 | 31 | 310 |
| 21 | Panampoovu * | <i>Myristica spp</i> | 257 | 9 | 147 |
| 22 | Pathiri veru * | <i>Schlecherea oleosa</i> | 11860 | 3 | 130 |
| 24 | Sathavary | <i>Asparagus racemosus</i> | 3838 | 27 | 313 |
| 25 | Vaiyyazhantha veru * | <i>Oroxylum indicum</i> | 17250 | 6 | 130 |
| 26 | Vayanappoovu * | <i>Cinnamomum Spp.</i> | 1668 | 17 | 155 |

(*- Threatened Species)

Chart No.5.5. Quantity of Major Threatened Plants collected from Palode Range

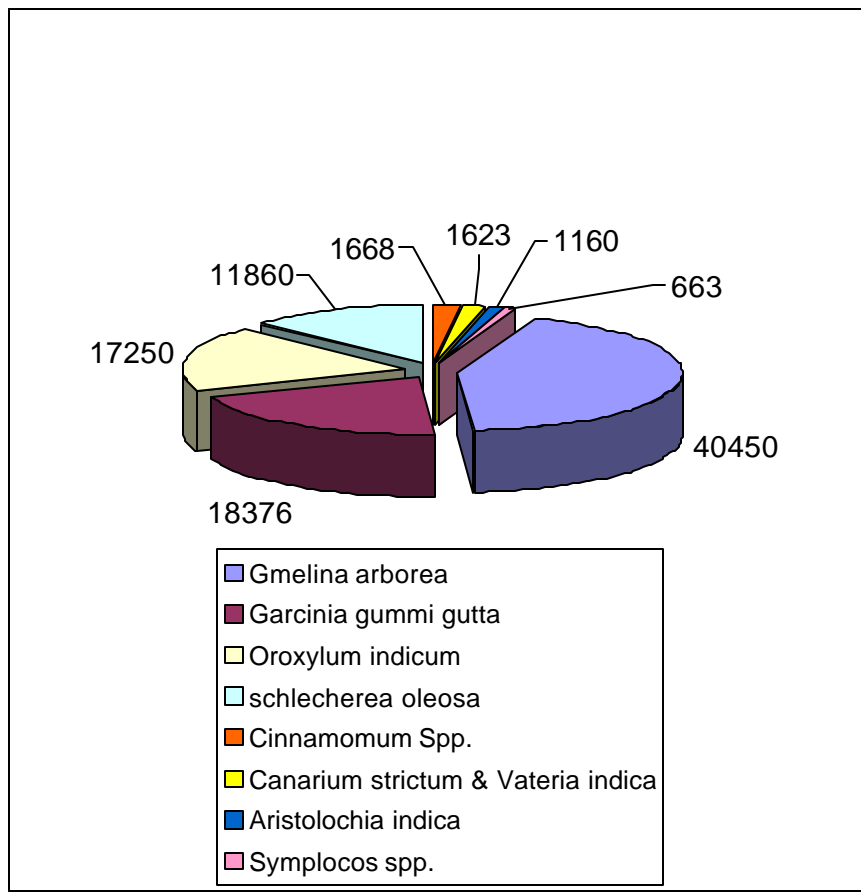


Table No.5.12. Palode –Location of Threatened Medicinal Plants

| Sl. No | Area | Item | Collector | TotalCollection |
|--------|--------------------|----------------------|-----------|-----------------|
| 1 | Chembankavu | Kodumpuli | 9 | 900.000 |
| 2 | Chembankavu | Vayanappoovu | 35 | 732.000 |
| 1 | Kallar | Kodumpuli | 8 | 133.360 |
| 2 | Kallar | Amalpory | 12 | 90.000 |
| 3 | Kallar | Panampoovu | 13 | 49.960 |
| 4 | Kallar | Garudakkodi | 4 | 20.000 |
| 1 | Koottamot hala | Kodumpuli | 7 | 175.000 |
| 2 | Koottamothala | Kattukurumulakuvally | 25 | 125.000 |
| 3 | Koottamothhala | Kunthirikkam | 121 | 1210.000 |
| 1 | Kozhakutty | Pathiri veru | 121 | 11320.000 |
| 1 | Madan Kuzhi | Garudakkodi | 42 | 104.970 |
| 2 | Madankavu | Manjavally | 7 | 262.500 |
| 1 | Manjanathum Kadavu | Kurumthotty | 25 | 187.500 |
| 2 | Manjanathum Kadavu | Kunthirikkam | 34 | 412.000 |
| 2 | Meenmutty | Kodampuli | 2 | 125.000 |
| 1 | Ponmudikkadu | Vaiyyazhantha veru | 130 | 17250.000 |
| 2 | Ponmudikkadu | Pathiri veru | 9 | 540.000 |
| 3 | Ponmudikkadu | Pachottypattah | 16 | 525.000 |
| 4 | Ponmudikkadu | Garudakkodi | 34 | 340.000 |
| 5 | Ponmudikkadu | Elluttyppattah | 7 | 270.000 |

5.7. Collection from Kulathupuzha Range

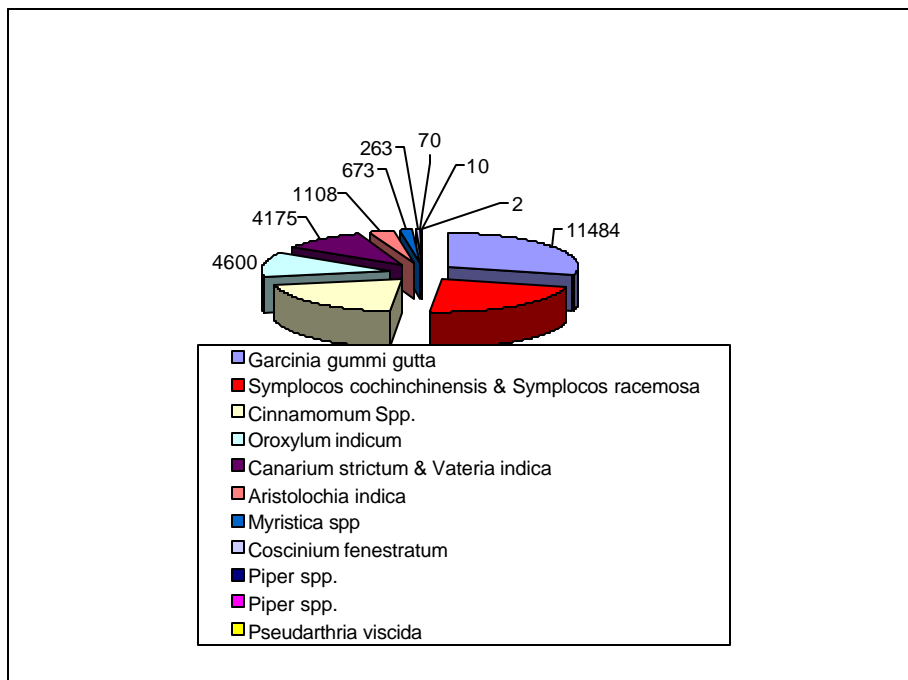
The forest range office Kulathupuzha is situated at Kulathupuzha town by the side of Thiruvananthapuram - Shenkotta road. This range is situated within Pathanapuram taluks of Quilon (Kollam) Revenue district and Nedumangadu taluks of Thiruvananthapuram(Thiruvananthapuram) Revenue district. The Division area lies with in 8° 17' 50'' and 8° 53' 42'' North latitudes and 76° 40' 24'' and 77° 17' East longitudes. The Kulathupuzha forest area lies within 8°5' and 8°55' North latitudes and 77°5' and 77°15' East longitudes.

The area is distinctly hilly except in place in the western portion where patches of more or less flat land occur. The main ghat stretches along the eastern border with elevations varying between 1,000 to 1,763 meters above sea level. River Kulathupuzha, which is the largest and most important of the rivers, which unites to form the Kallada River, has its origin on the main ridge, near the Karimalkadakal peak.

