



MINOR FOREST PRODUCE COLLECTION UNDER FOUR PROTECTED AREAS AND ADJOINING LANDSCAPES OF KERALA

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Ashish A P

Supervisor

Dr Anil Kumar Bhardwaj, Scientist G

Co-Supervisor

Dr Sonali Ghosh, Scientist F



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

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भारतीय वन्यजीव संस्थान
Wildlife Institute of India

CERTIFICATE

This is to certify that Mr Ashish A P has carried out an original piece of research in partial fulfilment of Master's Degree in Wildlife Science of the Saurashtra University, Rajkot. The topic of his dissertation is "Minor Forest Produce collection in four protected areas of Kerala". This study was carried out under our supervision from December 2016 to June 2017. We hereby certify that this work has not been submitted to any degree to any university.

Supervisor

Dr Anil Kumar Bhardwaj, Scientist G

Co-Supervisor

Dr Sonali Ghosh, Scientist F

Date: 11/7/2017

Place: DEHRADUN

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ABSTRACT

1. Minor forest Product are said to have a huge role in rural economy and livelihood of people. Dependence of people on Minor Forest Produces are said to be subjected to forest resource governing system and other socioeconomic as well as ecological factors

The first objective of the study is to assess the household level dependence of people on Minor Forest Produce and socioeconomic factors influencing the dependence and second objective is to assess the minor forest produce tree species abundance in immediate environment of households.

2. Study was carried out in four protected areas of Kerala namely Silent Valley National Park, Neyyar Wildlife Sanctuary, Attapady Reserve Forest and Agastyavanam Bio-Park. In Silent Valley and Attapady intensive study area was limited to single section under the protected area.
3. Household survey was carried out to assess the amount of Minor Forest Produce extraction. About 339 households in Neyyar Wildlife Sanctuary, 45 households in Agastyavanam Biopark, 68 households in Silent Valley National Park and 51 households in Attapady Reserved forest were surveyed for assessing the amount of Minor Forest Produce extraction and socioeconomic conditions. Vegetation sampling for Minor Forest Produce tree species were carried out near the households in Neyyar Wildlife sanctuary and Silent Valley National Park. Eighty vegetation plots of 10 m radius were laid in Attapady Reserved forest as well as in Neyyar Wildlife Sanctuary with forty vegetation plots in each area. Statistical analysis like t-test and Kruskal-Wallis One-Way ANOVA on Ranks were done for comparing the biomass extraction per households. Shannon diversity index and IVI were calculated using Microsoft and Kingsoft spreadsheets.
4. Minor Forest Produce collection amount per households do not show much difference in protected areas from same region with similar resource population such as Neyyar Wildlife sanctuary and Agastyavanam Bio-park (both areas under Agastyamalai Biosphere Reserve); Silent Valley National Park and Attapady Reserve Forest (both areas under Nilagiri Biosphere Reserve). However, protected areas from Nilgiri Biosphere reserve (Silent Valley National Park and Attapady Reserve Forest) had higher average Minor

Forest Produce collection per household per year than those in Agastymalai Biosphere Reserve (Neyyar Wildlife Sanctuary and Agastyavanam Bio-Park). Minor Forest Produce Tree species IVI near households are very low compared to forest away from households. Basic Socioeconomic condition indicators like education level, land holding, family size do not show any correlation with amount of extraction. Dependence on edible Minor Forest Produces are declining in the region and people are finding alternative source of income like cash crops, agriculture etc. People consider that Forest fires are essential for regeneration of productive Minor Forest produces indicating they are depended on Minor forest produces which grow in secondary forest.

CHAPTER ONE: INTRODUCTION

1.1 General Introduction

Forest as a natural resource is a contested resource and the ways in which it is governed at multiple levels have recently been intensively scrutinised (Agrawal et al. 2008, Krott et al. 2012). Effective governance is therefore a central need to improved forest cover and change outcomes. Changing forest governance today is for the most part a move away from centrally administered, top-down, regulatory policies that characterized much of the nineteenth and twentieth centuries.

Before Iron Age itself, human society was much specialised to use varieties of plants and animals for their needs (Gadgil & Guha 1992, Rangarajan and Sivaramakrishnan 2012). The discovery of metal (iron) helped in intensive cultivation of favoured species and cutting of trees (Gadgil & Guha 1992). Even after domestication of crops, a wide variety of wild plant and animal products continued to fulfil various requirements of humans (*ibid*). However, with the increased dependence and exploitation came a need for management of these resources either through the state or community leaders. This dependence on natural resources has been variously termed as Non-Timber Forest Produce, Non-Wood Forest Products, By-products of the forest, Non-Wood Goods and Services, Non-Wood Goods and Benefits, Secondary Forest Products, Other Forest Products, Minor Forest Produce etc.

For the sake of uniformity, the term Minor Forest Produce (or its acronym MFP) has been used in this study to denote the various plant and animal origin materials that grow in the wild and are collected by humans for consumption.

Billions of people around the world are said to meet their livelihood and cash income from gathered plant and animal products (Ticktin 2004). Commercially important MFP species alone are said to be about 4000-6000 in number around the world (*ibid*). In India alone, more than 3000 Minor Forest Produce Species have been reported (Rao and Saxena 1996) which are integral towards the livelihood benefits and culture sustenance of rural people. However, as large forest areas were converted for other land use practices (especially agriculture), pressure built up on Protected Areas that were either State owned or community owned leading to over exploitation and degradation of forest resources (Ehrlich and Ehrlich 1970, Rangarajan and Sivaramakrishnan 2012).

Kautilya's Arthashastra describes that earlier settlements (Jana Padas) separated by remaining forest tracts acted as sources of MFP including fuelwood, edible produces, and hay (Rangarajan and Sivaramakrishnan 2012). Banabatta's "Harshacharita" describes collection of forest produces like cotton from Semal trees, honey, waxes, bark, flax, hemp, forest fruits, water Lilly roots, charcoal for blacksmiths, etc. from Vindhya mountain region with well-stocked forests. Recent pollen studies/palynology studies also support these records from regions such as the Deccan plateau those forests no longer exist (Rangarajan and Sivaramakrishnan 2012). Even then, there existed forest exploitation regulations and sacred forests like KuruJunge, Nimisa, Utpalaranya where the hunting and forest produce exploitations was restricted by state authorities/rulers (Rangarajan and Sivaramakrishnan 2012). In some cases, the Atawikas/Aranycara/Atavi or forest dwellers were given concessions as well, like no tax for forest produce collection etc. (Rangarajan and Sivaramakrishnan 2012). These forest products ranged from plant products to animal products like venison, tortoises, fishes etc. Old literary works like Kalidasa's plays, and ancient traveller writings/paintings/ descriptions etc. gives account of such variety of uses of forest (*ibid*). With the increasing population size, and increased exploitation level beyond the productivity lead to environmental/ecosystem deterioration in the later centuries. Drying up of lakes and rivers like Lunkaransar-Saraswati, reduced water supplies etc. are some among them (Ehrlich and Ehrlich 1970, Rangarajan and Sivaramakrishnan 2012).

India currently has a population of more than 1.2 billion (Census 2011), conservation of India's biodiversity is facing a threat demanding more sustainable management of biodiversity (McKee 2004). The MFP collections have been regulated under various acts and rules (the Indian Forest Act, 1927, and National Forest Policies (1894, 1954 & 1988), National Biodiversity Act, 2002 and Scheduled Tribes and Other Traditional Forest Dwellers Recognition of Forest Rights Act-2006 (FRA), Community-Based Natural Resource Management and Management initiatives). However, there are limited studies about the ecological and socio-economic efficiency of these governance systems (Shahabudin and Prasad 2004, Ketes 2000). Similarly, even though billions of dollars' worth MFPs are extracted by millions of people there is little knowledge on their local, regional, and national economies, ecological aspects.

With this background, this study aims to look at Minor Forest Produce extraction from different forest areas and influence of socioeconomic conditions on Minor Forest Produce collection.

1.2 Review of literature

1.2.1. Studies on Minor Forest Produce

In 1995 during International expert consultation on Non-Timber Forest Products (NWFP/MFP) in Yogyakarta, Indonesia, FAO for the first time gave a unified definition for Non-Timber Forest Produce as " goods of biological origin other than wood, and as well as services derived from Forest and allied land uses". Later in 1999, FAO redefined NWFP/Minor Forest Product (MFP) as "goods of biological origin other than wood obtained from forests and wooded land and trees outside forests"(FAO corporate document Repository). This helped in solving the problem of many names and many definitions given by different people, although comparisons of studies and statistics on MFP still remains difficult.

MFP has been linked with the livelihood of people ever since the time of primitive hunting and gathering mode of life (Worster 1988). In India where about 275 million people are directly dependent on forest resources and about 100 million reside in and around lands classified as public forest (Lynch and Talbott 1995), MFP plays a major role in the livelihood of people with contribution ranging from household subsistence to cash income generation. These products range from necessities like food such as honey, bamboo shoots, wild fruits and vegetables, and wild animal products like bush meat, crabs, shrimps, fishes, etc.; Construction material such as bamboo, rattan, thatch grass, palms etc. Besides this they also provide products like fibres and flosses; dyes and tannins; spices and condiments; ornamental value; oils, gums, resins and most important medicines (Vongvilay Vongkhamsao 2006).

However, how to use MFPs sustainably is a question that needs answer. This is possible, only through biological, geophysical, social and technological researches (Ketes 2000). With more than 3000 MFP recorded in India (Rao and Saxena 1996) there is a felt need for sustainable utilisation of such species.

Dependence of people on Minor Forest Products range from use for basic household subsistence (where people devote their available resources for producing food and

maintaining shelter and security) or to use as a specialised livelihood options to generate cash income. In such a way, they consider the natural resources as a coping/integrated /supplementary/specialised strategy for meeting their various requirements (Quang and Anh 2006). In addition, forest-based activities help to increase rural employment, income and living standards of the rural people. These multiple roles of the biodiversity covering a wide range of environmental conservation and rational utilisation of natural resources are crucial for human welfare and sustainable socioeconomic development. Forests with diverse natural resources directly contribute to the livelihood of 90 percent of the 1.2 billion people in the developing world and within India some 33 to 69 percent of the livelihood needs of Indian tribal population derived from forests under traditional and customary rights (Anitha and Muraleedharan 2002).

1.2.2. Ecological aspects of Minor Forest Produce species and Minor Forest Produce collection

Compared to Timber extraction the exploitation of MFP is considered ecologically less destructive by many (Arnold and Perez 1998; Wollenberg and Ingles 1998). However, one study showed that the entire forest structure could change due to the bark collection of trees that led to associated gap creation in the canopy (Wollenberg and Ingles 1998).

1.2.3. Livelihood value of Minor Forest Produce

At one time, it was believed that MFPs could contribute to life and welfare of people (Wollenberg and Ingles 1998). In many cases, forest dwellers or rural people's income from MFPs can be more than that from the agriculture. Studies by Grenand and Grenand (1996) show that all indigenous systems may not always develop a sustainable harvest practice especially in the case of resource rich areas. The studies among American Indians in Amazon show such results (Wollenberg and Ingles 1998). Sometimes the subsistence extraction of MFP can also be destructive, Falconer's (1998) studies in West Africa shows such results (*ibid*). MFPs are also said to act as an emergency funding source in remote areas (Shackleton and Shackleton 2004, Timko 2010).

1.2.4. Commercial value of Minor Forest Produce

There are many views regarding commercialisation of MFPs. One such view is about achieving conservation by commercialisation. Some studies suggests removal of MFP causes threat to plant species with less density. This is said to be through effects on

dispersal, regeneration, and occurrence of MFP species as well as by effecting composition of forest (Wollenberg and Ingles 1998). With increasing exposure to trade and market, per capita income of MFP collectors is said to increase, and imported goods are substituted for some MFPs and others are exploited primarily for sale (Wollenberg and Ingles 1998). Since, market demand is selective certain species can be exploited leading to decline in its population (Wollenberg and Ingles 1998). MFPs are susceptible to seasonal fluctuations in supply owing to the phenology, climatic condition that inhibit gathering or harvesting, time to grow, perishability, geographically dispersed population (Minot 1986). Internationally about 11 billion US\$ MFP trade is said to happen every year (Perez and Byron 1999). MFPs are mainly marketed in local markets in the raw form where intermediaries procure them for further processing and selling to bigger companies (Shanley et al. 2002).

1.2.5 Special features of Minor Forest Produce and Minor Forest Produce Management and Industry

In case of MFP, social, economic, political powers over the resource are not equally distributed making the management of it difficult (Sellen et al. 1993, Wollenberg and Ingles 1998). MFP enterprise feasibility depends on a) Business planning, b) Enterprise market development) market analysis and development. Historical aspects are said to shape factors effecting people-forest relation (Dargavel et al. 1988, Hanson 1992, Coomes 1995, Potter 1996). Commercial organisation, legal rights, politics, market features, technology, etc. are also said play role in people forest relationship (Dove 1993, Ostrom 1994, Padoch, 1990, Anderson and Loris 1992, Hommer 1992, Panayotu and Ashton 1992, Iqbal 1993; Balee 1989, Perez and Byron 1999).

1.2.6 Legal definitions and associated terms

The Indian Forest Act, 1927, Section 2(4), defines "Forest Produce" as "those products whether found in or brought from forest such as Timber, Charcoal, Caoutchouc, Catechu, Wood oil, resin, natural varnish, bark, lac, manual flowers, Mahua seeds, Kuth and myrobalans. Trees and leaves, flowers and fruits, and all other parts or produce of trees. Plants not being trees (including grass, creepers, reeds, and moss) and all parts and produce of such plants. Wild animals and skins, tusk, horns, bones, silk, cocoons, honey and wax, and all part of such animals. Peat, surface soil, rock and minerals (including limestone, laterite, mineral oils), and all products of mines and quarries. The

FRA act 2006 Section 2(i) defines MFP as “all non-timber forest produce of plant origin and includes bamboo, brushwood, stumps, canes, tusser, cocoon, honey, waxes, lac tendu/kendu leaves, medicinal plants and herbs, roots, tubers and the like.”

In 1995 during International expert consultation on Non-Timber Forest Products (NWFP) in Yogyakarta, Indonesia, FAO for the first time gave a unified definition for Non-Timber Forest Produce as " goods of biological origin other than wood, and as well as services derived from Forest and allied land uses". Later in 1999, FAO redefined NWFP/Minor Forest Product (MFP) as "goods of biological origin other than wood obtained from forests and wooded land and trees outside forests"(FAO corporate document Repository). This helped in solving the problem of many names and many definitions given by different people, although comparisons of studies and statistics on MFP still remains difficult.

Similarly, Sustainable extraction has been defined as "Level of extraction that maintains the plant diversity, allows species regeneration without disturbing forest composition"(Belem 2007)

1.2.7 History of Forest governance and conservation in India

In the Vedic period itself, there were attempts for sustainable resource use of the natural resource (Pathak et al. 2012). During the Chandra Gupta Maurya period, there were rules to conserve forest and there were restrictions on felling of trees like Banyan tree (Appasamy 1993, Bhattacharya 2014). There are hymns in Rigveda speaking about the systematic use of plants, Yajurveda mentions about not killing the plants and animals that are helpful, and about many concepts like totemic plants, forest gods, etc. (Pathak et al. 2012). Totemic plants are another traditional way of conservation (Negi 2010, Pathak et al. 2012). There are traditions like the dedication of forests for forest gods that date back to 200-500(e.g. Kotgyari-forest goddess in Askote; Negi 2010). This prevents any kind of extractions from the area which was a mechanism of traditional sustainable use developed through cultural believes. Unofficially there are over 50,000 sacred groves likely to occur in India. some examples of these include the Gompa Forest areas of lamas in Arunachal Pradesh; "madaico" sacred groves of Dimasa tribe in Assam; matagudi, devgudi, gaondevi, sarana, jahera sacred groves of Bastar-Chattisgarh; devarakadu, nagabana, hulidevarakadu, bhutappanbana, jatakappanabana of Karnataka; cheerumba or cheevara of Dheevera fisher folk, madan kaavu.

yakshikavu, bagavathikaavu, ayyapan kavu, sasthankaavu etc. from Kerala; devrai, derhatti, devgudi of Maharashtra; gamkhap areas of Gangte tribes of Manipur, bamboo reserves of Mizoram; jahera and takuramma of Odisha; devbani of Alwar, Orans of Jaisalmer, Jodhpur, Bikaner in Rajasthan; Kovilkadu, Sthalavrikshas of Tamilnadu; Bugyals and devvans of Uttaranchal, forest areas demarcated for leaf litter/ leaf manure collection "Soppinagudda" in Karnataka and many others that show the omnipresence of such protection across India (Rai 2003).

According to Ghokale et al. (1998) the sacred grove area in India is around 33000ha covering about 0.01 percent of India's land area (Ghokale et al. 1998). Totemic plants are another traditional way of conservation. *Ficus religiosa* as a symbol of Lord Krishna, the 'sacred basil' *Ocimum sanctum* of Lord Rama and many other plants like *Acacia ferruginea*, *Cynodon dactylon*, *Saraca indica*, *Evolvulus alsinoides*, *Ocimum sanctum*, *Aegele marmelos*, *Lucas cephalotus*, etc. are given protection. Many religious restrictions like Jathidharma of tribes like Pardhis to release pregnant and young deer, Bishnois protecting khejri trees are examples of sustainable resource use (Gadgil and Guha 1992).

Later during the rule of kings there were protected forests from where the resource use by people was restricted, these are also examples of conservation methods across historical times (Gadgil and Guha 1992). During the colonial rule, there were attempts to regulate all the rights of people in the forest. In British India, Indian Forest Act was enacted in 1927 (although several Act versions precede this. for example the The Indian Forest Act of 1865 extended the British Colonial claims over forests in India; the 1878 Act truncated the centuries-old traditional use by communities of their forests and secured the colonial governments control over forestry) to consolidate and reserve the areas having forest cover, or significant wildlife, to regulate movement and transit of forest produce, and duty leviable on timber and other forest produce. It also defined the procedure to be followed for declaring an area to be a Reserved Forest, a Protected Forest or a Village Forest. It defined what is a forest offence, what are the acts prohibited inside a Reserved Forest, and penalties leviable on violation of the provisions of the Act. This Act has been interpreted by several authors as a denial of rights of people to the forest (Gadgil and Guha 1992).

Incidentally, denial of rights within forests provoked people across India and there were large number of tribal uprisings that were later manifested as rebellions for India's independence. Tribal resistance like the Koya, Konda Dora tribe rebellion of Gudem and Rampa hills of Andhra in 1879-1880s against MFP use restriction; Protest of Santhal tribes of Midnapur in 1918; Protests in Jaunsar-Bewar region of Tehri-Garhwal in 1915s, Gaddis protest in Himachal Pradesh, Birhor tribe protest in Chota Nagpur Plateau 1893, 920-Midnapur protests, Bastar protests 1910, and the Adilabad protests have been well documented (Gadgil and Guha 1992).

In 1921-1922 protest in Kumaon against regulation on forest, products led the government to setting up of Kumaon Forest Grievance Committee, which identified blocks of the forest where people can extract forest resources. It also divided forest into Class I forest - ruled by civil department with priority for rights of people and Class II forest under forest department with the existed way of management (Gadgil and Guha 1992). Later Indian Forest Act of 1927, National Forest Policy of 1952 gave preference to Industries. Resources like bamboo were allocated to paper mills in throwaway prices of Rs1 per tonne (which had an actual cost of Rs.2000). This led to the eradication of bamboos in once bamboo rich belts as well as the use by traditional users. These all biases lead to the protests like Chipko movement in Alakananda valley of Uttarakhand in 1973, and 1983 Appiko movement in Sirsi taluk of Uttara Kannada district in Karnataka (Guha 2006). In 1982, a committee on Forests and Tribal formed to look into the forest, tribal issues. This led to the consideration of people's rights and its inclusion in the National Forest Policy as formulated in 1988.

