JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF BIOLOGY

Indigenous knowledge on plant species of material culture used by Arsi Oromo in Limu-Bilbilo District, Arsi Zone, Southeast Oromia, Ethiopia.

By: Million Tebassa

A Thesis Submitted to Jimma University College of Natural Science School of Graduate Studies Department of Biology in Partial Fulfillment of the Requirements for the Degree of Master of Science in Biology.

Jimma, Ethiopia

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STATEMENT OF DECLARATION

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university, and that all sources of materials used for the thesis have been duly acknowledged.

Name: Million Tebassa
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Abstract

Indigenous knowledge on plant species of material culture is noted by few scholars to be unique and important to identify traditional botanical knowledge possessed by local people in a particular area and used as awareness for local conservation planning and management of plant resources. Although traditional botanical knowledge integration is inherent to ethnobotanical research, in Ethiopia, the knowledge of plant material link has not been fully explored. So, the study aimed to describe, organize and document information on indigenous knowledge of plant species material culture (construction, traditional arts and handicrafts) used by the indigenous people of Oromo community in Limu-Bilbilo District, Arsi Zone, southeast Ethiopia. A total of 80 informants (60 males and 20 females above 24 years old) were involved in this study. Of these, 40 knowledgeable key informants (10 females and 30 males) were selected based on recommendation from local community. Ethnobotanical data were collected using guided field observations, semi structured interviews, group discussions and market survey of the study area. Simple statistical methods, Pearson's correlation coefficient of association, preference ranking, direct matrix ranking and paired comparison, were applied for data analysis. *A total of 79 plant species distributed in 74 genera under 49 botanical families were collected and identified. Among 79 species, 56 (70.9%) species were documented from wild vegetation, 13(16.5%) plant species were found in the wild and also cultivated by the people in the study area and the remaining 10 (12.6%) species were cultivated for their special purposes.The growth forms of trees formed a major component with 33 species while shrubs, herb and lianas accounts for 27, 14, and 5 species respectively. The present study showed that processing of plants for material culture includes several preparation techniques. The most frequently utilized plant parts for the processing of objects were stem 60(55.56%), leaves 18(16.67%), bark 7 (6.48%), branches 6(5.56%). These plant parts were processed in various forms and the major one include splitting 39(21.79%), carving 30(16.76%), hewing 13(7.26%), burrowing (boring) 12(6.70%), sawing and* adzing *11(6.15%) each. Olea africana and Juniperus procera were preferred much in preference and direct matrix ranking for multipurpose uses. The reports showed that, men have greater knowledge than women in utilizing different plant species to produce different material cultures. Ethnobotanical knowledge of giving of the local names to individual plant species, choice of preference of plant species, processing of material culture are shown to linearly correlated with age ($p < .001$). The result also indicated the use of traditional material culture was shown to decline from time to time; this was accounted for the new generation attracted to modern technology products than traditional tools and arts. In this study, 48 (60%) informants claimed timber production by business men as the major threatening pressure of the plant resource in the study area. The study also indicated, besides traditional conservation practice; creating alternative income generations for the community depends on plant resource and developing community awareness on the use of plant resource for socio-economic and environmental wellbeing were the main alternative conservation methods described.*

Key words: - Arsi Oromo, indigenous knowledge, Plant material culture

1. INTRODUCTION

1.1. Background

The information and knowledge inherent in people's use of plants did not come about without great price. Time, trial, and error brought cultures to their intimacy with the plants in their environment. People likely struggled in their environment until someone discovered the particular use of a plant to aid in a survival need. Indigenous cultures evolved in their environment learning to utilize their native plants over thousands of years. Cotton (1996) indicated that an ever increasing interest of anthropologists, botanists, and explorers to document the potential use of plant resource by indigenous people. Martin (1995) also interested in documenting the unique indigenous knowledge (IK) possessed by traditional people around the world on plant resources. Since antiquity plants have been an important part of existence in many indigenous communities, and Africa is no exception (Sindiga *et al*., 1995). Apart from providing building materials, household objects, fodder, weapons and other commodities, plant resources contain and provide materials for day to day activities that are economic, food and medicinal values. Plants also possess and preserve cultural heritages, biological information, and IK on their utility. Many tribes and cultures in Africa have elaborated plant based traditional knowledge (Barrow, 1996). According to Berkes (2003), traditional knowledge has been described as a cumulative body of knowledge, practice, and belief, evolving through adaptive processes and handed over through generations by cultural transmission.

Bye (1985), reported that the investigation of the biological, including the ecological basis of interactions and relationships between plants and people over evolutionary time and geological space is refers to as ethnobotany. Specifically ethnobotany tries to find out how people have traditionally used plants in the past and are still using at present. Ethnobotanic studies also allow documentation of important information that serve as base line data for future research and preservation of valuable traditional knowledge for both present communities and future generations (Martin, 1995; Cotton, 1996; Hoft *et al*., 1999).

According to Cotton (1996), material culture is the total range of objects produced by a particular society including functional items such as tools, shelters, and clothing as well as more decorative

arts and handicrafts. He also states that although synthetic plant products have an increasing influence on the existing material culture of traditional societies, both wild and cultivated plants remain vital to many aspects of traditional life.

Findings by Bahru *et al*. (2012) also showed that more than 87% of the recorded plant species are used for construction purposes (house construction, furniture, fence posts, and dry fencing) by the local communities in Afar and Oromo Nations, East Ethiopia. Furthermore, they also found out that the largest proportion of plants part used in the production of material culture is woody stem. For example, a research by Abera (2013) indicated that woody tree stems, particularly *Arundinaria alpina, Eucalyptus* species, and *Cordia africana* are the most commonly used and preferred plant species used for construction of material culture in Jimma Zone, Southwest Oromia, Ethiopia.

