CONTENTS **Page No.**

DECLARATION

I K.Lalhmingsangi, hereby declare that the subject matter of this thesis is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to do the best of my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other University/Institute.

This is being submitted to the Mizoram University for the degree of Doctor of Philosophy in Department of Forestry.

K. LALHMINGSANGI

DEPARTMENT OF FORESTRY
MIZORAM UNIVERSITY: TANHRIL

Professor U.K. Sahoo
Mobile: +919436150944, +917005815370
E-mail: uksahoo_2003@rediffmail.com

SUPERVISOR'S CERTIFICATE

I hereby certify that the thesis entitled **"Production, Utilization and Marketing of Non-Timber Forest Products in Joint Forest Management in Mizoram"** submitted by Ms K.Lalhmingsangi, for the degree of Doctor of Philosophy in Forestry of Mizoram University, Aizawl embodies the record of original investigation under my supervision. She has duly registered and the thesis presented is worthy of being considered for the award of the Ph.D Degree. The work has not been submitted for any degree of another University.

AIZAWL
.........December, 2018

(PROF. U.K. SAHOO)
Supervisor

ACKNOWLEDGEMENT

Sincere gratitude is hereby extended to people who never ceased in helping me until this thesis was structured and materialized.

I would like to express my sincere gratitude to my supervisor Prof. U. K. Sahoo for his unwavering guidance and never ending support throughout the work.

I extend my heartfelt thanks to all the Village Council President (VCP) from the 25 study sites, VFDC members, Forest department staff and all the families who provide me an accomodation and helped me to carry out my field work. I am extremely thankful to all the villagers who spend their valuable time and energy and participate in Participatory Rural Appraisal (PRA).

I am obliged to the Head of Department, professors and staff of Department of Forestry, Mizoram University for their valuable support and kindness.

I am very grateful to Dr. Soibam Lanabir Singh, Mr Lalsangliana (Chhippui), Mr Emanuel Lalramengmawia and all my fellow research scholars for their support and encouragement.

Financial assistance received from National Fellowship and Scholarship for Higher Education of ST students (NFST) during my research work is gratefully acknowledged.

Above all, the utmost appreciation to the Almighty God for the endless blessings, families and friends for their moral and emotional support.

Date:

Place: Aizawl **K. LALHMINGSANGI**

List of Tables

List of figure

CHAPTER 1

INTRODUCTION

Non-Timber Forest Products (NTFPs) are defined as, ‘goods of biological origin other than wood derived from forests, other wooded land and trees outside forests” (FAO, 1997). NTFPs are also variously called as secondary, minor and non-wood forest products. Examples of NTFPs are products used as food and food additives (nuts, mushroom, fruits, spices and condiments, aromatic plants), fibers (used in construction, furniture, clothing or utensils), resins, gums, plant and animal products used for medicinal, cosmetic or cultural purposes. The importance of Non-Timber Forest Products (NTFPs) and their contribution to the livelihoods of the rural people and alleviating rural poverty is well known. They are primarily resources from forests in developing countries and significant to rural and national economies in providing food materials and other benefits (Chou, 2018a, b; Khosranis *et al*., 2017). Depending on the economic and cultural contexts, the role of NTFPs varies from one place to another. In developed countries NTFPs are usually used for cultural and recreational purposes, conserving biodiversity and development of rural economic growth (Suleiman *et al*., 2017).

At global level, more than a billion people are directly dwelling in forest, depending on NTFPs for subsistence, income and livelihood security (Vantomme, 2003) and the remaining six billion of the population depends on forest for various economic, social and environmental benefits services such as NTFPs, other biodiversity, pollinators, carbon storage and clean water. Among these NTFPs provide significant outcome in contribution of adequate food, fuel, health and fibre for growing populations (Pandey *et al.*, 2016). According to the World Bank (2001) report, approximately one-fourth of the world’s poor and 90% of the poorest rely significantly on forests for their livelihoods. De beer and Mc

Dermott (1989) estimated that about 100 million people especially communities living inside and on the fringes of forest areas depend on NTFPs for food, shelter, medicine, cash income etc. Despite the fact that NTFPs are important worldwide in sustaining livelihoods of many forest fringe communities, very little attention was given for proper inventory. Several other studies too Suleiman *et al.*, (2017) support the fact that the poorest forest dwellers are highly dependent on NTFPs to sustain daily family requirements (Xayvongsa *et al*., 2009; Toksoy *et al*., 2010; Sarmah, 2010).

In developing countries too, majority of households in urban areas depend on the NTFPs to supplement their nutrition, health, house construction, or other needs (Shackleton *et al*., 2015a). Besides, to nourish their macronutrients, carbohydrates, fats and proteins or other essential micronutrients requirements from NTFPs (FAO, 1992) NTFPs thus create high economic value for majority in providing people not only in meeting their subsistence need but also employment and improved rural livelihood (FAO, 1995; World Bank 2006). According to the studies carried out by Asfaw *et al.* (2013) and Babulo *et al.* (2009), the contribution of NTFPs daily net resources to livelihood typically ranges from 10-60% of total household income. Many reports also mentioned the role of NTFPs in providing household with means of income generation, either supplementary income to other livelihood activities, or as the primary means of cash generation (Areki and Cunningham, 2010; Babulo *et al*., 2009, Mahapatra *et al*., 2005; Marshall *et al.*, 2006; Schackleton *et al.*, 2008). Though NTFPs may not serve as the principal source of income generation for people living adjacent to the forest, yet their contribution to food security, household income and healthcare are quite significant.

NTFPs too have provision of multiple social and cultural values (Ojea *et al*., 2016 Endamana *et al.*, 2016). They are considered to be more accessible to rural population, especially to the rural poor (Kumar and Saxena, 2002); important for sustaining rural livelihood, reducing poverty in rural areas, biodiversity conservation and facilitating rural economic growth (Global NTFP partnership, 2005). In the developing countries, the potential of NTFPs in the livelihoods and wellbeing of local people is highly significant, yet it is intriguing that very little or no given for developing this sector and no supporting government policies are yet in place (Shackleton and Pandey, 2014).

Various studies reveal the role played by NTFPs in improving rural livelihoods. Several opportunities for improved rural development are linked to NTFPs (Adepoju and Solau, 2007). Many forest-dependent communities improve their food, shelter and obtain income through collection and marketing of NTFPs (Sahoo *et al*., 2010). It was estimated by FAO(1997) that 80 percent of the populations living in developing countries use NTFPs to meet their needs in health and nutrition. The estimated market value of herbal medicine alone (a large proportion of which is collected from the wild) is about US $ 14 billion (Secretariat of CBD, 2001). Harvesting, processing and marketing of products based on wood, non-wood materials and services provided by the forests are an important tool for deriving the value of forest resources (Lintu, 1995). Billions of people all over the world are utilizing NTFPs to provide them a social security, source of employment and income generation by providing food supplements, herbal medicine, fuel and fodder. The people's dependency on commercialization of NTFPs increases and in some cases, the revenue earned from NTFPs became the only source of cash income (Pandey *et al.*, 2016).

In India, it is estimated that 275 million people from the rural areas, i.e 25% of the total population depends on NTFPs for at least part of their subsistence and cash livelihoods. This dependency is particularly acute for half of India's 89 million tribal people who are presently living in the fringe of forest areas (Pandey *et al*., 2016). About 70% of collection of NTFPs in India occurs in the tribal areas of the country, whereas 55% of the employment in forestry sector is attributed to NTFP sector. NTFPs provide 50% of the household income from the forestry sector and approximately one third of India's rural population. NTFP collection being the major source of income and employment for forest dwellers, it gives multiple impact on economy through downstream processing and different trading activities (Malik, 2000). In India, socio-economic and cultural lives of forest dwellers all over the country are closely associated with NTFPs (Pandey and Bisaria, 1998; Anonymous, 2009). Depending on the ecological, historical and cultural factors, the livelihood of the tribal community varies considerably between different regions and also among different ethnic groups. In Manipur alone, a north-eastern state of India, nearly 90% of the population depends on forest products as a major source and some 250,000 women are employed in collecting forest products (Pandey *et al*., 2016). According to the recent report (Pandey *et al.*, 2016) at least 35 million man-days of employment can be generated in the NTFPs trading which includes collection and processing of economically valuable NTFPs species in India.

According to the studies by MoEF (2006), NTFPs provide substantial inputs to the livelihoods of forest dependent communities, especially to those of whom with limited non-agricultural income opportunities. However, tenure security, lack of processing skills and non systematic market access are the limiting factors restraining the generation of greater benefits from these forest resources. In India, contribution of NTFPs in income is equivalent to US$ 2.7 billion per year and absorbs 55% of the total employment in forestry sector. 50% of the forest revenues and 70% of forest based export income come from forest products (Shiva and Verna, 2002; Chauhan *et al.,* 2008).

Forest resource availability is expected to influence the forest products and what quantities are used and sold. The location of the villages from the forest is expected to have effect on the harvesting of NTFPs from the forest. According to the studies by Belcher *et al* ., (2015), closeness of forest and remoteness from markets tend to be positively correlated, though poor market accessibility may limit the advantage of better forest resource availability as a source of cash income. It was also found out that villagers with good forest resources and better accessibility would be able to generate higher forest-based revenues. The people living in the fringe of forest also tend to be politically and economically marginalized, many are indigenous or culturally conservative, with long established subsistence based livelihood traditions (Sunderlin *et al*., 2005). The economic relevance of NTFP differs between the poor and the wealthier household, as the poorer household are relatively more dependent on NTFPs as compared to those of the wealthier households. Markets, government services and urban amenities are usually far from the forested areas, with correspondingly lower income and employment opportunities and with higher levels of poverty and social and political marginalization are the factors expected to influence use of forest (Sunderlin *et al*., 2005). However, the economic significance of NTFPs differs between households with regard to their annual household income; the lower the total household income, the higher the share of NTFPs income, i.e. the higher dependency on woodland products to meet basic consumption needs. NTFPs providing plants are highly prone to overexploitation or overharvesting in the near future. It is not appropriate to restrict further access to woodlands in order to conserve woodland resources and biodiversity because it would be likely to increase poverty. In the same time, developmental action should consider that adopting the cultivation of NTFPs extraction remains a low return activity. Therefore, lowering the opportunity costs of conserving woodlands, i.e. NTFPs dependency, might be rather achieved by creating sturdy income opportunities independent of NTFPs extraction or by increasing the efficiency of crop production systems in order to avoid lean times which drive the people to exploit more resources. This technique will play an important role in improving the lives of rural community and also conserve woodland resources and biodiversity (Heubach *et al*., 2011). A study carried out by Cavendish (2000) on forest environmental income in Zimbabwe found that wild food (plants and animals), medicinal plants, various woodland grasses, forage plants as well as soil and termite uses to account for 35% of the average rural income. Sale of NTFPs was found to contribute 36% for the poor, 9% for the medium and 4% for the rich household. The NTFPs thus provide employment opportunities for the local people and the poorer households generate higher income from the sale of NTFPs as compared to the medium and rich households (Reshad *et al.,* 2017). According to Osemeobo (1991), 4000-6000 NTFPs have been cited for commercial value, and approximately 150 NTFPs have been documented in terms of international trade (FAO, 1997). FAO (1997) estimated that the total value of internationally traded NTFPs is about 1.1. billion US dollar annually. Hammet (1999) found out that the relationship between the economic benefits of NTFPs and their resource base and source are not well understood sufficiently. Arrnold and Perez (1998) have reported that NTFPs in some cases may provide higher contribution to the rural livelihood much better than timber products since timber growing has a very long gestation period, whereas NTFPs play an important role in providing seasonal employment and income to villagers. In recent years, NTFPs became global interest due to its contribution in providing different needs for the rural community, for the household food security, providing employment generation and income, NTFPs based marketing, foreign exchange earnings, support biodiversity and other conservation objectives (FAO, 1995; Getachew and Wubalem, 2004). In the past years, forest conservation was simply to sustain the forests' productive role for the timber industry. However, in many countries over the past 15 years, another view has emerged that formally acknowledged the importance of local use of forests (Marla and Rebecca, 2001). Ethiopia is well known for its rich and vast biodiversity resources that have a number of NTFPs, the rich NTFPs play significant role in subsistence as well as in marketing economy, food security and in poverty alleviation for a large number of communities in the country (Vivero, 2002).

Harvesting of NTFPs can have a positive or negative impact on the conservation of biodiversity (Bhattarai and Croucher, 1996; Schaafsma *et al.*, 2014; Chanthayod *et al*., 2017). Although non-lethal NTFPs harvest does not lead to direct plant mortality or removal, it may reduce reproduction and plant growth significantly (Gaoue and Ticktin, 2008), which in turn affect long term population demography (Ghimire *et al.*, 2008; Gaoue *et al.*, 2011). Both timber and Non-timber forest products can have synergistic effects on population dynamics, and NTFPs harvesting affects the plant population growth as well (Gaoue *et al.*, 2016). Sixty percent of NTFPs collected are consumed as food or as a dietary supplement by forest dwellers which serve as an important livelihood system of forest dwellers. The percentage of NTFPs varies from state to state and is estimated to range from 5.4 percent to 55 percent (Khare *et al.*, 2000).

Management and control during the collection of NTFPs is very important because they are becoming vulnerable, endangered and even extinct (Acharya, 2000). The collection of many NTFPs products like leaves, bark, fruit, roots, flowers and whole plant may cause high mortality but have low adverse impact in regeneration potential. If whole plant uprooted or felled to collect leaves and seeds instead of plucking from the twigs and branches then it might lead to unsustainable harvesting. Collection of roots, whole plants and barks are even more sensitive to plant growth. Inadequate knowledge about the phenology, ecology, and regenerative capacity of the important species (Hedge *et al*., 1996), appropriate harvesting time, harvesting techniques, post-harvesting practices and improved processing techniques for value addition, lack of standardized selling units in practice by collectors, weak market linkages between local collectors and road head traders, poor access to market information-product price, product chain, end users, product certification and quality control (Pierce,

2003) are some of the important issues which need to be addressed. The crucial role of non-timber forest products in rural livelihood and its biodiversity conservation strategy are realized day by day (Ojha, *et al*., 2001). Community forest contains a diverse species of non-timber forest products which are mainly endemic in their respective areas. Over exploitation of NTFPs leads to depletion of NTFPs, deforestation and forest degradation and thus have a major issue of concern that may affect the NTFP based livelihood and economics (Pandey *et al.*, 2016)

Non-timber forest products can be harvested for own consumption or sold to fill cash crops (World Bank 2001), they are also harvested to get economic returns. The weaker sections of the society are benefited with quick cash or consumption goods especially in the event of unpredicted shortfalls, such as disaster or failure of agricultural crops (Angelsen and Wender, 2003) and thus NTFPs provide a natural insurance or safety net (Vedeld *et al* ., 2007) or as a stepping stone to increase their income (Dorward *et al.*, 2001). To be financially competitive, there should be good production scale with good quality control which can provide the right quantities at the right time and be priced competitively (FFOT**)** Community Forest (CF) can play an important role in promoting NTFPs as well as in providing local employment (Malla, 1993).

Yet, in many developing countries with limited access to modern medicines, the World Health Organisation (WHO) estimated that up to 80% of the population rely on traditional medicines, mostly plant-based drugs, for their primary health care. In many cases, such medicines are a prime source of health care available to the poor and many people use these remedies. In Germany 40-50% of the population are using traditional medicines, 42% in USA, 48% in Australia, 49% in France, in the meantime both in India and China, traditional medicines based on wild plants and animal source are one of the most important major export industries (Pandey *et al*., 2016). The peoples' interest on medicinal plants are increasing worldwide because they are easy to prepare, cheap, and have few side effects on animals and the environment. The roots, leaves, seeds, flowers, whole plant or extract compounds can be used (Hai. 2016). According to an estimate between 35,000 and 70,000 plant species are used in folk medicine worldwide (Ali and Qaiser, 2009). Medicinal plants remained an important source of raw material for traditional system of medicines like Ayurveda, Chinese, Unani, Siddha, Tibetan and other across the globe (GOI, 2000). Many of the modern medicines are based on plants from the wild or from their extracts. The World Health Organization (WHO) (2002) estimated that up to 80% of the population in developing countries which are having limited access to modern medicine rely on traditional medicines, mostly plant based drugs for their primary health care. The herbal medicines are a prime source of health care available to the poor community and used as remedies. 40-50% of the population in Germany use traditional medicines, 42% in USA, 48% in Australia and 49% in France. In the country of China and India, traditional medicines based on wild plants and animals are major export industries (Pandey *et al*., 2016).

Products from hundreds of species are being collected from remote forests and meadows and traded to international markets and consumed (Olsen and Bhattarai, 2005). These harvests provide an important source of income to huge number of rural households. About 70 to 80% of the world population use traditional medicine for curing their illness and ailments (Fransworth and Soejarto, 1991). The percentage of people using traditional medicine decreased in developed countries (Titz, 2004) due to the availability of health facilities. Nearly 80% of the world populations rely on the use of traditional medicines to meet their primary health care needs (Sandhya *et al*., 2006) whereas; up to 90% of the developing world relies on the use of medicinal plants (WHO, 2002). Out of the total 4, 22,000 flowering plants reported from the world, more than 50,000 are used for medicinal purposes (Gavaerts, 2001; Schippmann *et al.,* 2002). The multipurpose use and increasing demands for plants have resulted in over-exploitation and over–harvesting of medicinal plants. In rural areas of developing countries, the role of NTFP in risk-smoothing is important since agricultural crops are affected by different types of risk which include price shocks, seasonal flooding or drought, pests and disease (Mahapatra and Shakleton, 2012).

Participation of women in community forestry is very important for good forest governance. Periodic assessment and understanding of gender and equity, women's participation, politics, education, empowerment and other public sphere in the process of managing common property resource through collective action are highly needed for the success of community forest management (Giri, 2011). Studies all over the world have shown that harvesting of forest resources for daily needs-firewood, fodder and leaf is primarily done by women. The extra burden added to women as a result of declining forest resources has been given a great deal of attention, especially to the Indian Himalayas (Agarwal 1992; 1997). From the research done by Agarwal (1997), Beck (1994), Daniggelis (1994) and Shiva (1998), it had shown that forest resources are an important source of livelihood security especially for the women and lower caste by providing access to resources. Although women makes a significant contribution in the collection, processing and marketing of NTFPs, they get back a low returns because of poor attention to the potential of NTFPs marketing by key stakeholder (policy makers, market players, extension services). This relative neglect is worsening by the shortage of data and analytical work on gender differences in forestry value chains (FAO, 2014).

In Gujarat, thousands of poor women rely on collection of gum karaya for their household income. Most of them do not own any collection licenses and are forced to sell at very low prices in the market (FAO, 2014). Self Employed Women's Association (SEWA) helped the female workers of gum collectors to organize into groups. These groups secured licenses for their members and were able to negotiate higher selling prices with the Gujarat State Forest

Development Corporation. Eventually, the women also won the right to sell on the open market, where prices are higher (SEWA, 2000). Out of the 87 community forest groups in India visited by Agarwal (2001), 60 had a ban on fuelwood collection, 21 did not permit entrance to the forest at all, and 24 allowed entrance for a few days annually for the collection of dry wood. As a result, many women were forced to travel long distances in search of fuelwood for their own consumption. The long-term goal was thus not necessarily to give everyone equal access to all resources but was rather to foster equitable distribution mechanisms such that everyone was able to obtain what they needed at different points in time. The management process within community forestry and how effective participation related to access and control over resources are important considerations in any successful community forestry programmes (Nightingale, 2002).

Ethno-botany of many NTFPs and their potential for socio economic development from the north eastern states are also reported by many authors (Dutta and Dutta 2005). Many communities still depend on hunting/ gathering from forest (Gangwar and Ramakrishnan 1987; Sundriyal *et al.*, 1998). There are some NTFPs of plant origin which has a high market potential and in turn be a source of income for the harvester if value addition is done to it (Dhyani and Khali, 1993; Maikhuri *et al.*, 1994).

Joint Forest Management (JFM) is a concept of developing partnership between the forest user groups and Forest department (FD) on the basis of mutual trust and jointly defined roles and responsibilities in forest protection and development. JFM is slowly emerging to form a sustainable forestry, which augments the forestry regime with processes for rapid adaptation to changes in what people need, want, and can do. As an adaptive social process, JFM strive to create sufficient future forest production opportunity to satisfy potentially competitive/conflicting interests that would diminish the forest if left unresolved. After the

National JFM guidelines were issued in 1990, many States are now implementing the programme. The JFM programme is currently implemented by 106,482 Joint Forest Management Committee (JFMC) covering 22 million ha of forest spread across 28 states of India and Union Territories (Bhattacharya *et al.,* 2010). Joint Forest Management (JFM) programme play an important role in the development of the state- community partnership and its attempt to shape the partnership between forest department and the forest users group in regeneration of degraded forest land is also known (Sundar, 2000). JFM programme in India is a remarkable example of institutional innovation and represents a major effort to make the policy work for both the forest and the people (Saxena, 1999). The implementation of community forestry policy was found to have positive impact on the sustainable production of NTFPs (Dhakhal *et al.,* 2016).

Mizoram issued enabling orders in 1998 for JFM and this program have brought many degraded forest and 'jhum' (local name for shifting cultivation) areas under forest conservation since 2003-2004 by assisted natural regeneration, artificial regeneration, bamboo plantation, regeneration of perennial herbs, shrubs of medicinal plants and mixed plantations of trees having minor forest products and medicinal values which can help in providing revenues to the people protecting the forests and encouraging sustainable harvesting of the products. Forest dwellers dependent on forest products for fuelwood, fodder, small timber and NTFPs across the state are now accessed to NTFPs under different right regimes. There are 24 FDs implementing National Afforestation Programme till Financial Year 2014-15 in the state of Mizoram. Since 2015-16, only 13 FDAs are implementing NAP scheme. Currently, there are 447 Village Forest Development Committees under these 13 FDAs. During the pre-JFM period, in many States including Mizoram, communities had illicitly extracted forest produce, with or without the knowledge of the FD field staff. However, under the JFM programme, the forest dwellers communities are allowed to harvest fodder, fuelwood and other NTFPs to meet their basic needs. In lieu of this, people are protecting and managing the forests with the FD. By implementing JFM, most State governments are attempting to improve the socio-economic status of forest-dependent communities in order to reduce pressure on forests through integrating micro watershed development etc. Conserving forest is a huge task and by making forest more valuable can encourage the local users (Plotkin and Famolare, 1992). However, under the JFM programme, residents of forest-fringe villages have been provided free access to forest produce as a means to achieve sustainable livelihood. The JFM programme is currently implemented by 106,482 Joint Forest Management Committees (JFMC) covering 22 million ha of forests and it was spreading into 28 states of India and union territories (Bhattacharya *et al.*, 2010). In Mizoram out of this 1671700 ha of reserved forest are, 3.33% (55990 ha) of land is covered under JFM (IFCRE, 2011). JFM thus represents one model of community-based forestry in which the state engage with communities for various forestry activities such as forest management and marketing functions.

The Village Forest Development Committee (VFDC) are being formed which vary in nomenclature, structure and composition between states and a number of self initiated groups are also involved in forest management. In most states, the VFDC's are registered with the FD and under the JFM; the proportion of the harvest that goes to the communities share varies across States. The JFM letter from the GOI stated that the NGOs are' particularly well suited for motivating and organising village communities for protection, afforestation and development of degraded forest land' (GOI, 1990). JFM is an institutional innovation programme with immense potential challenging the disempowerment of indigenous communities and environmental degradation (Isemonger and Tewari, 2000).

There have been few studies (Choudhary *et al*., 2017) on livelihood analysis of JFM user groups in India. For example, Dave and Upadhyaya (2002) found that when JFM commenced, forage availability decreased in Almora district of Uttarakhand, which suggest that improved forest conditions may not necessarily lead to improvement of the farmers. Murali (2002) on the after hand, found better flow of forest products through JFM. Behera *et al*., (2003) found tremendous potential of JFM to reduce poverty at social inclusion in rural community through JFM. Kafle (2006) reported that JFM programme supported 12.3% of total household income to poor, 4.06% to middle and only 2.78% to rich class households. Some studies too report on the employment generation through JFM. For example, Gangadharappa *et al*., (1999) noted JFM provides direct employment like wage labour through JFM activities and secoundary employment through primary forest industries like saw mills, pulp or paper industries. Nagaraja *et al*., (2008) reported that JFM generated paid employment for local people equivalent to 20 million rupees i.e. 0.11 million person days of paid employment during August 2006- July 207.

JFM in India is an attempt to reverse the process of forest degradation on one hand and to meet peoples need on the other. Forest user communities across the country have been dependent on forest for fuelwood, fodder, small timber and NTFPs for their basic needs. Under JFM programme, these communities play a special role as they have been provided access to forest produce including NTFPs to meet their basic needs in lieu of protecting, regenerating and maintaining forest in collaboration with forest department. NTFPs are critical to JFM programme because they can be a regular source of income and employment opportunities to JFM committees. JFM committees may take lead in sustainable management of NTFPs resources by focussing as i) collection of sustainable harvesting ii) processing and value addition iii) marketing of NTFPs. In many states, the collection of NTFPs has been of low intensity and therefore this is sustainable. However, the economic potential of NTFPs has become apparent, the intensity of collection has increased and better infrastructure for trade and processing have developed, causing a concern for sustainability of resources. While trading of NTFPs is controlled through state-owned institute such as state forest development cooperating federations, cooperatives of tribal societies (Newman and Hirsch 2000; Planning commission's working group on forests and natural resource management, 2011). Many states too have adopted the policy of giving mandatory rights to some private companies, wherein the local people collecting NTFPs are required to sell their collected products to the company's agent at preset process that are lower than those who could have obtained by selling directly to the processers. In states like Mizoram, many of the important NTFPs too are auctioned through Mahal system giving a chance for the private player to exploit the grass root level producers resulting into meagre price for the collectors. This process drastically affect the forest dependent community in terms of wages, socio-economic conditions or gender equality and the cost to the end users continue to increase (Dattagupta, *et al.*, (2010). Nevertheless, NTFPs are one of the key components to the success of JFM. The incentive to forest conservation under JFM are the agreement the people make to conserve in exchange for their livelihood benefits (Rode *et al*., 2015; Jones *et al*., 2016; Sisak *et al*., 2016). Therefore it is of paramount importance to examine the quantum of benefits that the people are receiving from the production, utilization and marketing of major group of NTFPs from the forest areas through under JFM in Mizoram.

1.2 OBJECTIVES

- Spatial distribution and abundance of selected non-timber forest products (bamboo, thatch grass, broom grass and medicinal plants) in different Village Forest Development Committee (VFDC) areas,

- to document existing management, harvesting, processing and marketing practices of these selected NTFPs
- to assess the constraints and challenges encountered in management, harvesting, processing and marketing of these products and suggest measures to overcome them *and*
- to identify best practices of harvesting, processing and marketing of these NTFP's and suggest future strategies for sustainable management, processing and marketing of these products.

CHAPTER 2

REVIEW OF LITERATURE

In the past, several approaches were initiated to conserve forests without involving the local communities but none of the approach was met with reasonable success. It was later increasingly recognized that involvement of people in forest management not only in bringing cost-effective conservation but also contributing to regeneration of degraded forest (Murali *et al*., 2002). Forest management policies in India have conventionally favoured the production of timber. Until recently, such policies failed to take proper account of the developmental and livelihood needs of forest-dependent communities and failed to involve local women and men as forest managers. The establishment of Forest Corporations and Tribal Development Co-operative corporations for the collection, processing and marketing of NTFPs was recommend by the Tribal Economy in Forest Areas (1967). National Commission on Development of Backward Areas (1984) emphasised the necessity of research on Minor Forest Products (MFPs) and the propagation of selected NTFP species. The National Report of the Committee on Forestry and Poverty Alleviation (1984) likewise recommended identification of new MFP resources, tapping techniques, refining chemical modification and the introduction of superior varieties of plants yielding NTFP (Tewari,1993). But these recommendations had a very little impact on forest planning and management in most States where, until recently, the priority was on accumulation of revenues through logging of natural and planted forests. In the household level, recognition of NTFPs has increased to the national economies and also to the environmental objectives including biodiversity conservation (Arnold and Perez, 2001). Millennium Ecosystem Assessment (2005) estimated that up to 96% of the values of forest are derived from NTFPs and services. They have been recognised internationally as an important element in sustainable forestry. In the year 1992, the United Nations Conference on Environment and Development (UNCED) identified sustainable forest management as a key element in sustainable economic development, and set out non binding guidelines for sustainable forest management with specific inclusion of NTFPs (Jones *et al*., 2004).

Production of many NTFPs under JFM can be increased in the short run and the benefits could be shared according to JFM conventions. In India, forest dwellers and small farmers depend heavily on NTFPs for food, medicine, fuel, drink and income. Sizeable industrial markets also exist in eastern India for NTFPs like sal oil, sal cakes, fibre grass, and bamboo. There is insufficient research and analysis on the collection, use and marketing of NTFPs by different groups of villagers (in terms of gender, literacy, landholdings etc) and little information for eastern India on the perception of forest users regarding market prices and market opportunities. NTFPs generate US $ 500 million per annum as per record from the Statistics. These figures refer only to traded products and do not reflect the true situation of the potential of NTFPs. For the production and trading in the eastern India, new development strategies will positively impact the livelihoods of forest dependent households, and also to the poorer households and women (Mitchell *et al.*, 2003). In Northeast India, it was estimated that NTFPs contribute 50% of the total forest output value and 70% export earnings (Gupta, 1994). The importance of NTFPs to the economy of north east India is believed to be much more than the rest of the country (Tewari, 2000). The benefits of NTFPs are increasingly discussed in valuing tropical forest with the changing political economy (Tewari, 2000).

Joint Forest Management (JFM) systems afford an opportunity to increase stakeholder participation in local forest management, but here too an unconsidered timber emphasis is often apparent. The gestation periods associated with timber or pole production can be lengthy and may discourage sustained community involvement in JFM. New forest management systems also continue to be gender-blind in many cases (Murali *et al*., 2002).

Although the precise information on JFM is scare, several factors indicating positive impact on forest conditions and regenerating with remarkable vigour and diversity (Sarin, 2014). In the wake of a largely male out-migration, the particular needs of female-headed households need to be taken into account when formulating development policies. Forest management strategies highlighting the value of NTFPs can redress the imbalance noted above and can be sustainable in the long run. Andel (2006) stated that commercial extraction of NTFP may contribute to the conservation of forest because collectors often protect useful trees from being logged. Recently, the sociological aspect of resource management has been the most neglected area in the resource management strategies of many countries (Karki, 2001). On the other hand, it was suggested by Chamberlain *et al.,* 2001 that NTFPs serve an important tool in helping to trace back their heritage and relationship with NTFPs back to several generations, and this traditional ecological knowledge is critical in understanding the fundamentals of NTFPs management. Public awareness about the contribution of NTFPs at local and national level are highly recommended by EARO and IPGRI (2004) so as to promote sustainable utilization of products for economic and environmental benefits.

The forest of India, once known for their valuable timbers are now looked for their NTFPs with a clear shift in paradigm. The rural people inhibiting the forests areas carry a very long history of extraction of NTFPs for subsistence and/or sale (Omkar *et al*., 2012). The forests of Mizoram in north-east India had a massive degradation owing to excess pressure for fuelwood and other forest products extraction, to slash-and-burn/shifting cultivation which is widely prevalent within the state, and to forest conversion (Sahoo *et al*. 2012). NTFPs have become one of key income sources for the rural households, with live examples indicating an income share greater than that from cash crops or informal cash incomes (Dovie, 2003). Local community institutions are protecting their forests far more effectively than the state forest departments could. (Sarin, 2014). It was reported by Jimoh and Haruna (2007) that the contribution of NTFPs to household income around the Onigambari Forest Reserve, Nigeria amount to 68.1% of total monthly income. In the Southeast of Cameroon, NTFPs have been found to contribute more than 50% to village household incomes. In Nepal, the Forestry Department collects US $ 15 million yearly revenue from the trading of NTFPs (DOF, 2004). The extraction of NTFPs can contribute significantly to local economies over the medium term and can improve life chances in terms of livelihood security and dietary risk minimisation (de Beer and McDermott, 1989, Godoy *et al.*, 1995).

Exploitation of NTFPs from the wild in many respects and depending on the plant part harvested can help for sustainable utilization of the species (Melese, 2016). However, the growth pattern and reproductive characteristics of the plants need to be understood and also harvesting practices that give good regeneration to the individual organisms (Sunderland *et al.*, 2004). When the exploitation of NTFPs from the wild cannot maintain sustainable management, domestication of NTFPs can be an alternative case. Some critics concerned with equity issues find that the amount of forest land required per family for sustainable NTFP extraction is too large (Anderson, 1991), and that an inequitable flow of benefits is caused by exploitative patron-client relationships in rural markets. In Nigeria, NTFPs are exploited in a large amount since they are not restricted the excess use of NTFPs from the forest and thus there is no sustainable harvesting of NTFPs (Jimoh *et al.*, 2012). Expanded sales of NTFPs could increase the value of forests and consequently help users to develop an interest in forest conservation. But an historical analysis of NTFP extraction does not suggest that increased local benefits automatically accrue to collectors as opposed to traders (local or non-local). It is not clear, either, that the supply of all or most NTFPs can be increased sharply in the short-run and maintained in the long-run (Mitchell *et al.*, 2003).

The Forests, under section 28 of the Indian Forest Act 1927 and the functioning of the Forest Department has undergone change in most States with the top-down planning and implementing approach being progressively replaced by the decentralized approach with emphasis on capacity building at the grassroots. India's National Forest Policy of 1988 and Joint Forest Management Notification of 1990 reflect the desire and need to ensure that rural people participate in the management of forests and capture benefits from those forests. Such people-oriented forest policy in India will be better implemented and have more impact if more researches on the analyses of NTFPs extraction quantities and values are undertaken across the diverse ecological, economic, and social settings in India. Different states are adopting practices for augmenting supply of NTFPs through participatory forestry like JFM, in order to provide incentives to the communities and thus bought economic returns to sustain forest protection and management efforts. It was also found out that in many states, unregulated grazing and extraction of forest products have led to degradation and loss of vegetation which affects the regeneration of plants (Murali *et al*., 2002). Some studies have recorded the impact of protection on vegetation has been assessed by comparing protected areas with unprotected forests in the vicinity which indicate that a longer period of protection enhances regeneration and greater tree diversity (Shastri *et al*., 2002). Community forestry serves as an important means to conserve biodiversity, manage common forest resources, improve the environment and contribute to rural livelihoods (Acharya *et al.,* 2006). Unsustainable harvesting of NTFP is yet another activity which can alter forest structure, composition and regeneration. Therefore, promotion of NTFP's is suggested to complement the objectives of rural development on one hand and appropriate forest management on the other (De Beer and Mc Dermott, 1989, Hall and Bawa 1993). Tolerance to harvest varies from the life history and parts of plants harvested. Moreover, the effects of harvest for any one species are mediated by variation in environmental conditions over space and time, and by human management practices. Specific management practices of NTFPs are important to withstand heavy harvest. And this can be carried out at different spatial scales and some of them are highly effective in fostering population persistence (Ticktin, 2004).

Nevertheless, Non-timber forest products are still a major source of food and income in many countries of the world, but few countries monitor their NTFPs systematically (Vantomme, 2003). It was reported by Ogunsawa and Ajala (2002) and Zaku *et al.,* (2013) that over 70% of the household in the country depend directly on fuelwood as their main source of energy and daily consumption of fuelwood was estimated to be 27.5 million kg/day. Countries can make NTFPs more visible in their existing national production and trade statistics by including specific product codes for major NTFPs into their existing national product classification system, with the aim of including them in international statistical classifications.

Throughout the world the prices and production of many NTFPs are fluctuating in different years and some of these NTFPs are exported and earning valuable foreign exchange. In Pakistan there was an export of 1384.72 million from NTFPs in 1990-2000. These products after the collection and processing sold to the middleman who then sells to the market and as many as 65% of the product is lost during the way to final product (Latif and Shinwari, 2005). Adepoju and Salau (2007) reviewed the methods use for the economic valuation of Non-timber forest products in which basically three methods are being used- direct market price, indirect market price and non market estimates. The tradable NTFPs are significant in international trade**.** In many developing countries, NTFPs constitute an important source of food security and serve an income for the poor people. Many studies have focussed on the dependence of villagers on forest resource for their food and shelter and obtain income through collection and marketing of NTFPs (Sahoo *et al*., 2010). Potential of Non-timber forest products have been focused and given importance in the reduction of poverty and food security, thus this improves the nutritional and sustainable management of forest resources (Marshall *et al.*, 2006).

Collection and marketing of NTFPs is an important source of food security and thus enhancing their income and in turn increasing their purchasing power, which creates economic access to food. When rural households use most of their agricultural output for subsistence consumption, cash from the sale of NTFPs can play an important role by allowing the households to use the same for vital cash-dependent transactions, namely, buying tools and paying for school (Cavendish, 2000). It is observed worldwide that the NTFPs collectors have poor access to credit**.** And depend on traders within the villages which have resulted to sell NTFPs at lower price. **T**herefore, only a small percentage of final prices go to the collectors. The local trade provides an opportunity for a segment of society who would otherwise struggle to compete in the formal employment sector and in more high value markets.

Development of policies to remove such economic and social constraints is essential if NTFPs management systems are to serve a large and diverse body of stakeholders. When the value of products accrues mainly to intermediaries the social objective of NTFPs systems may not be maximised (Fearnside, 1989). Some of the studies show that collectors of NTFPs very often live under regimes of economic and social dependence where prices and markets are effectively controlled by land-owners, merchants and private companies. Other studies suggest that NTFPs trading systems are often driven by monopolistic arrangements (Clay, 1992; Peluso, 1992), and are shaped by unfair legal restrictions on the direct sale of NTFPs by collectors. The variability and unpredictability of traded prices has also been commented on, and is widely seen as an impediment to the design of improved NTFPs management systems. Many households increasingly require flexible local income earning opportunities that allow space for other responsibilities such as child care, nursing the ill, maintaining the home and crop production income, risk coping strategies like illness (Takasaki *et al*., 2004; Albeet and Emmanuel, 2011).

Furthermore, local markets are often a pragmatic starting point for expanding trade to national, cross-border and international markets. In contrast to many export markets, which are often driven by externally imposed, project based intervention, local trade in NTFPs has generally evolved with remarkably little external support from government agencies and often in spite of significant obstacles and constrains. These indigenous markets are consequently commonly based on long standing traditional knowledge and skills and are the result of considerable local initiative, innovation, self- reliance and a continuing demand for the products offered (Shakleton *et al*., 2007). NTFPs can support remunerative enterprise by responsible use and proper husbandry. Thus, it is important to develop sustainable ways of bringing NTFPs into the mainstream of economics, while retaining their accessibility to local communities (Sah and Dutta, 1996). These markets may ultimately provide the entry point into more lucrative opportunities and the formal sector as has been the case with some craft products in South Africa (Rogerson and Sithole, 2001). To fight against the problem of unsustainable harvesting of NTFPs, a service NGO was funded by some donors so as to organize into proper registered harvesters. The harvesters of NTFPs exchanged knowledge about sustainable resource use and voluntarily adopted sustainable resource management practices that they helped to formulate (Pierce *et al*., 2003).

