POTENTIAL OF NON-TIMNER FOREST PRODUCTS OF THE MAGO NATIONALPARKAS AN IMPLICATION FOR BIODIVERSITY CONSERVATION, LIVELIHOOIMRROVEMENTAND SUSTAIABLE USE OF NATURAL RESOURCES.

THE CASE OF MAGO NATIONAL PARK, SOUTH, WEST, ETHIOPIA

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ACRONYMS AND ABBREVIATIONS

BA	Basal area
DBH	Diameter at breast height
Ha.	hectare
IVI	Important value index
m^2	meter square
$NTFP_S$	Non timber forest products

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1. Introduction

1.1 Background and justification

Forest ecosystems offer ample goods and services; timber and non-timber forest products (NTFPs) being the most common forest products. NTFPs have been studied by researchers from many different academic fields and each field used a slightly different definition of NTFPs. Non timber forest products (NTFPs) are, in broadest sense, any biological resources collected from wild by people for direct consumption or income generation on a small scale (Shackleton and Shackleton, 2004). NTFPs are any products other than timber that is produced in a forest (CIFOR, 2004). NTFPs include different types of food (wild edible mushrooms, fruits, and nuts), medicinal plants, floral greenery, horticultural stock, fiber and dye plants, lichens and fungi, oils, resins and other chemical extracts from plants, firewood and small-diameter wood used for poles, posts and carvings (McLain and Jones, 2005).

NTFPs are an indispensable part of the livelihood strategy of communities living in and near forests. Non-timber forest products (NTFPs) constitute an important source of livelihood for millions of people across the world. For centuries, people of the tropical rainforest have been collecting NTFPs either for their subsistence or in exchange for manufactured products and income generation (Pfund and Robinson, 2005).

Nevertheless, NTFPs were for long overshadowed by timber products and has received increased policy and research attention only in the last few decades. This policy and research attention was based on three propositions (Arnold and Ruiz-Perez, 2001): The first was that NTFP contribute significantly to the livelihood and welfare for households living in and adjacent to forest. Secondly exploitation of NTFP has ecologically less destructive than timber harvesting and other forest uses, and the third point was that NTFP production and development by giving a foundation for sustainable economic development could reduce tropical deforestation. These propositions encouraged researchers to put much effort on the determination of monetary values of NTFPs as well as their contribution to overall livelihoods.

Therefore, recently, there is a growing agreement that NTFPs play an important role in the livelihoods of rural poor as a source of food, medicine, construction materials and income. The interaction between forest and forest dwelling communities has received increasing attention from academicians and policy makers. Owing to the importance of NTFPs from

view point of community welfare and sustainable forest management, sustainable management of NTFPs is crucial for sustaining livelihood of rural poor.

Ethiopia is one of the tropical countries endowed with rich biodiversity resources that have numerous NTFPs. The rich NTFPs of the country play substantial roles in food security and in poverty alleviation for a large number of communities in the country (Vivero, 2002). For instance, over 80% (approximately 60,000,000) of the population of Ethiopia depend on herbal/wild medicines for their primary health care and biomass-derived fuel for their energy (Demel and Mulugeta, 2005).

However, like in other developing countries, the rationales for forest conservation and developments in Ethiopia have been primarily the production of fuelwood and environmental protection. The values and roles of NTFPs in general have been neglected at all times. Indeed, the capacity to promote sustainable NTFPs production and utilization and to facilitate increased financial benefits to local and national users as an incentive for forest conservation has been very low or nonexistent in the country. On the other hand, a closer assessment of the real socio-economic significance of the forest and woodland resources of the country clearly reveals their greater importance with regard to the supply of NTFPs. For instance, Ethiopia's forest-products-related export materials were mainly NTFPs, such as gums, incense, spices, honey and wax (Mulugeta, 2006). Despite these significances, little information is available on management of the forest resources such as herbaceous plants, shrubs or trees for NTFPs. Only few studies have been conducted on the importance of NTFPs in Ethiopia from the lowlands, from the southwestern moist forest and eastern highlands (Mulugeta et al., 2003; Tadesse and Ararsa, 2004; Tsegaye *et al*., 2004).