Concurrently, this also led to the development of Joint Forest Management (JFM) guidelines in 1990 with the objective of "involvement of people in the protection and management to check the speed of deforestation and to rehabilitate the degraded forests for multiple benefits to the society and local community". The Indian Wildlife (Protection) Act of 1972, Biological Diversity Act 2002 etc. were other milestones in biodiversity conservation for the preservation of biological diversity in India, and the Biodiversity act provided a mechanism for equitable sharing of benefits arising out of traditional biological resources and knowledge. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 was formulated to redress the "historical injustice" committed against forest dwellers and deals with

tenurial rights of forest-dwelling communities to land and other resources, denied to them over decades as a result of the continuance of colonial forest laws in India.

Globally, India is a signatory to the International Convention on Biological Diversity (CBD) (that originated at the Earth Summit held in Rio de Janeiro in 1992). India has commitments for controlling world's ecological issues including the pursual of economic development keeping in mind the three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources. As per Nagoya Protocol on Access and benefit Sharing (ABS), which was entered into force on 12 October 2014 and ratified by India in October 2012, the country, has responsibilities towards achieving the objective of this Protocol i.e. the fair and equitable sharing of benefits arising from the utilization of genetic resources.

1.2.8 Forest governance and Minor Forest Products Global Scenario

In 1960s development theory and practice dominated by industry led approaches and cared least about conservation of forest and forest resources (LaFrankie 1994). This was due to the situation that the demand for food products always grew faster than that for forest produce or agricultural produce (Lafrankie 1994). In this way Forest industry was not considered as a major contributor to poverty alleviation during this period (Westoby 1978).

However, in 1970s importance for wood fuel increased and forestry programmes were developed for rural fuel needs, rural basic needs and food security. First goal was food security, which later give way to livelihood security (LaFrankie 1994). Importance of forest on rural livelihood were more realized and forest outputs like subsistence and cultural importance; providing agricultural inputs like manure, climatic amelioration; commercial inputs like seasonal source of income through MFPS and timber were recognized. Role of forests and reliance of poor on forests was studied during this period (LaFrankie 1994).

It was in 1975 that the first social and community forestry programmes were starting (FAO) (Perez and Byron 1999). Sustainable development concepts came into formation during the 1980s (Perez and Byron 1999). This shift in concepts lead to the development of many projects focusing MFPS in 1980s and 1990s (Ruiz Perez et al. 1993). As a

result, participation of people become necessity for the MFP based development activity success.(Perez and Byron 1999). Later came the period of mutually reinforcing conservation and development concept (Perez and Byron 1999).However, some considered conservation and development could never go hand in hand and referred to the concept as a mirage (Perez and Byron 1999).

Another approach to the problem was market approach. This approach believed in the long-term economic and political goal to provide market to MFPs and make MFP collectors conserve forest for future (Perez and Byron 1999). Another approach was the Political empowerment approach, which gave preference for the economic and political rights (Perez and Byron 1999). Other approaches include conservation and development strategical alliance, balance between Socio-economic development, political rights, and conservation, etc. (Perez and Byron 1999).

Decentralization of forestry policies began in the mid to late 1980s, and had become a prominent feature of forest governance by the mid-1990s. In the 21st century, three important forest governance trends stand out: i) decentralization of management, especially for commercially low-value forests that nonetheless play an important role in the livelihoods of hundreds of millions of rural households in developing countries; ii) the substantial role of logging companies in forest concessions, typically for selective logging in tropical forests; and iii) the growing importance of market-oriented certification efforts, mainly in temperate forests in the developed world. Decentralization, concession, and certification-related trends in forest governance are the result of important social, economic and political drivers (Agrawal et.al. 2008).

Central governments own approximately 86 percent of the 5.4 billion hectares of the world's forests and wooded areas. Private and "other" (mostly communal) forms of ownership constitute just over 10 percent and below 4 percent of global forests, respectively. Official statistics on forest ownership, however, misrepresent the extent of and changes in forest cover. They also misrepresent the nature and changing forms of global forest governance (Agrawal et.al. 2008). Many government-owned forests are managed as common property for multiple uses by local communities and community-based organizations. Civil society organizations and market incentives increasingly play a role in forest governance through certification processes and changing consumer

preferences. At the same time, the growth in the number and size of strict protected areas in the latter half of the 20th century has also meant that approximately 6.4 million Sq. km of publicly owned forests are now under governance regimes that involve stricter restrictions on human use and habitation (Agrawal et.al. 2008).

In India although a majority of forests continue to be owned formally by governments, although it is now clear that the effectiveness of forest governance is increasingly independent of formal ownership. Studies indicate that Joint Forest Management which is loosely based on Community forestry has been described as a decentralized mode of forest governance that only partly lives up to its expectations (Krott et al. 2014).

1.2.9 Global comparison

There are beliefs like laws create insecurity among the local community and due to transaction cost, political issues etc. it is hard to follow rules for the poor (Colchester. 2006). Under these circumstances, in more than 60 countries natural resource management responsibilities were handed over to local governments (Colchester 2006).

86 percent of the world's forests are under the central government control and about 10 percent private and 4 percent other ownerships (Agrawal et al. 2008). By the last half of 20th century, 6.4 Km² areas of public owned forests came under strict protection reducing the human use and habitations. However, in 21st century there was movements towards decentralisation, certification for marketing forest products and Forest concessions by logging companies (Agrawal et al. 2008). Decentralisation forest policy begins in 1980-1990 period as part of recognition of local communities needs for forest resources and their role in management. Whereas forest certification came in the 1990s with an objective of sustainable forest management (Agrawal et al. 2010). There are some studies suggesting that centralised governance is costlier than local governance. However, programmes like REDD+ with the approach of mitigating emissions associated with climate change Reducing Emissions from Deforestation and Forest Degradation are movements for decentralising the governance (Phelps et al. 2010). There have been many studies dealing with the need for Terms of Trade like Improved international and rural-urban terms of trade enabling poor people to meet their demands sustainably; Equitable redistribution of resources, stable governance, stable rights and information; Professional change, infrastructure development, etc. as solutions to sustainable forest management (Agrawal et al. 2010). The belief that rural

populations with more density cause more many have tested degradation of resources studies and showed that the sustainable livelihood is possible only below and above some threshold of density. This skewed pattern in above threshold density said to be an artefact of less dependence of people on natural resources, and out migrations for jobs in highly populated areas. To add to this fact studies in Nepal (Carter and Gilmour 1989) found that tree cover increases with population density rather than decreasing (Agarwal et al. 2010). Also, the hypothesis like poor rural people lead simple lives and need simple solutions are proven to be wrong and they are said to seek diverse sources of subsistence and income by extracting more species, cattle rearing, agriculture, etc. (Agarwal et al. 2010). Simplicity said to be a luxury that rural poor cannot afford and said to have led to Local-Complex-Diverse-Dynamic-Uncontrolled (LCDDU) situation; opposite of universal, simple, uniform, controlled situations (Agarwal et al. 2010). According to World Conservation Monitoring Centre, only 30 percent of original forest cover is remaining in the world (Chambers 1994). In such a situation, moving from conservation to community forest management needs more scrutiny. At the same time, Indigenous traditional knowledge about plants said to disappear due to modern technology and changes in traditional culture (Renuga and Bai 2013).

A study in the pastures spreading across Russia, Mongolia, and China showed that indigenous Resource Extraction Management Mechanisms by pastoralists in Mongolia are capable of conserving the pastures than state-owned pasture use systems in China and Russia (Ostrom et al. 1999). In China where the government divided the pastures and individually allocated for each herding household, the degradation was about one-third of the pasture. Whereas in Mongolia where traditional group property practice was continued with seasonal movement of people across the pastures, degradation was only in about one tenth of the area (Ostrom et al. 1999).

Common Pool Resource is a term used for describing resource systems regardless of the property rights involved. CPR management said to affected by size, regeneration rate and mobility of the resource; harvesting technology; temporal and spatial availability of resources; etc. Solving CPR management problems are said to be possible through two ways either by restricting access or by incentives for users to invest in the resource. Users of CPR said to be of four kinds 1) free riders who selfishly exploit resources 2) who will not selfishly exploit if and only if no others do selfish

exploitation 3) those who are ready to initiate sustainable use/reciprocal cooperation 4) true sustainable users/reciprocal cooperative users. Users understanding of the resource is limited if the resources are large (Ostrom et al. 1999). Review of 70 NTFP harvest ecological implication studies reveal that tolerance of MFPs to extraction varies with life history characters of the species. Damage to the plant during harvest may be more impacting than the harvesting of plant parts (Varquez and Gentry 1989, Sinha and Bawa 2002). There are very few studies on liana and vine MFP species, high susceptibility of understorey palms to leaf extraction, importance of factors like seasonal timing of harvest, harvest time with respect to the life cycle of the plant, size of the individual harvested, frequency of harvest. Some studies shows the impact of MFP collection on the bird population of the area. Studies on impact of Competition between MFP collectors and primates are less studied aspects.

Studies by Grimes et al in Ecuador show that annual removal of about 1-4m strip of bark with 1/8th of the perimeter will not result in mortality and comments that MFP gives more income than other income sources in the area so promoted for forest development. If managed sustainably tropical forests can sustain the economy (Grimes et al. 1994). There are mainly five socioeconomic factors effecting level of dependency of people on MFPs, those are 1) Location 2) Gender 3) wealth status 4) education 5) seasonality (Timko et al. 2010). Studies suggest that income from MFPs make more contribution to the income of poor households (Sander and Zeller 2007, Timko 2010) and women are said to be more involved in MFP gathering (Shackleton and Shackleton 2004).

Table 1 : Minor Forest Products in different countries

| Countries | People's dependence on Minor Forest Produce. |
|-----------|--|
| Malawi | 30% of people's income from MFP (Timko et al. 2010). |
| Tanzania | More than 50% of people's income from MFP (Timko et al. 2010). |

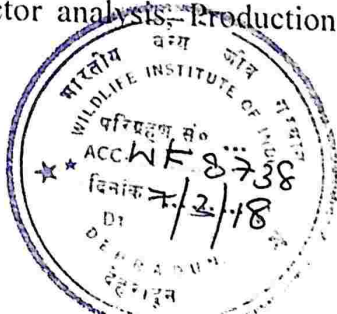
| | |
|-----------|---|
| Zimbabwe | 36.9 % of total income from MFP (Timko et al.2010). |
| Guinea | 25-30% of people's income from MFP (Timko et al. 2010). 448-ton trade in Colanut - a MFP in 1992 alone. |
| Cameroon | Bagyali people 90% of cash income from MFPs Bantu farmers 20 % of cash income (Timko et al. 2010). Pygmy tribes numbering about 1 lakh depend on trade and barter of MFPs. 6 lakh people dependent on farming. Timber industry 10 percent of Nation's GDP. |
| Germany | 93-98% of the 1543 medicinal plants extracted in Germany are harvested from wild population (Ticktin 2004) and contribute to the income of rural people. |
| India | 90 % of 400 medicinal plants extracted in India comes from wild population" (Ticktin 2004) and contribute to the income of rural people. |
| Ecuador | Out of 185-245 tree species seen in 1 ha forest, 13 are commercially important MFP species. (Quijos Quichua tribe-JatunSacha Biological station Perez and Byron 1999) |
| Sri Lanka | MFP contribute to 5.3 % of the income and forest based activity contribute about 63 % of the total income and 59 % of the cash income in Knuckles National Wilderness Area (Perez and Byron 1999). |
| Brazil | 1.5 billion in Brazilian Amazon derive part of their income from MFPs (Perez and Byron 1999) .Mainly Capimenses tribes, Caboclo community, Copim community. |
| China | 7 lakh people work in bamboo industry (Perez and Byron 1999). |

| | |
|------------|---|
| Costa Rica | <p>About 63 plant species of ethnobotanical importance to the Guyami tribe.</p> <p>54 wild edibles of total 63 species (Tardio et al 2008).</p> <p>63 plant species used by Guyami tribes (Castaneda and Stepp 2007)</p> <p>Other Indigenous groups like Cabecar, Bribri.</p> |
| Bolivia | <p>1.4 million People in rural area dependent on forests.</p> <p>1, 80000 people claim 224 million Ha of forestland, which is about 42 % of country's forest (Colchester 2006).</p> <p>30000 farmers engaged in MFP collection (Colchester 2006).</p> |
| Indonesia | <p>70 percent of the National Territory occupied by 40 to 95 million people who collect and extract Minor Forest Produce (Colchester 2006).</p> |
| Canada | <p>300 out of the 2000 communities heavily depended on Forest Produces (Colchester 2006).</p> |

It is important to note that in most tropical countries, forest laws have been modified or reviewed in last 12 years indicating the changing paradigms in this sector (Colchester 2006).

1.2.10 Methods used to analyse Minor Forest Product studies

Studies related to MFPs include (Wollenberg and Ingles 1998) production to consumption level studies; Finance, business, and MFP enterprise development studies including profitability analysis, enterprise feasibility, market analysis, and non-forest based income and social impact assessment etc. Ecological impact assessment of MFP collection, Ecological sustainability analysis of MFP collection, Biodiversity studies related to MFPs, etc. Studies on short term and long term effect of MFP collection, forest use and management. Participatory mapping was used in NTFP related surveys by Fox (1995), Carter (1996), Stockdale and Ambrose (1996) etc. (Wollenberg and Ingles 1998). Belcher (Wollenberg and Ingles 1998) has adopted market Chain Analysis, subsector analysis, Production to Consumption (PCS) approaches etc. in



studies like Rattan and bamboo studies in Asia. PCS is a three dimensional approach considering the production to consumption dimension, different firms operating at each point, intensity of labour and capital at each point. Sub Sector analysis (SSA) is developed by Agricultural economists of Michigan State University to study markets of agricultural products (Wollenberg and Ingles 1998). By manipulating the environment of the desired plant (by selection/breeding/genetic engineering), it is possible to increase production per area. For some MFPs, intensifying the production by plantations or cultivation is preferred due to the rarity or dispersed population (Wollenberg and Ingles 1998). Use value, exchange value, existence value, option value, etc. used for valuation of MFPs (Chopra 1993).

1.2.11 Medicinal Plant and Minor Forest Product extraction in India and Kerala

At present, the annual demand for the botanical raw drug in India is about 3,19,500 MT (as per the year 2005-06 period) which amount to 1069 crore Rupee per annum (Ved and Goraya 2007). There are about 960 medicinal plant species traded extensively including 178 species traded in quantities more than 100MT per year (Ved and Goraya 2007). Out of this 178 species, 21(12%) species are obtained from the temperate forest, 70(40%) species obtained from tropical forests, and 36 (20%) species from cultivation/plantations, 46 (25%) species obtained from roadsides and degraded land. Remaining five (3%) species are imported (Ved and Goraya 2007). About 62 percent is met from forests and 25 percent of fallow lands (together 87 percent of the total extraction) indicating the lack of cultivation and pressure on the wild population of plants.

Kerala with about 4600 flowering plant species is one of the biodiversity rich states in India and a part of the global biodiversity hotspot - Western Ghats (Kerala Forest Department-website). In addition, it is the second prominent manufacturer of traditional medicines in India after Uttar Pradesh with about 986 Ayurveda medicine-manufacturing units (Harilal 2009). As of 2005, about 60 to 65% of plants required for Ayurvedic medicines and 80% plants required for Siddha medicine found in Forests of Kerala (Kerala Forest Department-website). In addition, the traditional medicine practitioners are also dependent on forest for botanical raw materials. But many of these species collected from forest come under the 589 Rare, Endangered and Threatened

plants(RET) reported from forests of Kerala by KFRI (Kerala Forest Research Institute 2014).

There are only few studies looking at the ecological sustainability of extraction of Minor/Non-Timber Forest Produce including medicinal plants in India (Shahabuddin and Prasad 2014). Studies about the extent which plant adversely affects populations by harvesting depending upon the natural history of species, parts extracted, and harvesting technique etc. are a need for assessing ecological sustainability. Some of the studies show that the Non-Timber Forest Product (NTFP) species have lower regeneration in heavily extracted place compared to lower harvesting pressure areas (Rai 2003; Shahabudin and Prasad 2004). In traditional societies the use of forest resources is regulated through local customs . A study by Hegde et al about Soliga tribes of BRT hills showed that income from MFPs are high in comparison to the time spend for collection (Hegde et al. 1996), even though it is not the preferred vocation (Hegde et al. 1996).

Even though there are many studies on Minor Forest Produces and their governance, due to their site specificity and diversity more site specific, ecological, economical and governance studies are needed to address ecological and socioeconomic sustainability.

1.3 Study Objectives

- I. Assessing the abundance of Minor Forest Product species near households in protected areas**

- II. Assessing the present level of Minor Forest Product extraction in protected areas of Kerala and socioeconomic conditions influencing the collection.**

Following research hypothesis were framed to empirically ascertain the response to the study objective

- 1) Minor Forest Produce tree species abundance near the settlement areas are similar to interior forest areas
- 2) Minor Forest Produce extraction per households follows a similar pattern in all protected areas under the study
- 3) socioeconomic conditions like education, family size, land holdings, number of livelihoods are effecting Minor Forest Collection pattern

CHAPTER TWO: STUDY AREA

The study was carried out in two geographically separated locations namely Valley National park, Attapady Reserved Forest in Northern Kerala and Agastyavanam Bio Park and Neyyar Wildlife Sanctuary under in Southern Kerala. These locations were chosen because they reflected different forest governance regimes which were as follows:

Table 2 : Governance types in study sites

| SL No | Location | Governance types |
|-------|---|---|
| 1&2 | Agastyavanam Bio park and Neyyar Wildlife Sanctuary | MFP extraction governance: Under EDC |
| | | MFP Collectors/shops: Private |
| | | User group: Private |
| | | Scientific Institution: JNTBGRI |
| | | Area Protection status: Wildlife Sanctuary+Semi territorial Area(ABP) |
| 3 | Attapady Reserved Forest | MFP extraction governance:Under VSS |
| | | MFP Collectors/shops: Tribal Cooperative Society(Kurumba) |
| | | User group: Private and Public |
| | | Area Protection status: Territorial division |
| 4 | | MFP extraction governance: Under EDC (3 EDCS) |

| | | |
|--|--------------------------------|--|
| | Silent Valley National Park | MFPCollectors/shops: Kurumba Cooperative Society |
| | | User group: Private |
| | | Scientific Institution: FRLHT |
| | | Area Protection status: National Park |