When the woody biomass extraction exceeds annual biomass production, degradation of forest particularly the growing stock occurs. In many parts of India including North-east India, the range of extraction of fuelwood from the forest are reported higher than the annual biomass (Ravindranath *et al*., 2000; Shastri *et al.*, 2002). Murali *et al*. (2002), Tiktin (2004) and Shaanker *et al*. (2004) have quantified the ecological effects of harvesting NTFPs from plant species for better knowledge and guidelines for management as well as better directing future ecological research in the area. The case studies have illustrated that NTFPs harvest can affect ecological processes at many levels, from individual and population to community and ecosystem (Murali *et al*., 1996). However, the main aim of the research was on the population level and on a limited subset of harvested plants.

The domestication of selected non timber forest products such as wild pepper in Meghalaya have proved to be an effective instrument for rural development which has less impact on natural habitat, because its cultivation needs minimum input and labour and generates very attractive economic return (Tynsong *et al*., 2013). In many developing countries there is lack of systematic and religious data collection at national level on the importance of NTFPs in household (FAO, 2012). The study has prescribed wide scale cultivation, processing, and marketing of wild pepper in those areas where local habitats are favourable for its growth and where the value chain has already developed, and the growers are receiving a good return for their investments. The trade benefits almost all sections of society, as the growers benefit from the cultivation, the landless benefit by working as daily wage labour, and the traders and the transporters earn their livelihood by marketing the produce**.** The NTFP-based income generation through community forestry influences policy-makers and management of forest, thus it have both positive and negative impacts on the local community (Sah and Dutta, 1996). The importance of indigenous knowledge in sustainable NTFPs extraction and use sustainable harvesting of NTFPs from the indigenous knowledge give tremendous contribution to the source of income for rural people. Utilization and management of NTFPs are studied and the role played, dynamics and potential effect of local regulations are also given high importance in the life of the villagers. Lack of proper regulations may result in destructive harvesting practices (Neumann, 1996). But in the same time, well-adjusted regulations may result in the gradual intensification in management practices (Paudel and

Wiersum, 2002). There is considerable variation in the utilization, commercialization and management practices between different NTFP species in different regions because of the differences in land-use conditions and degree of commercialization (Fortmann and Bruce, 1998; Nabanoga, 2005; Berg *et al.,* 2012).

There is a complex nature of community-based regulatory frameworks for NTFPs exploitation and that these frameworks may be adjusted to rural change and allow intensification of NTFPs management. Whether such changes do occur depend on many social and political factors. In Cameroon several examples exist of NTFPs overexploitation in situations where community based institutions for controlling access to NTFPs and the intensity of their exploitation were weak. In many cases they have been overpowered by other regulatory frameworks such as state law (Berg and Biesbrouck, 2005). Under such conditions often de~facto open access regimes has emerged (Wilkie, 1998; Fisiy, 1997). Such observations indicate that it is wrong to assume that state regulations on NTFPs exploitation are always an improvement over the community-based regulations.

Despite the high dependence on NTFPs among forest users, there are still many barriers restricting the generation of greater benefits from these resources. These barriers include issues of security of tenure, lack of processing skills and limited market access. Augmenting the livelihoods of the forest dependent communities requires some focused intervention on NTFPs. NTFPs based interventions should be designed keeping in view the community involvement, collection and sustainable harvesting, conservation practices for NTFPs, processing and value addition and also setting up of NTFP based micro enterprises for facilitating primary processing, value addition and marketing of NTFPs (Pandey *et al*., 2011; Pandey, 2011). There are many impediments to the successful implementation of NTFP as a certified product and these impediments could range from unorganized and powerless labourers to basic difficulties in commercializing NTFPs to undeveloped demand for certified products among businesses and consumers (Pierce, 2003) resulting its low demand and competitiveness with the agricultural products. In Morogoro region of Tanzania, an empirical exploration of the dependence of villagers on NTFPs was done on the decision rules that the villagers use concerning where and how it was collected, how their collection changes degradation and the implication of introducing more restrictive access rules of participatory forest management. Depending on the forest products the villagers' respond to increase degradation varies: in response to degradation fuelwood collection tends to be displaced to other forests, fewer forest fruits and vegetables are collected, and the time of collection increase considerably for weaving and building materials (Robinson and Kajembe, 2009).

According to the International Union for Conservation of Nature and the World Wildlife Fund, there are between 50,000 and 80,000 flowering plant species used for medicinal purposes all over the world. Among these, about 1500 species are in threatened stage with extinction from overharvesting and habit destruction (Bentley, 2010) and 20% of their wild resource are exhausted with the increasing human population and plant consumption (Ross, 2005). Although this threat has been known for decades, the accelerated loss of species and habitat destruction worldwide has increased the risk of extinction of medicinal plants, especially in China (Heywood *et al*., 2003; Nelawade 2003), India (Heywood *et al*., Hamilton 2008), Nepal (Hamilton 2008), Tanzania (Zerabruk, 2012) and Uganda (Zerabruk, 2012). Wild plants have always been the matter of high concern and have always been used for their potential of human being (Ali *et al.,* 2003). The knowledge of plants is based on trial and error. Consequently, the authentic knowledge of the uses of medicinal plants passed on from one generation to another, after refining and additions (Qureshi *et al*., 2010).

Many studies have demonstrated that un-sustainable harvesting of NTFPs and over-exploitation threatens the survival of many species of high-demand, and also can alter forest structure and composition and therefore management practices must encourage the monitoring of sustainable harvesting levels of species and promote alternative plants for the same uses as part of conservation strategies (Ndangalasia *et al*., 2007). Firstly, the collection could be understood as a reaction of households to seasonal or unexpected natural or social hazards such as floods, disease of crops, failures in market , increase sickness rate of household members, political instability, food or cash insecurity (Quang and Anh, 2006; Babulo *et al*., 2008; Heubach *et al*., 2011), secondly the strategy might be considered as a regular activity continuously contributing to the household cash balance (Shackleton *et al.*, 2007; Heubach *et al.*, 2011; Saha and Sundriyal, 2012). According to Fu *et al*. (2009) or Saha and Sundriyal (2012), both strategies might lead to an unsustainable collection of NTFPs, which consequently could have a negative impact on the rural areas in terms of environmental degradation and biodiversity decline. Moreover, this could result in a lack of NTFPs supplies and a reduced standard of living among these specific rural households in the future. From the studies of Maharjan (1994); Hertog (1995); Edward (1996); Karki (1996) it was observed that, it is the desire of many forest users to gain formal control of their resources and initiate different activities to benefit financially from harvesting and processing of NTFPs. Therefore, it is important to help forest users gain or retain, in a formalized manner, control of the forests and pasture lands they use. A strong case can be made for supporting Forest User Groups (FUG) as they work to organize and develop operational plans for their forests and pasture lands, so that these resources can be handed over to the forest user group by HMG.

Earlier, in all the government afforestation programmes, the rural poor were not participated and bounded to wage employment as they were seen to ruin forest through overharvesting of forest resources. The relationship between forest poverty was described negatively, but the JFM talked about the positive role that forest can play in poverty alleviation and the responsibilities to be taken up the people for the protection of forest (Ghate, 2000). Kumar

(2002) concludes that JFM is convenient for the development of sustainable forest regeneration with low expense. The first successful model of Joint Forest management in India is known as the Arabari Model started in 1972, in Paschim Medinipur District of West Bengal. As on 31st March 2009, the total forest area under Joint Forest Management in West Bengal has been recorded as 557,063.13 hectares. In Arabari Reserve Forest, West Bengal, India, forty one women from the Sakhisol village have formed a forest protection committee. The experiment was made by the Arabari's community and forest department 45 years ago, and the success story has reached the Indian government's Joint Forest Management (JFM) programme, which then spread rapidly. This group of women start forming a committee and protect the Arabari forest by planting and harvesting the sal trees along with the forest department. In return, the forest department entitled 25% of the profit from the sale of timber and access to forest produce. Besides this they also collect the sal leaves (used for making plates and cups) and mushroom.

The success of JFM community forestry experiments from the joint state in Arabari, West Bengal and Sukhomaijri in Haryana has provided a framework for decentralizing forest management. It was an evident from these experiments that local populations have to be given a stake in the forests. By making them viable stake holders, it might be possible to regenerate, protect and manage forest resources for the joint benefit of the people and the state. The 1988 National Forest Policy together with a circular issued by the Indian government in 1990 legitimize local communities access to forests, encourage communities to form forest management committees, and guarantee a portion of the produce from the forest (Singh *et al.,* 1993).

Tripura was the first state in the northeast India to bring out the JFM resolution on Dec 20, 1992 and implement the scheme covering all the government forestland, except protected areas. Today Tripura has at least 157 JFM committees covering about 16,227.30 hectares

(Bahuguna, 2002). The community forest at Toirupha is about 300ha. It is a secondary forest dominated by *Melocanna baccifera*. The density of the bamboo is estimated to be 10,000-12,000. According to the state forest department, the legal status of the forest of Toirupha and surrounding areas are designated as protected forest. However, the forest department does not interfere in any of the administrative control and management of community forest or *Asha Van* at Toirupha. The unique feature of the *Asha Van* is that it is entirely protected and managed by the women of the village. The men interviewed noted that they are busy in other task and it is more appropriate for the women, so the work had hand over to the man Women are key players, participants and beneficiaries in the management and protection of the forest. The major responsibility of the committee is to protect forest. The major resources being extracted from the area is bamboo, both for household requirement and bamboo. The community has a definite pattern of collection of those bamboos. The time for extraction of bamboo is usually November- January. When the villagers are in need of those bamboos for their construction, repairing their house and fencing, they are generally done during the month of January, the collection of dry bamboo for collection of firewood is allowed during November-December. The number of bamboos to be extracted varies per year, but generally the average requirements have been around 200 poles per family. They believe that this is the sustainable yield for ensuring continued forest productivity in terms of matured bamboos. The bamboos harvested from the *Asha Van* are not allowed to sell the bamboo outside the forest. The reality experience of *Asha Van* (Forest of Hope) in Toirupha is an important example for women managed community forest.

There have been several surveys on non-timber forest products such as documentation, ethno botanical use, collection, consumption and sell of medicinal use and economic importance of income generation by forest dwellers (Sahoo *et al.,* 2012) around Dampa Tiger Reserve, resource consumption of sustainable utilization of NTFPs, flow of non timber forest products (Lalremruati, 2014) in northeast India and Mizoram, but all these studies are undertaken from the natural forest. However, no efforts have been made to document the production, utilization and marketing of important NTFPs from the forest brought under JFM in Mizoram.

A bird's eye review of literature reveals that NTFPs play important role in the improving the economies of the people who are directly depended on forests for numerous needs and many of the studies on NTFPs are carried out in protected forest areas and open-access systems, however, very few and far studies exist on the production, utilization and marketing of different non-timber forest products in JFM areas. Moreover, no work hitherto have been carried out in the JFM areas of Mizoram and therefore, the present study is expected to plug our lacunae on spatial distribution, abundance and regeneration potential of some of the NTFPs which are of great demand in the site and to understand the market flow of these NTFPs and income generation activities in the site.

CHAPTER 3

MATERIALS AND METHODS

3.1 Description of study site

The study on production, utilization and marketing of selected non-timber forest products (bamboo, thatch grass, broom grass and medicinal plants) was carried out in jointly managed forest areas of Mizoram. For the purpose, the forest raised under Joint Forest Management by five different Forest Development Agency (FDAs) located in Aizawl, Kolasib, Mamit, Champhai and Thenzawl were selected. Under each FDA, five villages were selected resulting areas was resulting into 25 sites. There are altogether 7,686 household inhabiting 38,906 populations in the study area. In Aizawl FDA, five villages namely Lungleng 1(23.6651° N 92.6618° E), Muthi (23.7759° N 92.9618° E), Ailawng (23.4059° N 92.3749° E), Sihphir vengpui (23.4952° N 92.4339° E) and Sumsuih (23.2904° N 92.4425° E) VFDC were covered consisting of 5,242 populations with 946 household. In Kolasib FDA, five villages namely New Diakawn (241734° N 92.4201° E), Saihapui K (24.1643° N 92.3930° E), Chemphai (24.1810° N 92.4502° E), Thingdawl (24.0731° N 92.4151° E) and Serkhan (23.5638° N 92.4334° E) VFDC and had 7,510 population and 1,511 household. In Champhai FDA the five villages are Khawzawl hermon (23.5345° N 93.1830° E), Khawhai (23.3766° N 92.1265° E), Kawlkulh (23.6153° N 92.0839° E), Hliappui (23.7426° N 92.1065° E) and Ngopa (23.8861° N 92.2119° E) with 12,173 populations and 2,900 household. In Mamit FDA the five villages are Tuahzawl (23.7682° N 92.5613° E), Chungtlang (23.4131° N 92.3412° E), Chhippui (23.3931° N 92.2843° E), Dapchhuah (23.4644° N 92.3040° E) and Lengte (23.7720° N 92.5997° E) with 3,606 population and 756 household. The five villages under Thenzawl FDA are Baktawng (23.5365° N 92.8465° E), Keitum (23.2320° N 92.9114° E), Samlukhai (23.4129° N 92.7313° E), Ramlaitui (23.1815° N 92.7369° E) and Neihloh (23.2349° N 92.7065° E) VFDC with a population of 1,573 and 8,375 household. The inhabitants of the studied area were Mizo community and Riang (Bru). The spatial distribution, survival, abundance of these NTFPs and practices of harvesting, processing and marketing of these products was studied in details by using Participatory Rural Appraisal (PRA) and field surveys. The socio-economic characters of the people of these VFDCs were collected. Study area as shown in Fig.

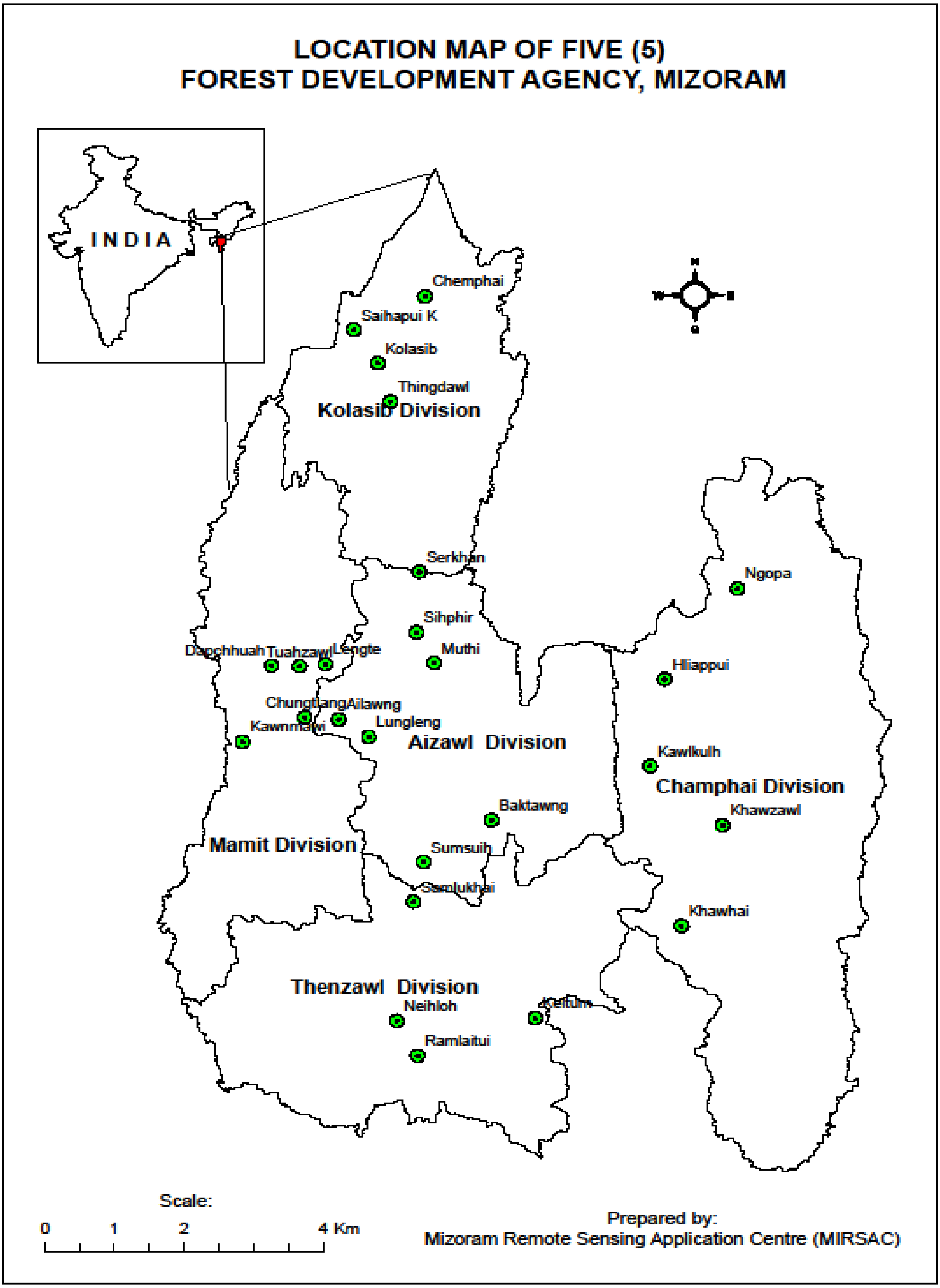

Fig 3.1 Map of Mizoram showing 25 forests (VFDC) under Joint Forest Management

3.2 Socio-economic Profile

Both primary and secondary data was obtained through semi-structured questionnaire, field observation, personal interview and group discussion with the villagers to generate information on to what extent they are involved in harvesting, processing and marketing of selected NTFPs, their importance, selling price to traders or middleman, prevailing policies and legislation of the area with respect to NTFPs was asked. Semi-structured questionnaire was given to approximately 10% of the household from each villages to provide information on to what extent they involved in exploitation of NTFPs as well as to know the different benefits they got through community forest *i.e.*, VFDC plantation areas. Socio economic survey, land use pattern, value addition on NTFPs and marketing strategy was also taken into consideration. Purposive sampling design was used for different marketing participants: collectors, processors, suppliers and producers of NTFP handicrafts.

Information on different aspects of NTFPs like use, locally growing condition, place of availability, state of collection, use category, marketing, cultivation, etc. was collected in each VFDC areas by participatory discussion method. In addition, personal observations were made in the fields wherever necessary, to note any noticeable event, which could help to draw conclusions and to develop conservation and management strategies.

3.3 Vegetative Analysis

In the selected sites, five tree quadrat of size 50m x 50 m, equal to an area of 0.5 ha were laid. All the trees with more than 10 cm girth at breast height (GBH) were measured and GBH class of trees in different FDA was calculated. Various attributes of vegetation like frequency, relative frequency, density, relative density, and coverage was calculated according to Zobel *et al*. (1987). Geographical coordinates of each site was recorded using a Global Positioning System (GPS) device.

For tree quadrate 50m × 50 m, 5m × 5 m for shrubs, 1m × 1m for herbs are used. Density, frequency, abundance and Important Value Index (IVI) of different species are calculated using the following formulae.

$$\text{Density} = \frac{\text{Total number of individuals of a species in all the sample plots}}{\text{Total number of sample plots study}}$$

$$\text{Relative density} = \frac{\text{Total number of individuals of a species}}{\text{Total number of individuals of all species}} \times 100$$

$$\text{Frequency} = \frac{\text{Total number of quadrats in which species occur}}{\text{Total number of quadrats studied}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{Number of occurrence of a species}}{\text{Number of occurrence of all species}} \times 100$$

$$\text{Abundance} = \frac{\text{Total number of individuals of the species in all quadrats}}{\text{Total number of quadrats in which the species occurred}}$$

$$\text{Basal area} = \frac{\text{Total basal area}}{\text{Number of trees}}$$

$$\text{Relative dominance} = \frac{\text{Total basal area of a species in all the quadrats}}{\text{Total basal area of all the species in all the quadrats}} \times 100$$

$$\text{IVI} = \text{Relative Frequency} + \text{Relative Density} + \text{Relative Dominance}$$

3.4 DBH distribution of the tree species in various FDAs

All the tree species that were growing in different FDAs were measured from $50m^2$ equal to an area of 0.5 ha tree quadrate. Girth at breast height (GBH) of trees was measured and recorded from all the trees within the quadrate. The GBH obtained were grouped into 7 classes' viz. 0-10, 10-20, 20-30, 30-40, 40-50, 50-60 and 60-70 cm class.

3.5 Production, utilization and marketing of selected NTFPs

The production and pattern of utilization of different NTFP species was performed based on the interview with the harvesters of NTFPs. Detailed information on the harvesting technique, processing involved, parts used and information on the formulation of the medicinal plants were also collected using questionnaire and interview. For the utilization pattern of medicinal plants, old aged person were mostly interviewed since they have a wider knowledge and experiences. Marketing channel of different NTFPs was recorded from the NTFPs seller and harvesters from the entire study site. The marketing channel of NTFPs was quite simple and did not involve a long chain. A thorough survey on the marketing of NTFPs was done on the local markets, neighbouring towns and nearby junction selling points. The NTFPs sellers were asked the selling price and the original price from the harvester in all the available convenient NTFP within the local market. They were also asked whether any middlemen involved in selling of those NTFPs and any other prevailing practices in marketing of NTFPs.

3.6 Use Value (UV)

The Use-Value (UV) of plants was first discovered by Prance *et al*, 1987 and modified by Manuel Pardo-de-Santayana *et al*, (2007). The calculation of UV is based on the diversity of uses. It is a method in which the informants were asked to identify the nature and use of selected plants on the basis of three categories (food, medicinal and economic) values. Five respondents were chosen randomly from each site, data from each informant were then used to calculate the mean number of uses of a given plant species. The overall mean value UV_{is} represents the mean number of all uses of a given plant species(s), as recognised by a single informant (i_s). Then the overall use value of species (UV_s) based on the information from the total number of informants was calculated by using the following equation:

$UV_S = \sum UV_{is} / i_s$

Where,
UV_S = the overall use- value of species'*s*'
UV_{is} = the use- value of the species s as determined by informant 'i'
i_s = total number of informants interviewed for species'*s*'

3.7 Similarity Index

Similarity index was used to calculate the percentage index of similarities between two sites. We calculated the similarity index between five FDAs for trees, herbs and shrubs as

$$\frac{2/C}{(A+B)} \times 100$$

Where, C= sum of common species.

A= Total number of species in site one.

B= Total number of species in site two.

3. 8 Ethno botanical use of plants

Ethno botanical information on different plants was collected through interviewing local inhabitants from all the twenty five study sites. Data was also collected using semi-structured questionnaire and detailed information on the parts used, formulations of the medicinal plants. In case of medicinal plants the informants mainly belong to the old aged group who have gathered information from their four fathers and pass on the information verbally. Besides this, secoundary information from "Micro-Plan" prepared by the Village Forest

Development Committee (VFDC) and several informal discussions with the practitioner and their patient was also done wherever possible/needed.

3.9 Statistical analysis

One way analysis of variance (ANOVA) was used to determine whether there were any statistically significant differences between the means of two or more independent (unrelated) groups. The Least Significant Difference (LSD 0.05) was calculated to check the significance between the six groups of NTFPs (Bamboo pole and cane, broom grass and thatch grass, edible food and fruits, fuelwood, fodder and medicinal plants) and the five parameters *viz.* NTFPs (% of household involved), Quantity harvested (kg^{-1} hh^{-1} yr^{-1}), Own consumption (kg^{-1} hh^{-1} yr^{-1}), Quantity sold (kg^{-1} hh^{-1} $yr^{-1)}$ and Income (Rs^{-1} hh^{-1} yr^{-1}) from the five FDAs.

CHAPTER 4

SOCIO-ECONOMIC PROFILE

4.1 INTRODUCTION

Non- timber forest products play an important role in socio economic upliftment of rural poor especially to the landless farmers (Acharya, 2013; Tejaswi and Basavarajappa, 2008; Hegde, 2010). In JFM arrangement, most of the rural poor are the beneficiaries who became member to jointly manage the forest resources across their inhabitants. The success of JFM may depend on several factors such as relationship between the forest department and the villagers, cooperation among the villagers, selection of species to be planted within the JFM plantation sites, site of plantation, management of plantation sites and the regeneration status of the forest (Tejaswi and Basavarajappa, 2008; Dutta *et al*., 2015) , however, the socio economic factors too could affect the forest management to a great extent (Reddy,2001; Dhanagare, 2000; Adikari *et al*., 2013). The imbalances in socio economic within the group are unavoidably associated with the capacity of the household in resource use (Sapkota and Oden, 2008).

This chapter deals with the socio economic profile of 5 FDAs *viz* Aizawl FDA, Thenzawl FDA, Kolasib FDA, Champhai FDA and Mamit FDA and that are actively engaged in JFM activities in the state. Various socio economic characters such as population, educational level, occupation, transportation and the involvement of the villages in the VFDC are reported.

4.2 RESULTS AND DISCUSSION

From the surveyed villages Champhai FDA has the highest population 14,173 followed by Thenzawl FDA (8,375), Kolasib FDA (7,510), Aizawl FDA (5,242) while Mamit FDA has the lowest population with 3,606. From table 4.1, it was observed that Champhai FDA has the highest household (2,900) followed by Thenzawl FDA (1,573), Kolasib FDA (1,511), Aizawl FDA (946) and least number of household was found to be Mamit FDA with 756 household. The results indicated that all household interviewed make use of non-timber forest products to greater or lesser extent.

4.2 I) Population

Among the twenty five surveyed villages Ngopa village under Champhai FDA has the highest number of household 970 with 4351 population. The least number of household was in Chemphai village under Kolasib FDA with 25 household and 117 populations (Table 4.1). The percentage of Below Poverty Line (BPL) and Antyodaya Anna Yojana (AAY) combined household was highest in Chemphai village (84%) under Kolasib FDA and it was least in Baktawng village under Thenzawl FDA (9.54%). The number of VFDC beneficiary household varies depending on the village. The BPL families tend to depend more on NTFPs as compared to the Above Poverty Line (APL) household. The village having lesser number of household had higher percentage of involvement in NTFPs as there were lesser number of livelihood options in rural areas that can supplement their income.

4.2 II) Education

The literacy rate varies from 65% (Chemphai village) to 99% (Tuahzawl village). Level of education of a household was expected to influence the nature of their economic activity and level of income because education would make easier for household to comprehend negative externalities and passive user values of natural resource (Neuton *et al.*, 2016). Chemphai village with the lowest literacy rate among all the surveyed villages had the highest full-time NTFPs exploiter along with Dapchhuah village. While Tuahzawl village under Mamit FDA with the highest literacy rate had no full-time NTFPs exploiter along with the other seven villages (Table 4.1). The respondents with higher education has lower exploitation rate of NTFPs as compared to those of lower educational background. People having graduate degree were highest in Aizawl FDA and lowest in Thenzawl FDA. We hypothesize that the higher educational background gives the lower dependency of NTFPs (Table 4.1).

4.2 III) Occupation

The occupations of majority of the surveyed villagers are primitive agriculture (shifting cultivation). They follow jhum cultivation and in the off season, they harvest NTFPs from the community forestry as well as from the adjoining forest. Few of the villagers are engaged in trading and other works. Full-time NTFPs exploiter was highest in Kolasib FDA (11.8% household) followed by Mamit FDA (8.6% household), Thenzawl FDA (3% household), Champhai FDA (2% household) and least in Aizawl FDA (1.6% household). Part-time NTFPs exploiter was highest in Mamit FDA (70% household) followed by Kolasib and Champhai FDA (62% household), Thenzawl FDA being the third one with 60% of household engaged in harvesting NTFPs part-time and least in Aizawl FDA (46% household).

Table 4.1Socio-economic profile of different villages under JFM in Mizoram

FDA	Village	No of household	No. of household sampled	Population	No. of BPL & AAY household	No of graduate	Literacy rate (%)	Full-time NTFP exploiter (%)	Part-time NTFP exploiter (%)
Aizawl	LLI	164	16	900	67&30	21	97	5	60
	MTH	187	18	990	30&29	15	98	2	40
	ALG	154	15	732	35&30	10	98	1	30
	SVP	247	24	1750	49&36	90	98	-	5
	SMH	194	19	870	63&46	32	97	-	98
Kolasib	NDK	375	37	2250	86&34	100	97	5	40
	SHP	189	18	823	15&7	-	70	10	60
	CEP	25	10	117	15&6	-	65	20	80
	TDH	752	75	3500	94&26	90	98	10	60
	SKH	170	17	820	61&49	17	97	14	70
Champh	KZH	283	28	1200	34 &28	20	97	-	70

ai	KWH	515	51	2800	14&67	80	98	-	80
	KLK	786	78	4150	208&60	95	98	5	10
	HLP	346	34	1672	175&68	53	98	-	90
	NGP	970	97	4351	230&120	150	97	5	60
Mamit	TZL	100	10	520	40&20	20	99	-	50
	CLT	100	10	476	50&15	7	98	5	80
	CHP	186	18	950	60&20	20	98	8	90
	DPH	235	23	1130	75&30	2	97	20	70
	LET	135	13	530	50&37	15	98	10	60
Thenzawl	BKT	681	68	3704	40&25	60	90	-	50
	KTM	446	44	2200	70&30	50	95	2	60
	SLK	256	25	1500	60&40	15	95	4	70
	RLT	120	12	580	50&33	15	94	3	50
	NLH	70	7	392	26&15	-	92	6	70

Aizawl FDA- (LLI-Lungleng I, MTH- Muthi, ALG- Ailawng, SVP- Sihphir Vengpui, SMH-Sumsuih),**Kolasib FDA**- (NDK-New Diakkawn, SHP-Saihapui K, CEP-Chemphai, TDH-Thingdawl, SKH-Serkhan), **Champhai FDA**-(KZM-Khawzawl Hermon, KWH-Khawhai, KLK- Kawlkulh, HLP-Hliappui, and NGP-Ngopa),**Mamit FDA**- (TZL- Tuahzawl, CLT-Chungtlang, CHP-Chhippui, DPH-Dapchhuah, and LET-Lengte), **Thenzawl FDA**-(BKT-Baktawng, KTM-Keitum, SLK-Samlukhai, RLT-Ramlaitui, and NLH- Neihloh) .

CHAPTER 5

PRODUCTION, UTILIZATION AND HARVESTING PATTERN OF NTFPs

5.1 INTRODUCTION

Non Timber Forest Products provide significant social and economic benefits at all levels, especially in developing countries. There has also been much speculation about its potential for the livelihood of the rural and other natural resources. Commercialization of NTFPs has become important to the livelihood strategies of rural people in recent times (Larsen *et al.,* 2000). NTFPs are an important key source of livelihoods among the forest dwellers in rural communities specifically for their food, medicines, fuelwood and raw materials for house construction (Martin 1995; Wollenberg and Ingles 1999). There is evidence that harvesting of NTFPs can accord significantly to local economies over the medium term and can give better life chances in terms of livelihood security and dietary risk minimization (De beer and Mc Dermott, 1989; Godoy *et al*., 1995). When NTFPs have a high commercial value, overexploitation has turned out and the products have become scarce (Plotkin and Famolare 1992).

In this chapter, distribution, production, utilization and harvesting patterns of a few selective NTFPs from different FDAs have been discussed.

5.2 RESULTS AND DISCUSSION

5.2 Spatial distribution of selected Non-timber Forest Products (NTFPs)

A total of 279 plant species having NTFPs value under 234 genera belonging to 85 families were documented from the 25 study sites and their distribution varied widely from site to site (Table 5.1). Out of the 279 plant species, 44 species belonged to herbs, 57 shrubs species, 23 climbers, 139 tree species, 10 bamboos and 6 palm species which were distributed unevenly in each of the site. Density of trees per hectare was highest in Mamit FDA (397.92) followed by Aizawl FDA (374.8), Kolasib FDA (271.52), Champhai FDA (246.56) and least in Thenzawl FDA (177.4) (Table 5.1). Aizawl FDA had the highest density of shrub per hectare (42200) followed by Kolasib FDA (42200), Champhai FDA (33500), Mamit FDA (28250) and least density of shrub per hectare in Thenzawl FDA (25600). Whereas Thenzawl FDA had the highest density of herbs per hectare (207400) followed by Champhai FDA (193600), Aizawl FDA (187200), Kolasib FDA (151600) and least density of herbs in Mamit FDA (128400). Density of tree saplings was highest in Champhai FDA (845.455) followed by Kolasib FDA (735.714), Aizawl FDA (346.429), Mamit FDA (346.429) and least in Thenzawl FDA (244.444). Density of tree seedlings per hectare was highest in Champhai FDA (5800), followed by Aizawl FDA (2450), Kolasib FDA (458.333), Mamit FDA (450) and least in Thenzawl FDA (257.143) (Table.5.1).

Table 5.1 Abundance of non-timber forest products from the five FDAs

	FDA				
Attributes	**Aizawl**	**Kolasib**	**Mamit**	**Champhai**	**Thenzawl**
No. of tree species	47	39	55	57	54
No. of shrub species	42	27	37	27	28
No. of herb species	33	28	34	21	38
No. of bamboo species	8	4	10	nil	3
No of families representing plant group	52	50	60	46	56
Density of trees/ha	374.8	271.52	397.92	246.56	177.4
Density of shrub/ha	42200	40800	28250	33500	25600
Density of herb/ha	187200	151600	128400	193600	207400
Density of tree saplings/ha	346.429	735.714	290	845.455	244.444
Density of tree seedlings/ha	2450	458.333	450	5800	257.143

5.2 .1 Distributions and density of bamboo

The distribution of bamboo species within the study site varies from each other (Fig 5.1). Bamboo species was not found within Champhai FDA plantation sites, so the frequency, density and dominance are nil for this specific site. The ten bamboo species found within the plantation sites of different FDAs are *Bambusa tulda* Roxb., *Bambusa vulgaris* Schrad.ex J.C.Wendl, *Dendrocalamus longispathus* (Kurz) Kurz, *Dendrocalamus giganteus* Munro, *Dendrocalamus hookeri* Munro, *Dendrocalamus hamiltonii* Gamble, *Melocanna baccifera* (Roxb.) Kurz, *Schizostachyum dullooa*, *Schizostachyum fuchsiamum*, *Schizostachyum mannii*. Frequency of bamboo was highest in Thenzawl FDA (17.333%) followed by Kolasib FDA (17%), Mamit FDA (13.818%) and least in Aizawl FDA (10.286%). Bamboo density was highest in Mamit FDA (133.585 ha^{-1}) followed by Thenzawl FDA (118.613 ha^{-1}), Kolasib FDA (84.56 ha^{-1}) and least in Aizawl FDA (54.926 ha^{-1}). Whereas dominance of bamboo in Mamit FDA was 95.170 m^2 ha^{-1} which was the highest, followed by Thenzawl FDA (95.074 m^2 ha^{-1}), Kolasib FDA (94.450 m^2 ha^{-1}) and Aizawl FDA with the lowest dominance (60.026m^2 ha^{-1}) among all the study sites.

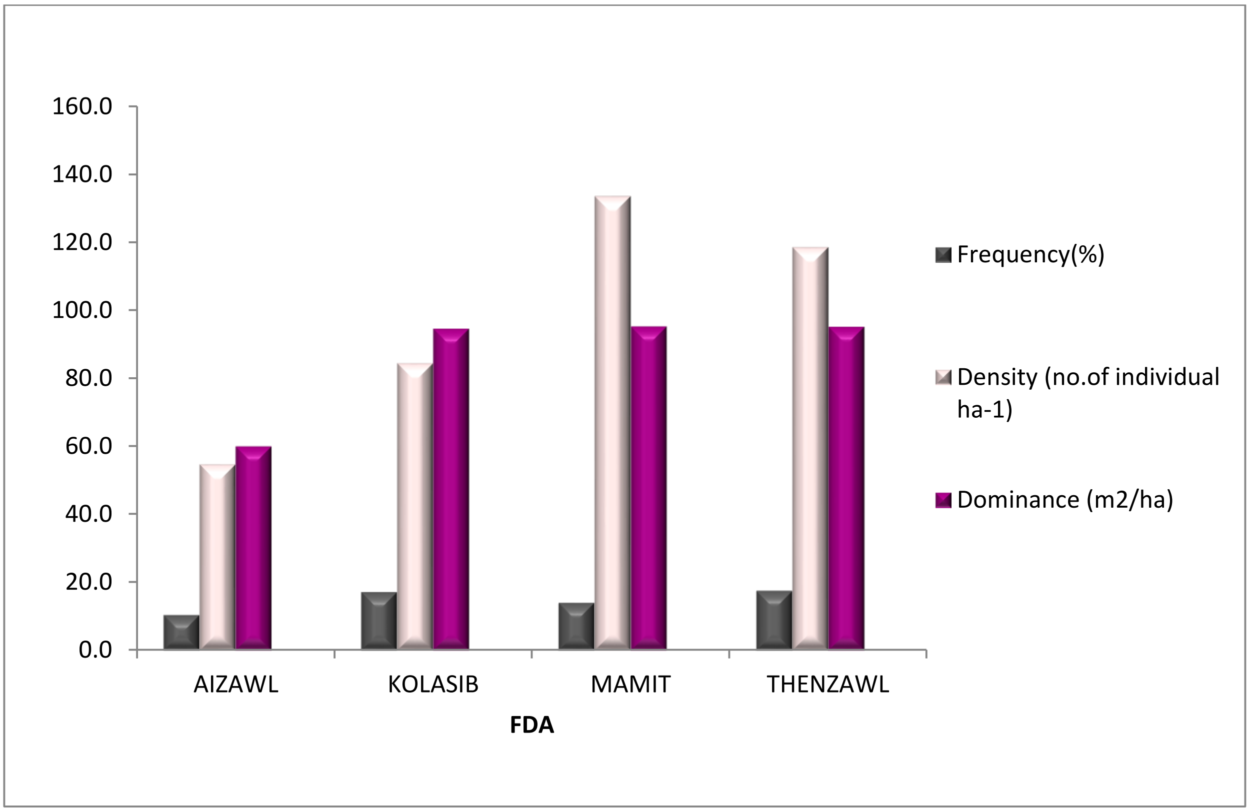

Fig. 5.1 Frequency, density and dominance of bamboo species within the five FDAs

5.2.2 Density and distribution of broom grass (*Thysanolaena latifolia* (Roxb. ex Hornem.) Honda / *Thysanolaena maxima* (Roxb.) Kuntze) and Thatch grass (*Imperata cylindrica* (L.) Raeusch.

