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Ethnobotanical Study of Wild Edible Plants Used by Local Communities in Mandura District, North West Ethiopia

Abatfenta Terefe Moges

A Thesis Presented to the School of Graduate Studies of Addis Ababa University in partial Fulfillment of the Requirements for the Degree of Masters of Science in Biology

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APPROVAL SHEET I

This is to certify that the thesis prepared by **Abatfenta Terefe Moges** under the title: **Ethno botanical study of wild edible plants used by local communities in Mandura District, Northwest Ethiopia** and submitted in partial fulfillments of the requirements for the Degree of Master of Science (M.Sc) in Biology compiles with regulation of the university and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

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ABSTRACT

Ethno botanical study of wild edible plants used by local communities in Mandura District, Northwest Ethiopia

Abatfenta Terefe Moges

Addis Ababa University, 2019

Changes in the life style of human society due to domestication of selected species and developing agro forestry caused ignorance of wild food plants and related knowledge. Moreover, the extensive utilization coupled with other human activities such as agricultural expansion, firewood and charcoal extraction and introduction of exotic species affects the natural environment where wild food plants occur. This study aimed to explore and document the wild edible plants along with the traditional knowledge on utilization of wild food plant resources used by local people in Mandura district Northwest Ethiopia. A total of 66 informants were selected by Systematic random sampling method from 5 study sites selected purposively. Semi-structured interview, focus group discussion and field observations were tools of data collection. Descriptive statistics, preference ranking, direct matrix ranking, and informant consensus were used to analyze the data. A total of 25 wild edible plant species have been identified from the study area. Of these plants species, trees account for 40% followed by shrubs (28%), herbs (20%) and climber (12%). Regarding with edible parts, fruits account 13(52%) followed by leaves 6 (24%), young stem 3 (12%), tuber 2 (8 %) and seeds 1(4%). These plant species are consumed either raw (60%) or cooked (40%) and most of them are collected by women or children. According to preference ranking analysis, leaves of Justicia ladanoides and Croton macrostachyus Del are the most preferred plant species because of their sweet taste. Although most popular multi-purpose wild food plants species such as Balanites aegyptiaca, Cordia africana , Saba comorensis are mostly exploited and endangered species due to, human impacts such as introduction of exotic weedy species, charcoal making, fire wood collection, house hold construction, and deforestation for agricultural expansion lands contributed much to the disappearance of these plants. But conservation practice of these wild food plants by local communities is less. Thus, community participation is the suggested solution for the conservation and sustainable use of the wild edible plants in study area.

Key Words: Conservation practice, Wild food plants, Mandura District

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LIST OF ACRONYMS

AAU	Addis Ababa University
BGRS	Benishangul Gumuz Reginal State
CSA	Central Statistical Agency
FAO	Food and Agricultural Organization
IBC	Institute of Biodiversity Conservation
IK	Indigenous knowledge
Km	Kilo meter
M.a.s.l.	Meter above Sea Level
MWOA	Mandura Woreda Office of Agriculture
SCBD	Sustainable Conservation of Biodiversity
UNEP	United Nation Environmental Protection
WEPs	Wild Edible Plants

CHAPTER ONE

1 Introductions

1.1 Background and Justifications

In the past human societies depend on a much wider range of species for food, fiber, health security and other needs (Shand, 1997). This makes wild food plants to have been used as part of human diet since time immemorial (Agca *et al*., 2011). However, changing in the life style of human society due to domestication of selected species resulted in their ignorance and made them cultivating the selected species. As a result, at present, human kind depends on a very limited number of crops to meet the needs of staple diets (Schunko and Vogl, 2010). Only about 30 crop species provide about 95% of the world's food energy whereas over 7000 species have been known to be used for food and are either partly or fully domesticated (FAO, 1995).

Different parts (fruits, leaves, stem, root, tuber, flower and others) of wild edible plant species are used as edible worldwide. Wild edible plants (WEP) provide staple food for indigenous people, serve as complementary food for non- indigenous people and offer an alternative source of cash income for poor communities (Ju, Y.,*etal*,2013). In addition to food and health security wild food plants also provide environmental benefits by protecting the soil; generating leaf litter, decreasing erosion, maintaining surface moisture and improving the physical properties of the soil (Akinnifesi *et al.*, 2007).

The Ethiopian flora has approximately 6000 species of higher plants of which about 10% are endemic (Teweldebirhan GebreEgzabeher, 1991). The country is known as the biodiversity hotspot and center of origin and diversification for a significant number of food plants and their wild relatives (Tesfaye Awas, 1997). The livelihoods of the majority of rural people of the country depend on the woodlands, bush lands and thickets as sources of agricultural land, fuel wood as well as non-timber forest products such as wild food plants (Amare Getahun, 1994).The consumption of wild plants seems more common in food insecure areas of the country as compared to relatively food sufficient areas (Abbink,1993).Thus, many rural people of Ethiopia usually feed on wild food plants for survival during food shortage (Fentahun Mengistu and Hager, 2008).

Although wild edible plants play an important role during periods of food shortage, little attention has been given to conservation of wild edible plant species.

Wild edible Plants (WEPs) species are still largely ignored in land use planning and implementation, in economic development, and in biodiversity conservation endeavors in Gumuz community of Kamash Woreda in western part of Ethiopia (Dessalegn Ayele, 2017). This indicates that the importance of biodiversity conservation and benefits of ecosystem services are not well understood by indigenous community in the region (FAO, 2005).

Likewise in Mandura district of Benshanguel-Gumez region, the non cultivated plants provide considerable amount of supplementary food and have significant contribution to generating additional income, but there were no documented information's on WEPs and biodiversity conservation and management practice is not applied in the area. Due to this reason this study was designed to (1) identify and document wild edible plant species, (2) identify and record the parts of wild edible plants which are edible to humans,(3) assess threats on the wild edible plant species and (4) identify the constraints for conserving wild edible plants by the local communities in the area and recommend the possible solutions for the problems depending on the findings.

1.2 Statement of the Problem

Researches on sustainable utilization of wild food plants are inadequate in Ethiopia due to the focus on cultivated plants than to wild food plants (Debela *et al*., 2011). Similar to most parts of the country, research and development initiatives in the area give little attention and there are few studies conducted regarding wild food plants. According to Martin (1995), ethnobotanical data are basic for conservation and community development activities. Ethnobotanical data are useful to broaden our plant use knowledge (Mesfin Tadesse and Sebsebe Demissew, 1992; Ensermu Kelbessa *et al*., 1992). In Benishangul Gumuz region of Mandura district life of local communities depend on wild vegetations and wild food plants. But wild vegetations resources including wild edible plants are highly at risks in the area. Currently, most of the natural vegetations and important wild food plants in the area are decreasing and losing the physical and species composition as a result of different human activities. In the study area, this vital information has been diminishing.

Therefore, collecting and documenting ethnobotanical knowledge before it is lost forever is a fundamental urgent task. Therefore, this study aimed at exploring and documenting wild edible plants used by the Gumuz community of Mandura district of North-West part of Ethiopia.

1.3 Research Questions

The main focus of this study was to investigate and document wild edible plant species which are used by local communities in Mandura district.

The findings of the study tried to answer the following main research questions.

1. Which important wild edible plant species are used as food for community in the study area?
2. Which part of the wild edible plants is used as food by local people in the study area?
3. How local communities consume wild food plants in the area?
4. What are the factors that affect Wild edible plants in the study areas?
5. What are the problems that hinder the conservations in the study area?

1.4 Objectives

1.4.1 General objectives

The general objective of this study was to explore and document the wild edible plants used by local people in Mandura district.

1.4.2 Specific objectives

1. To identify and document wild edible plants consumed by the people in the study area.
2. To identify and record parts of wild edible plants which are edible to humans.
3. To assess threats (factors) that affects wild edible plant species in the study area.
4. To determine the constraints associated with conservation of wild food plants in the study area.

CHAPTER TWO

2 Review of related literature

2.1 Plant and people interactions

Traditional people around the world possess unique knowledge of plant resources on which depend for food, medicine and general utility including tremendous botanical expertise (Martin, 1995).This implies that humans are dependent on other organisms for their life. Although various animal and mineral products contribute to human welfare, the plant kingdom is the most essential to human well being especially in supplying these basic needs. The indispensable dependency of humans up on plants for their livelihoods was primarily started by domestication and dates back to 10,000 years (Martin, 1995). Over centuries, indigenous people have developed their own locality specific knowledge on plant use, management and conservation (Cotton, 1995). Plants have been used as a source of food in Ethiopia from time immemorial to combat food insecurity and human sufferings the shortage of food (Zemede Asfaw et al., 1999).

Ethiopians have used traditional medicines and wild food plants for many centuries, the use of which has become an integral part of the different cultures in modern Ethiopia (Sentayehu Tamene, 2011). The indigenous peoples of different localities in the country have developed their own specific knowledge of plant resource uses, management and conservation (Pankhurst, 1965). As a result, the study of indigenous knowledge about natural resources is becoming increasingly important in defining strategies and actions for conservation (Khanal, 2006).

In most scenarios, the traditional knowledge in Ethiopia is passed verbally from generation to generation and valuable information can be lost. As a result, Proper identification and documentation of wild food plant resources associated with indigenous knowledge must be an urgent task.

2.2 Indigenous People and Indigenous Knowledge on Useful Plants

Indigenous people refer to who follow traditional, non industrial lifestyle in areas that they have occupied for generations (Balick and Cox, 1996). Indigenous knowledge refers to the accumulation of knowledge, rules, standards, skills, and mental sets, which are possessed by local people in a particular area (Quanash, 1998). It is the result of many generations' long years' experiences, careful observations and trial and error experiments (Martin, 1995).

Ethnobotany is mainly focused on indigenous peoples since the relationships between plants and people are clearer in indigenous societies (Balick and Cox, 1996). Traditional people around the world possess unique knowledge of plant resources on which they depend for food, medicine and general utility (Martin, 1995; Cotton, 1996; Khanal, 2006). Systematic application of this indigenous knowledge is important for sustainable use of resources and sustainable development (Thomas, 1995). Biodiversity and traditional knowledge of its various properties and uses have long provided and continue to provide vital resources for medicine discovery and health care (SCBD, 2010). In addition, indigenous knowledge can provide problem solving strategies for local communities, especially the traditional societies. For example, previous studies on medicinal plants (Kebu Balemie et al., 2003; Mirutse Giday and Gobena Ameni, 2003; Tilahun Teklehaymanot and Mirutse Giday, 2007; Haile Yinger et al., 2008) have shown that the traditional societies in Ethiopia have good plant use and management knowledge, which will have valuable contribution to conservation activities in the country. This knowledge is still underutilized resource in the development process of Ethiopia. But, Indigenous knowledge of medicinal plants in Ethiopia is unevenly distributed among community members (Zemede Asfaw, 2001). Therefore, special effort is needed to understand and disseminate this knowledge through ethnobotanical studies.