Plant and plant products also have additional uses in traditional arts and handicrafts including tool handles, cooking utensils, mortar and pestles, walking and herding sticks, combs, paddles, containers and many others. For example, fibrous stems and roots are used to make basket, cordage, and textiles (Cotton, 1996; Cunningham, 1996). Likewise, plant extracts and exudates are sources of dyes, gums, tannins, latex, waxes, resins, adhesives, and others. Additionally, in many cultures, there are traditional plant based tools, which are used in hunting and defense such as harpoons, bows, arrows, spears, fishing reels and traps, hunting clubs and so forth (Abbiw, 1990; Cotton, 1996).

Ethiopia is a land of great topographical and climatic diversity, which is suitable for plant diversity. It is estimated that there are about 6000 species of vascular plant recorded in this country, of which about 10% are endemic (Kelbessa and Demissew, 2014). Similarly Ethiopia has diverse ethnic groups and cultures with a deep knowledge concerning the use of plants for different purposes such as medicinal, material culture, food (Abebe and Ayehu, 1993; Kelbessa *et al*., 1992). In spite of these, there are many vanishing cultures that possess a wealth of knowledge in the utilization and conservation of plants (Berkes, 1993). Ethiopia is also one of the countries where useful plant species and the precious ethnobotanical knowledge are disappearing (Birhane *et al*., 2011).

The lack of documenting traditional botanical knowledge (TBK) and related material culture is observed in Limu-Bilbilo District. Similar to other areas in Ethiopia the current plant use trend of the area shows that the environment is facing problems of plant resource depletion and loss of related indigenous knowledge altogether. This study thus, seeks to provide preliminary findings on the extent of local community knowledge of a broad array of plant material culture in Arsi Zone of Limu-Bilbilo District, and the potential benefits that a community understanding of indigenous knowledge can hold for local conservation.

1.2. Statement of the problem

Although Ethiopia is rich in its plant biodiversity as a result of topology and variety of favorable climatic zones, and plant material culture still remains the central part of its traditional society. It has been reported that the use of plant made material by which the culture of people could have been preserved has been decreasing at an alarming rate and related traditional botanical knowledge is also in effect disappearing altogether before properly documented owing to a number of reasons (Yassin *et al*., 2015). In the first place, traditional botanical knowledge (TBK) is known to be transferred almost entirely through oral means and this highly contributes to its risk of vulnerability for disappearance (Fraktin, 1996). As indicated by Abera (2013) and Bahru *et al.* (2012), the availability of commercially cheap synthetic materials and their preference to the material culture in modern times, the depletion of natural forest due to deforestation, agricultural expansion and urbanization, and lack of interest among the young generation to preserve ones traditional knowledge and cultural values are confirmed to be the main sources of problem under investigation. In addition to this, in country with such various cultural resource and ethnic groups, ethnobotanical study of plant material culture remain a sort of out looked and hidden treasure. We are still unable to accurately assess either the quantity of the resource itself or value the contribution of its products and services to the welfare of the society. So the present study aimed to assess and document the material culture and plant species and parts of the plants from which the materials are produced, related TBK, and the segment of community or members within a family who have the knowledge and involve in the production of material culture.

1.3. Objectives of the study

1.3.1. General objective

The general objective of this study was to assess and document the indigenous knowledge on plant species of material culture used by Arsi Oromo in Limu-Bilbilo District.

1.3.2. Specific objectives

- ✓ To study, collect, and identify the plant species used in material culture.
- ✓ To document parts of plants used for making material culture.
- ✓ To record types and uses of plant based material objects.
- ✓ To identify the segment of community or members within a family who have indigenous knowledge of processing material culture.
- ✓ To document current status of plant made material objects utilization.
- ✓ To assess and document the present conservation status of plant species utilized for material culture.

1.4. Significance of the study

The final report of this study may serve as a reference material for those individuals interested in carrying out research on related topics. Additionally, the finding of this research may help to raise awareness in the target community and to other concerned bodies on the status of material culture and plant species used for this purpose and Traditional Botanical Knowledge (TBK) for possible course of action to enhance further documentation and preservation of material culture and related knowledge. The rural people in the study area collect useful plant resources from various habitats and use them using unique indigenous knowledge and practice. This vast stored indigenous knowledge is being lost because of deforestation, modernization and easy accessibility of synthetic plastics products. Hence, priority ought to be given to document the useful plants with indigenous knowledge, practices and related artifacts for the area before both are eroded altogether.

1.5. Limitation of the study

It is difficult to find all important information on ethnobotanical study of material culture within this short period of time. So extended period of time and freely involvement of the researcher to include and study more variables may results in better findings of different depth and width of knowledge on material culture. Besides most of the plant species used for processing material culture found in wild forest or not were easily accessible, so difficult to find live specimens around home garden. To solve this, the researcher was assisted by field guide, which needed extra budget and time. And there are only few works done on plant species material culture in Ethiopia to use as reference and to investigate the gaps of researches. Thus, to strengthen the field more works are expected from the researchers in the future.