Figure 1: SITE 1 Silent Valley National Park and Attapady Reserve Forest

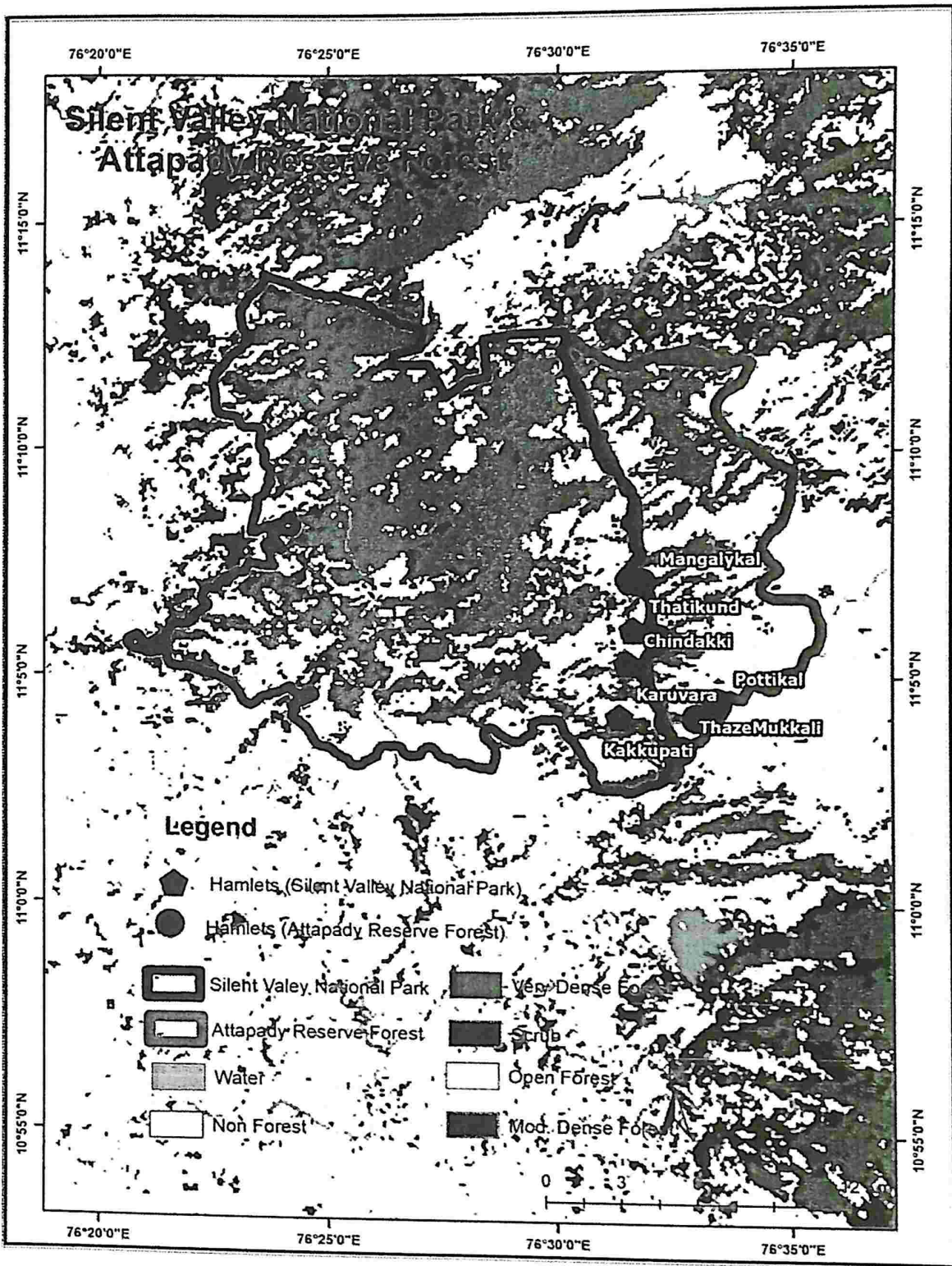
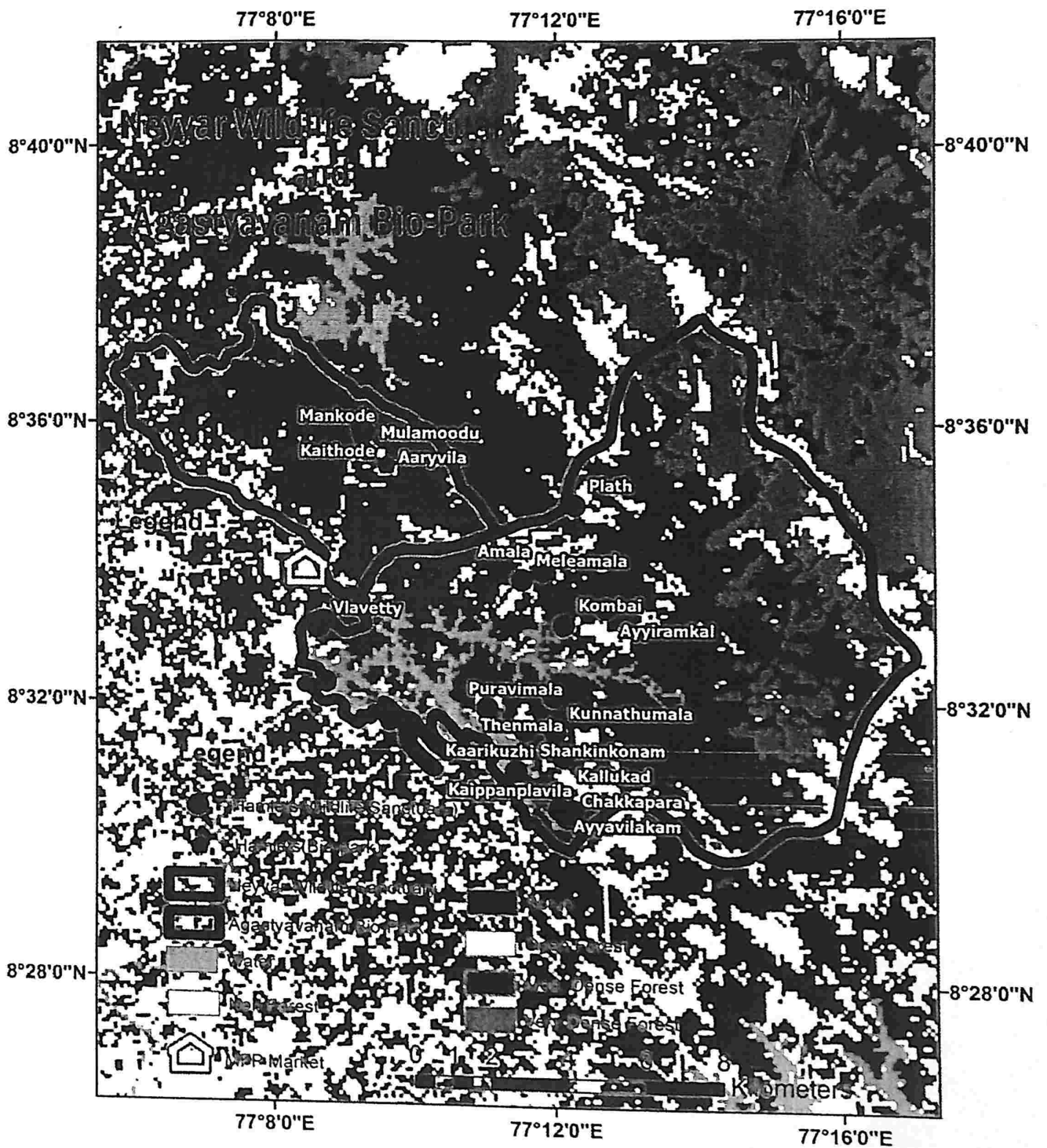


Figure 2-SITE 2: Neyyar Wildlife Sanctuary and Agastyanam Bio Park (Both are under Thiruvananthapuram Wildlife Division but governance status of Agastyanam Bio Park is intermediate between Territorial Reserves and Wildlife Reserves)



2.1 Site one: Silent Valley NP and Attapady RF

Silent Valley National Park is situated in the Palakkad district of Kerala state between latitude 11° 2' and 11° 14'N and longitude 76° 20' and 76° 32'E. Silent Valley was declared as a National Park in 1984 and made a part of the Nilgiri Biosphere Reserve during 1986 (Kerala Forest Department 2017). The total geographical area of Silent valley national park is distributed as 89.52 Km² under core zone and 176.88 Km² buffer zone (Kerala Forest Department 2017). It represents various vegetation types such as wet evergreen, shola, semi-evergreen, moist deciduous, dry deciduous, savannah, scrub and grasslands as per Champion and Seth (1968) classification (Manilal 1988). The forests of Silent Valley are characterised by high degree of endemism, as well as floral and faunal diversity. Several new taxa of flora and fauna described from the Silent Valley (Manilal 1988).

About 966 species of angiosperms belonging to 559 genera and 134 families reported from Silent Valley (Manilal 1988). About 80 species are having specialised habitats like Upland region and about 70 species are restricted to the riparian region and about 170 species are restricted to slopes (Manilal 1988). The traditional medicine practitioners of Silent Valley area including those from five villages Agali, Kottathara, Mannarkad, Padavayal, and Sholayur are said to be using about 102 ethno medicinal plants belonging to 53 families and 95 genera (Yabesh et al. 2014). The medicinal plant collection in Silent Valley mainly done by tribal EDCs (Eco Development Committees). These EDC are promoting more sustainable collection practices and have better infrastructure for value addition and scientific processing, and more organised market linkage (Anon 2015).

In Silent Valley, the main governance system to regulate Minor Forest Product extraction is through devolution of governance and the formation of Eco-development committees (EDC). EDCs have been taking actions for sustainable collection, warehousing, marketing of selected RET and highly traded plant species (Anon 2015).

Attapady RF under Mannarkad Forest Division

The area under Mannarkkad Division contains three Ranges namely Mannarkad, Attappady, and Agali. The present Mannarkad Forest Division came into being as per

GO (MS) 121/89 dated 28. 12. 1989 with effect from 01. 04. 1990. The total area of the Division is 539.08 Km² and an area of 107.09 Squ. Km was handed over to the Buffer zone of Silent Valley National Park and a new Range formed in Silent Valley called Bhavani Range. An area of 7.15 Km² is vested in this Division as Ecologically Fragile Land (Kerala Forest Department, 2017). The site was chosen due to its proximity to the Protected Area (Silent Valley) which was under a different governance regime.

Attapady is one among the two eastward sloping plateaus in Western Ghats of Kerala, and is located on South Western Side of Nilgiris (Muraleedharan et al. 1991) Located in the Northeastern part of Palakkad District and covering an area about 745 Km², Attapadi consist of three Panchayats namely Agali, Sholayar and Pudur (Annamalai 2006). Located between high Nilgiri Hills on the North and Vellingiri Ranges in the South (both are of about 1200 m average elevation) the average elevation of Attapady is 550 mts. The highest point in the plateau is the Malleswaran peak with a height of 1664m. Attapadi have an undulating terrain with majority of the area having more than 35 % slope. Plateau shows climatic variation due to its geography. Eastern margins laying in the rain shadow area of Western Ghats receive less than 1000mm rainfall and Western region of the plateau receive more than 3000 mm rainfall. Vegetation changes from Evergreen to dry deciduous forest across the rainfall gradient as follows:

West Coast tropical evergreen forests -Siruvani, Varadimala, Muthikulam

Southern Moist Mixed deciduous forests -Petical, Oorandam, Kuruvampady

Southern Tropical Dry Deciduous forests - Marappalam, Nattakkalchundapetty, Pattanakal

However, improper management of natural resources and different land use patterns has led to desertification and land degradation in the area during last half of 20th century (Vishnudas et al. 2012). Some of these factors are forest encroachment and exploitation, unsustainable cropping systems, excessive grazing, etc. that has led to disappearance of streams, soil erosion in the area, also leading to malnutrition and health hazard in the local tribes (Vishnudas et al. 2012).

The major rivers in the area include Bhavani, Shiruvani, Kunthi Puzha, Kodangarpallam, Varagar (Sujith et al. 2014). The area has two major river basins

Bhavani and Bharathpuzha with Bhavani basin having four sub basin and Bhartapuzha having one to two sub basins (Vishnudas et al. 2012) About 60% of the area is under forest, 21 percent under wasteland and 17 percent under agriculture (Vishnudas et al. 2008).

As per 2011 census, there are about 180 tribal hamlets in Attapadi with a population of 30,658 scheduled tribes. Kurumba, Irula, Muduga are the main tribes in the region with 90 percent of the tribal population living below poverty line (Sujith et al. 2014). In general, Kurumbas are said to occupy high rainfall area, Mudugas in medium rainfall areas and Irulas in low rainfall areas (Muraleedharan et al. 1991). Within tribes, Irulas (84%) are the majority. Muduga (10%) and Kurmbas (6%) are the minority (Muraleedharan et al. 1991) (Annamalai 2006). Major part of the Attapady was under the ownership of Zamorins of the Kozhikode until 1963 Land Ceiling Act came in to existence. Land reform legislation act, Vesting, and Assignment Act of 1971 lead to the transfer of ownership from Zamorin to Government.

In 1951, the population of tribal in the area was 10,200 forming 90.26 percent of the population. The new settlers were only 1,100 or 9.74 percentage (Sujith et al. 2014). But by 2011 settler population increased to 67,672 forming 66% of Attapadi's population and tribal population is only 34 percent (GOI Census 2011, Sujith et al. 2014). The reason for this is said to be the mass migration of people to the area from other parts of Kerala and Tamilnadu. Tribal people who gave land to this people in 1960s were not able to take back the land after end of lease period due to lack of ownership evidences (Vishnudas 2012). This led to the tribal land alienation and degradation of natural resources by over exploitation from new settlers (Vishnudas 2012). Under different government development schemes about INR43.77Crore was the spending in the area since 1987 but a majority of the population is still below poverty line (Vishnudas 2012). Studies suggest ecologically and economically sustainable Technological options using local materials, indigenous technologies and local labour for income generation will be able (Vishnudas et al. 2008) solve the problem of environmental degradation through addressing the socioeconomic problems of the area. Studies say that this assured only through wealthy people of the downstream paying the tribes living up stream for their environmental friendly lifestyles (Vishnudas 2012).

2.2. Site two : Agastyvanam Bio park and Neyyar Wildlife Sanctuary

Many Protected Areas in Western Ghats are said to be type localities of many rare plants. Agastyamalai range under Agastymalai region is such an area with more than 150 taxa exclusively confined to its parts in Thirunelveli in Tamil Nadu and Thiruvananthapuram in Kerala (Varghese and Balasubramanyan 1999). Due to its species richness and endemism, Agastyamalai is also one among the 26 endemic centres identified in India by Nayar (1996) (Varghese and Balasubramanyan 1999). It is also one among the five priority sites recognized internationally as not only rich but priority sites for data sheet treatment (WCMC-1992) (Varghese and Balasubramanyan 1999).

The region is home to the Kani tribal who are indigenous tribe in the area. With a total area of 23 Km² Agastyavanam Bio-Park is contiguous with Peppara Wildlife Sanctuary in the North East side and Neyyar in the south-west. This area comes under Agasthyavanam Biological Park formed after the recommendations of scientific committee constituted by Kerala government in 1992 to establish a biological park in the degraded forests of Kottur. Kottur Reserved Forest lies in the Western Slopes of Western Ghats and at the south-east corner of Nedumangad taluk (Kerala Forest Department - website). The indigenous tribe Kani have a population size of about 16,181 (as per 1991 census records) which is approximately 1.8 percent of the total population of the Thiruvananthapuram district. The Kanis are traditionally a nomadic community. The traditional occupation of the Kanis, which they continue to follow to some extent, includes handicrafts such as basket making, mat making and cane works. They are also engaged in the seasonal collection of minor forest produce such as honey and bee wax.

Neyyar Wildlife Sanctuary

Neyyar was declared as a Wildlife Sanctuary in 1958 and has an area of about 128 Sq. Km. Neyyar dam on its western boundary has an area of about 8.45 Sq. Km. It shares boundary with Peppara Wildlife sanctuary and Agastyvanam Bio park on the North and Kalakkad Mundanthurai Tiger reserve on the east and Kanyakumari district of Tamil Nadu in the South. As in Agastyavanam Bio-Park Kani tribes are present in this sanctuary area.

CHAPTER THREE: METHODS

A) Ecological survey:

Four 1 Km transects were laid near households in Neyyar Wildlife Sanctuary as well as in Attapady Reserve Forest for assessing the Minor Forest Produce Tree species abundance. Each transect consisted of ten vegetation sampling plots of 10 m radius. Individual trees of all species in this vegetation plots were counted and their girths were measured at breast height.

Transects near Aannirathi, Vettinirthankon, Marakkunnam Deerpark, Theerthankara path were used for vegetation sampling in Neyyar.

Transects at different distance from Bhavani river were used for vegetation sampling in Silent Valley, these included Mukkali to Chindakki transect along the plantation, Transect along Bhavani river near Pottikal plantation, Pottikal plantation to Chindakki ooru along southern bank of Bhavani river, Chindakki to Mangalaykal ooru transect along southern side.

Analytical Methods:

Importance Value Index or IVI of trees were calculated for each area based on all the 4 vegetation plots from 4 transects in that area.

$$\text{Relative Density (RDe)} = \frac{\text{No of Individuals of the species X 100}}{\text{Total No of all species}}$$

$$\text{Relative Dominance (RDo)} = \frac{\text{Basal area of the species X 100}}{\text{Total basal area of all species}}$$

$$\text{Relative Frequency (RF)} = \frac{\text{No of Plots where species present X 100}}{\text{Sum of frequency of all plants}}$$

Species Importance Value Index = Relative Frequency+Relative Dominance+
Relative density

IVI calculations were done using Microsoft Excel and Kingsoft Spreadsheets, and by using the equations for RDe, RDo, RF and IVI. Shannon diversity index was calculated using Microsoft excel spreadsheets.

B) MFP Extraction data

Household survey was carried out to assess the amount of Minor Forest Products extracted by different households in the protected area. Questionnaire with open ended and closed ended question were used for survey (questionnaire is given in appendix). Minor Forest Product market survey was also carried along with household survey(survey format given in Appendix).

Household survey was carried out from January 1st to January 25th in Agastyavanam Bio-park and Neyyar wildlife Sanctuary area. This survey covered about 22 EDCs including 17 tribal settlements and houses along the sanctuary boundary in Neyyar Wildlife Sanctuary. About two EDCs and 6 tribal settlements in Agastyavanm Bio-park were also covered. A total of about 373 households surveyed from Agastyvanam, and Neyyar during January 1 to January 25.

Household survey in Attapady Reserved Forest was carried out during 17th March to April 7. Thazemukkali, Pottikkal, Mangalaykal, Kakkupati were the four settlements covered under the household survey.

From February 28 to March 17 Social survey was carried out in three settlements in Bhavani Range of Silent Valley National Park. Karuvara, Thatikund, Chindakki were the three settlements covered under the social survey in Silent Valley.

Statistical Tools and techniques

For comparing biomass extraction, data non-parametrical tests like t test and non-parametric ANOVA were used for comparison of sites. Since data was not normal in parametric tests only t tests was used.

For analysis of household survey data, correlation analysis of MFP biomass extraction was done with variables like family size, land holding, education level etc. using non-parametric Spearman Rank Correlation coefficient.

CHAPTER FOUR: RESULTS

4.1 Results on Objective One

- 1) To assess and compare the status and population structure of MFP tree species under different governance systems.