Table No.5.13 Medicinal Plant Collection – Kulathupuzha Range

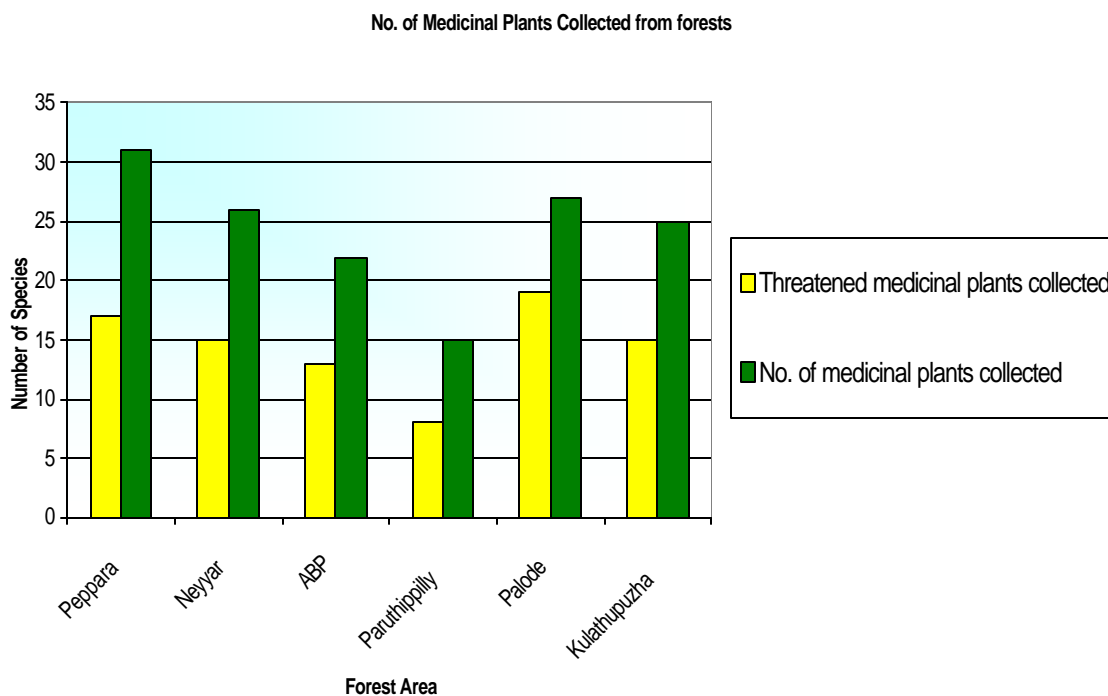
| Sl. | Item | Botanical name | Total Quantity of collection | Average no. of days of collection | Average no. of collectors in a year |
|-----|------------------------|--|------------------------------|-----------------------------------|-------------------------------------|
| 1 | Cheevakka | Acacia concinna | 211 | 5.15 | 41.00 |
| 2 | Edampiri Valampiri | Helecteris isora) | 133 | 10 | 27 |
| 3 | Garudakkodi * | Aristolochia indica | 1108 | 12 | 140 |
| 4 | Kadukkappoovu | Terminlia chebula | 65 | 20 | 2 |
| 5 | Kashurimanjal | Curcuma aromatica | 4450 | 5 | 194 |
| 6 | Kattukurumulaku * | Piper spp. | 10 | 5 | 1 |
| 7 | Kattukurumulakuvally * | Piper spp. | 70 | 5 | 7 |
| 8 | Kodampuli * | Garcinia gummi gutta | 11484 | 10 | 158 |
| 9 | Kolinji | Alpinia galanga | 50 | 10 | 1 |
| 10 | Kunthirakkam * | Canarium strictum & Vateria indica | 4175 | 13 | 42 |
| 11 | Manjavally * | Coscinium fenestratum | 263 | 5 | 7 |
| 12 | Moovila * | Pseudarthria viscida | 2 | 2 | 1 |
| 13 | Narunandi | Hemidesmes indicus | 626 | 26 | 82 |
| 14 | Nellikka | Phyllanthus emblica | 6925 | 6 | 111 |
| 15 | Orila | Desmodium gangeticum | 1631 | 34 | 86 |
| 16 | Pachottypattah * | Symplocos cochinchinensis & S.racemosa | 8550 | 7 | 154 |
| 17 | Padathali | Cyclea peltata | 255 | 23 | 77 |
| 18 | Panampoovu * | Myristica spp | 673 | 14 | 255 |
| 19 | Parandakka | Entada scandens | 390 | 10 | 41 |
| 20 | Thaen | Honey | 744 | 15 | 203 |
| 21 | Sathavary | Asparagus racemosus | 1203 | 17 | 94 |
| 22 | Thalipoovu, Viringa, | | 8 | 5 | 2 |
| 23 | Vaiyyazhantha veru * | Oroxylum indicum | 4600 | 6 | 23 |
| 24 | Vayanappoovu * | Cinnamomum Spp. | 8045 | 12 | 474 |

(*- Threatened Species)

Chart No. 5.6. Quantity of Threatened Medicinal Plants Collected from Kulathupuzha**Range****Table No. 5.14 Kulathupuzha - Location of Major Threatened Medicinal Plants**

| Area | Item | Collector | TotalCollection |
|---------------|--------------------|-----------|-----------------|
| Chathirikkadu | Vaiyyazhantha veru | 245 | 4600 |
| Chathirikkadu | Vayanappoovu | 121 | 2836 |
| Chathirikkadu | Garudakkodi | 51 | 510 |
| Chettiyamala | Vayanappoovu | 216 | 2343 |
| Chettiyamala | Garudakkodi | 2 | 7 |
| Chonamala | Vayanappoovu | 62 | 1396 |
| Chonanpara | Vayanappoovu | 7 | 75 |
| Chonanpara | Kattukurumulaku | 1 | 10 |
| Manachala | Pachottypattah | 121 | 5440 |
| Manachola | Manjavally | 7 | 263 |
| Nangan thurai | Panampoovu | 12 | 105 |
| Nanganthurai | Vayanappoovu | 1 | 1 |
| Nootty anchu | Pachottypattah | 32 | 3085 |
| Nootty anchu | Kodampuli | 32 | 2050 |
| Nootty anchu | Panampoovu | 121 | 303 |
| Prathuruthy | Kunthirikkam | 1 | 75 |
| Prathuruthy | Pachottypattah | 1 | 25 |
| Prathuruthy | Panampoovu | 2 | 23 |
| Prathuruthy | Kodampuli | 1 | 9 |

Chart No. 5.7. Total and Threatened Medicinal plants collected from the forests of Thiruvananthapuram



Peppara is followed by Palode and Neyyar in the collection of medicinal plant collection. Except for Paruthippilly, there is no remarkable difference among other areas. The reasons for the low no. of species extraction at Paruthippilly has to be investigated.

Table 5.15. Comparative & Total Quantity of Medicinal Plants Collected from Forests.
(Qty. in Kg.)

| Botanical name | PEPPARA | NEYYAR | ABP | P..PILLY | PALODE | K.PUZHA | TOTAL |
|---|---------|--------|------|----------|--------|---------|-------|
| <i>Holostemma adakodian</i> | 684 | 55 | 126 | | | | 865 |
| <i>Rauwolfia serpentina</i> | 21 | 270 | 278 | | 90 | | 659 |
| <i>Acacia concinna</i> | 211 | | | | | 211 | 422 |
| <i>Alpina calacarata</i> | 165 | 90 | | | | | 255 |
| <i>Elettaria cardamomum</i> | 126 | 55 | | | | | 181 |
| <i>Helecteris isora</i> | 194 | 75 | | | 120 | 133 | 522 |
| <i>Pterospermum rubignosum</i> | | | | | 270 | | 270 |
| <i>Aristolochia spp..</i> | 5165 | 883 | 475 | 881 | 1160 | 1108 | 9672 |
| <i>Kaemphaeraia galanga</i> | 116 | | | | 1 | | 117 |
| <i>Terminlia chebula</i> | 100 | | | | | | 100 |
| <i>Terminlia chebula</i> | 7965 | 1500 | 1735 | 870 | 3620 | 65 | 15755 |
| <i>Elaeocarpus serratus</i> | 1055 | 800 | 75 | | | | 1930 |
| <i>Curcuma aromatica</i> | 4331 | 902 | 380 | 778 | 1960 | 4450 | 12801 |
| Piper spp. | 2829 | 30 | 23 | 234 | 125 | 80 | 3321 |
| Curcuma spp. | | | 450 | 935 | | | 1385 |
| <i>Garcinia gummi gutta</i> | 17648 | 12786 | 990 | 4825 | 18376 | 11484 | 66109 |
| <i>Alpinia galanga</i> | 180 | 10 | 140 | | | 50 | 380 |
| <i>Gmelina arborea</i> | | 4200 | | | 40450 | | 44650 |
| <i>Canarium strictum</i> & <i>Vateria indica</i> | 2131 | 1185 | | | 1623 | 4175 | 9114 |
| <i>Sida</i> spp. | 20 | | | | 355 | | 375 |
| <i>Hydnocarpus pentandrus</i> | | 202 | | | | | 202 |
| <i>Cucuma longa</i> | 630 | | | | | | 630 |
| <i>Coscinium fenestratum</i> | 2960 | | 150 | | 263 | 263 | 3636 |
| <i>Pseudarthria viscida</i> | 4 | 1 | 4 | 1 | 3 | 2 | 15 |
| <i>Hemidesmes indicus</i> | 4053 | 943 | 359 | 1131 | 3480 | 626 | 10592 |
| <i>Phyllanthus emblica</i> | 27110 | 6362 | | 8380 | 42575 | 6925 | 91352 |
| <i>Desmodium gangeticum</i> | 3200 | 1199 | | 277 | 2658 | 1631 | 8965 |
| <i>Symplocos</i> spp. | 7070 | 835 | | | 663 | 8550 | 17118 |
| <i>Cyclea peltata</i> | 2393 | 689 | | 550 | 1389 | 255 | 5276 |
| <i>Myristica</i> spp | 1903 | 446 | | 50 | 257 | 673 | 3329 |
| <i>Entada scandens</i> | | | | | | 390 | 390 |
| <i>Stereospermum suaveolens</i> | | | | | 11860 | | 11860 |
| <i>Asparagus racemosus</i> | 5226 | 2370 | 638 | 1699 | 3838 | 1203 | 14974 |
| Thalippoovu, Viringa, Moongali | 30 | | 3 | | | 8 | 41 |
| <i>Oroxylum indicum</i> | | | | | 17250 | 4600 | 21850 |
| <i>Cinnamomum</i> Spp. | 3025 | 1613 | 647 | 255 | 1668 | 8045 | 15253 |