2. LITERATURE REVIEW

2.1. The origin of ethnobotany

Ethnobotany was a term first suggested by John Harshberger in 1896 to delimit a specific field of botany as the use of plants by aboriginal peoples (Harshberger, 1896). Prior to the use of the term ethnobotany, many botanists were already including the use of plants by people within their studies. In 1874 Stephen Powers coined the term "aboriginal botany" for the study of plant use among traditional societies. His term remained the accepted designation for the next quarter of a century. However, it was Harshberger who proposed that a discipline of ethnobotany might be developed with its own definition, scope, objectives and methodologies (Cotton, 1996). The indispensable dependency of human up on plants for their livelihood was primarily started by domestication and dates back 10, 000 years (Martin, 1995). From plants, humans can obtain food, construction materials, tools, fodder, medicines, fuel and derives aesthetic and spiritual fulfillments. Thus, indigenous knowledge on plants appeared when humans started and learned how to use plants (Posey, 1999). Over centuries, indigenous people have developed their own locality specific knowledge on plant use, management and conservation (Cotton, 1996).

Each indigenous population through time has developed its own way of conserving nature, as the life of each community has evolved with the biota existing in their ecological setup. Thus, indigenous knowledge has developed because of human interaction with their ecosystem. To view this ethnobotanical studies are useful in documenting, analyzing and disseminating of knowledge and interaction between biodiversity and human society, how diversity in nature is used and influenced by human activities (Martin, 1995).

Local communities have experienced indigenously developed perceptions and experiences to categorize plants. From their experience, a number of categorization and classification criteria were developed which is important in plant diversity, conservation and management. The common criteria here include plant use, habitat, life form, color, abundance, morphological characteristics and combinations (Martin, 1995; Cotton, 1996; Alexiades and Sheldon, 1996). It is this fact that enabled traditional people to develop several proverbs and poems that applied to

plants up on which they are so immediately and intimately dependent (Kokwaro,1976; Cotton,1996).

Moreover, indigenous knowledge on plant species of material culture, the use of plants in tools and construction sectors by local people over the past period take a huge concern as they have long year's lineage of utilization and management. This has been achieved through many generations of age old, time-tested practices, and as a consequent accumulation of knowledge through a series of observations, interactions and innovation (Abbink, 1995; Cunningham, 1996).

2.2. Historical development of plants material culture

There are indications that our ancestors increasingly interacted with plants. The actual evidence has been rare and ephemeral because of the perishable nature of plant forms. Consequently most of what we know of the past involves corroboration from durable material such as arrowheads and spear points emphasizing activity of males in the hunt, ignoring other members of the tribe such as woman, children, and the elderly. However there is Stone Age evidence of plant material. For example ethnobotanical study of Australia revealed that in burial sites 60,000 years ago, a high incidence of pollen associated with skeletons suggests flowery funerals (Fleckinger and Steiner, 1990).

Material culture is the first explorers' expeditions, which were the precursors of anthropological researches. The early days of anthropology were the time when the study of material culture received its strongest emphasis. But from the 1930s to the 1950s, material culture studies become limited to the issue of technology and where considered unfashionable. Material culture studies on the other hand, stayed in a neglected condition until 1970 (Yassin *et a.l*, 2015). Abera (2013) has also demonstrated that since antiquity plants have been used as a source of material culture by the human societies. And for a long time the science of material culture has been focused on objects recovered from archaeological explorations, but since two decades, this interest has been shifted to plant based material culture, which is defined as, the cultural objects made with the knowledge of particular ethnic groups for specific and multipurpose uses from whole plant and plant part(s) (Cotton, 1996; Abera, 2013).

2.2.1. Plants species and their respective parts for material culture

According to Mary-Lou *et al*. (1990), objects made from plant materials comprise a large portion of the ethnobotanical material in collection around the world. Parts of a great numbers of plants species are utilized in the manufacture of different artifacts. For example, the bark of the birch (*Bitola papyri era)* was extensively used by some Native American groups for utilitarian and religious artifacts. After the arrival of the Europeans, artifacts in European styles and incorporating trade materials were also made. Agrawal (1984) also stated that in India birch bark has been used for manuscripts for over two thousand years. He also reported that the inner bark (probably referring to the inner surface of the bark) was used for writing. First, the bark was peeled off the tree and dried. The surface then oiled and polished to produce a smooth writing surface. Ryman (1978) also described that the use of birch bark in Russia in buildings, kitchen utensils, and household objects predates its use as manuscript material in the ninth century. Similarly the Australia Aborigines utilized whole sections of birch bark for dwelling, canoes, container, paintings, religious figures, cordage, costumes and binding.

The ethnobotanical study of Caroline Islands in Micronesia by Kitalong *et al*. (2009), reported a total of 41 species of plants as construction materials. Even though metal tools have replaced the traditional shell or stone adzes once used to fell and shape the tree, tool handles continue to be fashioned from various plant species, including *Calophyllum inophyllum*, *Cocos nucifera, Hibiscus tiliaceus*, *Macaranga carolinensis*, *Rhizophora mucronata*, *Terminalia catappa* and *Syzygium samarangense*. Many plant species are used to build structures of the traditional house in Micronesia. For example: *Intsia bijuga* is a very heavy and strong hardwood used to build houses, house frames and flooring, woody stem of *Stemonorus ammui* is used for beams, posts, crossbeams and flooring. Matured stem from *Gmelina palawensis* is used for posts, flooring and walls. Flooring is also constructed from woody stems of *Bruguiera gymnorrhiza*, *Bambusa vulgaris* and *Serianthes kanehirae*. Trees used to build the main frame of the house include *Lumnitzera littoralis* and *Calophyllum pelewensis*. *Lumnitzera littoralis* is also used for a structure's posts and the upper house, as is *Campnosperma breviopetiolata* and *Sonneratia alba*. And five species of trees are specifically reported for making the hulls of canoes. *Gmelina palawensis* is used to make canoe sides or covers, *Lumnitzera littoralis* wood is good for the

canoe outriggers, with its curved branches straightened by heating. The sides, body and covering of canoes can be made from *Gmelina palawensis*.