2.3 Wild Plants Resources

According to Amare Getahun (1994), the term "wild" when applied to plants or plant species it refers to those that grow spontaneously in self-maintaining populations in natural or semi-natural ecosystems and can exist independently of direct human action. The term is contrasted with "cultivated" or "domesticated" plants or plant species that have arisen through human action, such as selection or breeding, and that depend on management on their continued existence. Wild plants may be transferred from forest or other ecosystems to trailside or near human habitations as well as in to fields so that they are readily available and easily collected (Ruffo et al., 2002). According to FAO (2005), the minimal form of domestication seems quite common and is practiced by many people in the world. The use of wild foods as the component of local response to increasing food insecurity is widely documented and this give rise to famine foods such as wild vegetables, berries, nuts, fruits, insects, etc. In periods of limited food stress, such foods may be eaten occasionally and more often by children and poorer sectors of society (Mzava, 1993). However, in periods of heightened food insecurity such foods

may be widely consumed. In reality, there is continuum resulting from development of co-evolutionary relationships between human and their environment (Bell, 1995). Over time, people have indirectly shaped many plants. Some have been domesticated in home gardens and in the fields together with farmers cultivated food and cash crops. Thus the term „wild food is used to describe all plant resources that are harvested or collected for human consumption in forests, savannah and other bush land areas (Chamber, 1990). Wild-foods are incorporated into the normal livelihood strategies of many rural people, pastoralists, shifting cultivators and hunter-gatherers (Getachew Olanni, 2001). They are usually considered as a dietary supplement to farmer‟s daily food consumption, generally based on their crop harvest, domestic livestock products and food purchases on local markets (FAO, 1995 and FAO, 1999; Bell, 1995). For instance, fruits and berries, from a wide range of wild growing plants are typically referred to as „wild food (Guinand and Dechassa Lemessa, 2000).

2.4 Wild food plants

Wild edible plants are with one or more parts that can be used for food if gathered at the appropriate stage of growth, and properly prepared. Edible wild plants could be weeds growing in urban areas to native plants growing in deep wilderness (Hinnawi, 2010).

Plants have been the source of food materials from the dawn of human civilization (Arnold, 1995 cited in Khanal, 2006). For instance, about 300 million people obtain part or their entire livelihood and food from wild, forests in the world (DMP, 1982). Over 70% of the wild edible plants are consumed when food scarcity is high and at times of starvation (Cunnigam, 2001; Tilahun Teklehaymanot and Mirutse Giday, 2010). On the other hand Getachew Addis et al. (2005) stated that wild plants in Ethiopia are used as source of food both at times of plenty and of food shortage. Despite agricultural the fact that societies primarily rely on crop plants, the tradition of eating wild plants has not completely disappeared, their nutritional role and health benefits being reported in many surveys worldwide (Pardo-de-Santayana et al., 2007). Thus, wild edible plants still play an important role in human nutrition especially in the time of starvation (Khanal, 2006). Globally, an estimated 1.02 billion people are undernourished (FAO, 2009) Wild food plants are of high nutritional content such as protein, vitamin B2, and vitamin C, which used as alternatives to conventional vegetables in the human diet (Fentahun Mengistu and Herbert, 2008). According to many sources, the amount of vitamins, minerals and other nutrients in wild food is on the average greater in wild foods (Hinnawi, 2010). Research sup-

ports that some of these foods, as part of an overall healthful diet, have the potential to delay the onset of many age-related diseases (Arnold, 1995 cited in Khanal, 2006).

2.5 Wild edible Plants and their role in combating food insecurity

According to FAO (2010), more than 35% of Ethiopian people are food insecure. The country's ever increasing population along with recurrent drought, war and poor agricultural practices with low productivity, have pulled the country into a vicious circle of food insecurity. In addition, over dependence on a limited number of food sources and poor efforts to diversify dietary sources aggravate the country's food insecurity problem. Many WEPs in Ethiopia were reported as emergency, supplementary or seasonal food sources to avert food insecurity in households of Ethiopian cultural groups. However, consumption of wild edibles is more common in food insecure areas than in other areas in the country (Teklehaymanot and Giday, 2010). Despite the wide availability and utilization of WEPs in Ethiopia, ethnobotanical information on cultural, socioeconomic and nutritional values of Ethiopian plants is limited. Hence, there is still a need for documentation, nutritional analysis and domestication of WEPs to assist in the nationwide effort to combat food insecurity and ensure dietetic diversity.

For example, invasive *Opuntiaficus indica* (L.) Miller (Cactaceae), was found to be widely exploited for its fruit in many parts of northern Ethiopia, playing a significant role in food source diversification (Addis, 2009). The fruits of this plant are also sold in many local markets in the Tigray region of Ethiopia along with other cultivated food sources such as potato, carrot, bean and maize. *Amorphophallus gallaensis* (Engl.) N. E. Br and *Carallumasprengeri* N. E. Br. were also reported for their role in fighting food insecurity during periods of drought and famine in Konso district (Guinand and Lemessa, 2001). This shows the role that WEPs of Ethiopia play, at least at local levels, to combat food insecurity and their potential to address existing food insecurity at national level if properly managed. WEPs in Ethiopia that are reported to have nutritional and commercial properties that are valued in other countries (for example, *Adansoniadigitata L., Tamarindusindica L.,* and *Ziziphusmauritiana Lam*.) are found to be underutilized in the country. Hence it is important that policy and decision makers consider all available ethnobotanical information on Ethiopian WEPs so as to develop regional and national plans for the conservation, management and sustainable utilization of the country's underused wealth of WEPs

2.5.1 Typical famine-food plants

Famine food consist of a variety of plants of which leafy and tender parts of stalk, pseudo stem, fruits and roots are mainly used for human consumption (Guinand and Ugas, 1999). Many of the root type of famine food plants are drought tolerant and can stay in the soil intact for a long time. Most of the leafy type famine food plants are locally classified as „weeds" sprouting and flourishing after rains (Webb and Braun, 1994). There are two main periods of maximum consumption of famine food plants. The first period is while farmers are waiting for the upcoming crop harvest and, the second main period is when they run out of food stocks from the previous harvest and are hence facing a food shortage.

In the Konoso special districts of southern Ethiopia, there are many famine food plants which are consumed during food crisis. Those are *Dobera glabra*, *Sterculia africana, Amorphophallus gallaensis, Arisaema specie* (bagana in konso language) and *Caralluma sprengeri* (Webb and Branu, 1994). The *Ariseama* species are a corm plants that are traditionally categorized in to three main varieties depending on the mode of preparation for consumption namely: the normal bagana, the litota and the romitta variety which are growing in the farm land. Compared to the bagana, the romitta, the littota variety is more preferred over the two because of it has relatively acceptable taste (such as sweeteness).

In general, there are many famine wild food plants in Ethiopia as reported by Demel Teketay and Abejie Eshete (2004) and Kebu Balemie and Fasill Kebebew (2006). Some of these are *Amorphophallus gallaensis, Arisaemia* species, Dobera glabra, Portulaca quadrifida, Caralluma sprengeri, Opuntia ficus indica and Guizotia scabra, Sporobolus indicus ('muryi/harataa' in Oromiffaa), Bidens pachyloma ('chuqii' in Oromiffaa).

2.6 Diversity of Wild Edible Plants in Ethiopia

In Ethiopia, the number of wild food plant species is enormous. Several studies recorded the occurrence of wild food plants at different spots of the country. This information is found in botanical monographs, glossaries, and informal notes as well as in the rich oral tradition of the different communities (Zemede Asfaw and Mesfin Tadesse, 2001). However, documentations of wild food plant species most often appear collected with other edible life forms under the general residence of wild food plants. So far, only two more or less comprehensive documentations of wild food plants are available for country reference. One is that of Azene Bekele et al. (1993) who documented 199 useful tree and shrub species out of which 123 species regard-

ed usable for food and medicines. Another important nationwide documentation of wild food plants comes from the work of Zemede Asfaw and Mesfin Tadesse (2001).

They later documented 203 wild food plant species consumed nationwide, of which wild fruit constituting 61.6%. Besides, from about 370 indigenous food plant species reported drawing from various studies by Demel Teketel and Abeje Eshetie (2004), 182 species belonging to 40 families are indicated to be edible fruit or seed bearing plants.

2.7 The status of wild Food plants in Ethiopia

According to Lawton (1982), the vast woodlands of Ethiopia are mostly regenerating, after long time degradation that was reported in these areas in the 1980s. The main cause of degradation was the increasing demand of the local communities for agricultural land, fuel, for wood production for income. However, over time such products were increasingly marginalized as the emphasis in forest management shifted to timber production. Presently, the increased interest in wild food plants has been prompted by the rediscovery of the role of edible wild food-plants to small-scale livelihoods and has resulted in a rapid rise in interest among conservations, foresters, protected area managers, social development advisers and indigenous rights groups (Campbell et al., 1993). Campbell et al., (1993) further reported that this has generated a proliferation of studies in to the potentials of wild food plants for income generation and as a means of involving local people in forest management and benefit sharing to ensure sustainable utilization of these resources. Previous study by Ruffo et al (2002) revealed that despite the fact that many wild food plants are used by the majority of rural population, they are still not as much appreciated or valued as some of the introduced food plants such as mango, orange or cabbage. This is to say, these wild food plants are still regarded as inferior and only appropriate for the poor. Studies by FAO (1990) and Kavishe (1993) have revealed that there has been a widespread decline in knowledge about wild food plants, especially among young and those who live in urban areas.

2.8 Need for Assessing Wild food plants

According to FAO (2001), biological resource quantification or inventory aims at understanding, which resource is more useful commercially and what consequences of exploitation are on the resources base itself. This can provide information for sensible and appropriate management of biological resources. For biologically sustainable harvest levels of a product to be determined, there must be a minimum set of good information available on the resource species

in terms of abundance, distribution and reproductive biology. Experience has shown that the assessment of different biological resources was done by using inventory and participatory resource assessment techniques to determine species composition, structure and diversities. However, the formal resource assessment of forest products, especially food plants in developing countries is relatively new and has received little attention to date. Due to inadequate data for each of the above methods and variations in utilities of wild food plants in forest ecosystem, Wong et al., (2001) asserted that field of plant products, utilization potential and conservation strategies for specific forest ecosystems are essential and can significantly improve our understanding about the missing information and statistical data on wild food plants. Furthermore, existing information on wild food plants availability, utilization pattern and conservation aspects are often based on case studies, often unclear, inconsistent and contradictory. In many cases methodologies to collect and analyze viable key information do not exist.

2.9 Threats of wild Edible plants in Ethiopia

Ethiopian wild edible plant species as elsewhere in Africa is faced with problems of continuity and sustainability (Tigist Wondimu et al., 2006).

There are two main sources of threats to wild edible plants i.e. manmade and natural causes. The rapid increase in population, urbanization, timber production, overgrazing, destructive harvesting, invasive species, commercialization, honey cut, agricultural land expansion and habitat destruction are human caused threats to wild food plants. Likewise, natural threats including recurrent drought, bush fire, disease and pest outbreaks cause the extinction of wild edible plant species (Kebu Balemie and Fasiil Kebebew, 2006).

According to Tariku Birhanu and Eyayu Molla (2017) in Benishangul Gmuz currently some of the remnant forests with large numbers of the wild edible plants are subjected to frequent deforestation by the local community. This is attributed mainly to human population pressure and its associated effects. Agricultural land expansions, wild fire, fuel wood collection, overgrazing, and overharvesting are the main reasons for the destruction of wild edible plants. As elsewhere in Ethiopia, the problem is manifested in Mandura districts due to the above mentioned factors.