In mago national park there is little documented information regarding the diversity NTFPs contribution of NTFPs in particular to the livelihood of the local community and for sustainable natural resources of the park .The local communities the around park is essentially based on agriculture and animal husbandry the feed grass from park used as the, demand for fire wood from the park and also are also beekeepers who own hives in the park.Those area are responsible factors for deforestation park vegetation (tree bush,shrbus) ,loss biodiversity of the park and subsequent consequences such as soil erosion, soil degradation. To avoid or minimize deforestation related negative consequence of the park ,for sustainable use of natural resources and to diversify the livelihoods of rural households, NTFPs can be a right alternative that deserves investigation at the study area. Comprehensive study on the type of NTFPs found in Mago national park, their diversity and their improving

the livelihood of the local communities is lacking. Indeed, there is a need to study the NTFP resources and the roles they can play in improving the uses natural resources in sustainable way, which may be used as a strategy for the conservation of the biodiversity of forest park.Therefore, to exploit the multifaceted roles of NTFPs and to ensure NTFPs-based forest management, the diversity and socio-economic significances of the major NTFPs need to be explored. With this rationale, this study is initiated in Mago national park

1.2 Objectives of the Study

1.2.1 General objective

The general objective of this study is the potential of non-timber forest products of the Mago national park as an implication for biodiversity conservation, livelihood improvement and sustainable use of natural resources, southwest, Ethiopia.

1.2.2 Specific objectives

- To identify NTFPs bearing species and study their diversity, abundance, and density in Mago national park.
- To assess the types of NTFPs currently utilized from park to formulate and recommend management and extraction option in Mago nation park.
- To assess the socio-economic roles of these NTFPs in improving the livelihood of the local communities in Mago national park.
- To identified the challenges related to $NTFP_s$ resources loss and analysing the associated policy gap that contributions for sustainable natural resources uses in Mago park right

1.3 Significance of the Study

- The study attempts $NTFP_s$ multipurpose benefited for livelihood socio-economic and also conserved biodiversity of forest park at some time long term benefited from non-timber forest product without disturbances
- This study to creat opportunity uses of forest product without tree then directly and indirectly reduces the negative result of NPFP extraction ,Improved natural habitat for park wild life ,improved the biodiversity then contributions for sustainable natural resources uses in Mago park. In the other hand creat opportunity for local communities and park ecosystem mutually benefited from natural resources that existed in park

- Assess policy gap related $NTFP_s$ to for understand the ongoing management system and assess the participation and recommend appropriate management strategy to ensure sustainability of resources and their biodiversity in Mago national Parks
- Sources of secondary document for other like researcher, academic, and policy design about potential $NTFP_S$ that park right way to improved biodiversity, improved livelihood and also sustainable use of natural resources of park.

1.4 Rationales

The rationales for the selection of MNP for this study were multiple.

- Mago National park Savannah bush and woodlands with small patches of grassland mostly cover the area, which is home to African elephants, buffalo, waterbuck, bushbuck, greater kudu, lesser kudu and a variety of small antelopes Hillman, 1993) at time, research shows that faunal and floral resources of the Park are threatened, but there has not been more study addressing the issue potential for non-timber forest products.
- The economy of the Ari people (around park) is essentially based on agriculture and animal husbandry. They are also beekeepers who own hives in the park. This indicate that local people depend on park NTFPs and forest like fuel wood fodder, hunting and gathering and keeping bee without unmanaged and unsustainable way due to this park biodiversity (plant,wildlife,microorganism)and sustainability use of natural resources decline time to time so, NTFPs management best solution for park problem.

- Around buffer zone of Mago National park the local communality have livestock, scattered trees need fodder, the agro-climate zone and the bee keeping activity of local comminute in park. Those are opportunities for the community management non timber forest products for mutual benefited and sustainable benefited both for park and local comminute.