Thatching is an important source of livelihood for the villagers. Different materials are used for thatching their roof and jhoom hut, besides *Imperata cylindrica* (L.) Raeusch., *Licuala peltata* Roxb.ex Buch.-Ham. leaves are also harvested and used for thatching. The consumption of thatch grass is mainly for roofing home and jhum hut. *Imperata cylindrica* (L.) Raeusch., has the highest frequency in Aizawl FDA (42%), followed by Kolasib FDA (34%), Thenzawl FDA (6%) and least in Mamit and Champhai FDA (4%). *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda has the highest frequency in Aizawl FDA (32%) followed by Thenzawl FDA and Mamit FDA (30%), Kolasib FDA (28%) and least in Champhai FDA (16%) (Fig. 5.2). Whereas abundance of *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda was highest in Mamit FDA (4.73) followed by Champhai FDA (4.625), Aizawl FDA (4.375), Kolasib FDA (4.43) and least abundance of broom grass in Thenzawl FDA (3.133). Abundance of *Imperata cylindrica* (L.) Raeusch., was highest in Aizawl FDA (13.762) followed by Kolasib FDA (13.353), Mamit (10.5), Champhai (9) and least abundance of *Imperata cylindrica* was in Thenzawl FDA (7.333). *Imperata cylindrica* (L.) Raeusch., had the highest density in Aizawl FDA i.e. 14450 ha^{-1}followed by Kolasib (11350 ha^{-1}), Thenzawl (1100 ha^{-1}), and Mamit (1050 ha^{-1}) and least in Champhai FDA (900 ha^{-1}). Highest density in *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda was found in Aizawl FDA (3500 ha^{-1}) and least in Champhai FDA (1850 ha^{-1}) (Fig. 5.3).

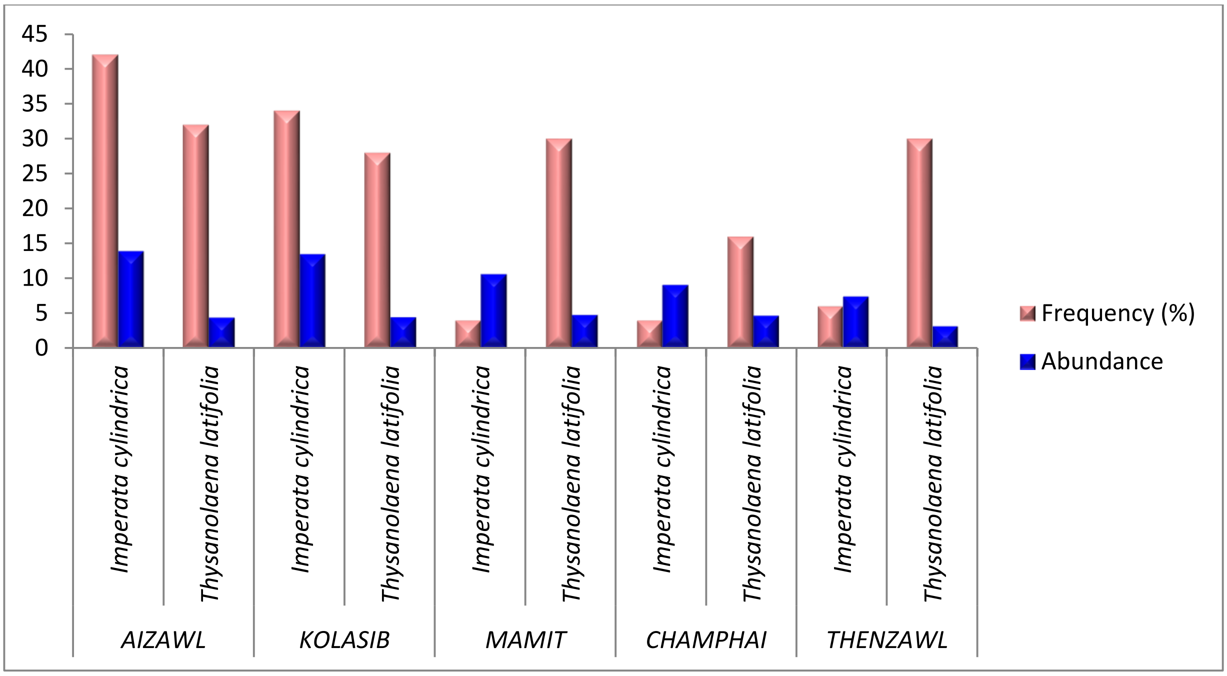

Fig. 5.2 Frequency and abundance of *Imperata cylindrica* (L.) Raeusch., and *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda within the five FDAs

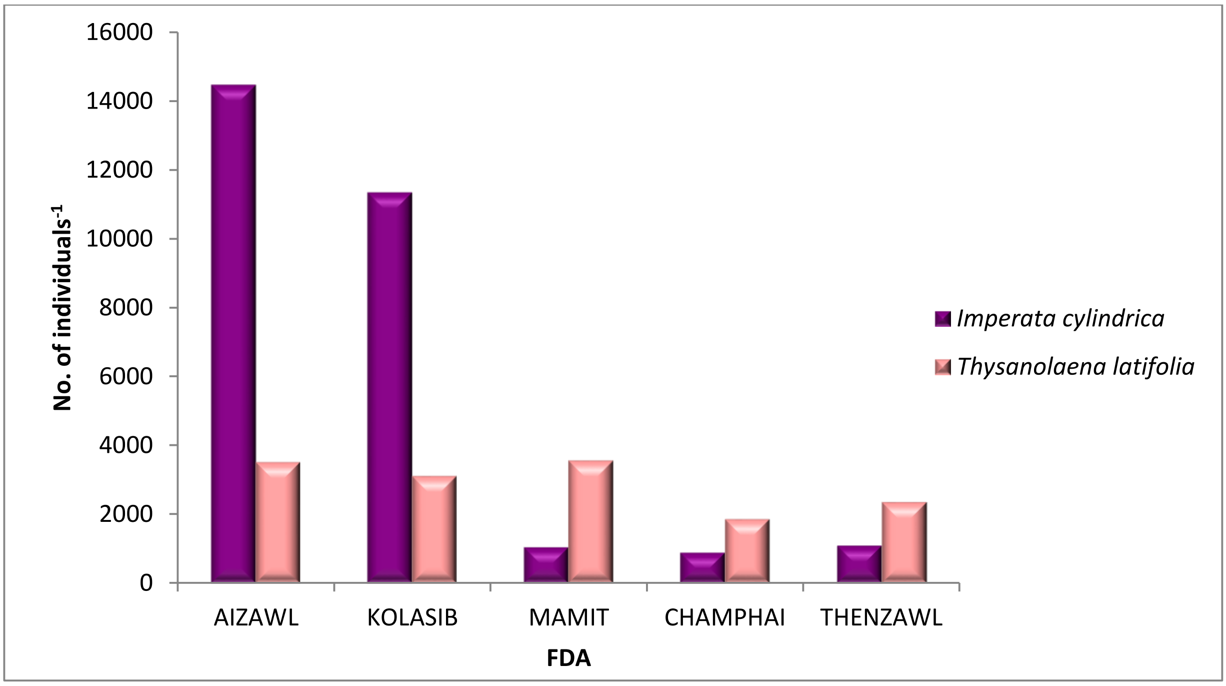

Fig. 5.3 Density (no. of individuals' ha^{-1}) of *Imperata cylindrica* (L.) Raeusch., and *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda **in forest under JFM in different FDAs**

5.2. 3 Density and distribution of medicinal plants

Frequency of medicinal plants was highest in Thenzawl FDA (17.82%) followed by Mamit (17.538%), Champhai (16.154%), Aizawl (16.130%) and least in Kolasib FDA (14.5%). Whereas abundance of medicinal plants was highest in Kolasib FDA (5.057), followed by Mamit (4.778), Thenzawl (4.691), Champhai (4.381) and least in Aizawl FDA (4.326) (Fig. 5.4). Density of medicinal plants was highest in Kolasib (3100.573 ha^{-1}), followed by Champhai (2304.337 ha^{-1}), Aizawl (2149.801 ha^{-1}), Thenzawl (1842.871 ha^{-1}) and least in Mamit (1913.212 ha^{-1}) (Fig. 5.5).

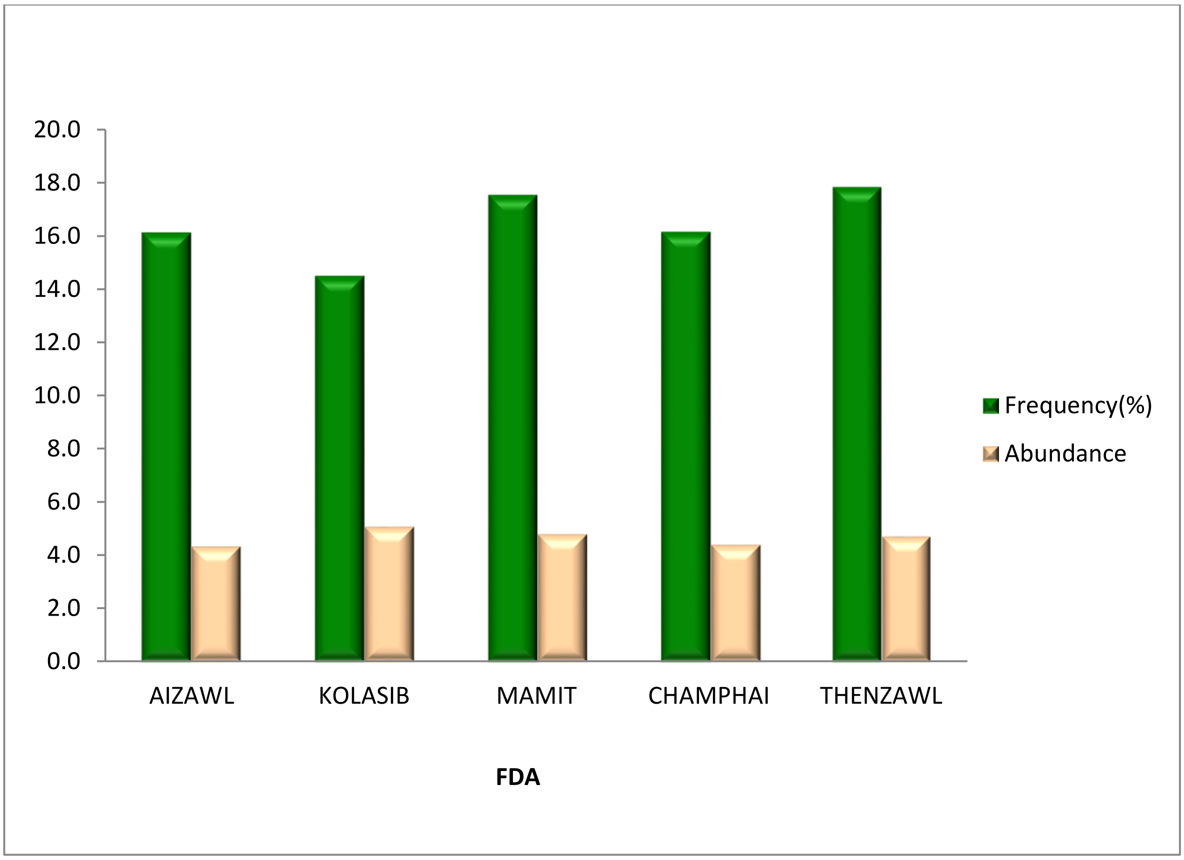

Fig. 5. 4 Frequency and abundance of medicinal plants in forest under JFM in different FDAs

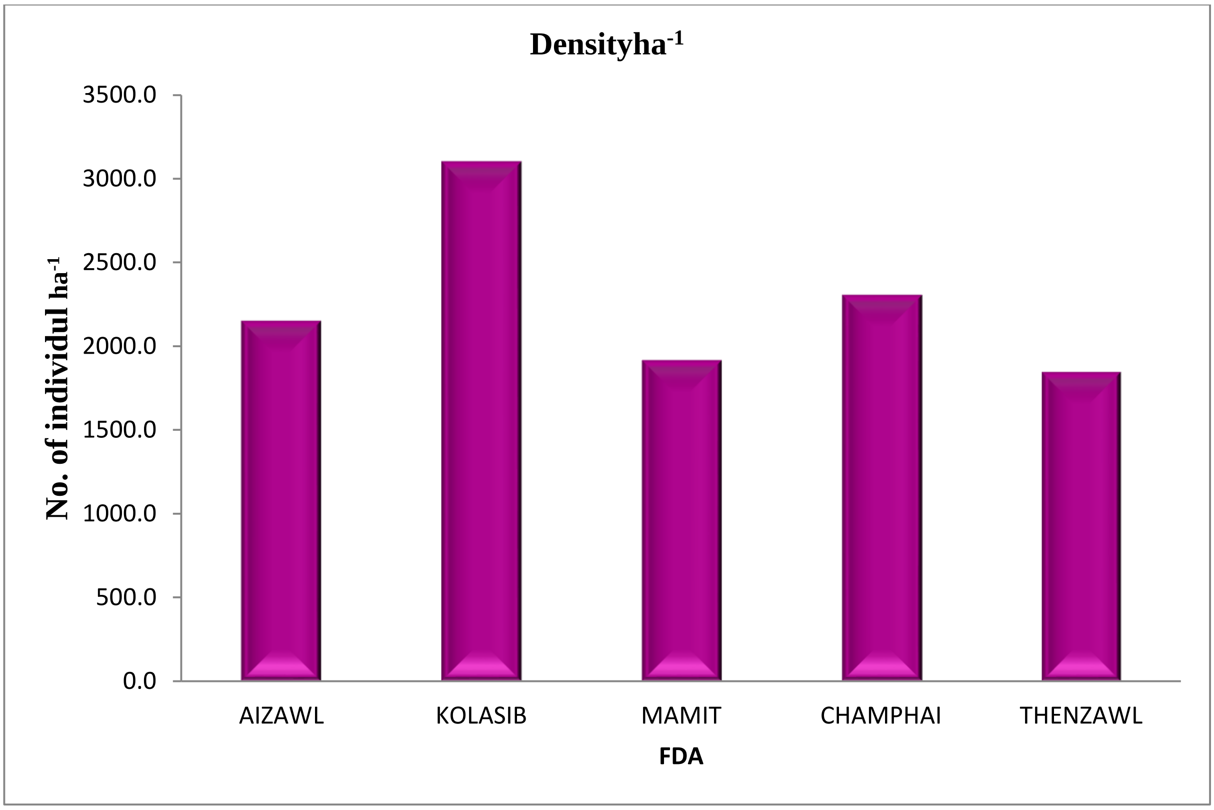

Fig.5.5 Density of medicinal plants in forest under JFM in different FDAs

5.3 Harvesting and processing of selected NTFPs

Non timber Forest Products utilised by the villagers are broadly classified into six major categories: (a) Bamboo pole and cane, (b) broom grass and thatch grass, (c) edible food and fruits, (d) fuelwood, (e) fodder and (f) medicinal plants. Harvesting period of NTFPs differed according to the plant species. NTFPs were harvested all through the year but there are some seasons in which the production favours higher harvesters, during the month of July-September harvesting peak of NTFPs (Fig.5.13). There is no special technique used in harvesting of NTFPs; it was mainly done by manual hand pluck and sometimes using Dao and other easily available sharp objects (Table 5.3). Most of the villagers are part-time NTFPs harvester; they harvested NTFPs during the off period of agricultural cash crops. The full-time NTFPs exploiters harvested all the available NTFPs from the forest all through the year in their respective seasons and sold to the market. Sustainable harvesting of NTFPs was followed only for some of the NTFPs in the study area. However, in case of harvesting some forms of NTFPs like rhizome, roots, bark and young shoots sustainable harvesting was not followed. The management and technique of harvesting NTFPs, in general varied from site to site and plant to plant as well.

5. 3 .1 Harvesting and processing of bamboo pole and cane

A total of 10 bamboo species belonging to 5 genera and 6 cane species belonging to 5 genera were encountered during the field sampling over the five Forest Development Agency (FDA). *Bambusa tulda* Roxb.*, Bambusa vulgaris* Schrad. ex J.C.Wendl*, Dendrocalamus longispathus* (Kurz) Kurz*, Dendrocalamus giganteus* Munro*, Dendrocalamus hookeri* Munro, *Dendrocalamus hamiltonii* Gamble, *Melocanna baccifera* (Roxb.) Kurz*, Schizostachyum dullooa, Schizostachyum fuchsiamum, Schizostachyum mannii* were the ten bamboo species harvested from the study sites. Besides bamboo, cane species *Arenga pinnata, Calamus gracilis, Calamus khasianus, Daemonorops jenkinsiana, Melocanna compactiflorus* and *Pinanga gracilis* were also harvested from the sites and were utilized by the villagers. They harvested these bamboos and cane species to meet their daily requirement; however, people also harvested bamboo poles and other NTFPs from adjoining areas. They had a strong believe that for all species of bamboo, harvesting mature culms and at the right season sustain their productivity. Bamboo and cane species were more frequent in Mamit FDA and it was absent in plantation of Champhai FDA. Each of the bamboo species were used differently. *Dendrocalamus longispathus* (Kurz) Kurz was mainly harvested for weaving local carrier ("Paiem"). One mature bamboo (approximately 15 feet) was sufficient to complete one local carrier. Weaving was done based on the demand of the customers. *Bambusa tulda* Roxb. was preferred over other bamboo species for weaving winnowing fan, however *Melocanna baccifera* (Roxb.) Kurz, was used for making locally used different instrument handle. Young shoots of *Melocanna baccifera* (Roxb.) Kurz, and *Dendrocalamus* *longispathus* (Kurz) Kurz were also harvested during the month of June - October and consumed in large amount by the villagers as vegetables and for supplementing after dietary requirements.

5.3 .2 Harvesting and processing of broom grass and thatch grass

Broom grass (*Thysanolaena latifolia* (Roxb. ex Hornem.) Honda ***/ Thysanolaena maxima* (Roxb.) Kuntze)**

It was harvested during the month of January to April annually. During this time the panicles became tough and its colour changed to light green or red which showed its maturity. It was harvested by direct hand pulled on the clumps or using cutter. The harvested culms are further processed by spreading thoroughly in open air and exposed to sunlight for a week. After that the seeds were cleaned off by beating and rubbing. 20-25 sticks tied properly makes one bundle and ready for used. Value addition of broom grass was also practiced in some of the studied sites which increased the market value and thus increased the market price. Broom grass is basic necessity of every household and they are easily available in the community forest as well as on the roadside. The relatively easy availability of broom grass in the area is the main reason for participation of more in harvesting this species throughout the study area. Harvesting and processing of broom grass is a simple technique and does not require any special knowledge.

Thatch grass (*Imperata cylindrica* (L.) Raeusch.)

Thatching is one of the most important activities for the villagers; though different materials are used for thatching their roof and jhum hut, *Imperata cylindrica* (L.) P. Beauv. and *Licuala peltata* Roxb. Ex Buch.-Ham. leaves are also occasionally used for thatching to signifies the tradition of local tribe (Mizo) in so many ways. They are harvested in dry season by cutting off the whole grass using dao. They are further processed it by spreading and exposed under the sunlight about a week to month after which they are ready for marketing. Besides using for thatching the roof, thatch grass was also used in pigsty, coop and also for decorating stall during cultural events. The processed grasses however were used for mulching purpose.

5. 3.3 Harvesting and processing of medicinal plants

Out of 279 plant species documented, 26 plants were being used for its medicinal purposes by the villagers all over the study sites. Utilization of medicinal plants was low because majority of the villagers had lesser knowledge about medicinal plants and they relied on the allopathic drug. The medicinal plants used by the villagers were *Adiantum philippense* L, *Aporosa roxburghii* (Wall.exLindl.) Baill., *Anogeissus acuminata* (Roxb.ex DC) Guill., *Artemisia vulgaris* L., *Benincasa hispida* (Thunb.) Cogn, *Begonia sikkimensis* A.DC., *Blumea lanceolaria* (Roxb.) Druce, *Callicarpa arborea* Roxb., *Cissampelos pareira* Linn., *Costus speciosus* (J.Konig) Sm., *Dendrocnide sinuata* (Blume) Chew, *Elaeagnus pyriformis* Hook. f., *Euphorbia royleana* Boiss., *Hedyotis scandens* Roxb., *Homalomena aromatica* (Spreng.) Schott., *Imperata cylindrica* (L). Raeusch., *Jasminum laurifolium* Roxb.ex Hornem., *Litsea monopetala* (Roxb.) Pers., *Lindernia ruellioides* (Colsm.) Pennell, *Mikania micrantha* Kunth, *Molineria capitulata* (Lour.) Herb *Securinega virosa* (Roxb.ex wild.) Baill., *Sapindus mukorossi* Gaertn, *Solanum indicum L, Trema orientalis* (L.) Blume and *Vitex glabarta* R.Br. belonging to 13 families. Through medicinal plants find low use but these were for diverse use. These plants were reported for treating 24 types of different ailments like stomach ulcer, diarrhoea, stomach problem, kidney problem, urinary problem sores, antiseptic, and tooth ache etc. (Table 5.2) Leaves, bark, stem, roots, rhizome, tuber, latex and fruits were the parts used for treating different ailments and among this leaves had the highest percentage of utilization (Fig. 5.6) followed by roots/rhizome/tuber, bark, stem, fruits, whole plant and latex has the least percentage of utilization among all the medicinal plants. Asteraceae was found to be most dominant family contributing the highest number of species to the medicinal use of plants in the study area (Fig. 5.7). Medicinal plants harvested from the site are semi processed according to the ailments to be used (Table 5.2).

Table 5.2 Ethno botanical use of different medicinal plants in the studied villages

Sl. No.	Scientific name	Vernacular name (Mizo)	Family	Parts used	Mode of utilization
1	*Adiantum philippense* L	Lungpuisam	Adiantaceae	Whole plant	The whole plant is boiled and used in treatment of dysentery and stomach ulcers.
2	*Aporosa roxburghii* (Wall.exLindl.) Baill.	Chhawntual	Euphorbiaceae	Bark	Decoction of bark is used as a remedy of stomach ulcer and diarrhoea.
3	*Anogeissus acuminata* (Roxb.ex DC) Guill.	Zairum	Combretaceae	Bark	Decoction of bark is boiled and used for the treatment of stomach problems.
4	*Artemisia vulgaris* L.	Sai	Asteraceae	Leaves	Leaves are boiled and used in treatment of stomach-ache and sores.
5	*Benincasa hispida* (Thunb.) Cogn	Mai-pawl	Cucurbitaceae	Fruit	Fruit juice is used for treating diarrhoea and vomiting.
6	*Begonia sikkimensis* A.DC.	Sekhupthur	Begoniaceae	Stem	Juice of stem for treating pile related problem.
7	*Blumea lanceolaria* (Roxb.) Druce	Buarze	Asteraceae	Leaves	Decoction of leaves used for treating stomach pain and also to rejuvenate cancer patient.
8	*Callicarpa arborea* Roxb.	Hnahkiah	Verbanaceae	Bark, leaves	Decoction of the bark for stomach ulcer.
9	*Cissampelos pareira* Linn.	Hnahbialhrui	Menispermaceae	Stem	Juice of pounded stem used for treating urinary problem and colic.
10	*Costus speciosus* (J.Konig) Sm.	Sumbul	Zingiberaceae	Rhizome	Juice of crush roots given to kidney related problems.
11	*Dendrocnide sinuate* (Blume) Chew	Thakpui	Urticaceae	Roots	Decoction of roots used in disease of liver, jaundice and skin itching.
12	*Elaeagnus pyriformis* Hook.f.	Sarzuk-te	Elaeagnaceae	Roots	Decoction of the roots given to women after delivery to clean the uterus.
13	*Euphorbia royleana* Boiss.	Chawng	Euphorbiaceae	Leaves, latex	The milky juice is used to treat ringworm.
14	*Hedyotis scandens* Roxb.	Kelhnamtur	Rubiaceae	Leaves, roots	Decoction of leaves is used in urinary problems.
15	*Homalomena aromatica* (Spreng.) Schott.	Anchiri	Araceae	Leaves, stem	The leaves and stem are cooked along the fodder of pigs to increase their breast milk.
16	*Imperata cylindrica* (L). Raeusch.	Di	Poaceae	Roots	Decoction of roots used for expelling thread worms from the body.
17	*Jasminum laurifolium* Roxb.ex Hornem.	Maufimhrui	Oleaceae	Leaves	Juice of the leaves is an effective remedy for kidney disease.
18	*Litsea monopetala* (Roxb.) Pers	Nauthak	Lauraceae	Leaves	Crushed leaves applied to cattle sores and also added along the food.
19	*Lindernia ruellioides* (Colsm.) Pennell	Tha-suih	Scrophulariaceae	Whole plant	The whole plant is used as a poultice for cramps, rheumatism, sciatica and wounds.
20	*Mikania micrantha* Kunth	Japan hlo	Asteraceae	Leaves	Juice of leaves applied to cuts as antiseptic
21	*Molineria capitulate* (Lour.) Herb.	Phaiphek	Hypoxidaceae	Tuber	Juice of crush tuber is used to cure abdominal pain.
22	*Securinega virosa* (Roxb.ex wild.) Baill.	Saisiak	Euphorbiaceae	Leaves	Decoction of the leaves used for bath in case of measles and chickenpox.
23	*Sapindus mukorossi* Gaertn	Hlingsi	Sapindaceae	Fruit	Infusion of the fruit pulp is used for curing sore throat and also fruits eaten by tonsillitis.
24	*Solanum indicum* L.	Tawkte	Solanaceae	Fruit	Crush fruits are applied to burns and insect bites
25	*Trema orientalis* (L.) Blume	Belphuar	Ulmaceae	Leaves	Crushed leaves are applied to tooth for treating toothache.
26	*Vitex glabarta* R.Br.	Thingkhawilu-nu	Verbanaceae	Bark	Decoction of the bark is used as a remedy for stomach problems.

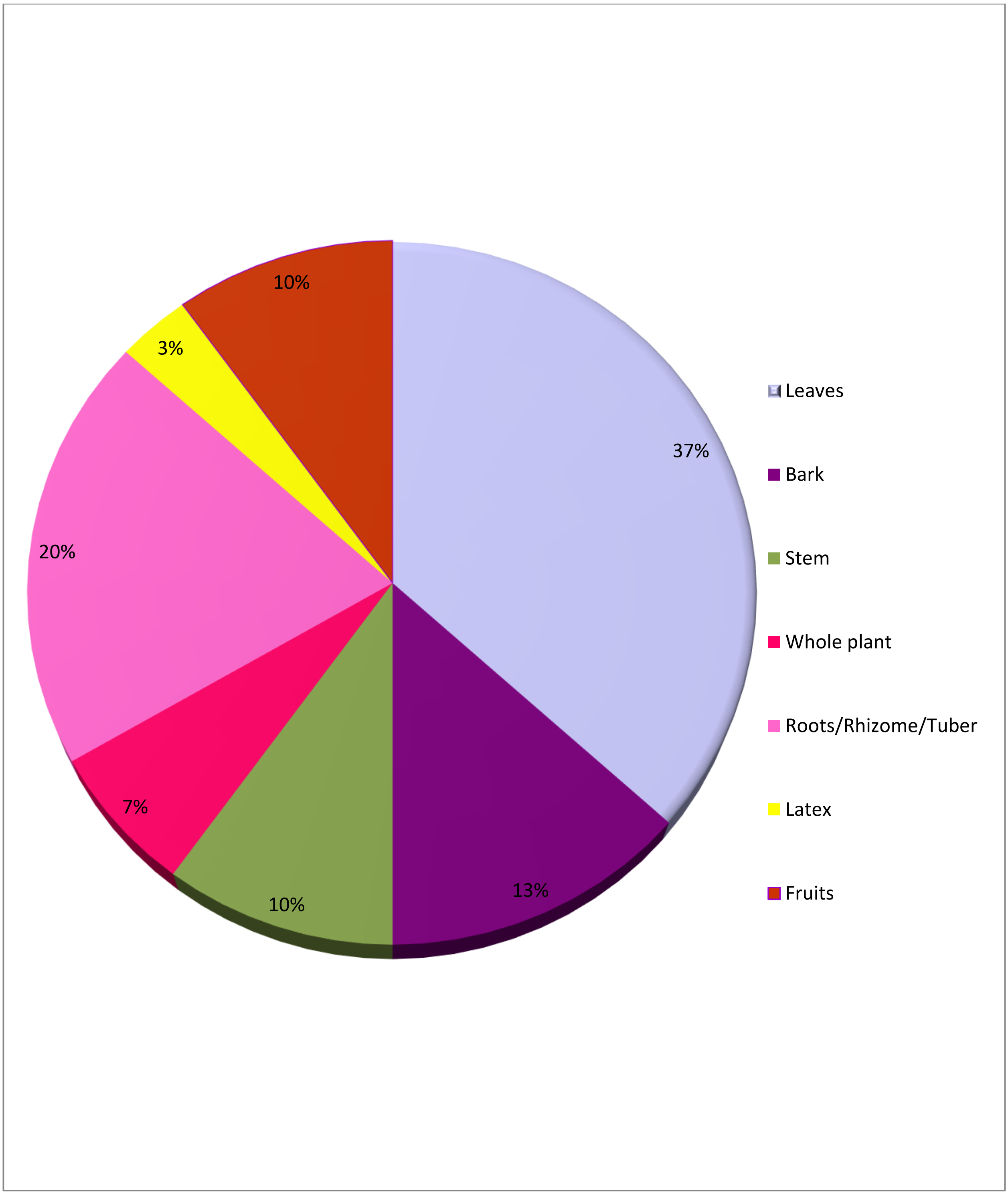

Fig. 5.6 Part wise use of medicinal plants under JFM in different FDAs

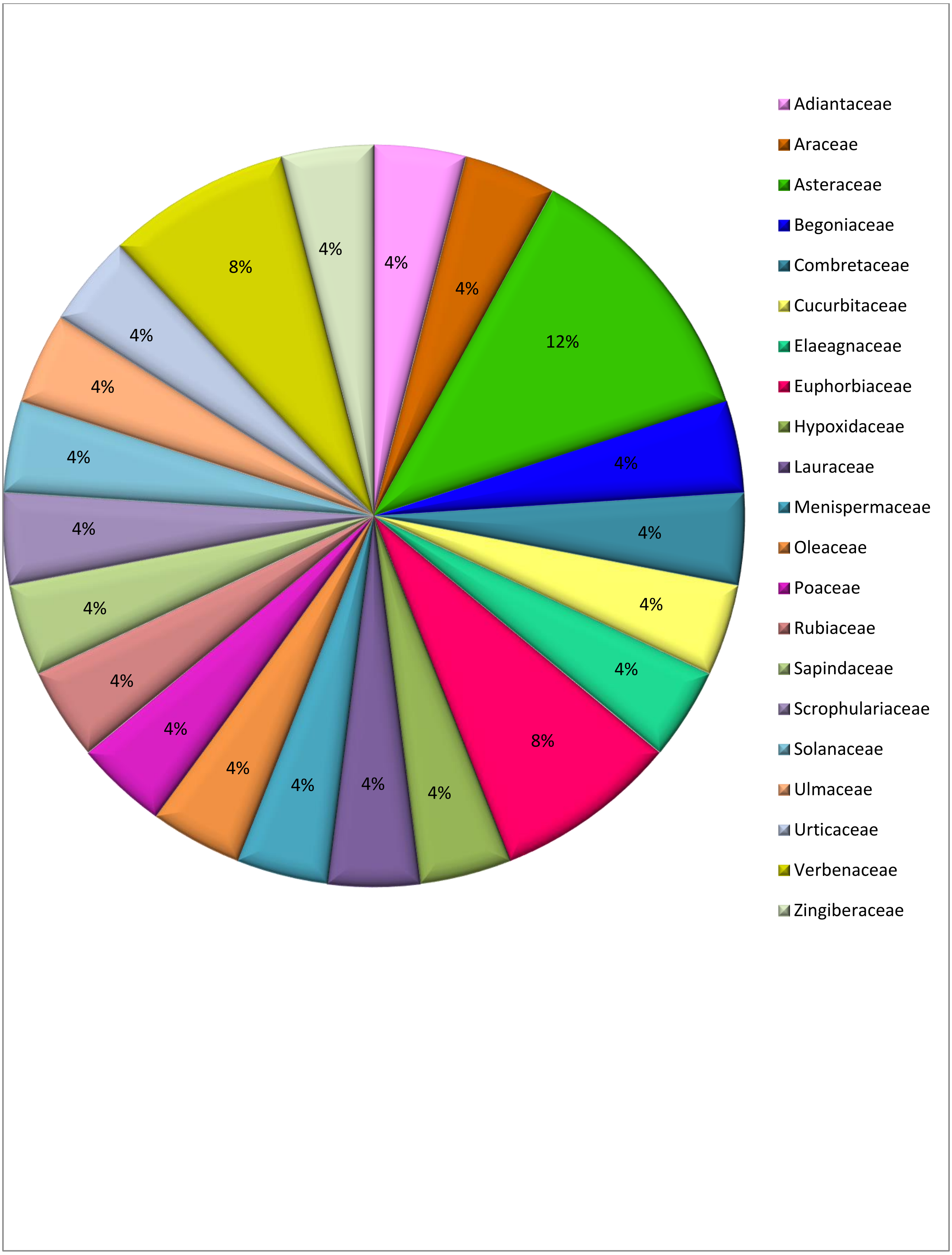

Fig. 5.7 Family wise distribution of medicinal plants under JFM in different FDAs

5. 3.4 Harvesting and processing of edible food and fruits

Edible food

Acmella paniculata (Wall.exDC) R.L.Jansen, *Amomum dealbatum* Roxb., *Amorphophallus nepalensis* (Wall.) Bogner & Mayo., *Agaricus campestris* Linn, *Cassia occidentalis, Calamus tenuis* Roxb., *Calamus erectus* Roxb. *Calamus guruba* Buch.Ham. *Centella asiatica* (L.) Urban., *Clerodendrum colebrookianum* Lindl., *Cucurma longa* Linn., *Cucurma caesia* Roxb., *Dendrocalamus longispathus* (Kurz) Kurz, *Diplazium esculentum* (Retz) Sw., *Entoloma microcarpum* Berk &Br., *Eurya acuminate* DC., *Gnetum gnemon* L., *Homalomena aromatica* (Spreng.) Schott., *Marsdenia maculate* Hook, *Marsdenia formosana Melocanna baccifera* (Roxb.) Kurz *Musa glauca* Roxb. *Oroxylum indicum* (L.) Kurz, *Parkia roxburghii* G.Don, *Persea americana* L., *Picria felterrae* Lour. , *Schizophyllum commune* Fr, *Solanum nigrum* Linn., *Solanum torvum* Sw, and *Zanthoxylum rhetsa* (Roxb.) DC are the 30 edible food species harvested by the villagers belonging to 21 families. Zingiberaceae, Agaricaceae and Arecaceae contributed maximaaly to edible foods followed by Araceae, Poaceae and Solanaceae (Fig. 5.8). Most of the edible foods were semi-processed in the site before consumption. For example *Amorphophallus nepalensis* (Wall.) Bogner & Mayo undergo a number of processing steps to make it into edible form. The peel were taken off and cut into small sections, boiled and cooked with cooking soda for about 30 minutes, after which they were wrapped properly with leaves and ready to sell in the market. Bamboo shoots were also semi-processed at home and stored in the refrigerator for the off season. Among the parts of food species harvseted, leaves had the highest percentage of consumption (38%) followed by shoots (19%) fruit/pod (16%), tuber/rhizome and fruiting body (9%), shoot (6%) and least by and stalk (3%) (Fig.5.9).