The comparative figures may be analysed to understand the reasons for variations among the forest areas.

Chart.5.8. Ten Most Collected Medicinal Plant Species in Thiruvananthapuram

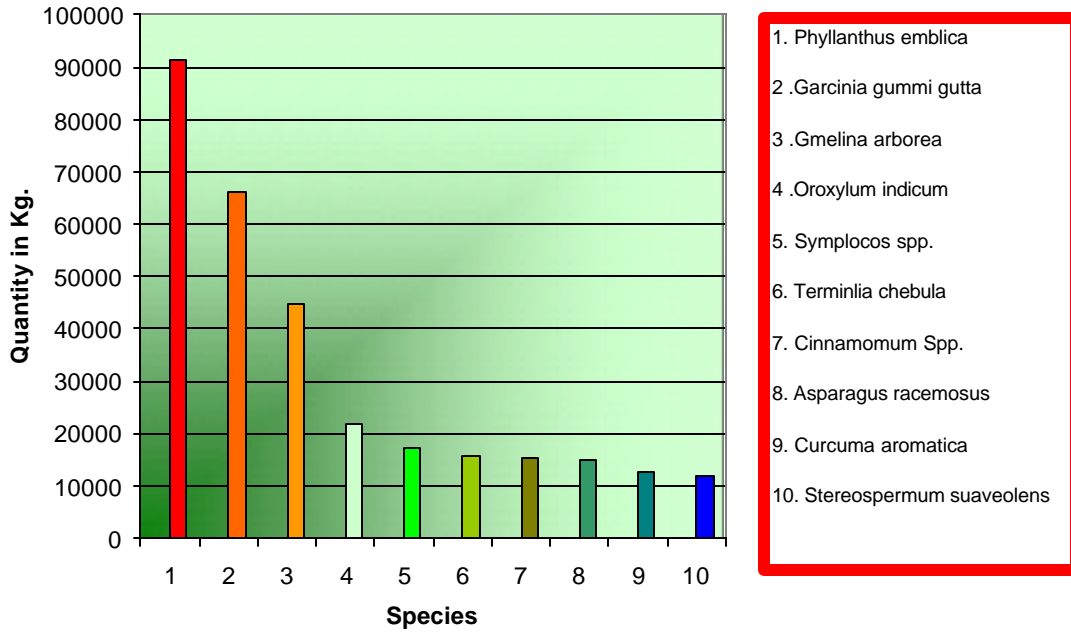
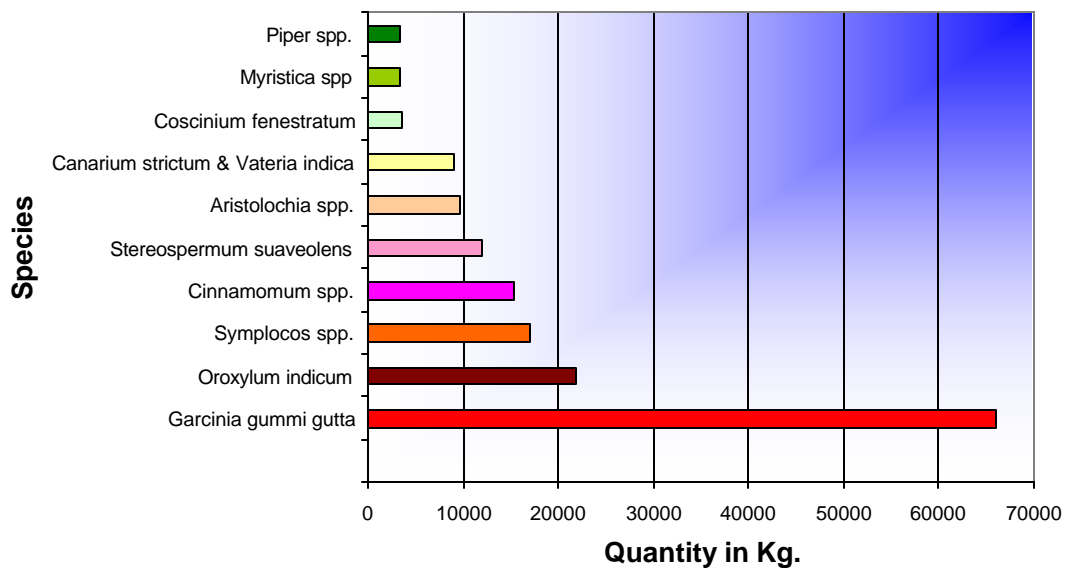


Chart.5.9. Ten Most Collected Threatened Medicinal Plants Species in Thiruvananthapuram



5.8 Marketing

The NWFP collected are marketed at the following outlets. It should be noted here that a parallel trade is occurring through illegal channels as well as direct sales either by the collectors taking the products to the buyers or the vice versa. It has been observed that some Kanikkar are bringing the products directly to the crude drug traders in Thiruvananthapuram. It has also been reported that buyers come from Tamil Nadu and the products are bought through agents located in the nearby villages. Fresh medicinal plants are often bought directly by the vaidyas or middlemen.

Table No. 5.16 Trade Centres/Markets.

| Sl.No. | Trade Centre /Market | Market Days |
|--------|----------------------|-------------------------|
| 1 | Nedumangad | Tuesday, Saturday |
| 2 | Vithura | Daily (evening) |
| 3 | Aryanad | Monday, Thursday |
| 4 | Kottur | Wednesday, Saturday |
| 5 | Kuttichal | Wednesday, Saturday |
| 6 | Kattakada | Monday, Thursday |
| 7 | Parandode | Daily (evening) |
| 8 | Panachammoodu | Wednesday, Saturday |
| 9 | Amboori | Daily (Evening) |
| 10 | Kallikkadu | Sunday, Tuesday, Friday |
| 11 | Pattakulam | Daily (Morning) |

* Apart from these markets, tribals sell their goods in the tribal auction centre held at Kottur every Wednesday and Saturday. Forest officials supervise the auction. The other outlets are Adiparambu (Collection centre of Njaraneeli Tribal Co-operative Society) and Kottur (Collection centre of Pottamavu Tribal Co-operative Society).

The pharmaceutical industries, crude drug dealers and traditional vaidyas in and around Thiruvananthapuram partly depend on the sanctuary for medicinal plants. Apart from the tribals, illegal collection of medicinal plants is rampant. Traders from Tamil Nadu also directly engage

tribals and other collectors for the supply of medicinal plants. Several of the medicinal plants collected and sold are considered to be rare and endemic eg. Coscinium fenestratum, Symplocos cochinchinensis (Mohan, 1991). Majority of the legal trade in medicinal plants is routed through the tribal co-operative societies' collection centres at Adiparambu and Kottur.

Essential oils are volatile, odoriferous liquids occurring in many plants. These have medicinal properties and thus can be included among the medicinal plant/ crude drug collection. Different parts of a plant like bark, wood, root, seed, flowers and fruits yield oil. Hydnocarpus pentandra (Marotti), Cymbopogon flexuosus (*Inchipullu*) Vetiveria zizanioides (*Ramachham*), Eucalyptus globulus (*Eukkali*) Cinnamomum zeylanicum (*Karuva*) etc. are oil-yielding plants in the area.