2. Material and Methods

2.1. Description of the Study site

2.1.1 Location

The study area, MNP, is located in south-western Ethiopia, west of the main Rift Valley It has an area of 2,162 km2 and lies between latitude 05°19'-05°56'N and longitude 35°56'-36°26'E. The elevation ranges from 400 m above sea level on the plains in the south, to 1,776 m on top of Mt Mago. (Demeke and Bekele , 2000)

2.1.2 Climate

The climate of MNP is described by Stephenson & Mizuno (1978) & Demeku (1994).It is semi-arid with high mean annual temperature and solar radiation. The mean annual temperature varies from 24 to 38 °C. The annual rainfall recorded was 830 mm. There are two well separated rainy seasons: heavy rain from March to April and light rain from August to September.

2.1.3 Social -economic

Six ethnic groups the Ari, Banna, Hamar, Kara, Muguji and Mursi rely on natural resources in the park for their fodder, firewood, and food. Most user settlements are located on the margins of the conservation area, and have limited infrastructures and access to social services. Severe disputes over hunting erupted when a large number of automatic rifles became available after the regime change in 1991. Wild animal populations have since decreased dramatically (Graham *et al*., 1996)

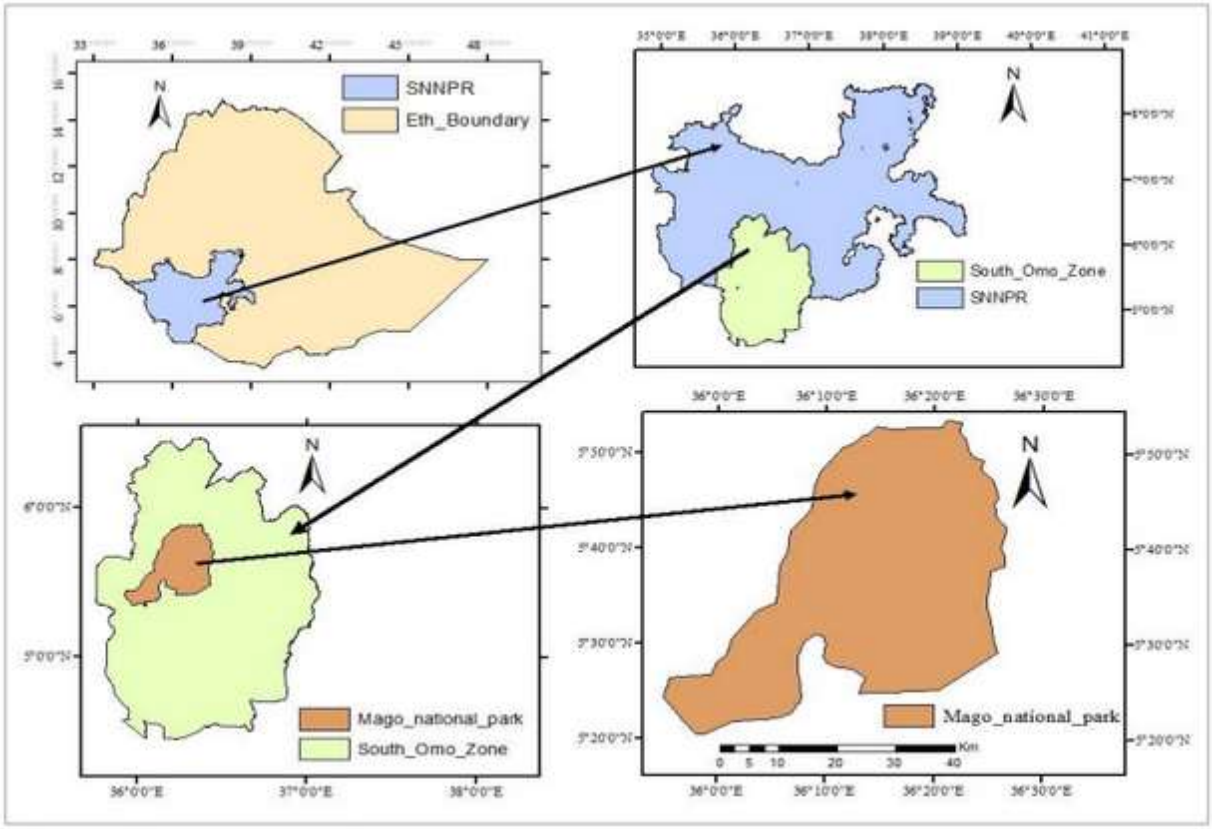

Figure 1: The Map of Study Site

2.2. Methods of Data Collection and Analysis

2.2.1 Sampling procedure and sample size determination.

A stratified random sampling technique will be applied following Alexiades (1996) and Taherdoost (2016) method. Using purposive sampling strategy, which more closed to Mago national park representative district and its surrounding kebele (where more depended on park), will be considered for the study. After the total numbers of households known from the selected kebele, desired number of representative households will be stratified selected using Watson (2001) formula: national park representative district and its surrounding kebele (where more depended on park), will be considered for the study. After the total numbers of households known from the selected kebele, desired number of representative households will be stratified selected using Watson (2001) formula:

$$n = \frac{\frac{P(1-P)}{\frac{A^2}{Z^2} + \frac{P(1-P)}{N}}}{R}$$

n = Sample size required [set by Watson (2001)], N = Total population, P = Estimated variance in population, as a decimal: (0.1) 90%, A = Precision desired expressed as decimal: (0.05) for 5%, Z = Based on confidence level: (1.96) for a 95% confidence level, R = Response rate: (0.99) for 99% response

2.3 Data collection

2.3.1 Vegetation Assessment

General survey of the study area will be carried out to determine the nature of terrain, tree composition, distribution and accessibility of different forest cover types. After the reconnaissance survey, transect lines running parallel to each other will be laid along an altitudinal gradient with the help of a compass and a systematic sampling design along the transect lines will be used to locate the sample plots and to generate the required vegetation and environmental data, which could help to investigate species composition, diversity, abundance, frequency, dominance, and population structure.