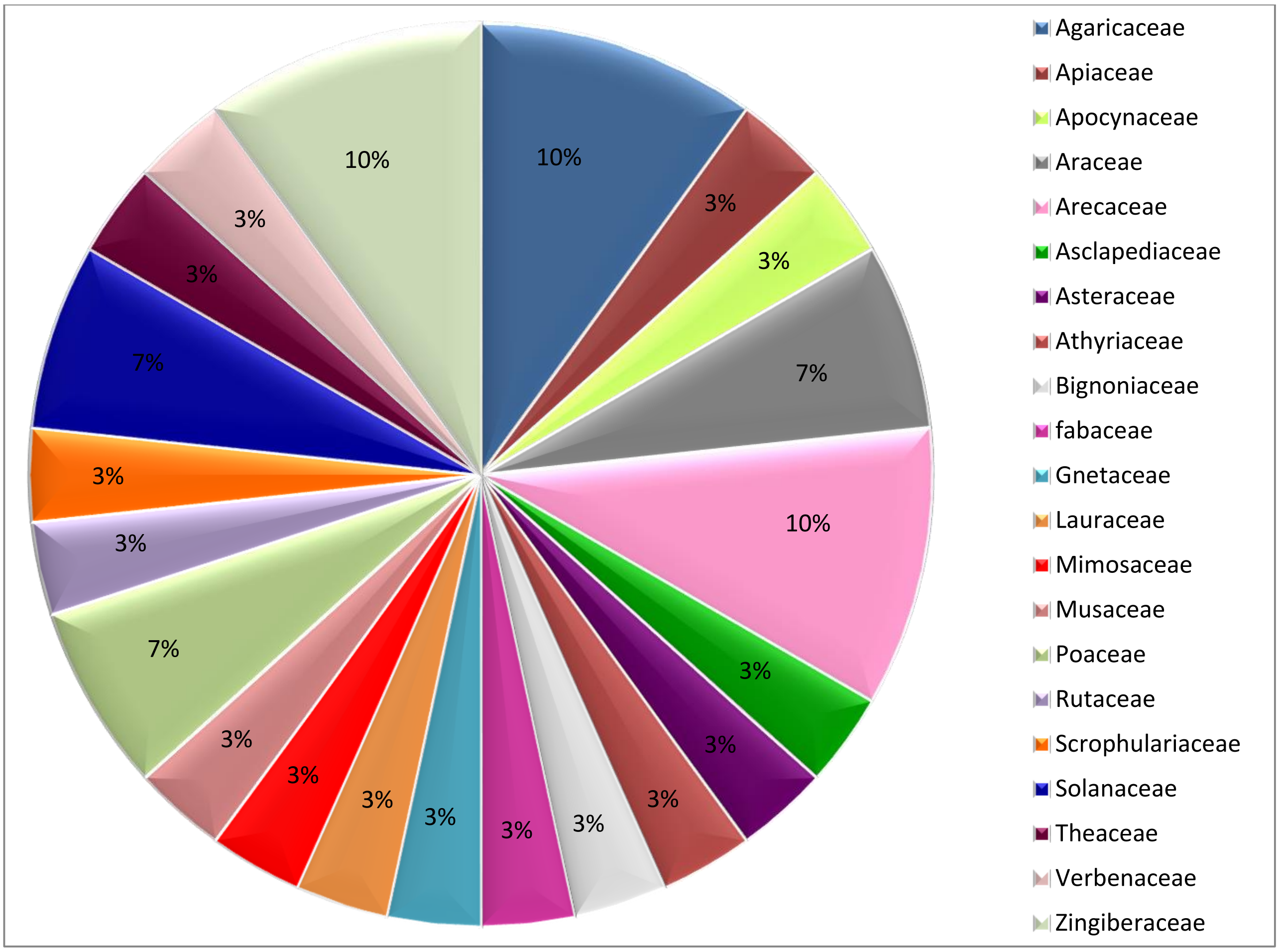

Fig.5.8 Food species belonging to different families in the studied forest under JFM

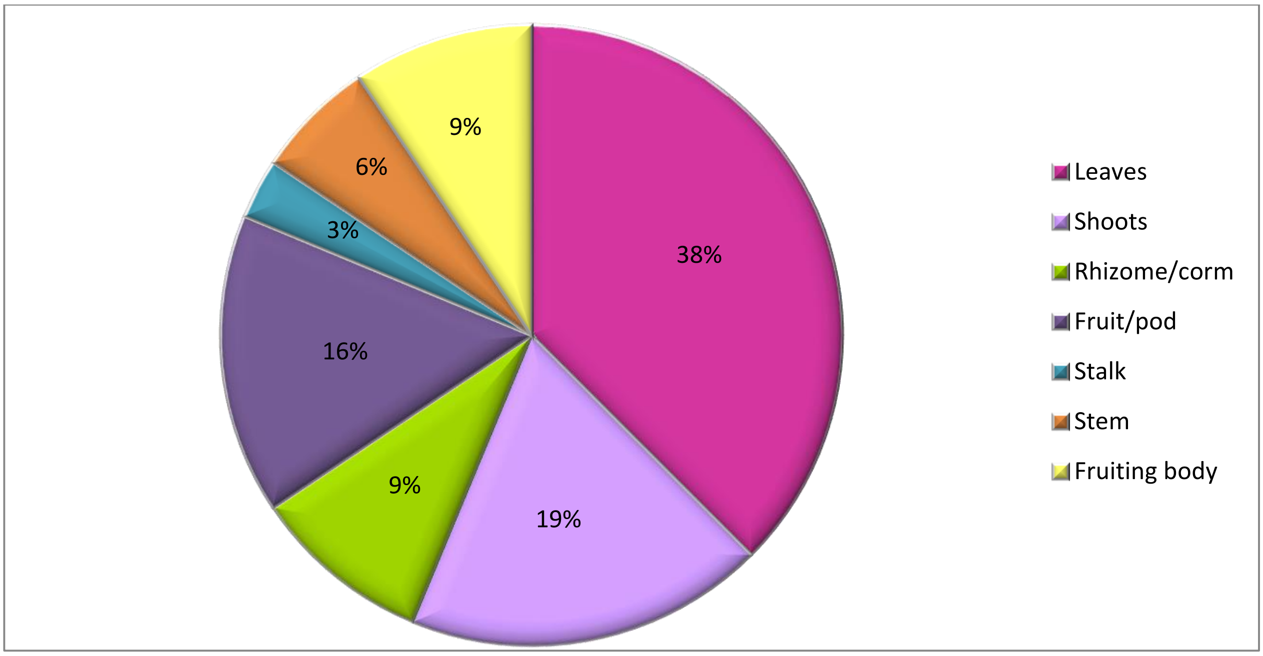

Fig.5.9 Proportion of different plant parts used for food consumption in forest under JFM

Table 5. 3 Technique of harvesting wild vegetables from the study sites under JFM in Mizoram

Sl no.	Scientific name	Parts used	Local name (Mizo)	Method of harvesting	Sustainability
1	*Acmella paniculata* (Wall.exDC) R.L.Jansen	Leaves	Ansate	Manual hand pluck	Yes
2	*Amomum dealbatum* Roxb.	Shoots	Aidu	Cut with dao	Yes
3	*Amorphophallus nepalensis* (Wall.) Bogner & Mayo.	Corm	Telhawng	Digging with dao and further processed it	No
4	*Agaricus campestris* Linn	Fruiting body	Maupa	Manual hand pluck	Yes
5	*Cassia occidentalis* L.Var.aristata Collad	Leaves	Reng an	Manual hand pluck	Yes
6	*Calamus erectus* Roxb.	Young shoot	Thilthek(hruizik)	Debarking with dao	No
7	*Calamus tenuis* Roxb.	Young shoot	Changdam (hruizik)	Debarking with dao	No
8	*Calamus guruba* Buch.-ham. ex.Mart	Young shoot	Thil te (hruizik)	Debarking with dao	No
9	*Centella asiatica* (L.) Urban.	Leaves	Lambak	Manual hand pluck	Yes
10	*Clerodendrum colebrookianum* Lindl.	Leaves	Phuhnam	Manual hand pluck	Yes
11	*Cucurma longa* Linn.	Rhizome	Aieng	Digging with sharp object	No
12	*Cucurma caesia* Roxb.	Rhizome	Ailaidum	Digging with sharp object	No
13	*Dendrocalamus longispathus* (Kurz)Kurz	Shoots	Raw nal	Debarking with dao	No
14	*Diplazium esculentum* (Retz) Sw.	Leaves	Chakawk	Manual hand pluck	Yes
15	*Entoloma microcarpum* Berk &Br.	Fruiting body	Pa sawntlung	Manual hand pluck	Yes
16	*Eurya acuminata* DC.	Leaves	Sihneh	Cut the younger branch using dao.	No
17	*Gnetum gnemon* L.	Leaves, fruits	Pelh	Cut the younger branch using dao.	No
18	*Homalomena aromatic* (Spreng.) Schott.	Stalks, leaves	Anchiri	Manual hand pluck	No
19	*Marsdenia maculata* Hook	Fronds, young stem	Ankhapui	Cut the immature stems with dao	No
20	*Marsdenia formosana* Masam	leaves	Ankhate	Cut with dao	No
21	*Melocanna baccifera* (Roxb.) Kurz	Shoots	Mautak	Debarking with dao	No
22	*Musa glauca* Roxb.	Leaf sheath	Saisu	Debarking with dao and cut into smaller sections after peeling off both the sides with knife.	Yes
23	*Oroxylum indicum* (L.) Kurz	Pods	Archangkawm	Manual hand pluck	Yes
24	*Parkia roxburghii* G.Don	Pods	Zawngtah	Pluck using fruit plucker made of bamboo	Yes
25	*Persea americana* L.	Fruit pulp	Butter thei	Manual hand pluck	No
26	*Picria felterrae* Lour.	Leaves	Khatual	Manual hand pluck	Yes
27	*Schizophyllum commune* Fr	Fruiting body	Pa si	Manual hand pluck	Yes
28	*Solanum nigrum* Linn.	Leaves	An hling	Manual hand pluck	Yes
29	*Solanum torvum* Sw	Fruit	Tawkpui	Manual hand pluck	Yes
30	*Zanthoxylum rhetsa* (Roxb.) DC	Leaves	Chingit	Cut the younger stem using dao	Yes

Fruits

Artocarpus heterophyllus Lam, *Baccaurea ramiflora* Lour. *Ficus prostrata* (Wall.ex Miq.) *Ficus semicordata* Buch.Ham ex Sm *Garcinia lanceifolia* Roxb. *Garcinia sopsopia* (Buch.-Ham.) Mabb. *Phyllanthus emblica* L. (*Emblica officinalis*), *Protium serratum* (Wall.ex Colebr.) Engl. *Rhus chinensis* Mill, *Rubus alceifolius* Poir. and *Spondias mangifera* Willd. are the 11 fruits species harvested by the villagers. They belonged to 6 families. All the fruits harvested from the sites are directly consumed. *Phyllanthus emblica* (*Emblica officinalis* L) besides consumed directly, it was processed by boiling with water and then preserving with sugar. It was also preserved for the off season by drying it in the sun.

5.3. 5 Harvesting and processing of fuelwood

Albizia chinensis (Osbecks) Merr., *Anogeissus acuminata* (Roxb.ex DC) Guill., *Bischofia javanica* Blume, *Callicarpa arborea* Roxb., *Derris robusta* (DC.) Benth., *Elaeocarpus lanceifolius* Roxb., *Gmelina arborea* Roxb., *Macaranga indica* Wight, *Mesua ferrea* Linn., *Michelia oblonga* Wall. Ex Hook.f. & Thoms., *Schima wallichi* (DC.) Korth., *Vitex peduncularis* Wall ex, Schauer, *Tetrameles nudiflora* R.Br., *Quercus dealbata* Wall. and *Quercus pachyphylla* Kurz. were the fuelwood harvested by the villagers from the all the study sites. All the fuelwood species were not freely accessible. They were harvested only from the dry and die out trees as the site was reserved by the authorities. The amount of fuelwood harvested was also limited to certain extent. The people were allowed to harvest for their own consumption and sold if they got surplus.

5. 3.6 Harvesting and processing of Fodder

Bidens pilosa L., *Imperata cylindrica* (L) Raeusch., *Mikania micrantha* Kunth, *Musa balbisiana* Colla and *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda (*Thysanolaena maxima)* were the five plant species harvested for fodder. They belonged to the family Asteraceae, Poaceae and Musaceae respectively. These fodders were harvested only for peoples own used and no marketing channel was linked with fodder species. These fodder species were processed by cutting into small sections and boiled along with other fodder.

5.4 Household involvement in harvesting and consumption of NTFPs

Among the NTFPs groups, broom grass and thatch grass had the highest percentage of household involvement in harvesting / year (50.4%), followed by fuelwood (46.93%), edible food and fruits (46.4%), fodder (37.2%), bamboo pole and cane (27.4%) and least in medicinal plants (5.12%) (Fig.5.10).

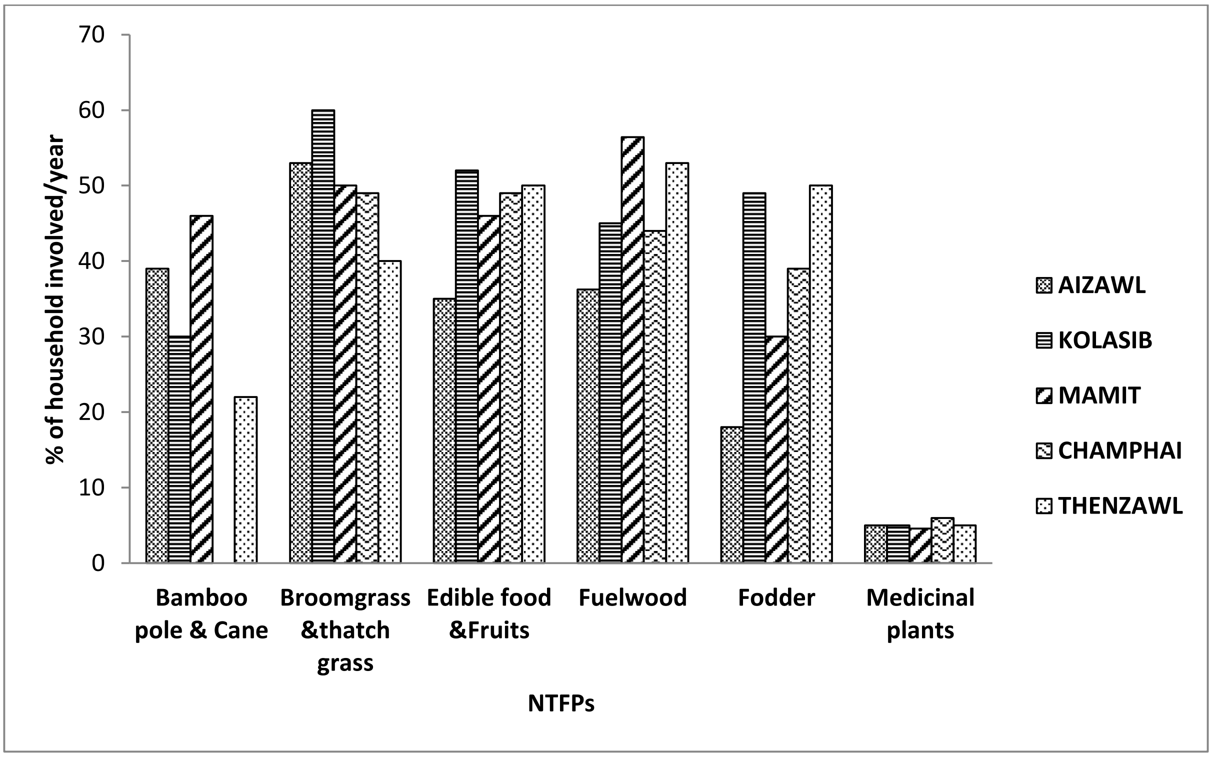

Fig. 5.10 Household involvement (%) in different NTFP activities in the five FDA

The quantity of NTFPs harvested varied widely among the FDAs. Bamboo pole and cane were harvested maximally (56.6 $kg^{-1}hh^{-1}yr^{-1}$) followed by fuelwood (48.94 $kg^{-1}hh^{-1}yr^{-}1$) edible food and fruits (39.2 $kg^{-1}hh^{-1}yr^{-1}$), fodder (37.8 $kg^{-1}hh^{-1}yr^{-1}$), broom grass and thatch grass (27.8 $kg^{-1}hh^{-1}yr^{-1}$) and medicinal plants have the least quantity harvested (3.76 $kg^{-1}hh^{-1}yr^{-1}$) (Fig 5.11).

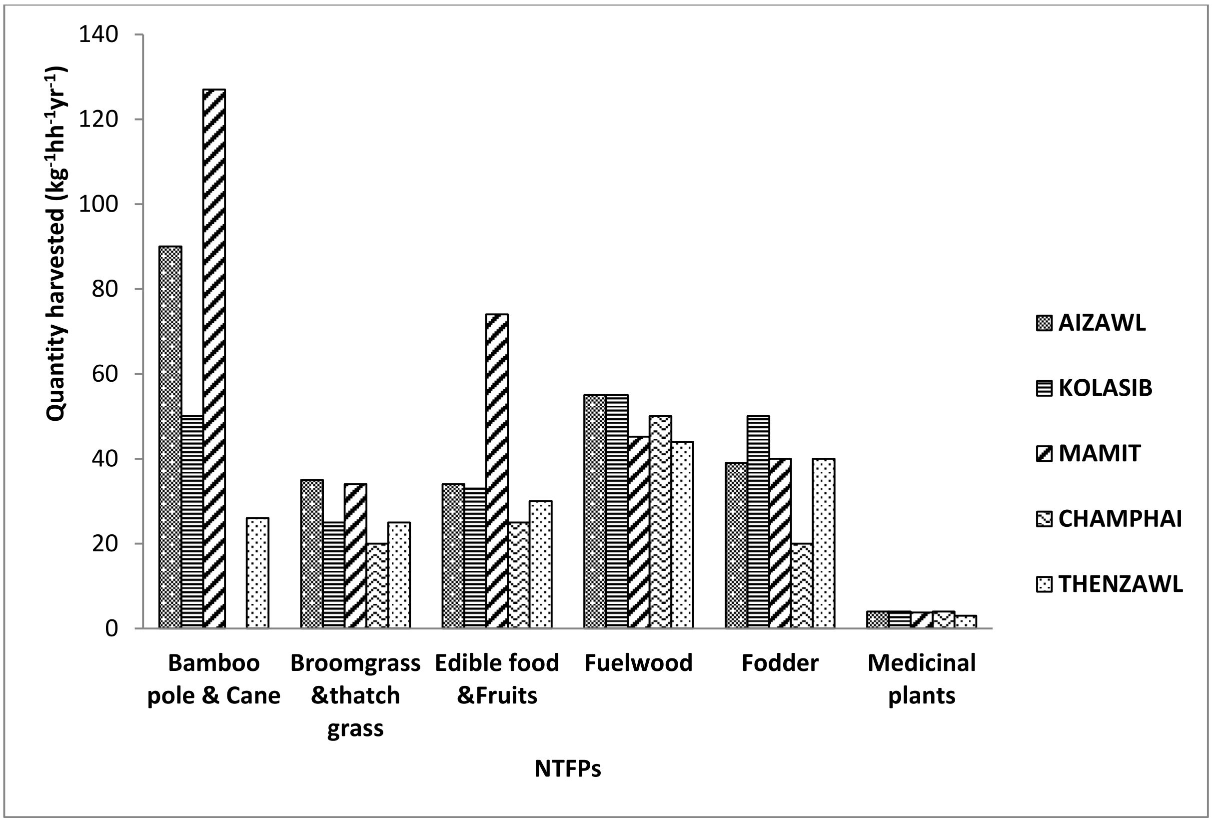

Fig. 5.11 Quantity of NTFPs harvested from the forest under JFM in different FDAs

Among the NTFPs harvested, some were harvested only for their own consumption while others were sold to the market. Fuelwood had the highest amount of consumption as compared to the other NTFPs (42.9 $kg^{-1}hh^{-1}yr^{-1}$) followed by fodder (37.8 $kg^{-1}hh^{-1}yr^{-1}$), bamboo pole and cane (34.8 $kg^{-1}hh^{-1}yr^{-1}$), edible food and fruits (19.4 $kg^{-1}hh^{-1}yr^{-1}$), broom grass and thatch grass (15.2 $kg^{-1}hh^{-1}yr^{-1}$) and least in medicinal plants (3.76 $kg^{-1}hh^{-1}yr^{-1}$) (Fig.5.12).

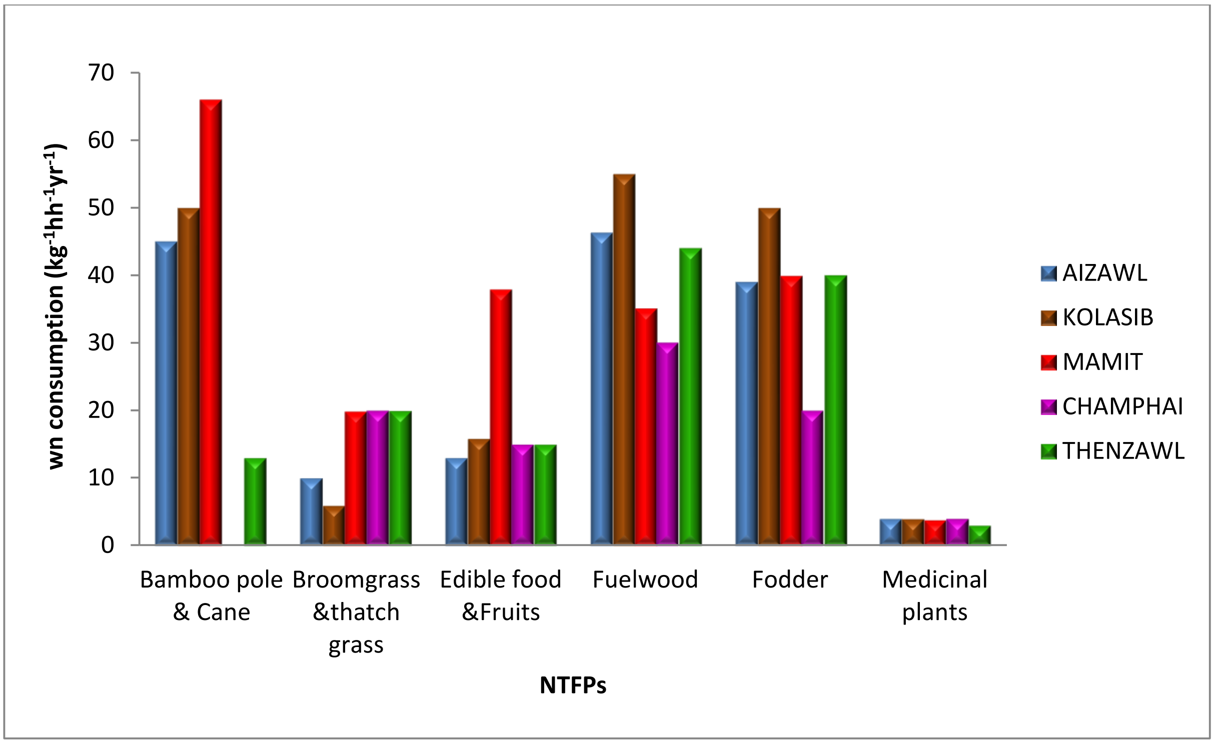

Fig.5.12 Quantity of NTFPs used for household consumption from the forest under JFM in different FDAs.

5.5 Seasonality of NTFP

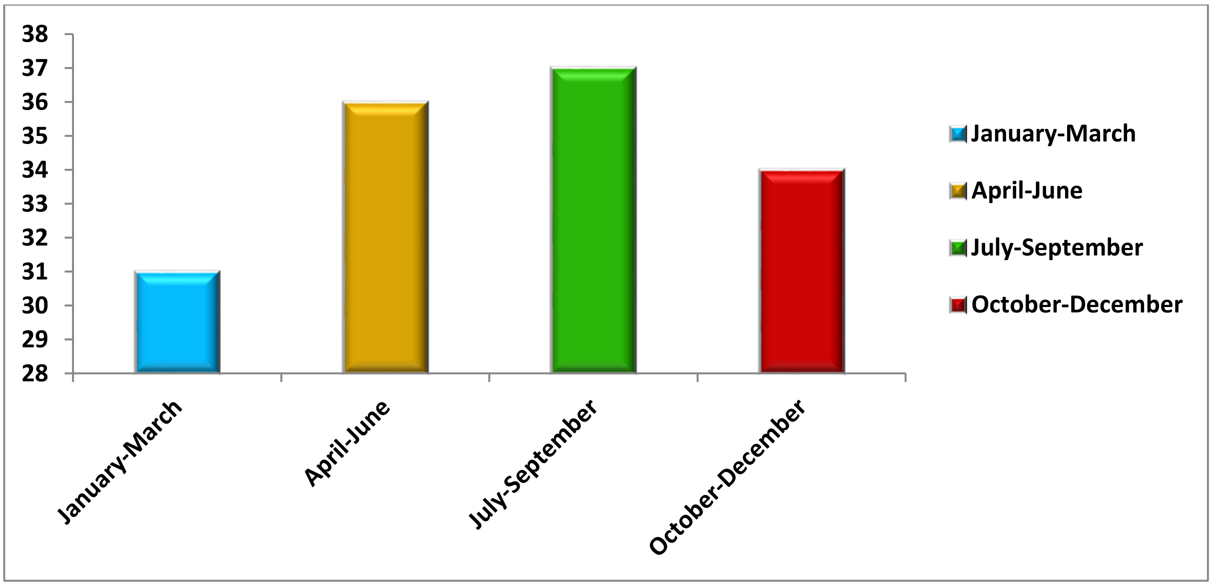

Fig.5.13 Seasonality of different NTFPs in different village under five FDAs

The quantity of NTFPs available varied from season to season. During the month of July-September maximum numbers of NTFPs were harvested, followed by April- June, October - December. Least quantities of NTFPs were harvested during January- March. This was true in all FDAs in Mizoram.

5.6 Use Value

5.6.1 Use value for selected NTFPs in Champhai FDA

Table 5.4 Use Value (UV) for selected NTFPs in Champhai FDA

CHAMPHAI FDA	Total ($\sum U_{is}$)	Mean (UV_{is})	Standard deviation
VEGETABLES			
Amomum dealbatum	12	2.4	1.09
Amorphophallus nepalensis	14	2.8	0.45
Arenga pinnata	8	1.6	0.45
Bamboo shoot	22	4.4	0.55
Mushroom	9	1.8	1.3
FRUITS			
Artocarpus heterophyllus	11	2.2	0.837
Garcinia sopsopia	9	1.8	0.570
Phyllanthus emblica	11.5	2.3	0.447
Protium serratum	10	2	0.707
Spondias mangifera	10.5	2.1	0.742
FUELWOOD			
Anogeissus acuminata	11	2.2	0.64
Macaranga indica	4	0.8	0.45
Mesua ferrea	3	0.6	0.55
Quercus dealbata	3	0.6	0.55
Quercus pachyphylla	8	1.6	0.55
MEDICINAL PLANTS			
Artemisia vulgaris	9	1.8	0.84
Lindernia ruellioides	11	2.2	0.84
Litsea monopetala	11	2.2	0.84
Mikania micrantha	12	2.4	0.89
Securinega virosa	13	2.6	0.55

From the wild vegetables bamboo shoot has got the highest mean use value (UV_{is} = 4.4) followed by *Amorphophallus nepalensis* (UV_{is} = 2.8), *Amomum dealbatum* (UV_{is} = 2.4), mushroom (UV_{is} = 1.8) and *Arenga pinnata* with the least mean use value (UV_{is} = 1.6) in Champhai FDA.

Overall use value for wild vegetables,

$UV_S = \sum UV_{is} / i_s$ = (4.4+ 2.8+2.4+1.8+1.6)/5 = 2.56

From the wild fruits harvested *Garcinia sopsopia* has got the highest mean use value (UV_{is} = 2.3) followed by *Artocarpus heterophyllus* (UV_{is} = 2.2), *Protium serratum* (UV_{is} = 2.1), *Phyllanthus emblica* (UV_{is} = 2) and least mean use value in *Spondias mangifera* (UV_{is} =1.8). Overall use value for fuel wood species,

$UV_S = \sum UV_{is} / i_s$ = (2.3+ 2.2+ 2.1+ 2 + 1.8)/5 = 2.08

From the fuelwood species *Anogeissus acuminata* has got the highest mean use value (UV_{is} = 2.2) followed by *Quercus pachyphylla* (UV_{is} = 1.6), *Macaranga indica* (UV_{is} =0.8) and *Mesua ferrea* and *Quercus dealbata* with the least mean use value (UV_{is} =0.6).

Overall use value for fuel wood species,

$UV_S = \sum UV_{is} / i_s$ = (0.6+ 0.8+0.6+2.2+1.6)/5 = 1.16

From the five medicinal plants *Securinega virosa* has got the highest mean use value (UV_{is} = 2.6) followed by *Mikania micrantha* (UV_{is} = 2.4), *Lindernia ruellioides* and *Litsea monopetala* (UV_{is} =2.2) and *Artemisia vulgaris* with the least mean use value (UV_{is} =1.8).

Overall use value for fuel wood species,

$UV_S = \sum UV_{is} / i_s$ = (2.6+2.4+2.2+2.2+1.8)/5 =2.24

From the wild vegetables bamboo shoot has got the highest mean use value (UV_{is} = 6.9) followed by *Oroxylum indicum* (UV_{is} = 2.9) *Amomum dealbatum* (UV_{is} = 2.75), *Diplazium esculentum* (UV_{is} = 2.7) and *Amorphophallus nepalensis* (UV_{is} = 2.5) *Marsdenia maculate* with the least mean use value (UV_{is} = 2.3)

5.6.2 Use value for selected NTFPs in Kolasib FDA

Table 5.5 Use Value (UV) of four types of NTFPs from Kolasib FDA

Kolasib FDA	Total ($\sum U_{is}$)	Mean (UV_{is})	Standard deviation
VEGETABLES			
Amomum dealbatum	12.5	2.75	0.5
Amorphophallus nepalensis	12.5	2.5	0.5
Bamboo shoot	34.5	6.9	1.342
Diplazium esculentum	13.5	2.7	0.570
Marsdenia maculate	11.5	2.3	0.274
Oroxylum indicum	14.5	2.9	0.894
FRUITS			
Baccaurea ramiflora	11.5	2.3	0.447
Ficus prostrata	13.5	2.7	0.671
Ficus semicordata	15.5	3.1	0.894
Garcinia sopsopia	16	3.2	1.151
Phyllanthus emblica	21	4.2	2.139
Rhus chinensis	15	3	0.791
Rubus alceifolius	16.5	3.3	0.758
Spondias mangifera	18.5	3.7	0.671
FUELWOOD			
Anogeissus acuminata	8.5	1.7	0.837
Callicarpa arborea	14.5	2.9	0.548
Derris robusta	13	2.6	0.548
Gmelina arborea	17	3.4	1.557
Macaranga indica	12.5	2.5	0.500
Michelia oblonga	14	2.8	0.758
MEDICINAL PLANTS			
Aporosa roxburghii	17.5	3.5	0.500
Begonia sikkimensis	20.5	4.1	1.140
Callicarpa arborea	14	2.8	1.095
Cissampelos pareira	12	2.4	0.652
Hedyotis scandens	9	2.25	0.289
Homalomena aromatica	18.5	3.7	1.204
Lindernia ruellioides	12.5	2.5	0.500
Molineria capitulate	15.5	3.1	0.742
Trema orientalis	15.5	3.1	0.548

Overall use value for wild vegetables,

$UV_S = \sum UV_{is} / i_s$ = (6.9+ 2.9+2.75 +2.7+2.5+ 2.3)/6 = 3.341

From the fruits *Phyllanthus emblica* (UV_{is} = 4.2) has the highest use value followed by *Spondias mangifera* (UV_{is} = 3.7), *Rubus alceifolius* (UV_{is} = 3.3), *Garcinia sopsopia* (UV_{is} = 3.2), *Ficus semicordata* (UV_{is} = 3.1), *Rhus chinensis* (UV_{is} = 3), *Ficus prostrata* (UV_{is} = 2.7)

Overall use value for fruit species,

$UV_S = \sum UV_{is} / i_s$ = (4.2+3.7+3.3+3.2+ 3.1+3+2.7) = 4.64

From the fuelwood species *Gmelina arborea* has got the highest mean use value (UV_{is} = 3.4) followed by *Callicarpa arborea* (UV_{is} = 2.9), *Michelia oblonga* (UV_{is} =2.8) and *Derris robusta (*UV_{is} = 2.6), *Macaranga indica* (UV_{is} = 2.5) and *Anogeissus acuminata* with the least mean use value (UV_{is} = 1.7).

Overall use value for fuel wood species,

$UV_S = \sum UV_{is} / i_s$ = (3.4+2.9+2.8+2.6+2.5+1.7)/5 = 3.18

From the five medicinal plants *Begonia sikkimensis* has got the highest mean use value (UV_{is} = 4.1) followed by *Homalomena aromatica* (UV_{is} = 3.7), *Aporosa roxburghii* (UV_{is} = 3.5), *Molineria capitulate* (UV_{is} = 3.1), *Trema orientalis* (3.1), *Callicarpa arborea* (UV_{is} = 2.8), *Cissampelos pareira* (UV_{is} = 2.4), *Hedyotis scandens* (UV_{is} = 2.25) and *Lindernia ruellioides* with the least mean use value (UV_{is} =2.5).

Overall use value for fuel wood species,

$UV_S = \sum UV_{is} / i_s$ = (4.1+3.7+3.5+3.1+3.1+2.8+ 2.4 +2.25 +2.5)/5 =5.49

5.6.3 Use value (UV) of selected NTFPs in Thenzawl FDA

Table 5.6 Use Value (UV) for selected NTFPs in Thenzawl FDA

Thenzawl FDA	**Total ($\sum U_{is}$)**	**Mean (UV_{is})**	**Standard deviation**
VEGETABLES			
Amomum dealbatum	8.5	1.7	0.447
Amorphophallus nepalensis	8	1.6	0.548
Bamboo shoots	19	3.8	1.095

Diplazium esculentum	8.5	1.7	0.671
Eurya acuminata	10	2	0.707
Gnetum gnemon	10	2	0.707
Solanum nigrum	12.5	2.5	0.500
FRUITS			
Ficus prostrata	7.5	1.5	0.500
Garcinia sopsopia	13.5	2.7	0.671
Phyllanthus emblica	12	2.4	0.548
Protium serratum	7	1.4	0.548
Rhus chinensis	11.5	2.3	0.447
Spondias mangifera	6	1.2	0.447
FUELWOOD			
Anogeissus acuminata	8	1.6	0.548
Callicarpa arborea	14	2.8	0.274
Derris robusta	8	1.6	0.548
Gmelina arborea	13	2.6	0.418
Macaranga indica	8	1.6	0.548
Michelia oblonga	11.5	2.3	0.837
MEDICINAL PLANTS			
Aporosa roxburghii	10	2	0.707
Callicarpa arborea	8	1.6	0.548
Hedyotis scandens	15	3	1.000
Mikania micrantha	14	2.8	0.837
Securinega virosa	10	2	0.707
Trema orientalis	7	1.4	0.548
Vitex glabarta	8	1.6	0.548

In wild vegetables bamboo shoot has got the highest mean use value (UV_{is} =3.8) followed by *Solanum nigrum* (UV_{is} =2.5), *Eurya acuminata* and *Gnetum gnemon* (UV_{is} =2), *Amomum dealbatum, Diplazium esculentum* (UV_{is} =1.7) and least in *Amorphophallus nepalensis* (UV_{is} =1.6)

$UV_S = \sum UV_{is} / i_s$ = (3.8+ 2.5+2+2+1.7+1.7 +1.6)/5 = 3.06

Among the fruits *Garcinia sopsopia* (UV_{is} =2.7) had the highest use value followed by *Phyllanthus emblica* (UV_{is} =2.4), *Rhus chinensis* (UV_{is} =2.3), *Ficus prostate* (UV_{is} =1.5), *Protium serratum* (UV_{is} =1.4) and least use value in *Spondias mangifera* (UV_{is} =1.2)

$UV_S = \sum UV_{is} / i_s$ = (2.7+2.4+ 2.3+1.5+1.4+1.2)/5 = 2.3

Among the fuelwood *Callicarpa arborea* had the highest use value (UV_{is} =2.8), followed by *Gmelina arborea* (UV_{is} =2.6), *Michelia oblonga* (UV_{is} =2.3) and least mean use value in *Anogeissus acuminate, Derris robusta* and *Macaranga indica* (UV_{is} =1.6).

$UV_S = \sum UV_{is} / i_s$ = (2.8+2.6+2.3+1.6+1.6+1.6)/5 = 2.5

Among the medicinal plants *Hedyotis scandens* has the highest use value (UV_{is} =3) followed by *Mikania micrantha* (UV_{is} =2.8), *Securinega virosa* and *Aporosa roxburghii* (UV_{is} =2), *Callicarpa arborea* and *Vitex glabarta* (UV_{is} =1.6) and least use value in *Trema orientalis* (UV_{is} =1.4)

$UV_S = \sum UV_{is} / i_s$ = (3+2.8+2+2+1.6+1.6+1.4)/5 = 2.88

5.6.4 Use value of selected NTFPs from Mamit FDA

Table 5.7 Use Value (UV) for selected NTFPs in Mamit FDA

Mamit FDA	Total ($\sum U_{is}$)	Mean (UV_{is})	Standard deviation
VEGETABLES			
Amorphophallus nepalensis	13	2.6	1.140
Bamboo shoots	28	5.6	1.342
Diplazium esculentum	13	2.6	1.140
Eurya acuminata	14	2.8	0.447
Oroxylum indicum	16	3.2	0.447
Solanum nigrum	10.5	2.1	0.742
FRUITS			
Artocarpus heterophyllus	13.5	2.7	0.447
Ficus prostrata	12.5	2.5	1.225
Garcinia sopsopia	11.5	2.3	0.447
Phyllanthus emblica	10.5	2.1	0.742
Protium serratum	14	2.8	0.837
Rhus chinensis	11	2.2	0.570
FUELWOOD			
Anogeissus acuminata	12.5	2.5	0.500
Callicarpa arborea	12.5	2.5	0.500
Derris robusta	8	1.6	0.894
Gmelina arborea	12	2.4	1.140
Macaranga indica	13.5	2.7	0.447
Michelia oblonga	11.5	2.3	0.447
MEDICINAL PLANTS			

Aporosa roxburghii	12.5	2.5	0.500
Callicarpa arborea	12	2.4	1.140
Hedyotis scandens	8.5	1.7	0.671
Mikania micrantha	12	2.4	1.140
Securinega virosa	17.5	3.5	0.500
Trema orientalis	11.5	2.3	0.447

From vegetables bamboo shoots has the highest mean use value (UV_{is} =5.6) followed by *Oroxylum indicum* (UV_{is} =3.2), *Eurya acuminata* (UV_{is} =2.8), *Amorphophallus nepalensis and Diplazium esculentum* (UV_{is} =2.6) and least in *Solanum nigrum* (UV_{is} =2.1).

$UV_S = \sum UV_{is} / i_s$ = (5.6+ 3.2+ 2.8+2.6+2.6+ 2.1)/5 = 3.26

From fruits *Protium serratum* has the highest mean use vale (UV_{is} =2.8) followed by *Artocarpus heterophyllus* (UV_{is} =2.7), *Ficus prostrata* (UV_{is} =2.5), *Garcinia sopsopia* (UV_{is} =2.3), *Rhus chinensis* (UV_{is} =2.2) and least use value in *Phyllanthus emblica* (UV_{is} =2.1)

$UV_S = \sum UV_{is} / i_s$ = (2.8+ 2.7+2.5+2.3 +2.2 +2.1)/5 = 2.92

Among the fuelwood *Macaranga indica* has the highest use value (UV_{is} =2.7), followed by *Anogeissus acuminate* and *Callicarpa arborea* (UV_{is} =2.5), *Gmelina arborea* (UV_{is} =2.4), *Michelia oblonga* (UV_{is} =2.3) and least use value in *Derris robusta* (UV_{is} =1.6)

$UV_S = \sum UV_{is} / i_s$ = (2.7+ 2.5+2.5+ 2.4+2.3+1.6)/5 = 2.8

Among the medicinal plants *Securinega virosa* has got the highest use value (UV_{is} =3.5) followed by *Aporosa roxburghii* (UV_{is} =2.5), *Mikania micrantha* and *Callicarpa arborea* (UV_{is} =2.4), *Trema orientalis* (UV_{is} =2.3) and least use value in *Hedyotis scandens* (UV_{is} =1.7)

$UV_S = \sum UV_{is} / i_s$ = (3.5+2.5+2.4+2.4+2.3+1.7)/5 = 2.96

5.6.5 Use value of selected NTFPs from Aizawl FDA

Table 5.8 Use Value (UV) for selected NTFPs in Aizawl FDA

Aizawl FDA	Total ($\sum U_{is}$)	Mean (UV_{is})	Standard deviation
VEGETABLES			
Amomum dealbatum	11.5	2.3	0.4
Amorphophallus nepalensis	11.5	2.3	0.7
Bamboo shoots	20	4	1
Eurya acuminata	12.5	2.5	0.7
Solanum nigrum	13	2.6	0.9
FRUITS			
Baccaurea ramiflora	8.5	1.7	0.7
Ficus prostrata	9.5	1.9	0.9
Garcinia sopsopia	12.5	2.5	0.5
Phyllanthus emblica	13	2.6	0.5
Rhus chinensis	12	2.4	0.5
Rubus alceifolius	7	1.4	0.5
FUELWOOD			
Callicarpa arborea	7.5	1.5	0.7
Derris robusta	10.5	2.1	0.7
Gmelina arborea	12	2.4	0.5
Macaranga indica	9	1.8	0.8
Michelia oblonga	11.5	2.3	0.8
MEDICINAL PLANTS			
Aporosa roxburghii	13	2.6	0.9
Callicarpa arborea	13	2.6	0.9
Cissampelos pareira	10	2	1
Hedyotis scandens	10	2	0.7
Lindernia ruellioides	9	1.8	0.6
Molineria capitulata	12	2.4	1.1
Trema orientalis	13	2.6	0.5

In vegetables the highest mean use value was in Bamboo shoots (UV_{is} =4) followed by *Solanum nigrum* (UV_{is} =2.6), *Eurya acuminata* (UV_{is} =2.5) and least in *Amomum dealbatum* and *Amorphophallus nepalensis* (UV_{is} =2.3)

$UV_S = \sum UV_{is} / i_s$ = (2.6+ 2.5+ 2.3+2.3)/5 = 1.94

Among the fruit species *Phyllanthus emblica* has the highest use value (UV_{is} =2.6) followed by *Garcinia sopsopia* (UV_{is} =2.5), *Rhus chinensis* (UV_{is} =2.4), *Ficus prostrata* (UV_{is} =1.9), *Baccaurea ramiflora* (UV_{is} =1.7) and least in *Rubus alceifolius* (UV_{is} =1.4),

$UV_S = \sum UV_{is} / i_s$ = (2.6+ 2.5+ 2.4+1.9+1.7+ 1.4)/5 = 2.5

Among the fuelwood species *Gmelina arborea* has the highest mean use value (UV_{is} =2.4) followed by *Michelia oblonga* (UV_{is} =2.3), *Derris robusta* (UV_{is} =2.1), *Macaranga indica* (UV_{is} =1.8), and least mean use value in *Callicarpa arborea* (UV_{is} =1.5)

$UV_S = \sum UV_{is} / i_s$ = (2.4+2.3+ 2.1+ 1.8+ 1.5)/5 = 2.02

Among the medicinal plants *Aporosa roxburghii*, *Callicarpa arborea* and *Trema orientalis* has got the highest mean use value (UV_{is} =2.6) followed by *Molineria capitulata* (UV_{is} =2.4), *Cissampelos pareira* and *Hedyotis scandens* (UV_{is} =2) and least in *Lindernia ruellioides* (UV_{is} =1.8).