2.10 Loss of wild food resources

Threats of wild plants are mostly caused by human beings (Rodgers and Homewood, 1982). Results from this array of human threats, rates of extinction are now estimated to be between 1,000 and 10,000 times greater than in the past (Pearce and Moran , 1994). Recent global and national information sources show significant and still increasing loss of biological resources in most tropical regions including Ethiopia. The factors leading to the loss of the biological resources including wild food plants are described bellow:-

2.10.1 Habitat loss, fragmentation and degradation

Wild plants, by definition, grow in natural or semi- natural ecosystems in different biomes around the world (Ruffo et al., 2002). At present all these have been greatly affected and modified by human activities such as the conversion for other uses (agriculture, pasture, urbanization, industrial, etc.) and these lead to removal of large proportions of natural ecosystems and replace them with a greatly modified matrix, with in which small remnants of the native ecosystem remain (FAO, 2001). According to Amare Getahun (1974), one of the consequences of habitat loss, fragmentation or degradation is the loss of large number of wild species that are threatened, including many that are used by farm households.

2.10.2 Overexploitation and over harvesting

The increase in the number of urban dwellers who still rely on traditional plant-based remedies has added to the pressure on wild resources and has led several species to face to a serious risk of population loss and genetic erosion through unsustainable harvesting practices such as decortications (Rodgers and Homewood, 1982; Pearce and Moran, 1994). However, overharvesting is encouraged by market requirements. There is a widely held perception that plants collected from the wild are more effective than cultivated ones (Ruffo et al., 2002) and this idea is even used as a marketing strategy . It may however, have the effect of allowing producers to charge higher prices. Sustained harvesting of plant species for which there is a commercial demand may lead to genetic erosion (UNEP, 1991).

People use many wild plant species for medicine, clothing, shelter, firewood, fiber, timber production and fulfilling of cultural and spiritual needs throughout the world (Zemede Asfaw, 1997). The primary causes of this problem are loss of taxa with the associated indigenous knowledge

2.10.3 Introduced and invasive species

One of the greatest threats to natural and semi-natural vegetation, which is often overlooked, is the deliberate human introduction of species of trees and fodder crops which have largely replaced the native ecosystems (Sisk et al., 1994). Introduced species may also be a threat to productive systems. On the other hand, many weedy species are tolerated or even encouraged in traditional farm systems such as home gardens, where they may be an important resource.

2.11 Conservation practices of wild Edible plants

The concept of Sustainability is now seen as the guiding principle for economic and social development, particularly with reference to biological resource. (Endalew Amenu, 2007.The objective of conservation is to conserve maximum diversity within each species to ensure that its genetic potential will be available in the feature ideally all plants should be conserved as evolving population in their natural ecosystem. However, this is not practically feasible for all species. Plants genetic resource can be conserved in-situ or ex-situ the two systems are complementary and are being adapted in to the conservational strategy in Ethiopia. (Abebe Demessie, 2001).

In broader sense conservation is achieved through in-situ and ex-situ means. In-situ conservation is conservation of species in their natural habitat (Zemede Asfaw, 2001). Ethiopia has polices and strategies that support the development and utilization of plant resources in a sustainable manner. These policies are reflected under various sectors including environmental protection, development of the natural resources and diversification of the domestic and export commodities. (Endashaw Bekele, 2007).

The reviewed research outputs on WEPs of the country indicate the need for conservation as well as documentation (Balemie and Kibebew, 2006; Addis, 2009; Asfaw, 2009; Teklehaymanot and Giday, 2010; Fantahun and Hager, 2010). Conserving Ethiopian WEPs in situ (in their natural habitat as in nature reserves and parks) or ex situ (e.g. in field gene banks, botanic gardens or cold rooms) is mandatory (Teklehaymanot and Giday, 2010).

Work with communities to evolve improved methods of managing trees and other plants have many potential benefits for conservation and sustainable development (Hamilton et al., 2003).

In Benishangul Gumuz Regional State of Kamashi Zone understanding of the local people about the importance of conserving the wild edible plants, only some in situ (in original/natural habitat) conservation methods like planting in the form of fences and protected pasture land in different worship areas (churches, mosques) and in their farm field/farm margins are being practiced in the study area. This indicates that the necessary conservation measures are not being taken in the area, and hence the wild edible plants are not free from threats (Tariku Birhanu and Eyayu Molla, 2017). Elsewhere in Kamashi district, the conservation and management of wild plant resources problem is manifested in Mandura district as well.

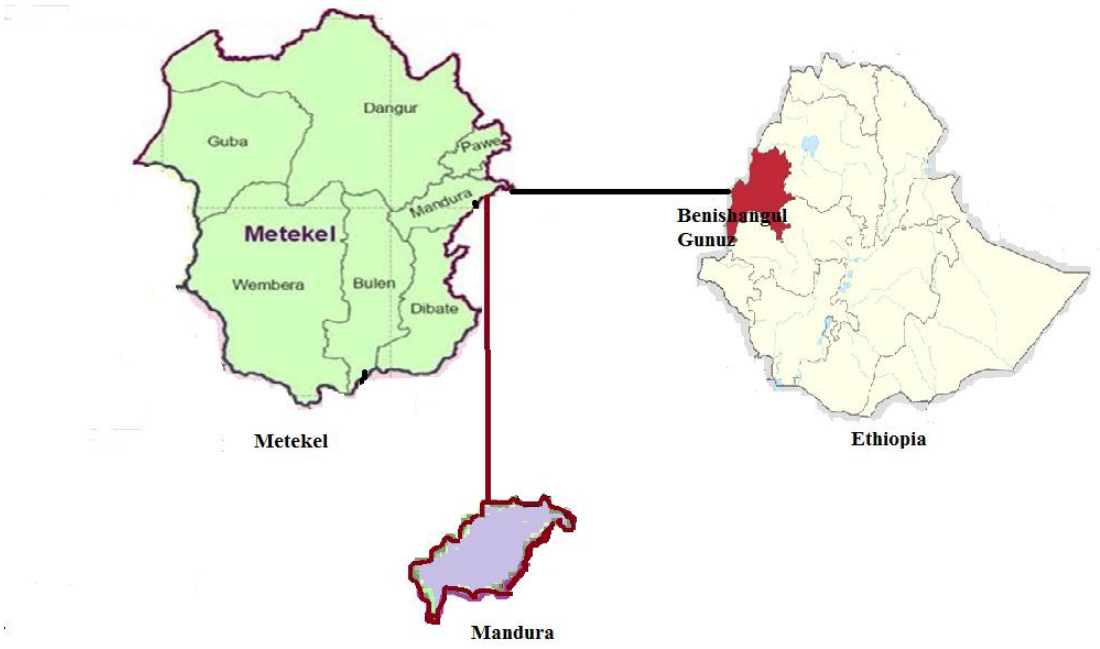
CHAPTER THREE

3 Materials and Methods

3.1 Description of the Study Area

3.1.1 Location and Topography

This study was conducted in Mandura District in the Benishangul Gumuz Regional state of Metekel zone, North West Ethiopia. It is bordered by Dangur in the north and northwest, by Pawe Woreda in the northeast, by Amhara Region in the east, by Dibate in the south, and by Bulen in the southwest. Mandura is situated at about 547Km north west away from the capital city, Addis Ababa and 384 Km away from the capital of the region Assosa and the GPS location of the district is $11^0$19’59.47’’ N latitude and $36^0$25’00.66’’E longitude. (Solomon



Asnake *etal*, 2016).Map of the study area is shown in (Figure 1).

Figure 1: Map of study area

3.1.2 Population

Based on the figure from CSA, (2007), the total population of the district is estimated to be 56,530 (male 29,004 and female 27,526). The four largest ethnic groups reported in Mandura were the Gumuz (87%), the Awi (8.9%) a subgroup of the Agaw the Amhara (3.9%); all other ethnic groups made up 0.2% of the population. Gumuz is spoken as a first language by 87%, 8.4% speak Awngi and 4.6% speak Amhara. The majority of the inhabitants practiced traditional religions, with 72.5% of the population reporting beliefs classified under that category, while 24.5% practiced Ethiopian Orthodox Christianity. Administratively Mandura Woreda is subdivided into 29 administrative kebeles, four of them found in town while the rest are rural kebeles (MWCO, 2018).Mandura woreda comprises 17 rural kebeles and 3 town Kebeles and totally 20 kebeles (Villages).

3.1.3 Climate

According to Pawi metrological center (2018) Mandura district receives high rainfall distribution between June and October as well as relatively good amount from September to November. The mean monthly rainfall of the study area is 1054mm. It receives uni-modal rain fall and occurs for 6 months of the year, usually between May and October. The average maximum temperature in the study area was recorded in April 22.18 ^{0}C .On the other hand, average minimum temperature recorded was during September 11.70 ^{0}C. In general the mean annual temperature and mean annual rainfall of the district is 29.20 ^{0}C and 88.89mm, respectively.

3.1.4 Topography and Soil

The District is part of the North-West areas of Ethiopia. High points of the Woreda include the Kar Ber Mountains in the Southern part, which run along the 'Tiski' River and turns to the South West as a boundary of Amhara Regional State. According to MWOA(2018), the area comprises variety of land features, dominantly of plain lowlands (31%), mountains (52%) and rugged (14%) and altitude ranging from 900 to 1700 m.a.s.l. Steep sided and wide gorges have been/are being formed mainly by the Gilgel Beles River. There are two agro ecologies: midland (1500-1700 m.a.s.l) and lowland (900-1500 m.a.s.l). About 20% of the Woreda is midland, while 80% lowland agro-ecology. There are rivers and streams traversing the Woreda

and often serving as sources of water for the population (MWOA).The major soil covers of Mandura Woreda is 65 % sandy soils, 30% loamy soils and 5% Vertisols (MWOA, 2018).

3.1.5 Vegetation

The total area of the district is estimated to be about 338,289 hectares, of which farm land accounts 23%, Forest land 46%, grazing land 13%, cultivable farm land 14%, and unusable land 3% and settlement 1%. The forest land of the district is characterized by patchy distribution of different trees that do not form dense canopy covers (MWOA, 2018).

The vegetation of the study district is predominantly composed of different woody and herbaceous species. The natural vegetation of Mandura is mainly composed of various lowland and midland species such as *Acacia sp.*, *Ficus spp. (*Such as *Ficus thonnigi, Ficus sur, Ficus vasta, Ficus mochsttery,e.t.c.,Cordia africana, Albizia spp. Coroton macrostachyus, Adonsoniadigitata, Dombeya spp. ,Ekeverglacapensis, Carissa,* and other trees, shrub and herbaceous species (MWOA, 2018).

3.1.6 Economic Activities

In terms of economic activity, agriculture is the dominant economic sector in the Woreda from which nearly 92.5% of the total population derives its subsistent way of life (hand to mouth). The major source of income in the Woreda is traditional way of crop farming (hand digging farming) and animal rearing. Therefore no food security in the area, their life depends on the wild food plants for survival. In addition to this in a Gumuz ethnic group, community members are engaged in selling charcoal, fire wood and timber wood for other community members to support their incoming. (Sources MWAO, 20018).

3.1.7 Agriculture

According to MWOA (2018), the total area of the district about 35,200 hectors and 17,100 ha of land is farm land, 10,500 ha is grazing land and 12,100 ha are forest land and woodlands. The livelihood of the local people is mainly based on subsistence mixed agriculture (Crop-livestock production). The dominant crops grown in the district are cereals like Millet, Ground nut, Maize, Sorghum, and Soya. According to the office, large ruminants are the dominant livestock population in the district, while small ruminants and equines are the second and the third largest populations, respectively.

3.2 Research Design

The research design of the study was summarized in (figure 2).