The size of sample plots, distance between adjacent sample plots and transect lines and even their number, will be decided based on the size area of the park forest. Circular sample plots will be established along in each transect lines to collect the vegetation data and subplots will be constructed for seedlings and saplings within the large circular sample plots. All encountered woody species will be recorded and categorized into 1) seedling (if height is < 1.5 m), 2) sapling (if height is 1.5 m - 3 m), and 3) tree (if height is > 3 m).

The dominance, frequency, abundance, diversity, importance value index (IVI) and population structure or regeneration profile of all encountered woody species will be investigated. The current regeneration status of each tree species will be determined by measuring and recording Diameter at Brest Height (DBH) and total height (H), using diameter tape and hypsometers, respectively. For plants having a height of less than 1.5 m, their height will be measured using calibrated sticks (Abeje, 2002). Plants will be identified at the field, for those species that are not known at field, local names will be registered and voucher specimens will be collected and identified at the National Herbarium of Ethiopia, Department of Biology, Addis Ababa University.. Based on visual observation any damage and the cause of the damage occurred at each sample quadrants on NTFPs species will be recorded which helps to know visual factors affecting the forest condition.

2.3.2 Socio-economic data collection

Socio-economic data collection will be conducted by both formal and informal survey. Preliminary survey will be conducted prior to the actual data collection. Information on the use of NTFPs will be assessed using household survey, interviews, discussions with key informants, and personal observations. Households will be stratified into different wealth categories: rich, medium, poor. The parameters used for this stratification will be based ,level of dependences on park, on farm size and number of livestock. Proximity to the resource base will be another factor accounted in the socio-economic survey.

2.3.3 Market survey

A market survey will be conducted in all existing local markets in the Wondo Genet catchment. The purpose of this assessment is to collect data about the number of NTFPs sellers involved in each market place, and the type of products supplied to these markets. The market survey is assumed to provide information on the importance of NTFPs to the household economy, as a means of complimentary or supplementing contributions in the household survey. To conduct such activities, personal observation and informal discussion will be undertaken with members of the participating NTFP sellers.