Table 3: IVI of MFP plants Neyyar Wildlife Sanctuary (Detailed list in Appendix II)

| SI No | Species | IVI |
|-------|---|-----|
| 1 | <i>Phyllanthus emblica</i> <i>EUPHORBLACEAE</i> | 5.1 |
| 2 | <i>Vateria indica</i> <i>DIPTEROCARPACEAE</i> | 2.9 |
| 3 | <i>Elaeocarpus serratus</i> <i>ELAEOCARPACEAE</i> | 4.5 |
| 4 | <i>Cinnamomum</i> <i>species</i> <i>LAURACEAE</i> | 1.5 |
| 5 | <i>Cycas spp</i> | 1.6 |

Table 4: IVI of MFP plants in Attapady Reserved Forest (Detailed list in Appendix III)

| Sl No | Species | IVI |
|-------|---|------|
| 1 | <i>Mangifera indica</i> ANCARDIACEAE | 7.5 |
| 2 | <i>Phyllanthus emblica</i> EUPHORBIACEAE | |
| 3 | <i>Terminalia bellerica</i> COMBRETACEAE | 5.0 |
| 4 | <i>Wrightia tinctoria</i> APOCYNACEAE | 7.1 |
| 5 | <i>Syzygium spp</i> MYRTACEAE | 10.7 |

As per earlier studies (Singh et. al, 1983) in Silent Valley forest the dominant species in general vegetation and their IVI are

Tree diversity and diversity indices in Neyyar and Attapady Region Based on the vegetation sampling

Table 5: Diversity indices for Attapady Reserved Forest

| Biodiversity indices | Site 1 | Site 2 |
|---------------------------|--------|--------|
| No of species | 39.00 | 45.00 |
| Individuals | 184.00 | 269.00 |
| Shannon Diversity Index H | 3.13 | 3.49 |

4.2 Results for Objective two

To assess the amount of extraction per household under different Protected areas

4.2.1. Biomass collection comparison between sites

Figure 3: MFP Biomass Extraction (Kgs) under different protected areas

(Mean and Standard Error Plot)

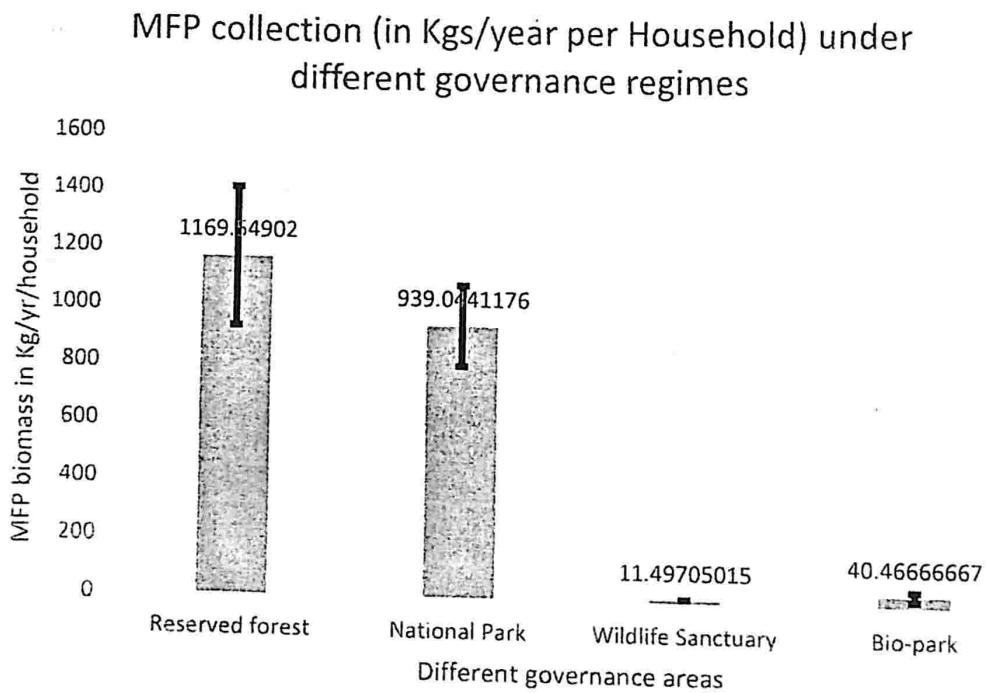


Table 6: MFP collection (in Kgs/year per Household) under different protected areas.

| Descriptive Statistics | Reserved forest | National Park | Wildlife Sanctuary | Bio Park |
|-------------------------|-----------------|---------------|--------------------|----------|
| Mean | 1169.5 | 939.0 | 11.5 | 40.5 |
| Standard Deviation | 1720.1 | 1154.3 | 40.9 | 109.4 |
| Maximum | 5035.0 | 3285.0 | 405.0 | 690.0 |
| Sum | 59647.0 | 63855.0 | 3897.50 | 1821.0 |
| Count | 51.0 | 68.0 | 339.0 | 45.0 |
| Confidence Level(95.0%) | 483.8 | 279.4 | 4.4 | 32.9 |

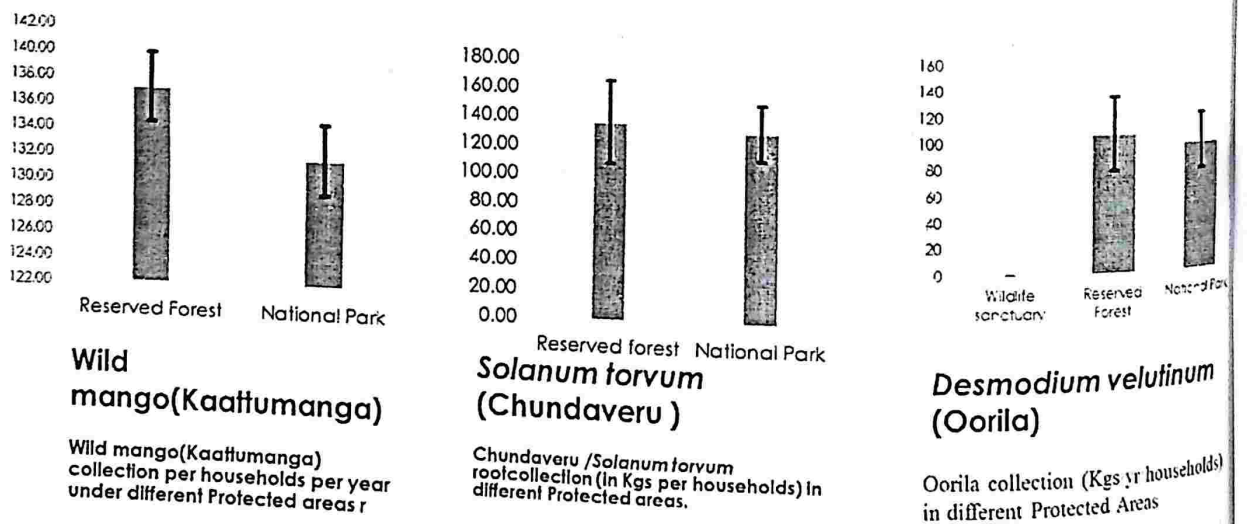
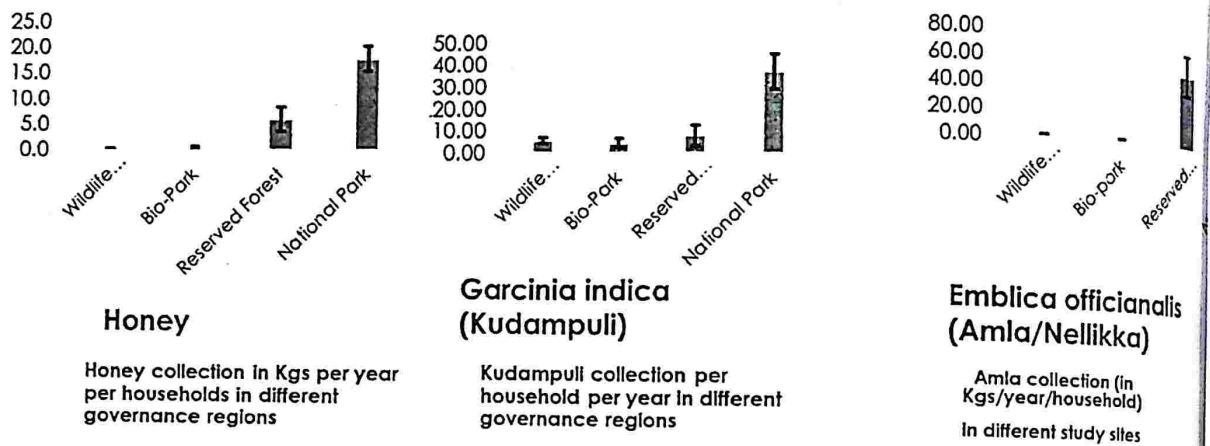
Aspin Welch unequal variance test between Minor Forest Produce collections by households in Silent Valley National Park and Attapady Reserve Forest shows that there is no difference in collection (T-Value=0.8274, Power (Alpha=.05) 0.129432, Probability level=0.410388).

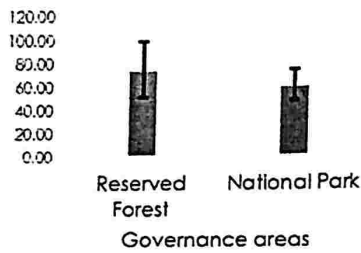
Aspin-Welch Unequal-Variance Test Section between Minor Forest Produce collections by households in Neyyar Wildlife sanctuary and Agastyavanam Bio-park also showed no significant difference in collection amount by households(T value= 1.7606, P value= 0.085007).

As per Kruskal-Wallis One-Way ANOVA on Ranks the medians of MFP collection from household in different areas are not equal (Chi value=79.378, p value=0.000) indicating difference in medians for at least two groups.

4.2.2 . An assessment of collection of select MFP from the Study sites.

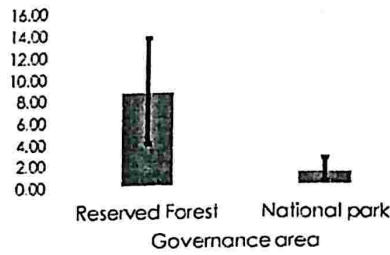
Figure 4: Comparison of Collection of 15 MFPs In Study Sites





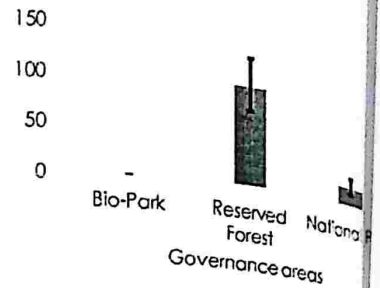
Balanophora indica (Nilabomb)

Nilabomb collection per households (in Kgs/households) in different governance regimes



Zingiber zerumbet (Kaatinchi)

Kaatinchi collection per household under different governance regimes (In Kgs/year)



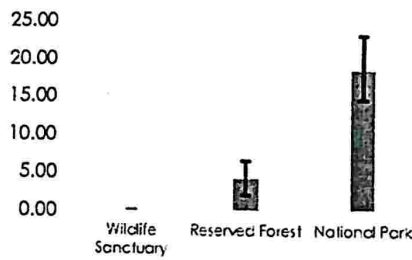
Hemidesmas indicus (Naruneendi)

Naruneendi collection per households in different governance regimes (In Kgs/year)



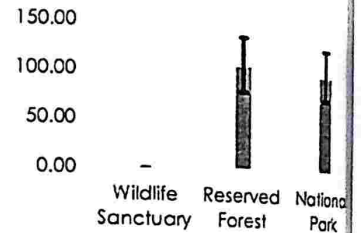
Acacia concinna (Cheenikka)

Cheenikka/Acacia concinna collection in Kgs per household per year in different governance regimes



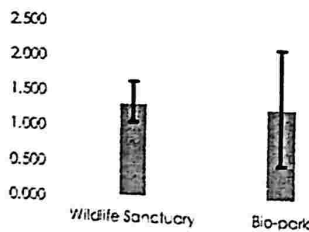
Canarium strictum (Kunthirikkam/Black dammar)

Kunthirikkam (Black dammar) collection in Kgs/year per household in different governance regions



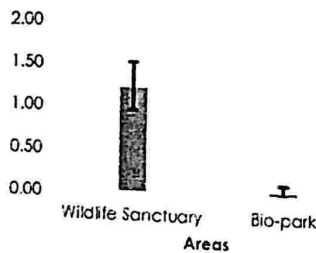
Psudarthria viscida (Moovila)

Moovila collection in Kgs per household per year in Different governance regimes



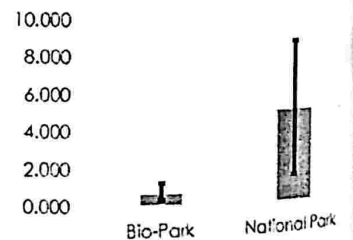
Cinnamomum (Vayanapoo)

Vayanapoo(Cinnamomum) collection per household (In Kgs per year in different governance regions)



Myristica seed aril (Panampoo)

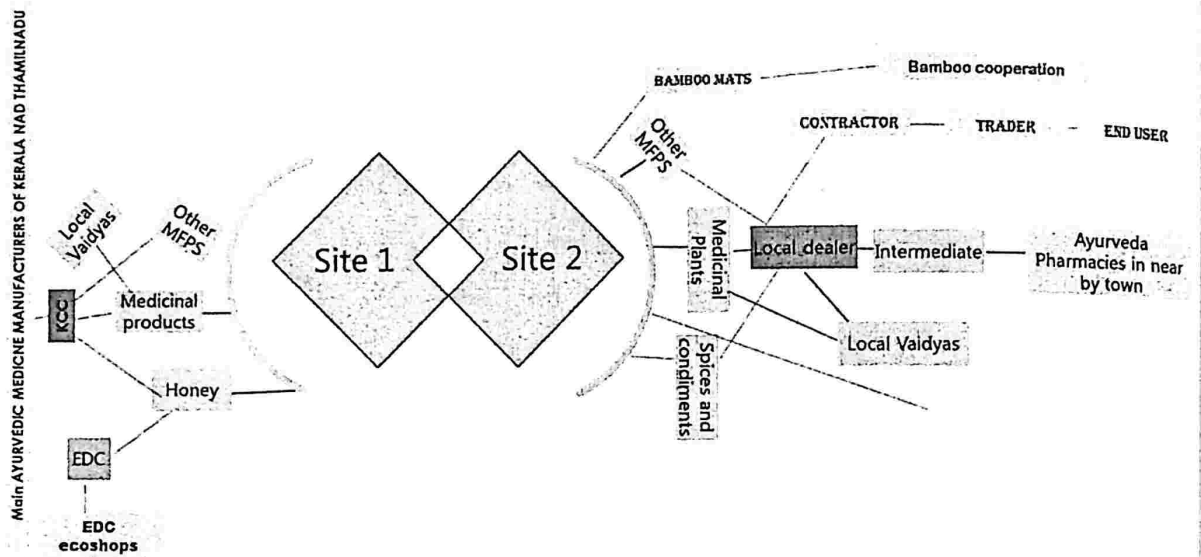
Panampoo/Myristica seed aril collection (In Kgs/year/household) under different governance areas



Asparagus racemosus (Shathavari)

Shathavari collection per households under different governance regimes (In Kgs/year)

Figure 4: Market chain for Minor Forest Produce in Site 1 and site 2



4.2.3. Assessment of socioeconomic conditions driving the MFP dependence.

CORRELATION BETWEEN FAMILY SIZE AND COLLECTION

Correlation analysis between family size and Minor Forest Produce extraction showed no correlation in all areas (p values-0.2475, 0.7583, 0.766, 0.9807).

Table 7:Correlation between family size and collection

| Study area | correlation | Spearman rank correlation rho | P value | S |
|-----------------------------|-------------|-------------------------------|---------|--------|
| Silent Valley National Park | 0.2133617 | 0.1824462 | 0.2475 | 10089 |
| Agastyavanam Bio-Park | 0.1539885 | 0.07545365 | 0.766 | 895.89 |
| Neyyar Wildlife Sanctuary | -0.03726593 | 0.003212911 | 0.9807 | 34110 |

CORRELATION BETWEEN LAND HOLDING AND BIOMASS EXTRACTION

Correlation analysis between land holding and Minor Forest Produce extraction showed no correlation in all areas (p values-0.7274, 0.2675).

Table 8: Correlation between land holding and biomass extraction

| Study area | correlation | Spearman rank correlation rho | P value | S |
|---------------------------|-------------|-------------------------------|---------|--------|
| Agastyavanam Bio-Park | -0.09035742 | -0.102454 | 0.7274 | 501.62 |
| Neyyar Wildlife Sanctuary | 0.329842 | 0.2054516 | 0.2675 | 3941 |

CORRELATION BETWEEN ADULT EDUCATION LEVEL AND BIOMASS EXTRACTION

In Neyyar Wildlife Sanctuary and Attapady Reserved Forest there is negative correlation (p values=0.007021, 0.03843) except there no other sites showed any correlation between education level and biomass extraction.

Table 9: correlation between adult education level and biomass extraction

| Study area | correlation | Spearman rank correlation rho | P value | S |
|-----------------------------|-------------|-------------------------------|----------|--------|
| Silent Valley National Park | 0.0268303 | 0.22937 | 0.8282 | 126790 |
| Attapady Reserved Forest | -0.3028 | =-0.2955633 | 0.007021 | 119040 |
| Agastyavanam Bio-Park | -0.08712626 | 0.1442157 | 0.248 | 40996 |
| Neyyar Wildlife Sanctuary | -0.1287 | -0.1839492 | 0.03843. | 404170 |

CHAPTER FIVE

DISCUSSION

1) Minor Forest Produce tree species abundance near households

A) Neyyar Wildlife Sanctuary

In Neyyar Wildlife Sanctuary about 636 individuals of 39 plant species belonging to 23 families were observed in 40 vegetation plots. Results showed that the *Terminalia paniculata*, *Aporosa lindliana*, *Actinodaphne madraspatana*, *Macaranga peltata*, *Tabernaemontana heyneana* the dominant tree species in the region with highest IVI values. MFP species like *Vateria indica* (White Dammer) had an IVI value of 2.8596 showing that the species is very less represented in the vegetation near households. As per an earlier study by Varghese and Balasubramanyan in the Agastymalai region, *Vateria* had an IVI of 5.17 in wet evergreen forest from elevation of 600 m to 1000m (Varghese and Balasabramanyan, 1999). This clearly shows that the species abundance is low near households compared to forest areas in Agastyamalai region.

As per study of Varghese and Balasubramanyan *Garcinia indica*'s have IVI of 2.25. However, *Garcinia* was not present in any of the four transects near the households. Even though *Garcinia* tree was observed in one household and during the household survey; many households said they have *Garcinia* tree in their private land. In addition, *Garcinia* trees were observed commonly near boundary of sanctuary along the dam (Pantha to Amboori stretch). However, vegetation-sampling data shows *Garcinia* is not common in forests near households even though they occur in households and private lands (Varghese and Balasabramanyan, 1999).

As per study of Varghese and Balasubramanyan *Canarium strictum* has IVI of 0.55 in wet evergreen forests of Agastymalai region (Varghese and Balasabramanyan, 1999). This is again less than *Garcinia* and *Vateria indica*. Among the four transects in forests near households *Canarium* was never observed. Only one person responded that there is a tree near Kottur Kaithode road. Except that most people interviewed responded that *Canarium* become extremely rare in the region and plants that were present died off within last few decades. This indicates *Canarium strictum* population is declining in forests near households and is even not abundant in wet evergreen part of the sanctuary.

Hydnocarpus was not encountered in any of the transects in forest near households, but as per study of Varghese and Balasubramanyan it has a relative abundance of 0.50, 0.15 -relative density, relative frequency of 15 and IVI of 5.91 (Varghese and Balasubramanyan, 1999). It is more abundant than *Vateria indica*, *Canarium strictum*, and *Garcinia indica*, in wet evergreen forests of Agastymalai region. However, it never occurred in any of the vegetation transects as well as none of the households responded that they are collecting *Hydnocarpus*. Other *Hydnocarpus* species like *Hydnocarpus macrocarpa* and *Hydnocarpus alpina* had IVI of 5.3 and 0.41 in wet evergreen forest as per previous studies but never encountered in transects in forests near households. As per earlier studies in Wet evergreen forest parts Vayana tree/*Cinnamomum verum* abundance in the wet evergreen region was next to that of *Vateria* with an IVI of 4.57. Whereas *Myristica malabarica* is not reported from wet evergreen forests of Agastymalai region in studies by Varghese and Balasubramanyan suggesting that they are present only in lowland forests and *Myristica* swamps. Even *Myristica* was never encountered in any of the transects.

An important factor, which lead to such a vegetation pattern in forests near households, was the forest management during the past. There has been a *Eucalyptus* plantation of about 111 ha in 1964 and 1965 and this included the removal of natural vegetation in the area. Secondary succession is happening in these plantations after the removal of *Eucalyptus* trees, high IVI of species like *Aporosa lindliana*, *Macaranga peltata* assures this secondary succession stage of vegetation in the area.

The results of vegetation sampling shows clear difference in vegetation composition forests near households and forests far from households in Agastymalai region. This suggest people of settlements are actively managing the forest around the households. This is supported by the responses of people from settlements during the interview. Many of the residents in settlement responded that forests would not regenerate if there is no fire occurrence and yields from forests will decline if forest fires are not occurring. They also responded that the evergreen forests do not provide much MFPs, this indicate that they are more dependent on MFPs that grow in secondary forests. Even the market surveys support this fact. People are collecting species like *Cyclea peltata*, *Hemidesmas indicus*, and many common medicinal herbs that grow in secondary forests. During the study period, there were many forest fire occurrences in the region and many were near

settlements. Settlers as well as forest department staffs agrees that the residents intentionally burn forest and these are not natural wild fires.

Agastymalai region vegetation is said to include variety of seral and edaphic stages of evergreen forest along the elevational gradient from southern secondary moist deciduous forest to subtropical hill forest above 1200 m elevation.

Plesioclimax of the region is *Cullinea-Mesua-Palaquium* series as per Pascal classification but studies by Varghese and Balasubramanyan suggests a *Mesua-Cullenia-Dimocarpus* type of forest with plants belonging to families like Culsiaceae, Lauraceae, and Myrtaceae, etc. But forests near households never reflected such a *Mesua-Cullenia-Democarpus* type of forest.

