DIVERSITY, DISTRIBUTION AND USE OF NON-TIMBER FOREST PRODUCTS IN THE EKATA COMMUNITY FOREST OF NAWALPARASI (EAST), NEPAL

A THESIS SUBMITTED FOR THE PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE MASTER'S DEGREE IN BOTANY

BY

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DECLARATION

I, "Sharada Neupane", hereby declare that this thesis entitled **"Diversity, Distribution and Use of Non-Timber Forest Products in the Ekata Community Forest of Nawalparasi (East), Nepal."** is my original work, and all other sources of the information used are duly acknowledged. I have not submitted it or any part of it to any other universities for any academic award.

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RECOMMENDATION

This is to certify that the Master's thesis entitled "Diversity, Distribution and Use of Non-Timber Forest Products in the Ekata Community Forest of Nawalparasi (East), Nepal." was carried out by Sharada Neupane was under my supervision. The entire work was accomplished based on the candidate's original research work. To the best of my knowledge, the work has not been submitted to any other academic degree. It is hereby recommended for acceptance of this dissertation as part of the requirement for a Master's Degree in Botany at the Institute of Science and Technology, Tribhuvan University, Kathmandu, Nepal.

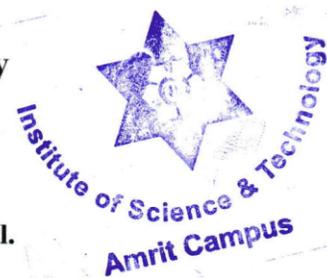**Yadav Uprety, Ph.D.**

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ACRONYMS AND ABBREVIATIONS

CBD   : Convention on biological diversity

CEAPRED   :   Center for Environmental and Agricultural Policy Research, Extinction and Development

FAO   :   Food and Agriculture organization

F_{ic} :   Informant consensus factor

FL   :   Fidelity level

GDP   :   Gross domestic product

KATH   :   National Herbarium and Plant Laboratories

LNP   :   Langtang National Park

NTFPs   :   Non -timber forest products

RC   :   Relative Cover

RD   :   Relative Density of species

RF   :   Relative Frequency

RRA   : Rapid Rural Assessment Appraisal

Sp.   :   Species

ABSTRACT

Non-Timber Forest Products (NTFPs) include all biological products, and services except timber, that are derived from forests, grasslands, pasturelands, manmade habitat and other habitats. In Nepal, hundreds of species are used as NTFPs which include food, medicine, fiber, spices, aromatic herbs, oils, cosmetics, bamboos and construction materials, which have considerable conservation and economic values. This study was carried out to find the baseline information on diversity, distribution and use of NTFPs in the Ekata community forest of Nawalparasi (East) district. The study was done by extensive field visits along with a questionnaire survey and group discussion with local people. Importance value index and Simpson's index of diversity and Shannon's diversity indices were calculated for ecological study. Forest were mainly dominated by *Shorea robusta*. A total of 59 species of NTFPs were recorded belonging to 35 families, of which 40 species were used for medicinal purposes, followed by 18 species used for food and vegetable, 2 species for fiber and spices, one species each for aromatic and dyes. Informant consensus factor (F_{Ic}) and fidelity level (FL) were calculated to estimate the use variability of medicinal plants. Stomach problems, cough, cold, fever, headaches, cuts and wounds, have low informant consensus factor and respiratory problems, jaundice and toothache have highest informant consensus factor. Fidelity level (FL) value for the medicinal plants ranges from 13.7 to 100 percent. The study determines *Cuscuta reflexa, Calotropis gigantea, Cheilanthes dalhosiae,* and *Euphorbia hirta* have 100 percent value. *Centella asiatica* has 13.7 percent of fidelity for treatment of blood pressure. *Shorea robusta* (IVI 150.6)*, Mallotus phillipensis* (IVI 6.38), *Terminalia alata* (IVI 9.6), *Phoenix humilis* (IVI 47.56) were the dominant plant species. *Alstonia scholaris* (IVI 0.48), *Terminalia chebula* (IVI 1.10), *Remusatia vivipara* (0.75), *Tinospora sinensis* (IVI 1.42) have low IVI and diversity. Plants had low IVI and diversity should be conserved. Domestication of rare and valuable resources can help in the conservation of wild and endangered species. In the study, Shannon Weiner's index (H) and Simpson's index (D) of diversity was found maximum for herbs (2.17 and 0.88) followed by shrubs (1.48 and 0.8) and trees (0.66 and 0.22).

Keywords: *NTFPs, Ekata community forest, Nawalparasi (east), Informant consensus factor, fidelity level*

सारांस

गैर काष्ठ वन पैदावार (NTFPs) अन्तर्गत जडीबुटी, घाँस, फल, तरकारीहरू, बाँस र बाँसबाट बनेका सामानहरू, वनमौरीको मह, खर आदि पर्दछन् जुन हामीले वन, घाँसे मैदान, बारी तथा घरको सेरोफेरोबाट प्राप्त गर्न सक्छौँ। यस्ता पैदावारको दिगो उपयोगले स्थानीय समुदायको जीवनस्तर सुधार्न मदत गर्दछ। स्थानीय समुदायहरुले वनबाट जडीबुटी, फल तथा तरकारीहरू, मसला, मह जस्ता उत्पादनहरु प्रयोग गरिरहेका छन्। यस अध्ययनमा पैदावारहरुको अवस्था, विविधता र प्रयोगविधी सम्बन्धी खोज अनुसन्धान गरिएको छ। यस अध्ययनको क्रममा एकता सामुदायिक वन, देवचुली नगरपालिका, नवलपरासी (व. सु. पू.) मा साल, साज, थाकाल, अम्रिसो जस्ता गैर काष्ठ वन पैदावार तथा हर्रो, गुर्जो, कुरिलो, गुर्जगानो जस्ता महत्वपूर्ण जडिबुटीहरू रहेको पाइयो। यस अध्ययनमा ५९ प्रकारकागैर काष्ठ वन पैदावार (NTFPs) प्राप्त भए जसमध्ये ४० जडीबुटी, १८ प्रकारका फल तथा तरकारीहरू, दुई प्रकारका मसला र १-१ प्रकारका रङ्ग र धूप बनाउने वनस्पति भेटिए | औषधिजन्य वनस्पतिहरुको informant consensus Factor(Fic) र fidility level (FL) पनि निकालिएको छ। Stomach problems, Cough, Cold, Fever, headaches, cuts and wounds, जस्ता रोगहरूका लागि Fic कम रहेको पाइयो भने respiratory problems, jaundice and toothache जस्ता रोगका लागि Fic धेरै पाइयो। त्यस्तै जडिबुटीको fedility level १३.६ % देखी १००% छ। जसमा आकाशबेली, आँक, दुधे घाँस तथा रानीसिन्कीको fidelity level १००% छ। *Cuscuta reflexa, Calotropis gigantea, Cheilanthes dalhosiae*, and *Euphorbia hirta* जस्ता वनस्पतिको 100% fidility level र *Centella asiatica* को 13.7 percent fidility level पाइयो। यँहा साल (IVI १५०.६), सिन्दुरे (IVI ६.३८), थाकल (IVI ४७.५६) जस्ता बनस्पतिहरु, प्रसस्त मात्रामा छन्। छतीवन (IVI १०.४८), हर्रो (IVI 1. १०), जलुका (IVI ०. ७५) गुजरगाना (IVI १.४२) जस्ता बनस्पतिहरु निम्न मात्रामा छन। यस अध्ययन अनुसार ठुला रुखक तुलनामा साना बिरुवाको Shannon Weiner's index (H) र Simpson's index (D) धेरै रहेको छ।

Keywords: गैर काष्ठ वन पैदावार (NTFPs), एकता सामुदायिक वन, देवचुली नगरपादलका, नवलपरासी (व.सु.पू.),Informant consensus factor, fidelity level

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CHAPTER ONE: INTRODUCTION

1.1 Background

Non-timber forest products (NTFPs) refer to all biological products and services except timber, that are derived from forests, grasslands, pasturelands, manmade habitat and other habitats (FAO, 1999; Gubhaju and Ghimire, 2009). These products play an important role in the livelihood of rural population. NTFPs encompass a wide range of resources that are harvested from forests and other natural ecosystems. These are not limited to food, medicine, fibers, resins, essential oils and handicrafts. NTFPs are an integral part of the livelihood supporting system in Nepal. NTFPs play an important role in the livelihood of the rural population through income generation, which helps to meet their basic needs. The use and trade of NTFPs in Nepal has become an important strategy for poverty reduction and it also can help in the conservation of forests (Ghimire, 2008). Globally, significant number of rural population depends on NTFPs for livelihoods (Shrestha *et al*., 2020). About 1.6 billion rural population depend on forests to some extent (Chao, 2012), where forests make up 22.2% of household income in developing countries (Angelson *et al*., 2014). The socio-economic, environmental and commercial values of NTFPs are in existences. In Nepal NTFPs contributes substantially to the national and local economy.

NTFPs provide raw materials for industries like dye, paper, chemicals, medicine, etc. Herbal plants are a useful source of Ayurvedic medicine, which is largely used by rural communities, and in turn, these were a useful source of homeopathic medicine. The forestry sector in Nepal has contributed about 15 percent of total GDP and among which 5 percent is contributed by NTFPs (Ghimire *et al*., 2008). In Nepal, the total number of NTFPs are not known but the estimates show that there are over 2000 species are useful (Ghimire *et al*., 2008). Community forest program is playing a major role in proper management and conservation of NTFPs in Nepal. NTFPs provides important community needs for improved rural livelihood. Involving local communities in the management and decision making process can support biological diversity and other conservation objectives (FAO, 1995).

Categorization of NTFPs according to their use helps to understand the role and potential of these products to contribute to livelihood and conservation objectives.

Different roles imply quite different potentials and indicate the need for different kinds of intervention (Belcher *et al*., 2005). NTFPs are commonly grouped into medicine, food and vegetables, spices, aromatic herbs, oils, and cosmetics. It can be categorized based on their use value, use part and their distribution (Pyakurel and Baniya, 2011). Commercialization of MAPs, wild food, vegetables, and honey is an important source of income for many household (Byron and Arnold, 1999). These products are traded both locally and globally and they generate a substantial amount of income for the country. Nepal is a major exporter of herbal medicinal plants. About 90 percent of traded NTFPs are exported to India largely in row form (Edwards, 1996).

NTFPs documentation is done by documenting traditional knowledge and utilization of NTFPs by local people. The documentation of various uses of NTFPs is essential because it provides choices and helps to improve economic conditions of local people by exploring more market values and potential (Uprety *et al*., 2010).

NTFPs can play a crucial role in the conservation of the forest and biodiversity. The sustainable use of these products can provide an incentive for communities to conserve forests and their resources (Evans, 1993). When communities have a financial interests in the preservation of the forest ecosystems, they are more likely to take steps to ensure their sustainable use and management. In this way, the sustainable harvesting of NTFPs can help conserve biodiversity and protect important ecological processes such as nutrient cycling, water regulation, and carbon sequestration. However, the unsustainable harvest of NTFPs can also have negative impacts on biodiversity, particularly when the harvest is not properly managed. Over- harvesting, destructive harvesting practices, and habitat degradation can all contribute to the loss of biodiversity and ecosystem services (Ehrlich and Daily, 1993). It is therefore important to ensure that NTFP harvesting is carried out sustainably and in a way that supports biodiversity conservation.

There are various issues related to the conservation and sustainable use of NTFPs. These are over- harvesting, habitat destructions, loss of traditional knowledge, poverty, and lack of marketing information. To address these issues, Nepal has implemented several policies and initiatives aimed at promoting the sustainable use of NTFPs (Ojha, 2000). These include the development of community forestry programs, which

empower local communities to manage their forest resources sustainably, and the establishment of protected areas to conserve important ecosystems and wildlife species.