Resins are exuded as a normal phenomenon and as a result of injury. Extraction of Kingiodendron pinnatum (*Kulavu enna*) is banned due to the fact that the tree has become very rare in the wild; moreover the extraction method of drilling the wood destroys the tree. However, illegal extraction is rampant. The highly inflammable resin have been reported to be the cause of some wildfire due to spillage of the resin when the drilled hole is left uncovered after extraction. Black Damer (*Kunthirikkam*) is a resin obtained from Canarium strictum, an evergreen tree that has become very few in the sanctuary. White Damer (*Vellakunthirikkam*) from Vateria indica is also extracted in substantial quantities from the Sanctuary. Medicinal plants like Curcuma aromatica is cultivated and sold.

Table No. 5.17 Average Procurement of Medicinal Plants by the Njaraneeli & Pottamavu Tribal Co operative societies.

| Sl. No | Name of plant | Botanical Name | 1997-2000 |
|--------|--------------------|-----------------------------|------------------------------|
| | | | Average collection/yr. (kg.) |
| 1 | Adalodakam | <i>Adhathoda vasica</i> | 16.25 |
| 2 | Adapathian | <i>Holostemma adakodian</i> | 2.25 |
| 3 | Cheevakka | <i>Acacia concinna</i> | 116.5 |
| 4 | Chittaratha | <i>Alpina calcarata</i> | 72.25 |
| 5 | Ealum | <i>Elattaria cardamomum</i> | 721.5 |
| 6 | Edampiri Valampiri | <i>Helecteris isora</i> | 18 |
| 7 | Garudakkodi | <i>Aristolochia indica</i> | 4.7 |
| 8 | Kacholam | <i>Kaempharia galanga</i> | 1.175 |
| 9 | Kadukkapoovu | <i>Terminalia chebula</i> | 41.5 |
| 10 | Kakkumkaya | | 498 |
| 11 | Kannadivella | | 5.25 |

| | | | |
|----|------------------|--|----------|
| 12 | Kasthurymanjal | <i>Curcuma aromatica</i> | 3460.5 |
| 13 | Kattumanjal | <i>Curcuma longa</i> | 38 |
| 14 | Kolinji | <i>Alpina galanga</i> | 413.75 |
| 15 | Kombuvella | | 920.375 |
| 16 | Kudumpuli | <i>Garcinia gummigutta</i> | 2775 |
| 17 | Kunthirikkam-I | <i>Canarium strictum</i> | 2837.5 |
| 18 | Kunthirikkam-II | | 2724.75 |
| 19 | Kunthirikkam-III | | 199.25 |
| 20 | Kurumulakuvalli | <i>Piper spp.</i> | 4227.625 |
| 21 | Kurunthotti | <i>Sida spp.</i> | 2.5 |
| 22 | Maramanjil | <i>Cocinium fenestratum</i> | 7183.5 |
| 23 | Marotty kkuru | <i>Hydnocarpus spp.</i> | 187.5 |
| 24 | Nellikka | <i>Phyllanthus emblica</i> | 75.75 |
| 25 | Oorila | <i>Desmodium gangeticum</i> | 226.25 |
| 26 | Pachotty | <i>Symplocos spp.</i> | 3136.25 |
| 27 | Padathali | <i>Cyclea peltata</i> | 3 |
| 28 | Pathimugham | <i>Caesalpinia sappan</i> | 19.5 |
| 29 | Ponnampoovu | <i>Myristica spp., Knema attenuata</i> | 1120.25 |
| 30 | Poovanathari | | 552.5 |
| 31 | Ramacham | <i>Vetiveria zizanioides</i> | 16.5 |
| 32 | Sathavari | <i>Asparagus racemosus</i> | 61.75 |
| 33 | Seethari | | 360.25 |
| 34 | Thalipoovu | | 125.25 |
| 35 | Tharavella | | 2742.5 |
| 36 | Vayanapoovu | <i>Cinnamomum spp</i> | 330.25 |

5.9. Non-forest areas

The major non-forest areas from where medicinal plants are collected in the vicinity of Thiruvananthapuram City are the coastal areas of Kovalam, Shangumugham, Thumba, Valiathura and also the Varkala beach. Marshy area near the City like Iranimuttam, Vellayani, Poundukadavu, Akkulam are the major sources of plants like *Kaitha*, *Kanjankora*, *kozhuppa* etc. Paddy Fields and its banks are rich sources of medicinal plants like *Brahmi*, *Kudangal*, *Vayalchulli*, *Kozhuppa*, *Kaithonni*, *Karingoovalam*, *Ama*, *Aanachuvadi*, *Thekkada* etc. The alarming speed in which paddy fields in the city suburbs are converted into residential areas or coconut plantations could cause extinction of many such species. Homestead gardens are another source. 46 plants are collected from here. 61 species from common lands or 'Poramboke'

in the villages near the City. *Thekkada, Orilathamara, Attuthakara, Chuttithiruthali, Njekku* etc., are some of the plants collected from riverbanks.

Thiruvananthapuram City itself has certain pockets, which provide medicinal plants. Sreekanteswaram Park, campuses of Govt. Agricultural College and Govt. Homeo College are favourite locations of some collectors. Plants such as *Aal, Kallal, Kuvalam, Nagalingam, Athi, elanji, Chittarayal, Arasu*, etc. are collected from the temple compounds in the city. Airport, Karamana, Thiruvallom, Muttathara and Sreevaraham are some other parts of the City from where plants are collected. Even the lands by the railway lines provide such plants as *Thakara* and *Mullancheera*. Nellyampara is another location from where 12 species such as *Garudakkodi, Kanikonna, Kattucheera, Kattukurumulagu, Moodillathalli, Kodangal, Anakkurunthtti* and *Changalamparanda* are collected.

Medicinal plant collectors of Thiruvananthapuram go even into Tamil Nadu – ISRO campus, Thuthuvial, Thovala are some of such locations. *Mattivazha, Mullan njerinjil, Vellaruku, Kandankathiri, Naykurana, Pepadavalam, Ponnankani, Pongu, Pulivaka, Thazhuthama, Vasalacheera, Peychura, Nenmenivaka, Aratha, Adalodakam, Cherukumbalam*, etc., are brought from Tamil Nadu.

5.9.1. Threatened medicinal plant collection from Non-forest areas

A list of threatened species collected from the non-forest areas is given below:

| SI No | Local name | Botanical name | Part Collected |
|-------|------------------------------|------------------------------|----------------|
| 1 | Aattumaruthu (Neermaruthu) | <i>Terminalia arjuna</i> | Bark |
| 2 | Adapathiyan | <i>Holostemma adakodian</i> | Tuber |
| 3 | Anathippali (kattuthippali) | <i>Raphidophora pertusa</i> | Fruits |
| 4 | Asokam | <i>Saraca asoca</i> | Bark, Flowers |
| 5 | Azhukanni | <i>Drosera peltata</i> | Plant |
| 6 | Chandanam | <i>Santalum album</i> | Stem |
| 7 | Chembakam | <i>Michelia chembaka</i> | Flower bud |
| 8 | Cheru | <i>Semicarpus anacardium</i> | Seeds, Fruits |
| 9 | Cherupunna | <i>Calophyllum apetalum</i> | Seeds |

| | | | |
|----|--------------------------------|----------------------------------|-------------------|
| 10 | Cittadalodakam | <i>Adhathoda beddomei</i> | Leaves, All parts |
| 11 | Eakanayakam (Ponkorandi) | <i>Salacia oblonga</i> | |
| 12 | Garudakkodi | <i>Aristolochia indica</i> | All Parts |
| 13 | Garudakkodi(Pokkanam thookky) | <i>Aristolochia tagala</i> | All Parts |
| 14 | Karimkurinji | <i>Nilagiraianthus ciliatus</i> | All parts |
| 15 | Kariyilanchi | <i>Smilax zeylanica</i> | Plant |
| 16 | Kattu chena | <i>Amorphophallus commutatus</i> | Tuber |
| 17 | Koovalam | <i>Aegle marmalos</i> | All Parts |
| 18 | Kudampuli | <i>garcinia gummi gutta</i> | Fruits |
| 19 | Maenthonni | <i>Gloriosa superba</i> | Tuber |
| 20 | Moovila | <i>Pseudarthria viscida</i> | Root |
| 21 | Orila thamara | <i>Nervalia araguana</i> | All Parts |
| 22 | Thippali | <i>Piper longum</i> | Fruits |

5.9.2. Diminishing species.

In the course of the study, collectors from non-forest areas have reported that several species found in abundance earlier are diminishing. This is due to many reasons such as the shrinking of wetlands, common lands, conversion of homestead gardens to monoculture plantations of Coconut, Rubber, and residential constructions that are obliterating the rural scenery. Villages of yesteryears have become small townships. As the price of land goes up, the old sources of medicinal plants dry up and the pressure on forests increase.