IVI and biodiversity indices of the region calculated by Varghese and Subramanyan, 1999) based on quadrates from Bonaccord/Bonakaad (600m elevation-Peppara Wildlife Sanctuary), Karamana area(800m) and Athirumala (1000m-Neyyar Wildlife Sanctuary), Chemmunjimottai(1200m) shows that *Mesua nagassarium* have the highest mean density, followed by *Diospyros candolleana*, *Carellia brachiata* and *Xanthophyllum arnottianum* (Varghese and Balasubramanyan, 1999). But these species were absent in the forest near households. As per previous studies in Agastyvanam, *Vateria indica* have highest **mean abundance value** of 2.27 followed by *Mesua nagassarium* (2.04), and *Diospyros candolleana* (1.66) (Varghese and Balasubramanyan, 1999). However, in forest area near households these trees were absent or very low.

Value of Shannon index of diversity for forests near settlements is about 3.49 in Neymar Wildlife Sanctuary, which is more than Shannon index of diversity value (3.13) of forests near households in Attapady Reserve Forest region. However, this value is comparable to values reported from other studies for other forested regions of Western Ghats: Nelliampathy-3 to 3.7, Nilambur-3.59, Achankovil-1.5 to 2.2, Kalakad Mundanthurai Tiger Reserve-3.37.

B) Attapady Reserve Forest

When comparing with earlier studies, Shannon Diversity index value of 3.13 for the vegetation around households is less than the Shannon diversity index value recorded for forests of Silent Valley (3.52 to 4.15). Earlier studies show that Shannon index values of forests in Silent Valley includes 4.15 for Riparian forest, 4.08 for Mesic-upland forest, and 3.52 for less mesic upland forests of Silent Valley region. Shannon diversity Index value from earlier studies on Forests of Attapadi shows value of four, which is also higher than this study result (3.13).

Shannon index for Climax evergreen forest of Western Ghat is about 3.6 to 4.3. Eventhough Attappady block was said to be a part of thick evergreen forests that extended from Wayanad to Muthikkulam (KA and AK 2015), diversity indices value of study site in Attapady did not fall within this range. This assures that vegetation of the area has changed drastically from the earlier natural vegetation. This can be due to the Shifting cultivation prevalent in the area since centuries; fire occurrence; Plantation forestry works during 1934 to 1936, which converted forest area near Chindakki into hardwood species of *Tectona grandis*, *Pterocarpus marsupium*, *Dalbergia latifolia* and *Artocarpus hirsutus*; etc. (KA and AK 2015).

Management history of this forest area has a great role in explaining the present vegetation structure. Attapady plateau where the study area falls was under the ownership of Zamorins of Kozhikode. In 1790, Attapady came under British administration (KA and AK 2015). Under the Land Acquisition Act, British administration brought 119 Sq. km area including part of Silent Valley under the control and about 1.03 lakh rupees was paid for this (KA and AK 2015). During this period, the area was rich with evergreen forests. During 1882-1886 period, British government realised the need for protecting the forests because of several reasons including the threat from shifting cultivation of tribes in the area. More explorations were carried out during 1887 in the area. As per the inspection report of Porter (1887), the area including Attappady block VI (Muthikkulam) was full of dense mass of evergreen forest with no deciduous forest and a little grassland. Later during 1900-1912 period an area of about 204.04 Sq. Km was declared as reserved forest (KA and AK 2015). From 1933 onwards forest area was managed under working plans and plantations were started during 1934 to 1936 period. Plantation works continued from 1934-36 until 1960-75

converting forests into plantations (KA and AK 2015). Deciduous forests of Panthenthodu and Bhavani valley were converted to plantations during Van Haeften's working plans during 1943 to 58 and this included about 50.83 ha. Area. In 1960-1975 about 438.51, ha area came under plantation (KA and AK 2015). By this time period, out of 745 Sq. Km Attapady plateau except 204.04 Sq. km of reserved forest, remaining area came under private ownerships of Mannarghat Mooppil Nair, Palat Krishna Menon and Eralpad Raja (KA and AK 2015). After the implementation of 'Kerala Vested Private Forest' Act, 1971 led to the de-splitting of these areas into the hands of many small landholders. Even practices like giving license to clear-fell large areas, giving land on lease for cultivation (KA and AK 2015). During 1959 to 1976, the forest cover in the area reduced from 82 percent to a drastic 20 percent (KA and AK 2015). The construction of Mannarkkad-Anakkatti road accelerated encroachment of the area (KA and AK 2015). These changes affected the precipitation of the region reducing it from 3000 mm to 900 mm (KA and AK 2015) this also made most of the Western Attapady similar to Eastern Attapady, which fall under rain shadow area. The presence of a more deciduous forest vegetation near household also must be a result of past management of the region.

Stand density of evergreen forests of Western Ghat are

Idukki-780 trees/ha

Nilambur-908 trees/ha

Ranni-893 trees/ha

Parambikulam-881 trees/ha

Silent Valley-1082 trees/ha

Attapady 1520 trees/ha

Agastyvanam Bio-Park-460 trees/ha (Varghese and Balasubramanyan, 1999).

From the present study stand, density of forests near households in Neyyar Wildlife Sanctuary is about 653.380 trees/ha and in case of Attapady area it is about 222.315 trees/ha. This low stand density in the Attapady area is mostly due to the plantations present in the area. Along the transects from Mukkali to Chindakki trees were less since

there were coffee plantation, constant fire occurrence and clearing for shifting cultivation. This must be the factors contributing to the low stand density of the region.

2) Minor Forest Produce extraction general observations

Minor Forest Produce biomass collection in Neyyar Wildlife Sanctuary and Agastyavanam Bio-Park occurred mainly from Agastyarkoodam hill stretches of Western Ghats. In Neyyar all the 17 Kaani tribal settlements reported Minor Forest Produce collection by the inhabitants. In Agastyavanam Bio-Park out of five settlements surveyed all MFP collection was reported from all the settlements. Main MFPs collected in the region are *Myristica malabarica* (Paanampoo), *Cinnamomum* spp (Vayanapoo), *Psudarthria viscida* (Moovila), *Desmodium velutinum* (Oorila), *Garcinia gummigutta* (Kudampuli), *Emblica officianalis* (Nellikai/Amla), *Aristolochia tagala* (Garudakodi), Honey, *Terminalia chebula* (Katukka), *Helecterus isora* (Etampiri), *Phrenium rheedei* (Koovayila/Korambakoova), etc.

In addition, about 70 wild plant parts are collected all together in Wildlife Sanctuary and Bio-Park. This exclude many medicinal plants used by the tribes since they did not disclose the medicinal plants they used due to the taboos and beliefs. Kaanis believe that if they say the use of medicinal plant to someone the plant will lose the medicinal property or their treatment will not work later. Hence, plants used in ethno medicine were not added, but medicinal plants in trade are included in the MFP list.

Many minor MFPs like Koovayila (*Phrenium rheedei*), Thakkalipoo (*Bryophyllum* species) were collected only by few collectors and had special uses. Koovayila was used in Hotels in the region for making traditional dish "Aada" that is wrapped inside Koovayila. Thakkalipoo was sold mainly as a toy for the child to play since inflorescence of it have buds-which burst with a sound. Many medicinal plants were collected tribes based on order from the local Vaidyaas. Black dammar collection was reported by only few collectors and most of the collectors responded that black dammar trees have been eliminated from the region. Most of the collectors pointed out natural deaths (Pattupokal) as the main reason for disappearance of black dammar. This reasoning must be correct based on the fact that continuous harvesting of gum lead to the death of black dammar tree. Many responded that now there are only very few *Canarium* trees in Neyyar or Peppara Wildlife Sanctuary and if they want to collect,

they have to go to Tamil Nadu side (Kalakkad Mundanthurai Tiger Reserve). This facts point out that in Kerala were *Canarium Strictum* collection is not banned (even though not allowed in wildlife Sanctuary) is causing the elimination of *Canarium strictum* in the wild, whereas in Tamil Nadu were the collection of *Canarium strictum* gum is banned was able to save the remaining trees of *Canarium*. However, many collectors said that since *Canarium* is not available in Kerala side of the Agastyarkoodam they used to go to the Tamil Nadu side/Eastern sides to collect black dammar if they require. Black dammar collection in the region is very low and if happening it is through illegal means. Unlike in Silent Valley were the collection of Black Dammar is not regulated in Neyyar Black dammar collection from Sanctuary area is not allowed and MFP collectors responded that they do not collect . During the survey Black Dammar was seen only once in the market.

From the social survey in Neyyar Wildlife Sanctuary and Agastyavanm Bio-Park of Agastymalai region and Attapady Reserve Forest and Silent Valley National park of Attapady region, most evident fact is that MFP collection was not much influenced by the Forest Governance category (Reserve Forest, Bio Park, Wildlife Sanctuary, and National Park). The governmental bodies as EDCs and VSSs are only in developmental stages with majority of the MFP collection is managed through private sector (in Agastyamalai region) and Tribal cooperative Societies (Kurumba Cooperative Society in Silent Valley, Attapady Region). In Agstyamalai region eventhough MFP collection and processing was started under EDC it was successful only for a short time period. The processing unit and MFP collection under EDC does not exist in the area now. This is mainly due to the gaps in providing monetary help to the collectors when they are in need of money. Since MFPs are seasonal and monetary help during off seasons play great role in getting their support. Main MFP shop owners in the region provides such help, which attracts the tribal people to sell their products to such shop owners.

In Silent Valley EDCs were comparitively more successful with EDCs still collecting some MFPs like honey. EDCs in Silent Valley also provided alternative income to the residents reducing the dependency on forests. Whereas, VSS in Attapady is in the beginning stage with plans to start MFP collection under it. During the study period, no collection under VSS was present and the MFP collected in the region was sold to Kurumaba Cooperative Society.

Market channel in Agastyvanam and Neyyar had key differences in functioning. In Neyyar private MFP shop owners collected MFPs and distributed to local Ayurvedic pharmacies in the region or within Thiruvananthapuram district. But in Attapady Kurumba Cooperative Society trade the MFPs with main Ayurvedic Medicine manufacturers like Kottaykal Aryavaidya Shaala and Coimbatore Aryavaidyashaala, Oushadhi, etc. of Kerala and Tamil Nadu. In Attapady, the MFP market is monopolistic in nature but in Agastyamalai region, there were many private collectors even though there is monopoly of single MFP shop owner.

EDC MFP collection initiatives under forest department fails in providing such monetary help and advance money-lending, leading to the weakening of EDC system of MFP collection. Even though EDCs in the region are effective in providing alternative income sources to the people through Eco-tourism activities with a significant population of settlements employed under forest department and EDC. In addition, LPG gas allocations in tribal settlement areas under EDC programmes helped in reducing the dependence on forest for fuelwood. Different government Housing schemes lead to the less dependence of people own forest for housing material like *Ochlandra* etc. However, even though this helped in reducing the dependence on forest, alternative incomes along with the developmental activities are changing the attitude of people to forest. Many of the *Ochlandra* patches in the area have been cleared since people are now considering these as not useful. Matt making industry in the region under Kerala Bamboo Development Cooperation is also facing a setback due to the change in people's dependence on forest. With the employment-guarantee-schemes providing more remunerative alternatives, tribal women are now leaving the matt making profession. In Neyyar region where people now depend more on cash crops like Rubber, Pepper, Clove, Turmeric etc. forests (in settlement areas) with many Minor Forest Products are being cleared without caring for the less remunerative MFP species in the region.

With the Improved connectivity to the markets and efficient PDS system the dependence of tribal on wild edibles have declined with many households no longer collecting wild edibles like *Dioscorea* and *Smilax* tubers (four wild *Dioscorea* species- Nooli, Neduvan, nooran, Kavala). Only a minority in the region responded that they still collect wild fruits. Forest fruits are collected only by people who dependent on

MFP collection as main income source, that too they collect only while going to forest for commercial MFP collection. Fruits of *Baccaurea courtallensis* (Moottipazham), *Grewia* fruits, *Syzygium* fruits, *Elaeocarpus* (Kaarapazham) fruits are not familiar to the young generation and even elderly people responded that they had it only in their child hood. Only one elderly person said about the edible wild fruit *Democarpus longan*.

Dependence of tribal on wild spices and condiments is also declining in the region. Many responded that earlier they used Kudampuli in traditional dishes but now shifted to tamarind, which is more available in the area or else available in market. Many responded about the use of *Cycads* seeds, *Entada* (Parandaykka) seeds and *Ochlandra* seeds for making food items. They also responded that they will use it only if it is available near their household. During the survey in Neyyar, no one responded about the use of any wild leafy vegetables. Whereas in Silent Valley and Attapady many responded that, they collect wild leafy vegetables like *Solanum nigrum*, *Amaranthus spinosum*, ETC. In Silent Valley and Attapady region, also tribal responded that they collect wild *Dioscoreas* and *smilax* tubers as edibles.

During the survey in Neyyar and Silent Valley, many responded that in the absence of forest fire plants will not regenerate in forest and forest will become unproductive evergreen forest. In other words, tribal find secondary forests and open forests as more productive since many common medicinal herbs and shrubs, edible tubers and commercially valued MFPS are available from such areas. Even one responded that if MFP species were not harvested in one year they would die off. This indicates the knowledge of local people regarding successional stages in forest and regarding the replacement of one seral stage by other.

Frequent forest fires during the study period suggests that people intentionally burn the forest near the settlement to get MFPS as well as wild edibles. Even forest staffs and residents responded that villagers intentionally set forest fires. This assures that the people in forest villages are actively managing their forest to get Minor forest Products and other wild products through fire or forest clearing. Along with forest fire, Panchakkad-or the shifting cultivation fields are also prevalent in the Attapady study area. This describes the different vegetation composition in forests (Low value of species richness) near households in the area.

Compared to Agastyvanam-Neyyar region people dependency on Minor Forest produce was more in Silent Valley-Attapady area. This can be due to higher resource abundance of the region as well as due to absence of cultivation cash crops like Rubber (*Hevea barsiliensis*) in the region. Almost all residents in settlements engage in MFP collection in Silent Valley as well as in Attapady.

Among the non-farm rural commercial activities of people living around the forests, small scale forest product, wage employment in forest industries, wage employment in plantation are reported to be most dominant (Lieholm and Mead 1993, FAO 1987, LaFrankie 1994). Survey supports the fact that the management and use of this common pool resource need different kind of intervention and assistance including technical, governance and other aspects (LaFrankie 1994). This study also shows that MFP collection do not show much difference under different governance system, as forest is an open pool resource and quarantining it from people is difficult. With FRA 2006, which assures access to forest resources for people living in National Parks-Wildlife Sanctuaries- Reserved Forests, resources extraction follows a similar pattern. Since forests are open pool resource they are susceptible to use by people living in and around forests (Colchester 2006). These uses are many times not sustainable and there is a great need to regulate this since the demand for resources like medicinal plants are increasing in the consumerist society. Domestication of many wild Minor Forest Product can play major role in preventing the species population decline and extinction.

There is large amount of wild Mango/Kaattumanga extraction from Attapady region. In this region, unripen Wild mangoes are collected in large amounts in every season, which are used for pickle making. Even Wild mango barks are used in traditional medicine and collected in large amount from the area. Many times collectors do girdling of tree while collecting bark leading to the death of the tree. Domestication of these wild mangoes using grafting methods can help in meeting the market demand and avoiding pressure on wild population. Even domestication using grafting can help in saving already declining population and help in saving the gene pool. *Vateria indica*, which is a fast growing tree species, can be domesticated easily and making plantations outside the protected areas can help in reducing the exploitation of wild population. Wild edibles constitute a portion of diet of tribes in India which is about 8 percent of the population of India (Ramachandran 2007) and women folks are said to be mainly

involved in the wild edible collection activity (Ramachandran 2007). Most of the tribes in Western Ghats uses large number of wild edible species which include tubers, leafy vegetables, wild fruits etc. About 74 wild edible plants are used by Kaadar, Pulayar, Malasars and Malaimalasars in Anamalai part of Western Ghats (Ramachandran 2007), 102 edible plant species used by three tribal groups (Paniya, Kuruma, Kaattunaika) and one heterogeneous non-tribal community in Wayanad are some of the examples of people's dependence on wild edibles (Narayanan and Kumar 2007). Many of these wild edibles, which occur abundantly, and sometimes as weed can be domesticated without much efforts. This will help in saving the traditional knowledge about these plants in addition they will help in maintaining the eco system health. Cultivation of many non-native plants including food plants, cash crops are being promoted in the rural areas of India. Many of this introductions causes irrevocable damage to the ecosystem (*Hevea brasiliensis* effecting water tables, *Eucalyptus*, Black wattle, Silver wattle introduction in Nilgiris etc.) In Neyyar, forests in settlement area are being cleared for and Rubber plantation, clove cultivation etc. Even Rubber Board is providing rubber to tribal for planting in settlement areas, which are vested under forest. Settlers themselves responded that rubber plantations leads to decrease in water table and drying up of streams in the area.

Instead of promoting cash crops if market and demands are created for traditional species this can help in native wild species conservation in the area. Promoting *Ochlandra* Matts and cane furniture can in turn promote cultivation of these plants in the area if people are provided with adequate knowledge to grow or domesticate these plants.

However, at present even though a sub depot of Kerala State Bamboo Cooperation in Kuttichal is providing good *Ochlandra* reed raw material, the matt making in the region is declining. Out of 150 passes issued from the sub depot now not even 100-pass holders are taking *Oschlandra* raw material for matt making. A first quality 6.1/4x4.1/4 feet matt gets about Rs. 67.50 and second quality matts fetches Rs 54. These Matts used for plywood making and 5x3 feet Matts are used for general purposes. The Matts are being send to Plywood manufacturers in Ankamaali region and even exported to Mumbai. Tribal women mainly do matt making and a matt requires one-man day work, but with the implementation MGNREG scheme people get more than Rs. 67.5/day for

their work hence, the matt making craft abandoned. Now the produced Matts transported to Bamboo Co-operation Headquarters in Ankamali.

Many wild fruits in South Asia are considered as delicacies (Dhurian, Rambutan). Western Ghats holds large number of wild edible fruits like *Flacortia Montana*, *Democarpus longan*, *Artocarpus hirsutus*, *Elaeocarpus* species, *Canthium dicocum*, *Chrysophyllum roxburghii*, *Scolopia crenata*, etc.

Many of the lesser-known wild fruits provide many unusual flavours, antioxidants and anthocyanins, which are said to provide help in treatment of chronic diseases like cancer, heart diseases, hypertension, etc. (Karuppuswamy et al. 2011). Domestication of these plants can help in conservation of these plants since their habitats are already declining and are cleared without knowing their value.

Nutritional transition is said to be occurring across the world resulting in the replacement of traditional plant based diets in to diet consisting of few cultivated plants (Karuppuswamy et.al, 2011). In Attapady, which was under evergreen forest cover just few decades ago, the tribal like Kurumbas who are not settled agricultural practisioners depended entirely on wild edibles and millet crops. However, when many parts of Attapady turned to arid areas in last five to six decades, it resulted in nutritional deficiencies among tribes. At present child mortality rates in the region is higher than the state average for Kerala and is said to be due to nutritional deficiencies. In such a scenario, promoting wild edible domestication and saving the traditional knowledge about them can be helpful. This also assures the fact that Forest Law enforcement include not only legislations regarding forest but also regarding land tenure, forest dependant people, international laws, constitutional provisions, human rights law, employment laws etc. (Colchester 2006).

To conclude the need to look deeper, therefore, into how governance arrangements work is of paramount importance if forest dwellers, users, managers, and policy makers are to make better choices about forest governance at a variety of scales. A very large number of factors influence the effectiveness and outcomes of forest governance. Among these, more careful definition of user rights and responsibilities in forests, greater participation by those who depend on forests, downward and outward accountability of decision makers, better monitoring of forest outcomes, stronger enforcement of property rights and governance arrangements, and investments in

institutional capacities at local, regional, and national levels have been identified as critically important for more effective forest governance in tropical country contexts (Agrawal et al. 2008).