The report by Kitalong *et al*. (2009) also indicated that many plants are used in a ritualistic cleansing after giving birth to their first child; women undergo a complex bathing process that lasts from four to ten days. The ritual's purpose is to heal the new mother and celebrate her first child. At least two months of preparation are needed for this event. Activities include constructing the bathing and steam hut, gathering firewood, gathering herbs, preparing ginger and coconut oil for the bath, preparing food, and making the traditional skirt and accessories for the mother for the last day of celebration. This ceremony culminates in a final bath and display of the young mother in her traditional dress for the father's family. The mother's family prepares a banquet of food, the father's family provides money, and a life-long bond is then established. A variety of herbs is used in the ritual to energize and heal the new mother. There is no single prescribed set of plants used in the first bath ceremony and many clans have their own particular formula. But, the most commonly listed plant is *Curcuma longa*.

2.2.2. Plant based artifacts, material objects and uses

Artifacts are the product of man's imagination and workmanship of pre historic origin. They are man-made objects mostly from the raw materials of plants available in their surroundings. Paul (2000) has demonstrated from the study on Wiradjuri Culture in Australia; the long leaves of *Carex tereticaulis*, *Lomandra longifolia* and lilies were collected to make baskets and mats, or soaked and beaten to free the fibers to make string. The bark of trees was used to make buckets, dishes and shields. The bark of River red gum (*Eucalyptus camaldulensis*) was good for making canoes. The canoes were used on rivers and lakes. Mostly the large river red gums were used as they had suitable bark and they grew along the rivers. Cutting a canoe left an oval shaped scar above three meters long. Large sheets of bark were used to put on the lean-to shelter as a covering material. Bark was also used for coffins and wrapping the dead. Wood was used to make all sorts of tools and weapons, for instant shields, boomerang, spears, spear throwers wooden bowls, resins and gums as well as digging sticks and many other hunting tools were all made of woody stem of *Acacia melanoxylon*, *E. camaldulensis* and *E. polyanthemos*.

Traditional agricultural implements, artifacts, tools and shelters are exists worldwide in all communities covering varied areas. Abera (2013) made reports on various traditional agricultural implements produced by Oromo community in Jimma Zone, southwest Ethiopia. His report indicated the community in Jimma Zone produces their livelihood agricultural tools from several plants parts, to a great extent woody stems, of different species supplemented with locally made metal instruments. For instance, his reports explained how local people made different agricultural implements from plants: plough is made from cut and carved woody-stem of *Albizia schemperiana*, *Cordia africana, Prunus africana* and *Podocarpus falcutus* estimated to be 2½ m in length. The second part connected to a plough is a yoke locally called qanbarrii made from stem cuttings of *Albizia schemperiana*, *Croton macrostachys*, and *Syzygium guineense*. The two implements are connected by forming a hole at the tip of a plough and at the mid of yoke, and tied to the neck of the oxen.

2.2.3. Indigenous knowledge to process plant material culture

Indigenous knowledge (IK) is defined as the cumulative body of strategies, practices, techniques, tools, intellectual resources, explanations, beliefs, and values accumulated over time in a particular locality, without the interference and impositions of external hegemonic forces (Quanash, 1998). The immediate and intimate dependency of local people on natural resources resulted in the accumulation of indigenous knowledge that helped people to adapt to and survive in the environments in which they live. According to Thomas (1995), IK is defined as local knowledge that is unique to a given culture or society and the base for agriculture, construction, tools, health care, food preparation, education, environmental conservation and a host of other activities. Thus, IK is the result of many generations long year's experiences, careful observations and trial and error experiments. The quantity and quality of traditional knowledge differs among community members according to their gender, age, social standing, profession and intellectual capabilities.

According to Balick and Cox (2005), traditional (or indigenous) knowledge is the body of knowledge and practices developed and maintained by people interacting with their natural environment over time, this can include information on plants used for tools, arts and crafts, food, shelter, medicine, aesthetic beauty and spiritual purposes. Lee (1980) indicated that due to its dynamic nature, traditional knowledge is difficult to quantify. The loss of traditional practices

is a threat to biodiversity globally. IK is the cornerstone to local development because of the view that: “Development efforts that ignore local circumstances, local technologies and local systems of knowledge have wasted enormous amounts of time and resources. Compared with many modern technologies, traditional techniques have been tried and tested; are effective, inexpensive, locally available, and culturally appropriate; and in many cases are based on preserving and building on the patterns and processes of nature” (Grenier, 1998).

One of the widely used indigenous knowledge system in many communities is the knowledge and utilization of plants based traditional material objects. For example ethnobotanical knowledge that involves categorize plants, collection of plants' raw materials, processing into form and shapes of important material objects utilization for various purpose in many countries pass from one generation to the other generation verbally and encountered problems (Agrawal, 1984).