Table No. 5.19 Non-forest areas- Plants reported to be diminishing by the collectors.

| Sl. No | Local name | Botanical name | Part Collected |
|--------|-------------------------------|------------------------------|--------------------|
| 1 | Aal | <i>Ficus benghalensis</i> | Bark |
| 2 | Adakkamaniyan | <i>Sphaeranthus indicus</i> | Plant |
| 3 | Adalodakam | <i>Adhathoda vasica</i> | Roots, Leaves |
| 4 | Adambu | <i>Ipomoea pes caprae</i> | Stem |
| 5 | Adapathiyam | <i>Holostemma adakodian</i> | Tuber |
| 6 | Adavi kacholam | | Tuber |
| 7 | Ambazham | <i>Spondias pinnata</i> | Leaves, Bark, seed |
| 8 | Arashu | <i>Ficus religiosa</i> | Roots |
| 9 | Athy | <i>Ficus glomerata</i> | Roots |
| 10 | Brahmi | <i>Bacopa monnieri</i> | Plant |
| 11 | Chakkarakkolli | <i>Gymnema sylvestre</i> | Leaves |
| 12 | Chamatha | <i>Butea parviflora</i> | Twigs, Bark |
| 13 | Cheriyam Rama thulasi | <i>Oscimum basilicum</i> | Plant |
| 14 | Cheru | <i>Semicarpus anacardium</i> | Seeds, Fruits |
| 15 | Cheru chunda (Puthari chunda) | <i>Solanum indicum</i> | All parts |
| 16 | Cherunjara | | Leaves |
| 17 | Cheruthekkku | <i>Clerodendrum serratum</i> | Plant |
| 18 | Chillarikizhangu | <i>Kaemphaeria rotunda</i> | Tuber |

| | | | |
|----|----------------------------|---------------------------------|-----------------------|
| 19 | Choriyanam | <i>Tragia involucrata</i> | Seeds |
| 20 | Chuvanna kadaladi | <i>Achyranthus species</i> | All parts |
| 21 | Eazha chembakam | <i>Plumeria</i> | Leaves & Latex |
| 22 | Ithy | <i>Ficus gibbosa</i> | Roots |
| 23 | Kadalaavanakku | <i>Jatropha curcas</i> | Roots, Leaves |
| 24 | Kadambu | <i>Neolamarkia cadamba</i> | Seeds |
| 25 | Kaippan cheera | <i>Mullugo oppositifolia</i> | Plant |
| 26 | Kaippan padavalam | <i>Trichosanthes cucumerina</i> | |
| 27 | Kaithonny | <i>Eclipta alba</i> | |
| 28 | Kakkathondi | <i>Torrenia bicolor</i> | Roots |
| 29 | Kallal | <i>Ficus mysorensis</i> | Bark |
| 30 | Kanakkudu | | All Parts |
| 31 | Kandakarichunda | <i>Solanum xanthocarpum</i> | All Parts, Fruits |
| 32 | Kanikkonna | <i>Cassia fistula L.</i> | Bark,Leaves |
| 33 | Karimkoovalam | <i>Monochorea hastaefolia</i> | All Parts |
| 34 | Karimthumba | <i>Anisomeles malabarica</i> | All Parts |
| 35 | Karppoorathulasi | <i>Artemisia nilagirica</i> | Leaves |
| 36 | Karutha kodangal | <i>Geophila sp.</i> | All Parts |
| 37 | Kattu mallika (kattumulla) | <i>Jasminum flexile</i> | Flowers |
| 38 | Kattu Muringa | <i>Ormocarpum sennoides</i> | Leaves, Roots |
| 39 | Kattu muthira | <i>Atylosia scarabaeoides</i> | All Parts |
| 40 | Kattu paval | <i>Momordica cymbalaria</i> | Tuber, Leaves |
| 41 | Kattu payar | <i>Phaseolus sp.</i> | All Parts |
| 42 | Kattu ramathulasi | <i>Oscimum canum</i> | Plant |
| 43 | Kattu uzhunnu | <i>Atylosia goensis</i> | Seeds |
| 44 | Kattu vellari | <i>Melothria indica</i> | All Parts |
| 45 | Kazhanji | <i>Caesalpinia bonducella</i> | Leaves, Roots, Fruits |
| 46 | Kolinji | <i>Alpinia galanga</i> | Tuber |
| 47 | Kurumthotty | <i>Sida spp.</i> | Tuber |
| 48 | Munja | <i>Premna integrifolia</i> | Roots |
| 49 | Narunandi | <i>Hemidesmus indicus</i> | Tuber |
| 50 | Neela Amari | <i>Indigophera tinctoria</i> | All Parts |
| 51 | Njottanjodiyam | <i>Physalis minima L.</i> | All parts |
| 52 | Panachy | <i>Diospiros embryopteris</i> | Bark |
| 53 | Parppadakappullu | <i>Mullugo pentaphylla</i> | Plant |
| 54 | Poovamkurunnila | <i>Vernonia cineria</i> | All Parts |
| 55 | Sunnmukhi (Nilavaka) | <i>Cassia aungustifolia</i> | Leaves |
| 56 | Velipparuthy | <i>Daemia exelsa</i> | Leaves, stem |
| 57 | Vellaraku(Vellilam) | <i>Mussaenda frontosa</i> | Leaves, Roots |
| 58 | Vettupala | <i>Wrightia tinctoria</i> | Leaves |

The traders too have reported that certain plants have become rare. Table 5.20 is on the basis of the opinion of traders. The traders in the City have reported the largest number. This could be due to the fact that the demand in the City is more and varied. Also, the traders in the suburban towns often get their merchandise directly from the local collectors.

Table No. 5.20. Non -Forest Areas: List of Medicinal Plants reported scarce by traders/ drug manufacturers

| Sr.No. | Common Name | Botanical name | City | Kattakada | Peyad | Nedumangad | Kadakavoor | Attingal | Neyyatinkara |
|--------|------------------|---------------------------|------|-----------|-------|------------|------------|----------|--------------|
| 1. | Adalodakam | Adathoda vasica | | + | | | | | |
| 2. | Adapathiyam | Holostemma ada-kodian | + | | | | | | |
| 3. | Asokam | Saraca asoca | + | | | | | | |
| 4. | Azhukanni | Drosera peltata | + | | | | | | |
| 5. | Brahmi | Baccopa monnieri | + | | | + | | | |
| 6. | Changalamparanda | Vitis quadrangularis | | | | | + | | |
| 7. | Dasamoolam | (10 spp.) | | + | | | | + | |
| 8. | Garudakodi | Aristolochia indica | | | | | + | | |
| 9. | Kaiyonni | Eclipta alba | + | | + | | | | |
| 10. | Kalthamara | Ariopsis peltata | + | | | | | | + |
| 11. | Karinochi | Vitis negundo | + | | | | | | + |
| 12. | Keezharnelli | Phyllanthus amarus | + | + | | | | | |
| 13. | Kodithuva | Tragia involucrata | + | | | | | | |
| 14. | Koduveli | Plumbago spp. | | | + | | | | |
| 15. | Koovalam | Aegle marmalos | | | | | | + | |
| 16. | Kudangal | Centella asiatica | | | | + | | | |
| 17. | Kurinji | Strobilanthus sp. | + | | | | | | |
| 18. | Kurumthotti | Sida retusa | + | | | + | | | |
| 19. | Malavazha | Enisita superba | + | | | | | | |
| 20. | Mukkutti | Biophytum sensitivum | | | | + | | | |
| 21. | Neela amari | Indigophera tinctoria | + | + | + | + | + | | + |
| 22. | Nejrinjam puli | Zehneria umbellata | | | | | | | + |
| 23. | Nilapana | Curculigo orchioides | | | | + | | | |
| 24. | Nilamparanda | | + | | | | | | |
| 25. | Orila | Desmodium gangeticum | + | + | | | | | |
| 26. | Pathimugham | Caesalpinia sappan | + | | | | | | |
| 27. | Perumthumba | | | + | | | | | |
| 28. | Ponkorandi | Salacia oblonga | + | | | | | | |
| 29. | Prasarini | Merremmia tridentata | + | | | | | | |
| 30. | Sathavari | Asparagus racemosus | | | + | | | | |
| 31. | Thaivela | Gynandropis gynandra | + | | | | | | |
| 32. | Thazhuthama | Boerhaavia diffusa | | | | + | | | |
| 33. | Uzhinja | Cardiospermum helicacabum | + | + | | | | | |
| 34. | Vayalchulli | Hygrophylla spinosa | + | | | | | | |
| 35. | Veliparuthi | Daemia exelsa | + | | | | + | | |

Chapter 6.