The government has also taken steps to regulate the harvest and management of valuable NTFPs and manage to control revenue coming from them, ensuring that it is carried out sustainably and legally (Edwards, 1996; Baral, 1998). For instance, the Federation of Community Forestry Users Nepal has been working to promote community-based forest management and the sustainable use of NTFPs. Community forest programs have been playing an important role in the conservation of valuable forest resources. Community forest program also helps to alleviate poverty as well as improve the general livelihood and socioeconomic condition of the Nepalese people (Dongol *et al*., 2002; Acharya, 2003).

1.2 Research questions

The following are the research questions that the present research answer:

1. What is the status of NTFPs in the Ekata community forest of Nawalparasi (East) district?
2. How many plant species are used as NTFPs?
3. What is the ecological status of NTFPs?

1.3 Objectives

The overall aim of the study is to have an inventory study on NTFPs in the Ekata community forests of Nawalparasi (East) district.

1. To enumerate the locally available NTFPs in the study site.
2. To find the baseline information on the distribution and conservation status of NTFPs in Ekata community forest of Nawalparasi (East) district using ecological methods.
3. To documents indigenous knowledge on utilization of the NTFPs (medicinal plants, fiber, food, spices, dyes, ornamental, handicrafts etc.).

1.4 Statements of problems

NTFPs are very important components of rural livelihood used in the household level. NTFPs are used by local people for traditional purposes and also as a source of income. A detailed study of NTFPs should be done for management, sustainable harvesting, use and commercialization of NTFPs which is important for socio-economic development, poverty reduction, and livelihood enhancement of rural people in Nepal. NTFPs are also an important part of biodiversity. Sustainable harvesting of NTFPs and its cultivation in farm land can help in the management and conservation of forest resources (Larsen and Olsen, 2007).

More NTFPs are collected in remote areas than in the accessible area but bigger quantity is in the accessible areas. NTFPs can play an important role in biodiversity conservation, particularly in developing countries like Nepal, Where they are a crucial source of livelihood for many rural communities. Sustainable harvesting practices of NTFPs can promote the conservation of forest ecosystems, maintain biodiversity, and contribute to poverty reduction (Pandey *et al.,* 2016). NTFP resources has been neglected due to skewed management towards the timber resources (Acharya, 2005). NTFPs are important in the sustainable use of forests, help to meet the commercial demands of a very large number of people.

An inventory study on NTFPs involves systematically documenting and assessing the various non-wood forest resources that are collected, harvested, and utilized by local communities and industries. Conducting an inventory study on NTFPs can provide valuable information for conservation efforts, sustainable management, and economic development. An inventory study on NTFPs requires a multidisciplinary approach, involving expertise from fields such as ecology, anthropology, economics, and policy. The goal is to better understand the ecological, economic, and cultural dimensions of these valuable forest resources and to promote their sustainable use and conservation.

An inventory study of NTFPs on community forests of the Chure region of Nawalparasi (East) district is needed to find out the status and diversity of NTFP species, their uses, harvesting procedure, and estimate economic profit. This will help to examine local people's dependency on these resources and their potential. Furthermore traditional use and conservation practices will help to deploy better conservation plans.

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CHAPTER TWO: LITERATURE REVIEW

2.1 Studies conducted regarding NTFPs

NTFPs encompasses a wide range of obtained from forests, excluding traditional timbers and wood products. These products can include foods, medicinal plants, resins, fibers, and various other plant and animal products.

Research and study related to NTFPs flourished after 1990 in Nepal. Some of the works done with collection, management, utilization and marketing of the plant are mentioned below in chronological order.

Malla *et al*. (1993) has estimated two important NTFPs *Rheum austral* and *Asparagus racemosus* in term of trade in Rasuva and Makawanpur Districts.

Edward (1996) described the different aspects of NTFPs in Nepal in his book of title 'Non-timber forest products from Nepal: Aspects of the trade in medicinal and aromatic plants.

Amatya (2003) found that in Makawanpur District 100 tons of Lichens, 45 tons of *Pinus* species, six tons of *Swertia chirayita* (Roxb.) H.Karst., Three tons of *Berginia ciliata*, and one ton of *Asparagus racemosus* are traded but the official data of District Forest Office(now Division Forest Office) shows zero amount of these species.

Bista and Webb (2006) investigated the marketing dynamics and financial benefits gain from the collection of NTFP resources in Baitadi district. They mention that the number of NTFP sold by the collector determines the amount of plant collections and contribution of NTFP resources. They mentioned that about ninety percent of the total income of households comes from NTFPs-related trade. This consumption rate and inappropriate harvesting practices degrade the NTFPs resource.

Poudyal (2007) reviewed the trade potentiality and ecological status of NTFPs in Nepal. They identified ten important NTFPs as very remunerating plant species for commercial promotion. They are *Phyllanthus emblica*, *Matricaria chamomilla*, *Mentha arvensis* in Terai. *Zanthoxylam armatum*, *Cinnamomum tamala*, *Swertia chirayita*, and *Sapindus mukorossi* in Mid-hill and *Valeriana jatamansi*, *Rheum austral*, *Nardostachys grandiflora*, and *Aconitum spicatum* in High-Mountain.

Medicinal plants an important role in the livelihoods of the rural population by providing products for trade, substance and traditional therapies. *Asparagus racemosus*, *Berberis asiatica*, *Cordyceps sinensis, Phyllanthus emblica* possessed the highest consensus factors of medicinal plants. These plants were widely used in traditional therapies (Kunwar *et al*., 2008).

Gubhaju and Ghimire (2009) conducted a survey in Dovan Palpa for the study of diversity of NTFPs in palpa. They recorded one hundred and fourteen species as potentially useful. The study revealded that the important potentially useful species being *Asparagus racemosus*, *Cinnamomum tamala*, *Terminalia alata*, *T. chebula* and *Woodfordia fruticosa*.

Acharya (2012) reported 161 different species of medicinal plants in used by the Magar community of Badagaun VDC, Gulmi district. Most of the species were herbs followed by trees, shrubs and climbers. The leaf and bark of most species were used for medicinal purposes. Easy access to modern medicine and less recognition of traditional healers are the main causes leading to a decrease in interest of the young generation in the use of traditional medicinal practices.

MoFSC (2012) reported over 2,000 species of plants are considered to be potentially useful, including food, nutrition and medicinal plants.

According to Sharma and Kandel (2014) identified 133 species of medicinal plants having use value in buffer zone of Langtang National Park. They found that *Gaultheria fragrantissima* and *Edgeworthia gardneri* were more potential species for commercial production.

Uprety *et al.* (2016) studied the traditional use and management of NTFPs in the Kangchenjunga Landscape. They reported 363 species of NTFPs used by locals and medicinal and edible were the major use categories of NTFPs. Unsustainable harvesting was a main constrain for the management of NTFPs in the Kangchenjunga Landscape.

Sharma *et al.,* (2016) investigated the diversity of NTFPs in India. They recorded 92 plant species out of this 39% were woody species, 50% herbaceous species and 11% grasses. Eighteen trees, nine herbs, four shrubs and one Climber species were recorded as having ethno medicinal importance and they mention that anthropogenic activities directly affect the diversity of NTFPs.

Subedi (1999) analyzed and explored the opportunities and challenges of NTFPs in Nepal. They highlighted the issues related to NTFP trade, management and challenges and made certain recommendations to successfully tackle them. They mention that the current practice of NTFP extraction, production and management practices are not satisfactory.

In the Baghmara Buffer Zone community forest altogether one hundred nine species were identified. *Trewia nudiflora*, *Clerodendrum viscosum*, *Imperata cylindrica* and *Mikania micrantha* were dominant plants (Danekhu, 2019).

Silwal (2020) found 51 medicinal plants in Ramkot village in Kathmandu, to treat different diseases belonging to 38 families. Most of these plants used for the treatment of stomach problem. Most of these medicinal plants were herbs.

Reta *et al*. (2020) studied the contribution of non-timber forest products to household food security and income generation in Ethiopia. Income generation through the collection of NTFP generation is higher than other sources and it also helps in food security.

Lamichhane *et al*. (2021) have prepared a list of 53 different types of NTFPs traded from Jagarkot district mainly to India and Chaina. They have concluded that the increased rate of unsustainable harvest and trade of NTFPs from this area may lead to the depletion of number of species from this area.

Falana *et al*. (2023) found a total of 25 different types NTFPs in Oyo state of Nigeria. Rural households of the state utilized NTFPs as a major source of food and they contributes about 80 percent of household income from their sale. These products contribute in food security and the livelihood of local people through income generation.

2.2 NTFP categories

Non-timber forest products encompass a wide variety of products derived from forests that are not primarily timber. These products can include various plant and animal-based resources gathered from forests, including fruits, nuts, herbs, resins, fibers, medicinal plants and more. Categorization of these products helps to organize them based on their characteristics, uses and economic importance. NTFPs can be grouped into two categories: consumptive and non –consumptive. Consumptive are those which

are utilized at the personal and household level and products which are sold in market. Non-consumptive are related to indirect benefits of sound forest management and promoting ecotourism. With the increased concern about conservation and sustainable management of forest resources in recent decades researchers and development organizations together made an effort to bring NTFPs at the center of discussion (Belcher *et al*., 2005). NTFPs are generally categorized into fiber, medicinal, aromatic, food, resins, spices, ornamental, construction and dyes based on their use value. They could be herbs, shrubs and climbers on habit (Pakurel and Baniya, 2011).

CHAPTER THREE: MATERIALS AND METHODS

3.1 Study area

3.1.1 Location

This study was done in the Ekata community forest located in Devchuli municipality of Nawalparasi (East) District in central Nepal. Devchuli Municipality is located in the southern part of Nawalparasi (East) of Gandaki Province. Ekata community forest covers an area of 125 hectares and located at an elevation of 182m to 689m. It lies in lowland tropical vegetation dominated by Sal (*Shorea robusta*). Amala (*Phyllanthus emblica*), Kurilo (*Asparagus racemosus*), Barro (*Terminalia bellirica*), Harro (*Terminalia chebula*), Saj (*Terminalia alata*) etc. are also found. The study area fall under the Chure range. Nawalparasi (East) possesses a large variety of non-timber forest products. The study area experience warmer climate.
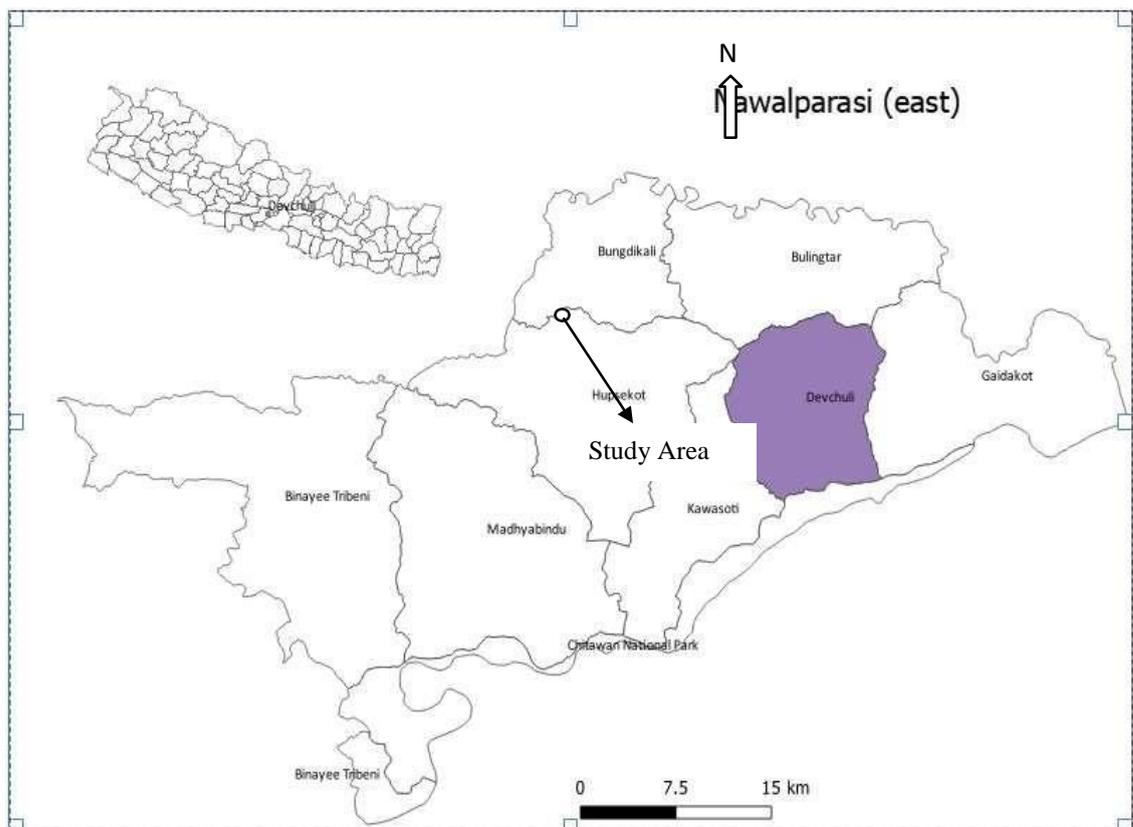
Fig 1: Map of study area.