The study in Jajpur District of Odisha, India by Tripathy *et al*. (2014) revealed that making artifacts from the matured stem of Bena *(Chrysopogon zizanioides*) is exclusively the hand work of female folk of the village. The report also indicated almost all females are engaged in making various household traditional artifacts by collecting the raw materials from the field by cutting with a sickle. First the leaf sheath of Bena is separated and it is sun dried for about a week. The golden yellow colored hollow stem locally called kaninja is then stored in a dry and closed room for future use. The tools used for craft making are simple iron needles. Either the whole stem is used or it is made to split in to two equal half's lengthwise as per necessity.

In Wiradjuri culture carved trees are the ones that have patterns cut into the bark or wood. The Wiradjuri were one of the main groups in Australia to develop tree carving as part of the culture. Actual designs were carved by men into the trees without killing. Wiradjuri carved complex designs to mark the burial sites of important men. The designs were associated with man and were thought to provide a pathway for his spirit. The carvings are like a headstone to identify the dead person’s social standing. Mostly only one tree would be carved at a burial site but at some sites a few trees were carved with the carvings facing the burial site. The carvings were done by initiated men (Paul, 2000).

In Yoruba people live on the west coast of Africa in Nigeria men are responsible for woodcarving. Men use knives and adzes to carve wood. Divination trays and many other sacred objects are carved out of wood. Men and women both act as weavers and dyers. Weaving is done on different types of looms. Weavers create hundreds of different patterns on their looms. Wild silk and cotton are used to make cloth. Indigo, a native plant is often used as a dye to color threads (Mullen, 2004). Similarly woodcarving is the most important art form in Oromo culture of Jimma Zone and in other ethnic groups living in Masha and Yeki District of southwest Ethiopia (Abera, 2013; Yassin *et al*., 2015).

2.2.4. Current status of plant made material objects utilization

The reports by Nedelacheva *et al*. (2007) from ethnobotanical study carried out in European countries were revealed that nowadays, the use of homemade brooms and brooms making crafts are disappearing. The brooms have lost their necessity in their daily lives. The principal reasons are realities of the modern life: loss of the specific tasks and places which they were used, industrialization of traditional farming, the modern tools of cleaning, partial adoption of modern materials, and reduced number of craftsman. Thus, the skills transmissions through generations are in danger and much more threatened with extinction.

In Australia many Aborigines today have no need for traditional products from fiber; however in some communities' people still make beautiful baskets, bags and mats. Most of these are sold although some are made for personal use or for gifts. When Europeans first came to Australia almost every Aboriginal person would have been skilled in some form of fiber craft. Today, in south-eastern Australia only a very small number of mostly elderly women and some men now have knowledge of traditional fiber crafts. These people value their skills and are in most cases eager to pass on these skills to younger generations (Kitalong *et al*., 2009).

The study by Abera (2013) also indicated that the plants remain in wide use among rural household communities as a source of handcrafts although; the application in traditional arts is disappearing from time to time. The major factors for this include the wide distribution of synthetic and sophisticated industrial products; a lack of formal indigenous knowledge education and ignorance of own cultural identity. For instance, the introduction of metal and plastic containers has led to a decrease in the production of domestic baskets while the use of aluminum

canoes has resulted in the loss of many skills required for traditional canoe construction (Alexiades and Sheldon, 1996). Oral based transmission of indigenous knowledge in developing nations has played a pivotal role for the deterioration of the exploitation of cheap and access material culture (Gemedo-Dalle *et al*., 2005). Asefa *et al*. (2010) similarly indicated that the tendency for modern education, the migration to cities for profitable jobs and education, the decline of the plant population due to deforestation are some of the reasons for the decline of the use of traditional plant based material culture.

Many authors reported factors like over-harvesting of plant species, land conversion, and habitat loss increasingly threaten a considerable portion of the world's plants resources and populations. For these reasons, approaches to wild plant species collection that balance the needs of local, regional, and international markets with the need for conservation and sustainable use are urgently needed (Bahru *et al*., 2012; Gebregziabher, 1991; Kelbessa *et al*., 1992).

2.3. Global use of plant material culture

Throughout their lives all human societies have direct or indirect relationship with plants. For example, plants have provided human societies with an enormous range of useful materials, ranging from wood for building materials, bows and arrows; fibers to make rope, twine and clothing; pigments used as dyes and resins which provide a range of sealants and adhesives (Cotton, 1996).

Many other authors (Terashima, 2001; Reta, 2010; Abbiw, 1990) also described the traditional uses of plants as material cultures, for instance, plant fibers are strong, string tissues that people can weave, braid or plait to make hunting nets, matting, shoes and baskets. Strong woods like mesquite and ironwood were used for bows and arrows, tool handles, cooking and food collecting tools, shelters, roof shingles, house posts, roof supports, and side wall; as well as more decorative arts and crafts. Grasses were mixed with mud to strength plaster and adobe bricks and for thatching roof, in addition to these plants were used to make other items like musical instruments, toys and ceremonial masks.

According to Dunkelberg (1992), several species of bamboo offers surprising large numbers of applications and uses, which indicates that building with bamboo looks back on an ancient

tradition in the regions in which bamboo grows in abundance, such as South America, Africa and South-East Asia. In South and South-East Asia the leaves of palm are also used to make manuscripts and to thatch buildings.

Many thousands of plant species were used for material culture and magi-co religious purpose by various tribal in different states of India. Among these species *Acacia nilotica* and *Butea Monosperma* are used for hand grinding mills; *Acacia leocophyloea*, *Wrightia tinctoria* and *Albezia lebbeck* are used for making mortars; *Acacia catechu* and *Azardirachu india* are chosen for making pestles; dried fruit shells of *Cucurbita moschata* or *Lagenaria siciraria* are used for temporary storage of water; dried hallowed fruit shell of *L. siciraria* or small circular bamboo baskets with lid are used for storing seeds to be used in the next season (Choudhary *et al.,* 2008).