Conclusions & Recommendations

6.1. Conclusions

Looking at the entire gamut of information generated by the study, it can be seen that each of the aspects such as trade, adulteration and the collection of medicinal plants have tremendous scope for improvement and urgent action. They are not different issues but are interlinked parts of the larger picture of our interaction with the human communities involved in this activity and the careful management of our vital natural resources. Therefore, plans and policies have to be made with a long-term perspective to ensure sufficient and regular supply of plant materials as well as conservation of the resource bases not only in the wild but also in the man-altered ecosystems.

The first objective of the study was to understand the crude drug trade in threatened medicinal plants in Thiruvananthapuram district. Generally the crude drug trade is in a primitive state compared to other branches of commerce. Inconsistent prices, indeterminable quality of products, non-standardized measurements – crude drug trade retains the traditional character. A major share of the trade is based on crude drug prescriptions which is used by the consumers to make their own concoctions. On the other hand, several drug manufacturers have standardized medicines for common ailments such as cold, cough, high blood pressure, cholesterol and diabetes.

From the broader scene of all medicinal plants and threatened medicinal plants, the study narrowed down to those species that are found in the study area. The idea is to focus on conservation of the species in the district. The advantage of this approach is that the study is species specific and area-specific. The former aspect helps to prioritise species to be conserved and the latter to focus conservation measures. In a similar fashion, studies could be taken up in other parts of the state like Thrissur, which is considered as the main crude drug trade centre in Kerala.

Raising nurseries or reintroducing such rare species to the forests is insufficient from a conservation angle. Their wild and natural habitats have to be located and protected. This study shows that the forests of Thiruvananthapuram District are an important source of medicinal plants.

As the extraction increases, the regeneration capability of the ecosystem would diminish. It is interesting to note that the 'Plathi' (medicine-man of the Kani tribe) believes that the artificially cultivated medicinal plants are far less potent than those grown in the wild. This could be a matter for scientific investigation.

This is where another objective of this study, viz., to locate the sources of threatened medicinal plants in trade, stands attained. The major forest as well as non-forest sources in the district was located. In the several floristic studies mentioned in the literature review, the status of threat has been bestowed on the plants on bases other than trade. Though such investigations reveal the threatened species, they do not provide the exact locations; nor is it necessary that such plants be in trade. Their rarity could be due to deforestation, commercial plantations, dams or human encroachment.

As a result of this study; some taxa have been identified as scarce based on the reduced availability in the market and the report of plant collectors and traders. Such 'Candidate' species have to be subjected to scrutiny to assess their status.

But, as mentioned elsewhere in the report, such conservation initiatives cannot be upheld unless the interests of the plant collector, esp., those living in forests are considered. It is of utmost importance that the invaluable plant species do not become extinct, for which, in addition to protection of their habitats, sustainable methods of extraction have to be practiced. The collectors who are from the most economically and socially deprived communities have to be encouraged and adequately compensated for their service to the society. Many studies have pointed out that the harvesting techniques are unsustainable and that the collectors have no motivation for adopting comparatively less destructive practices. A major reason is that the collectors get a poor deal from the trade. This aspect of the crude drug trade has been subjected to detailed investigation here. The huge disparity between the collection charges and retailers' price has been graphically brought out. Studies by KFRI have shown similar results in areas such as Wynad, Attapadi, etc (KFRI, 2002). Mechanisms such as the tribal co-operatives and SC/ST Federation have not been upto expectation; avoidance of middle-men, a cliché-d term in NWFP trade is next to impossible, due to the extra-trade relations between them and the collectors. Therefore, it is imperative that other avenues be explored by which the collectors' income can be enhanced. This can be in the form of value-addition at the collectors' level. Adequate training

and provision of necessary infrastructure at local levels could alleviate this problem to a great extent. The 'Herb for All, Health for All' project by the TBGRI with World Bank aid is a step in this direction. However, there are cultural, economic and social aspects which have to be carefully monitored and a long-term technical support to be provided for such schemes to bring the tribal community into the mainstream society successfully. Later studies such as the KFRI study on participatory management programme for NWFP (ibid.) recognizes the close linkage between the ecological and economic systems and shows that sustained income for collectors as a pre-requisite for successful management of the resource.

Assuming that plant-based healthcare system would gain more ground in the future, it has to be ensured that the consumer gets what he pays for. Adulteration of crude drugs has, to a great extent dented the trust in traditional healthcare. It has to be ensured that the fly-by-night operators among the drug manufacturers and traders do not contaminate our traditional healthcare system and the health of the people through adulteration of the drugs. The unethical practices of the drug manufacturers would not only reduce the efficacy of the drugs but also be affect the trust of the people in the traditional healthcare systems. The investigation into the adulteration/substitution of crude drug revealed its wide practice in the crude drug trade. This is an area which needs considerable research. Clinical and pharmacological research would bring to light the comparative disadvantages of such adulterations.

Most of the conservation projects are aimed at forests and such wild ecosystems, overlooking the fact that in Kerala, despite the decline, common lands and homesteads are still an important source for medicinal plants. Between strict in situ and ex situ conservation, there is a third category that exists on non-wild lands in human –made wilderness areas, such as degraded lands. These lands should be taken up for ex –situ conservation of medicinal plants and then as the soil quality improves natrual revegration would follow and natural diversity would take over. It starts as ex situ and ends [in in situ](#) (Khushoo, 1996). The study shows that there are substantial medicinal plant sources in the urban and rural areas. This is in spite of the rapid urbanisation of the countryside. It may not be possible to check its spread fully; but steps can be initiated to create more parks and open spaces within the city with nurseries of medicinal plants as part of a conservation awarenes programme among the city dwellers. Certain low-lying areas can even be declared as common lands where natural plant life is allowed to flourish. Thus creating belts

or patches of natural areas will not only reduce the pressure on forests but also provide recreational and health supporting systems within human habitations.

6.2. Recommendations

6.2.1. Trade.

- Retail price of crude drug should be fixed and regulated. Standardization of drugs is still in a developing stage in Ayurveda. More research has to go into this aspect.
- The tribal Co-operatives and the SC/ST Federation marketing system has to be strengthened for better procurement and marketing of crude drugs. This system is limited to only some non- perishable NWFP and crude drugs.
- The tribal Co-operatives should be given support by empowering the tribals for more say in the management and for demanding better and reasonable charges for their efforts.
- Imbalance in price spread has to be minimalised. Giving them training and financial assistance in value-addition of crude drugs by manufacturing simple and basic plant-based drugs can enhance the collectors' share in trade.
- The ethnomedicinal practices of the tribals have to be recognised for their effectiveness and support provided to popularise it. Thus, as collectors, practitioners and manufacturers, the tribals can corner a larger share of the trade.
- Policy support to encourage semi-processing units near the centres of cultivation / gathering, with small - scale industrial status is necessary. This will conserve the medicinal plants by reducing wastage and the resultant savings could be made available for future use. Research and Development in evolving appropriate semi-processing technologies be developed by pharmacies / academic institutions. Such value –addition strategies would narrow the present gap between the earnings of the primary collectors and the retailer price as the collectors themselves are made partners in the semi-processing activities.

6.2.2. Adulteration

- The collectors and traders have to be educated about the danger and unethical nature of adulteration. Legal sanctions based on proven studies on the ill effects of adulteration have to enforce to check the practice.
- Standardization of drug formulations to the maximum possible extent has to jointly develop by Ayurvedic, Botanical, Phytochemical and Pharmacological experts.
- Crude drug adulteration has to be developed as a major area of study for both Biology & Auyurveda students.

6.2.3. Collection of Medicinal Plants

- Unsustainable harvest of medicinal plants and other NWFPs can have a major negative impact on the biodiversity. Certain general guidelines in this regard have been developed by the FRLHT, Bangalore which can be suitably adapted for local conditions. Regional studies have to be made on the harvesting practices based on which the tribal collectors should be trained on sustainable practices.
- The study has indicated areas where high medicinal plant extraction is taking place. Such areas should be further subjected to investigation for their suitability as germplasm conservation areas.
- Rotation of areas for collection as practised in Tamil Nadu (Madurai) is a sustainable method.
- Teams of taxonomists/ para taxonomists have to constantly monitor, evaluate and analyse the impact of medicinal plant collection. Periodic regeneration surveys, harvest assessment, etc should be part of the monitoring programme.
- Communities / groups may be given subsidies or encouragement for protecting/ conserving an area or certain plants that are critically endangered.
- Every school, Colleges & other education institutions, Government as well as private institutions should be encouraged to cultivate medicinal plant gardens. Incentives and recognition of such activities should be made part of annual flower show or such festivities.
- Every District/Region should have a medicinal plants garden where students and the public can visit and learn. These centres can also serve as a sales outlet.