3.1.2 Physical Features and Climate

Nawalparasi (East) district possesses high geological diversity especially Chure consists of conglomerates, mudstone and sandstone of Neocene age (Pandey, 2009).The altitudinal range of the district varies from 91m to 1936 m have different ecological zones. Soil types varies greatly in this district. Mostly loamy and alluvial soil is dominant one. Mahabharat range and Churiya range in the northern part of the district consists of sandy loamy soil as well as acidic/reddish soil. Soil type found in study area is Sandy soil, having high coarsely bedded stone, crystalline rocks, clays and conglomerate soil. The southern part of the district particularly the Terai region are characterized by sub-tropical climate. It is very hot during the day time. The northern part of the district, particularly Mahabharat range and upper part of the Churia is characterized by warm temperate climate. Rainy season starts from the month of July and lasts until the end of September. The average annual tempreture and rainfall of Devchuli municipality from 2019 to 2023 A.D. by the Department of Hydrology and Meteorology, Government of Nepalis shown in figure below:
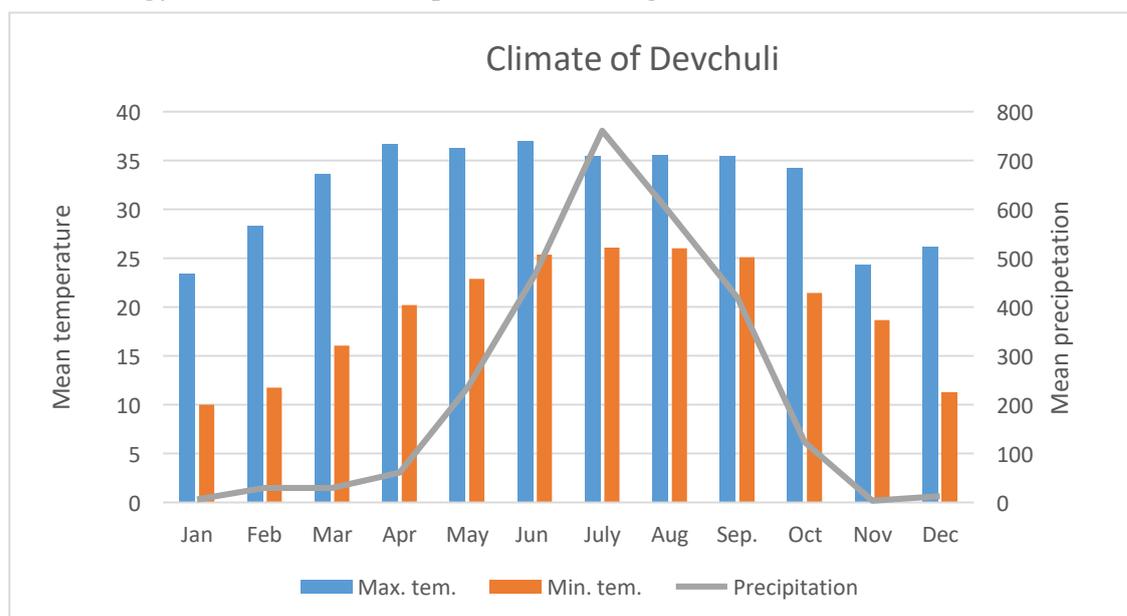
Source: Department of Hydrology and Meteorology

Fig 2: Graph representation of annual mean temperature and precipitation

3.1.3 Biodiversity

Nawalparasi (East) possesses high variation in altitudinal range, climate and land cover, which provides wide range of habitat for plants and animals. Forest is the dominant type of land in the district. Forest resources plays an important role in the improvement of livelihood of rural ethnic community. Sal forest is important forest type in this region. There are 208 community forests in the district. The community forests of the

district are dominated by *Shorea robusta*. It also consists of Saj (*Terminalia alata*), Amala (*Phyllanthus emblica*), Bel (*Aegle marmelos*), Harro (*Terminalia chebula*), Dhayero (*Woodfordia fruticosa*), and Kaniu (*Ficus semicordata*). It also consists of potential diversity of shrub species such as Thakal (*Phoenix humilis*), Amriso (*Thysanolaena maxima*), Asare (*lagerstroemia indica*), Asuro (*Justica adhaltoda*), Bhorla (*Bauhinia vahlii*), Gittha (*Dioscorea bulbifera*), Gurjo (*Tinospora cordifolia*), Kurilo (*Asparegus recemosus*), Rudilo (*Pogostemon bengnalensis*), Bhyakur (*Dioscorea species)* and herbs species like Rani sinka (*Cheilanthes dalhosiae),* Batulpatte (*Cissampelos pareira*), Babeu (*Eulaliopsis binate*), Ghod Tappere (*Centella asiatica*), Niuro (*Dryopteris* sp.) etc.

3.1.4 Socio-cultural diversity

The study area is known for its rich sociocultural diversity, influenced by its geographical, ethnic, and historical factors. It is home to various ethnic groups including Tharu (7.49%), Magar (24.88%), Gurung (2.10%), Newar (3.26%) and Tamang (2.71%). Total population of study area were 2,302 and 507 households. The Tharu people are indigenous to Terai region and have their own unique culture, languages and traditions. Magar community has a significant presence in the district contributing to its cultural diversity. Brahmin and Chhetri are the dominant groups and often hold position in government, education, and other administrative sectors. The languages are linguistically diverse due to the presence of various ethnic groups. Various religions are practiced, contributing to its sociocultural mosaic. Hinduism is the predominant religion, but there are also communities practicing Buddhism, Islam, Christianity, and indigenous beliefs. The Municipality celebrates a multitude of festivals, both Hindu and indigenous. Dashain, Tihar, Holi, and Maghe Sankranti are some of the major festivals celebrated with great enthusiasm. In Tharu communities, festivals like Maghi and Hariyo Bibaha hold cultural significance. Similarly, Magar and Gurungs have their own unique festivals and traditions.

3.1.5 Economy and livelihood pattern

Most people of the municipality depend upon the agriculture. Agriculture is a significant contributor to the economy of Nawalparasi District. The Terai region is fertile and supports the cultivation of crops like rice, wheat, maize, sugarcane, and various fruits. Livestock farming is another important livelihood activity, with

communities raising cattle, buffalo, goats, and poultry for meat, milk, and other dairy products. Educational institutions, health services, and other service-related activities provide livelihood opportunities for the local population. Natural resources, including forests and non-timber forest products, contribute to the livelihoods of local communities, particularly in the rural areas. Some communities engage in cottage industries, such as weaving, pottery, and handicrafts, which contribute to both local consumption and tourism-related sales. Like many parts of Nepal, it also receives a significant amount of remittances from individuals working abroad. These remittances helps in improving the economic conditions of many households.

3.2 Methodology

3.2.1 Inventory study on NTFPs

a) Ethical consideration

The study was conducted from February –April, 20, 2022. Permission for the study was obtained from the committee members of the community forest. Written permission was taken from the committee members of the community forest.

b) Key information interview

The household survey was conducted to access local knowledge about the distribution and diversity of NTFP species in the community forest (Martin, 1995). Fifty households were interviewed. Majority of them were Magar and all of them were age group above 45. Elder people have good knowledge about use, conservation and management of NTFPs. Sharing of these knowledge into young generation will help in proper conservation and management of NTFPs. They are involved in farming, livestock farming, worked in abroad, social works, educational institution and in construction works. Rapid Rural Appraisal, was used to gather, confirm and validate information. In Rapid Rural Appraisal, information was obtained by conduction of semi-structured interviews with small groups of people or with individuals. Members of community forest user groups who used to collect forest products, forest guard and committee members were considered as the Key informants and information about NTFPs were collected through interviewing with them. Interview guidelines were used for focus group discussions at the community level, as well as for interviews with key informants such as local healers, family heads, elders, and community forest heads.

c) Focus group discussion

In focus group discussion method, 4-7 members of senior people of village, local healers, family heads and community forest heads were consulted for collection of information on the use, harvest and trade of NTEPs. A total of three focus group discussions were carried.

3.2.2 Plant collection, identification and herbarium preparation

NTFP species were collected from various sites. Location, altitude, and local area and photograph were taken from study site. Whole part of herbs was taken to show the root and branch was taken for shrubs, trees and climbers. Herbarium were prepared from collected plants. For species that are not identified prepared herbarium was taken to the National Herbarium and Plant Laboratories (KATH) for comparative identification and literature were also be consulted (Hara *et al*., 1982; Hara and Williams, 1979; IUCN, 2000; Press *et al*., 2000).

3.2.3 Variability of Medicinal Plants

Household survey and focus group discussion was conducted to obtain information about medicinal plants. Informant consensus factor (F_{Ic}) and fidelity (FL) was calculated to estimate the use variability of medicinal plants. F_{Ic} is calculated by using following formula (Heinrich *et al*., 1998; Canales *et al*., 2005).

FIC= Nur –Nt/Nur -1

Where Nur is the number of individual plant use reports for particular illness category, and Nt is the total number of species used by all informants for this illness category.

Fidelity level (FL) is the percentage of informants claiming the use of a certain plant for the same major purpose, and it is calculated according to the following formula (Friedman *et al*., 1986).

$$FL = Ip/Iu \times 100$$

Where Ip is the number of informants that claim the use of a plant species to treats a particular diseases and Iu is the number of informants that use the same plant as a medicine to treat any diseases.