2.3.1. Plants material culture in Africa

According to Blench and Dendo (2006), African tools particularly agricultural tools remain remarkably little studied by archaeologists and ethnographers and much of what has been published relates to Francophone countries, giving a skewed image of the continent as a whole. Yet the introduction of iron tools introduced a revolution in the agriculture of the continent and the need to produce iron by smelting a major economic transformation. The study of tools is also a matter of urgency, as many unusual local types are disappearing and being replaced either with factory-made implements or with more standard tools used across a wide area.

In African culture plants have been an important part of existence in many indigenous communities, and Africa is no exception (Sindiga *et al*., 1995). Abbiw (1990) stated that in Ghana at least 15 various plant species are useful to make roof shingles, which were chosen according to their availability, durability and water proofing nature. He also described that plant species like, *Afzelia africana* and *Craterispermum laurinum* are selected for timber production on the basis of their resistance to termites and fire, respectively, while *Conarium schweinfurthii* and *A. africana* are used for the construction of flooring and stairs due to their considerable resistance to abrasion.

Plant fibers are also vital to traditional material culture in Africa providing lashing materials for both the construction of building and the manufacture of wooden tools, mats, baskets, brushes

and hats, while soft fibers are used for weaving textiles. Fibers from the leaves of palm, *Phoenix reclinata* have been used for making brooms among the pokomo in Kenya (Mitsuo *et al*., 2001).

2.3.2. Plants used for material culture in Ethiopia

Plant is used for various material cultures and is essential raw materials for construction, fiber, kitchenware, timber, resins, agricultural implements and ritual activities. Woody stem is not only the most suitable and most widely used materials for traditional utensils and equipments, but it is also easily available and comparatively cheaper than metal. According to Abbiw (1990), plant is used for simple kitchen stool to the furnishings in average sitting rooms, or the more sophisticated furniture for special occasions and state functions. The reports on material culture and other miscellaneous use on plant resources of Ethiopia are very scanty and limited to certain area and ethnic groups (Adal, 2004; Abera, 2003 and 2013; Leulkal, 2005). But in the last decade there are some progresses in this field of study. For instance, the Cheffa people in Amhara regional state, Oromia special zone, North-East of Ethiopia, depend on traditionally made plant materials for house construction, carving mortar and pestles, thatching roofs, to make milk containers, mattress, pillows and toothbrushes (Tamene, 2000).

Borena people in Oromia regional state, South-Ethiopia use plant species like *Salvadora persica*, *Lannea schimperi*, *Indigofera Arrecta*, *Sida ovata*, *Hibiscus flavifolius* and *Pterolobium stellatum* to make toothbrush, kitchen utensils, containers, corrals, and other artifacts (Dalle *et al*., 2005). According to Tesfaye (2009), different plant species like *Ziziphus spinachristi, Cordia africana*, *Olea europaea*, *Eucalyptus species*, *Balanties aegyptiaca* and *Acacia species* are used for house and household materials construction, preparation of farm implements by peoples in and around Alamata Wereda, Tigray regional state, Northern Ethiopia. Abera (2013) also reported that the Oromo community of the Jimma Zone, Southwest Oromia of Ethiopia are relies on traditionally made agricultural tools, house construction, household furniture, beehives, utensils and other traditional arts. He described that about 46 plant species are used for material culture by the community and some plant species are served as ritual values, to make hunting tools, toothbrushes and musical instruments.

3. MATERIALS AND METHODS

3.1. Description of the study area

3.1.1. Geographical location

The study was conducted in Limu-Bilbilo District of Arsi Zone, Oromia National Regional State in Southeast highlands of Ethiopia. Geographically it lies between 07^0 10`14" - $7^0$40'20" N latitude and 39^0 4'59" - $39^0$38'56" E longitude. The study site is about 56 km southeast of Assela, which is the capital city of Arsi Zone, and about 231km southeast of Addis Ababa on the Addis Ababa- Bale road. The District includes 32 kebeles (the smallest administrative division in Ethiopia), in which Bekoji town is the administrative center of the District. The total area of the study site (District) is about 1,212.5 km^2. Accordingly, 10 kebeles were selected and established for data collection. These kebeles were selected by considering the vegetation resources of the area, recommendation given from Culture and Tourism Office of the District on the availability of knowledgeable elders, the accessibility of transportation to the study site, variation in vegetation distribution and homogeneity of nations and religions were also considered.

Table 1: Selected study sites with their respective geographical location in Limu-Bilbilo District

S. No	Name of kebeles	Location	Elevation (in meter above sea level)
1	Tamegni Awarie	07^0 09' 21" N and 39^0 19' 55" E	1598- 1665 m a s l
2	Bekoji Negeso	07^0 32' 29" N and 39^0 15' 54" E	2876- 2970m a s l
3	Liemu Dima	07^0 17' 09" N and 39^0 34' 41" E	2870- 3008 m a s l
4	Koma Ketara	07^0 40' 13" N and 39^0 14' 47" E	2143- 2298 m a s l
5	Liemu Burkitu	07^0 39' 19" N and 39^0 37' 59 "E	2980- 3180 m a s l
6	Bedi Michael	$07^0$35' 29" N and 39^0 29' 31" E	2490-3090 m a s l
7	Koji Chefa	07^0 14' 05" N and 39^0 31' 44" E	2600- 2970 m a s l
8	Chiba Michael	07^0 32' 15" N and 39^0 31' 44" E	1800- 2165 m a s l
9	Koji Kaka	07^0 27' 13"N and 39^0 16' 49" E	3090- 4190 m a s l
10	Ulule harchasa	07^0 36' 17" N and 39^0 22' 51" E	1650- 1885 m a s l