- Existing herbal gardens should be maintained well. An example is the one at Kulathupuzha, which, allegedly due to lack of funds have lost most of its valuable specimens.
- Database on the availability of medicinal plants, rarity etc & sustained conservation practices, of medicinal plants should be created. Indigenous knowledge of the tribal communities should be incorporated into such studies.
- Training programmes for forest officials should be developed for identification and conservation of threatened plants.
- NGOs involved in conservation should be made associates of conservation initiatives. Financial and technical support should be given for establishment of regional gene banks, cryobanks and tissue culture repositories.
- Suitable legislations should be enacted to prevent bio-piracy and to ensure community benefits from commercialization of medicinal plants.
- Between strict in situ and ex situ conservation, there is a third category that exists on non-wild lands in human –made wilderness areas, such as degraded lands. These lands should be taken up for ex –situ conservation of medicinal plants and then as the soil quality improves natural revegetation would follow and natural diversity would take over. It starts as ex situ and ends in in situ. (Khushoo, 1996)

The substantial medicinal plant sources in the urban and rural areas indicate that our land is indeed ‘God’s Own Country’. This is in spite of the rapid urbanisation of the countryside. It may not be possible to check its spread fully; but steps can be initiated to create more parks and open spaces within the city with nurseries of medicinal plants as part of a conservation awareness programme among the city dwellers. Patches of wetlands and freshwater tanks still remain amidst human settlements. Such areas have to be brought under direct government control and preserved as public property. Certain low-lying areas can even be declared as common lands where natural plant life is allowed to flourish. Thus creating belts or patches of natural areas will not only reduce the pressure on forests but also provide recreational and health supporting systems within human habitations.

6.3. Limitations of the study

This study shows that crude drug trade is a vast and multi-disciplinary area of study. Contributions from botany, sociology, economics, ayurveda and forestry have to be channelled into one stream to understand and to act upon this critically important issue that has far-reaching effect on our lives. The area of study is small; if one single district on Thiruvananthapuram could yield so much of information, the database on the whole state or the entire Western Ghats would be huge.

The entrenched traditional nature of crude drug trade makes it very difficult to extract information from the trading community. Since trading is yet to be standardized and modern, the exact figures of quantity, price etc., could be determined only as an average due to the large variations in prices and measurements. The limited scientific application and knowledge of the traders and collectors proved to be another major impediment in identifying the species. Source identification is another major problem as it required extensive field trips. In the absence of sufficient funds and technical support that only large institutions can provide, data collection from field has been a laborious undertaking. Taking the tribal collectors into confidence is yet another major issue. The tribals have been victims of many frauds by which most of their material as well as cultural treasures were robbed from them. This has made them very wary of sharing their knowledge with the researchers. It was only because of the long-standing association of the researcher with the tribals that most of the information could be extracted from them. The illegal aspects of harvesting (unlawful entry, unsustainable harvesting methods and parallel trading channels) also proved to be a block in data collection.

Only concerted and sincere efforts by the government departments such as Health, Revenue, Forests and Education with the huge resources at their disposal can make effective and exhaustive studies and also formulate policies and practices for the sustainable management of these vital natural resources. This study has only rubbed off a little of the dust and dirt of anonymity that envelopes the crude drug trade, to gain a glimpse of the wealth and beauty of our land; it remains the duty of the people to preserve it and the pleasure in doing so is their privilege.

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Appendix.1.**List of Threatened Medicinal plants of Thiruvananthapuram**

| Sr.No. | Local name | Botanical name | Part used | Some Medicinal uses |
|---------------|----------------------|------------------------------|---------------------|---|
| 1. | Vayambu | Acorus calamus | Rhizome | Enhance memory, digestive disorders, rheumatism |
| 2. | Muthakku | Adenia hondala | Tuber | Hernia |
| 3. | Chittadalodakam | Adhatoda beddomei | Roots, leaves | Cough & cold |
| 4. | Koovalam | Aegle marmelos | All parts | Digestive disorders, fever, jaundice, ophthalmia, piles, deafness |
| 5. | Kattucherula | Aerva wightii | All parts | |
| 6. | Kattu chena | Amorphophallus commutatus | Flower, corm | Piles, tumors, cysts |
| 7. | Kattu chena | Amorphophallus paeoniifolius | Flower, corm | Piles, tumors, cysts |
| 8. | Kattu therachi | Ampelocissus araneosa | Roots | Astringent |
| 9. | Chemaram | Aphanamixis polystachya | Bark | Liver, spleen & abdominal complaints, tumors |
| 10. | Garuda kodi | Aristolochia indica | Roots | Carminative, skin problems, bowel complaints, snake bite |
| 11. | Pokkanam thooki | Aristolochia tagala | Roots | Skin problems, bowel complaints, snake bite |
| 12. | Ayani | Artocarpus hirsutus | Leaves, fruit, bark | Skin diseases, hydrocele |
| 13. | | Asparagus rottleri | Tuber | Coolant |
| 14. | Nagadanthi | Baliospermum montanum | All parts | Purgative, rubefacient, skin problems, asthma |
| 15. | Cheru punna | Calophyllum apetalum | Seed oil | Leprosy, skin problems, menstrual disorders |
| 16. | Thelli, Kunthirikkam | Canarium strictum | Resin | Skin diseases, fever, rheumatism |
| 17. | Velutha chori valli | Cayratia pedata | All parts | Cough, bronchitis, asthma, joint pain |
| 18. | Valulavam | Celastrus paniculatus | Leaf, bark | Abortifacient, brain tonic, memory enhancing, |
| 19. | Appuppan thadi | Chonemorpha fragrans | Root | Laxative, skin problems, blood purification |
| 20. | Karuva | Cinnamomum macrocarpum | Bark, leaves | Cough, diarrhoea, rheumatism |
| 21. | Kattu karuva | Cinnamomum sulphuratum | Bark, leaves | Cough, spider poison, mouth freshener |
| 22. | Kattu karuva | Cinnamomum wightii | Bark, fruit | Paralytic disorder, digestive & gynecological disorders, |
| 23. | Maramanjil | Cosciniun fenestratum | Stem | Anti inflammatory, antiseptic, piles, cough |
| 24. | Eentha pana | Cycas circinalis | Seeds, endosperm | Flatulence, aphrodisiac |
| 25. | Narunandi | Decalepis hamiltonii | Root | Blood purifier, cooling agent |
| 26. | Kari | Diospyros candolleana | Root | Joint pain, swelling |
| 27. | Karivella | Diospyros paniculata | Fruit | Burns, gonorrhoea |
| 28. | Kal payin | Dipterocarpus indicus Bedd. | Resin | Rheumatism |
| 29. | Thee pullu | Drosera indica | Leaves | Corns |
| 30. | Thee pullu | Drosera peltata | Leaves | Blisters, tonic, syphilis |
| 31. | Vella akil | Dysoxylum malabaricum | Wood | Rheumatism, ear & eye disorders |