2.4. Data analysis

2.4.1 Vegetation data analysis

Based on the collected data, the current situation about population status of woody species will be investigated by constructing population structure of the whole vegetation in general, and NTFP bearing species in particular. Density, importance value index (IVI), dominance and frequency of each species will be computed to compare the status of each species and to know their proportion of NTFPs from the whole vegetation. Density, dominance, IVI and diversity of species will be calculated based on the total number of individual tree species recorded in all quadrants. Heterogeneity of the entire species will be determined using Shannon-Weiner diversity and Evenness indices. Descriptive statistics using SAS software will be employed, and results will be displayed using tables, percentages and graphical illustrations. Each measuring criteria will be computed as follows:

Density: it is the total number of individual stems per hectare.

Abundance: which is the number of stems per given species at a given quadrat. It is calculated as average abundance and relative abundance. Average abundance is calculated as the sum of the number of individual stems of a given species from all quadrats divided by the total number of quadrants. Relative abundance is calculated as the percentage of the abundance of each species divided by the total stem number of all species (Kindeya, 2003)

$$\text{Relative abundance} = \frac{\text{number of individuals of a species}}{\text{Total number of individuals in the sample}} \times 100$$

Frequency: is the presence of a given species in individual test plots (quadrats). It is computed as absolute frequency and relative frequency. Absolute frequency is calculated as the number of quadrats at which the species are recorded (Tadesse, 2003) while relative frequency of a species is calculated as the percentage of the frequency of a species divided by the sum total of the frequency of all species. Frequencies of major NTFPs will be determined by calculating the proportion of quadrats in which their individuals are encountered at each of the sites.

$$\text{Relative frequency} = \frac{\text{frequency of a single species}}{\text{Sum of all species frequencies}} \times 100$$

Dominance: it is the degree coverage of a species in the sample area. It is determined by stem basal area (Kent and Coker, 1992). It will be calculated as absolute dominance and relative dominance. Absolute dominance is calculated as the sum of basal areas (BA) of the individual tree species in m^2 /ha, and relative dominance is the percentage of the total basal area of a given species divided by the total measured basal areas of all species. BA is calculated for all woody species $BA=\Pi d^2/4$

Where BA = Basal area in m^2

d = Diameter at breast height in cm.

$\Pi = 3.14$

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

Importance value index: (IVI): it is calculated to know the overall ecological importance and vegetation status of study species in the study area. IVI is calculated as the sum of relative abundance (%), relative dominance (%), and relative frequency (%) of the study species.

Diversity of species: Species diversity refers to variation that exists in an ecosystem. It is an indicator of the extent of biodiversity. Diversity is often represented in the form of indices. These indices incorporate both species richness and abundance into a single numerical value.

These are also referred to as the heterogeneity indices. Shannon Wiener index gives the probability of occurrence of two individuals belonging to two different species in a habitat, when selected at random. The diversity indices consider the number of species, the number of individuals of a species as well as the total number of individuals of all species.

The diversity of the whole and major NTFPs will be calculated using Shannon and Wiener (1949). This diversity formula is used to compute heterogeneity of the study species composition.

$$\text{Diversity H'} = -\sum_{i=1}^{s} pi \ln pi$$

Where,

H'=Shannon-Wiener index

S= the number of species

Pi=the proportion of individuals or the abundance of the i^{th} species expressed as a proportion of the total

Ln =log $base_n$

Species richness: it is defined as the number of species found in a community. The Shannon average uncertainty increases as the number of species increases. In this particular case, the numbers of observed species across the whole sample quadrants are used as a representation of species richness.