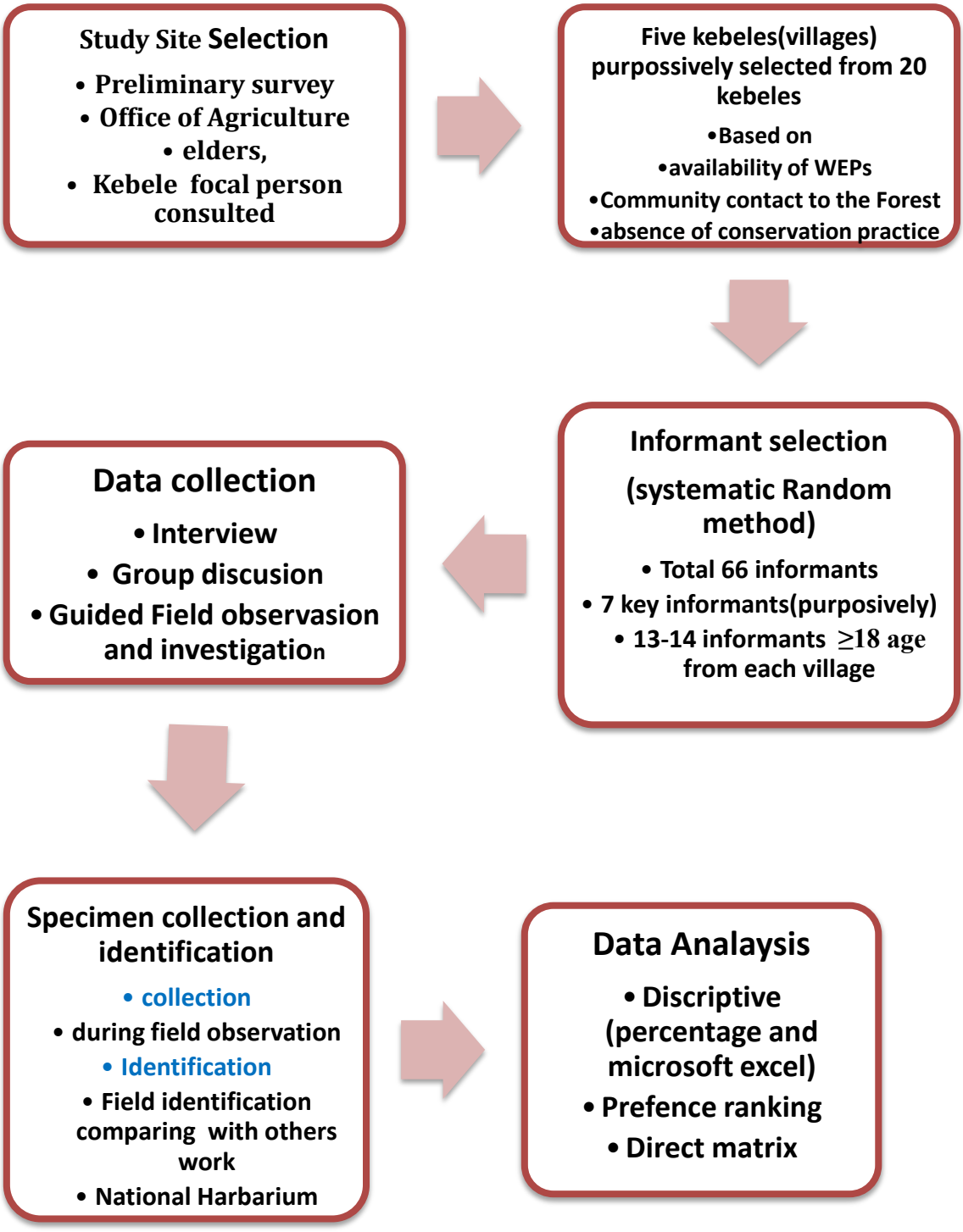


Figure 2: Summery of research design

3.3 Materials Used

Plant press, plastic bag, note books, and digital photo camera were the materials used in the field study.

3.4 Method of the study

3.4.1 Study Sites Selection.

The study was conducted in Mandura District from September 1/01/2018 – June 30/10/2019. Preliminary survey was held in order to have an overview of the culture and socio-economic aspects of the communities in the study area. Mandura Woreda Office of Agriculture (MWOA), elders, and Kebele administrative person were also consulted during survey before the selection of specific study area. The District was selected purposively based on their high utilization of wild edible plants, presence of vegetations cover and absence of conservation practice of wild food plants in the area. The district has a total of 20 kebeles(villages) and among these, 5 kebeles (Dafili, Qutir hulet, DAbuh, Dikul, and G/Mariam) were identified and selected purposefully based on their high utilization of wild edible plants, presence of vegetations cover and absence of conservation practice of wild food plants in the area.

3.4.2 Informant selection

3.4.2.1 Key Informant and Focus Group selection

Key informants were purposively selected from the study site based on their better knowledge on WEPS, the socio-economic and culture of individuals, who have been lived for a long period of time in the villages and by using recommendations from the local kebele administrators, knowledgeable elders and kebele agricultural and development officials. Seven key informants were selected for focus group discussion. Focus group discussions were conducted with a group of individuals with in both sexes aged from 18 and above years old.

3.4.2.2 General informant Selection

Systematic random sampling method was employed to select the general informants. The number of villagers or households interviewed was randomly selected using the village registers. From the register, the name of household heads were sampled using a systematic random sampling technique (i.e. every tenth person on the list was interviewed) since the names were listed in a completely random manner and this type of sampling minimizes selection bias. Based on the sampling frames, a total of 66 informants (22 males and 44 females) age above 18 were included from Genete Mariyam (14), Qutir Hulet (13), Dafilli (13), Dikul (13) and

Dabuh (13). It was assumed that women in Gumuz communities mostly engaged in gathering, preparing and consuming WEPs and hold family responsibilities than males.

3.5 Plant specimen collection and identification

Based on ethnobotanical information provided by informants, collected voucher specimens during guided field walk were pressed, numbered and given vernacular names on each sheets and dried. Most of the identification was done mainly based on the works of Tariku Birhanu (2017) and Dessalegn AYele (2017) who had done the similar study in Benishangul Gumuz and whereas few species identification was conducted at the National Herbarium of Addis Ababa University, Ethiopia by using taxonomic keys in published volumes of the flora of Ethiopia and Eritrea by aid of taxonomists.

3.6 Ethnobotanical data collection

Ethnobotanical data was collected between Januarys to May, 2019 on two field trips. The data was collected based on prepared semi-structured interviewees, observation, focus group discussion, and guided field walks with key informants were employed to obtain ethnobotanical wild food plants information and indigenous knowledge of the local communities concerning them. All questions of interview and focus group discussions include the various data sets such as local names, parts of the plant used, types of plants species and methods of consumption and management/conservation practice in the area. All of the interviews and group discussion questions were held in Gumuz language for informants by the help of native translators. The place and time for discussion were set based on the interest of the informants.

3.6.1 Semi-structured interviews

Semi-structured interviews were conducted in places where the informants were most comfortable and during the time they have wanted or chosen. Interviews were held in a group to gather the data or information regarding local name of wild edible plant, parts used, methods of preparation, threats and management and other relevant information were recorded.

Interviews and discussions were based on a checklist of topics or questions prepared before hand in English and the translated to Gumuz language by native translator (Appendix I&II) and information were gathered technically by the researcher from the villagers as shown in the (Figure 3).

Figure 3: Interview with informants

3.6.2 Group discussion

Discussion was made with selected key informants about the knowledge and use of nutritionally important wild food plants. At the time of discussion all informants were allowed to talk freely without interruption. All relevant information such as plant species used as a food, local names, parts of plants used, method of preparation, current status and degree of management and conservations of wild edible plants and vegetations in general they discussed(AppendixII).

3.6.3 Guided field walk and observation

Guided field walks were performed with key informants and they were interviewed during the trip. Based on ethnobotanical information provided by informants, voucher specimens were collected at the festal (bag), numbered, named by using local names, pressed, dried, deep freeze and identified some in the field. During field observation and investigation available information about WEDPs was recorded in the prepared questions (checklists) (Figure4).

Figure 4: Field observation and investigation

3.7 Ethnobotanical data Analysis

The Ethno botanical data collected was analyzed following survey and analytical tools for ethno botanical methods which were Informant's preference ranking, descriptive statistic (Microsoft excel spreadsheets soft ware, table and percentage), preference ranking, and Direct matrix ranking conducted following (Martin, 1995), (Cotton, 1996) and (Nemarundwe and Richards, 2002).

3.7.1 Descriptive statistics

Descriptive statistics that are percentage and Microsoft excel spreadsheet, percentage, tables and charts were used to analyze the ethnobotanical data of the reported wild edible plants and their associated indigenous knowledge. The analyzed data were summarized and presented using tables, percentage and graphs.

3.7.2 Preference ranking

Preference ranking was computed to assess the degree of preference of wild edible plant parts, and importance of species at different seasons. And also edibility ranking was carried out by the key informants to prefer the plant species based on their taste, species availability, economical and social values by giving values 1-5, 1 the least preferable and 5 the most preferable(Table 7).

3.7.3 Direct matrix ranking

Direct matrix ranking was done following (Martin, 1995 and Cotton, 1996) in order to compare multipurpose use of a given species and to relate this to the extent of its utilization versus its dominance. Priority ranking was employed to determine threats of wild edible plants based on their level of destructive effects. To recognize threats of wild edible plant species, values from 1–5 were given:1 is the least destructive threat and 5 the most destructive threat (table 9). Based on information gathered from informants, six multipurpose plant species were selected out of the total wild edible plants and use diversities of these plants were listed for seven selected key informants to assign use values to each species (Table.10). Seven key informants were chosen from other key informants depending on their activities during interview to conduct this activity and each key informant was asked to assign use values (5 = best, 4 = very good, 3 = good, 2 = less used, 1 = least used and 0 = not used).

CHAPTER FOUR

4 Results and discussion

4.1 Results

4.1.1 A socio demographic characteristics

4.1.1.1 Ages and sex of informants

The distribution of informants with respect to age class shows that, the majority of knowledge-able elders were in the age class of 41 to 50 (31.31%) followed by 51 to 60 (25.25%) age class. The study was indicated that the majority of the key informants were elder age groups 21 (31.31%).

Regarding sex, 44 (66.67%) of the major informants were females whereas the remaining 22 (33.33%) were males (Table 1).

Table 1:- Age and sex of the informants

Informant's age	No. of informants in sex			Percentage (%)
	M	F	Total	
20-30	-	5	5	7.58
31-40	2	11	13	19.69
41-50	6	15	21	31.81
51-60	8	10	18	27.28
61-70	5	3	8	12.12
71 and above	1	-	1	1.52
Total	22	44	66	100%

4.1.2 Marital Status of Informants

The total informants, 81.82% were married, but 7.58% and 10.60% were single and divorced respectively. The most common dominant informants during the interviewed were married followed by divorced people (Table 2).

Table 2:- Marital Status of the informants

Marital Status	Sex			Percentage(%)
	M	F	Total	
Single	3	2	5	7.58
Marred	16	38	54	81.82
Divorced	3	4	7	10.60
Total	22	44	66	100%

4.1.3 Occupational status of informants

The total informants, 66.67% were farmer where as 6.06% and 27.27% were merchants and charcoal &fire wood sellers respectively. Furthermore, farming was the main task of the people in the study with traditional (hand digging) way of farming (Table 3).