| | | | | |
|-----|--------------------|------------------------------------|---------------|--|
| 32. | Vizhal | <i>Embelia ribes</i> | Root, seed | Anthelmintic, skin problems, headache |
| 33. | Vizhal | <i>Embelia tsjeriam-cottam</i> | Root, seed | Anthelmintic, skin problems, headache |
| 34. | Chilanthi kizhangu | <i>Eulophia cullenii</i> | Rhizome | Aphrodisiac, cardiac problems |
| 35. | Kodam puli | <i>Garcinia gummi-gutta</i> Robson | Fruit | Purgative, obesity, emetic, |
| 36. | Punam puli | <i>Garcinia indica</i> | Fruit | Dysentery, cardiac problems |
| 37. | Karukam puli | <i>Garcinia morella</i> | Fruit | Constipation, rheumatism, skin problems, antibacterial |
| 38. | Somanadikayam | <i>Gardenia gummifera</i> | Leaf resin | Neuropathy, anorexia, colic, obesity |
| 39. | Menthonni | <i>Gloriosa superba</i> | Seed, root | Anti-inflammatory, snake bite, muscle relaxant |
| 40. | -- | <i>Glycosmis macrocarpa</i> | leaf | Skin problems, liver complaint |
| 41. | -- | <i>Gymnema khandalense</i> | leaf | Diabetes |
| 42. | Karppura veru | <i>Hedychium coronarium</i> | Rhizome | Carminative, stimulant |
| 43. | Telkatta | <i>Heliotropium keralense</i> | | Ulcers, insect bites |
| 44. | Nilapana | <i>Helminthostachys zeylanicus</i> | Leaf, rhizome | Sciatica pain, snake poison, impotency, intoxicant |
| 45. | Chittaelam | <i>Heracleum candolleianum</i> | Tubers | Digestive disorders, cardiac problems, wounds |
| 46. | Adapathian | <i>Holostemma ada-kodien</i> | Roots | Ophthalmic problems, tuberculosis |
| 47. | Kaara pongu | <i>Humboldtia vahliana</i> | Bark | Epilepsy, leprosy |
| 48. | Piner vetty | <i>Hydnocarpus alpina</i> | Fruit | Leprosy |
| 49. | Mala kummatti | <i>Hydnocarpus macrocarpa</i> | Seed oil | Skin diseases, leprosy |
| 50. | Cheria marotti | <i>Hydnocarpus pentandra</i> | Seed oil | Skin diseases, leprosy |
| 51. | Amrthapala | <i>Janakia arayalpathra</i> | Tubers | Stomach pain |
| 52. | Kacholam | <i>Kaempferia galanga.</i> | Rhizome | Cough, |
| 53. | Kulavu | <i>Kingiodendron pinnatum</i> | Oleoresin | Gonorrhoea, rheumatism, |
| 54. | Chora payin | <i>Knema attenuata</i> | Bark, seed | Breathing disorder |
| 55. | Ilippa | <i>Madhuca neriifolia</i> | Heartwood | Ulcers, kidney problems |
| 56. | Chembakam | <i>Michelia champaca</i> | All parts | Urinary problems, impotency, malaria, |
| 57. | Vella chembakam | <i>Michelia nilagirica</i> | Bark, leaf | Febrifuge |
| 58. | Panam poo | <i>Myristica dactyloides</i> | Aaril | Diarrhoea, bronchitis, liver& skin disorders |
| 59. | Ponnam Poo | <i>Myristica malabarica</i> | Aril | Cough, muscular pain |
| 60. | Orila thamara | <i>Nervilia aragoana</i> | Tuber | Postnatal treatment |
| 61. | Konnaraveetti | <i>Nothapodytes nimmoniana</i> | Wood | Tumors |
| 62. | Palakapayyani | <i>Oroxylum indicum</i> | All parts | Anti-inflammatory, carminative, tonic, ulcers, |
| 63. | Druri | <i>Paphiopedilium druryi</i> | Flower | Horticultural |
| 64. | Ooravu | <i>Persea macrantha</i> | Stem bark | Asthma, constipation, rheumatism |
| 65. | Kattu padappan | <i>Piper barberi</i> | Fruit | Cough, bronchial problems |
| 66. | Thippali | <i>Piper longum.</i> | Root, spike | Diarrhoea, jaundice, oedema |
| 67. | Kattu kurumulagu | <i>Piper mullesua</i> | Root, spike | Diarrhoea, jaundice, oedema |
| 68. | -- | <i>Plectranthus nilgherrius</i> | Roots | Anipyretic |
| 69. | Moovila | <i>Pseudarthria viscida</i> | Roots | Rheumatism, diarrhoea, asthma, piles |

| | | | | |
|-----|---------------|----------------------------------|------------------|--|
| 70. | Palmuthukku | <i>Pueraria tuberosa</i> | Tubers | Cough, malaria, dysuria |
| 71. | Akaramkolli | <i>Rauvolfia serpentina</i> | Root, leaf | Sedative, high blood pressure, rat bites, mental disorders |
| 72. | Mara marambu | <i>Rhaphidophora pertusa</i> | Stem juice | Liver & spleen inflammation |
| 73. | Kadal azhiṅṅi | <i>Salacia oblonga</i> | Stem bark | Diabetes, gonorrhoea |
| 74. | Ekanayakam | <i>Salacia reticulata</i> | Roots | Diabetes, gonorrhoea, inflammation |
| 75. | Chandanam | <i>Santalum album</i> | Hardwood | Hemorrhage, white discharge, skin problems |
| 76. | Asokam | <i>Saraca asoca</i> | All parts | Indigestion, blood purifier, fractures, menstrual problems |
| 77. | Mala plasu | <i>Schrebera swietenoides</i> | Root, leaf, bark | Skin diseases, anaemia, diabetes |
| 78. | Amukkuram | <i>Semecarpus travancorica</i> | Bark, gum | Skin diseases, snake bite |
| 79. | Kareelanchi | <i>Smilax zeylanica</i> | Root | Venereal disease, rheumatism |
| 80. | | <i>Swertia corymbosa</i> | All part | Fever, boil, vomiting |
| 81. | Parala | <i>Symplocos cochinchinensis</i> | Stem bark | Uterine complaints, eye diseases |
| 82. | Pachotti | <i>Symplocos racemosa</i> | Stem bark | Acne, poisons, menstrual disorders |
| 83. | Kallal | <i>Syzygium travancoricum</i> | Bark | Diarrhoea, diabetes |
| 84. | Neer maruthu | <i>Terminalia arjuna</i> | Bark | Cardiac tonic, ulcers, leprosy |
| 85. | Kattu amrithu | <i>Tinospora sinensis</i> | Stem | Piles, liver complaints, muscular relaxant |
| 86. | Koduthoova | <i>Tragia bicolor</i> | Roots | Skin problems, worms, diabetes |
| 87. | Aarogya pacha | <i>Trichopus zeylanicus</i> | Fruit | Energiser, anti-hepatotoxic, antifatigue |
| 88. | Marappala | <i>Utleria salicifolia</i> | Tuber | Intestinal problems, tuberculosis, skin diseases |
| 89. | | <i>Valeriana leschenaultii</i> | Rhizome | Mental disorders |
| 90. | Thelli | <i>Vateria indica</i> | Resin | Cough, asthma, dysentery, rheumatism |

Appendix No.2.

CONSERVATION AND CONSUMPTION – A STUDY ON THE CRUDE DRUG TRADE IN THREATENED
MEDICINAL PLANTS IN THIRUVANANTHAPURAM DISTRICT, KERALA

(Interview Schedule: Trader/Drug Manufacturer)

Name of the field investigator:

Date:

No:

Area:

Name of the trader/ manufacturer:

Status: crude drug trader / manufacturer

Shop/ manufacturer license No:

Address:

A. The trade

1. When was the business started?
2. Is it a wholesale/retail business/ manufacturing unit?
3. What is the sales turnover? Give figures for the last 5 years.
4. What does the respondent know about the increase in demand and the subsequent supply?
5. How is the demand foreseen? Are certain items generally in demand or are there any seasonal variations in demand?
6. Does the respondent export? Can details be given?

B. The goods

7. Can a list of medicinal plants used in trade / for manufacture of drugs be given? (if yes, attach list)
8. Among them which are the items that are in high demand. (collect details for the last 5 years)
9. Which are the items that are expensive?
10. Which, according to the respondent, have become progressively rare and difficult to obtain? Give reasons.
11. Are there any items, which are no longer available? Collect list.
12. Which are the items that are abundant and cheaply available?

13. Is the respondent aware that some plants could have become extinct? What, according to him, can be done about it?
14. Are the plant parts received in whole or only the medicinally valuable parts?

C. The source

15. Which are the sources that supply the materials? Give details. (Collect details of auction centres, suppliers, etc.)
16. Does any collector supply directly?

D. Adulteration

17. Is the respondent aware of any kind of adulteration? If yes, collect details.
18. Can he detect adulteration? Make notes.
19. How is quality control applied?

Appendix No.3.

Conservation & Consumption: A Study On The Crude Drug Trade In Threatened Medicinal Plants In
Thiruvananthapuram District, Kerala.

(Data Sheet : Medicinal Plant Collector)

Name of the field investigator:

Date:

Area:

1. Name & address of the collector
2. No. and names of persons who collect medicinal plants in the family
3. Details of medicinal plants collected

| Sl. No | Name of the plant collected | Part of the plant | Method of collection | Quantity collected at a time | Season of collection | Locality of collection | Whether available now. (Yes/No) | Greater (G) or lesser (L) when compared to the past |
|--------|-----------------------------|-------------------|----------------------|------------------------------|----------------------|------------------------|---------------------------------|---|
| | | | | | | | | |

Cover Page: *Trichopus zeylanicus* with fruit (Aarogya Pacha).

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