3.3 Forest sampling and Ecological data collection

3.3.1 Systematic Sampling Strategy

Field visit were carried out in February and March 2022. Systematic random sampling method was used to collect data. Longitude, latitude and elevation of each plot was recorded by Global Positioning System (GPS). For the primary data collection, field work was done on March 2022. First of all consulted meeting with the forest Management committee was held. Total 25 circular plots were laid down for trees, 25 circular plots were laid down for shrubs and 50 plots were laid down for herbs. Circular plots of 10 meter radius were used for tree species, 5 meter radius for shrubs and saplings and 1 meter radius for herbs and seedlings. Saplings are young trees with diameter less than 5m at breast height and height greater than 1.3m. Seedlings are young plant sporophyte having height less than 1.3m.
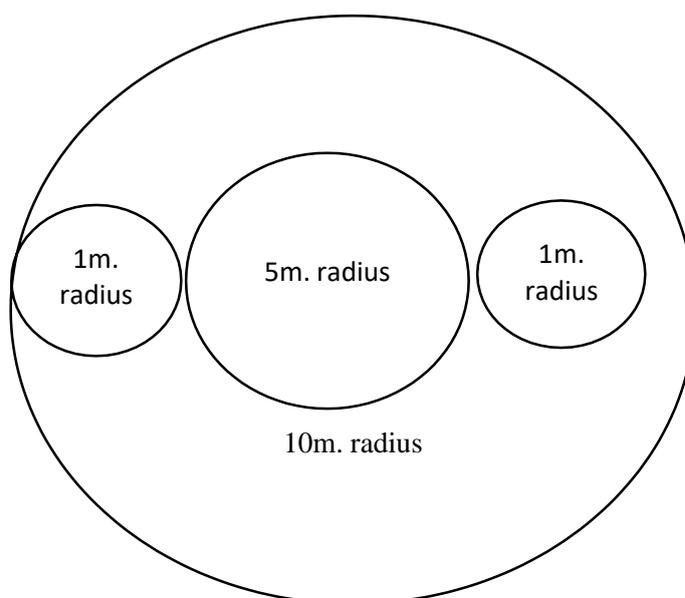
Fig 3: Plot design.

3.3.2 Data analysis

Statistical analysis was carried out by Microsoft excel and GPS data recorded at each study area and GIS were used for preparation of map of the site. The descriptive statistics such as simple density, frequencies and coverage were used for the analysis of quantitative data.

3.2.3 Quantitative Data

Quantitative data of NTFPs obtained from sample plot were analyzed based on the formulae given by (Zobel *et al*., 1987).

Frequency

Frequency is the proportion of sampling units containing the species.

$$Frequency = \frac{No.\ of\ quadrat\ in\ which\ species\ occured}{Total\ no.of\ quadrat\ studied} \text{ x } 100\%$$

$$Relative\ Frequuency = \frac{Frequency\ of\ individual\ species}{Total\ frequency\ of\ all\ species} \text{ x } 100\%$$

Density

Density is the number of individuals per unit area.

$$Density = \frac{Total\ no.\ of\ species\ occured}{Total\ no\ of\ quadrate\ studied} \text{ x } 100\%$$

$$Relative\ Density = \frac{Density\ of\ individual\ species}{Total\ density\ of\ all\ species} \text{ x } 100\%$$

Average Cover

Cover is amount of ground cover by species.

$$Average\ Coverage = \frac{Total\ coverage\ of\ species}{Area\ of\ quadrate\ x\ Total\ no\ of\ quadrat} \text{ x } 100\ \%$$

$$Relative\ Coverage = \frac{Coverage\ of\ individual\ species}{Total\ coverage\ of\ all\ species} \text{x } 100\%$$

Important value index (IVI)

Importance Value was obtained by summation of the relative frequency, relative density, and relative cover as given below.

IVI = RF + RD + RC

Where,

IVI = Importance Value Index of species

RF = Relative Frequency of species

RD= Relative Density of species

RC = Relative Cover of species

Diversity indices

For diversity calculation, Simpsons and Shannon index were calculated. Former tells about dominancy and later denotes diversity having more species and more nearly even distribution of them.

Shannon-Wiener index (H)

It was calculated as:

$$H = - \Sigma \, Pi \, (\ln Pi)$$

Where pi is the proportion of individuals found in species i. For a well-sampled community, we can estimate this proportion as pi = ni/N, where ni is the number of individuals in species i and N is the total number of individuals in the community (Shanon and Wiener, 1949).

Simpson's Index (D)

Simpson index purposed by Simpson in 1949 and can be calculated by using its modified reciprocal form (Peet, 1974) as:

$$\text{Simpson's Index (D)} = \frac{\Sigma \, n(n-1)}{N(N-1)}$$

CHAPTER FOUR: RESULTS

4.1 Taxonomic distribution of NTFPs

The taxonomic distribution of NTFPs from the study area was diverse and spans across multiple categories. Here, 59 potentially important NTFPs were found. These NTFPs belonging to 35 different botanical families.

Table 1: NTFPs recorded in Devchuli municipality.

S.N.	Botanical Family	Common name	Scientific name	Use category	Habit	Used part	Herbarium number
1.	Acanthaceae	Asuro	*Justicia adhatoda* L.	Medicine	Shrub	Leaves	2
2.	Asteraceae	Titepatti	*Artemisia indica* Willd.	Medicine	Herb	Young leaves	4
		Gandhe	*Ageratum conyzoides* L.	Medicine	Herb	Leaves	-
		Bhringraj	*Eclipta prostrata* L.	Medicine	Herb	Whole Plant	6
		Banmasa	*Ageratina adenophorum* Spreng.	Medicine	Herb	Leaves	9
3.	Amaranthaceae	Datiwan	*Achyanthes aspara* L.	Medicine	Herb	Stem	3
4.	Apiaceae	Ghodtapre	*Centella asiatica* (L.) Urb.	Medicine	Herb	Whole plant	5
5.	Arecaceae	Thakal	*Phoenix humilis* Khajuri (Thr.)	Food	Shrub	Fruit	10
6.	Asparagaceae	Kurilo	*Asparagus racemosus* Willd.	Medicine, Food	Herb	Shoot, Rhizome	8
7.	Acoraceae	Bojho	*Acorus calamus* L.	Medicine	Herb	Rhizome	42
8.	Apocynaceae	Chhatiwan	*Alstonia scholaris* R. Br.	Medicine	Tree	Stem	7
		Aank	*Calotropis gigantean* (L.) Dryand.	Medicine	Shrub	Stem	39
9.	Anacardaceae	Aamp	*Mangifera indica* L.	Medicine	Tree	Bark	19

		Amaro	*Spondias pinnata* (L.) Kurz Amora,	Medicine, Food	Tree	Bark	-
10.	Araceae	Jaluka	*Remusatia pumila* (D. Don) H.Li. & A. Hay	Vegetable	Herb	Tender shoot	34
11.	Bombacaceae	Simal	*Bombax ceiba* L.	Medicine	Tree	Flower, Root	-
12.	Combretaceae	Barro	*Terminalia bellirica* (Gaertn.) Roxb.	Medicine	Tree	Fruit, Bark	-
		Harro	*Terminalia chebula* (Gaertn.) Retz	Medicine	Tree	Fruit, Bark	-
		Saj	*Terminalia alata* Heyne ex Roth	Dyes	Tree	Bark	43
13.	Cyperaceae	Mothe	*Cyperus rotundus* L.	Medicine	Herb	Root	41
14	Convolvulaceae	Aakash beli	*Cuscuta reflexa* Roxb.	Medicine	Climber	Whole Plant	38
15	Cryophyllaceae	Abijalo	*Drymaria cordata* (L.) Willd. Ex Schult.	Medicine	Herb	Whole plant	23
16	Dioscoraceae	Gittha	*Dioscorea bulbifera* L.	Food	Climber	Tuber	-
		Ban tarul	*Dioscorea hamiltonii* Hook. f.	Food	Climber	Rhizome	-
17.	Dipterocarpacae	Sal	*Shorea robusta* Gaertn.	Aromatic, Medicine	Tree	Resin	-
18.	Dryopteridaceae	Nyuro	*Dryopteris sp.*	Vegetable	Herb	Young shoot	-
		Kalonyuro	*Dryopteris concolar* (Langsd. & Fish.) Kuhn	Vegetable	Herb	Young shoot	-
19.	Euphorbiaceae	Sindure	*Mallotus philippensis* (Lam.) Muell. Arg.	Medicine	Shrub	Leaves, Bark	36
		Dude ghas	*Euphorbia hirta* (L.) DC.	Medicine	Herb	Whole plant	1
20.	Fabaceae	Koiralo	*Bauhinia variegate* L.	Medicine	Tree	Flower, Bark	35
		Lajjawati	*Mimosa pudica* L.	Medicine	Herb	Root	22

21.	Lamiaceae	Dahichamaile	*Callicarpa macrophylla* Vahl.	Medicine	Shrub	Root, Fruit	11
		Rudilo	*Pogostemon benghalensis* (Burm.f.) Kuntze	Medicine	Shrub	Leaves	13
		Ginari	*Premna barbata Wall. Ex* Schauer	Medicine	Tree	Leaves	33
		Tulsi	*Ocimum sanctum* L.	Medicine	Herb	Leaves	-
22.	Lauraceae	Tej patta	*Cinnamomum tamala* (Buch-Hum.) T. Nees & C.H. Eberm.	Spices	Tree	Bark	12
23.	Leguminosae	Saddhan	*Desmodium oojeinensis* (Roxb.) H. Ohashi	Medicine	Tree	Bark	-
		Bhorla	*Bauhinia vahlii* Wight & Arn.	Food	Climber	Fruit	44
24.	Lythraceae	Dhayero	*Woodfordia fruiticosa* (L.) Kurz	Medicine	Shrub	Flower	32
25.	Menispermaceae	Batulpatte	*Cissampelos pareira* L.	Medicine	Climber	Leaves	16
		Gurjo	*Tinospora cordifolia* (Thunb.) Miers	Medicine	Climber	Whole Plant	-
		Gujar gana	*Tinospora sinensis* (Lour.)Merr.	Medicine	Climber	Rhizome	-
26.	Meliaceae	Neem	*Azadirachta indica* A. Juss.	Medicine	Tree	Leaves	25
27.	Moraceae	Khaniyo	*Ficus semicordata* Buch-Ham. ex Sm.	Food	Tree	Fruit	21
		Kavro	*Ficus lacor* Buch-Ham.	Food	Tree	Young Shoot	31
		Dumbre	*Ficus racemosa* L.	Food	Tree	Fruit	26
28.	Musaceae	Ban Kera	*Ensete glaucum* (Roxb.) Cheesman	Food	Tree	Fruit	-
29.	Myrtaceae	Jamuna	*Syzygium cumini* (L.) Skeels	Food	Tree	Fruit	24
30.	Oxalidaceae	Chariamilo	*Oxalis corniculata* L.	Medicine	Herb	Whole plant	15

31.	Phyllanthaceae	Amala	*Phyllanthus emblica* L.	Food, Medicine	Tree	Fruit	-
32.	Pteridaceae	Ranisinka	*Cheilanthes dalhosiae* Hook	Medicine	Herb	Whole plant	14
33.	Poaceae	Bans	*Bambusa nutans* Wall. Ex Munro	Handicraft, Food	Shrub	Stem	27
		Dubo	*Cynodon dactylon* (L.) Pers.	Medicine	Herb	Whole plant	-
		Amriso	*Thysanolaena Latifolia* (Roxb. Ex Hornem.) Honda	Fiber	Herb	Flower	40
		Babio	*Eulaliopsis binata* (Retz.) C. E. Hubb.	Fiber	Herb	Leaves	30
		Siru	*Imperata cylindrical* (L.) P. Beauv.	Medicine	Herb	Root	17
34.	Rutaceae	Bel	*Aegle marmelos* (L) Correa	Medicine, Food	Tree	Fruit	20
		Mittho neem	*Murraya koenigii* (L.) Spreng.	Spices	Shrub	Leaves	29
35.	Sapotaceae	Chiuri	*Diploknema butyracea* (Roxb) H. J.Lam	Food	Tree	Fruit	28