Table 3:- The occupational status of the informants

Occupational status	Sex			Percentage
	M	F	Total	
Farmers	18	26	44	66.67
Merchants	4	-	4	6.06
Charcoal &fire wood sellers	-	18	18	27.27
Total	22	44	66	100%

4.1.4 Educational status of informants

In comparison of educational status, non-educated informants handled much knowledge of WEDPs. The result of the study in (Table 4) shows that 41 (62.12%) were illiterate followed by adult illiteracy educators 14(21.21%) and grade 1-4 informants comprises 11(16.67 %) from the total informants. This illiteracy educated and grade 1-4 informants could not read and

write correctly. This shows that the community in the study area did not focus on modern education rather than subsistent way of life. But non-educated informants handled much knowledge on how to use WEPs and edible parts of the species.

Table 4:- Educational status of the informants

Educational status	Informant sex			Percent (%)
	M	F	T	
Illiterate	11	30	41	62.12
1-4	5	6	11	16.67
Adult education	6	8	14	21.21
Total	22	44	66	100%

4.2 Indigenous Vegetation Classification

The local people of the study area categorize the vegetation based on plant density, distribution and associated landforms

Chegiziya:- This type of vegetation is with densely populated plant species and composed of a range of larger trees, where many wild animals stay. In the study area, some local people communities call it Chaka and others refer to it as Den. This type of vegetation has declined in the study area because of agricultural expansion and plant species like Acacia abyssinica, Cordia *africana, Croton macrostachyus*, and *Gardenia ternifolia* (Dessalegn Ayele,2017).

Kancha **:-** Open woody and shrub land with patches of trees, bushes, shrubs and herbaceous species. It is common near agricultural margins and mountain escarpments. Plant species like *Rhus glutinosa, Dispcopodium penninervum, Phytolacca dodecandra, Rubus steudneri* and *Rosa abyssinica* are found.

Chambelda Giziya:- Refers to an area covered by grass and serves especially as grazing land.

4.3 Soil Classification by Indigenous People

The local people classify soil based on soil characteristics such as color of the soil, fertility of the land, and other criteria. The following four soil types have been identified by local people:-

Mihyma Enya: This soil type refers to black soil and with better fertility and production in contrast to other soil types. The people use this soil to grow crops like *Eragrostis tef, Allium sativum, Zea mays, Allium cepa,*

Embadima Enya: Mix of both red soil and black soil type suitable for crop production (for examples *Guizotia abyssinica* and *Eragrostis tef*).

Miyema Enya**:** This soil is red soil type; it is less fertile in comparison to the black soil. But, it can enable to grow crops of various types by applying fertilizer. The people use this soil to grow crops like *Brassica carinata*, *Mangifera indica*, *Capsicum annuum,* and *Zea mays.*

Empuma Enya: This type of soil is white soil which is not suitable for crop production.

4.4 Indigenous Knowledge (IK) Transfer and Practice

Out of the 66 informants, 35 (53.03%) reported that their knowledge of wild food plants was acquired through observation, and oral history, while 16(24.24%) reported that they acquired knowledge secretly from elders, when they became very old. Moreover, 15(22.73%) of the respondents reported that the knowledge of wild food plants was transferred through songs, and riddles in local languages at different times especially when the people are at rest especially during the night time (Figure 5).

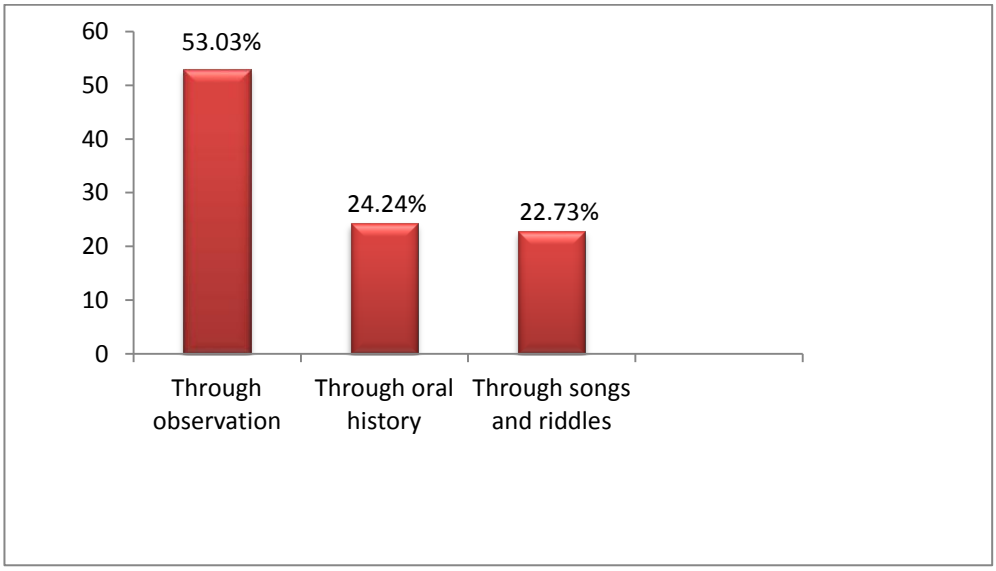


Figure 5:- How Indigenous knowledge transfer to next generation

4.5 Wild Food Plants and Their Multi-purpose Values in the Study Area

Among the 25 WEPs documented in the study area, 15 plant species (60%) were reported to have multipurpose roles while 10 of them (40%) have only food role in the area (table 7). This finding shows that the local people used wild edible plants in addition to food, mostly for construction and building, fuel consumptions and medicinal value (Figure 6).

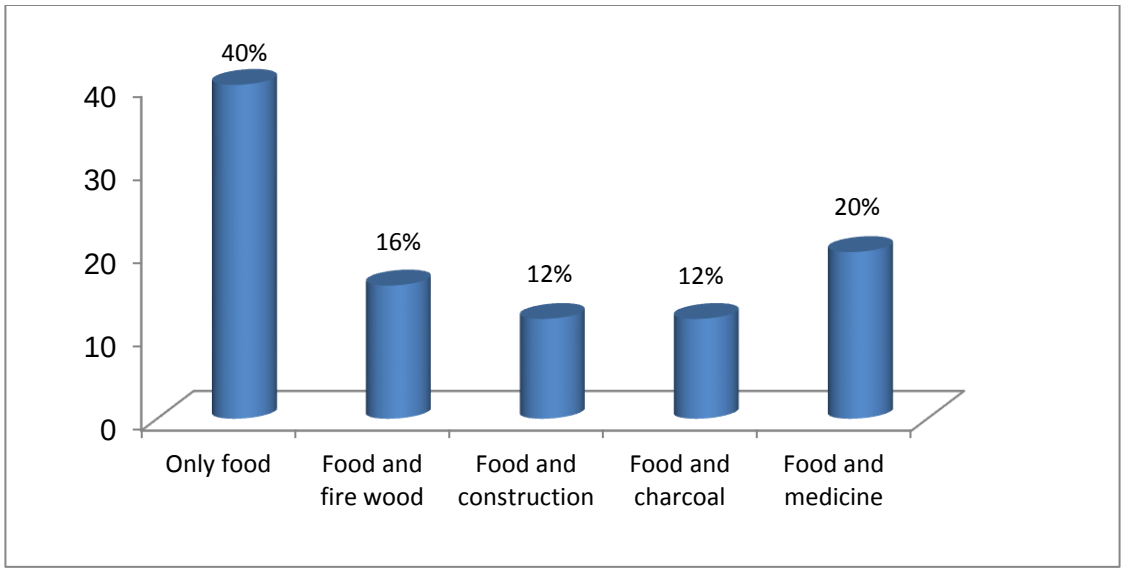


Figure 6:- Multi purposes of wild edible plants in the study area

4.6 Habit, Parts Used, and Mode of Consumption/Preparation.

Totally 25 WEP species with their 19 family were collected and recorded with regarding parts used, growth forms, and the mode of consumptions/preparation in the study area.

Table 5;- List of the reported wild edible plants in the study area based on family name, Scientific name, habit , parts used and mode of consumption and preparation .

Habit:- T=tree, H= herbs, S= shrubs and C= climber.

Table 5:- parts used and mode of consumption/ preparation

Family	Scientific Name	Local Name (Gumuz)	Habit	Parts used	Preparation and mode of consumption
Acanthaceae	*Justicia ladanoides*	Kakim	H	Leaves	Flesh leaves are boiled and eaten
Apocynaceae	*Carissa spinarum*	Soha	S	Fruit	Fruit is eaten raw and as juice
Asteraceae	*Vernonia amygdalina*	Banjaga	H	Leaves	Leaves are eaten either raw or cooked
Boraginaceae	*Cordia africana*	Banja	T	Fruit	Fruit is eaten raw
Flacourtiaceae	*Oncoba spinosa*	Ankuta	S	Fruit	Fleshy endocarp is eaten raw
Moraceae	*Ficussy comorus*	Fuqa	T	Fruit	The fruit is eaten raw

Rhamnaceae	*Ziziphus abyssinica*	Ander-guga	T	Fruit	The fruit is eaten raw
Balanitaceae	*Balanites aegyptiaca*	Qota	T	Fruit	Fleshy exocarp of the fruit is removed first and then the stony mesocarp is broken and the endocarp fruit is roasted and is eaten after getting immersed with alcohol for sexual excitement and to neutralize the alcoholic effects
Anacardiaceae	*Rhus retinorrhoea*	Gangiya	T	Fruit	Fruit is eaten raw
Vitaceae	Ampelocissus schimperiana	Antsiqina	S	Stem	Young stem is eaten raw
Myrtaceae	*Syzygium guineense*	Diwa	T	Fruit	The fruit is eaten raw
Solanaceae	*Physalis peruviana*	Ejisiya	T	Young stem	Young bud and Flower cooked and eaten
Dioscoreaceae	*Dioscorea praehensilis*	Echa	C	Tuber	Root is cooked and eaten
Olacceae	*Ximenia americana*	Feya	S	Fruit	The fruit is eaten raw
Tiliaceae	*Grewia mollis*	Gidiya	S	Fruit	The fruit is eaten raw
Apocynaceae	*Saba comorensis*	Huya	C	Seed	The fruit is eaten raw
Tiliaceae	*Corchorus olitorius*	Laliqa	H	Leaves	Young leaves eaten raw or after being cooked
Poaceae	Oxytenanthera abyssinica	Enta/ Kambua	H	stem	The young stem is cut off and eaten after cooked
Fabaceae	*Piliostigma thonningii*	Mecha	T	Fruit	The fruit is eaten raw
Rubiaceae	*Gardenia ternifolia*	Kota	S	Fruit	The raw fruit eaten raw
Verbenaceae	Vitex doniana	Anguh-manza	T	fruit	Raw ripped fruit eaten
Solanaceae	*Solanum alatum*	Bosiya	T	Fruit	The fruit is eaten raw

Cucurbitaceae	*Momordica foetida*	Bida	C	Leaves and fruit	Young leaves are eaten after cooking and the fruit endocarp is eaten raw
Fabaceae	Phaseolus vulgaris	Jajuwa	H	Leaves	Leaves eaten after cooked
Asteraceae	*Vernonia auriculifera*	Agidema	S	Leaves	The young leaves and shoots eaten after cooked

4.7 Habit of Wild Edible plants in the study area

In the study area there are many habits of WEPs species includes herb, shrub, tree and climber. The result of the study shows that analysis of habits of WEPs in the study area revealed that tree constitute the largest category 10 (40%) followed by shrubs 7 (28%), 5 (20%) herbs and 3 (12%) Climbers were recorded respectively (Figure 7).