$UV_S = \sum UV_{is} / i_s$ = (2.6+ 2.6+ 2.6+2.4+2+2+1.8)/5 = 3.2

It is evident that the highest UV value in each NTFP has got a broad spectrum of uses in comparison to the other NTFPs which has a limited way of uses. The mean of the selected plants in wild vegetables, fruits, fuel wood and medicinal plants in all the FDA are greater than zero and standard deviation is lesser than the mean. This indicates that there is a high chance that the data collected about their uses will be positive.

5.7 Similarity index of different plant groups at various Forest Divisions managed under JFM in Mizoram

Among the tree species, Champhai FDA and Aizawl FDA has the highest similarity index 52.83% followed by Thenzawl and Mamit FDA 52.43%, Kolasib and Mamit 46.66%, Thenzawl and Aizawl 44.44%, Mamit and Aizawl 44%, Mamit and Champhai 39.64%, Kolasib and Aizawl 34.09 %, Thenzawl and Champhai 32.73% and least similarity index of trees among the five FDA are Kolasib and Champhai FDA 30.11% (Table 5.9).

Among the shrub species, Mamit and Kolasib FDA has the highest similarity index 48.57%, followed by Champhai and Thenzawl FDA 46.43%, Kolasib and Thenzawl FDA 42.85%

Champhai and Mamit FDA 41.79%, Mamit and Aizawl 41.46%, Kolasib and Champhai FDA 39.34%,Mamit and Thenzawl FDA 39.34%, Aizawl and Champhai FDA 34.66% and least in Thenzawl and Aizawl FDA 28.57%.

Among the herb species, Kolasib and Aizawl FDA has the highest similarity index 43.01%, followed by Champhai and Mamit FDA 40%, Kolasib and Mamit FDA 39.39%, Kolasib and Thenzawl FDA 35.89%, Champhai and Thenzawl FDA 34.78%, Aizawl and Champhai FDA 33.33%, Mamit and Aizawl FDA 31.37%, Thenzawl and Aizawl FDA 30.36 % and least similarity index in Champhai and Kolasib FDA 28.07% (Table 5.9).

Table 5.9 Similarity index of different plant groups at various Forest Divisions managed under JFM in Mizoram.

FDA		AZL			CHP			MMT			KLS			TZL		
		T	**S**	**H**	**T**	**S**	**H**	**T**	**S**	**H**	**T**	**S**	**H**	**T**	**S**	**H**
AZL	T	-			52.83			44			34.09			44.44		
	S		-			34.66			41.46			28.57			28.57	
	H			-			33.33			31.37			43.01			30.36
CHP	T				-			39.64			30.11			32.73		
	S					-			41.79			39.34			46.43	
	H						-			40			28.07			34.78
MMT	T							-			46.66			52.43		
	S								-			48.57			39.339	
	H									-			39.39			20.77
KLS	T										-			34.09		
	S											-			42.85	
	H												-			35.89
TZL	T													-		
	S														-	
	H															-

(AZL=Aizawl, CHP=Champhai, MMT=Mamit, KLS=Kolasib, TZL=Thenzawl, T=Trees, S=Shrubs, H= Herbs)

5.8 Distribution of trees according to DBH class

In all the studied area trees with DBH class range 20-30 has the maximum number of trees, followed by 10-20 range, 30-40 range, 0-10 range, 40-50, 60-70 range and least number of trees in DBH range 50-60. In FDA wise Aizawl FDA has the maximum number of trees followed by Mamit FDA, Kolasib FDA, Champhai FDA and least in Thenzawl FDA.

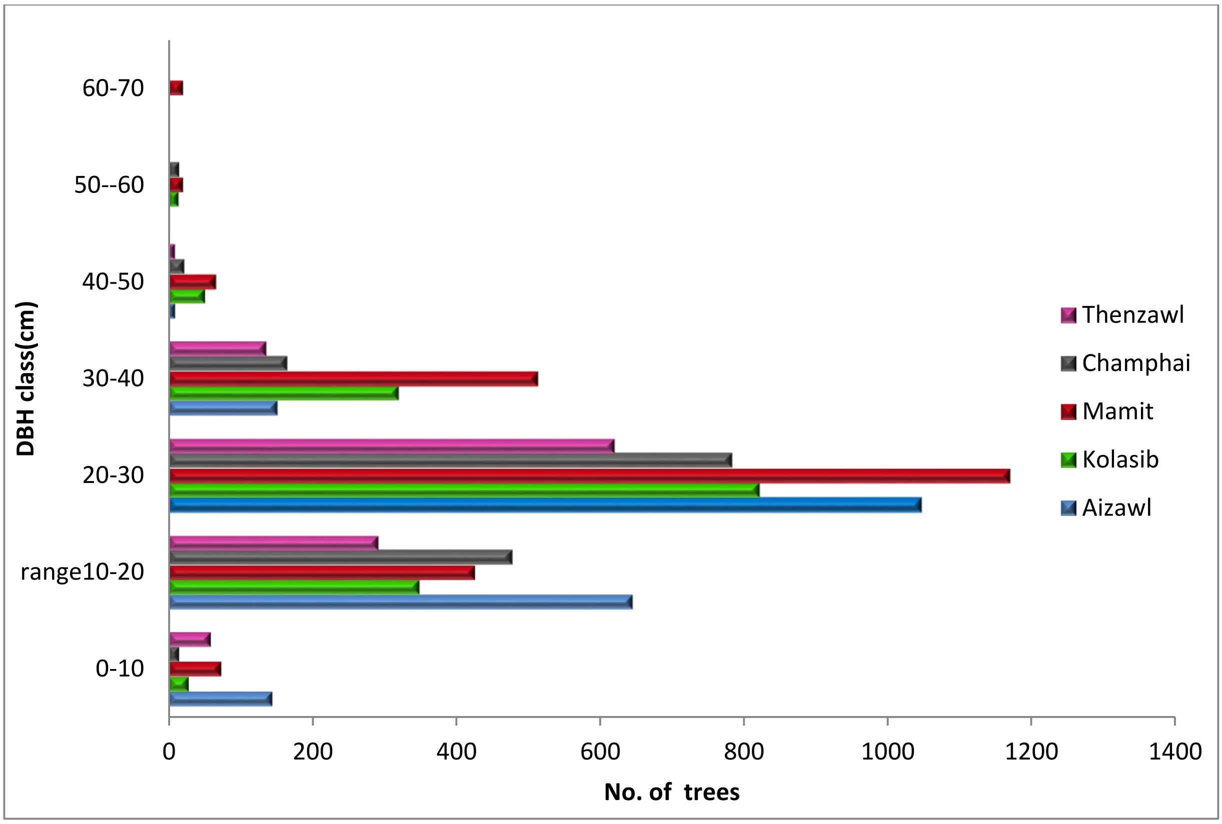

Fig.5.14 Distribution of trees according to their DBH in different FDAs

5.9 Statistical analysis

Least Significant Difference (LSD)

The LSD between all the FDAs and six types of NTFPs are calculated which was based on the four parameters i.e. Percentage of household involved in harvesting of NTFPs, quantity harvested, quantity harvested only for own consumption.

Table 5.10 Least Significant Difference (LSD) of NTFPs percentage of household involved between different NTFPs and different FDAs.

NTFPs (% of household involved)	FDA					LSD@0.05
	AZL	KLS	MMT	CHP	TZL	
Bamboo pole & Cane	39	30	46		22	**12.75**
Broom grass &thatch grass	53	60	50	49	40	**24.24**
Edible food &Fruits	35	52	46	49	50	**18.2**
Fuelwood	36.2	45	56.4	44	53	**25.1**
Fodder	18	49	30	39	50	**20.01**
Medicinal plants	5	5	4.6	6	5	**3.11**
(LSD @ 0.05)	**18.41**	**24.77**	**12.66**	**18.67**	**19.3**	

(AZL=Aizawl, KLS=Kolasib, MMT=Mamit, CHP=Champhai, TZL=Thenzawl)

Percentage of household involved in harvesting of bamboo pole and cane was differed insignificantly (0.05) between Aizawl, Kolasib and Mamit FDA. Whereas was significant between Aizawl and Thenzawl, Aizawl and Champhai FDA. Kolasib FDA was insignificant with Thenzawl FDA. Mamit FDA was insignificant with Aizawl FDA and significant with the rest of the FDA's. Thenzawl FDA was insignificant with Kolasib and significant with the rest of the FDAs.

In broom-grass and thatch grass, edible food and fruits, fuelwood and medicinal plants all the FDAs are insignificant to each other's FDA. In fodder Aizawl FDA was insignificant with Mamit FDA and significant with the rest of the FDAs.

Table 5.11 LSD of quantity harvested ($kg^{-1}hh^{-1}yr^{-1}$) of NTFPs between the five FDAs and six types of NTFPs.

Quantity harvested (kg^{-1} hh^{-1} yr^{-1})	FDA					LSD@0.05
	AZL	KLS	MMT	CHP	TZL	
Bamboo pole & Cane	90	50	127		26	**29.43**
Broom grass &thatch grass	35	25	34	20	25	**12.26**
Edible food &Fruits	34	33	74	25	30	**9.42**
Fuelwood	55	55	45.2	50	44	**20.88**
Fodder	39	43	40	20	40	**16.82**
Medicinal plants	4	4	3.8	4	3	**2.14**
(LSD @ 0.05)	**18.84**	**19.57**	**23.25**	**11.08**	**10.64**	

(AZL=Aizawl, KLS=Kolasib, MMT=Mamit, CHP=Champhai, TZL=Thenzawl)

The quantity harvested in bamboo pole and cane between Aizawl, Mamit and Champhai FDA was differed significantly between each other's FDA. Whereas Kolasib FDA was insignificant with Thenzawl FDA and significant with the rest of the FDA.

In Broom grass and thatch grass Aizawl and Champhai FDA are significant to each other. Kolasib, Mamit FDA and Thenzawl FDA were insignificant with the rest of the FDAs. Champhai FDA was significant with Aizawl and Mamit FDA.

Edible food and fruits, Aizawl FDA was significant with Mamit FDA. Kolasib FDA was significant with Mamit FDA and insignificant with the rest of the FDAs. In the mean time, Champhai FDA was insignificant with Kolasib, Aizawl and Thenzawl FDA. Thenzawl FDA was significant with all the FDAs except Mamit FDA.

In fuelwood and medicinal plants all the FDAs are insignificant to each other. In fodder, Aizawl FDA was insignificant with all the other FDAs. Kolasib FDA was significant with Champhai FDA and Mamit FDA was significant with Champhai FDA. Thenzawl FDA was significant with Champhai FDA and insignificant with the rest of the FDAs.

Table 5.12 LSD of NTFPs harvested used for own consumption ($kg^{-1}hh^{-1}year^{-1}$) between the five FDAs and six types of NTFPs.

Own consumption (kg^{-1} hh^{-1} yr^{-1})	**FDA**					**LSD@0.05**
	AZL	**KLS**	**MMT**	**CHP**	**TZL**	
Bamboo pole & cane	45	50	66	0	13	**15.02**
Broom grass & thatch grass	10	6	20	20	20	**8.19**
Edible food &Fruits	13	16	38	15	15	**8.5**
Fuelwood	46.25	55	35.2	30	44	**20.14**
Fodder	39	50	40	20	40	**16.82**
Medicinal plants	4	4	3.8	4	3	**2.14**
(LSD @ 0.05)	**10.89**	**18.27**	**16.48**	**8.26**	**8.41**	

(AZL=Aizawl, KLS=Kolasib, MMT=Mamit, CHP=Champhai, TZL=Thenzawl)

NTFP harvested for own consumption in bamboo pole and cane was insignificant between Aizawl and Kolasib FDA. Aizawl FDA was significant with all the FDAs. Kolasib FDA was significant with all the FDA except with Aizawl FDA. And for Mamit, Champhai and Thenzawl FDA, they are significant to each other's FDA.

In broom grass and thatch grass Aizawl FDA was significant with Kolasib FDA and insignificant with the rest of the FDAs. Kolasib FDA was insignificant with Aizawl FDA and is significant with the rest of the FDAs. Mamit, Champhai and Thenzawl FDA are significant with Kolasib FDA and Aizawl FDA.

In edible food and fruits Aizawl FDA was significant with Mamit FDA and insignificant with the rest of the FDAs. Kolasib FDA was significant with Mamit FDA. Mamit FDA was significant with all the FDAs. Thenzawl FDA was insignificant with all the FDAs except Mamit FDA (Table 5.12)

In fuelwood, Aizawl, Mamit and Thenzawl FDA are insignificant with all the FDA. Kolasib and Champhai FDA are significant with each other but insignificant with all the other FDAs.

In fodder, Aizawl, Kolasib, Mamit and Champhai FDA are insignificant with all the FDA. Champhai FDA was significant with Mamit and Thenzawl FDA. All the FDAs are insignificant to each other's FDA in case of medicinal plants (Table 5.12).

5.10 DISCUSSION

In all the study sites, majority of the households are concerned with harvesting of broom grass from the VFDC plantation sites as well as from the nearby forest. Broom grass being one of the basic necessities for each and every household, the percentage of household involved in harvesting was high regardless of the lesser amount harvested. Since there was no clear marginal demarcation of VFDC plantation site, the villagers harvest the NTFPs from the VFDC plantation sites as well as from the adjoining forest; so it was somewhat difficult to calculate the exact quantity of NTFPs harvested from the plantation sites alone. Most of the villagers are part time NTFP exploiter; they collected NTFP in times of off season of their jhum crops. But there were few full-time NTFP exploiters who collected all the available NTFPs in all the seasons. Those full-time NTFP exploiters usually belonged to the landless farmer and the widowed family. They sold their NTFPs within their village itself to make their living. *Imperata cylindrica* (L.) Raeusch.) was mainly harvested for thatching in all the FDAs, barring Aizawl FDA where it was harvested for fodder purpose. The density of many of the NTFPs is becoming lower within the plantation sites as compared to the normal forest because many of these NTFPs species get cleaned during weeding in the former than the later.

In all the study sites, the local people dependence on medicinal plants was somewhat very low. Harvesting and utilization pattern of plants and their value varies according to the site; species valued for their medicinal properties in one area why differently valued in another area. Additional approaches and awareness among the villagers are needed to safeguard plants that have been recognised as medicinal. The senior citizens believe in the medicinal properties of plants but most of the villagers rely more on chemical drugs. Among the youth, they have a believe that chemical drugs works faster as compared to the medicinal plants that makes them chose over the medicinal plants. The medicinal plant harvesters are mainly senior citizen who knows the real value with their experiences in the past and they preferred over chemical drug especially for treating chronic disease. The techniques of harvesting of various NTFPs in the site were mostly of primitive nature. Out of the 30 wild vegetables recorded in the JFM sites (Table 5.3), in 16 cases, it was found that the harvesting practice was sustainable, while in other 14 cases, the practice was unsustainable. The sustainability of NTFPs harvest depends on the organs that are harvested but also as the life cycle of harvested species (Pandey *et al*., 2016). Adoption of sustainable harvesting practices nevertheless would have positive impact on socio-economic status of the community, quality of the produce, economic returns and ultimately on resource conservation. Studies have also shown that harvesting of medicinal plants at night time can yield better quality ingredients concentrations (Pandey and Sheckleton, 2012). Further, in many cases, harvesting was done in more than one ways, sometimes by cutting, plucking and uprooting. Options should therefore be chosen considering the lowest impact on the individual plant or the population remaining so that the population can sustain.

Bamboo shoots are high in demand in all the villages and the bamboo shoot within the plantation sites are also harvested All the forest products present within the plantation sites are taken care by the concern department and are allowed to harvest only to certain extend. Timber yielding plants are mainly planted within the plantation sites so as share the benefit between the beneficiaries and the forest department at the maturity of those trees. But so far, most of the planted trees are not yet fully matured to be harvested and they range from 5-15 years old. Distance of the forest, change in forest management regime, seasonality of NTFPs and change in rainfall pattern are very important factor for the supply of NTFPs at household level (Balama *et al.*, 2016). Majority of the NTFPs sold by the collectors undergo only the basic value addition like cleaning, chopping and drying which was performed by primary collectors, even though this has increased the value and quantity of the produce, involvement of preparing time schedule for collection of NTFPs, maintaining hygienic conditions while processing, following non destructive harvesting techniques, removal of foreign material will give better and higher value addition (Pandey *et al.*, 2016). Besides the major NTFPs, Cinnamomum aromaticum barks are harvested and sold in the market and also *Gmelina arborea* Roxb. stem are used for making the wheels of wooden cart which serves as an important transportation for carrying vegetables and fuelwood from the jhum.

The villagers were nevertheless benefited from the VFDC plantation sites directly as well as indirectly. They benefited from Entry Point Activities (EPA) in which different works of community development was done with maximum benefitted to the village people. The EPA work targets were set as per the resolution arrived at the committee meeting of the VFDC, and the main priority is to enhance a sense of ownership to the plantation giving a great impetus to participate in the protection of the plantation and bio-diversity conservation in general. This led to draw the attention and attitude of village inhabitants towards the importance of conservation and propagation of the forest. Minor infrastructure of community assets- construction of community information centre, community hall, public urinal, bazaar set, vegetable godown, public water tank, approach road, step and funds for playground, torch light (for old aged), pressure cooker and LPG gas connection was also distributed to the villagers. Besides this the villagers are benefited by a long term benefits in which the degraded forest around them are regenerated which will provide a good source of NTFPs in the near future. Within the plantation sites, a new plot of land are also used for intercropping between agricultural cash crops and planting bamboos, medicinal plants and timber yielding plants. The villagers take care of those planted seedlings along with the cash crops. The seedlings when they are managed in this way, they are considered to produce better output because of proper care and frequent weeding.

CHAPTER 6

MARKETING CHANNEL OF DIFFERENT NTFPs

6.1 INTRODUCTION

Harvesting and selling of Non- Timber Forest Products (NTFPs) are mostly from the local forest fringe communities and leaves, fruits, tuber is the principle NTFPs collected and sold to the market. The marketing price of NTFP varies in different seasons. NTFPs collection depends upon the location, size and need of the market, price of NTFPs, the background of FPC members and the demand of the particular market-consumers. There is an irregular functioning of NTFP markets on account of price instability. Marketing of NTFP assumes importance because it provides safety nets for the income of rural households in lean agriculture season or when crop fails (Ahmed *et al*., 2016). The potential economic value of NTFPs either in terms of utilization or their market value is often underestimated or unknown (Wickens, 1994). In India there are about 15,000 plant species out of which nearly 3000 species (20%) yield NTFPs. However, only about 126 species (0.8%) have been commercially developed (Maithani, 1994). Out of 300 NTFP species in India, only 126 have emerged the marketability (FAO, 2005) and those include medicinal plants, edible plants, starches, gums and mucilage, oil and fats, resins and oleo-reins, essential oils, species, drugs, tannin, insecticides, natural dyes, bamboos and canes, fibers and flosses, grasses, tendu leaves, animal products and edible products. The marketing of NTFPs was regulated by different tool in different states. Under the forest produce (Control and Trade) act 1981, trading is largely controlled through public institutions, such as State development corporations, federations, cooperatives and tribal societies (Prasad *et al.,* 1996).

In this chapter, an attempts has been made to study the marketing aspects of various NTFPs and trace the market channels from the source of collection to the point of reach to the consumers and finally, to study the loss of revenue due to involvement of intermediaries/middlemen in marketing process of some important NTFPs gathered from JFM areas of the state.

6.2 RESULTS AND DISCUSSION

6.2 Marketing Channel of NTFPs in different FDAs

6.2.1 Marketing of broom grass *(Thysanolaena latifolia* (Roxb. ex Hornem.) Honda / *Thysanolaena maxima)* and thatch grass (*Imperata cylindrica*)

Local market rate of broom grass was found to be Rs 30-35/ bundle in all the villages, but they sold in bulk to the middleman at the rate of Rs 25-30/ bundle. The middleman usually makes a profit of 5-10 Rs/bundle by selling it @Rs 30-40/ bundle in Aizawl market. Some of the middleman sold the broom grass in the neighbouring states. Collectors from Aizawl FDA (Lungleng I, Sumsuih, Lengte, Sihphir and Muthi villages) used to sell the broom grass directly to Aizawl town without the involvement of middleman since they are nearby to the town and had better access to the capital through good transportation facilities as compared to the rest of the villages. Collectors from Aizawl FDA were more benefited as compared to other FDAs because they did not have to involve middleman and besides that the cost of transportation was lesser for them. The market rate of broom grass in Aizawl is Rs 30-40/ bundle. Thatch grasses are sold within their own villages in all the study sites and there is no marketing link with other towns and villages. The price of dried thatch grass of one bundle (20 Kg approximately) cost Rs 50.

6.2.2 Marketing of bamboo pole and cane

The villagers were allowed to harvest bamboo pole and cane species only to a certain extent from the VFDC plantation sites only to meet their requirement**.** Mamit has the highest density of bamboo species (Fig. 5.1) and higher utilization is also observed from this area and thus higher income from selling bamboo pole and cane. In few cases they sold bamboo pole collected from the FDA in the village itself, however processed form of bamboo pole and cane were sold out for better income and made into handicrafts and weave local carrier ("Pai em" and "Pai kawng"), winnowing fan, hat and crab basket. They sold local carrier in the village market itself and as demand in the neighbouring villages and town. The weavers usually sell their products directly to the customers within their town, but sometimes they sell through the middleman with marginal profit. The weavers of local carrier are usually old aged person who do not carry out jhum activities and other physical activities; it becomes easier for them to sell their products through the middlemen with a price ranging in between Rs 350- 400 in their villages or adjoining villages and sold at Rs 400-450 when sold in Aizawl market.

6.2.3 Marketing of edible food and fruits

Market prize of edible food varies from season to season. The prize fluctuation obviously was related to the type of edible food and fruits. Most of the edible food and fruits are perishable and cannot be stored for long; as a result, they often sold with a meagre profit. *Melocanna baccifera* (Roxb) Kurz. and *Dendrocalamus longispathus* (Kurz) Kurz, are the two main bamboo shoots harvested by the villagers in large quantities from the VFDC plantation sites and mostly sold in the local market. The rate of bamboo shoot is priced at Rs 50/ bundle containing 20-25 pieces of bamboo shoot, but the rate reduces to Rs 30/bundle in the peak season. In all the FDAs, bamboo shoot was in high demand and had a good market which gave when ample quantities of the products were made available for the consumers. Most of the edible food and fruits collected from the FDAs are sold in the same form as collected without low cost. In some cases, the villagers semi-processed some fruits by sun dried and stored for the off season consumption and sale. These products are both sold in village markets and other selling points closer to the villages. The market rates of different edible food and fruits are mentioned in the table 6.1

Table 6.1 Local market rate of edible food and fruits within the study sites of Mizoram

Edible food	Vernacular name (Mizo)	Family	Unit	Local market rate(INR)
Acmella paniculata (Wall.exDC) R .L. Jansen	Ansate	Asteraceae	bundle	20
Amomum dealbatum Roxb.	Aidu	Zingiberaceae	plate	30
Amorphophallus nepalensis (Wall.) Bogner & Mayo.	Telhawng	Araceae	cup	20
Agaricus campestris Linn	Maupa	Agaricaceae	plate	150
Cassia occidentalis L.	Reng an	Fabaceae	bundle	20
Calamus erectus Roxb.	Thilthek (hruizik)	Arecaceae	plate	100
Calamus tenuis Roxb.	Changdam (hruizik)	Arecaceae	plate	100
Calamus guruba Buch. Ham	Thil te (hruizik)	Arecaceae	plate	100
Centella asiatica (L.) Urban.	Lambak	Apiaceae	bundle	10
Clerodendrum colebrookianum Lindl.	Phuihnam	Verbanaceae	bundle	30
Cucurma longa Linn.	Aieng	Zingiberaceae	kg	60
Dendrocalamus longispathus (Kurz)Kurz	Raw nal	Poaceae	bundle	50
Diplazium esculentum (Retz) Sw.	Chakawk	Athyriaceae	bundle	20
Entoloma microcarpum Berk &Br.	Pa sawntlung	Agaricaceae	plate	100
Eurya acuminate DC.	Sihneh	Theaceae	bundle	20
Gnetum gnemon L.	Pelh	Gnetaceae	bundle	20
Marsdenia maculate Hook	Ankhapui	Asclepiadaceae	bundle	30
Melocanna baccifera (Roxb.) Kurz	Mautak	Poaceae	bundle	50
Musa glauca Roxb.	Saisu	Musaceae	bundle	20
Oroxylum indicum (L.) Kurz	Archangkawm	Bignoniaceae	pod	30
Parkia roxburghii G.Don	Zawngtah	Mimosaceae	Bundle	50
Persea americana L.	Butter thei	Lauraceae	fruit	20
Picria felterrae Lour.	Khatual	Scrophulariaceae	pack(dried)	50
Schizophyllum commune Fr	Pa si	Agaricaceae	plate	100
Solanum nigrum Linn.	An hling	Solanaceae	bundle	20
Solanum torvum Sw	Tawkpui	Solanaceae	plate	20
Zanthoxylum rhetsa (Roxb.) DC	Chingit	Rutaceae	bundle	20

Edible fruits	**Vernacular name (Mizo)**	**Family**	**Unit**	**Local market rate(INR)**
Artocarpus heterophyllus Lam	Lamkhuang	Moraceae	Fruit	50-80
Baccaurea ramiflora Lour.	Pangkai	Euphorbiaceae	cup	20
Ficus semicordata Buch.Ham ex Sm	Theipui	Moraceae	cup	20
Garcinia lanceifolia Roxb.	Chengkek	Clusiaceae	plate	20
Garcinia sopsopia (Buch.-Ham.) Mabb.	Vawmva	Clustaceae	plate	30
Phyllanthus emblica L.	Sunhlu	Euphorbiaceae	cup	20
Protium serratum (Wall.ex Colebr.) Engl.	Bil	Burseraceae	cup	20
Rhus chinensis Mill	Khomhma	Anacardaceae	cup	20
Spondias mangifera Willd	Tawi taw	Anacardaceae	cup	30

Of all the fruits harvested from the sites *Phyllanthus emblica* L. *(Emblica officinalis)*, *Protium serratum* (Wall.ex Colebr.) Engl., *Rhus chinensis* Mill and *Garcinia lanceifolia* Roxb. were sold to the market. The rest of the fruits harvested from the sites are used for household consumption. In all the study sites fruits were sold within their own villages. The market price of these fruits is listed in Table 6.1

6.2.4 Marketing of fuelwood

The quantities of fuelwood extracted/harvested from various FDAs were regulated by the VFDC. Fuelwood was collected from the fallen logs, dead branches and diseased trees and occasionally by pruning or pollarding the live trees. Therefore, there were not much quantities of fuelwood left after household consumption for sell to the local market from these FDAs. However, many full-time exploiter households collect fuelwood outside the FDAs, around the boundary where no restriction was imposed, thereby having surplus quantities of products, which could be used for sell to generate household income. However, the fuelwood extracted so was not limited to any particular season. The extraction was spread over the entire year and similarly, the sell of fuelwood could be as and when the full-time exploiter needed income to meet various household requirements. Most of the fuelwood were sold in local market. People buying fuelwood were the middle income group who reared pigs, cattle and other livestock and besides fuelwood were used for ceremonial purpose. Fuelwood was priced INR 2-5 per stick.

Table: 6.2 Marketing channel of different NTFPs under JFM in Mizoram

NTFPs	MARKETING CHANNEL
Broom grass	Harvesters → Local market @ INR 30-35/bundle → Aizawl market @INR 30-40/bundle Middleman @ INR 25/bundle Harvesters → Silchar (middleman involves)
Thatch grass	Harvesters → (@INR 50/bundle) → Sold directly within the villages itself
Bamboo pole and cane	Harvesters → Processed into mats, handicrafts and other instrument's handle and sold in the local market → Aizawl market Harvesters → Semi-processed the pole and sold within the village
Bamboo shoot	Harvesters → Local market @ INR 50/bundle
Fruits	Harvesters → Local market/roadside/junction selling point
Fuelwood	Harvesters → Sold directly within the village itself

6.3 Monetary income from NTFPs at household level

The amount of NTFP sold to the market was highest in bamboo pole and cane (23.8 $Kg^{-1}hh^{-1}yr^{-1}$) with an income of 326 $Rs^{-1}hh^{-1}yr^{-1}$, followed by edible food and fruits (19.8 $Kg^{-1}hh^{-1}yr^{-1}$) with the highest income (332 $Rs^{-1}hh^{-1}yr^{-1}$), fuelwood (7 $Kg^{-1}hh^{-1}yr^{-1}$) with an income of 110 $Rs^{-1}hh^{-1}yr^{-1}$ (fig.6.1), among all the NTFPs. The least amount of NTFP sold to the market was broom grass and thatch grass (12 $Kg^{-1}hh^{-1}yr^{-1}$) with an income of 212 $Rs^{-1}hh^{-1}yr^{-1}$ (fig 6.2).

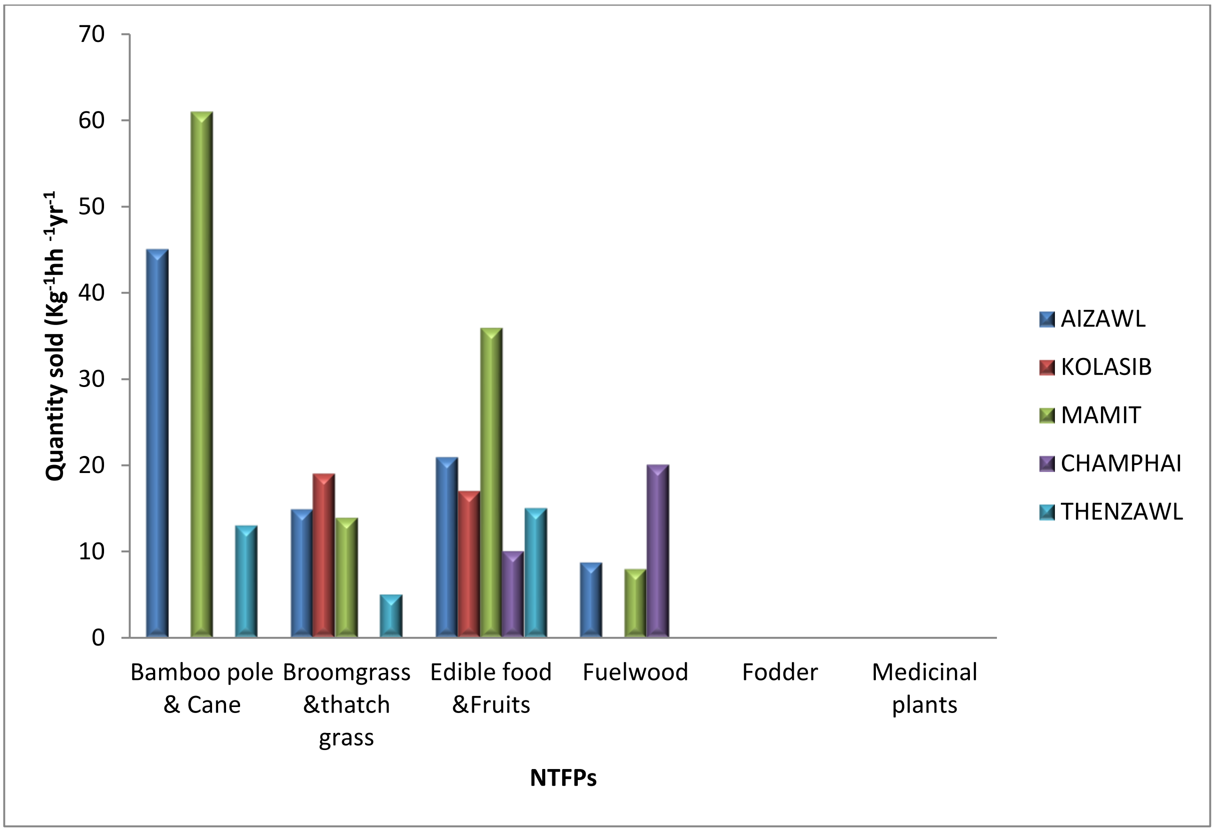

Fig.6.1 Quantity of NTFPs sold to the local market from the forest under JFM in different FDA

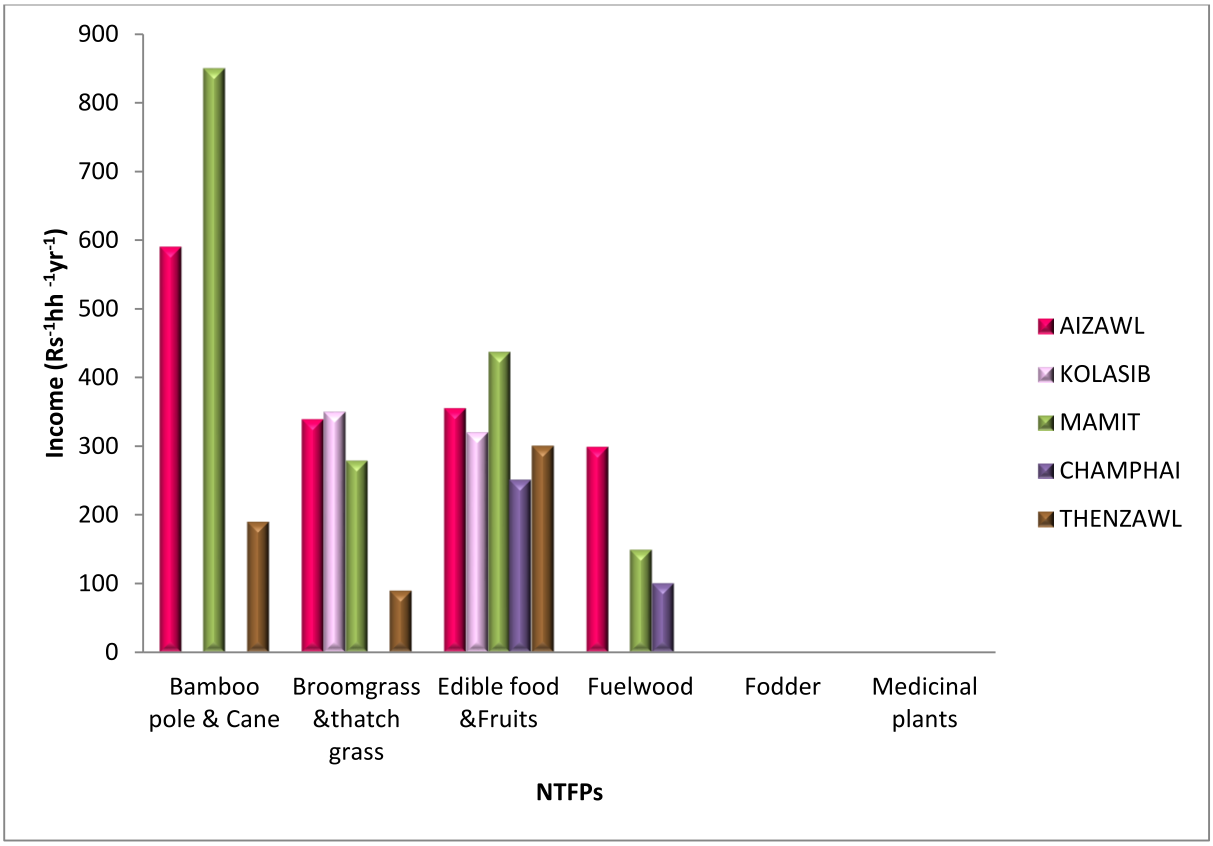

Fig.6.2 Income generated from sell of different NTFPs from the forest under JFM in different FDAs

6.4 Matrix ranking of medicinal plants from the five FDAs

Matrix ranking of each of the 25 medicinal plants was done based on different criteria like their availability, production potential, utility, socio-economic and cultural significance, demand and economic return. Based on the total score individual medicinal plants obtained were given a rank. *Mikania micrantha* Kunth belonging to Asteraceae obtained the highest score among all the medicinal plants. Nevertheless, it is one of the most common weed and fairly distributed throughout the state of Mizoram. It's easy accessibility, availability and high utility leads to higher score among all the uses across the FDA. *Mikania micrantha* Kunth was followed by *Imperata cylindrica* L. Raeusch and *Costus speciosus* (J. Konig) Sm. (Table 6.3).