Evenness: This index describes the quality of species abundance in a community. Maximum evenness arises when all species are equally abundant. The more the relative abundance of the species differs the lower the evenness. It helps to quantify the unique representation of a given species against a hypothetical community in which all species are equally common, such that if all species have equal abundance in the community, it is calculated as following (Kent and Coker 1992).

$$\text{Equitability (evenness) J} = \frac{-\sum_{i=1}^{s} pi \ln pi}{\text{LnS}}$$

Population structure: is the numerical distribution of individuals at arbitrary given diameter/height classes that are different in size or age within a population of a given species at a given moment of time (Peters, 1996). Population structures of the entire and selected major NTFPs will be constructed by grouping into different arbitrary diameter classes. Frequency histogram of both diameter and height class distributions will be used to construct

population structure by using diameter and height class versus number of individuals categorized in each class.

2.4.2. Socio-economic data analysis

The data gathered by formal survey (quantitative) will be analyzed using descriptive statistics to understand the local people's socioeconomic characteristics, attitudes and knowledge of the community members towards NTFPs, different uses of NTFPs, current management activities, and involvement of the local community on both benefits and conservation activities. Correlation analysis will also be used to determine whether there is a significant variation of NTFPs benefits among different wealth ranking (poor, medium and rich). Data obtained from Key informants, and field observations will be used as supplementary information for the formal survey.

3. Outcome of study

- Will be identified species that important extraction NTFPs, determine current situation about population status of woody species in terms of $NTFP_s$ variety of bearing species, number of individuals per species, total number of individual stems and estimate important parameters to explain density of non-timber forest products.
- Will be understand the local people's socioeconomic characteristics, attitudes and knowledge of the community towards NTFPs, different uses of NTFPs, current management activities, and involvement of the local community on both benefits and conservation activities in Mago national park. And evaluated the management, and the way that benefited for stakeholder of park.
- Will be investigated the potential of non-timber forest product for socio and economical benefited for local communities.
- Will be understand and suggested solution the driving factor NTFPs of that affect the biodiversity and sustainable use of natural resource
- Will be analysis the policy gap that promotes the use of NTFPs for all stakeholders and for sustainable ecosystem in park.

Finally, assess and show potential of non-timber forest products of the Mago national park as an implication for biodiversity conservation, livelihood improvement and sustainable use of natural resources.

4. Work plan and Budget

4.1. Work plan

Table 1: Plan of activities

No.	Activity	Months(september2021G.C - April 2022G.C)									
		Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
1	Preliminary survey and site observation	Xx									
2	Proposal writing Questionnaire development	Xx	Xx	Xx							
3	Data Collection		Xx	Xx	xx						
5	Data encoding and analysis				xx	Xx	Xx				
6	First Draft Result Writing						Xx	Xx	xx		
7	First Draft Result summation						Xx				
8	Taking Correction and comments			Xx	xx	Xx	Xx	Xx	xx	xx	Xx
9	Presentation of the result										Xx
10	Final thesis submission										Xx

4.2 Budget for action plan

Table-2 Budget for action plan

No	Item	Unit	Amount	Price /unit in birr	Total Birr
	Budget for stationary				
1	Pen	Pack	1	15	180
2	Paper	Pack	2	400	800
3	Binder	No	5	200	1000
5	Note book	Pack	1	30	750
6	Copy	Page	200	1	200
7	Print	Page	200	2	400
	Sub –Total birr				3330
	Per-dime.				
No	Activities	No. of participant	No. of days	Payment/Day	Total
8	Reconnaissance survey	3	10	450	13,500
9	Field assistance	2	30	450	27,000
10	Expert	2	10	450	9,000
11	Advisor	1	10	900	9000
12	Researcher	1	30	900	27000
	Sub –Total birr				85,500
	Transportation &comm.cost				

No -	Items	Unit	Amount litters	Price(birr)	Total
14	Fuel	Litter	650	24	15,600
15	Current	Day	30	2500	100,000
16	Driver	Day	30	500	20,000
17	Communication cost	Card	100	100	1000
	Sub-total birr				136,600

Table 3 - Budget summary

No	Item	Total cost(ETB) /birr
1	Budget for stationary	3330
2	Per-dime. Cost	85,550
3	Transportation &communication cost	136,600
5	Contingency 5% of total budget	11,271
	Grand Total	236,751

N.B. Costs are in Ethiopian birr (ETB)

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