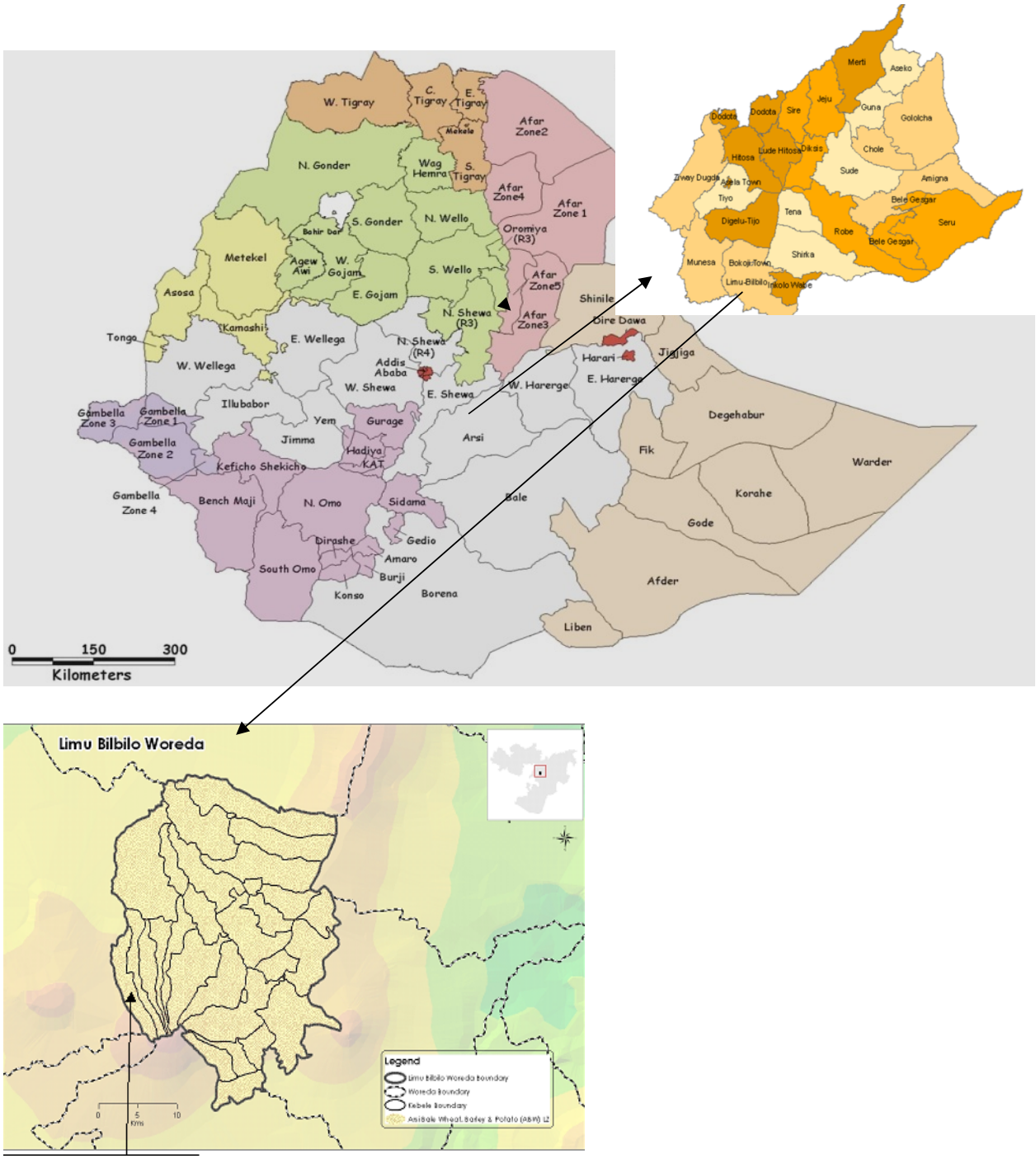

Figure 1: Map of Ethiopia, Oromia Regional State, Arsi Zone Limu-Bilbilo District.

3.1.2. Climate, topology and vegetation type

According to the data from National Meteorological Agency (2014), the study areas fall between an altitudinal ranges of 1500 meters above sea level around Kataar River to 4195 meters above sea level at mount Kaka. According to Jabessa (2004), Limu-Bilbilo District is ecologically

classified as cool zone (Baddaa) 89%, subtropical zone (Badda-daree) 9%, and tropical zone (Gammoojjii) 2% with an average mean annual rainfall of about (800-1200) mm.

Limu-Bilbilo District is characterized by plains, valleys, hills and massive mountainous terrains. According to the report by Jabessa (2004), about 433.4 ha of land in the study area was covered by natural vegetation which is about 0.36% of the total area of the District and about 48.1% of the total area of the District is cultivated land.

Mountainous parts of the District such as Kaka and Gallama are more covered with larger trees and diverse plants with variety of shrub and herbaceous species than other areas. Gallama is the chain of massive mountain chain extended to Bale Zone. However, human interference is intense as there is settlement and agricultural activities in and around all sides of the mountain chains. Recently, foothills of mountainous areas are under severe treat than the past decades due to population pressure and the need for agricultural and grazing land. The case of *"Gaara Kaka",* which is highly claimed by the informants as the area was the home for a number of Ethiopian wolf, cheetahs, bushbucks, and many other mammals, reptiles can be mentioned.