Table 6.3 Matrix ranking of 25 medicinal plants from the five FDAs in Mizoram

Species name	Vernacular name (Mizo)	Family	Av	Pp	Ut	Sc	Dm	Er	Ts	R
Mikania micrantha Kunth	Japan hlo	Asteraceae	9	9	8	5	6	0	37	1
Imperata cylindrica L. Raeusch	Di	Poaceae	8	6	7	6	5	4	36	2
Costus speciosus(J. Konig) Sm.	Sumbul	Zingiberaceae	8	8	8	5	6	0	35	3
Benincasa hispida (Thunb.) Cogn	Maipawl	Cucurbitaceae	6	7	7	5	4	5	34	4
Securinega virosa (Roxb. Ex wild.) Baill.	Saisiak	Euphorbiaceae	8	7	6	6	6	0	33	5
Artemisia vulgaris L.	Sai	Asteraceae	8	8	6	4	5	0	31	6
Homalomena aromatica (Spreng) Scott.	Anchiri	Araceae	6	5	5	3	5	6	30	7
Lindernia ruellioides (colsm.) Pennell	Thasuih	Scrophulariaceae	6	7	6	5	5	0	29	8
Begonia sikkimensis A. DC.	Sekhupthur	Begoniaceae	8	8	5	3	4	0	28	9
Aporosa roxburghii(Wall ex lindl) Baill	Chhawntual	Euphorbiaceae	6	6	8	2	5	0	27	10
Molineria capitulate (Lour.) Herb	Phaiphek	Hypoxidaceae	7	6	4	5	4	0	26	11
Blumea lanceolaria (Roxb.) Druce	Buarze	Asteraceae	7	6	6	1	5	0	25	12
Adiantum philippense L.	Lungpuisam	Adiantaceae	8	7	4	1	4	0	24	13
Anogeissus acuminata (Roxb. Ex DC.) Guill.	Zairum	Combretaceae	5	4	6	3	5	0	23	14
Dendrocnide sinuate(Blume) Chew	Thakpui	Urticaceae	5	4	4	5	5	0	23	14
Solanum indicum L	Tawkte	Solanaceae	5	4	3	3	3	5	23	14
Sapindus mukorossi Gaertn	Hlingsi	Sapindaceae	5	5	4	5	4	0	23	14
Callicarpa arborea Roxb	Hnahkiah	Verbenaceae	6	5	5	3	3	0	22	15
Hedyotis scandens Roxb.	Kelhnamtur	Rubiaceae	5	4	5	3	5	0	22	15
Litsea monopetala (Roxb.) Pers	Nauthak	Lauraceae	7	4	3	3	4	0	21	16
Euphorbia royleana Boiss.	Chawng	Euphorbiaceae	5	4	5	3	4	0	21	16
Elaeagnus pyriformis Hook. F	Sarzukte	Elaeagnaceae	4	3	4	3	4	2	20	17
Jasminum laurifolium Roxb.ex Homen	Maufimhrui	Oleaceae	4	5	4	4	3	0	20	17
Cissampelos pareira Linn	Hnahbialhrui	Menispermaceae	5	5	4	2	3	0	19	18
Trema orientalis (L.) Blume	Belphur	Ulmaceae	5	4	3	2	4	0	18	19
Vitex glabarta R.Br.	Thingkhawilu nu	Verbenaceae	4	3	4	3	3	0	17	20

(Av=Availability, Pp= Production potential, Ut=Utility, Sc= Socioeconomic cultural significance, Dm=Demand, Er=Economic return, Ts=Total score, R=Rank.)

6.5 Statistical analysis

Table 6.4 LSD of quantity of NTFPs sold ($Rs^{-1}hh^{-1}yr^{-1}$) between the five FDAs and the four types of NTFPs

Quantity sold (kg^{-1} hh^{-1} yr^{-1})	FDA					LSD(0.05)
	AZL	KLS	MMT	CHP	TZL	
Bamboo pole & Cane	45		61		13	**27.41**
Broom grass &thatch grass	15	19	14		5	**8.59**
Edible food &Fruits	21	17	36	10	15	**11.04**
Fuelwood	35		50	20		**7.75**
LSD (0.05)	**19.31**	**13.1**	**26.42**	**8.94**	**10.35**	

(AZL=Aizawl, KLS=Kolasib, MMT=Mamit, CHP=Champhai, TZL=Thenzawl)

In Aizawl FDA, the quantity of bamboo pole and cane was sold differed significantly (PC 0.05) between Kolasib, Champhai and and Thenzawl FDA while it was not significant between Aizawl and Mamit FDA (Table 6.4).

In broom grass and thatch grass Aizawl, Kolasib and Mamit FDA are significant with Champhai and Thenzawl FDA. Thenzawl FDA was significant with Champhai FDA. Similar was the case with that of edible food and fruits (Table 6.5), Aizawl FDA was insignificant with Kolasib and Champhai FDA and significant with Mamit FDA. Kolasib FDA was significant with Mamit FDA. Mamit FDA was significant with all the FDAs. Champhai FDA was insignificant with Aizawl, Kolasib and Thenzawl FDA. Thenzawl FDA was significant with Mamit FDA and insignificant with the rest of the FDAs. In fuelwood all the FDAs were significant with each other's FDA.

Table 6.5 LSD of income generated from NTFPs ($Rs^{-1}hh^{-1}yr^{-1}$) between the five FDAs and the four types of NTFPs.

Income(Rs^{-1} hh^{-1} yr^{-1})	FDA					LSD(0.05)
	AZL	KLS	MMT	CHP	TZL	
Bamboo pole & Cane	590		850		190	**457.45**
Broom grass & thatch grass	340	350	280		90	**141.02**
Edible food &Fruits	356	320	438	250	300	**113.83**
Fuelwood	300		150	100		**104.34**
LSD (0.05)	**259.92**	**109.87**	**326.23**	**93.19**	**86.69**	

(AZL=Aizawl, KLS=Kolasib, MMT=Mamit, CHP=Champhai, TZL=Thenzawl)

The income generated from bamboo pole and cane differed significantly (PC 0.05) between Aizawl, Kolasib and Champhai FDA. For broom grass and thatch grass Aizawl, Kolasib and Mamit FDA were insignificant to each other. Thenzawl FDA was significant to Aizawl, Kolasib and Mamit FDA (Table 6.5). In edible food and fruits Aizawl FDA was insignificant with all the FDAs. Kolasib FDA was significant to Mamit FDA and insignificant with the rest of the FDAs. Mamit FDA was insignificant with Kolasib, Champhai and Thenzawl FDA. Champhai FDA was significant with Mamit FDA. Thenzawl FDA was significant with Mamit FDA and insignificant with the rest of FDAs. In fuelwood, Aizawl FDA was significant will all the other FDAs. Mamit and Champhai FDA are insignificant to each other's FDA and significant with the rest of the FDAs (Table 6.5).

6.7 DISCUSSION

The marketing of NTFPs in Mizoram is highly imperfect unstructured. There is no proper market for sell of NTFPs that are collected from various FDAs. There could be several reasons to the informal market of NTFPs. Most of the NTFPs are harvested in low quantities, mostly consumed at household levels and sold at the nearby markets. The NTFPs such as bamboo shoot, fruits, fuelwood are consumed either by the households and/or sold in the local market whereas broom grass, thatch grass, canes, medicinal plants have prospects for reaching urban centres. The later products are sold to the local traders which in turn sell it to the urban center and finally reach to consumers. Bamboo shoots has got a high financial investment in merchandizing among the North-eastern states of India and observed to be highest in Mizoram (Jha and Laha, 2003). The distribution channel from FDA to urban wholesale in case of broom grass, cane and medicinal plants involves 2-3 middlemen, who in turn make larger profit. Poor access to markets, little or no bargaining power and/or high dependence of intermediaries to sell the surplus NTFPs result in reduced share of profit or income for the grass root/participating households of JFM in different FDAs.

To promote better management of JFM, the forest department should come forward in creating a market, which could generate higher revenue and offer better incentive for forest/JFM dependent communities so that they are motivated to take increasing responsibility for forest management and promote efficient forest utilization. Besides, forest department should establish few centers for basic value addition to the NTFPs at the primary collectors' level. Some of these efforts like removal of foreign materials from the collected products, drying and storage appropriately and packaging of collected materials could improve the price structure of this NTFPs. Identification of correct plant parts for NTFPs use, maintaining hygienic conditions following harvesting techniques too can add better values to the products. The government of Mizoram, therefore, should come out with NTFPs laws and Policies to promote ecological sustainability, equality in trade and improved livelihoods. Few processing facilities in and around different FDAs through convergence of existing schemes and programmes could help augment livelihood of the communities involved in JFM programmes in the state.

SUMMARY AND CONCLUSION

A study on production, utilization and marketing of Non-timber Forest Products was studied during 2014-2018 from twenty five villages under five Forest Development Agency (FDA) within the state of Mizoram. It was carried out using Participatory Rural Appraisal (PRA), questionnaire, group discussion with the villagers and headmen. A thorough interview with the knowledgeable persons and informal discussions was done with the villagers. Vegetative analysis was done using quadrat method. Various attributes of vegetation like frequency, relative frequency, density, relative density, and coverage was calculated according to Zobel *et al*. (1987). Geographical coordinates of each site was recorded using a Global Positioning System (GPS) device.

The major findings of the present study may be summarised as follows:

- Through Participatory Rural Appraisal (PRA) 25 VFDC villages belonging to 5 FDAs (Aizawl, Kolasib, Mamit, Champhai and Thenzawl FDA) are surveyed. Champhai FDA has the highest population 14,173 followed by Thenzawl FDA (8,375), Kolasib FDA (7,510), Aizawl FDA (5,242) and Mamit FDA has the lowest population (3,606). Villages under Champhai FDA has the highest number of household 2,900 followed by Thenzawl FDA (1,573), Kolasib FDA (1,511), Aizawl FDA (946) and least household was in Mamit FDA with 756.
- The occupations of majority of the surveyed villagers are primitive agriculture (shifting cultivation). They follow jhum cultivation and in the off season, they harvest NTFPs from the community forestry as well as from the adjoining forest. Full-time NTFPs exploiter was highest in Kolasib FDA (11.8% household) followed by Mamit FDA (8.6% household), Thenzawl FDA (3% household), Champhai FDA (2%

household) and least in Aizawl FDA (1.6% household). Part time NTFPs exploiter was highest in Mamit FDA (70% household) followed by Kolasib and Champhai FDA (62% household), Thenzawl FDA being the third one with 60% of household engaged in harvesting NTFPs part time and least in Aizawl FDA (46% household).

- A total of 279 plant species having NTFPs value under 234 genera belonging to 85 families were documented from the 25 study sites. Out of the 279 plant species, 44 species belonged to herbs, 57 shrubs species, 23 climbers, 139 tree species, 10 bamboos and 6 palm species.
- Ten bamboo species belonging to 5 genera and 6 cane species belonging to 5 genera were documented Viz. *Bambusa tulda* Roxb., *Bambusa vulgaris* Schrad.ex J.C.Wendl, *Dendrocalamus longispathus* (Kurz) Kurz, *Dendrocalamus giganteus* Munro, *Dendrocalamus hookeri* Munro, *Dendrocalamus hamiltonii* Gamble, *Melocanna baccifera* (Roxb.) Kurz , *Schizostachyum dullooa, Schizostachyum fuchsiamum, Schizostachyum mannii* were the ten bamboo species harvested from the study sites. *Arenga pinnata*, *Calamus gracilis*, *Calamus khasianus, Daemonorops jenkinsiana*, *Melocanna compactiflorus* and *Pinanga gracilis* are the six cane species harvested.
- The 26 medicinal plants utilized by the villagers are *Adiantum philippense* L., *Aporosa roxburghii* (Wall.exLindl.) Baill., *Anogeissus acuminata* (Roxb.ex DC) Guill., *Artemisia vulgaris* L., *Benincasa hispida* (Thunb.) Cogn, *Begonia sikkimensis* A.DC. *Blumea lanceolaria* (Roxb.) Druce, *Callicarpa arborea* Roxb., *Cissampelos pareira* Linn., *Costus speciosus* (J.Konig) Sm., *Dendrocnide sinuate* (Blume) Chew, *Elaeagnus pyriformis* Hook.f., *Euphorbia royleana* Boiss., *Hedyotis scandens* Roxb., *Homalomena aromatica* (Spreng.) Schott, *Imperata cylindrica* (L). Raeusch., *Jasminum laurifolium* Roxb.ex Hornem., *Litsea monopetala* (Roxb.) Pers, *Lindernia*

ruellioides (Colsm.) Pennell, *Mikania micrantha* Kunth, *Molineria capitulate* (Lour.) Herb *Securinega virosa* (Roxb.ex wild.) Baill., *Sapindus mukorossi* Gaertn, *Solanum indicum L*, *Trema orientalis* (L.) Blume and *Vitex glabarta* R.Br. belonging to 13 families.

- 30 edible food species belonging to 21 families, 11 fruits species belonging to 6 families, 15 fuelwood species belonging to 13 families and 5 fodder species belonging to 3 families are harvested by the villagers.
- Non timber Forest Products utilised by the villagers are broadly classified into six major categories: (a) Bamboo pole and cane, (b) broom grass and thatch grass, (c) edible food and fruits, (d) fuelwood, (e) fodder and (f) medicinal plants. Among the NTFPs groups, broom grass and thatch grass had the highest percentage of household involvement in harvesting (50.4%), followed by fuelwood (46.93%), edible food and fruits (46.4%), fodder (37.2%), bamboo pole and cane (27.4%) and least in medicinal plants (5.12%).
- Bamboo pole and cane were harvested maximally (56.6 $kg^{-1}hh^{-1}yr^{-1}$) followed by fuelwood (48.94 $kg^{-1}hh^{-1}yr^{-}1$) edible food and fruits (39.2 $kg^{-1}hh^{-1}yr^{-1}$), fodder (37.8 $kg^{-1}hh^{-1}yr^{-1}$), broom grass and thatch grass (27.8 $kg^{-1}hh^{-1}yr^{-1}$) and medicinal plants have the least quantity harvested (3.76 $kg^{-1}hh^{-1}yr^{-1}$).
- Fuelwood had the highest amount of consumption as compared to the other NTFPs (42.9 $kg^{-1}hh^{-1}yr^{-1}$) followed by fodder (37.8 $kg^{-1}hh^{-1}yr^{-1}$), bamboo pole and cane (34.8 $kg^{-1}hh^{-1}yr^{-1}$), edible food and fruits (19.4 $kg^{-1}hh^{-1}yr^{-1}$), broom grass and thatch grass (15.2 $kg^{-1}hh^{-1}yr^{-1}$) and least in medicinal plants (3.76 $kg^{-1}hh^{-1}yr^{-1}$).
- The amount of NTFP sold to the market was highest in bamboo pole and cane (23.8 $Kg^{-1}hh^{-1}yr^{-1}$), followed by edible food and fruits (19.8 $Kg^{-1}hh^{-1}yr^{-1}$), fuelwood (7 Kg^{-}

^{1}hh $^{-1}$yr^{-1}) and the least amount of NTFPs sold to the market was broom grass and thatch grass (12 Kg^{-1}hh $^{-1}$yr^{-1}).

- The monetary value from the NTFPs was highest in edible food and fruits (332 Rs^{-1}hh $^{-1}$yr^{-1}) followed by bamboo pole and cane (326 Rs^{-1}hh $^{-1}$yr$^{-1)}$, broom grass and thatch grass (212 Rs^{-1}hh $^{-1}$yr^{-1}) and least amount of income from fuelwood with an income of 110 Rs^{-1}hh $^{-1}$yr^{-1}.
- Among the NTFPs harvested, some were harvested only for their own consumption while others were sold to the market. All the NTFPs excluding medicinal plants are linked to the marketing channel. They are sold to the local market, nearby junction selling point and sometimes sell it to the main town *i.e* Aizawl. Medicinal plants are harvested by the villagers only for their own consumption.
- Frequency of bamboo was highest in Thenzawl FDA (17.333%) followed by Kolasib FDA (17%), Mamit FDA (13.818%) and least in Aizawl FDA (10.286%).
- Bamboo density was highest in Mamit FDA (133.585 ha^{-1}) followed by Thenzawl FDA (118.613 ha^{-1}), Kolasib FDA (84.56 ha^{-1}) and least was in Aizawl FDA (54.926 ha^{-1}).
- Dominance of bamboo in Mamit FDA was 95.170 m^{2} ha^{-1} which was the highest, followed by Thenzawl FDA (95.074 m^{2} ha^{-1}), Kolasib FDA (94.450 m^{2} ha^{-1}) and Aizawl FDA (60.026m^{2} ha^{-1}) with the lowest dominance among all the study sites.
- *Imperata cylindrica* (L). Raeusch. has the highest frequency in Aizawl FDA (42%), followed by Kolasib FDA (34%), Thenzawl FDA (6%) and least in Mamit and Champhai FDA (4%). Abundance was highest in Aizawl FDA (13.762) followed by Kolasib FDA (13.353), Mamit (10.5), Champhai (9) and least in Thenzawl FDA (7.333). *Imperata cylindrica* (L). Raeusch. had the highest density in Aizawl FDA i.e.

14450 ha^{-1}followed by Kolasib (11350 ha^{-1}), Thenzawl (1100 ha^{-1}), and Mamit (1050 ha^{-1}) and least in Champhai FDA (900 ha^{-1}).

- *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda has the highest frequency in Aizawl FDA (32%) followed by Thenzawl FDA and Mamit FDA (30%), Kolasib FDA (28%) and least in Champhai FDA (16%). Whereas abundance was highest in Mamit FDA (4.73) followed by Champhai FDA (4.625), Aizawl FDA (4.375), Kolasib FDA (4.43) and least abundance of broom grass in Thenzawl FDA (3.133). Highest density was found in Aizawl FDA (3500 ha^{-1}) and least in Champhai FDA (1850 ha^{-1}).
- Frequency of medicinal plants was highest in Thenzawl FDA (17.82%) followed by Mamit (17.538%), Champhai (16.154%), Aizawl (16.130%) and least in Kolasib FDA (14.5%). Whereas abundance was highest in Kolasib FDA (5.057), followed by Mamit (4.778), Thenzawl (4.691), Champhai (4.381) and least in Aizawl FDA (4.326) Density of medicinal plants was highest in Kolasib (3100.573 ha^{-1}), followed by Champhai (2304.337 ha^{-1}), Aizawl (2149.801 ha^{-1}), Thenzawl (1842.871 ha^{-1}) and least in Mamit (1913.212 ha^{-1}).
- Matrix ranking of 25 medicinal plants was done based on different criteria like their availability, production potential, utility, socio-economic and cultural significance, demand and economic return. *Mikania micrantha* Kunth belonging to the family Asteraceae obtained the highest score among all the medicinal plants followed by *Imperata cylindrica* (L). Raeusch. and *Costus speciosus* (J. Konig) Sm.

From the studies it may be concluded that Joint Forest management (JFM) has supplemented the livelihoods improvement to the villagers in so many ways. NTFPs from the plantation sites are an important source for the forest fringe communities within the study sites. Majority of the villagers are involved in harvesting of different NTFPs for their own consumption in times of short fall of agricultural crops. People tend to have more concern on the timber yielding trees because of the decreasing availability of fuelwood and timber within the village. In some of the sites, the VFDC plantation area which was formerly degraded was now transformed and provides a good ecological restoration. The VFDC plantation sites will be more benefited by the villagers when the planted trees are matured enough for harvesting. For time being they are utilizing only the NTFPs within the plantation sites. The villagers are also benefited from the assets created under Entry Point Activities (EPA) which gives them the ownership spirit and in turn makes them to participate more in the VFDC activities. In one of the VRDC village, *Cucurma longa* L. was harvested and shared equally among the VFDC beneficiaries to put across the idea of benefit sharing mechanism in VFDC. Delaying in receiving of funds is the major constrain in each and every VFDC. In Champhai FDA, the foresters take a chance of giving awareness to the villagers while the weeding was done with them. Awareness and informal discussion conducted among the villagers and the foresters gave better ideas in maintaining the plantation sites and also provide cooperation among them.

Among all the NTFPs broom grass and thatch grass has the highest percentage involvement of the villagers as a whole. This is so because broom grass being one of the basic necessities of each and every household, do not require a hard labour and is easily available. The number of people involves in harvesting bamboo pole and canes are not so high as compared to the other NTFPs and it was mainly harvested for their own consumption. *Bambusa tulda* Roxb, *Dendrocalamus longispathus* (Kurz) Kurz and *Dendrocalamus hamiltonii* Gamble are processed and weaved into different handicrafts and sold in the market. Edible food and fruits provides a good amount of income to the harvesters. Among the 30 food/vegetables species harvested, shoots of *Melocanna baccifera* (Roxb.) Kurz and *Dendrocalamus longispathus* (Kurz) Kurz, contribute the highest in terms of supply and demand by the customers. The dried and die out trees are harvested for the fuelwood. *Quercus pachyphylla* Kurz., *Anogeissus acuminata* (Roxb.ex DC) Guill, *Bischofia javanica* Blume and *Gmelina arborea* Roxb. are the common fuelwood species harvested because of the easy availability and lasting flame. Dried bamboos are also harvested as fuelwood in times of scarcity of wood. Fodders are harvested only for their own consumption. People's involvements in harvesting of medicinal plants are lesser among the youth as they are more interested in allopathic medicine. The old aged people still believe in the medical properties of various plants and used to treat various ailments whenever possible. Even though the monetary benefit from all types of NTFPs may not be as high as compared to the agricultural crops, these NTFPs serve as one of the most important substitute to the villagers as they do not require separate maintenance and can be harvested directly in the fruiting season. Though there were a few concerns reported on VFDC management and small misunderstandings with the forest department, nevertheless JFM provide a good platform for ecosystem restoration *vis-a-vis* meeting various requirements of the people from the forest and to enhance their socio-economic conditions. It is therefore urged that the Government of Mizoram should focus more on the managemental issues of JFM with the active participation of various FDAs to make the JFM areas more vibrant and sustainable.

RECOMMENDATIONS

The following major suggestion(s) and recommendations emerged out of the deliberations of discussion with the beneficiaries of JFM members across various FDAs.

- Maintaining special cell from the concern department to take care of the VFDC plantation sites, suited species to be planted, to check the growth status, to maintain good relationship with the VFDC beneficiaries and to clarify their problems and queries related to the VFDC.
- Promotion of semi processing center for various NTFPs at each FDA. This will help in the markets of NTFPs providing sustain profitable trade on their own especially to the easily perishable items.
- Domestication and cultivation of various wild vegetables and other NTFPs in the community forest area. Planting *Aloe vera* in the boundary of the plantation sites is also highly suggested as it protects the plantation sites from animals and also ensures the natural barrier saving the planted tree. *Aloe vera* is a one of the commonly used medicinal plants within the state and it if is planted within the plantation sites it will ensure a fruitful results.
- To develop home herbal healthcare/ centre within each FDA or VFDC by utilising knowledge of the senior citizen in each of their community and also under the supervision of other experts for the processing, way of consumption and storing of medicinal plants.
- Encourage the use of medicinal plants and give awareness among the youth the importance of medicinal plants and the need to conserve. To encourage the local communities in the production, management and development of the existing forest.
- Proper rules and regulation need to be laid out on the pattern, time and technique of harvesting NTFP. It is important to explore the potential of different NTFPs which

can give in more economic return to the villagers if their potential is harnessed properly.

- Local markets are often poorly acknowledged and neglected, but marketing of NTFP through local markets even though it is a small scale can play a vital role and provide substantial economy for the future. Incorporation of training strategies on value addition and marketing of NTFP is essential.
- More emphasis has to be laid on sustainable harvesting of NTFP. It is important to have awareness among the villagers who are always in touch with the forest resources. Villagers have to put on extra effort to bridge a wide gap between the large demand and less supply of NTFPs resources.
- Management strategies have to be developed by listening to the present problems and the consequences.
- Efforts should be made to introduce the quick profitable crops and multipurpose tree species (MPTs) in the community forest for fulfilling the basic requirements of the villagers, which will reduce the pressure on natural resources.
- Encroachment and illegal feeling within the community forest area should be taken seriously.

REFERENCES

Acharya, G. K. (2013). An economic analysis of collection, primary processing and marketing of non-timber forest products in Baster district of Chattisgarh. Thesis submitted for the fulfilment of Msc, Department of agricultural economics college of agriculture, Indira Gandhi Krishni Vishwavidyala, Raipur.

Acharya, K. P., Goutam, K. R., Acharya, B. K. and Gautam, G. (2006). Participatory assessment of biodiversity conservation in community forestry in Nepal. *Banko Janakari*, **16(1)**: 46-56.

Acharya, T. P. (2000). Conservation of non-timber forest products (NTFPs) in Humla Nepal: A case study of Rudikot (Margor) region for Biodiversity conservation. Proceedings of the third regional workshop of community based NTFP management, Kathmandu, Nepal. South and east Asian countries NTFP network (SEANN). Page: 264-271.

Adepoju, A. A. and Salau, A. S. (2007). Economic valuation of non timber forest products (NTFP's). Munich Personal RePEc Archive (MPRA) 9th April 2007. MPRA No. 2689.

Adhikari, B., Di-Falco, S. and Lovett, J. C. (2003). Household characteristics and forest dependency; evidence from common property from forest management in Nepal, *Ecological economics*, **48(2):** 245-257.

Agarwal, B. (1992). The gender and environment debate: lessons from India. *Feminist Studies*, **18(1):** 119-158.

Agarwal, B. (1997). Environmental action: gender equity and women's participation. *Development and change*, **28:**1-43.

Agarwal, B. (2001). Participatory exclusion, community forestry and gender: an analysis for South Asia and a conceptual framework. *World Development,* **29 (10):** 1623-1648.

Ahmed, M. U., Jana, S. K. and Roy, S. D. (2016). Marketing of non-timber forest products a case study in Paschim Medinipur district in West Bengal, India. *Journal of marketing research*, **4(3):**330-337.

Albeet, T. and Emmanuel, B. (2011). Improving nutrition and health through non-timber forest products in Ghana. *Journal of health, population and nutrition.* **29(2):**141-148.

Ali, H. and Qaiser, M. (2009). The Ethno botany of chitral valley, Pakistan with particular reference to medicinal plants. *Pakistan journal botany,* **41(4):** 2009-2041.

Ali, H., Ahmed, H. and Yousaf, M (2003). Trade of local medicinal herbs in Mingora City. Proceedings of Workshop on Conservation and sustainable uses of Medicinal and Aromatic plants of Pakistan.

Andel, T. (2006). Non-timber forest products: the value of wild plants. Agromisa; Technical center for agriculture and rural corporation (CTA), **39:**1-71.

Anderson, A. B. (1991). Forest management strategies by rural inhabitants in the Amazon estuary. Rainforest regeneration and management, UNESCO, Paris. Page: 351-360.

Angelsen, A. and Wunder, S. (2003). Exploring forest poverty link: key concepts, issues and research implication. Center for International Forest Research (CIFOR) occasional paper No. **40:**1-40.

Anonymous, (2009). Empowering tribal livelihoods through partnership. Collectives for integrated livelihood initiatives, April 2009.

Areki, F. and Cunningham, A. B. (2010). Fiji: Commerce, carving and customary tenure. Wild product governance : Finding policies that work for non- timber forest products, Earthscan, London, UK., Page : 229-242.

Arnold, J. E. M. and Perez, M. R. (1998). The role of non-timber forest products in conservation and development, incomes from the forest: Methods for the development and conservation of forest products for local communities. CIFOR/IUCN, 17-42.

Arnold, M .J .E. and Perez, M. R. (2001). Can non-timber forest products much tropical forest conservation and development objectives? *Ecology Economy*, **39:** 437-447.

Asfaw, A., Lemenih, M., Kassa, H. and Ewnetu. Z. (2013). Importance, determinants and gender dimensions of forest income in Eastern. *Forest Policy and Economics,* **28**: 1-7**.**

Babulo, B., Muys, B., Nega, F., Tollens, E., Nyssen, J., Deckers, J. and Mathijs, E. (2009). The economic contribution of forest resource use to rural livelihood in Tigray, northern Ethiopia. *Forest Policy and Economics*, **11:** 109-117.

Babulo, B., Muys, B., Nega, F., Tollens, E., Nyssen, J., Deckers, J. and Mathijs, E. (2008). Household livelihood strategies and forest dependence in the highlands of Tigray, northern Ethiopia. *Agricultural System*, **98 (2):** 147- 155.

Bahuguna, V. K. (2002). Joint forest management in India: Current status and research needs. A decade of joint forest management; retrospection and introspection, ICFRE, Dheradhun.

Balama, C., Augustino, S., Mwaiteleke, D., Lusambo, L. P. and Makonda, F. B. S. (2016). Economic valuation of Non-timber Forest Products under the Changing Climate in Kilombero District, Tanzania. *International Journal of Forestry Research*. Volume 2016, Article ID 7893143, 13 pages

Behera, S. K. and Sharma, B. (2003). Determinants of sustainable management of natural resources: The case of Joint Forest Management (JFM) in Andhra Pradesh. *Nature and Science*, **8(8):** 168-173.

Belcher, B, Achdiawan, R. and Dewi, S. (2015). Forest-Based Livelihoods Strategies Conditioned by Market Remoteness and Forest Proximity in Jharkhand, India. *World Development*, **66:** 269–279.

Bentley, R. (2010). Medicinal plants, London: Domville. Page: 23-46.

Berg, V. D. B and Biesbrouck, K. (2005). Dealing with power imbalances in forest management: Reconciling multiple legal systems in south Cameroon. Interdisciplinary studies in conservation and forest management, *African Studies*, **81:** 221-254.

Berg, V. D. J., Wiersum, K. F. and Dijk, H. V. (2012). The role and dynamics of community institutions in the management of NTFP resources. *Forests, Trees and Livelihoods*, **17 (3):** 183- 197.

Bhattacharya, P., Pradhanb, L. and Yadav, G. (2010). Joint Forest Management in India: Experiences of two decades. Resources, conservation and Recycling, **54:** 469-480.

Bhattachharyaa, L., Pradhanb, L. and Yadav. G. (2010). Joint forest management in India: experiences of two decades. *Resources, Conservation and Recycling*, **54:** 469-480.

Bhattarai, N. K. and Croucher, J. (1996). Viability of local commercialization of non-timber forest products as a strategy for promoting biodiversity conservation.

Environment and biodiversity in the context of South Asia. ecological society, Kathmandu, Nepal. Page: 346-353.

Cavendish, W. (2000). Empirical regularities in the poverty-environment relationship of rural households: evidence from Zimbabwe. *World Development*, **28(11):**1979-2003.

Chamberlain, J. L, Hammett, A. L. and Araman, P. A. (2001). Non-timber forest products in sustainable forest management. Proceedings of southern forest science conference United States, USA. Pages: 1-10.

Chanthayod, S., Zhang, W. and Chen, J. (2017). People's participation of the benefits of natural beekeeping and its positive outcomes for forest conservation: A case study in Northern Lao PDR, *Tropical Conservation Science*, **10**: 1-11.

Chauhan, K. V. S., Sharma, A. K. and Kumar, R. (2008). Non-timber forest products subsistence and commercial uses: Trends and future demands. *International Forestry Review*, **10:** 201-216.

Chou, P. (2018, a). The role of non-timber forest products in creating incentives for forest conservation: a case study of Phnom Prich Wildlife Sanctuary, Cambodia. *Resources*, 7.41.doi; 10.3390/ resources 7030041.

Chou. P. (2018, b). The utilization and institutional management of non-timber forest products in Phnom Prich Wildlife Sanctuary, Cambodia. *Environment, Development and Sustainability*, 1-6.

Choudhary, B. B., Pitambara and Srivastava, S. K. (2017). Evaluating the Joint Forest Management : A review of impact, performance and constraints. *International Journal of Pure and Applied Bioscience*, **5(2):** 813-825.

Clay, J. (1992). Some general principles and strategies for developing markets in North America and Europe for non-timber forest products: lessons for cultural survival enterprises. 1989-1990. Non-timber products from tropical forests: evaluation of conservation and development strategy, *Advances in economic botany*, **9:**101-106.

Daniggelis, E. (1994). The Jangal's "hidden" wealth: women's behavioural response to food scarcity in eastern Nepal. Multipurpose tree species network report No. 22

Dattagupta, S., Gupta, A and Ghose, M. (2010). Non-timber forest products of the inner line reserve forest, Cachar, Assam, India; dependency and usage pattern of forest dwellers. Assam university journal of science and technology: *Biological and Environmental Science*, **6(1)**: 21-27.

Dave, H. and Upadhyaya, J. K. (2002). Village resources development programme of village forest committees in Almora Forest Circle, Uttarakhand- A case study. *The Indian Forester,* **23(6):** 271-285.

De Beer, J. H. and McDermott, M. J. (1989). The economic value of non-timber forest products in Southeast Asia. The Hague council for international union of the conservation of nature, Amsterdam.

Department of Forestry (DOF) Nepal, (2004). Community forest resource inventory guidelines, 2061, Community forest division, department of forest, Kathmandu, Nepal .

Dhakal, P., Paudel, D. R. and Baral, D. R. (2016). Inventory of non-timber forest products in western Nepal and strategies for sustainable management". *International journal of environment*, **5(3):** 87-103.

Dhanagare, D. N. (2000). Joint forest management in Uttar Pradesh: people, panchayats and women. *Economic and political weekly,* **35(37):** 3315- 3324.

Dhyani, P. P. and Khali, M. P. (1993). Fruit yield and economic of jelly and jam production from fruits of some promising Ficus (figs) tree crops. *Ecology of food and nutrition,* **30:**169-178.

Dorward, A., Anderson, S., Clark, S., Keane, B. and Moguel, J. (2001). Asset functions and livelihood strategies: a framework for pro-poor analysis and practice. European association of agricultural economics, Seminar on livelihoods and rural poverty, September, 2001, Imperial College Wye, United Kingdom.

Dovie, D. B. K. (2003). Rural economy and livelihoods from the non-timber forest products trade. Compromising sustainability in southern Africa? *International journal of sustainable development and world ecology*, **10:** 247-262.

Dutta, B. K. and Dutta, P. K. (2005). Potential of ethno botanical studies in north east India: An overview, *Indian journal of traditional knowledge,* **4(1):** 7-14.

EARO, IPGRI (2004). Conservation of genetic resource of NTFPs in Ethiopia: proceeding of the first national work shop in NTFPs in Ethiopia, 5-6 April 2004.

Edwards, D. M. (1996). Non-timber forest products and community forestry: Are they compatible? *Banko janakari,* **6(1):** 3-8.

Endamana, D., Angu, K. A., Akwah, G. N., Shephard G. and Ntumwel, B. C. (2016). Contribution of non-timber forest products to cash and non cash income of remote forest communities in central Africa. *International forestry review*, **18(3):** 280- 295.

FAO (1992). Forests, trees and food. Food and Agriculture Organization, Rome, Italy. http://www.fao.org/docrep/006/ u5620e/U5620E00.HTM

FAO (1995). Non-wood forest products in nutrition. Food and nutrition division. In non-wood forest products for sustainable forestry. Yogyakarta, Indonesia, 17-27 January 1995. Non-wood forest products. Food and Agriculture Organization of the United Nations, Rome.

FAO (1995). Non-Wood Forest Products in Nutrition. In: Non-Wood Forest Products for Rural Income and Sustainable Forestry, FAO (Ed.). Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO (1997). State of the World's forests, FAO, Rome, Italy Food and Agriculture Organization of the United Nations Rome, 2007.

FAO (1997). Towards a harmonized definition of non-wood forest products. *Unasylva,* 50**(198):** 63-64.

FAO (2005). Global Forest Resource Assessment 2005. Progress towards sustainable forest management. Food and Agriculture Organization of the United Nations Rome, 147.

FAO (2012). State of the world's Forests 2012, Food and Agriculture Organization of the United Nations Rome, 2012.

FAO (2014). Women in forestry: Challenges and Opportunities. I3924E /1/07.14, Pages: 1-11.

Fearnside, P. M. (1989). Extractive reserves in Brazilian Amazonia. *Bio Science,* **39 (6):** 387-393.

Fisiy, C. (1997). State dislocation of customary management systems: Land colonization on the slopes of Mount Oku, North-West Province of Cameroon. *Law and Anthropology,* **9:** 124-- 145.

Fortmann, L. and Bruce, J. W. (1988). Whose trees? Proprietary dimensions of forestry. Westview Press, Boulder & London, Page: 341.

Fransworth, N. R. and Soejarto, D. D. (1991). Global importance of medicinal plants. The conservation of medicinal plants: proceedings of an international consultation 21-27th March, 1998, Chiang Mai, Thailand Cambridge University Press, Cambridge, Pages: 25-51.

Gangadharappa, S. and Roberts, D. G. (1999). JFM and its impact as the Indian Forest Sector. *The International Forestry Review*, **10(2)**: 401-413.

Gangwar, A. K. and Ramakrishnan, P. S. (1987). Cropping and yield patterns under different land use systems of the Khasi's at higher elevations of Meghalaya in North-eastern India, *International journal of ecological and environmental science*, **13**:73-86.

Gaoue, G. O., Ngonghala, C. N., Jiang, J. and Lelu, M. (2016). Towards a mechanistic understanding of the synergistic effects of harvesting timber and non-timber forest products, *Methods in Ecology and Evolution*, **7:** 398–406.

Gaoue, O. G. and Ticktin, T. (2008). Impacts of bark and foliage harvest on *Khaya senegalensis* (Meliaceae) reproductive performance in Benin. *Journal of Applied Ecology*, **45:**34–40.

Gaoue, O. G., Horvitz, C. and Ticktin, T. (2011). Non-timber forest product harvest in variable environments: modelling the effect of harvesting as a stochastic sequence. *Ecological Applications*, **21**:1604–1616.

Getachew.D and Wubalem, T. 2004. Conservation of genetic resources of non-timberForest products in Ethiopia; socio-economic importance and resource potential of nontimber forest products of Ethiopia. Addis Ababa, Ethiopian. Pp. 13-36

Ghate, R. (2000). Joint Forest Management: Constituting new commons. A case study from Maharastra, India. Paper submitted on eight biennial conference of the IASCP, entitled “Constituting the commons: Crafting sustainable commons in the new millennium,” at Indiana University, Bloomington, 31stMay- 4th June, 2000.

Ghimire, S., Gimenez, O., Pradel, R., McKey, D. and Thomas, Y. A. (2008). Demographic variation and population viability in a threatened Himalayan medicinal and aromatic herb *Nardostachys grandiflora*: matrix modelling of harvesting effects in two contrasting habitats. *Journal of Applied Ecology*, **45:** 41-51.

Giri, K. (2011). Women's participation in community forest (A case study of Bukeni Dada Community forest, Maranthana VDC, Pyuthan) A thesis Submitted to Central Department of Sociology. In Partial fulfilment of the requirement for the degree of Master of Arts in sociology.

Global NTFP Partnership (2005). Inception workshop held on 1-2 December at Marrakech, Morocco.

Godoy, R., Brokaw, N. and Wilkie, D. (1995). The effect of income on the extraction of non-timber tropical forest products: model, hypothesis and preliminary findings from the Sumu Indians of Nicaragua. *Human Ecology*, **23(1):** 29-52.

GOI. (1990). Involvement of village communities and vas in regeneration of degraded forests, circular on joint forest management, ministry of environment and forests, New Delhi.

GOI. (2000). Report of the taskforce on medicinal plants in India. Government of India, Planning Commission, New Delhi, India.

Govaerts, R. (2001). How many species of seed plants are there? *Taxon*, **50**: 1085-1090.

Gupta, B. N. (1994). India country report. In Non- wood forest products in Asia. Food and Agriculture organization of the United Nations, Bangkok. RAPA publication, Pages: 19-48.

Hai. N.V. (2016). The use of medicinal plants as immuno stimulants in aquaculture: A review, *Aquaculture,* **446**: 88-96.

Hall, P. and Bawa, K. S. (1993). Methods to assess the impact of extraction of non-timber tropical forest products on plant populations, Economic *Botany*, **47:** 234- 47.

Hamilton, A. C. (2008). Medicinal plants in conservation and development: case studies and lessons learned. Medicinal plants in conservation and development Salisbury, United Kingdom, November, 2008.