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APPENDIX

Appendix I: House Hold Survey Questionnaire

(Adapted from Evaluating Outstanding Universal Values of Western Ghats (Sahyadri sub-cluster) for Provisioning and Regulating Ecosystem services in the region, WII)

Household code:

Address: DistrictBlock Village

Date of interview:

PART I: Personal Information

1. Individual

1.1. Age: Yrs.

1.2. Gender: (a) Male (b) Female

1.3. Family Size: (i) Over 18 years old (ii) Under 18 years old.....

1.4. Ethnicity:

1.5. Education: Years

1.6. Occupation (main income source first): (i) (ii)..... (iii).....

1.7. Living in this area : (a) Born here (b)..... years

1.8. Landholding and Tenure :

1.9. Major products collection and use

| products | Total Amount extracted/ Needed | Quantity collected from land holdings | Quantity collected from Forests | Quantity purchased from market | Quantity needed for household use | Quantity needed for sale | Price per unit (IRs) Price |
|----------|--------------------------------|---------------------------------------|---------------------------------|--------------------------------|-----------------------------------|--------------------------|----------------------------|
| | | | | | | | |

| | | | | | | | | |
|--|---------------------------------|--|--|--|--|--|--|----------------------|
| | (Weekly/ Monthly/ Yearly) | | | | | | | per unit (IRs) |
| | | | | | | | | |

1.10. How long your production can meet your household food demand?

(a) <3 months (b) 3 to 6 months (c) 6 to 9 months (d) 9 to 12 months (e) >12

| Land characteristics | Land type and Area (Kathha) | | | No. of crops per year | Name of crops |
|----------------------|-----------------------------|----------------|-----------------|-----------------------|---------------|
| | Own land | Shared crop in | Shared crop out | | |
| Irrigated | | | | | |
| Unirrigated | | | | | |
| Forest | | | | | |
| Others | | | | | |

months

a) Name of the Forest area from where you mostly collect products/services:

b) Distance to the collection area:

c) Property rights related to the extraction: under Vana Samrakshana Samithi/Eco Development Committee/Girijan Cooperative Societies/Informal collection

Private /Biodiversity Management committee/other Institution-indigenous community association

d) Distance to the market:

e) Possession of vehicles and public transportation available: Car/Motorbike/Truck/Cycle/Bus/Tractor.

1.11. Indicate whether your household possesses the following items and how many

| | | | | | | |
|---------|------------|-------|-------|--------|---------------------|-------|
| Car | Motorbike | Bus | Truck | Solar | Cooking gas | |
| Tractor | Television | Cycle | Radio | Biogas | Improved cook stove | |

1.11.1. Mention the type of improved cook stove: (a) Mud (b) Metal
(c) Others

1.12. Major crops, and quantity produced and sold in the last year .

1.13. Livestock (number)

| Crops | Unit | Total production | Unit sold | Unit price (Rs) | Income from selling (Rs) |
|----------------------------|------|------------------|-----------|-----------------|--------------------------|
| Rice | | | | | |
| Maize | | | | | |
| Wheat | | | | | |
| Potato | | | | | |
| Vegetable | | | | | |
| Fruits | | | | | |
| Others (Please specify) | | | | | |

(a) Buffalo (b) Cow..... (c) Ox (d) Goat..... (e)

Others

1.14. Income from livestock products

| Product | Unit | Total Production | Unit sold | Unit price (Rs) | Total income (Rs) |
|---------|------|------------------|-----------|-----------------|-------------------|
| Milk | | | | | |
| Meat | | | | | |

| | | | | | |
|---------------------|--|--|--|--|--|
| Egg | | | | | |
| Other milk products | | | | | |
| Others | | | | | |

b. In your opinion, are there any MFP plant species disappeared in the area (those which were available earlier 20 yrs back, but not seen in recent years)? a) Yes

b) no

If yes, please list them 1) 2) 3)

c. In your opinion, what are the changes in Minor Forest Product Extraction and use

A) Increasing in amount of extraction and use b) decrease in amount of extraction and use C) stable

what are the main factors leading to such change

please list them 1) 2) 3)

2. Factors effecting MFP

In your opinion, what are the major Factors affecting MFP species population and yield (Production).

| Drivers | Perception on change (prioritised drivers) | Remarks | | | |
|---------|--|-----------|-------------|----------|---------------|
| | | High (-1) | Neutral (0) | Low (+1) | Very low (+2) |
| | | | | | |
| | | | | | |

| Species | Part used and | collection method | Affects of Extraction | Amount of collection (amount in Kg/year) | Grading/seasoning/processing done | Uses | Market Price | Selling price |
|---|---------------|-------------------|-----------------------|--|-----------------------------------|------|--------------|---------------|
| Kudampuli(<i>Garcinia gummigutta</i>) | | | | | | | | |

EDC /VSS SURVEY QUESTIONNAIRE AND MARKET SURVEY QUESTIONNAIRE

- 1) Name of VSS/EDC/Tribal Cooperatives :
- 2) Number of Minor Forest Product species collected under its governance:
- 3) Number of collectors under their governance :
- 4) Collection area under their property rights :
- 5) Do Illegal collection happening in the area :
- 6) Species wise amount of extraction :

Is grading/processing/seasoning done, If done different grades/product, price and methods.

| SI No | Species | Raw product price | Grading/seasoning/processing method | Price of the final product | Costs involved | Market Price | Selling price |
|-------|---------|-------------------|-------------------------------------|----------------------------|----------------|--------------|---------------|
| | | | | | | | |

9) Information about the use, demand, user group etc.:

Appendix II: IVI of tree species in Neyyar their phenology and MFP value

| SL NO | SPECIES | IVI | Description |
|-------|--|------|--|
| 1 | <i>Albizia spp</i> FABACEAE | 2.6 | Vaaka Flowering: throughout Gum, softwood, green manure, shampoo, oil, ornamental |
| 2 | <i>Alstonia scholaris/Echites scholaris</i> APOCYNACEAE | 2.8 | Ezhilampala Flowering: June to March Medicine, fire, softwood, |
| 3 | <i>Aporosa lindleyana/A. cardiosperma</i> EUPHORBIACEAE | 27.7 | Ponvetti/Aechil/Amavetti/ Kotili Flowering and fruiting: Dec-June. Medicine, food, oil, softwood |
| 4 | <i>Artocarpus hirsutus</i> MORACEAE | 1.8 | Ayaniplavu/Aanjili Flowering and fruiting: Dec-Jun Medicine, food, timber, oil |
| 5 | <i>Butea monosperma</i> FABACEAE | 0.7 | Plash/Chamatha Flowering and fruiting: Dec to June |

| | | | |
|----|--|-----|---|
| | | | Medicine, dye, fibre, poison, green manure, lac, tannin, paper pulp |
| 6 | <i>Calycopteris floribunda</i> COMBRATACEAE | 1.4 | Pullani/Varavalli Marathi: Ukshi Flowering and fruiting: Nov-May Medicine, Basket making, Fish poison. |
| 7 | <i>Canthium spinosum</i> | 0.7 | |
| 8 | <i>Careya arborea</i> LECYTHIDACEAE | 7.0 | Flowering and fruiting: Jan to March Medicine, food, fibre, tannin, Fish poison, ornamental, softwood |
| 9 | <i>Knema atunata</i> MYRISTICACEAE | 0.7 | Chorapain/Chennelli/Chorapali/Chorapathiri. Flowering and fruiting: Throughout Oil, softwood |
| 10 | <i>Cinnamomum</i> spps LAURACEAE | 1.5 | Vayana Spices and condiments |
| 11 | <i>Cycas species</i> | 1.6 | Chalangya/ Eeenda Food |
| 12 | <i>Dillenia pentagyna</i> DILLENACEAE | 0.7 | Kudapunna/Kaattupunna/Naithekkku/Pattipunna Flowering and fruiting: throughout |

| | | | |
|----|---|-----|---|
| | | | Fibre, food, thatch, soft wood, green manure, tannin etc. |
| 13 | <i>Diospyros candolleana</i> EBONACEAE | 1.4 | Karimaram Flowering and fruiting: Jan-Nov |
| 14 | <i>Elaeocarpus serratus</i> ELAEOCARPACEAE | 4.5 | Kaara/Avil Flowering and fruiting: Throughout Food, medicine, softwood, fibre |
| 15 | <i>Ficus racemosa</i> MORACEAE | 0.7 | Atthi/Atthialu Flowering and fruiting: Throughout Medicine, dye, timber, gum, fodder, latex, Food, |
| 16 | <i>Flacourtia indica</i> FLACOURTIACEAE | 0.7 | Aghori Cherumullikachedi Flowering and fruiting: March-Sept Food, fodder, medicine. |
| 17 | <i>Gmelina arborea</i> VERBENACEAE | 0.7 | Kumbhil/Khumizhu Flowering and fruiting: Nov-Jun Medicine, food, fodder, dye, softwood, paper pulp, musical instruments |
| 18 | <i>Grewia tiliifolia</i> | 0.7 | Chadachi |

| | | | |
|----|---|------|--|
| | <i>TILIACEAE</i> | | Timber, shampoo, mat making Flowering and Fruiting: Feb-Aug Food, Fodder, fibre, |
| 19 | <i>Holarrhena antidysenterica/H.pubescens</i> <i>APOCYNACEAE</i> | 0.8 | Kadalapala/Kudakapala Flowering and fruiting :Throughout Medicine, oil, gum, tannin |
| 20 | <i>Homonoia riparian</i> <i>EUPHORBIACEAE</i> | 0.8 | Aattuvanchi/Kalloorvanchi Flowering and fruiting: Throughout Medicine, food. |
| 21 | <i>Ixora pavata/I.arborea/I.parviflora</i> <i>RUBIACEAE</i> | 1.4 | Koravi Flowering and fruiting: Jan-May |
| 22 | <i>Macaranga peltata</i> <i>EUPHORBIACEAE</i> | 17.9 | Vatta/Uppothi Flowering and fruiting:Dec-July Gum, Tannin, resin, softwood, medicine |
| 23 | <i>Mesua ferrea</i> <i>CLUSIACEAE</i> | 3.0 | Churuli/Elipongu/Nanga/Perinannu Flowering and fruiting: March-May Medicine, dye, food, timber |
| 24 | <i>Xanthophyllum arnottianum</i> <i>XANTHOPHYLLACEAE</i> | 7.0 | Mottal/Madakka Used as green manure |

| | | | |
|----|---|------|--|
| 25 | <i>Actinodaphne madraspatana</i> LAURACEAE | 14.8 | Munkoli/Irolimaram Flowering fruiting: July-March softwood |
| 26 | <i>Olea dioica</i> OLEACEAE | 7.0 | Edana/etala/karivetti/erippa Flowering and fruiting: Oct-April Medicine, food, timber, green manure |
| 27 | <i>Glycosmis pentaphylla</i> RUTACEAE | 0.7 | Paanal Flowering and fruiting: Through out Medicine, tannin, food, hygiene |
| 28 | <i>Atlantia racemosa</i> RUTACEAE | 0.9 | Kaatunaragam |
| 29 | <i>Symplocos cochinchinensis</i> SYMLOCACEAE | 6.0 | Pachhotti/Kamblivetti Fruiting flowering-Oct Nov Timber and dye, medicine. |
| 30 | <i>Phyllanthus emblica</i> EUPHORBIACEAE | 5.1 | Nellikai Fruiting and flowering:thoroughout Medicine, food, dye, gum, ink, fodder, |
| 31 | <i>Pterocarpus marsupium</i> FABACEAE | 5.1 | Venga/Karimthakara/Malamthakara Flowering and fruiting: July-April Medicine, green manure, oil, resin, tannin, timber, gum, |
| 32 | <i>Scleichera oleaosa/S.trijuga</i> | 7.3 | Flowering and fruiting: Jan-Aug |

| | | | |
|----|---|------|--|
| | <i>SAPINDACEAE</i> | | Medicine, poison, timber, tannin, lac, fodder. |
| 33 | <i>Semecarpus anacardium</i> | 4.1 | Thenkotta, Alakkucheru, Tamil-Shenkottai Fruiting and flowering: Throughout. Medicine, food, dye, marking ink, softwood, gum, poison |
| 34 | <i>Tabernaemontana heyneana/T.alternifolia</i> | 12.8 | Kundalapaala/Ataykapaala/Kuruttupaala Flowering and fruiting; Nov-June Medicine, dye, latex, resin, perfume. |
| 35 | <i>Tectona grandis</i> <i>VERBENACEAE</i> | 2.5 | Theak Flowering and fruiting: May-March Medicine, dye, oil, timber, resin, thatching, tannin, musical instrument |
| 36 | <i>Terminalia bellerica</i> <i>COMBRETACEAE</i> | 1.4 | Thannikka Fruiting and flowering: Jan-March Medicine, Tannin, food, poison, dye, oil, gum |
| 37 | <i>Terminalia paniculata</i> <i>COMBRETACEAE</i> | 37.1 | Vellamaruthu/Venmaruthu Medicine, dye, green manure, timber, tannin |
| 38 | <i>Terminalia tomentosa</i> <i>COMBRETACEAE</i> | 6.4 | Throughout Medicine, fodder, lac, timber, poison, gum, dye. |
| 39 | <i>Vateria indica</i> <i>DIPTERCOCARPACEAE</i> | 2.9 | Vellakunthirikkam/Painipasha/ Paini/Perumpaini Fruiting and flowering: Feb-Nov Medicine, softwood, tannin, oil, resin, brewery, ornamental |

Appendix III : IVI of tree species in Attapady

| SL NO | SPECIES | IVI |
|-------|---|------|
| 1 | <i>Adina cordifolia</i> RUBIACEAE | 1.4 |
| 2 | <i>Ailanthus excelsa</i> SIMARUBACEAE | 1.4 |
| 3 | <i>Albizia species</i> FABACEAE | 11.4 |
| 4 | <i>Alstonia scholaris</i> APOCYNACEAE | 4.1 |
| 5 | <i>Anogeissus latifolia</i> COMBRETACEAE | 10.8 |
| 6 | <i>Artocarpus heterophyllus</i> MORACEAE | 3.1 |
| 7 | <i>Bauhinia malabaricum</i> FABACEAE | 2.8 |
| 8 | <i>Bombax ceiba</i> BOMBACACEAE | 11.5 |

| | | |
|----|---|------|
| 9 | <i>Calophyllum apetalum</i> CLUSIACEAE | 4.1 |
| 10 | <i>Cassia fistula</i> FABACEAE | 2.4 |
| 11 | <i>Dalbergia latifolia</i> FABACEAE | 12.0 |
| 12 | <i>Dillenia pentagyna</i> DILLENACEAE | 5.1 |
| 13 | <i>Diospyros candolleana</i> EBONACEAE | 1.3 |
| 14 | <i>Erythrina spp</i> FABACEAE | 1.4 |
| 15 | <i>Eucalyptus spp</i> MYRTACEAE | 0.9 |
| 16 | <i>Ficus spp</i> MORACEAE | 5.5 |
| 17 | <i>Ficus spp</i> MORACEAE | 8.5 |
| 18 | <i>Gmelina arborea</i> VERBANACEAE | 4.4 |
| 19 | <i>Grevillea robusta</i> PROTEACEAE | 5.1 |

| | | |
|----|---|------|
| 20 | <i>Grewia tiliifolia</i> TILIACEAE | 16.4 |
| 21 | <i>Helicteres isora</i> STERCULIACEAE | 1.3 |
| 22 | <i>Homonoia riperia</i> EUPHORBIACEAE | 1.4 |
| 23 | <i>Ixora spp</i> RUBIACEAE | 1.3 |
| 24 | <i>Lagerstroemia lanceolata</i> | 16.2 |
| 25 | <i>Lanea coromandelica</i> ANACARDIACEAE | 6.4 |
| 26 | <i>Macaranga peltata</i> EUPHORBIACEAE | 0.7 |
| 27 | <i>Mallotus philippinsis</i> EUPHORBIACEAE | 1.4 |
| 28 | <i>Mangifera indica</i> ANCARDIACEAE | 7.5 |
| 29 | <i>Olea dioca</i> OLEACEAE | 1.3 |
| 30 | <i>Phyllanthus emblica</i> EUPHORBIACEAE | 2.7 |
| 31 | <i>Pongamia pinnata</i> FABACEAE | 12.4 |

| | | |
|----|--|-------|
| 32 | <i>Psidium gujava</i> MYRTACEAE | 0.660 |
| 33 | <i>Pterocarpus marsupium</i> FABACEAE | 9.12 |
| 34 | <i>Roystonea regia</i> FABACEAE | 0.7 |
| 35 | <i>Samania saman</i> FABACEAE | 1.4 |
| 36 | <i>Sapindus emarginatus</i> | 2.1 |
| 37 | <i>Scleichera oleaosa/S.trijuga</i> SAPINDACEAE | 12.7 |
| 38 | <i>Sterculia urens</i> STERCULIACEA | 2.7 |
| 39 | <i>Stereospermum chelanoides</i> BIGNONACEAE | 12.3 |
| 40 | <i>Sweitina mahogony</i> MELIACEAE | 0.7 |
| 41 | <i>Syzygium spp</i> MYRTACEAE | 10.7 |
| 42 | <i>Terminalia bellerica</i> COMBRETACEAE | 5.0 |

Appendix IV : MFP species and collection amount in Kgs under different governance systems

Abbreviations NWLFS=Wildlife Sanctuary (Neyyar), ABP = Bio-Park (Agastyvanam), SVNP: National Park (Silent Valley), ARF: Reserved Forest (Attapady)

| Sl No | Local name | Scientific name | NWL FS | ABP | SVN P | ARF |
|-------|---------------------------|---|--------|------|-------|------|
| 1 | Chundaveru | <i>Solanum spp</i> | 0 | 0 | 8365 | 5500 |
| 2 | Cheenikka | <i>Acacia sinuata/A.concinna</i> | 0 | 0 | 8115 | 3610 |
| 3 | Kaattukurumulak | <i>Piper argyrophyllum/P.walkeri and Piper barberi</i> | 86 | 0 | 7000 | 400 |
| 4 | Karimkuringi veru | <i>Strobilanthus ciliatus</i> | 0.5 | 0 | 7000 | 0 |
| 5 | Moovila | <i>Psudarthria viscida</i> | 13 | 50 | 6650 | 0 |
| 6 | Orila | <i>Desmodium velutinum</i> | 33.5 | 65 | 6650 | 3780 |
| 7 | Kudampuli | <i>Garcinia gummigutta or Garcinia cowa/Kaattukudampuli</i> | 2012.2 | 598 | 6215 | 0 |
| 8 | Nilabombu/Athithippali | <i>Belanophora indica</i> | 0 | 0 | 4180 | 2000 |
| 9 | Amla | <i>Phyllanthus emblica</i> | 671 | 198 | 3975 | 2360 |
| 10 | Paatathali | <i>Cyclea peltata</i> | 10 | 5 | 3415 | 4852 |
| 11 | Kurumthotti | <i>Sida spp (Sida acuta, Sida alinifolia, Sida cordata)</i> | 0.5 | 0 | 1965 | 5580 |
| 12 | Kunthirikkam(grade 1,2,3) | <i>Canarium strictum</i> | 33.5 | 501 | 1085 | 5450 |
| 13 | Honey | | 104.5 | 38 | 1075 | 240 |
| 14 | Naruneendi | <i>Hemidesmus indicus</i> | 22.5 | 10.5 | 965 | 3310 |



| | | | | | | |
|----|---|---|-----|----|-----|------|
| 15 | Cherutheak | <i>Callicarpa tomentosa</i> | 0 | 0 | 600 | 150 |
| 16 | Kaatinchi | <i>Zingiber zerumbet</i> | 0 | 0 | 100 | 550 |
| 17 | Mulayari | <i>Bamboo sps</i> | 0 | 0 | 20 | 0 |
| 18 | Aatalodakam | <i>Adathoda zeylanica</i> | 6 | 0 | 0 | 0 |
| 19 | Arampuli | <i>Bauhinia malabarica</i> | 0 | 0 | 0 | 0 |
| 20 | Aatuvanji veeru | <i>Homonium riparia</i> | 0.5 | 0 | 0 | 0 |
| 21 | Adapathiyam | <i>Holostemma annulare</i> | 15 | 0 | 0 | 20 |
| 22 | Amalporiveru | <i>Rauwolfia serpentina</i> | 5 | 0 | 0 | 70 |
| 23 | Anachavitti | <i>Elephantopus scaber</i> | 0.5 | 0 | 0 | 0 |
| 24 | Arogyapacha | <i>Trichopus zeylanicus</i> | 2 | 10 | 0 | 0 |
| 25 | Ashokathechi | <i>Ixora coccinea</i> | 0.5 | 0 | 0 | 0 |
| 26 | Cherupullati | <i>Indigofera linnaei</i> | 1 | 0 | 0 | 0 |
| 27 | Chittarath | <i>Alpinia galanga</i> | 0.5 | 0 | 0 | 0 |
| 28 | Dhantapala | <i>Wrightia tinctoria</i> | 5.5 | 0 | 0 | 0 |
| 29 | Ellottipatta/Malamthoda li/Chittilapalvu | <i>Ptereospermum rubiginosum</i> | 3 | 0 | 0 | 0 |
| 30 | Erik | <i>Calotropis gigantia or Calotropis procera(Chitteric)</i> | 0.5 | 0 | 0 | 0 |
| 31 | Etampiri valampiri | <i>Helecterus isora</i> | 0 | 10 | 0 | 0 |
| 32 | Etayilakki/Ettakaya | <i>Musa paradisiaca</i> | 0.5 | 0 | 0 | 0 |
| 33 | Garudakodi/Eeshwaram ulla | <i>Aristolochia tagala</i> | 20 | 10 | 0 | 0 |
| 34 | Kaattumanga | <i>Mangifera indica</i> | 0 | 0 | 0 | 2900 |