Most of the species belongs to the family Poaceae with 5 species, followed by Lamiaceae and Asteraceae with 4-4 species in each, and Combretaceae, Menispermaceae, Moraceae families had 3-3 species with each. Apocynaceae, Anacardaceae, Dioscoraceae, Dryopteridaceae, Leguminosae and Rutaceae had 2-2 species in each. Other families had 1-1 species with each (fig. 2).
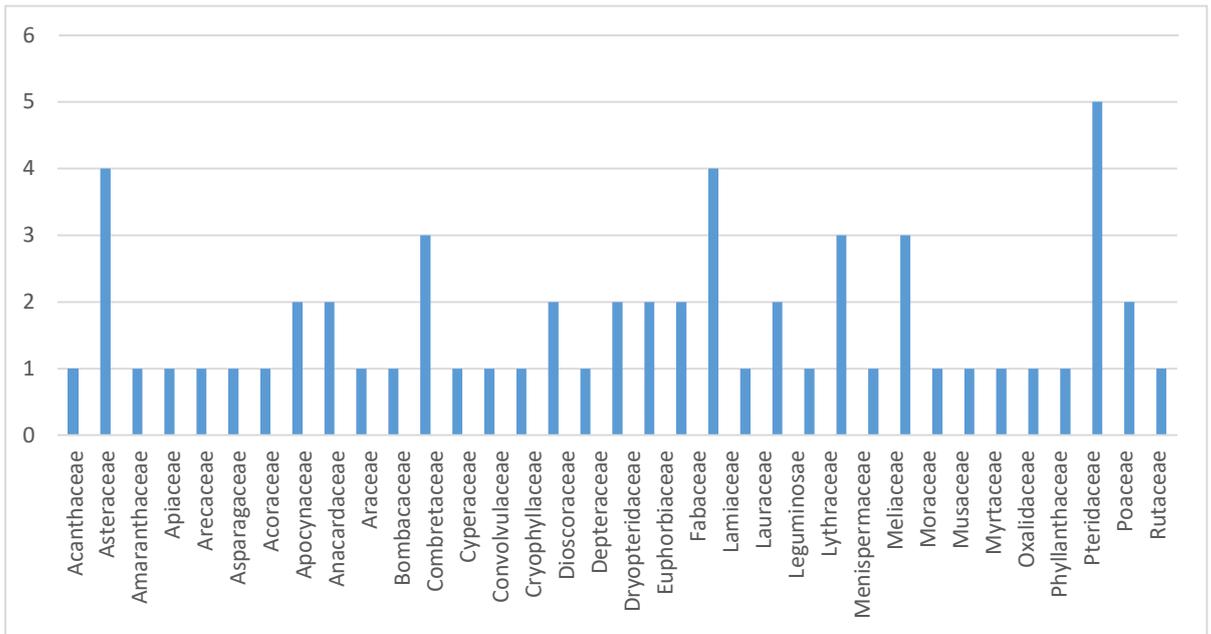
Fig 4: Botanical families of NTFP species.

4.1.1 Life forms of NTFPs

59 species of NTFPs were recorded in the study area, in which 22 species were herbs, 21 trees, followed by 9 shrub species and 7 climbers (Figure 3).
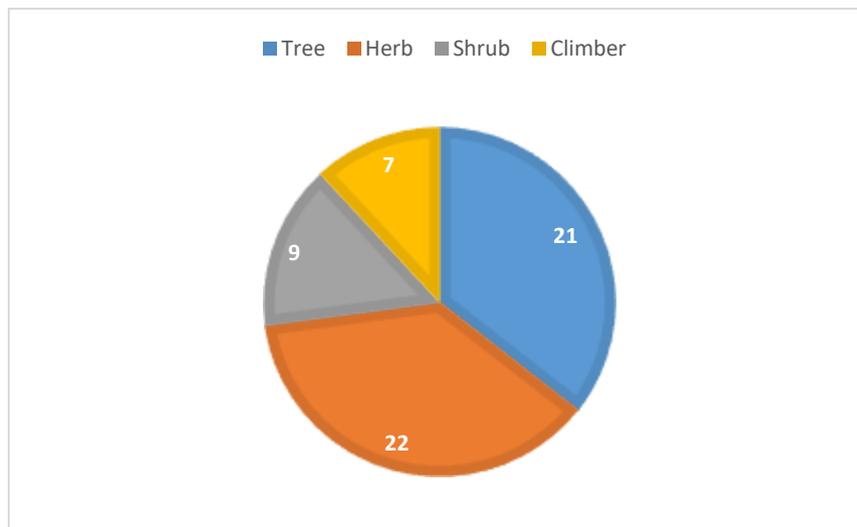
Fig 5: Life form of NTFPs

4.1.2 List categories of NTFPs

Plant species found in this area were used as NTFPs for one or various purposes. They were used as medicine, fiber, food and vegetable, dyes, handicraft, resin, and spices. Forty plant

species were used as medicine, 18 species used for food and vegetables, 2 species for fiber and spices, 1-1 species for aromatic, and dyes (Figure 6).
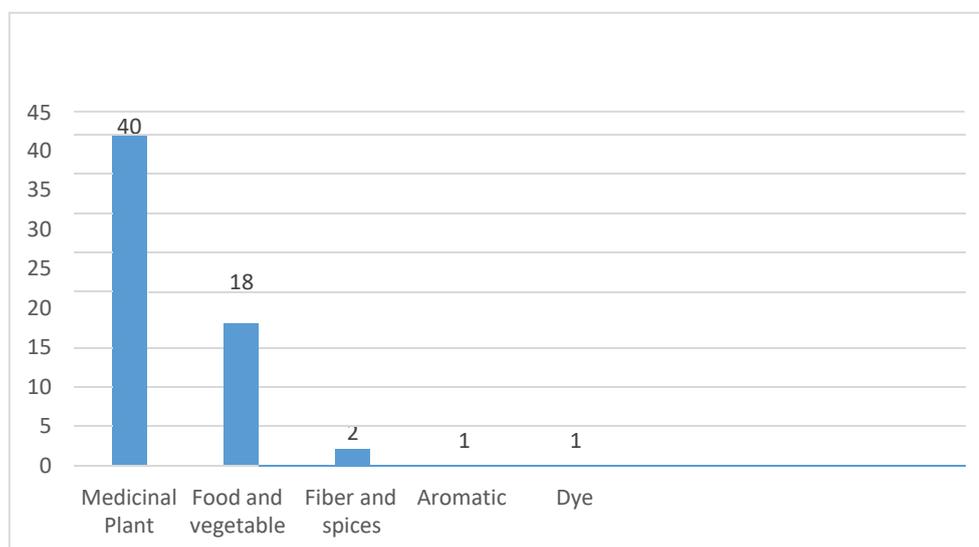
Fig 6: Use purposes of NTFPs.

4.1.3 Used part of NTFPs

Leaves (12 sp.) were the most frequently used part of plants, followed by fruits (10 sp.), bark (8 sp.), whole plants (8 sp.), rhizome (5 sp.), flower (4 sp.), stem (4 sp.), root (4 sp.) and tender shoots (4 sp.). Fruits of 11 species were used for food and medicinal purpose. Flower of plant used for making pickles and for medicinal purpose (Figure 7).
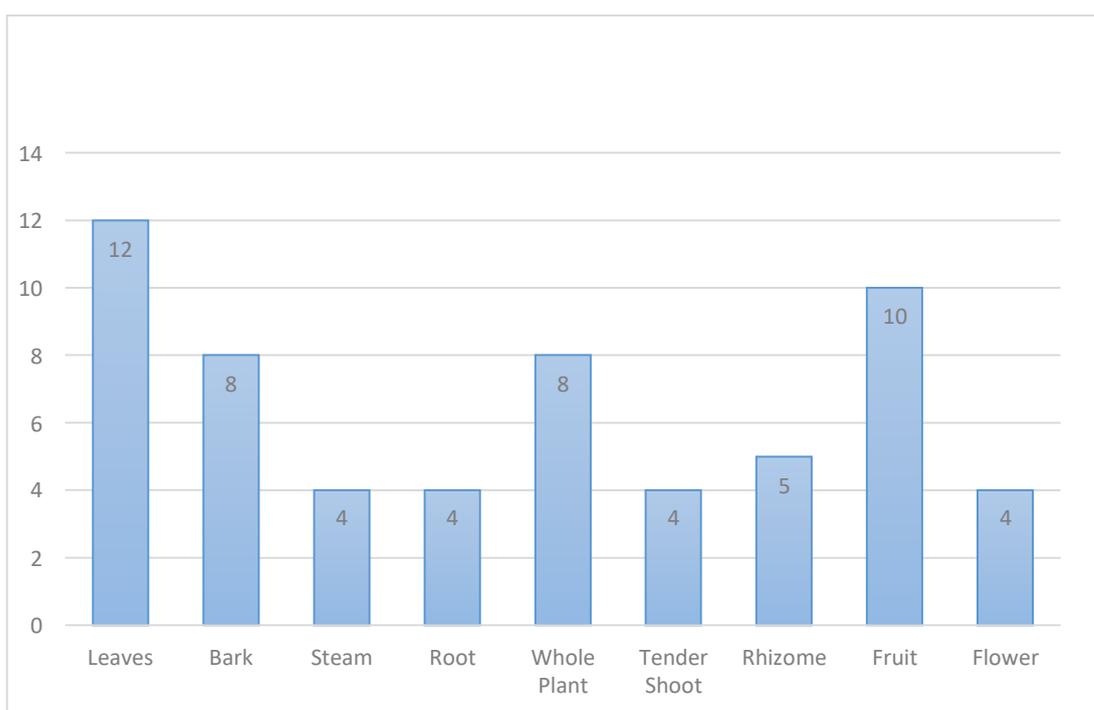
Fig 7: Used part of NTFPs.

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4.2 Medicinal plants

A total of 40 species of various families were used for medicinal purposes. Leaves and bark were the most frequently used part of plant. 14 species used for Diarrhea and constipation, 9 species for cuts and wounds, 1 species for Pregnancy and delivery, 2 species for blood pressure, 3 species for skeleton and muscular, 2 species for Acne/skin disease, 11 species for fever/headaches, 9 species for cough and cold, 1 species for Respiratory problems, 4 species for Uro-genital, 2 species for body cooling and 1species for jaundice were used (Table 2).

Table 2: Medicinal plants recorded in the study area

S. N.	Plant Name	Family	Common Name	Habit	Used part	Mode of use
1.	*Acyanthus aspara* L.	Amaranthaceae	Datiwan	Herb	Stem, root	Stem used in dental problemes, skin diseases, root used in stomach problems.
2.	*Acorus calamus* L.	Acoraceae	Bojho	Herb	Rhizome	Dried or fresh rhizome is chewed in cold and cough.
3.	*Aegle marmelos* (L.) Correa	Rutaceae	Bel	Tree	Fruits	Fruits use in diarrhea.
4.	*Agaratum conyzoides* L.	Asteraceae	Gandhe	Herb	Leaves	Leaves juice applied over cut and wounds to control bleeding.
5.	*Alstonia scholaris* R.Br.	Apocynaceae	Chhatiwan	Tree	Latex	Latex applied on sprain.
6.	*Artimisia indica* Willd.	Asteraceae	Titepati	Herb	Leaves	Leaf paste used in cuts to control bleeding.
7.	*Asparagus racemosus* Willd.	Asparagaceae	Kurilo	Herb	Rhizome and tender shoot	Rhizomes and tender shoots are used as tonic and laxative. Used to increase milk supply.