Hammet, A. L. (1999). Sustainable use of non-timber forest product: alternative to forest-based income opportunities. Paper presented at the Natural Resources Income Opportunities on Private Land Conference, April 5-8, 1999, in Hagerstown, Maryland.

Hedge, N. G. (2010). Small holders and role of NGOs in improving their livelihood. Paper presented at the NAARM workshop, Hyderabad, September.

Hegde, R., Suryaprakash, S., Achoth, L. and Bawa, K. S. (1996). Extraction of non-timber forest products in the forests of biligiri rangan hills, India: contribution to rural income, *Economic botany***, 50:** 243.51.

Hertog, W. D. (1995). Trees and people in balance: Forest utilization in Salyan District. SNV- Nepal.

Heubach, K., Wittig, R., Nuppenau, E. A. and Hahn, K. (2011). The economic importance of non-timber forest products (NTFPS) for the livelihood maintenance of rural West African communities: A case study from northern Benin. *Ecological Economics,* **70 (11)**: 1991-2001.

Heywood, V. H. and Iriondo, J. M. (2003). Plant conservation: old problems, new perspectives. *Biological Conservation,* **113:**321-335.

ICFRE (Indian Council of Forestry Research and Education) (2011). Status of Joint Forest Management in India. Proceedings of national workshop on JFM 27-28 June 2011, 63 pages.

Jha, L. K. and Laha, R. C. (2003). Commercial edible bamboo species and their market potentiality in three Indian tribal states of the North-eastern Himalayan Region. *Journal of Bamboo and Rattan*, **2(2):**111-133.

Jimoh, S. O. and Haruna, E. A. (2007). Contributions of non-timber forest products to household food security and income around Onigambari forest reserve, Oyo State, Nigeria. *Journal of Environmental Extension***, 6:** 28- 33.

Jimoh, S. O., Amusa, T .O. and Azeez, I. O. (2012). Prevalence, utilization and conservation strategies for non-timber forest products in south western zone of Nigeria. *Resources and Environment,* **2(1):** 46-54.

Jones, E. T, McLain R. J. and Lynch, K. A. (2004). The relationship between non-timber forest product management and biodiversity in the United States. Institute for Culture and Ecology. U.S. NTFP management and Biodiversity. Page 1-59.

Jones, K. W., Holland, M. B., Naughton- Treves, L., Morales, M., Suarez, L. and Keenam, K. (2016). Forest conservation incentives and deforestation in the Ecu adorian Amazon. *Environmental Conservation,* **44:** 56-65.

Kafle, M. R. (2006). Contribution of Joint Forest Management Programme to user's household income: A financial analysis. *Journal of Forest and livelihood*, **6 (3):** 254-271.

Karki, M. (2001). Institutional and Socio-economic factors and Enabling Policies for Non Timber Forest Products Based Development in Northeast India. Paper presented in the Pre-identification Workshop for NTFP-led Development in NE India, Report No. 1145.

Karki, S. (1996). Investigating non -timber forest products (NTFPs) opportunities in Nepal. Nepal Australia Community Forestry Project. Page: 16.

Khare, A., Mayers, J. and Morrison, E. (2000). Joint forest management: policy, practice and prospects. IIED, London.

Khosravi, S., Maleknia, R. and Khedrizadeh, M. (2017). Understanding the contribution of non-timber forest products to the livelihoods of forest dwellers in the northern Zagros in Iran. *Small Scale Forestry*, **16:** 235-248.

Kumar, N. and Saxena, C. (2002). India forests: potential for poverty alleviation: 99-136. Managing a global resource: challenges of forest conservation and development. Transaction publishers, New Brunswick, New Jersey, USA.

Kumar, S. (2002). Does participation in common pool resource management help the poor? A social cost benefit analysis of joint forest management in Jharkhand, India. *World Development*, **30(5):** 7630782.

Lalremruati, J. H. (2014). Study on market and non-market benefits of selected non-timber forest products around dampa tiger reserve of Mizoram.

Larsen, H. O., Olsen, C. S. and Boon, T. E. (2000). The non timber forest policy in Nepal: actors, objectives and power. *Forest Policy and Economics*, **1:**267-281.

Latif A. and Shinwari, Z. K. (2005). "Sustainable Market Development for Non Timber Forest Products in Pakistan," *Ethno botanical leaflets*, **1:**13-27.

Latif, A and Shinwari, Z. K. (2005). Sustainable Market Development for Non-Timber Forest Products in Pakistan. Ethnobotanical Leaflets, *An International Journal of Ethnobotanical Research*, **1(3):**1-9

Linlin, M. (2009). The relevance and impact of gender issue on the outlook for forestry to 2020 in north Asia pacific. Forestry sector outlook study II working paper series No AOFSOS II/WP/2009/12. Food and Agriculture Organization of the United Nations regional office for Asia and the Pacific, Bangkok.

Lintu, L. (1995). Trade and marketing of non-wood forest products. Paper presented in Expert consultation on NWFP, 17-27 January. 1995. FAO, Indonesia.

Mahapatra, A .K., Albers, H. J. and Robinson, E. J. Z. (2005). The impact of NTFP sales on rural households' cash income in India's dry deciduous forest. *Environmental Management*, **35:** 258-265.

Mahapatra, A. K and Shakleton, C. M. (2012). Exploring the relationships between trade in naturaaaaal products, cash income and livelihoods in tropical forest regions of Eastern India. *International Forestry Review,* **14(1):** 62-73.

Maharjan, M. R. (1994). Chiraito Cultivation in Community Forestry. Project Report B/NUKCFP/13.

Maikhuri, R. K., Semwal, R. L., Singh, A. and Nautiyal, M. C. (1994). Wild fruits as a contribution to sustainable rural development: a case study from the Garhwal Himalayas. *International Journal of Sustainable Development and World Ecology,* **1:** 56-68.

Maithani, G. P. (1994). Management perspectives of minor forest produce. MFP News, October– December

Malla, Y. B. (1993). Changing role of the forest resource market: an ignored dimension of community forestry in Ban Ko jankari, *A journal of Forestry information for Nepal***, 4(1):** 28-31.

Mallik, R. H. (2000). Sustainable management of non-timber forest products in Orissa: Some issues and options. *Indian Journal of Agriculture Economics,* **55**: 384-394.

Manuel Pardo-de-santayana., Pieroni, A. and Puri, R.K (2007). Ethnobotany in the New Europe: People, Health and Wild Plant Resources. Studies in environmental Anthropology and Ethnobiology Volume 14.

Marla, R. E. and Rebecca, J. M. (2001). Medicinal herbs, fungi, edible fruits and nuts and other natural products from the forest. Non-timber forest products, CRC press, Taylor and Francis group 1st Edition.

Marshall, E., Schreckenberg, K. and Newton, A. C. (2006). Commercialization of non-timber forest products : Factors influencing success: Lessons learned from Mexico and Bolivia and policy implications for decision-makers. UNEP World Conservation Monitoring Centre, Cambridge. UK. www.odi.org/sites/odi.org.uk/files/odi-assets/publicationsopinion-files/3769.pdf

Martin, G. J. (1995). Ethno botany: a methods manual. People and plants conservation manuals, Chapman and Hall, Page: 268.

Melese, S. M. (2016). Importance of non-timber forest production in sustainable forest management, and its implication on carbon storage and biodiversity conservation in Ethiopia, *International Journal of Biodiversity and Conservation,* **8(11):** 269-277.

Millennium Ecosystem Assessment, MEA. (2005). Ecosystems and human well-being: Policy responses.Vol.3, Island Press, Washington, DC.

Mitchell, C. P., Corbridge, S. E., Jewitt, S. L., Mahapatra, A. K. and Kumar, S. (2003). NTFP availability, production, consumption, management and marketing in Eastern India.

MoEF (2006). National Environment Policy 2006. Government of India, Ministry of Environment & Forests, 18th May, 2006 Pages: 1-52.

Murali, J. R. (2002). Does the establishment of Joint Forest management facilitate the rejuvenation of Indian degraded forest land: are you surprised? *Journal of Environmental Economics and Management*, **37 (3):** 272- 289.

Murali, K. S., Murthy, I. K. and Ravindranath, N. H. (2002). Joint forest management in India and its ecological impact. *Environmental Management and Health*, **13(5)**: 512-528.

Murali, K. S., Uma Shankar R., Uma Shaanker, K. N., Ganeshaiah, K. N. and Bawa K. S. (1996). Extraction of non-timber forest products in the forests of Biligiri Rangan Hills, India. 2. Impact of NTFP extraction on regeneration, population structure and species composition. *Economic Botany*, **50**: 252-269.

Nabanoga, G. N. (2005) Transgressing boundaries. Gendered spaces, species, and indigenous forest management in Uganda. Wageningen University, Tropical Resource Management Papers No. 60, Page-227.

Nagaraja, A. and Somashekar, H. L. (2008). Development and status of Joint Forest Management in India: A case study from South India. *International Forestry Review*, **34:** 116-123.

Nalawade, S. M., Sagare, A. P., Lee, C.Y., Kao, C. L. and Tsay, H. S. (2003). Studies on tissue culture of Chinese medicinal plants resources in Taiwan and their sustainable utilization. *Botanical Bulletin Academia Sinica*, **44**:79-98.

Ndangalasia, N. J., Bitariho, R. Delali, B. K. and Dovie. (2007). Harvesting of non-timber forest products and implications for conservation in two Montane forests of East Africa. *Biological Conservation*, **134:** 242-250.

Neumann. R. P. (1996). Forest products research in relation to conservation policies in Africa. Current issues in non-timber forest products research. Proceedings of the workshop "Research on NTFP", Pages: 161-177, Hot Springs, Zimbabwe, 28 August-2 September 1995. CIFOR, Jakarta, Indonesia.

Newton, P., Miller, D. C., Byenkya, M .A .A. and Agarwal, A. (2016). Who are forest-dependent people? A taxonomy to aid livelihood and land use decision- making in forest regions. *Land Use Policy,* **57:** 388-395.

Nightingale, A. J. (2002). Participating or just sitting in? The dynamics of gender and caste in community forestry. *Journal of Forest and Livelihood,* **2 (1):** 17–24.

Ogunsawa, O. Y. and Ajala, O. O. (2002). Firewood crises in Lagos-implication on the suburban and rural ecosystem management, proceeding of the 28th annual conference of forestry association of Nigeria at Akure, Ondo state. Nov. 4th-8th, Pages : 257-264.

Ojea, E, Loureiro M. L., Allo, M. and Barrio, M. (2016). Ecosystem services and REDD: estimating the benefits of non-carbon services in worldwide forests. *World Development*, 78: 246-261.

Ojha, H. R., Subedi, B.P. and Dangol, S. P. (2001). Assessment of sustainable harvesting of non timber forest products: some initiatives in community forestry in the hills of Nepal. Asia network for small-scale agricultural bio resources, Kathmandu, Nepal.

Olsen, C. S. and Bhattarai, N. K. (2005). A typology of economic agents in the Himalayan plant trade. *Mountain Research and. Development,* **25**: 37-43.

Omkar, K., Suthari, S., Alluri, S., Ragan, A, A. and Raju, V. S. (2012). Diversity of NTFPs and their utilization in Adilabad district of Andhra Pradesh, India. *Journal of Plant Studies,* **1(1):**35-46.

Osemeobo, J. C. (1991). Effect of common property resource utilization on wildlife conservation in Nigeria. *Geographical Journal,* **23(3):** 241-248.

Pandey, A. K. and Bisaria, A. K. (1998). Rational utilization of important medicinal plants: A tool for conservation. *Indian Forester*, **124:** 197-206.

Pandey, A. K. (2011). Non-timber forest products marketing interventions for augmenting livelihoods of forest-dependent communities. *Community forest*, Issue 24/June 2011

Pandey, A. K. and Shackleton (2012). The effect of harvesting approaches on forest yield, embelin concentration and regrowth dynamics of the forest shrubs, *Embelia tsjeriam-cottam*, in central India. *Forest Ecology and Management*, **266:** 180-186.

Pandey, A. K., Bhargava, P. and Negi, M. S. (2011). Sustainable management of non-timber forest products through joint forest management. *Indian Forester,* **137**: 105-113.

Pandey, A. K., Tripathi, Y. C. and Kumar, A. (2016). Non Timber Forest Products (NTFPs) for Sustained Livelihood: Challenges and Strategies. *Research Journal of Forestry*, 10**(1):** 1-7.

Paudel, S. and Wiersum, K. F. (2002). Tenure arrangements and management intensity of Butter tree (*Diploknema butyracea*) in Makawanpur district, Nepal. *International Forestry Review*, **4 (3):** 223-230.

Peluso, N. L. (1992). The rattan trade in East Kalimantan, Indonesia. *Advances in Economic Botany*, **9:** 115 - 128.

Pierce, A., Shanley, P. and Laird, S. (2003). Certification of non-timber forest products: Limitations and implications of a market-based conservation tool. Paper presented at The International Conference on Rural Livelihoods, Forests and Biodiversity.19-23 May 2003, Bonn, Germany.

Plotkin, M. and Famolare, L. (1992). Sustainable harvest and marketing of rain forest products, conservation. International- Island Press, Washington DC. Page: 103-105.

Prance, G.T., Balee, W., Boom, B. M, and Cameiro, R. L. (1987). Quantitative Ethnobotany and the Case for Conservation Amazonia. *Conservation Biology,* **1:** 296- 310.

Prasad, R., Sukla, P. K. and Bhatnagar, P. (1996). Leaves from the Forest: a case study of tendu leaves in Madhya Pradesh, Jabalpur, Lucknow, India. Centre for Environment and Sustainable Development, Page: 64.

Quang, D. V and Anh, T. N. (2006). Commercial collection of NTFPs and households living in or near the forests: case study in: Que, Con Cuong and Ma, Tuong Duong, Nghe An, Vietnam. *Ecological Economics,* **60(1):** 65-74.

Qureshi, R., Bhatti, G. R and Memon, R. A. (2010). Ethno medicinal uses of herbs from northern part of Nara desert, Pakistan. *Pakistan Journal of .Botany,* **42 (2):** 839-851.

Ravindranath, N. H., Murali, K. S., Murthy, I. K., Sudha, P., Palit, S. and Malhotra, K. C. (2000). Joint forest management and community forestry in India: An ecological and institutional assessment, New Delhi, Pages: 279-318.

Reddy, V. R. (2001). People's participation and forest management in India: few emerging issue. *Asia Pacific journal of rural development,* **11**:2.

Reshad, M., Mohammed, M., Mohammed, A. and Beyene, A. (2017). Socio-economic importance of non-timber forest products and its implication on natural forest conservation: The case of Jello-Muktar forest, south eastern Ethiopia. *Journal of Economics and Sustainable Development,* **8(17):** 2222-2855.

Robinson, E. J. Z, and Kajembe, G. C. (2009). Changing to access forest resources in Tanzania. Environment for development, April. 2009. Pages: 1-21.

Rode, J., Gomez-Baggethun, E. and Krause, T. (2015). Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. *Ecological Economics*, **117**: 270-282.

Rogerson, C. M. and Sithole, P. M**.** (2001). Rural handicraft production in Mpumalanga, South Africa: Organisation, problems and support needs. *South African Geographic Journal*, **83(2):** 149-158.

Ross, I. A. (2005). Medicinal plants of the world (volume 3): chemical constituents, traditional and modern medicinal uses. New Jersey: Humana Press Inc, 110-132.

Sah, S. P. and Dutta, I. C. (1996). Inventory and future management strategies of multipurpose tree and herb species for non-timber forest products in Nepal. *Non-wood Forest Product*, **3:** 123-146.

Saha, D. and Sundriyal, R.C. (2012). Utilization of non-timber forest products in humid tropics: Implications for management and livelihood. *Forest Policy and Economics*, **14(1):** 28-40.

Sahoo, U. K, Jeeceelee, L, Lalremruata, J. H, and Lalramnghinglova, H. (2012). Diversity of non-timber forest products of plant origin, use and local dependence in Mizoram, north-east India. *Journal of Non-timber Forest Products*, **19:**147–161.

Sahoo, U. K., Lalremruata, J., Lalramnghingllova, H., lalremruati, J.H. and Lalliankhuma, C. (2010). Livelihood generation through non-timber forest products by rural poor in and around Dampa tiger reserve in Mizoram. *Journal of Non-Timber Forest Products*, **17(2):** 147-161.

Samah, A. A. (2010). The Suhakam Report: The Status of Women's Right in Malaysia, Human Rights Commission of Malaysia, Kuala Lumpur. www.suhakam.org.my/wp-content/uploads/2013/11/SUHAKAM-Report-on-the-Status-of-Women- Rights-in- Malaysia-2010-pdf.

Samar, S and Khare, A. (1993). Peoples' participation in forest management. Wastelands News, **3(4):** 34-38.

Sandhya, B., Thomas, S., Isabel, W. and Shenbagarathai, R. (2006). Ethno medicinal plants used by the valaiyan community of pairanmalai Hills (Reserved forest), Tamil Nadu, India- a pilot study. *Journal of Alternative and Complementary Medicine*, **3(1):** 101-114.

Sapkota, I. P. and Oden, P. C. (2008). Household characteristics and dependency on community forest in Terai of Nepal, *International Journal of Social Forestry*, **1(2):** 123-144.

Sarin, M. (2014). Joint forest management in India: achievement and unaddressed challenges. Common property forest resource management. FOA Corporate Document Repository, *Unasylva* - No. 180.

Saxena, N. C. (1999). Joint forest management policy, practice and prospects (Executive Summary), IIED publications, London UK.

Schaafsma, M., Morse-Jones, S., Posen, P., Swetnam, R. D., Balmford, A., Bateman, I. J. Burgess, N.D., Chamshaman, S. A. O., Fisher, B. and Freeman, T.*et al*. (2014). The importance of local forest benefits: Economics valuation of non-timber forest products in the Eastern Arc Mountains in Tanzania. *Global Environmental Change*, **10:** 1-11.

Schippmann, U., Leaan, D. J. and Cunningham, A. B. (2002). Impact of cultivation and gathering of medicinal plants on biodiversity: Global trends and issues. In

(FAO), Biodiversity and the ecosystem approach in agriculture, forestry and fisheries. Satellite event on the occasion of the Ninth regular session of the commission on genetic resources for food and agriculture. Inter departmental working group on biological diversity for food and agriculture. Rome, 12-13 October.

Secretariat of CBD. (2001). Sustainable management of NTFP, CBD technical series no. 6, Montreal: SCBD.

SEWA (2000). The Gum Collectors: Struggling to Survive in the Dry Areas of Banaskantha, SEWA Academy, Ahmadabad.

Shaanker, R. U., Ganeshaiah, K. N., Rao, M. N. and Aravind, N. A. (2004). Ecological consequences of forest use: from genes to ecosystem – a case study in the Biligiri Rangaswamy temple Wildlife Sanctuary, South India. *Conservation and Society*, **2:** 347-363.

Shackleton, C. M. and Pandey, A. K. (2014). Positioning non-timber forest products on the development agenda. *Forest Policy and Economics*, **38:** 1-7.

Shackleton, C. M., Pandey, A .K. and Ticktin, T. (2015, a). Ecological sustainability for non-timber forest products: dynamics and case studies of harvesting. Routledge, New York, USA, Pages: 1-3.

Shackleton, C. M., Pandey, A. K. and Ticktin, T. (2015, b). The ecological sustainability of non-timber forest product harvest: Disarming the narrative and the complexity. *In: Ecological sustainability for non-timber forest products dynamics and case studies of Harvesting*, New York, USA, Pages: 260-278.

Shackleton, C. M., Shackleton, S. E., Buiten, E. and Bird, N. (2007). The importance of dry woodlands and forest in rural livelihoods and poverty alleviation in South Africa. *Forest Policy and Economics*, **9(5):** 558-577.

Shackleton, S., Campbell, B., Lotz-Sisitka, H. and Shackleton, C. (2008). Links between the local trade in natural products, livelihoods and poverty alleviation in a semi-arid region of South Africa. *World Development*, **36:** 505-526.

Shakleton, S., Shanley, P. and Onoye, O. (2007). Invisible but viable; recognising local markets for non timber forest products. *International Forestry Review*, **9(3):** 697-712.

Shastri, C. M., Bhat, D. M., Nagaraja, B .C., Murali, K. S. and Ravindranath, N. H. (2002). Tree species diversity in a village ecosystem in Uttara Kannada district in Western Ghats, Karnataka. *Current Science*, **82(9):** 1080-1084.

Shiva , V. (1988). Staying alive: women, ecology and development. London: Zed Books.

Shiva, M. P. and Verma, S. K. (2002). Approaches to sustainable forest management and biodiversity conservation: With pivotal role of non timber forest products. Centre for Minor Forest Products, Valley Offset Printers, Dheradun.

Singh, Samar and Khare, A. (1993). Peoples' participation in forest management *Wastelands News*, 3**(4):** 34-38.

Sisak, L., Rieldl, M. and Dudik, R. (2016). Non-market non-timber forest products in the Czech Republic- Their socio economic effects and trends in forest land use, *Land Use Policy*, **50:** 390-398.

Suleiman, M. S., Wasonga, V .O., Mbau, J. S., Suleiman, A. and Elhadi, Y. A. (2017). Non-timber forest products and their contribution to households' income around Falgore Game Reserve in Kano, Nigeria. *Ecological Process*, **6**: 23.

Sundar, N. (2000). Unpacking the "joint" in joint forest management, *Development and Change*, **31(1):** 255-279.

Sunderland, T. C. H., Harrison, S. T. and Ndoye, O. (2004). Commercialization of non-timber forest products in Africa: history, context and prospects. In:

Sunderland TCH, Ndoye O (eds). Forest products, livelihoods and conservation: case studies of non-timber forest product systems. CIFOR, Bogor. *Africa,* **2:** 1–24.

Sunderlin, W., Angelsen, A., Belcher, B., Burgers, P., Nasi, R., Santoso, L. and Wunder, S. (2005). Livelihoods, forests and conservation in developing countries: An overview. *World Development*, **33 (9):** 1383-1402.

Takasaki, Y., Barham, B. L. and Coomes, O. T**.** (2004). Risk coping strategies in tropical forests: floods, illness and resource extraction. *Environment and Development Economic,* **9(2)**: 203-224.

Tejaswi, and Basvarajappa, P. (2008). Non-timber Forest Products (NTFPs) for food and livelihood security: an economic study of tribal economy in Western Ghats of Karnataka, India. Thesis submitted in partial fulfilment for the joint degree of International Master of Science in rural development from Ghent University (Belgium), Agrocampus Rennes (France), Humboldt university of Berlin (Germany) and university of Corboda (Spain) in collaboration with Wageningen University (Netherlands), Slovak university of agriculture in Nitra (Slovakia) and university of Pisa (Italy).

Tewari, D .N. (1993). MFP in Forestry – keynote address. Proceedings of international seminar on MFP in forestry, Dehradun, 17-18 April 1993.

Tewari, D. D. (2000). Managing non-timber forest products as an economic resource. *Journal of Interdisciplinary Economics,* **11:** 269-287.

Ticktin, T. (2004). The ecological implications of harvesting non-timber forest products. *Journal of Applied Ecology*, **41**:11-21.

Titz, A. (2004). Medicinal herbs and plants - scope for diversified and sustainable extraction. 22-26th July, 2004, Bangalore.

Toksoy, D., Alkan, S. and Hacisalihoglu, S. (2010). Usage of non timber forest products by women in forest village of Trabzon, *Journal of Environmental Biology*, **31(6):** 1013-1016.

Tynsong, H., Dkhar, M. and Tiwari, B. K. (2013). Domestication, conservation, and livelihoods: A case study of *Piper peepuloides* Roxb.— An important non timber forest product in south Meghalaya, Northeast India. *International Journal of Biodiversity,* **2013:** 1-8.

Vantomme, P. (2003). Compiling statistics on non-wood Forest products as policy and decision-making tools at the national level. *International Forestry Review,* **5(2):**156-160.

Vedeld, P., Angelsen, A., Bojo, J., Sjaastad, E. and Kobugabe, G. K. (2007). Forest environmental income and the rural poor. *Forestry Policy and Economics,* 9**(7):**869-879.

Vivero, J. L. (2002). Forest is Not Only Wood: The Importance of non-wood forest products for the food security of rural households in Ethiopia. In: Forests and Environment. (Ed. Demel Teketay and Yonas Yemshaw). Proceedings of the fourth Annual Ccnference. Forestry society of Ethiopia, 14-15 January 2002, Addis Ababa. Pages: 16-31.

WHO. (2002). Traditional medicine- growing needs and potential, WHO Policy perspectives, *Medicines,* **2:** 1-6.

Wickens, G. E. (1994). Sustainable management for non-wood forest products in the tropics and subtropics. In Readings in Sustainable Forest Management, FAO, Rome, Pages: 55–65.

Wilkie, D. (1998). CARPE and non-wood forest products. Current research issues and prospects for conservation and development. Based on the outcome of the International expert meeting on non-wood forest products. The Limbe Botanic Garden, Cameroon, May 10-15, 1998. FAO, Rome, Italy.

Wollenberg, E. and Ingles, A. (1999). Incomes from the forest: methods for the development and conservation of forest products for local communities. CIFOR, IUCN, Bogor, Indonesia.

World Bank, (2006). Unlocking opportunities for forest-dependent people in India. Main Report No. 34481-IN, Volume 1, February, 2006, India.

World Bank. (2001). A revised forest strategy for the World Bank Group, Washington, DC: World Bank.

World Bank. (2001). World Development Report 2000/2001: Attacking Poverty.

Xayvongsa, L., Bae, Y., Choi, Y. and Yi, J. (2009). Role of NTFPs in rural livelihood of Lao PDR, *Journal of Forest Science,* **25(2):** 85-91.

Zaku, S. G., Tukur, A. A, Kabir, A. and Jimento, I. G. (2013). Wood fuel consumption in Nigeria and the energy ladder: a review of fuelwood use in Kaduna state. *Journal of Petroleum and Alternative Fuels,* **4(5):** 85-89.

Zerabruk. S. and Yirga, G. (2012). Traditional knowledge of medicinal plants in Gindeberet district, Western Ethiopia. *South African Journal of Botany,* **78:** 165-169.

Zobel, D. B., Jha, P. K., Behan, M .J. and Yadav, U. K .R. (1987). A practical manual for ecology. Ratna Book Distributors, Kathmandu. Pages: 149.

Production, Utilization and Marketing of Non-Timber Forest Products in Joint Forest Management in Mizoram

PART A. General Information

1. Name of the respondent: ________________________________Age_____ Sex_____
2. Division / FDA: ___________________________
3. Name of the village: _______________________
4. District: ___________________
5. Respondent details:

<table>
<tr><td colspan="3">Family size (no's)</td><td>Educational status</td><td>Occupation</td><td>Family income (monthly)</td><td>House type</td><td>Land holding size</td></tr>
<tr><td>M</td><td>F</td><td rowspan="5"></td><td>Illiterate</td><td rowspan="6"></td><td rowspan="6"></td><td rowspan="6"></td><td rowspan="6"></td></tr>
<tr><td rowspan="4"></td><td rowspan="4"></td><td>PM</td></tr>
<tr><td>MID</td></tr>
<tr><td>HSLC</td></tr>
<tr><td>HSSLC</td></tr>
<tr><td colspan="3">Total:</td><td>GRA</td></tr>
</table>

6. Are they aware of VFDC and its activities?

7. Distance of VFDC field from the village?

8. Area (Ha.) of plantation site?

9. Do they take part in VFDC activities?

10. Employment generation.

11. Dependence on NTFPs:

   a) To what extend his livelihood is achieved?
   b) Any nutritional security?
   c) Any economic benefits?
   d) Any livelihood improvement for society?
   e) Employment generation?

12. Any conservation steps taken?

13. Any improvement from previous year?

14. Involvement of the villagers?

15. Any woman participation?

16. Is there a good cooperation between Forest department and villagers in taking care of plantation area?

17. Steps to be taken for better improvement.

PART B

(1). PRODUCTION:

1. NTFPs found in VFDC plantation area? Whether natural / planted?

2. Production potential of NTFPs.

3. Seasons of production.

Sl. No.	**NTFPs**	**Seasonality**
1		
2		
3		

4. Collection calendar

Sl.No.	**NTFPs**	**Seasons of collection/harvesting**
1		
2		
3		

5. Harvesting technique.

Sl. No.	**NTFPs**	**Technique used in harvesting.**
1		
2		
3		

(2) UTILIZATION

1. What are market related benefits they get from NTFP?

2. Among the NTFPs which has highest marketing potential?

3. Among the NTFPs which has the lowest marketing potential?

4. Which NTFP has the highest abundance in VFDC plantation area?

5. Different non-market utility from NTFPs.

Sl. No	**NTFPs**	**Parts used**	**Utility**
1			
2			
3			

(3) MARKETING

1. Marketing flow/channel of NTFP.

2. Among NTFPs which has the highest and lowest market price and why?

3. Problems/ hindrances face by the producers in selling of NTFP?

4. Any problems between the producers and other stakeholder?

5. Do the producers (villagers) get their satisfaction in their profit from NTFPs?

6. Do the state Government took any initiation for the betterment of marketing channel of NTFPs or any steps in improvement of infrastructure of local market.

PART C (Entry Point Activities)

1. Any works done through EPA (Entry Point Activities)?

2. Knowledge on fund availability for their village plantation/ EPA?

3. Any voluntary work done?

4. Frequency of weeding?

5. Any livelihood improvement for society?

6. Short term benefits (Financially/exploiting any NTFP/ fuelwood extraction etc)

7. Long term benefits (Construction of public property…)

8. Problems /Hindrances face by the villagers with respect to VFDC.

D. Questionnaire for NTFP Collectors

1. What is the annual household income from the following activities?

Occupation	Annual household income
Farming	
NTFP collection/processing	
Self employed	
Other	

2. What all activities are you involved in, as far as income generation from NTFP is concerned?
   a) Collection? Yes/ No
   b) Processing? Yes/ No
   c) Marketing? Yes/ No
   Please tick the appropriate answer.

3. Which types of NTFPs do you collect and how much was your annual income last year? What was the volume of collection?

NTFP	**Annual Household Income**	**Volume of collection**
Bamboo and cane		
Broom grass and thatch grass		
Fuelwood		
Fodder		
Medicinal plants		
Others		

4. Since how long have you been collecting these NTFPs?
   a) 1-3 years? b) 3-5 years? c) More than 5 years?
   Please tick the appropriate answer.

5. Have you noticed any changes in the availability of these varieties?
   a) Is it constant?
   b) Has it become less?
   c) Not available? (If this is the case, please mention the name of the NTFP which is no longer available)

6. Where are these NTFPs found?
   a) Forest? b) Farm?
   Please tick the appropriate answer.

7. Economics of NTFP collection

Particulars	No. of person days spent in Collection (a)	No. of person days spent in processing (b)	No. of person days spent in marketing (c)	Rate of person days (d)	Total value of person days (e=a+b+c) * d	Storage costs (f)	Transportation costs (g)	Total costs (e+f+g)
Bamboo and cane								
Broom grass and thatch grass								
Fuelwood								
Fodder								
Medicinal plants								
Others								

8. Sale of NTFPs

NTFP	Total collection	Quantity self-consumed	Quantity sold	Rate at which sold	Sold to whom?	Total sales

Bamboo and cane						
Broom grass and thatch grass						
Fuelwood						
Fodder						
Medicinal plants						
Others						

9. How long does it take to get to the forests?

…………………………………………………………………………………………………
………………………………………………………………………………………

   a. In case of NTFPs found on farms, are they

   a) Planted? or b) simply managed?

   Please tick the appropriate answer.

10. Are you a) self employed or b) do you work for an agent?

    Please tick the appropriate answer.

11. In a year, in how many months is your income obtained from NTFP collection?

    a) 1-4 months b) 5-8 months c) 8-12 months

    Please tick the appropriate answer.

12. Where do you sell the NTFPs?

    a) Agent/ middle man?
    b) Trader?
    c) Local market?

    Please tick the appropriate answer.

13. What do you think should be done to improve your family income based on NTFPs?

E. Questionnaire for those involved in Processing

1. Name ………………………………………………………………………………...

2. District ……………………………………………………………………………….

3. Village ……………………………………………………………………………….

4. How many members are there in your family?
   a) Male …………………. b) Female …………………. c) Children ………………..

5. Among them, how many are employed?
   a) Male …………………. b) Female …………………. c) Children ………………..

6. What is the annual household income from the following activities?

Occupation	**Annual Household Income**
Farming	
NTFP collection/ processing	
Self employed	
Others	

7. What all activities are you involved in, as far as income generation from NTFP is concerned?
   a) Collection? Yes/ No
   b) Processing? Yes/ No
   c) Marketing? Yes/ No
   Please tick the appropriate answer.

8. Which types of NTFPs do you collect and how much was your annual income last year? What was the volume of collection?

NTFP	**Annual Income**	**Volume of Collection**
Bamboo and cane		
Broom grass and thatch grass		
Fuelwood		
Fodder		
Medicinal plants		
Others		

9. How do you procure the NTFPs?

   a) Directly from collectors?
   b) From agents/ middle man?
   Please tick the appropriate answer.

10. How far is it from your area of work?

……………………………………………………………………………………………
……………………………………………………………………………………

11. How do you reach there?

12. Do you use any equipment for processing products? Yes/ No
    Please tick the appropriate answer.

13. Whom do you sell them after the products are processed?
    d) Agent/ middle man?
    e) Trader?
    f) Retail shop?
    Please tick the appropriate answer.

14. In a year, in how many months is your income obtained from NTFP collection?
    b) 1-4 months b) 5-8 months c) 8-12 months
    Please tick the appropriate answer.

Note: Information to be gathered on existing policies and their impact on the NTFP collectors. (to be done through secondary research).

Name of the researcher:
K. Lalhmingsangi
Department of Forestry,
Mizoram University.

PHOTO PLATE 1

Use of bamboos species

Fig No.1

Fig No.2

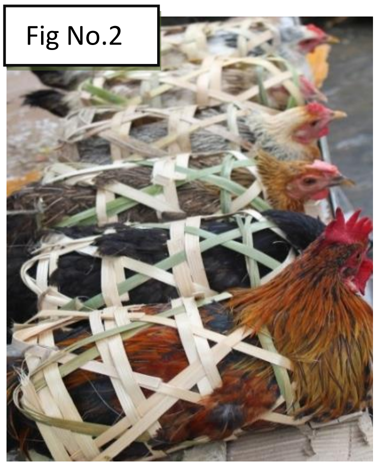

Fig No.3

Fig No.4

Fig No.5

Fig No.6

Fig No.7

Fig No.8

Fig No.9

Fig. 1-9 Use of bamboo (*Dendrocalamus longispathus* and *Melocanna baccifera*) for making various basket for trapping crab and poultry, carrier, winnowing fan and hut.

PHOTO PLATE-2

Fig. 10-13 Processing and selling of *Melocanna baccifera* and *Dendrocalamus longispathus* shoots
Fig.14- *Calamus erectus* (Thil-thek)
Fig.15- *Calamus guruba* Buch. Ham (Thil te)

PHOTO PLATE- 3

Fig No. 16

Fig No. 17

Fig No. 18

Fig No. 19

Fig No. 20

Fig No. 21

Fig. 16- *Musa acuminata* (Tumbu)

Fig. 17- *Musa glauca* (Saisu)

Fig. 18 - *Cassia occidentalis(*Reng an)

Fig 19 - *Eurya acuminata* DC (Sihneh)

Fig. 20- *Amomum dealbatum* (Aidu)

Fig. 21- *Oroxylum indicum* (Archangkawm)

PHOTO PLATE - 4

Fig No. 22

Fig No. 23

Fig No. 24

Fig No. 25

Fig No. 26

Fig No. 27

Fig. 22- *Centella asiatica*(lambak)
Fig. 23-*Acmella paniculata* (Angasa)
Fig. 24 – *Gnetum gnemon* (Pelh)
Fig 25 - *Marsdenia maculata*(Ankhapui)
Fig. 26- *Calamus tenuis* (Chang-dam)
Fig. 27- *Arenga pinnata* (Thangtung)

PHOTO PLATE - 5

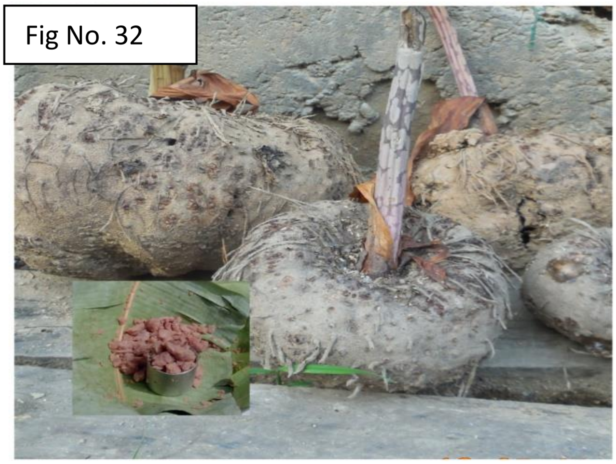

Fig. 28- Dried *Picria felterrae* (Khatual) Fig.29-Dried bamboo shoots

Fig. 30 – *Zanthoxylum rhetsa* (chingit) Fig.31- *Marsdenia formosana* (Ankhate)

Fig. 32–*Amorphophallus nepalensis*(telhawng) Fig.33-*Cinnamomum aromaticum* (thakthing)

PHOTO PLATE - 6

Fig No. 34

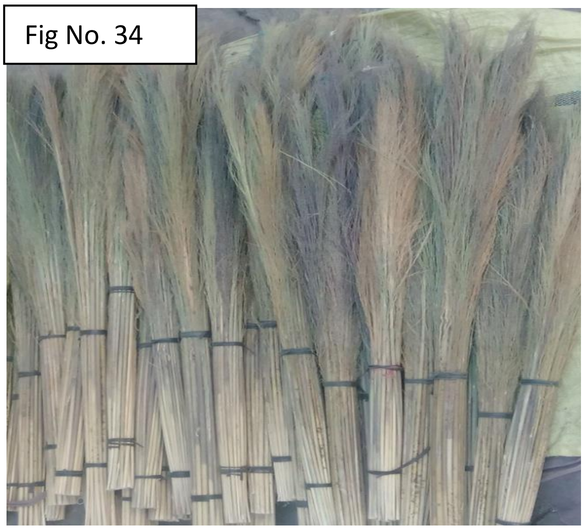

Fig No. 35

Fig No. 36

Fig No. 37

Fig. 34 and 35- Broom grass value addition

Fig. 36 – *Imperata cylindrica* used for thatching roof.

Fig. 37- Use of *Gmelina arborea* Roxb. for making wheels of wooden cart.

PHOTO PLATE - 7

Fig No. 38

Fig No. 39

Fig No. 40

Fig. 38-40 Entry Point Activities (EPA) from the study sites.