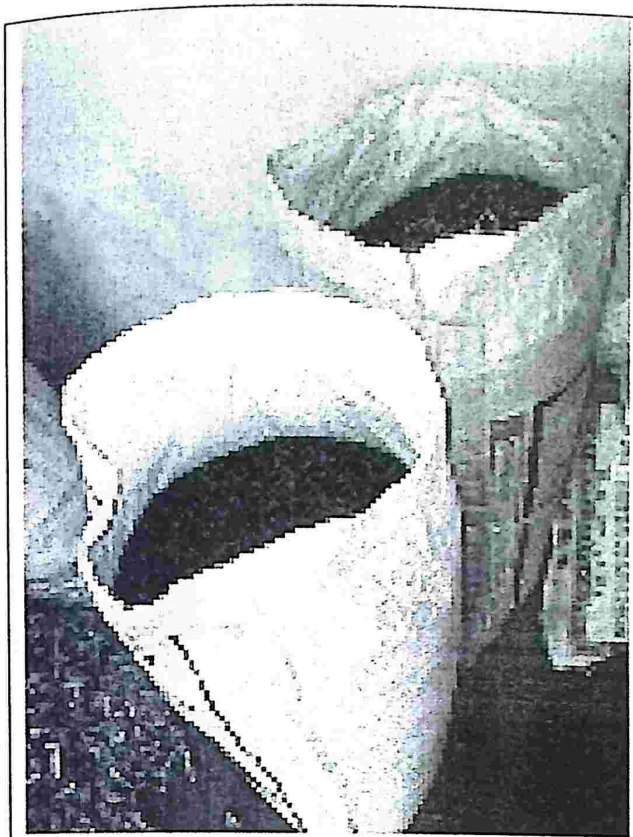
| | | | | | | |
|----|-------------------------------|--|-----|----|---|---|
| 35 | Kaattupadavalam | <i>Trichosantus cucumerina</i> | 0.5 | 0 | 0 | 0 |
| 36 | Kaattuthetti | <i>Ixora spp</i> | 0.5 | 0 | 0 | 0 |
| 37 | Kadalati | <i>Achyranthes aspera</i> | 0.5 | 0 | 0 | 0 |
| 38 | Kadukka | <i>Terminalia chebula</i> | 11 | 32 | 0 | 0 |
| 39 | Kaithonni | <i>Eclipta alba</i> | 1 | 0 | 0 | 0 |
| 40 | Karimtharavu | <i>Spermacocae spp</i> | 0.5 | 0 | 0 | 0 |
| 41 | Karivalanchipatta | <i>Smilax zeylanica Or Heynea trijuga</i> | 1.5 | 0 | 0 | 0 |
| 42 | Kattarvazha | <i>Aloe vera</i> | 1 | 0 | 0 | 0 |
| 43 | Karukapatta | <i>Cinnamomum spp</i> | 5 | 0 | 0 | 0 |
| 44 | Keerikizhangu/keerilapachila? | <i>Anaphyllum wightii</i> | 0.5 | 0 | 0 | 0 |
| 45 | Keezharnelli | <i>Phyllanthus amarus</i> | 0.5 | 0 | 0 | 0 |
| 46 | Kiriyath/Nilaveppu | <i>Swerti chiratta</i> | 2 | 0 | 0 | 0 |
| 47 | Koovayila | <i>Phrenium rheedei</i> | 0 | 40 | 0 | 0 |
| 48 | Koramkandapachhila | <i>Flemingia macrophylla</i> | 0.5 | 0 | 0 | 0 |
| 49 | Kuzhimunda/Kakknjara/Kolarkk | <i>Ardisia solanaceae</i> | 0.5 | 0 | 0 | 0 |
| 50 | Kutangal/muthil | <i>Centella asiatica</i> | 1 | 0 | 0 | 0 |
| 51 | Malathangi | <i>Pericampylus glaucus/Cocculus incanus</i> | 0.5 | 0 | 0 | 0 |
| 52 | Mootillathali | <i>Cuscuta reflexa</i> | 0.5 | 0 | 0 | 0 |
| 53 | Mutthangakishang | <i>Cyperus rotundus</i> | 0.5 | 0 | 0 | 0 |
| 54 | Navara | | 0.5 | 0 | 0 | 0 |
| 55 | Neelaamari | <i>Indigofera tinctoria</i> | 5.5 | 0 | 0 | 0 |
| 56 | Nellikapachila | <i>Phyllanthus spp</i> | 0.5 | 0 | 0 | 0 |
| 57 | Orilakanjiram | | 5.5 | 0 | 0 | 0 |

| | | | | | | |
|----|-----------------------|--|------|-------|---|-----|
| 58 | Pachhoottipatta | <i>Symplocos cochinchinensis</i> | 0 | 0 | 0 | 0 |
| 59 | Panapoo | <i>Myristica malabarica</i> | 460 | 133 | 0 | 0 |
| 60 | Plamanja | <i>Coscinium fenestratum</i> | 5 | 0 | 0 | 0 |
| 61 | Ponkorandi | <i>Salacia oblonga</i> | 0.5 | 0 | 0 | 0 |
| 62 | Poovamkurunnila | <i>Vernonia cinerarea</i> | 1 | 0 | 0 | 0 |
| 63 | Shankupushpam/Aaral | <i>Clitoria ternatea</i> | 2 | 0 | 0 | 0 |
| 64 | Shathavari | <i>Asparagus racemosus</i> | 66.5 | 76 | 0 | 350 |
| 65 | Thaanikka | <i>Terminalia bellerica</i> | 1 | 0 | 0 | 0 |
| 66 | Thakkalipoo | <i>Kalanchoe spp</i> | 10 | 0 | 0 | 0 |
| 67 | Theendanazhi/Mukkutti | <i>Biophytum sensitivum</i> | 0.5 | 0 | 0 | 0 |
| 68 | Teakseeds | <i>Tectona grandis</i> | 0 | 0 | 0 | 300 |
| 69 | Thulasi | <i>Ocimum tenuiflorum</i> | 1 | 0 | 0 | 0 |
| 70 | Ushnakranthi | <i>Evolvulus alsinodies</i> | 0.5 | 0 | 0 | 0 |
| 71 | Vathamaparathi | <i>Artanema longifolium</i> | 1 | 0 | 0 | 0 |
| 72 | Thumba | <i>Leucas aspera</i> | 0.5 | 0 | 0 | 0 |
| 73 | Vayanapoo | <i>Cinnamomum verum</i> | 493 | 130.5 | 0 | 0 |
| 74 | Veliparuthi | <i>Pergularia daemia or Talipariti tiliaceum</i> | 0.5 | 0 | 0 | 0 |
| 75 | Vellikunniveru | | 0.5 | 0 | 0 | 0 |
| 76 | Venga | <i>Pterocarpus marsupium</i> | 0.5 | 0 | 0 | 0 |
| 77 | Veppila | <i>Azadirachta indica</i> | 0.5 | 0 | 0 | 0 |
| 78 | Nochi | <i>Vitex negundo</i> | 6 | 0 | | |
| 79 | Pathimukham | <i>Caesalpinia sappan</i> | | | | |
| 80 | Chool pull | | | | | |

Note: Species are identified from their common name based on common names given in "Flowering plants of Kerala" book published by JNTBGRI. Ambiguous common names with two or more species known by the same name are also retained in the table.

Annexure V : Photos from the Field

| | |
|---|--|
|  | <p>Minor Forest product shop of Velukutty in Kottur Market, Private players are having a monopoly in Minor Forest Produce market in the region with lion share of the MFP from Agastyvanam Biopark, Neyyar Wildlife Sanctuary reaching here.</p> |
|  | <p><i>Zingiber zerumbet</i> Wild ginger in Kottur market</p> |



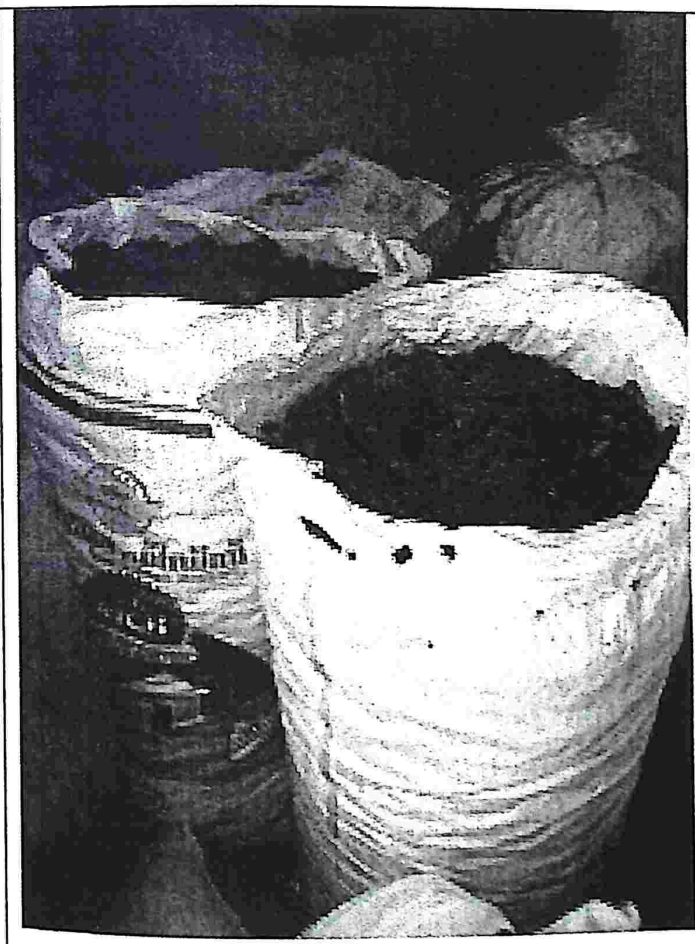
Wild pepper which are smaller than pepper have slightly different smell and taste and is used mainly in medicines. Price of Wild Pepper is less than pepper



Cyclea peltata root in Kottur MFP market



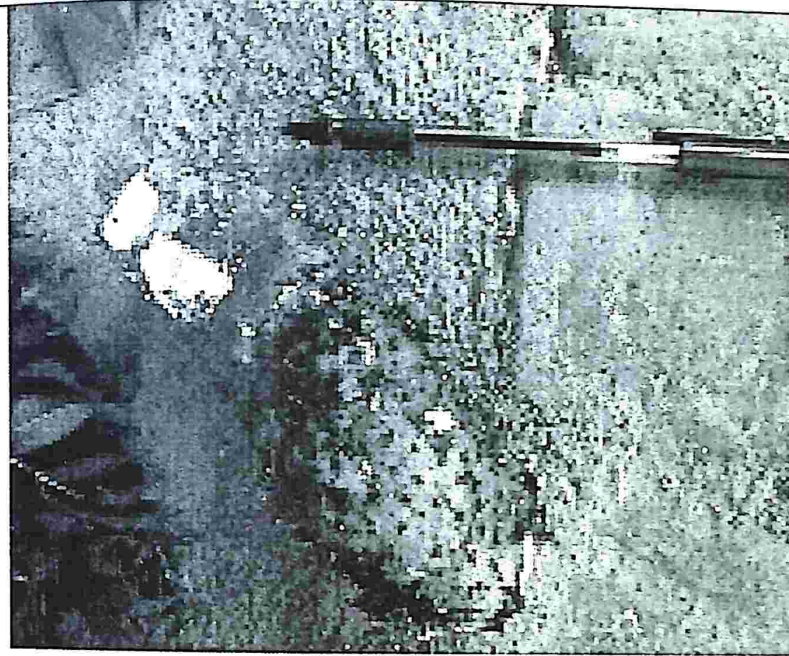
Kudampuli(*Garcinia gummigutta*) which was traditionally used by tribal people as condiment is now replaced by Tamarind. Kudampuli in MFP shop in Kottur.



Myristica malabarica seed aril collection in Kottur market



Myristica seed aril in Kottur market



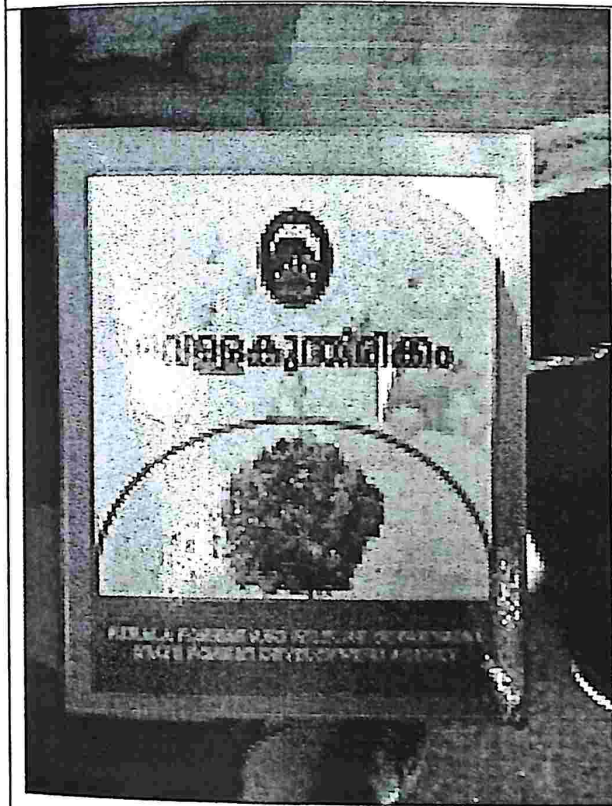
Dioscorea pentaphylla is one among the commonly used wild edible tuber in all study sites



Bryophyllum species- (Thakkali poo) is sold as toy for kids (since it's buds burst with a sound)



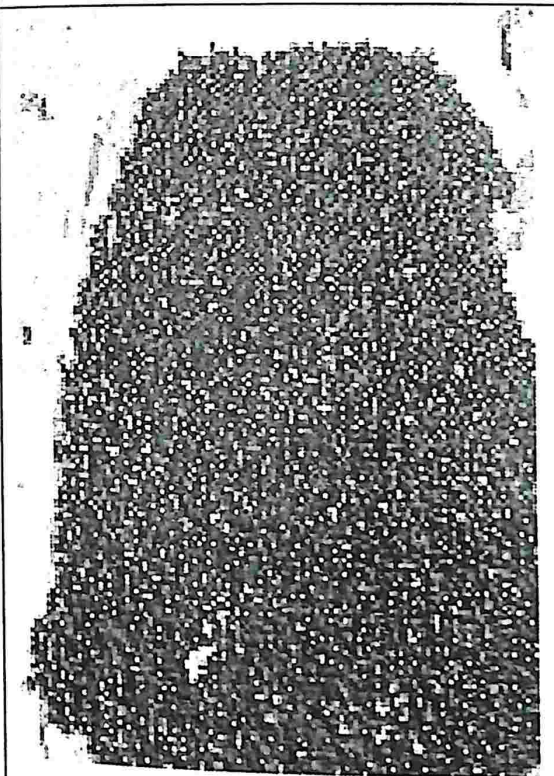
Black dammar in Kottur market



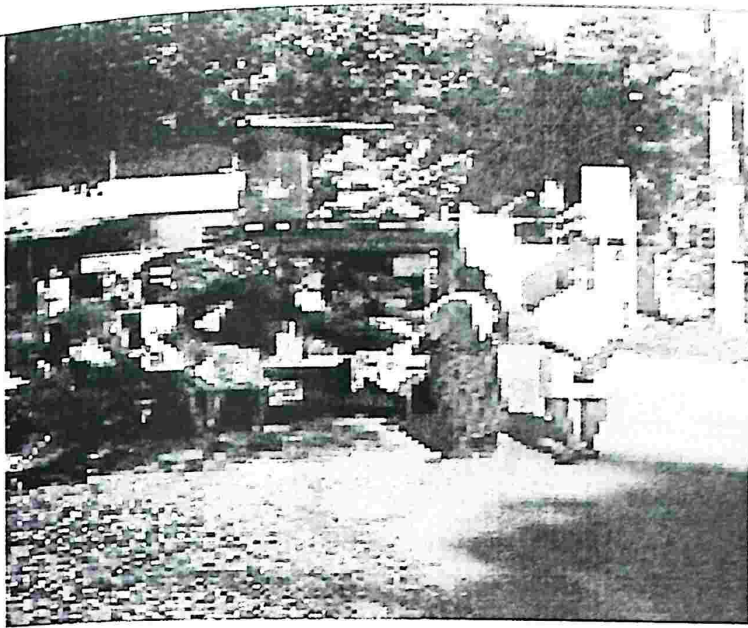
White dammar pack sold through Eco-shops of Kerala Forest Department. Eco shops helps in getting higher prices for the same product.