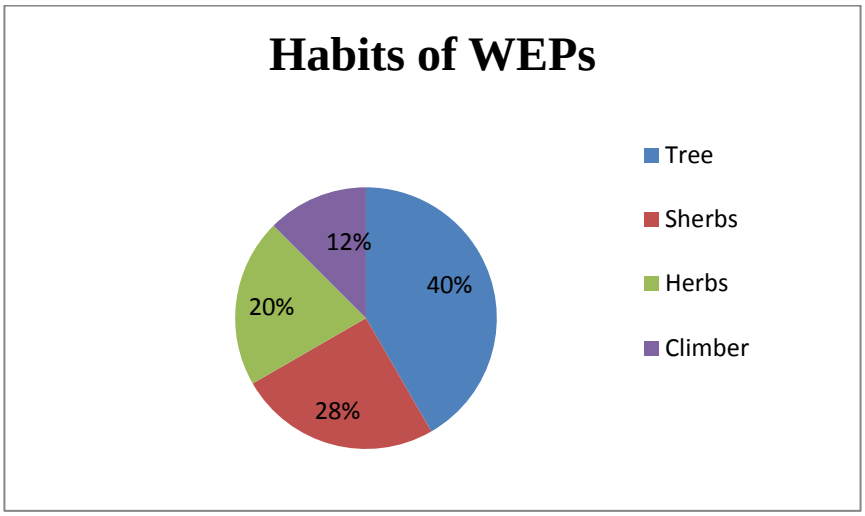


Figure 7:- Habits of wild edible plants in the study area

4.8 Parts of wild edible plants used in the study area

Among 25 wild edible plant species recorded in the study area, the most widely used plant part were fruits, which accounted for 13(52%) followed by leaves 6 (24%), young stem 3 (12%), tuber 2 (8 %) , and seeds 1(4%) . This result is similar with the study conducted by Dessalegn Ayele (2017) on wild edible plants at Benishangul Gumuz, Kamashi district of Ethiopia which 18 (30%) fruit and 14(23.33%) leaf were highly consumable parts of wild edible plants species by indigenous peoples of the study area. Tuber/Root 7(11.67%) and stem 5(8.33%) were next edible parts of the plants by the peoples. Seed 4(6.67%), Flower, stem & fruit, and

fruit & seed each accounts for 3(5%), edible parts. The rest of parts like leaf and fruit, leaf and seed, and young bud and flower contributes 1(1.66%) each (Figure).

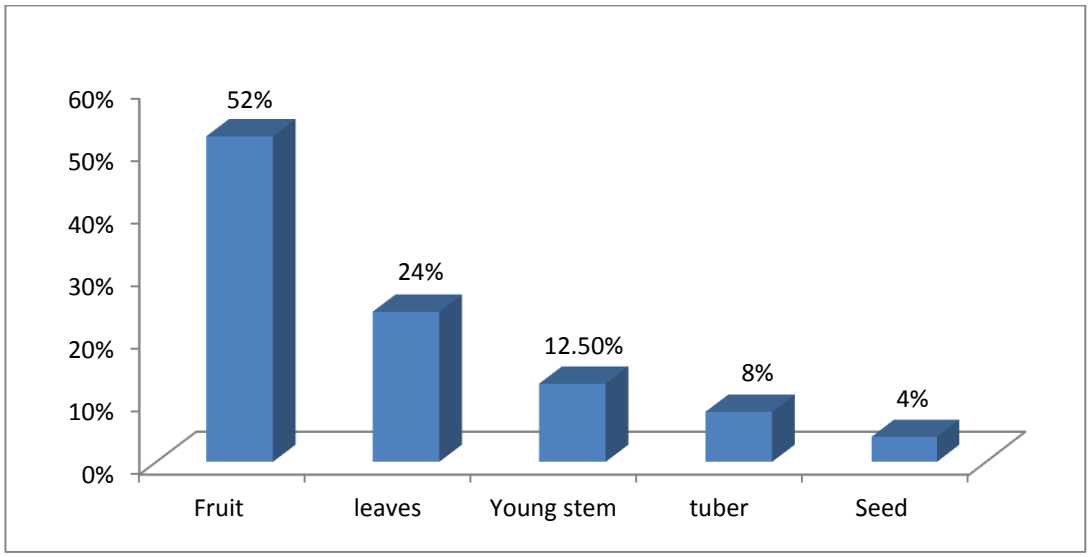


Figure 8:- Parts of wild edible plants

4.9 Seasonal Availability of Wild edible plants

All the recorded wild edible plants were available in different seasons in the study area. About 9(36%) of plant species were found in autumn season followed by about 7 (28%) of species in winter season whereas about 6(24%) and 3(12%) of plant species were found only in all season and summer, respectively (Figure 9). This might be due to the fact that most of wild edible plants are annual plants and needs rain for maturation and it is favorable condition for the plants (Figure 9).

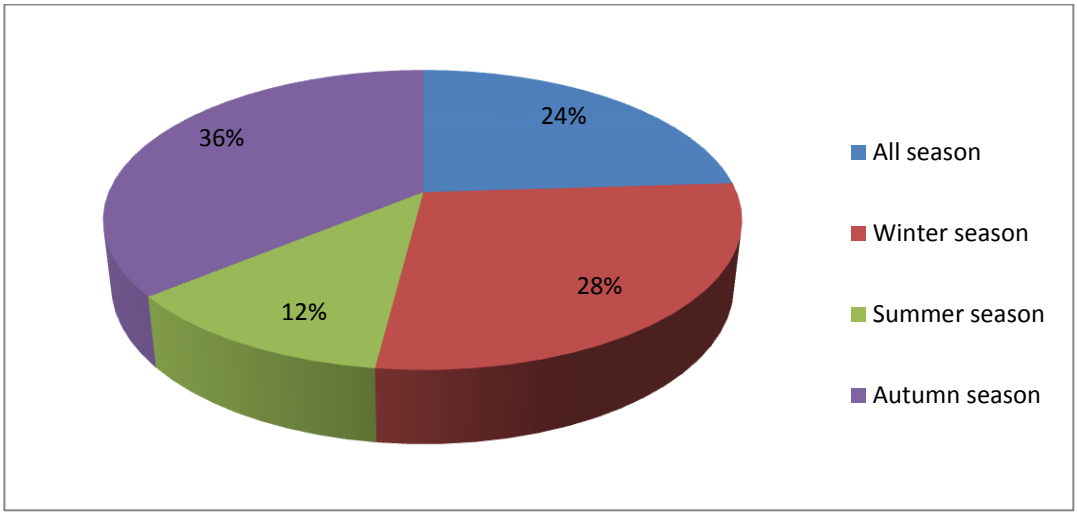


Figure 9:-Seasonal availability of the wild edible plants in the study area

4.10 Edibility Preference

Preference ranking for ten wild food plants mostly used by local communities (Table 7) made by seven informants showed that *Justica ladanoides* is ranked first and hence is the most preferable edible plant species. And *Physalis peruviana*, *Saba comorensis*, *Corchorus olitorius*, *Vitex doniana Sweet* are 2^{nd}, 3^{rd}, 4^{th}, 5^{th} preferable food plants respectively. But others are less preferable plant species in the study area as respondents reported.

Table 6:- Result of preference ranking on ten most popular selected wild food plants based on their taste, availability and frequently used by local people as perceived by respondents in the study area (5=most preferred, 1=least preferred).

Name of plants species	Respondents(R1-R7)							Total	Rank
	R_1	R_2	R_3	R_4	R_5	R_6	R_7		
Justical adanoides	4	5	5	5	4	5	5	33	1^{st}
Vitex doniana Sweet	4	5	3	3	2	3	5	25	5^{th}
Physalis peruviana	5	4	3	4	5	4	3	30	2^{nd}
Balanites aegyptiaca	3	4	3	2	3	4	3	22	7^{th}
Saba comorensis	4	5	4	3	5	4	3	28	3^{rd}
Dioscorea praehensilis	3	2	3	4	3	3	2	20	9^{th}
Ampelocissus schimperiana	4	3	3	3	3	3	2	21	8^{th}
Corchorus olitorius	4	4	3	4	3	4	5	27	4^{th}
Ziziphus abyssinica	2	3	3	3	2	3	3	19	10^{th}
Syzygium guineense	4	3	3	3	3	4	3	23	6^{th}

4.11 Direct matrix ranking

Direct matrix ranking was performed to assess the relative importance of each of the plant species. Direct matrix ranking of six most popular multi-purpose wild food plants species showed that *Balanites aegyptiaca, Cordia africana* and *Saba comorensis* ranked 1st, 2nd and 3rd, respectively. In contrast, *Dioscorea praehensilis* was the least ranked (Table 7).

Table 7:- Results of direct matrix ranking on six multi-purpose wild food plants based on 7 key informants (Use values given from 0 to: 5 = Excellent, 4 = Very good, 3 = Good, 2 = Less, 1 = least and 0= No use)

Plant species	Only food	Food and medicinal	Food and charcoal	Food and firewood	Construc-tion and building	To-tal	Rank
Justica ladanoides	5	5	1	1	1	13	5th
Cordia africana	4	3	5	5	5	22	2nd
Balanites aegyptiaca	5	5	5	5	4	24	1st
Oxytenanthera abyssinica	3	1	4	5	4	17	4th
Dioscorea praehensilis	5	3	1	1	2	12	6th
Saba comorensis	5	5	2	2	5	19	3rd

4.12 Current situations of wild edible plants in the study area

In this study area WEPs were collected mostly from wild habitats or on their natural habitat. As the result shows that most of the WEPs used by the communities were collected from wild 20(80.00%) ,Home garden 3(12.00%) and 2(8%) both in wild and home garden. Out of 20 WEPs species recorded, from wild 11(55%) are found in the forest, 6(30%) from the farm land and 3(15%).from the other natural habitat. However the least species were recorded from roadside ,all of the wild habitates listed in figure(10).

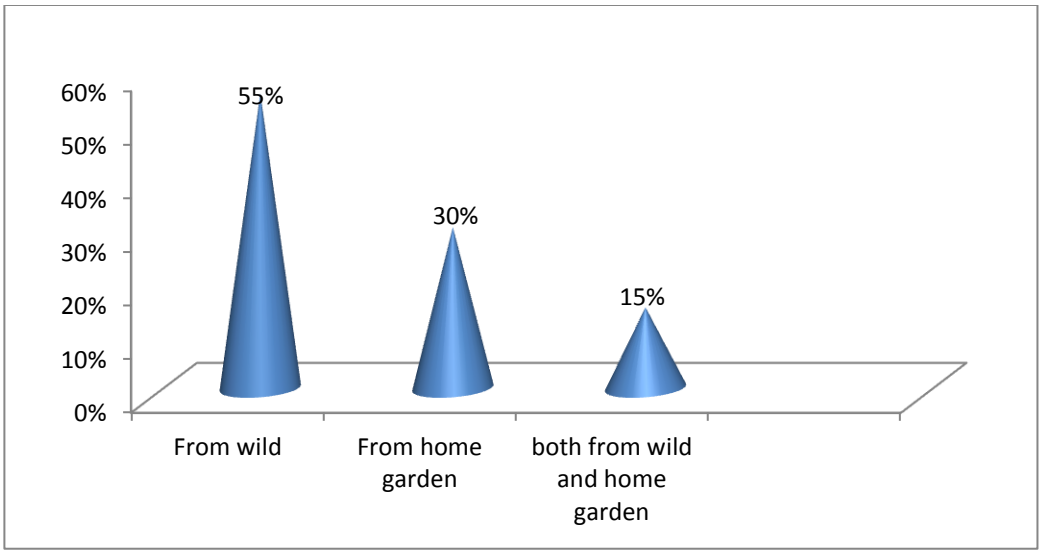


Figure 10: Habitat of WEPs in the study area

4.13 Factors threatening Wild Edible plants in the study area

In this study, the information gathered from the key informants was indicated that the threats of wild food plants increase from time to time in study area. The agricultural expansion, charcoal, and fire wood collection and introduction of exotic weed species were the major threats to WEPs in the study area. Similarly in (Table 9) the result of the reference ranking of six most threatening factors for wild edible plant species showed that Agriculture expansion, Charcoal Making, Fire wood and Introduced exotic species are 1st, 2nd ,3nd are and 4th the most threatening factors for WEP species in the study area respectively.