PHOTO PLATE - 8

Fig No. 41

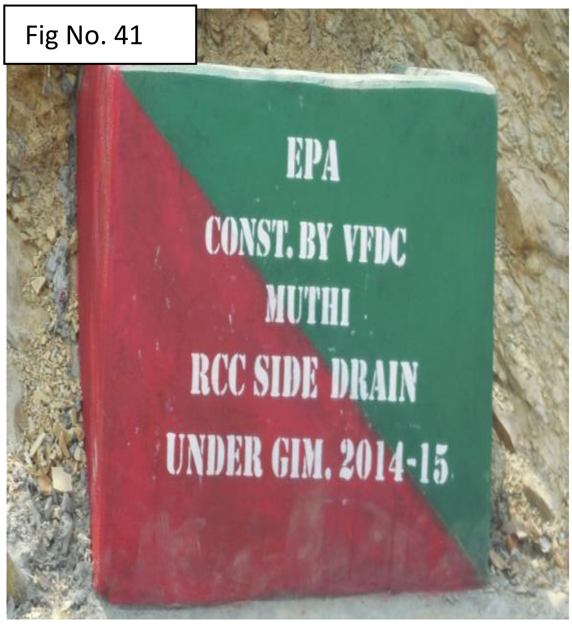

Fig No. 42

Fig No. 43

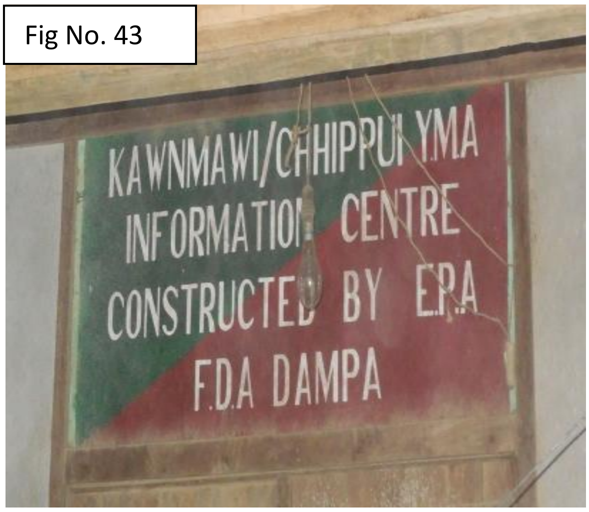

Fig No.44

Fig No.45

Fig No. 46

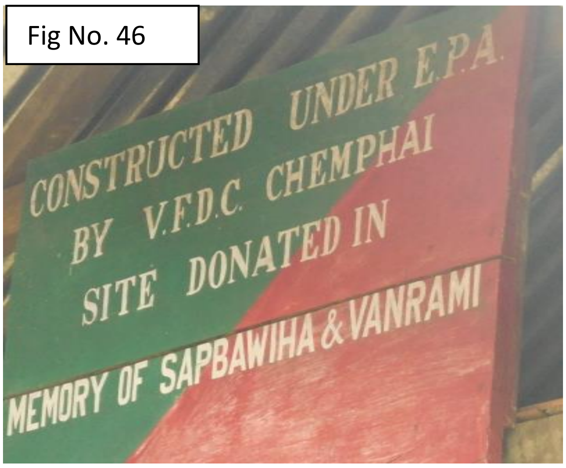

Fig. 41-46 Entry Point Activities (EPA) from the study sites

PHOTO PLATE – 9

Fig No. 47

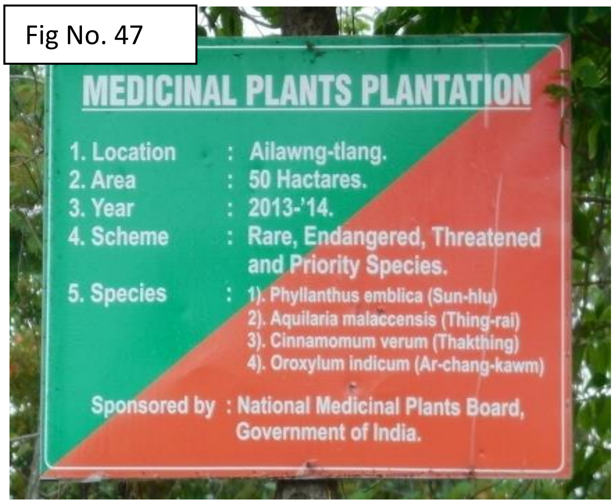

Fig No. 48

Fig No. 49

Fig No. 50

Fig No. 51

Fig No.52

Fig. 47-52 VFDC plantation from the study sites

PHOTO PLATE – 10

Fig No. 53

Fig No. 54

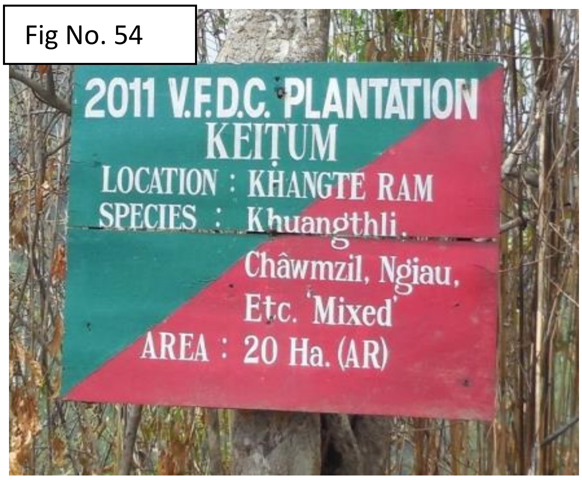

Fig No. 55

Fig No. 56

Fig No. 57

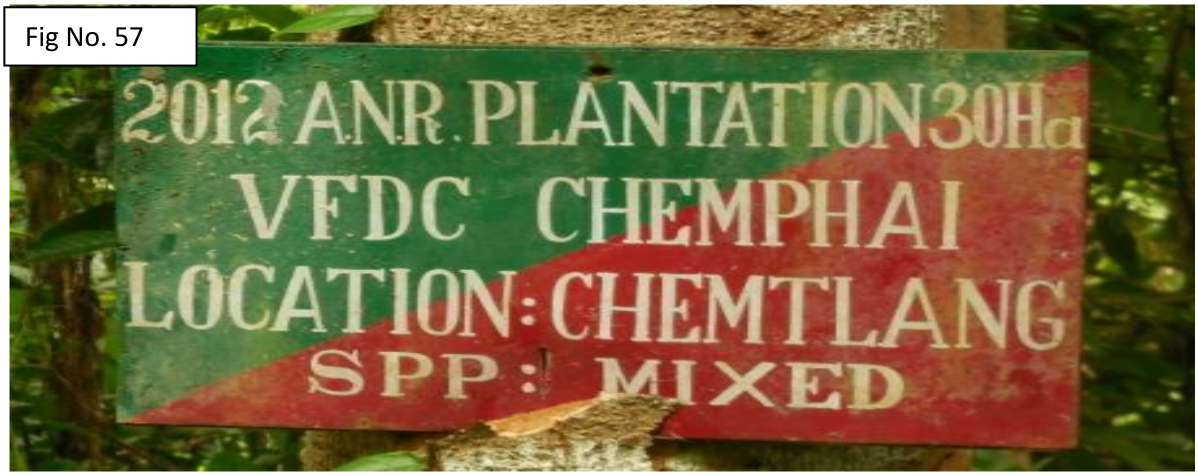

Fig. 53-57 VFDC plantation from the study sites

APPENDIX-2

Table 1 Information about Aizawl FDA plantation area (LLI - Lungleng I, MTH-Muthi, ALG- Ailawng, SVP-Sihphir Vengpui, SMH-Sumsuih)

ATTRIBUTES	AIZAWL FDA				
	LLI	MTH	ALG	SVP	SMH
VFCD PLANTATION SITE					
Location	Bel lei ram	Hmun huai	Ailawng tlang	Rophum ram	Hrianghmun ram
Area (ha)	40	30	50	55	20
Date of plantation	2004	2011	2004	2008	2007
Name of species planted	*Tectona grandis, Mesua ferrea, Toona ciliata, Michelia champaca*	*Bischofia javanica, Michelia champaca*	*Melocanna baccifera, Phyllanthus emblica, Cinnamomum zeylanicum, Oroxylum indicum*	*Parkia roxburghii, Michelia champaca, Dendrocalamus longispathus*	*Bauhinia variegata, Michelia champaca, Toona ciliata*
Spacing(meter)	2	3	3	4	3
Application of fertilizer, FYM, herbicides/pesticides	-	-	-	-	-
Any indigenous techniques adopted towards soil & water/moisture conservation	-	-	-	-	-
Any gap filling	Yes	Yes	No	Yes	Yes
Any fire protection measure	Fire line cutting	Fire line cutting	Fire line cutting	Fire line cutting	Fire line cutting
Frequency of weeding (per year)	1	1	1	1	2
Method of raising plants	Polypot	Polypot	Polypot	Polypot	Polypot
Average height of the planted species(feet)	5	7	18	5	10
Maximum height of the planted species(feet)	8	15	30	25	20
Minimum height of the planted species(feet)	3	5	1	5	14
Number of species planted per ha	700	550	490	600	550
Who selected the species	Concern department	Concern department	Concern department	Concern department	Concern department
Any voluntary work done	No	Yes	No	No	No
Any social fencing done	No	Yes	No	No	No

Survival percent	60%	80%	75%	80%	60%
Most abundant species in the planted area	*Michelia champaca*	*Michelia champaca*	*Phyllanthus emblica*	*Parkia roxburghii*	*Toona ciliata*
VFDC					
Date of formation	2004	2011	2004	2008	2007
No. of executive members	6	6	6	6	6
No. of NGOs representing VFDC	3	3	3	3	3
Frequency of election	Once in two years	annually	Depend on convenience	Depend on convenience	Depend on convenience
Awareness campaign	Yes	Yes	Yes	Yes	Yes

Table 2 Information about Kolasib FDA plantation area (NDK-New Diakawn, SHP-Saihapui K, CEP-Chemphai, TDH-Thingdawl, SKH-Serkhan)

ATTRIBUTES	KOLASIB FDA				
	NDK	**SHP**	**CEP**	**TDH**	**SKH**
Location	Forest ram	Forest ram	Neon khal chem tlang	Thalna luikam	Ralven kawn
Area (ha)	20	20	20	30	40
Date of plantation	2011	2007	2011	2011	2012
Name of species planted	*Michelia champaca, Tectona grandis*	*Bischofia javanica, Melocanna baccifera*	*Michelia champaca, Bischofia javanica, Lagerstroemia speciosa, Artocarpus chama*	*Tectona grandis, Michelia champaca, Bischofia javanica*	*Michelia champaca, Gmelina arborea, Melocanna baccifera, Tectona grandis, Vernicia montana*
Spacing(meter)	3	2	3	4	2
Application of fertilizer, FYM, herbicides/pesticides	-	-	-	-	-
Any indigenous techniques adopted towards soil & water/moisture conservation	-	-	-	-	-
Any gap filling	Yes	No	No	Yes	Yes
Any fire protection measure	Fire line cutting	Fire line cutting	Fire line cutting	Fire line cutting	Fire line cutting
Frequency of weeding (per year)	2	1	1	1	2
Method of raising plants	Polypot	Polypot	Polypot	Polypot	Polypot
Average height of the planted species(feet)	7	8	12	16	12
Maximum height of the planted species(feet)	20	32	27	20	30

Minimum height of the planted species(feet)	4	10	5	4	7
Number of species planted per ha	500	550	490	600	550
Who selected the species	Concern department	Concern department	Concern department	Concern department	Concern department
Any voluntary work done	No	Yes	No	No	No
Any social fencing done	No	Yes	No	No	No
Survival percent	80%	95%	70%	70%	80%
Most abundant species in the planted area	*Tectona grandis*	*Melocanna baccifera*	*Michelia champaca*	*Michelia champaca*	*Gmelina arborea*
VFDC					
Date of formation	2011	2007	2011	2014	2012
No. of executive members	6	6	6	6	*6*
No. of NGOs representing VFDC	3	3	3	3	*3*
Frequency of election	Depend on convenience	Once in two years	Depend on convenience	Depend on convenience	Once in two years
Awareness campaign	Yes	Yes	Yes	Yes	Yes

Table 3 Information about Champhai FDA plantation area (KZM-Khawzawl Hermon, KWH-Khawhai, KLK- Kawlkulh, HLP-Hliappui, and NGP-Ngopa)

ATTRIBUTES	CHAMPHAI FDA				
	KZM	**KWH**	**KLK**	**HLP**	**NGP**
Location	Chhumliam khawn	Hauhsak ram	Sunhlu mual , Bevuak	Rawkhawn	Sentezel ram
Area (ha)	20	30	50, 80	40	35
Date of plantation	2012	2012	2015	2003	2011
Name of species planted	*Toona ciliate, Michelia champaca, Chukrasia tabularis*	*Pinus kesiya, Gmelina arborea, Toona ciliata, Bischofia javanica*	*Toona ciliate, Michelia champaca, Pinus kesiya, Phyllanthus emblica*	*Persea americana, Clerodendrum colebrookianum, Phyllanthus emblica, Melocanna baccifera, Pinus kesiya, Curcuma longa, Cucurma caesia, Solanum torvum*	*Pinus kesiya*
Spacing(meter)	2	2	4	3	3
Application of fertilizer, FYM, herbicides/pesticides	-	-	-	-	-
Any indigenous techniques adopted	-	-	-	-	-

towards soil & water/moisture conservation					
Any gap filling	Yes	No	Yes	Yes	Yes
Any fire protection measure	Fire line cutting	Fire line cutting	Fire line cutting	Fire line cutting	Fire line cutting
Frequency of weeding (per year)	2	1	2	1	2
Method of raising plants	Polypot	Polypot	Polypot	Polypot	Polypot
Average height of the planted species(feet)	25	20	20	20	6
Maximum height of the planted species(feet)	30	30	30	30	8
Minimum height of the planted species(feet)	1	2	2	2	2
Number of species planted per ha	900	800	500	750	350
Who selected the species	Concern department	Concern department	Concern department	Concern department	Concern department
Any voluntary work done	Yes	Yes	Yes	Yes	Yes
Any social fencing done	No	Yes	No	No	No
Survival percent	80%	90%	90%	95%	98%
Most abundant species in the planted area	*Toona ciliata*	*Gmelina arborea*	*Phyllanthus emblica*	*Persia americana*	*Pinus kesiya*
VFDC					
Date of formation	2012	2012	2013	2003	2011
No. of executive members	11	11	8	16	*6*
No. of NGOs representing VFDC	3	3	3	3	*3*
Frequency of election	Depend on convenience	Once in two years	Depend on convenience	Once in two years	Once in two years
Awareness campaign	Yes	Yes	Yes	Yes	Yes

Table 4 Information about Mamit FDA plantation area (TZL- Tuahzawl, CLT-Chungtlang, CHP-Chhippui, DPH-Dapchhuah, and LET-Lengte)

ATTRIBUTES	MAMIT FDA				
	TZL	CLT	DPH	CHP	LET
Location	Ngai mual	Vantlang ram	Dampui ram	Vantlang ram	Tuahzawl kai
Area (ha)	50	20	50	25	40
Date of plantation	2013	2004	2006	2003	1998
Name of species planted	*Michelia champaca, Toona ciliata*	*Gmelina arborea, Michelia champaca, Tectona grandis*	*Michelia champaca, Gmelina arborea, Parkia roxburghii*	*Michelia champaca, Gmelina arborea*	*Bischofia javanica, Tectona grandis, Toona ciliata, Gmelina arborea*

Spacing(meter)	2	3	2	3	4
Application of fertilizer, FYM, herbicides/pesticides	-	-	-	-	-
Any indigenous techniques adopted towards soil & water/moisture conservation	-	-	-	-	-
Any gap filling	Yes	No	Yes	Yes	Yes
Any fire protection measure	Fire line cutting	Fire line cutting	Fire line cutting	Fire line cutting	Fire line cutting
Frequency of weeding (per year)	2	1	2	2	2
Method of raising plants	Polypot	Polypot	Polypot	Polypot	Polypot
Average height of the planted species(feet)	5	15	30	35	35
Maximum height of the planted species(feet)	8	20	40	50	40
Minimum height of the planted species(feet)	2	5	15	20	30
Number of species planted per ha	350	500	1200	700	1000
Who selected the species	Concern department	Concern department	Concern department	Concern department	Concern department
Any voluntary work done	Yes	Yes	Yes	Yes	Yes
Any social fencing done	No	No	No	No	No
Survival percent	50%	90%	50%	95%	70%
Most abundant species in the planted area	*Michelia champaca*	*Gmelina arborea*	*Michelia champaca*	*Michelia champaca*	*Gmelina arborea*
VFDC					
Date of formation	2013	2004	2005	2003	1998
No. of executive members	6	6	7	6	*7*
No. of NGOs representing VFDC	3	3	3	3	*3*
Frequency of election	Depend on convenience	Once in two years	Depend on convenience	Depend on convenience	Depend on convenience
Awareness campaign	Yes	Yes	Yes	Yes	Yes

Table 5 Information about Thenzawl FDA plantation area. (BKT-Baktawng, KTM-Keitum, SLK-Samlukhai, RLT-Ramlaitui, and NLH- Neihloh)

ATTRIBUTES	**THENZAWL FDA**				
	BKT	**KTM**	**SLK**	**RLT**	**NLH**
Location	Vantlang ram	Vaisam tlang	Khangte ram	Kangsah ram	Vantlang ram

Area (ha)	20	10	20	20	20
Date of plantation	2011	2001	1997	2006	2005
Name of species planted	*Michelia champaca, Gmelina arborea, Melocanna baccifera*	*Gmelina arborea, Michelia champaca, Ligustrum robustum, Castanopsis tribuloides*	*Michelia champaca, Gmelina arborea, Toona ciliate, Bischofia javanica*	*Phyllanthus emblica, Cinnamomum zeylanicum, Tectona grandis*	*Gmelina arborea, Melocanna baccifera*
Spacing(meter)	3	3	2	3	4
Application of fertilizer, FYM, herbicides/pesticides	-	-	-	-	-
Any indigenous techniques adopted towards soil & water/moisture conservation	-	-	-	-	-
Any gap filling	Yes	Yes	Yes	Yes	Yes
Any fire protection measure	Fire line cutting	Fire line cutting	Fire line cutting	Fire line cutting	Fire line cutting
Frequency of weeding (per year)	2	2	2	2	2
Method of raising plants	Polypot	Polypot	Polypot	Polypot	Polypot
Average height of the planted species(feet)	20	10	10	10	14
Maximum height of the planted species(feet)	30	15	35	33	27
Minimum height of the planted species(feet)	10	5	5	2	10
Number of species planted per ha	500	1000	1200	750	1150
Who selected the species	Concern department	Concern department	Concern department	Concern department	Concern department
Any voluntary work done	Yes	Yes	Yes	Yes	Yes
Any social fencing done	No	No	No	No	No
Survival percent	80%	90%	50%	85%	70%
Most abundant species in the planted area	*Gmelina arborea*	*Castanopsis tribuloides*	*Gmelina arborea*	*Tectona grandis*	*Melocanna baccifera*
VFDC					
Date of formation	2011	2001	1997	2006	2005
No. of executive members	5	5	5	6	*7*
No. of NGOs representing VFDC	4	3	3	3	*3*
Frequency of election	Depend on convenience	Once in two years	Depend on convenience	Depend on convenience	Depend on convenience
Awareness campaign	Yes	Yes	Yes	Yes	Yes

List of paper publication arising out of the thesis work:

1. **K. Lalhmingsangi** and U.K. Sahoo (2016) .Utilization of Non-timber forest products from village Plantation forests managed by Aizawl Forest Development Agency, Mizoram, India. *Research Journal of Agriculture and Forestry Sciences*, Vol. 4(8): 1-9.
2. **K. Lalhmingsangi** and U.K. Sahoo (2018). Dependence on Non-Timber Forest Products from community forest as a safety net for livelihood security among the villagers of Mamit district, Mizoram, Sustainable Horticulture Vol. 2, Food Health and Nutrition. ISBN-9781771886499.
3. **K. Lalhmingsangi** and U.K. Sahoo (2018). Impact of Joint Forest Management (JFM) to the Fringe Community's Livelihood of Kolasib District, Mizoram, North-East India. Biodiversity Appraisal, Monitoring and Utilization, Pages: 1-11. ISBN 978-81-7910-568-9.

Personal information:

Name : K.Lalhmingsangi

Date of Birth : 26th March 1989

Sex : Female

Marital status : Single

Father's name : K. Lalchhunga

Mother's name : R. Lalsangluaii

Email id : sangsangikholhring@gmail.com

Contact No. : 91-8730924536

PhD registration No and date : MZU/Ph.D./655 of 02.05.2014

Topic of research : Production, Utilization and Marketing of Non Timber Forest Products in Joint Forest Management in Mizoram.

Department : Department of Forestry

Supervisor : Prof. U.K. Sahoo

Academic records:

Name of Exam	**Year of Passing**	**Subject**	**Board/ University**	**Percentage**
PhD Course work	2014	Recent advance in Forestry, Research Methodology, Indigenous practices of medicinal plants	Mizoram University	80%
Post Graduate (Botany)	2013	Plant Science and Herbal Wealth (PSHW)	Bangalore University	71.45%
Under Graduate (Botany honour)	2011	Botany, Environmental studies, Chemistry, Zoology	Mizoram University	65.13%
HSSLC	2008	English, Mizo, Physics, Chemistry, Biology	Mizoram Board of School Education	54%
HSLC	2006	English, Mizo, Mathematics, Science, Social science, Information Technology	Mizoram Board of School Education	65.2%

List of paper publication:

1. **K. Lalhmingsangi** and U.K. Sahoo (2016) .Utilization of Non-timber forest products from village Plantation forests managed by Aizawl Forest Development Agency, Mizoram, India. *Research Journal of Agriculture and Forestry Sciences*, Vol. 4(8): 1-9.
2. **2. K. Lalhmingsangi** and U.K. Sahoo (2018). Dependence on Non-Timber Forest Products from community forest as a safety net for livelihood security among the villagers of Mamit district, Mizoram, Sustainable Horticulture Vol. 2, Food Health and Nutrition. ISBN-9781771886499.
3. **3. K. Lalhmingsangi** and U.K. Sahoo (2018). Impact of Joint Forest Management (JFM) to the Fringe Community's Livelihood of Kolasib District, Mizoram, North-East India. Biodiversity Appraisal, Monitoring and Utilization, Pages: 1-11. ISBN 978-81-7910-568-9.

List of papers presented in conference and symposium:

1. National conference on Green Wealth -a strategy for health (27th-28th February, 2013) at Mount Carmel College (Autonomous), Bangalore, Karnataka, India. Topic-Estimation of antioxidant activity in selected medicinal plants using DPPH and phenolics from North east India.
2. International Symposium on Sustainable Horticulture 2016, Mizoram University, Aizawl, India 14th-16th March, 2016. Topic-Dependence on Non-Timber Forest Products from community forest as a safety net for livelihood security among the villagers of Mamit district, Mizoram.
3. International conference on Global Biodiversity, Climate Change and Sustainable Development (ICBCS-2016) held on 15-18th October 2016 at Rajiv Gandhi

University, Itanagar, Arunachal Pradesh, India. Topic- Social benefits from Non Timber Forest Products among the villagers of Champhai district, Mizoram.

4. International conference on Natural Resource management and Technology Trends (ICNRM-17) held on 27-29th March, 2017 at Manipur University, Imphal, Manipur, India. Topic- Impact on Joint Forest Management (JFM) to the Fringe Community's Livelihood of Kolasib district, Mizoram, North-east India.

Seminar, conference and workshop attended:

1. UGC-Sponsored short term course on, 'One Week Workshop on Applied Statistics" from 23rd-28th September, 2013 at Mizoram University.
2. UGC-Sponsored 3 weeks programme on "Interaction Programme for Ph.D Scholars" organized during 23rd September to 12th October, 2013 at Mizoram University.
3. UGC- Sponsored Additional Course on Interaction Programme for Ph.D. Scholars held from 5th- 25th November 2014 by Academic staff college, Mizoram University.
4. National Conference on Ethno botanical Importance in North East India on 13-15th October, 2015 at Mizoram University.
5. One week workshop on Health and Culinary for students, scholars and staff of Mizoram University organized by UGC-Women's Studies Centre, Mizoram University, held during 24th-29th July 2017.
6. Sustainable Mountain Summit-VI, organized by the Integrated Mountain Initiative (IMI) and hosted by Mizoram Sustainable Development Foundation (MSDF) during the period 20th-22nd September, 2017 at Aizawl, Mizoram.

Other courses and programmes attended:

1. Advance diploma course on Medicinal plants and Primary Health Care under Institute of Ayurveda & integrative Medicine (I-AIM), Bangalore.
2. Course on Computer Concepts under National Institute of Electronics and Information Technology (NIELIT).

Declaration

I hereby declared that the above information given is true and relevant.

K. LALHMINGSANGI

ABSTRACT

A study on production, utilization and marketing of non-timber forest products (bamboo, thatch grass, broom grass and medicinal plants) was carried out in jointly managed forest areas of Mizoram. The forest raised under joint forest management by five different Forest Development Agency (FDAs) located in Aizawl, Kolasib, Mamit, Champhai and Thenzawl were selected. Under each FDA, five villages were selected resulting into 25 sites. There are altogether 7,686 household inhabiting 38,906 populations in the study area. In Aizawl FDA, five villages namely Lungleng 1, Muthi, Ailawng, Sihphir vengpui and Sumsuih Village Forest Development Committee (VFDC) were covered consisting of 5,242 populations with 946 household. In Kolasib FDA, five villages viz. New Diakawn, Saihapui K, Chemphai, Thingdawl and Serkhan VFDC and had 7,510 population and 1,511 household. In Champhai FDA the five villages are Khawzawl hermon, Khawhai, Kawlkulh, Hliappui and Ngopa with 12,173 populations and 2,900 household. In Mamit FDA the five villages are Tuahzawl, Chungtlang, Chhippui, Dapchhuah and Lengte with 3,606 population and 756 household. The five villages under Thenzawl FDA are Baktawng, Keitum, Samlukhai, Ramlaitui and Neihloh VFDC with a population of 1,573 and 8,375 household. The inhabitants of the studied area were Mizo community and Riang (Bru). Both primary and secondary data was obtained through semi-structured questionnaire, field observation, personal interview and group discussion with the villagers to generate information on to what extent they are involved in harvesting, processing and marketing of selected NTFPs, their importance, selling price to traders or middleman, prevailing policies and legislation of the area with respect to NTFPs was asked. Semi-structured questionnaire was given to approximately 10% of the household from each villages to provide information on to what extent they involved in

exploitation of NTFPs as well as to know the different benefits they got through community forest *i.e.*, VFDC plantation areas. Socio economic survey, land use pattern, value addition on NTFPs and marketing strategy was also taken into consideration. The spatial distribution, survival, abundance of these NTFPs and practices of harvesting, processing and marketing of these products was studied in details by using Participatory Rural Appraisal (PRA) and field surveys.

The production and pattern of utilization of different NTFP species was performed based on the interview with the harvesters of NTFPs. Detailed information on the harvesting technique, processing involved, parts used and information on the formulation of the medicinal plants were also collected using questionnaire and interview. Vegetative analysis was done using quadrat method. Various attributes of vegetation like frequency, relative frequency, density, relative density, and coverage was calculated according to Zobel *et al*. (1987). Geographical coordinates of each site was recorded using a Global Positioning System (GPS) device. The calculation of UV is also done based on the diversity of uses. The informants were asked to identify the nature and use of selected plants on the basis of three categories (food, medicinal and economic) values. Ethno botanical information on different plants was collected through interviewing local inhabitants from all the twenty five study sites. Data was also collected using semi structured questionnaire and detailed information on the parts used, formulations of the medicinal plants. Similarity index was used to calculate the percentage index of similarities between two sites. The major findings of the studies are mentioned below:

Full time NTFPs exploiter was highest in Kolasib FDA (11.8% household) followed by Mamit FDA (8.6% household), Thenzawl FDA (3% household), Champhai FDA (2% household) and least in Aizawl FDA (1.6% household). Part time NTFPs exploiter was highest in Mamit FDA (70% household) followed by Kolasib and Champhai FDA (62%

household), Thenzawl FDA being the third one with 60% of household engaged in harvesting NTFPs part time and least in Aizawl FDA (46% household). A total of 279 plant species having NTFPs value under 234 genera belonging to 85 families were documented from the 25 study sites. Out of the 279 plant species, 44 species belonged to herbs, 57 shrubs species, 23 climbers, 139 tree species, 10 bamboos and 6 palm species.

Non timber Forest Products utilised by the villagers are broadly classified into six major categories: (a) Bamboo pole and cane, (b) broom grass and thatch grass, (c) edible food and fruits, (d) fuelwood, (e) fodder and (f) medicinal plants. Among the NTFPs groups, broom grass and thatch grass had the highest percentage of household involvement in harvesting (50.4%), followed by fuelwood (46.93%), edible food and fruits (46.4%), fodder (37.2%), bamboo pole and cane (27.4%) and least in medicinal plants (5.12%).

Ten bamboo species belonging to 5 genera and 6 cane species belonging to 5 genera were documented Viz. *Bambusa tulda* Roxb., *Bambusa vulgaris* Schrad.ex J.C.Wendl, *Dendrocalamus longispathus* (Kurz) Kurz, *Dendrocalamus giganteus* Munro, *Dendrocalamus hookeri* Munro, *Dendrocalamus hamiltonii* Gamble, *Melocanna baccifera* (Roxb.) Kurz , *Schizostachyum dullooa*, *Schizostachyum fuchsiamum, Schizostachyum mannii* were the ten bamboo species harvested from the study sites. *Arenga pinnata, Calamus gracilis, Calamus khasianus, Daemonorops jenkinsiana, Melocanna compactiflorus* and *Pinanga gracilis* are the six cane species harvested.

The 26 medicinal plants utilized by the villagers are *Adiantum philippense* L., *Aporosa roxburghii* (Wall.exLindl.) Baill., *Anogeissus acuminata* (Roxb.ex DC) Guill., *Artemisia vulgaris* L., *Benincasa hispida* (Thunb.) Cogn, *Begonia sikkimensis* A. DC. *Blumea lanceolaria* (Roxb.) Druce, *Callicarpa arborea* Roxb., *Cissampelos pareira* Linn., *Costus speciosus* (J.Konig) Sm., *Dendrocnide sinuate* (Blume) Chew, *Elaeagnus* *pyriformis* Hook.f., *Euphorbia royleana* Boiss., *Hedyotis scandens* Roxb., *Homalomena aromatica* (Spreng.) Schott, *Imperata cylindrica* (L). Raeusch., *Jasminum laurifolium* Roxb.ex Hornem., *Litsea monopetala* (Roxb.) Pers, *Lindernia ruellioides* (Colsm.) Pennell, *Mikania micrantha* Kunth, *Molineria capitulate* (Lour.) Herb *Securinega virosa* (Roxb.ex wild.) Baill., *Sapindus mukorossi* Gaertn, *Solanum indicum L*, *Trema orientalis* (L.) Blume and *Vitex glabarta* R.Br. belonging to 21 families.

30 edible food species belonging to 21 families, 11 fruits species belonging to 6 families, 15 fuelwood species belonging to 13 families and 5 fodder species belonging to 3 families are harvested by the villagers. Bamboo pole and cane were harvested maximally (56.6 $kg^{-1}hh^{-1}yr^{-1}$) followed by fuelwood (48.94 $kg^{-1}hh^{-1}yr^{-}$1) edible food and fruits (39.2 $kg^{-1}hh^{-1}yr^{-1}$), fodder (37.8 $kg^{-1}hh^{-1}yr^{-1}$), broom grass and thatch grass (27.8 $kg^{-1}hh^{-1}yr^{-1}$) and medicinal plants have the least quantity harvested (3.76 $kg^{-1}hh^{-1}yr^{-1}$). Fuelwood had the highest amount of consumption as compared to the other NTFPs (42.9 $kg^{-1}hh^{-1}yr^{-1}$) followed by fodder (37.8 $kg^{-1}hh^{-1}yr^{-1}$), bamboo pole and cane (34.8 $kg^{-1}hh^{-1}yr^{-1}$), edible food and fruits (19.4 $kg^{-1}hh^{-1}yr^{-1}$), broom grass and thatch grass (15.2 $kg^{-1}hh^{-1}yr^{-1}$) and least in medicinal plants (3.76 $kg^{-1}hh^{-1}yr^{-1}$). The amount of NTFP sold to the market was highest in bamboo pole and cane (23.8 $Kg^{-1}hh\ ^{-1}yr^{-1}$), followed by edible food and fruits (19.8 $Kg^{-1}hh\ ^{-1}yr^{-1}$), fuelwood (7 $Kg^{-1}hh\ ^{-1}yr^{-1}$) and the least amount of NTFPs sold to the market was broom grass and thatch grass (12 $Kg^{-1}hh\ ^{-1}yr^{-1}$). The monetary value from the NTFPs was highest in edible food and fruits (332 $Rs^{-1}hh\ ^{-1}yr^{-1}$) followed by bamboo pole and cane (326 $Rs^{-1}hh\ ^{-1}yr^{-1)}$, broom grass and thatch grass (212 $Rs^{-1}hh\ ^{-1}yr^{-1}$) and least amount of income from fuelwood with an income of 110 $Rs^{-1}hh\ ^{-1}yr^{-1}$.

Among the NTFPs harvested, some were harvested only for their own consumption while others were sold to the market All the NTFPs excluding medicinal plants are linked to the marketing channel. They are sold to the local market, nearby junction selling point and sometimes sell it to the main town *i.e* Aizawl. Medicinal plants are harvested by the villagers only for their own consumption. Frequency of bamboo was highest in Thenzawl FDA (17.333%) followed by Kolasib FDA (17%), Mamit FDA (13.818%) and least in Aizawl FDA (10.286%). Bamboo density was highest in Mamit FDA (133.585 ha^{-1}) followed by Thenzawl FDA (118.613 ha^{-1}), Kolasib FDA (84.56 ha^{-1}) and least in Aizawl FDA (54.926 ha^{-1}).

Dominance of bamboo in Mamit FDA was 95.170 m^2 ha^{-1} which was the highest, followed by Thenzawl FDA (95.074 m^2 ha^{-1}), Kolasib FDA (94.450 m^2 ha^{-1}) and Aizawl FDA (60.026m^2 ha^{-1}) with the lowest dominance among all the study sites. *Imperata cylindrica* (L). Raeusch. has the highest frequency in Aizawl FDA (42%), followed by Kolasib FDA (34%), Thenzawl FDA (6%) and least in Mamit and Champhai FDA (4%). Abundance was highest in Aizawl FDA (13.762) followed by Kolasib FDA (13.353), Mamit (10.5), Champhai (9) and least in Thenzawl FDA (7.333).

Imperata cylindrica (L). Raeusch. had the highest density in Aizawl FDA i.e. 14450 ha^{-1}followed by Kolasib (11350 ha^{-1}), Thenzawl (1100 ha^{-1}), and Mamit (1050 ha^{-1}) and least in Champhai FDA (900 ha^{-1}). *Thysanolaena latifolia* (Roxb. ex Hornem.) Honda has the highest frequency in Aizawl FDA (32%) followed by Thenzawl FDA and Mamit FDA (30%), Kolasib FDA (28%) and least in Champhai FDA (16%). Whereas abundance was highest in Mamit FDA (4.73) followed by Champhai FDA (4.625), Aizawl FDA (4.375), Kolasib FDA (4.43) and least abundance of broom grass in Thenzawl FDA (3.133). Highest density was found in Aizawl FDA (3500 ha^{-1}) and least in Champhai FDA (1850 ha^{-1}).

Frequency of medicinal plants was highest in Thenzawl FDA (17.82%) followed by Mamit (17.538%), Champhai (16.154%), Aizawl (16.130%) and least in Kolasib FDA

(14.5%). Whereas abundance was highest in Kolasib FDA (5.057), followed by Mamit (4.778), Thenzawl (4.691), Champhai (4.381) and least in Aizawl FDA (4.326) Density of medicinal plants was highest in Kolasib (3100.573 ha^{-1}), followed by Champhai (2304.337 ha^{-1}), Aizawl (2149.801 ha^{-1}), Thenzawl (1842.871 ha^{-1}) and least in Mamit (1913.212 ha^{-1}). Matrix ranking of 25 medicinal plants was done based on different criteria like their availability, production potential, utility, socio-economic and cultural significance, demand and economic return. *Mikania micrantha* Kunth belonging to the family Asteraceae obtained the highest score among all the medicinal plants followed by *Imperata cylindrica* (L). Raeusch. and *Costus speciosus* (J. Konig) Sm. Besides NTFPs, the villagers are also benefited from the assets created under Entry Point Activities (EPA) which gives them the ownership spirit and in turn makes them to participate more in the VFDC activities

From the studies it may be concluded that Joint Forest management (JFM) has supplemented the livelihoods improvement to the villagers in so many ways. NTFPs from the plantation sites are an important source for the forest fringe communities within the study sites. Majority of the villagers are involved in harvesting of different NTFPs for their own consumption in times of short fall of agricultural crops. People tend to have more concern on the timber yielding trees because of the decreasing availability of fuelwood and timber within the village. In some of the sites, the VFDC plantation area which was formerly degraded was now transformed and provides a good ecological restoration. The VFDC plantation sites will be more benefited by the villagers when the planted trees are matured enough for harvesting. For time being they are utilizing only the NTFPs within the plantation sites. The villagers are also benefited from the assets created under Entry Point Activities (EPA) which gives them the ownership spirit and in turn makes them to participate more in the VFDC activities. In one of the VFDC village, *Cucurma longa* L. was harvested and shared equally among the VFDC beneficiaries to put across the idea of benefit sharing mechanism in VFDC. Delaying in receiving of funds is the major constrain in each and every VFDC. In Champhai FDA, the foresters take a chance of giving awareness to the villagers while the weeding was done with them. Awareness and informal discussion conducted among the villagers and the foresters gave better ideas in maintaining the plantation sites and also provide cooperation among them.

Among all the NTFPs broom grass and thatch grass has the highest percentage involvement of the villagers as a whole. This is so because broom grass being one of the basic necessities of each and every household, do not require a hard labour and is easily available. The number of people involves in harvesting bamboo pole and canes are not so high as compared to the other NTFPs and it was mainly harvested for their own consumption. *Bambusa tulda* Roxb, *Dendrocalamus longispathus* (Kurz) Kurz and *Dendrocalamus hamiltonii* Gamble are processed and weaved into different handicrafts and sold in the market. Edible food and fruits provides a good amount of income to the harvesters. Among the 30 food/vegetables species harvested, shoots of *Melocanna baccifera* (Roxb.) Kurz and *Dendrocalamus longispathus* (Kurz) Kurz, contribute the highest in terms of supply and demand by the customers. Even though the monetary benefit from all types of NTFPs may not be as high as compared to the agricultural crops, these NTFPs serve as one of the most important substitute to the villagers as they do not require separate maintenance and can be harvested directly in the fruiting season. Though there were a few concerns reported on VFDC management and small misunderstandings with the forest department, nevertheless JFM provide a good platform for ecosystem restoration *vis-a-vis* meeting various requirements of the people from the forest and to enhance their socio-economic conditions.

*****