8.	*Azadirachta indica* A. Juss	Meliaceae	Neem	Tree	Leaf and bark	Leaf and extract is applied for treatment of skin diseases.
9.	*Bauhinia variegate* L.	Fabaceae	Koiralo	Tree	Flower and bark	Flower is used in diarrhea and gastro intestinal diseases.
10.	*Bombax ceiba* L.	Bombacaceae	Simal	Tree	Flower and Roots	Used to treat asthma, diarrhea.
11.	*Callicarpa macrophylla* Vahl.	Lamiaceae	Dahichamale	Shrubs	Fruit and root	Fruit and root paste used in cough, fever and headache.
12.	*Calotropis gigantean* (L.) Dryand.	Apocynaceae	Aank	Shrub	Latex	Latex is applied on sprain, joint pain.
13.	*Centella asiatica* (L.) Urb.	Apiaceae	Gholtapre	Herb	Whole plant	Used in fever, cough and cold, blood pressure.
14.	*Cheilanthes dalhosiae* Hook	Pteridaceae	Ranisinka	Herb	Whole plant	Used in gastrointestinal problems.
15.	*Cissampelos pareira* L.	Menispermaceae	Batulpatte	Climber	Leaves	Used in gastrointestinal problems.
16.	*Cuscuta reflexa* Roxb.	Convolvulaceae	Aakashbeli	Climber	Whole plant	Used to treat jaundice.
17.	*Cyperus rotundus* L.	Cyperaceae	Mothe	Herb	Root	Useful in stomachache.
18.	*Cynodon dactylon* (L.)Pers.	Poaceae	Dubo	Herb	Whole plant	Useful in controlling high blood pressure.
19.	*Drymaria cordata* (L.) willd. Ex Schult.	Cryophyllaceae	Abhijalo	Herb	Whole plant	Used in diarrhea and fever.
20.	*Desmodium ooijeinensis* (Roxb.)H. Ohashi	Leguminaceae	Sadhan	Tree	Bark	Used to treat gastrointestinal problems.

21.	*Eclipta prostrate* L.	Asteraceae	Bhiringraj	Herb	Whole plant	Useful in fever.
22.	*Ageretina adenophora*	Asteraceae	Banmasa	Shrub	Leaf	Used in cuts and wounds.
23.	*Euphorbia hirta* (L.)DC.	Euphorbiaceae	Dudhe jhar	Herb	Whole plant	Useful in cuts to control bleeding.
24.	*Imperata cylindrical* (L.) P. Beauv.	Poaceae	Siru	Herb	Root	Use to treat stomach problems.
25.	*Justicia adhatoda* L.	Acanthaceae	Asuro	Shrub	Young leaves	Useful in fever, cold and cough.
26.	*Mangifera indica* L.	Anacardiaceae	Aamp	Tree	Bark	Used in stomachache.
27.	*Mallotropus philippensis* (Lam.) Muell. Arg.	Euphorbiaceae	Sindure	Tree	Leaf and Bark	Useful in ulcer treatment and wounds, helps in urogenital infection.
28.	*Mimosa pudica* L.	Fabaceae	Lajjawati	Herb	Root	Used in treatment of urogenital diseases, paste applied on wounds.
29.	*Ocimum sanctum* L.	Lamiaceae	Tulsi	Herb	Whole plant	Useful in cough, cold fever and headache.
30.	*Oxalis corniculata*	Oxalidaceae	Chariamili	Herb	Whole plant	Wound healing and anti-inflammatory.
31.	*Phyllanthus emblica* L.	Phyllanthaceae	Amala	Tree	Fruit	Fruit used as diuretic, improves immunity.
32.	*Pogostemon benghalensis* (Burm.f.)Kuntze	Lamiaceae	Rudilo	Shrub	Leaf	Used in cough, fever and headache.
33.	*Premna barbata* Wall. Ex Schauer	Lamiaceae	Gidhari	Tree	Bark	Used in diarrhea and fever.
34.	*Shorea robusta* Gaertn.	Depteraceae	Sal	Tree	Resin	Used to treat headache.

35.	*Spondias pinnata* (L.) Kurz Amora	Anacardiaceae	Amaro	Tree	Bark	Paste applied on rheumatism and muscle pain.
36.	*Terminalia bellirica*	Combretaceae	Barro	Tree	Fruit and bark	Useful in cough, cold and gastrointestinal problems
37.	*Terminalia chebula* (Gaertn.) Retz	Combretaceae	Harro	Tree	Fruit and bark	Used in gastrointestinal problems. Fruit used in cough.
38.	*Tinospora cordifolia* (Thunb.) Miers	Menispermaceae	Gurjo	Climber	Whole plant	Used in diabetes, urinary tract infection and as immunity enhancer.
39.	*Tinospora sinensis* (Lour.) Miers	Menispermaceae	Gurje gano	Climber	Stem	Stem extract used to treatment of fever, urinary diseases.
40.	*Woodfordia fruticosa* (L.) Kurz	Lythraceae	Dhayero	Shrub	Flower	Use for treatment of diarrhea, wounds and cuts.

4.3 Wild edible plants

A total of 18 species were used for food and vegetables. Different parts like Young shoot, tuber, rhizome, Fruits are used as vegetable. Fruits of most species were edible (Table 3).

Table 3: Food and Vegetables used in study area

SN	Plant Name	Family	Common Name	Habit	Use part	Use purpose
1.	*Aegle maramlos* (L.) Correa	Rutaceae	Bel	Tree	fruit	Fruit pulp is use to make juice.
2.	*Asparagus racemosus* Willd.	Asparagaceae	Kurilo	herb	Tender shoot	Tender shoots are used as vegetable.

3.	*Bambusa nutans* Wall. Ex Munro	Poaceae	Bans	Shrub	Young shoot	Young shoot used as vegetable.
4.	*Bauhinia vahlii* Wight & Arn.	Leguminosae	Bhorla	Climber	Fruit	Fruits are eaten raw.
5.	*Diploknemabutyracea* (Roxb) H. J.Lam	Sapotaceae	Churi	Tree	Food	Fruits are eaten raw.
6.	*Dioscorea bulbifera L.*	Dioscoraceae	Gittha	Climber	Tuber	Tuber is use as vegetable.
7.	*Dioscorea humiltonii* Hook. f.	Dioscoraceae	Ban tarul	Climber	Rhizome	Rhizome is use as vegetable.
8.	*Dryopteris concolar* (Langsd. & Fish.) Kuhn	Dryopteridaceae	Kalonyuro	Herb	Young shoot	Young shoots used as vegetable.
9.	*Dryopteris* sp.	Dryopteridaceae	Nyuro	Herb	Young shoot	Young shoots used as vegetable.
10.	*Ensete glacum* (Roxb.) Cheesman	Musaceae	Ban Kera	Tree	Fruit	Fruits are eaten raw.
11.	*Ficus semicordata* Buch-Ham. ex sm.	Moraceae	Khaniyu	Tree	Fruit	Fruits are eaten raw.
12.	*Ficus lacor* Buch-Ham.	Moraceae	Kavro	Tree	Fruit	Young Shoot
13.	*Ficus racemosa* L.	Moraceae	Dumbre	Tree	Fruit	Fruits are eaten raw.
14.	*Phoenix humilis* Khajuri (Thr.)	Arecaceae	Thakal	Shrub	Fruit	Fruits are eaten raw.
15.	*Phyllanthus emblica* L.	Phyllanthaceae	Amala	Tree	Fruit	Fruit is use to make pickle.
16.	*Remusatia pumila* (D. Don) H.Li. & A. Hay	Araceae	Jaluka	Herb	Tender shoots	Tender shoots used as vegetable.
17.	*Spondias pinnata* L.	Anacardaceae	Amaro	Tree	Fruit	Fruit is used to make pickle.
18.	*Syzygium cumini* (L.) Skeels	Myrtaceae	Jamuna	tree	Fruit	Fruits are eaten raw.

4.4 Informant consensus factor (ICF) and Fidelity level of medicinal plants

Informant consensus factor (ICF) was calculated to estimate the use variability of medicinal plants. Stomach problems, constipation, cough, cold, fever, headaches, cuts and wounds, have low informant consensus factor and respiratory problems, jaundice and tooth ache have highest informant consensus factor (Table 4).

Table 4: informant consensus factors for different aliments categories.

Aliments	N_{ur}	N_t	Nur- Nt	Nur-1	Informant consensus factors
Stomach problem and Constipation	83	14	69	82	0.84
Cuts and wounds	51	9	42	50	0.84
Pregnancy and delivery	9	1	8	8	1
Blood pressure	5	2	3	4	0.75
Skeleton and Muscular	7	3	4	6	0.66
Acne/skin diseases	14	2	12	13	0.92
Fever and headaches	79	11	68	78	0.87
Cough and cold	98	9	89	97	0.91
Respiratory problems	3	1	2	2	1
Ureo-genital	25	4	21	24	0.87
Body cooling	12	2	10	10	0.90
Jaundice	4	1	3	3	1
Tooth acne	7	1	6	6	1

Fidelity level (FL) value for the medicinal plants ranges from 13.7 to 100 percent. The study determines *Cuscuta reflexa, Calotropis gigantean, Cheilanthes dalhosiae,* and *Euphorbia hirta* have 100 percent value. *Centella asiatica* have 13.7 percent of fidelity for treatment of blood pressure (Table 5).

Table 5: Fidelity level of Medicinal plants

Aliments	Name of sp.	Ip	Iu	Fidelity level
Pregnancy and delivery	*Asparagus racemosus* Willd	7	9	77.7
Blood pressure	*Cynodon dactylon* (L.) Urb.	3	3	100
Blood pressure	*Centella asiatica* (L.) Urb.	4	29	13.7
Respiratory problems	*Achyranthus aspara* L.	3	10	30

Jaundice	*Cuscuta reflexa Roxb.*	4	4	100
Tooth ache	*Achyranthus aspara* L.	7	10	70
Skeleton and Muscular	*Calotropis gigantean* (L.)	4	4	100
Skeleton and Muscular	*Alstonia scholaris* R.Br.	3	5	60
Body cooling	*Aegle maramlos* (L.) Correa	11	15	73.3
Skin diseases	*Azadirachta indica* A. Juss	7	10	70
Skin diseases	*Achyranthus aspara* L.	4	10	40
Urogenital	*Tinospora cordifolia (Thunb.)* Miers	4	11	36.36
Urogenital	*Mumosa pudica L.*	9	9	100
Cough and cold	*Terminalia chebula* (Gaertn.) Retz	17	20	85
Cough and cold	*Ocimum Sanctum* L.	14	26	53
Headach and fever	*Centella asiatica* (L.) Urb.	18	29	62
Headach and fever	*Callicarpa macrophylla* Vahl.	6	9	66.6
Gestro-intestinal	*Terminalia bellirica* (Gaertn.) Roxb.	7	9	77.7
Gestro-intestinal	*Cheilanthes dalhosiae* Hook	14	14	100
Cuts and wounds	*Euphorbia hirta* (L.) DC.	17	17	100
Cuts and wounds	*Mallotropus philippensis* (Lam.) Muell. Arg.	3	5	60

4.5 Vegetation sampling

The IVI was found highest for *Shorea roubsta* and lowest for *Alstonia scholaris* for trees. It was highest for *Phoenix humilis*, lowest for *Justica adhaltoda* for shrubs and highest for *Thysanolaena latifolia*, lowest for *Remusatia vivipara* for herbs.

The IVI was calculated in the table below (Table 6).