Natural gum
exudation from
White dammar



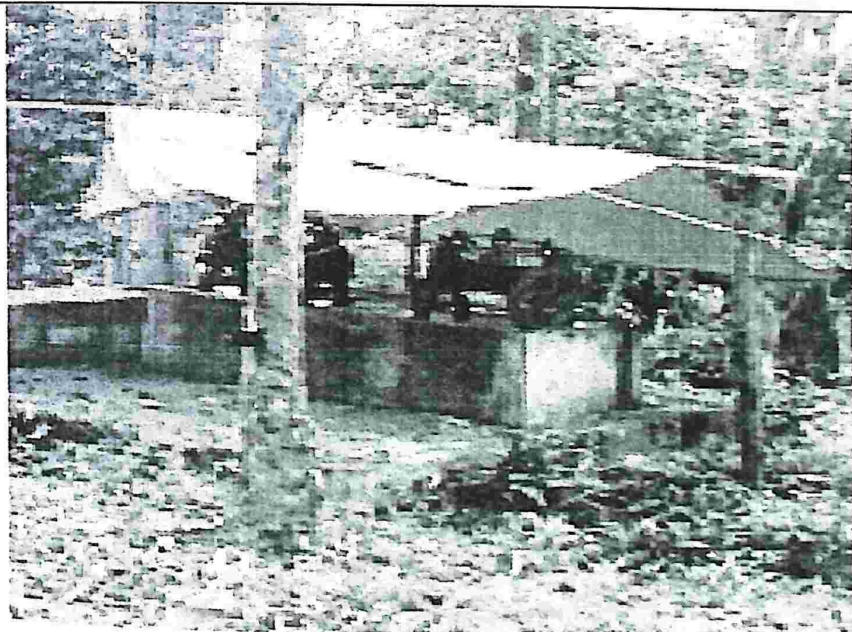
Wild banana seed
processing by MFP
shop owner in Kottur
market



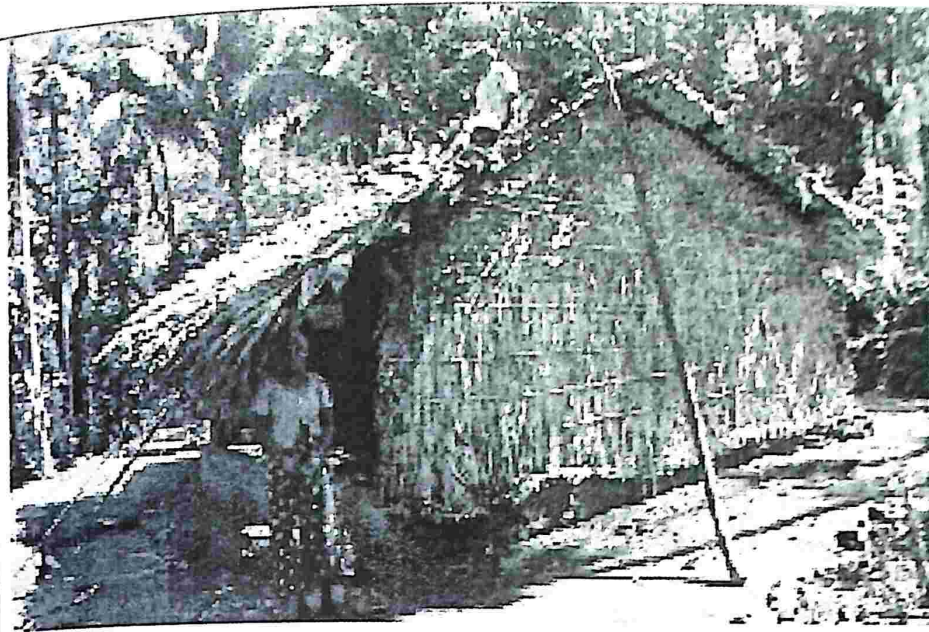
Kottur MFP market is similar to a weekly market with main sale only in Wednesdays and Saturdays. On these days people even from remote villages in forest will come and sell their product and purchase essential needs for that week from that money. Kottur market is said be present even during rule of Aye and other dynasties of the region. The main cost for MFP collectors in remote is the transport charge for jeep. Since the villages are located in hills with rough terrain except jeeps there is no transportation facility.



Trichopus
zeylanicus near
Athirumala in
Neyyar

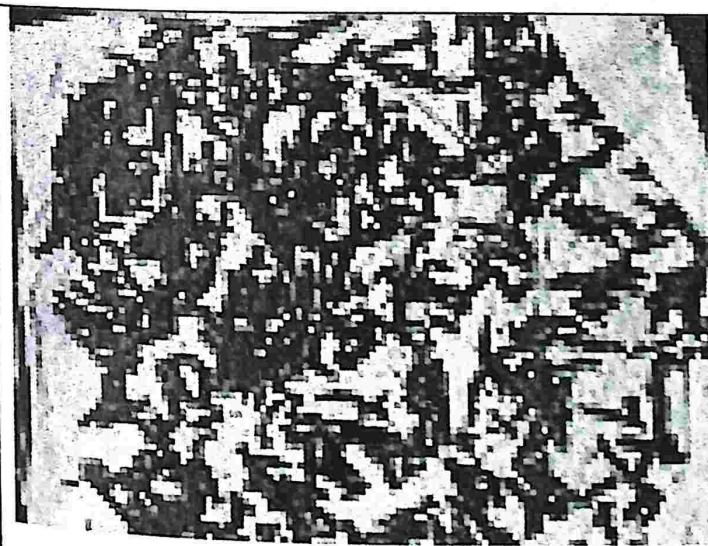


In tribal settlements inside sanctuary natural vegetation are converted into Rubber and other cash crop plantations since tribal see it as more remunerative and easy income source than MFP collection.

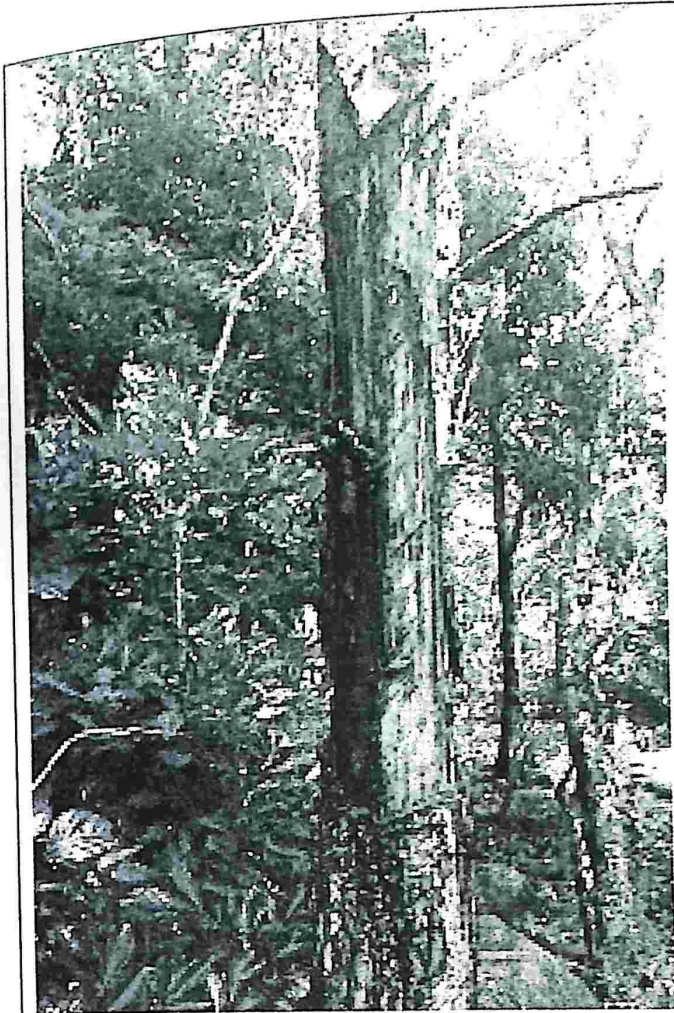


House made out of *Ochlandra* reed poles and leaves. Majority of the households in the study areas have houses provided under different Housing schemes by government and other organisations like AHADS. Now only very few houses are built in traditional way as this one from Neyyar wildlife sanctuary.

Site II: Silent Valley National Park and Attapady Reserve Forest



Cheenikka/Shikkaka i collection from a household in chindakki settlement, Silent Valley



Wild mango tree bark is collected by MFP collectors since there is huge demand for it in the local market. Traditional medicine practitioners in the region use wild mango bark.

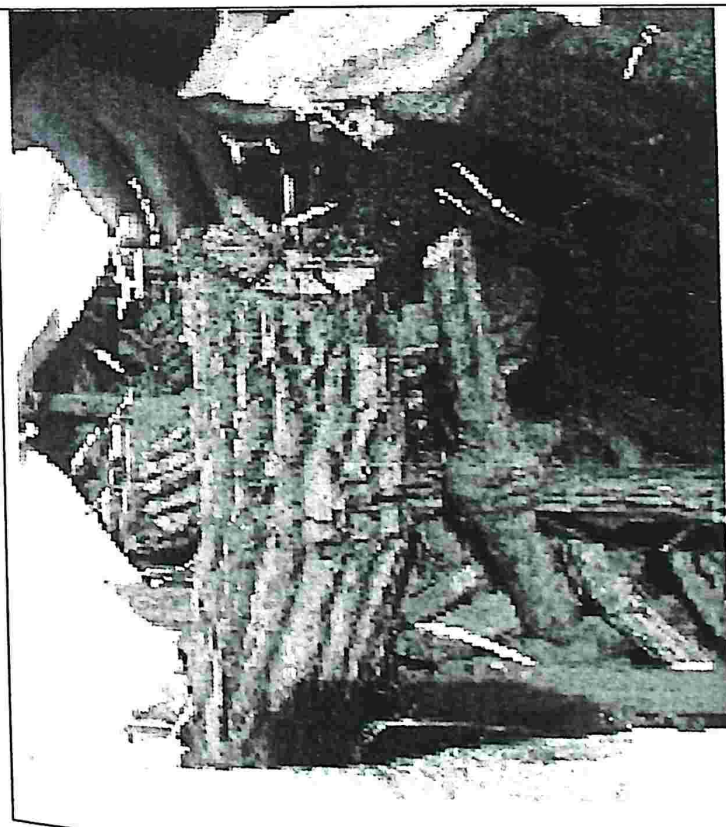
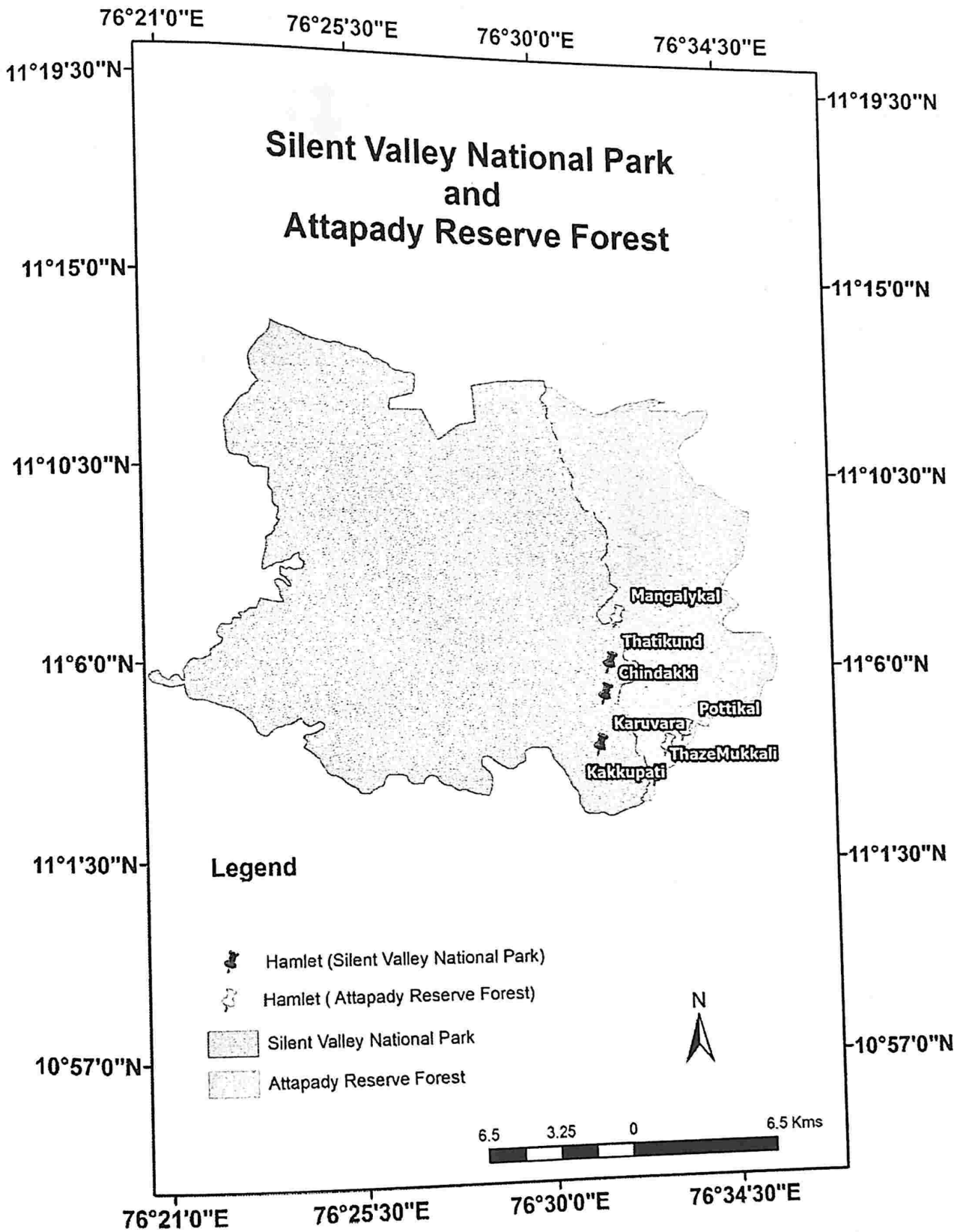


Image of Wild pepper stem collection in Thatikund Settlement, which include even base of large climbers. Such collection destroys the whole climber and is a destructive harvesting practise.



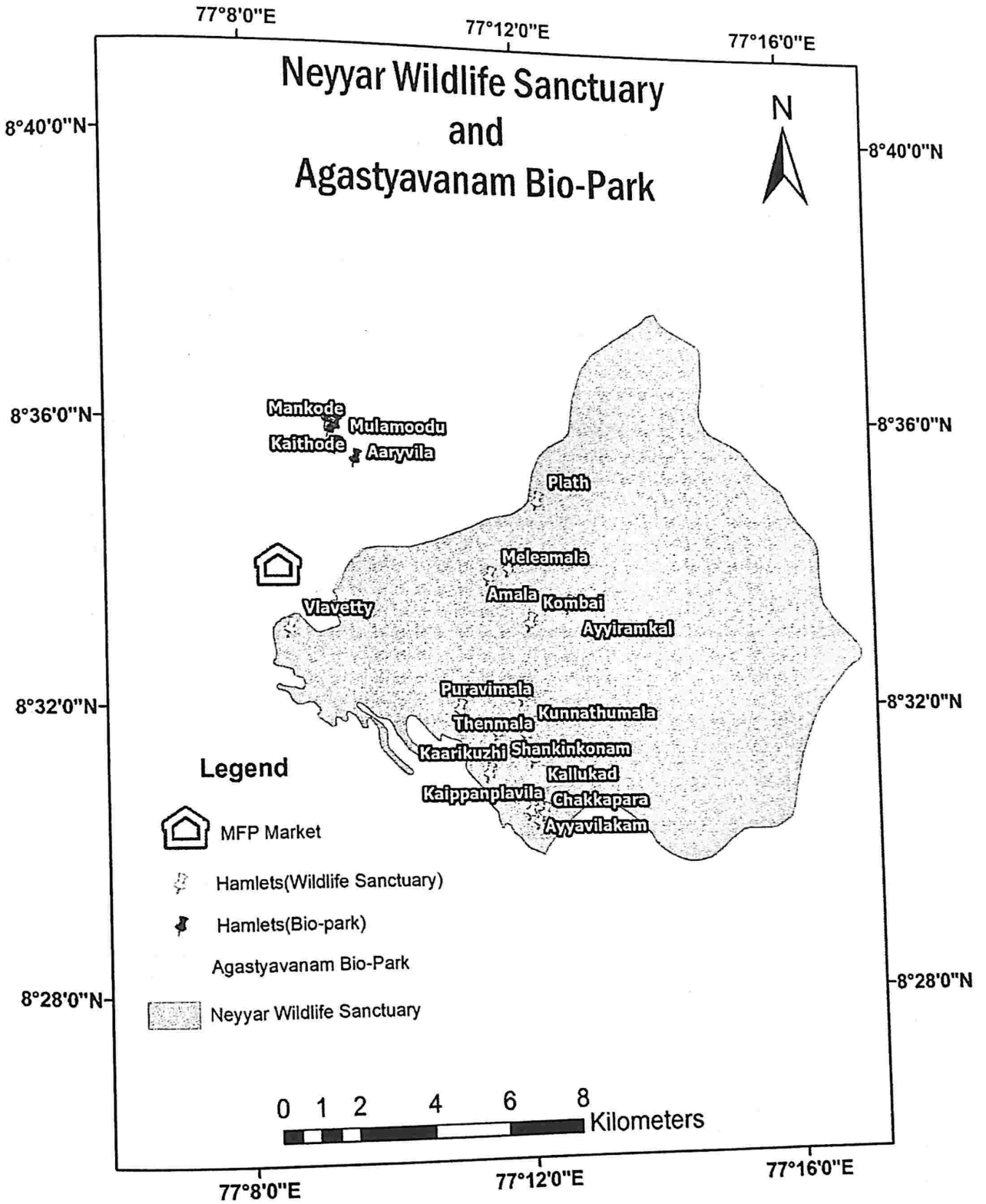
Area cleared for shifting cultivation in Attapady Range. Such cleared areas are called "Panchakad" by the tribe.

Annexure VI: Site 1



Note: (only study area in Attapady Reserve Forest is shown in the map not entire range)

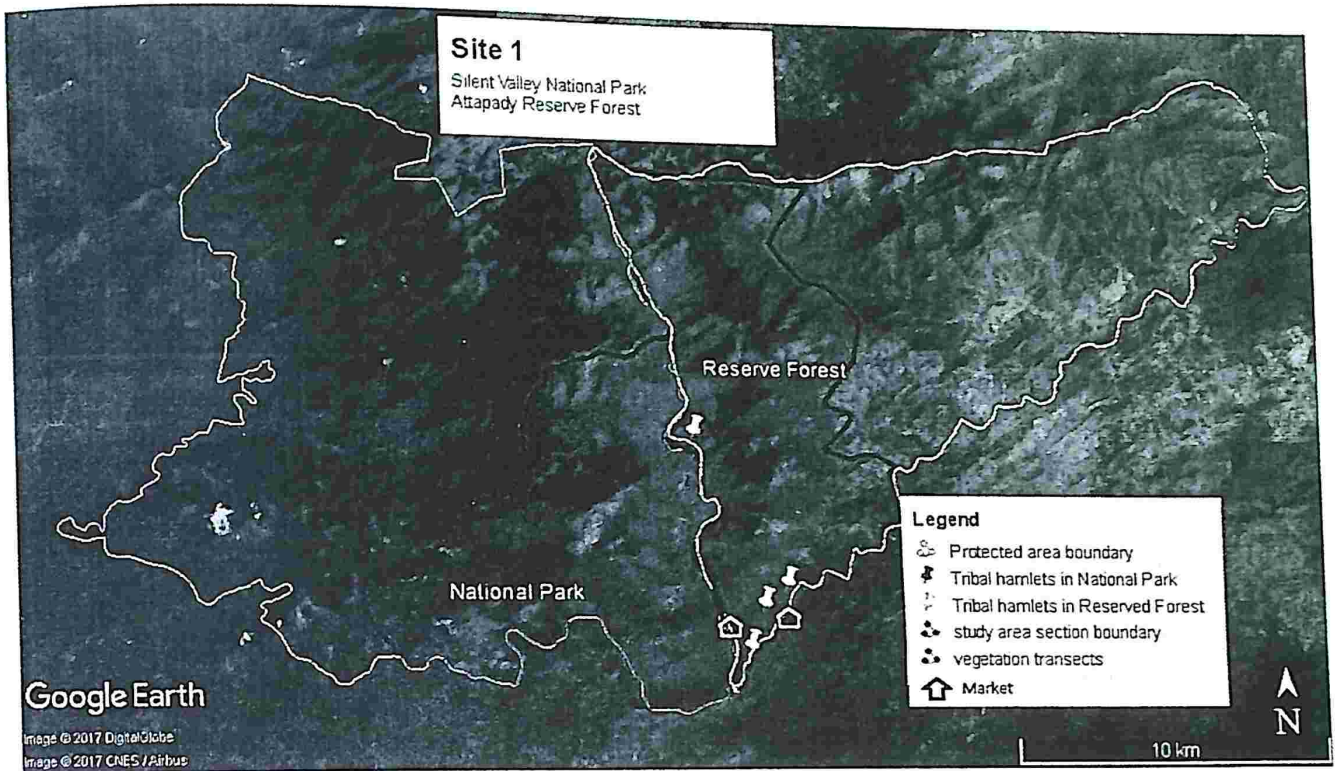
Annexure VII: Site 2



Note: Agastyavanam Bio-park boundaries may not show the original forest boundary

Annexure VIII: Forest cover and hamlet locations in site 1

(Attapady Reserve Forest and Silent Valley National Park)



Annexure IX: Forest cover and hamlet locations in site 2

(Neyyar Wildlife Sanctuary and Agastyanam Bio-Park)