Table 8:- Direct matrix ranking results of seven respondents on six factors perceived as threats to wild food plants (values: 1=least destructive, 5=most destructive)

Name of plants species	Respondents(R1-R7)								
	R_1	R_2	R_3	R_4	R_5	R_6	R_7	Total	Rank
Fire wood	4	5	5	4	3	4	3	28	3nd
Charcoal Making	4	5	5	4	3	5	4	30	2nd
Construction and building	4	2	3	3	1	2	4	19	6th
Wild fire	3	4	4	2	5	4	3	25	5th
Agriculture expansion	5	4	5	5	5	4	4	32	1st
Introduced exotic species	5	2	3	4	5	5	3	27	4th

Some of the chronic factors that affect and lead to disappear the wild edible plants in the study area are shown in (Figure 11).

Figure 11:- Invasive weed species and Charcoal selling respectively

Similarly in (Table 9) the result of the direct matrix ranking of six most threaten wild edible plant species showed that *Cordia africana, Balanites aegyptiaca and Saba comorensis* are 1st, 2nd and 3nd are the most threatened WEP species in the study area respectively because of their multipurpose and over exploitation of species..

Table 9:- The result direct matrix ranking of five most threatened wild edible plants (5=most threatened, 1= least threatened).

Species Name	Respondents							Total	Rank
	R1	R2	R3	R4	R5	R6	R7		
Justicia ladanoides	2	2	4	1	2	1	3	15	6th
Cordia Africana	5	5	5	5	4	5	5	34	1st
Balanites aegyptiaca	3	5	5	5	5	4	4	31	2nd
Ficussycomorus	5	4	3	4	3	4	4	27	4th
Saba comorensis	4	3	5	2	4	4	3	25	3rd
Dioscorea praehensilis	2	3	4	3	1	4	4	21	5th

4.14 Management and Conservation of Wild Edible Plants

The result of the study showed that (80%) of the respondents explained no effort for conservation of wild food plants. Whereas (20%) of them said that there is general conservation methods on natural resources which also include wild edible plants as part of the conservation methods by in situ (in original/natural habitat) conservation methods like planting in the form of fences and protected pasture land in different worship areas (churches, mosques) and in

their farm field are being practiced in the study area. This indicates that the necessary conservation measures are not being taken in the area, and hence the wild edible plants are not free from threats. Some of wild edible plants species like *Balanites aegyptiaca, Cordia africana* and Saba comorensis are multipurpose plant species widely used by local communities and which are under serious threats in the study area.

4.15 Constraints Associated With Wild Food Plants Conservation in Madura District

The present study revealed several problems hindering the conservation and promotion of the wild food plants. According to the informants, some of the most important problems hindering conservation was lack of community institutions responsible for resource conservation and management which led the domestication practice unsuccessful and this accounted for 27 (40.91%) of all the respondents. Other problems were associated with the lack of planting materials 18(27.27%), lack of conservation advisors 9(13.64%), poor growth of the planted trees due to soil infertility 7(10.60%) and persistant drought 5(7.57%) respectively (Table 10).

Table 10:- Problems in conservation of wild food plants in Mandura District.

Problem	G/Maryam (n=14)	Qutirhulet (n=13)	Dafilli (n=13)	Dabuh (n=13)	Dikul (n=13)	Total percentage
Lack of conservation advisor	2	1	1	3	2	9(13.64%)
Lack of planting seedlings	4	5	3	3	3	18(27.27 %)
Infertility of land	1	2	1	2	1	7(10.60)
Lack of community institution	6	4	7	5	5	27(40.91 %)
Persistent Drought	1	1	1	0	2	5(7.57%)

The constraints associated with the conservation of the wild edible plant species in the area can be also presented by the graph (figure 12).

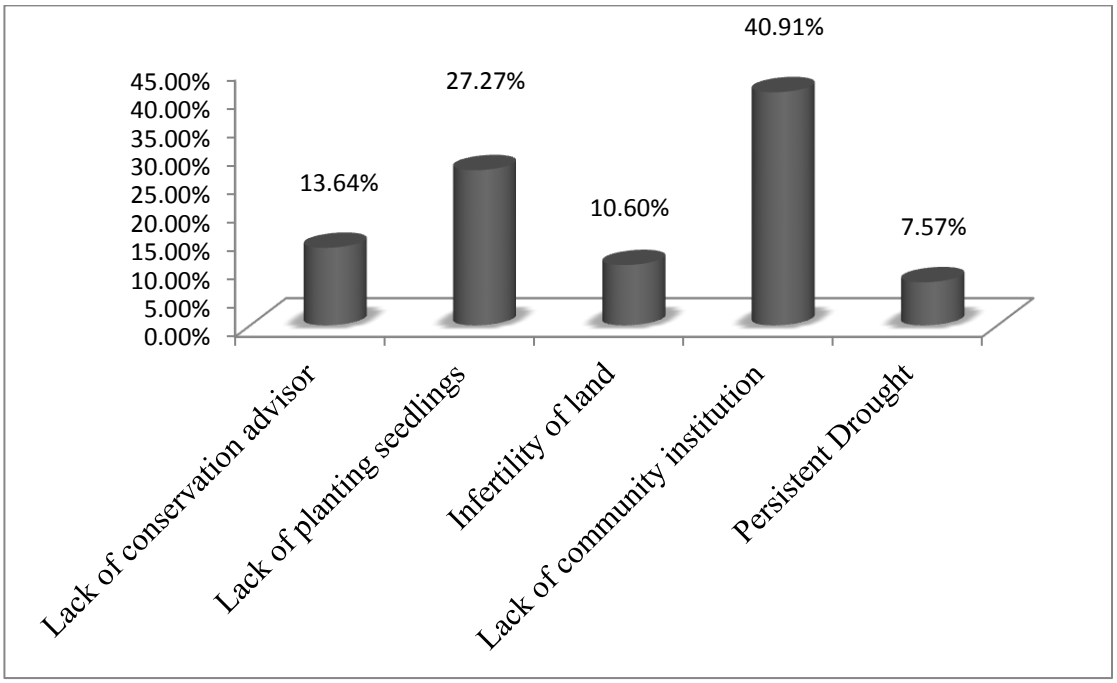


Figure 12: Problems for conservation of Wild edible plants in the area

4.16 Discursions

4.16.1 Sociodemographic characterstics

The distribution of informants with respect to age, majority of them were elders who have a long lasting experience of relationship, interaction with each other and have deep IK on wild food plant resources that exist there. In the case of knowledge difference and use of WEDPs as a food between the two sexes, females tend to be more deeply close to WEPs as compared to males. At this point, because of cultural influence, it is understandable that females were allowed to go out of home to collect and search WEPs for the survival and as well as have more house responsibilities.

Concerning the marital status of the informants, married informants were the dominant. This indicates that married informants have their children and mostly they search WEPs for nutritional value as compacting food insecurity and for other purposes in the study area. This makes them to consume widely WEPs and engaged in charcoal sales as additional income sourc es in their daily life activity. This was in line with report by (Tariku Birhanu and Eyayu Molla, 2017).

When compared informants educational status, non-educated informants were dominant than educated informants. This shows that the community in the study area did not focus on modern education rather than subsistent way of life. But non-educated informants handled much knowledge on how to use WEPs and edible parts of the species.

According to the informants Ik about the WEPs and generally concerning natural plant resources transferred to the next generation through observation, imitation oral history and also secretly from elders. This is in lined with the study of Tariku Birhanu and Eyayu Mola(2017). In addition, Emic classifications of the natural habitat are drawn from the way people perceive things through their own eyes and classify objects in their own language (Martin, 1995). Furthermore, Zemede Asfaw (2006) explained that, the people of Ethiopia are knowledgeable about the name and classification of their environment, plants in their surroundings, and their values for the local people, which they have gained orally from generation to generation.

4.16.2 Habit, Parts and mode of consumption of species in the study area

The analysis results shown in table 5 showed that totally 25 WEPs species recorded in the study area. This wild food species recorded in this study area were edible in normal times as well as at times of food shortage so as to prevent starvation and sustain life during prolonged drought and social unrest. The role of wild food plants mainly during a unsustainable conditions were also explained by Cotton (1996) and Zemede Asfaw (1997).

The record of the highest number of tree plant species in the study were widely used and dominated. This may be due to their relative better abundance and accessibility in nearby areas as compared to other life forms. This led the community members to have accumulated IK on different life forms. This finding is similar with Hinnawi (2010). Meanwhile, fruits are the most important edible plant parts. This might be due to their taste they are, delicious and easily accessible and edible from the wild without any processing. As a result, fruits are important sources of essential vitamins and minerals for the communities in the study area. This agrees with Beyafers Tamene, (2000) and Tigist Wondimu et al. (2006).

The result of the study showed that fruits were reported as the most utilized plant parts out of the total parts and consumed raw without cooking (Figure 8). This result is similar with the study conducted by Dessalegn Ayele (2017) on wild edible plants at Benishangul Gumuz, Kamashi district of Western Ethiopia, at which 18 (30%) fruit and 14(23.33%) leaf were highly consumable parts of wild edible plants species by indigenous peoples of the study area.

According to the justification of the informants, most of the wild edible plants recorded were available during autumn season and all rainy seasons. This indicates that most of them were annual species needs rain and the season was favorable for their maturation and reproduction.

In this study, residents of each site/village preferred one species to the other for food. Informants knowledge, species availability, economical and social values are some of the reasons that made informants to rank the wild food plants differently. Likewise the communities around Mandura District ranked *Physalis peruviana*, *Saba comorensis*, *Corchoru olitorius*, and *Vitex doniana* (Table 7). This result is related to Fantahun Mengistu and Hager (2008) in which the presence of marked variation in species distribution between different sites has without doubt influenced species preferences.

People in the study area largely depend on the forests for various purposes such as medicinal, construction, charcoal production, fencing, shade, fire wood. Thus, identification of such multi-purpose plant species in the study area is very crucial from the conservation and management point of view. This is because the most valued should be given priority in order to conserve and manage them before extinction takes them away (Cunningham, 2001).Direct matrix ranking of six most popular multi-purpose wild food plants species showed that *Balanites aegyptiaca*, *Cordia Africana* and *Sabaco morensis* ranked 1st, 2nd and 3rd, respectively. This means that these multi-purpose plant species have been used for the various major daily life activities of the local community to meet their basic needs.