Table 6: IVI of Tree species

Scientific name	Den.	Re. Den.	Fre.	Re. Fre.	Cov.	Re. Cov.	IVI
Phyllanthus emblica L.	0.24	0.29	12	0.02	0.84	2.0	2.42
Spondias pinnata (L.)Kurz Amora	0.04	0.04	4	0.04	0.19	0.47	0.53
Aegle marmelos (L.) Correa	0.56	0.69	32	0.06	0.94	2.35	3.10
Terminalia bellirica (Gaertn.) Roxb.	0.44	1.18	32	0.10	1.06	3.08	4.37
Alstonia Scholaris R.Br.	0.08	0.09	8	0.009	0.15	0.38	0.48
Ficus racemosa L.	0.20	0.24	4	0.02	0.23	0.57	0.84
Terminalia chebula (Gaertn.) Retz	0.44	0.54	32	0.04	1.06	2.63	3.23
Syzygium cumini (Gaertn.) Retz	0.88	1.09	28	0.09	1.29	3.20	4.39
Bauhinia variegate L.	0.36	0.44	28	0.04	0.90	2.25	2.74
Shorea robusta Gaertn.	68.16	84.48	100	17.48	19.53	48.69	150.6
Terminalia alata Heyne ex Roth	1.56	1.93	52	0.17	3.02	7.52	9.6
Desmodium ooijeinense (Roxb.) H. Ohashi	0.32	0.39	24	0.03	0.74	1.84	2.27
Mallotus phillipensis (Lam.) Muell. Arg.	1.2	1.48	44	0.13	1.91	4.76	6.38
Bombax ceiba L.	0.6	0.74	4	0.06	0.34	0.85	1.66

Legend: Den.: Density, Re. Den.: Relative Density, Fre.: Frequency, Re. Fre: Relative Frequency, Cov.: Cover, Re. Cov: Relative Cover and IVI: Important Value Index

Table 7: IVI of Shrub and Saplings

Scientific Name	Den.	Re. Den.	Fre.	Re.Fre.	Cov.	Re. Cov.	IVI
Murraya koenigii (L.) Spreng.	1.36	3.13	36	6.76	6.10	5.18	15.09
Justica adhaltoda L.	0.2	0.46	8	1.50	0.76	0.64	2.61
Cissampelos pareira L.	1.16	2.67	28	5.26	5.44	4.62	12.56
Aegle marmelus (L.) Correa	0.52	1.19	24	4.51	2.69	2.29	8.0
Dioscorea humiltonii Hook. f.	0.8	0.18	4	0.75	1.67	1.42	2.36
Bauhinia vahlii Wight & Arn.	0.36	0.83	12	2.25	4.37	3.71	6.80
Woodfordia fruticosa	0.12	0.27	8	1.50	0.12	0.1	1.87

Scientific Name	Den.	Re. Den.	Fre.	Re.Fre.	Cov.	Re.Cov.	IVI
(L.) Kurz							
Tinospora cordifolia (Thumb.) Miers	0.28	0.64	16	3.0	2.13	1.81	5.46
Terminalia chebula (Gaertn.) Retz	0.08	0.18	4	0.75	0.20	0.17	1.1
Syzygium cumini (L.) Skeels	0.24	0.55	12	2.25	1.11	0.95	3.76
Ficus semicordata Buch-Ham.	0.72	1.66	16	3.0	3.15	2.68	7.34
Pogostemon bengnalensis (Burm. f.) Kuntze	5.96	13.14	52	9.77	13.18	11.19	34.71
Phoenix humilis Khajuri (Thr.)	7.8	17.98	56	10.52	22.42	19.04	47.54
Shoraea robusta Gaertn.	2.84	6.54	40	7.51	8.19	6.96	21.01
Mallotropus philipensis (Lam.) muell. Arg.	1.08	2.49	8	1.50	0.45	0.38	4.38
Tinospora sinensis (Lour.) Merr.	0.2	0.46	4	0.75	0.25	0.21	1.42

Legend: Den.: Density, Re. Den.: Relative Density, Fre.: Frequency, Re. Fre: Relative Frequency, Cov.: Cover, Re. Cov: Relative Cover and IVI: Important Value Index

Table 8: IVI Table of Herbs and Seedlings

Scientific Name	Den.	Re. Den.	Fre.	Re.Fre.	Cov.	Re.Cov.	IVI
Thysanolaena latifolia (Roxb. Ex Hornem.) Honda	4.8	8.51	24	5.02	193.6	9.71	23.25
Murraya koenigii (L.) Spreng.	0.26	0.46	12	2.51	13.3	0.67	3.64
Eupatorium adenophorum Spreng.	0.32	0.56	4	0.83	15.19	0.79	2.20
Dioscorea humiltonii Hook. f.	0.04	0.07	2	0.41	1.27	0.06	0.55
Eclipta prostrate L.	0.56	0.99	6	1.25	5.09	0.25	2.50
Eulaliopsis binate (Retz.) C. E. Hubb.	1.18	2.09	4	0.83	41.40	2.07	5.0
Oxalis cornicolata L.	2.2	3.90	6	1.25	21.65	1.08	6.24
Euphorbia hirta (L.)DC.	0.4	0.70	4	0.83	24.20	1.21	2.76
Woodfordia fruticosa (L.) Kurz	1	1.77	12	2.51	11.46	0.57	4.85
Cynodon dactylon	0.88	1.56	2	0.41	5.73	0.28	2.26

	Den.	Re. Den.	Fre.	Re. Fre.	Cov.	Re. Cov.	IVI
(L.) Pers.							
Ageratum conyzoides L.	0.56	0.99	10	2.09	28.02	1.40	4.49
Centella asiatica (L.) Urb.	1	1.77	4	0.83	26.75	1.34	3.95
Syzygium cumini (L.) Skeels	0.68	1.20	24	5.02	29.29	1.47	7.69
Remusatia pumila (D.Don) H.Li. & A. Hay	0.08	0.14	2	0.41	3.8	0.19	0.75
Asparagus racemosus Willd.	0.28	0.49	6	1.25	6.36	0.31	2.07
Cyperus rotundus L.	4.2	7.44	34	7.1	64	8.24	22.81
Dryopteris sp	2.76	2.05	8	2.51	66.87	2.30	6.87
Cheilanthes dalhosiae Hook		3.01		0.83		1.53	5.38
Pogostemon benghalensis (Burm.f.) Kuntze	1.26	2.23	24	5.02	110.9	5.53	12.78
Shorea robusta Gaertn.	1.16	2.05	12	2.51	45.85	2.30	6.87
Imperata cylindrical (L.) P. Beauv.	0.7	1.24	2	0.41	20.38	1.02	2.68
Artemisia indica Willid.	0.18	0.31	4	0.83	17.19	1.21	2.76

Legend: Den.: Density, Re. Den.: Relative Density, Fre.: Frequency, Re. Fre: Relative Frequency, Cov.: Cover, Re. Cov: Relative Cover and IVI: Important Value Index

4.6 Diversity indices

Simpson and Shannon-Wiener Diversity index was calculated and tabulated below in table.

Table 9: Diversity indices

Diversity indices	Shannon Weiner's index (H)	Simpson's index (D)
Herbs	2.17	0.88
Shrubs	1.48	0.8
Trees	0.66	0.22

CHAPTER FIVE: DISCUSSION

5.1 Plants and people

Nepal has a rich biological diversity and a significant portion of its land area is covered by forests. NTFPs have an important function in the fulfilment of basic needs of rural communities in Nepal, particularly those in rural and forest-dependent communities (Salafsky and Wollenberg 2000; Carpenter *et al*., 2006). So, there is an urgent need to develop proper management techniques to traditional practices to safeguard productivity, sustainability and rural livelihoods (CBD, 1992). These products provide income, employment, and sustenance to numerous households. Collection and trade of these products since the long period of time cannot always serve as the model for the future. Despite the importance of the NTFPs, there are challenges related to over harvesting, habitat Loss, climate change impacts, lack of proper regulation, inadequate market infrastructure, and limited knowledge about sustainable harvesting practices. Research and development efforts are ongoing to identify new NTFPs, study their potential uses, improve cultivations techniques, and explore market opportunities. Local people has very important role and responsibility in the conservation, management, use and development of forest resources. So, local communities should take in any kind of management practices of forest resources.

The information and findings of the present study are based onthe participatory assessments, field observation, interviews and ecological samplings. Fifty households were interviewed. Majority of them were Magar, and other people were Tamang, Brahmin, Chhetri, Sunari, gurungs, Rai. All of them were age group above 45. They are involved in farming, livestock farming, worked in abroad, social works, educational institution and in construction works. Some of them were educated up to school level and some of them were illiterate. Study area is home to various ethnic groups, including Magar, Gurung, Tamang. They have their own use, conservation and management practices. Traditional management practices are one of the management practices used in the rural areas of Nepal which helps in the conservation of biodiversity (Ghimire, 2008). Elder people have good knowledge about use, conservation and management of NTFPs. New generation need to know about those conservation and management practices. About 59 non-timber forest products were reported in the study area. In which 22 tree, 22 herbs, 8 shrubs and 7 of climbers were found. Gubhaju and Ghimire,

(2009) reported about 114 plant species as non-timber forest products from Dovan, Palpa. In which 36 sp. belonged to herbs, 21 sp. are shrubs, 42 sp. are tree and 15 sp. are climber. Total 109 non timber forest products were reported by the Danekhu *et al*. (2019), from Bagmara Bufferzone Community Forest in Chitwan. Chhettri and Gupta (2003) reported 121 Non-timber forest products from upper Mustang area.

According to an estimate about 1600-1900 species of NTFPs are used for medicinal purposes (Ghimire, 2008). These wider number of NTFPs served as the source of diverse material products, such as food, fodder, dye, medicine, fibers, resins, handicraft, ornaments etc. Plants are the basic part of human life and they have cultural values. Most of the plants were used for the medicinal purposes and wild food and vegetables. Same kind of result were found in other part of Nepal (Uprety *et al*., 2010; *Uprety et al*., 2008, Shrestha *et al*., 2020). Local people have good knowledge about wild food resources. They used these resources for their food security in combination with agricultural production, can help to mitigate malnutrition (Balemie and Kebebew, 2006). Pradhan and Manandhar, (1997) listed 22 medicinal and aromatic plant, 16 species of wild edible plants, 18 species of fodder plants, 14 species for fuel wood in Teharathum district.

Medicinal uses of plant resources are important for livelihood of rural communities (Coe and Anderson 1996; Heinrich *et al*., 1988; Kala *et al*., 2004; Rossato *et al*., 1999; Kalauni and Joshi, 2018; Acharya *et al*., 2015). More than 75% people of Nepal used herbal drugs. Medicinal plants (40 sp.) found in this area were reported to be used for treatments of 13 different illness categories diarrhea and constipation, cuts and wounds, pregnancy and delivery, blood pressure, skeleton and muscular, skin diseases, fever and headaches, cough and cold, respiratory problems, ureo- genital, body cooling and jaundice. Highest number of plants (14 sp.) were used for treatment of digestive problems, fever, and headaches (11 sp.). Nine species used for the treatment of cough and cold, two species for skin diseases, two species for body cooling and one species for jaundice. Similar kind of report were found in chitwan by the Danekhu *et al.* (2019). The user group of community forest user group has a very rich traditional knowledge and has been making use of wild plant for various purposes. Despite of all the marvelous advancements of medicine, traditional herbal medicine has been always practiced by the local people. Respiratory problem, pregnancy and delivery, jaundice, and tooth acne have highest informant consensus factor 1. Digestive problems, cuts and wounds have

informant consensus factors 0.84. Blood pressure have F_{ic} value 0.75. Skeleton and muscular disease have F_{ic} value 0.66 and uro genital and fever has F_{ic} value 0.87 and Body cooling had F_{ic} 9. Similar kind of results were obtained from study conducted in the Rasuwa district, central Nepal by Uprety *et al*. (2010). The study determine *Cuscuta reflexa, Calotropis gigantean, Cheilanthes dalhosiae,* and *Euphorbia hirta* have 100 percent value. A FL of 100 percent for a specific plant indicates that all of the use-reports mentioned the same method of the plant for treatment. *Centella asiatica* have 13.7 percent of fidelity for treatment of blood pressure. *Asparagus racemosus* Willd. Has 77.7 percent fidelity. *Achyranthus aspara* have fidelity 70 percent for treatment of tooth ache. Mallotus philippensis have 60 percent fidelity for the treatment of wounds. *Alstonia scholaris* have 60 percent fidelity for skeleton and muscular disease. Caunca and Balinado, (2021) reported 106 medicinal plants used to treat 16 different aliments categories. They found IFC value 0.43 (*Senna alata*) for the treatment of infectious and parasitic diseases, o.68 (*Magnifera indica*) for the treatment of metabolic diseases, and all these plants (*senna alata*, *Magnifera indica*, *Chrysophyllum cainito*, *Lagerstroemia speciosa*) has FL value of 100 percent. Malla *et al*. (2015) identified 132 plant species under 67 botanical families for medicinal purposes to treat various diseases under 12 disease categories. Highest number of plant species were used to treat gastro-intestinal disease (F_{ic}). Highest fidelity value recorded in *Paris polyphylla* FL value 96%.

The ethnobotanical survey identified the 59 plant species used for different purposes, and majority of them were angiosperms. NTFP species are used for different purpose as food, treating diseases, ornaments, fiber, Dyes, resin and spices. Majority of species are used for medicinal purpose (40), Followed by foods and vegetable (17), spices and fiber (2), dyes and aromatic (1). Uprety *et al*. (2010) reported most of the plants were used for the Medicinal purposes (56) species and wild food and vegetables (26) species in the study conducted in Bardiya district of Nepal. Roy (2010) reported 47 NTFPs species were collected from six villages in Humla district. Most were found to be wild edible plants followed by medicinal plants. Piya *et al*. (2011) reported that 23 types of NTFPs were collected and sold by the Chepang households in Shaktikhor VDC Makawanpur. Most of the plants were used for the medicinal purpose followed by fruits. Humagain and Shrestha (2009) documented 60 species of important medicinal plants from Rasuwa District, About 40 percentage of household of chilime VDC were found to be involve in the collection and trade of medicinal plants. Uprety *et al*.(2016)

reported 363 species of NTFPs used by locals from Kanchenjunga landscape in Nepal, medicinal and edible was the major purpose of use of NTFPs. Danekhu (2019), reported 100 medicinal plants followed by 86 fodder plants and 47 plant species used for food and vegetables in Chitwan.

A total of 18 species were used for food and vegetables. Different parts like Young shoot, tuber, rhizome, Fruits were used as vegetable. Fruits of most species were edible. Young shoots, rhizome and tubers were used as vegetable. Shahi *et al*. (2022) identified 27 types of food and vegetables. In which leaves of most species are used as vegetables and fruits are eaten raw. In Nepal, 440 types of wild plants are used as food (Subedi *et al.*, 2014).

Leaves (12 sp.) were the most frequently used part of plants, followed by fruits (10 sp.), bark (8 sp.), whole plants (8 sp.), rhizome (5 sp.), flower (4 sp.), stem (4 sp.), root (4 sp.) and tender shoots (4 sp.). Fruits of 11 species were used for food and medicinal purpose. Flower of plant used for making pickles and for medicinal purpose. Fruit of the 10 species were used for medicine and leaves of *Cinnamomum tamala* and *Murraya koenigii* were used for spices. In the study conducted in Chitwan by Danekhu (2019), leaves were the most used part of the plant then whole plant, root, bark, stem and flower. Yonzon (1994) mention the collection of 93 NTFP species in Langtang National Park. They found leaves, flower, and fruits were the most frequently used part of the plant.

5.2. Diversity, Conservation and Management of Non timber forest products

Altogether 59 species under 35 families were identified as NTFPs in study area. Most of the species (5) belonging to the Poaceae family followed by Asteraceae and Lamiaceae with 4-4 families in each. Apocynaceae, Anacardaceae, Dioscoraceae, Dryopteridaceae, Leguminosae and Rutaceae had 2-2 species in each. Other families had 1-1 species with each. Silwal, (2020) identified 51 species of medicinal plants belonging to the 38 botanical families. In which large number of species belongs to Asteraceae, Berbaridaceae and Poaceae families.

In community forestry management main concern were given to the timber products than lower herbs and shrubs. Forest were mainly dominated by *shorea robusta* with almost 100 percentage frequency, *Terminalia alata* 52 percentage frequency. The ground vegetation consists seedlings of *shorea robusta, Thysanolaena maxima, Pogostemon bengnalensis, Phoenix humilis.* Other important ground flora were

Asparagus racemosus, Remusatia vivipara, Dryopteris sp., Cissampelos pareira, Cyperus rotundus.

Density, frequency, coverage, Importance Value Index (IVI) and Diversity indices were calculated for ecological status of existing NTFP resources. Ekata community forest lies in lowland tropical forest and dominated by Sal. *Shorea robusta* was dominant tree with highest IVI value (150). *Terminalia alata*, *Mallotus phillipensis*, *Woodfordia fruticosa*, *Aegle marmelos, Terminalia bellirica* were the dominant trees with IVI 9.6, 6.38, 5.57, 3.10, 4.37. *Sapondias pinnata* and *Alstonia scholaris* have lowest IVI 0.53 and 0.48. *Phoenix humilis* was the dominant shrub species with highest IVI value (47.5). *Pogostemon benghalensis* (IVI 34.7), *Murraya koenigii* (IVI 15.09) were the dominat species. *Tinospora sinensis* have lowest IVI 1.42. *Eulaliopis binate* (IVI 5.0), *Cyperus rotundus* (IVI 22.81), *Cheilanthes dalhosiae* (5.38) were the dominant herbs. *Remusatia vivipara* have lowest IVI 0.75. Plants like *Asparagus racemosus*, *Tinospora sinensis, Terminalia bellirica* have low IVI may be due to scatted distribution, over exploitation of resources. According to the elder people forest was dense with high species diversity in the past. Now some plants becomes threaten may be due to over exploitation of resources for medicine, fodder, firewood etc. In the study Shannon Weiner's index (H) and Simpson's index (D) of diversity was found maximum for herbs (2.17 and 0.88) followed by shrubs (1.48 and 0.8) and trees (0.66 and 0.22). Plants which has low IVI and diversity indices should be conserved. Similar types of result was found in the study conducted in the Chitwan, Nepal by Danekhu (2019). Shannon Weiner's index (H) and Simpson's index (D) of diversity was found 0.54 and 0.2 for tree species. Rahman and Vacik, (2010) found abundance of medicinal and edible plants were highest in mixed forest than pure sal forest. Sapkota et al., (2009) also found Sal (*Shorea robusta*) as a most abundant species in two community forests of terai bhabar landscape with IVI 174.4 and 206.9 respectively, followed by *Schima wallichi* and *Syzygium operculatum*. Shannon-Weiner and Simpsons indices 2.42, 0.6 and 1.38 and 0.3. They also suggests that species composition and diversity of forest is partly affected by altitude.

Ekata community forest lies in the Chure region, southern part of Nepal, Chure hill is known for its diverse ecosystems and rich biodiversity. Community forests in this region play a crucial role in sustaining ecological balance, providing livelihoods for local communities, and promoting overall environmental conservation. In community

forest management activities are carried out by community forest user groups. There are some conservation and management practices commonly employed in study area. Local communities are actively participate in decision-making process related to forest management. This include planning, implementation, and monitoring activities. Communities are granted legal right to use and manage the resources within the community forest. Community forest user groups can collect fuel wood and fodder to feed domestic animals from the month of Ashwin to Falgun, three days in a week. The community forest was handed over to the local community. They play a key role in decision making regarding forest management. Timber, fodder, and other valuable resources can be collected by user group after taken the permission of the management committee.

Community forest management practices typically emphasizes sustainable resource use. In sustainable harvesting practices the regeneration pattern of the species do not alters by the extraction of species (Cunningham, 2000). Those practices used by the user groups are do not overharvest, do not harvest the whole plant, control grazing, regulate forest guards, make rules about resource management, and regulate the collection of NTFPs to ensure that the ecosystem's health is maintained over the long term. Collaboration with governmental and non-governmental organization, research institutions and other stakeholders is crucial for the success of community forest management. It can provide additional resources, technical expertise and support for implementing sustainable practices. Effective community forest management is often supported by clear legal frameworks and policies that recognize and empower local communities to manage and benefit from the forests. NTFPs from forest is not sufficient to improve economic condition of rural population. Domestication of valuable forest resources can help to improve economic condition also help in conservation and reduces the pressure on wild and endangered species (Rajchal, 2006).

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

About 58 potentially important NTFPs were found in study area. Plant species found in this area were used as NTFPs in one or various purposes. Most of them were used as medicine and food. After field visit and cons with committee members and local people 40 species of various families were used as medicine, 17 species were edible, 2 species for fiber and spices, 1-1 species for aromatic, and dyes. *Shorea robusta* (IVI 150.6), *Mallotus phillipensis* (IVI 6.38), *Terminalia alata* (IVI 9.6), *Phoenix humilis* (IVI 47.56) were the dominant plant species. *Alstonia scholaris* (IVI 0.48), Terminalia chebula (IVI 1.10), Remusatia vivipara (0.75), Tinospora sinensis (IVI 1.42) have low IVI and diversity. Plants had low IVI and diversity should be conserved. Domestication of rare and valuable resources can help in the conservation of wild and endangered species. In the study Shannon Weiner's index (H) and Simpson's index (D) of diversity was found maximum for herbs (2.17 and 0.88) followed by shrubs (1.48 and 0.8) and trees (0.66 and 0.22). Local people were found to be well aware of using the NTFPs found in study area. The conservation status of NTFPs was also good indicating the good management system of Ekata Community Forest. Proper management and harvesting can create more option for source of income and livelihoods of local people. Sustainable harvesting and export of NTFPs can also contribute in nation's economy growth.

6.2 Recommendations

- Proper awareness program on the conservation and management of NTFPs, sustainable use, management, harvest and preservation of highly valuable NTFPs at local level is necessary.

- Local communities should involve in decision-making processes related to NTFP management. Consider their traditional knowledge and practices. Conduct awareness and training programs to empower communities in sustainable harvesting techniques, value addition and marketing of NTFPs.

- Guidelines for sustainable harvesting should implement, ensuring that collection rates do not exceed the natural regeneration capacity of NTFP species. Promote selective harvesting methods and seasonal restrictions to protect reproductive phases of plants.

- Identify and prioritize NTFP species with high ecological and economic value for conservation efforts.

- Implement measures to protect the habitat and promote the coexistence of various plant and animal species within the ecosystem.

- Facilitate market linkages for NTFP products, connecting local communities with buyer, traders, and markets.

- Few studies has been carried out in the study area, there are a number of plant species that are not studied and evaluated. NTFPs should be studied in detailed and entered into a database for use as a management tool. The research directed towards the more detailed exploration of plant species diversity during different season is required.

- Such types of ecological studies should done in future, which will be helpful for identification and conservation of threatened species. Those valuable plants which have multiple uses, and comparatively more threatened, this plants should also be given due consideration for immediate conservation measures.

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ANNEXES

Questionnaire for data collection on NTFPs use and conservation in Devchuli municipality

Date:

Name:

Sex:

Age:

Occupation:

Ethnic group:

Education level:

Questions:

1) Do you use forest products from nearby forests?

……………………………………………………………………………………………
…

2) For what purpose do you use forest products?

……………………………………………………………………………………………
….

3) How often do you collect forest products?

……………………………………………………………………………………………
….

4) What are the NTFPs found in your forest, that you use?

………………………………………………………………………………………………
…….

5) Are all the products consumed or also sold in local market?

………………………………………………………………………..………………………
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6) What about the importance of NTFPs in your livelihood?

………………………………………………………………………………………………
…….

7) Do you cultivate NTFPs in your farmland? What are they and purpose of use?

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8) In your opinion what is the resource condition of NTFPs?

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9) What are the most frequently used NTFP?

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………

10) What is your concept about future security or sustainable harvesting?

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11) Do other flora or fauna are affected during collection?

………………………………………………………………………………………………
……….

12) Why do you collect NTFPs?

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………

13) Is it easy to collect and consume?

…………………………………………………………………………………………
……..

14) Is it easy to sell and generate income?

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…….

15) What are traditional preferences of NTFPs?

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PHOTOGRAPHS

Thysanolaena maxima

Cissampelos pareira

Asparagus racemosus

Woodfordia fruiticosa

DIVERSITY, DISTRIBUTION AND USE OF NON-TIMBER FOREST PRODUCTS IN THE COMMUNITY FORESTS OF NAWALPARASI (EAST), NEPAL