4.16.3 Current situation of wild edible plants in the area

Wild edible plants in the study area are distributed in the wild, home garden and both home garden and wild. Wild plant species are distributed in the forest, in and around farm land as weeds live in fens tree, roadside, river side. As the result shows that most of the WEPs used by the communities were collected from wild 22(88.00%) and Home garden 3(12.00%).This finding is similar with the Study done by Getenet Chekol (2011) in Libokemkem district. This indicated that the practice of cultivation of WEPs for their Food consumption and other purpose in home gardens is low. In a similar way people in the study area have less effort to cultivate WEPs in their home gardens rather go to the nearby or far place in the wild. This and field observation during data collection clearly confirmed that some of local communities do not have interest to grow in their home garden because most of WEPs simply available and dominated in the wild without cultivation.

In most part of the country the knowledge of wild plants use and management technique remained oral (Demel Teketay and Abeje Eshete, 2004). Similar trend was observed in Mandura district, In addition to, in this study, individual and group discussion was done concerning current situation of wild food plant species at a time of field observation and group discussion with local informants in the study area. Accordingly, the plants current situation and distribution were identified in the study area as 53% is rarely distributed, 39% is sparsely distributed and 8% is found particular area mostly in home garden.

4.16.4 Threat factors for wild edible plants in the study area

The cause of threats to Wild food plants can be generally grouped into natural and human induced factors. However, as reported in this study most of the causes for the threats to wild food plants and the associated indigenous knowledge are the anthropogenic factors such as introduction of exotic weedy species, deforestation due to charcoal making, wild fire burning, fire wood collection, house hold construction, cutting and burning of plants to create new agricultural expansion lands. Informants ranked charcoal collection, agricultural expansion, and fire wood and population pressure as the most serious threat to the WEP species. The finding was in line with other findings (Giday *et al*., 2001; Mesfin Taddes *et al.,* 2009). This might be due to continuous agricultural expansions, deforestation and draught in addition to lack attention towards the wild food plants.

4.16.5 Conservation and management practice of WEPs in the study area

Agricultural land expansion, fuel wood collection, and uncontrolled fire setting are the major threats to the conservation of wild edible plants in the study area.

The study indicated that local communities give priority to the immediate use of the wild food plants than to its sustainable future uses; as a result their harvesting style is destructive. However, some plants has protected for their spiritual and cultural purposes. Thus, these places are good sites for the protection since cutting and harvesting are not allowed in such particular areas. This was indicated that a good practice for the conservation of wild edible plants through cultivation (Dereje Mosissa, 2017).

Some authors clarify that home gardens can be refuge for wild species that are threatened in the wild by deforestation and environmental changes. Concerning this (Zemede Asfaw, 2001) reported that home gardens are being used as informal experimentation plots for new varieties and exotic species.

4.16.6 Constraints for conservation of wild food plants

According to the informants responses some factors that hinder the development of conservation practices the study area were lack of community institution, lack of conservation advisor, absence of planting material(seedlings), soil infertility and drought and results to less conservation efforts on conservation of wild food plants in the study area. This study is in line with the study of Getenet Chekol(2011). Despite the fact that, absence of institution is a significant problem in maintaining traditional wild food plants in the area. The constraints reported in this study are not far from those reported by Peters *et al* (2004) that skills, storage and seasonality of fruits. Lack of conservation advisors had also posed significant problems in which there was no sensitization of local communities on the importance of indigenous wild food plants and how to add value through processing of various products to improve nutritional status, health, income and livelihoods of rural communities. From such point, it is anticipated that through awareness creation on the importance of wild food plants and their production on farms will result in their conservation and sustainable use.

CHAPTER FIVE

5 CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

Based on the results and subsequent discussion, the knowledge of wild food plants was transferred through observation, imitation, and oral history in local languages at different times especially when the people are at rest especially during the night time and when practiced. Local peoples have their own IK on the classification of landscape, vegetations and soil type. But there was no documentation concerning WEPs species and associated IK in the study area.

The study revealed that all household members of the study area were involved in the collection and consumption of wild edible plant species. Fruits parts of WEPs and trees were widely used than other due to better abundance, life span and accessibility of nearby area. The finding of the study showed that WEPs highly dominated and distributed in the wild than home garden because no cultivation of them around home garden. The studied site harbors limited number of wild food plant species in the area. This indicates the area needs immediate conservation actions. The study area has number of threats for wild food plant species but governmental action is less; no local conservation institute, no local focal person. Then no sustainable management plan in place and no enforcement of the rules in the study area. Thus, currently the wild plant resources are experiencing high rate of destruction because of the frequent (daily) visits of the people from nearby villages for their daily requirement of fuel (charcoal), agricultural expansion, wild fire, wood for construction and other forest products. This has resulted in the depletion of the woodland; there by causing damage to both plant and animal diversity of the area. Wild food plants make a major contribution to dietary intake of rural people during times of food shortage. Apart from their food value, most of the identified wild edible plant species in the study area are used by the community for other different purpose. Due to this reason multipurpose wild food plants are at risk in the area However, there was little number of edible plant species in Mandura district and this shows that the area was highly degraded due to human activities. The conservation, use and management system awareness rising should be made among the local communities so as to avoid plant and animal destructions and to ensure its sustainable use.

5.2 RECOMMENDATIONS

Based on the results of the study, the following recommendations are forwarded:

- A mobilized work should be carried out in enhancing the existing knowledge on Wild edible plants before the knowledge is completely disappeared.
- Local communities should be encouraged and motivated to cultivate wild food plants on their home garden through provision of technical as well as materials.
- The local people need supports through awareness raising education on the sustainable utilization and management of plant resources.
- Since some of the highly valued wild edible plants are being over exploited due to their multi-purposes, Example *Cordia affricana, Balanites aegyptiaca, Ficus sycomorus, Saba comorensis, Dioscorea praehensilis* and other WEPs are over exploited and endangered. Therefore specific wild food plant conservation strategy should be formulated and implemented for long term management of plants in the area.
- Community Institution must be established in the area which enhances wild food plant conservation and management strategies.
- The findings suggest further investigation into nutritional profiles, processing methods and conservation strategies of all the species reported and others not reported.

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LIST OF APPENDICES

Appendix1. Semi-structured interview schedule employed by Gumuz people in Mandura Woreda (Checklist of questioners/issues prepared for data collections in the study Area)

I. General Information on respondents:

1. Date _____ Keble_____

2. Name of respondent _____ sex_____ Age _____

3. Occupation _____marital status _____ _____Education level_____

II. Ethno botanical Data collection concerning wild edible plants

1. List the traditional classification methods of forests (vegetation), landscapes and the soils.
2. Mention the common widely used wild edible plants kebele?
3. What is local name of each wild food plant species?
4. Where do these plants grow in the area? / From where do you get these plants?
5. When do you get (collect) these wild edible plants for utilization?
6. Which plant species are used as wild foods throughout the year?
7. Who collect the wild food plants in your family?
8. What is a habit of the plant? Tree(T),Shrubs(S). Herbs(H),Climber(C) and Corn(Co)
9. What is the habitat of each wild edible plant?
10. What parts of the plant do you used? Leaves/Fruits/Roots/stem/Tuber/seed/flower?
11. How do you consume each parts of the food plants? Raw/ After cooked /After boiled?
12. What function (benefits) do you obtain after the consumption of wild edible plants?
13. Are there any division of wild food plants like famine foods, non-famine foods etc. in your areas?
14. Which types of wild edible plant do you frequently and commonly used?
15. Are the wild food plants easily accessible? If not, why?
16. How is the knowledge of wild food plants transfer from elders to the young generation?
17. Which plant species are the most preferred in their uses wild food and why?
18. For what other purposes do you use the wild food plants?
19. Are there community members who frequently depend more on wild edible plants as compared cultivated foods? Why?
20. Are there treats to wild food plants? If so what are the major problems associated with them in the area?

21. Are there mostly threatened (endangered) wild plant species in your area? Why?

22. How do the local people manage and conserve these wild food plant species through their traditional indigenous knowledge? If so mention the management practices by the indigenous people.

23. Any additional information ?

----------Thank you----------

Appendix 2 Check lists for key informants and focus group discussion

1. Do you know this plant local name?
2. Do you think it is plant edible?
3. If it is edible do you consume or utilize the plant?
4. If edible which part of the plant do you use?
5. How do you consume wild edible plant parts? Raw/ by cocking
6. Where do you get the wild food plants? Home garden/ in forest
7. Mention by using local names more preferable wild food plant species in your area?
8. What are threats for the Wild edible plants species in the area?
9. Are you conserving the wild food plants? A) Yes B) No.

A. If Yes how? Describe existing practices for conserving wild food plants in the area.

_____

_____

_____

B. If No Why? What are the factors/constrains to conservation wild food plants in the area?

_____

_____

_____

10. Are there any concern bodies such as NGOs and Governmental bodies that support conservation/ management practice about the WEPs?

_____ Thank You_____

Appendix 3 List of wild edible plant species recorded in the study area

No	Local Name/Gumuz	Family	Scientific Name	Parts used	Habit
1	Agidema	Asteraceae	*Vernonia auriculifera Hiern*	Leaves	Shrub
2	Ander-guga	Rhamnaceae	Ziziphus abyssinica Hoechst	Fruit	Tree
3	Anguh-manza	Verbenaceae	Vitex doniana Sweet	Fruit	Tree
4	Ankuta	Flacourtiaceae	Strychnosinnocua Del.	Fruit	Shrub
5	Antsiqina	Vitaceae	Ampelocissus schimperiana (L.)	stem	Shrub
6	Antsitsa	Flacourtiaceae	Oncoba spinosa Forssk.	Fruit&stem	Shrub
7	Banja	Boraginaceae	Cordia africana Lam.	Fruit	Tree
8	Banjaga	Apiaceae	VernoniaamygdalinaDel	Leaf	Herbs
9	Bosiya	Solanaceae	*Solanum alatum Moench*	Fruit	Tree
10	Bida	Cucurbitaceae	Momordica foetida	Leaf	Herbs
11	Diwa	Myrtaceae	Syzygium guineense (Willd.) DC. subsp guineense	Fruit	Tree
12	Echa	Dioscoreaceae	Dioscorea praehensilis Benth.	Root	Climber
13	Ejisiya	Solanaceae	Physalis peruviana L.	Young-bud&Flower	Tree
14	Elangi-ya/Jajua	Acanthaceae	Justicia ladanoides Lam.	Leaf	Herbs
15	Feya	Olacceae	Ximenia americana L.	Fruit	Tree
16	Fuqa	Moraceae	FicussycomorusL MorasalbaL	Fruit	Tree
17	Gangiya	Anacardiaceae	Rhus retinorrhoea Oliv.	Fruit	Tree
18	Gediya	Tiliaceae	Grewia mollis A. Juss	Fruit	Tree

19	Huya	Apocynaceae	Saba comorensis	Fruit &seed	Climber
20	Kakima	Acanthaceae	Justica ladanoidesLam.	Leaf	Herbs
21	Kambua	Poaceae	Oxythenantra abysinica (A. Rich) Munro	Young stem	Herbs
22	Lalqa	Tiliaceae	Corchorus olitorius L.	Leaf	Shrub
23	Mecha	Fabaceae	Piliostigma thonningii	Fruit	Tree
24	Qota	Rubiaceae	Gardenia ternifolia Schum.	Fruit	Tree
25	Soha	Annonaceae	Carissasp inarum(Forssk)Vahil	Fruit	Shrub