3.1.3. Population and the livelihoods of the people in the study area

The name of the District is derived from Arsi Oromo sub-clan (Limu) which dominantly harbored in the District and Bilbilo is the name of a mountain found in the area. The Oromo is the main ethnic group in the study site, although some other ethnic groups have also been settled in the area. The two main ethnic groups reported by Central Statistical Agency (2007) were Oromo (95%) and Amhara (4.3%) and others (0.7%) of the population. CSA (2007) also reported that the District has an estimated total population of 180,697 of whom 89,352 were men and 91,343 were women, of which almost all population of the study area were rural dwellers at that time. Afaan Oromo is spoken as a first language (95.95%); Amharic (3.43%) and other nations (0.62%) speak their own languages. The data from the same source also indicate that the majority of the inhabitants were practicing Ethiopian Orthodox Christianity (50.04%); while 45.68% of the population were Muslim, and 4.07% of the population were Protestants Christian.
The people in the study area economically depend on agricultural products from where barley and wheat cultivation provide most sustenance and income, with all areas receiving enough

rainfall to support one harvest season per year. Rural peoples of the District completely lead their life on cropping and livestock rearing. Thus, crop production and livestock rearing are the main activities of the population in the study area.

3.2. Sample size and sampling techniques

3.2.1. Reconnaissance survey and site selection

A reconnaissance survey of the study area was carried-out between February 10-20, 2015 to obtain general information about site conditions, to collect information on accessibility of plant species that serve as material culture and to identify sampling sites. Accordingly, 10 kebeles were selected and established as data collection sites. During the survey some homes, farms and markets were visited. The purpose of the survey and the contribution of the study were explained for some local people living in 10 selected kebeles of study sites.

3.2.2. Informant selection from different age groups and gender

According to Martin (2004), a statistical approach to generalist knowledge in a study community requires random (not haphazard or opportunistic) selection of participants and sufficient sample size. In other cases, specialized knowledge of a few key informants or elders is sought and low sample size could be likely precluding robust statistical analysis (Martin, 2004). Therefore, in this particular ethnobotanical study informant sample size was determined by the researcher based on factors like; easily manageable data size, limitations of field time, and budget allocated for the research.

Both random and preferential methods of informant selection were equally applied for this particular ethnobotanical study. All informants who have lived in the area for a decade and more were considered in the selection of a sample population. This was to ensure that they have sufficient knowledge of the sociocultural and the natural settings of the area. And in order to capture as much local knowledge as possible 40 key informants were selected out of 80 total participants (Appendix 3). Selection of key informants was based on the comments and recommendation given by Culture and Tourism Office of Limu-Bilbilo district, clan and religions leaders, knowledgeable elders in the study area and kebele administrators. Likewise,

according to Cotton (1996), elder informants were prioritized as studies have showed that they are more knowledgeable on plant species and their use than young people.

In this study, 80 informants, 8 individuals from each study site or kebele (60 men and 20 women) from the age of 24 and above were included. From the 10 study sites 40 key informants were selected; 2-4 persons from each study site (Appendix 3; in * are key informants) to collect data on accessibility of plant species that serve as material culture and indigenous knowledge possessed by the community. Despite of their number only few females were take part in the study since men are more responsible to cut and make plant made material objects during their field work than females.

Table 2: Age group and gender of informants

Age of informants (in year)	**Number and percent of informants in gender**				**Total**	
	Male		**Female**			
	Number	Percentage (%)	Number	Percentage (%)	No	%
24-34	11	13.75	2	2.5	13	16.25
35-45	18	22.5	10	12.5	28	35
46-56	17	21.25	5	6.25	22	27.5
>=57	14	17.5	3	3.75	17	21.25
Grand total	60	75	20	25	80	100

3.2.3. Educational status of informants

Fortunately 34 men and 7 females informants (41 or 51.25% of informants) were joined the modern schools, whereas 26 men and 13 females did not go to the modern school at all (48.75%). The educational status of informants were treated as modern education, for those who joined the modern school (range from grade 1 to university level), and traditional education, for those who did not attained formal and informal education at all, but they have enough knowledge in socioeconomic and sociocultural activities and to identify plants by their local name and to utilize them for different purposes.

Table 3: Educational status versus traditional botanical knowledge

Educational status of informants				
Educational status	**Gender**			
	Male	**Female**	**Total**	**Percentage**
Modern education	34	7	41	51.25
Traditional education	26	13	39	48.75

3.2.4. Occupation of informants in the study area

Occupation of the informants stands for the livelihood (or a means of earning the necessities of life), from which the majority of the informants were totally or partially depends on agricultural practices (farming, house wife, local drink makers, kebele administrators, school guard, carpenters & masonry, clan & religion leaders) accounts for 93.75% of the informants. Whereas 6.25% of the informants were civil servants: health extension, agricultural experts & teachers.

Table 4: Occupation of the informants

Occupation of the informants	**Gender of informants**			
	Male	Female	Total	Percentage (%)
Agrarian/ farming	56	19	75	93.75
Civil servants	4	1	5	6.25
Total	60	20	80	100

3.2.5. Religion and cultural practice of the informants in the study area

Since antiquity religious faith is the main characteristics of human society. The relationship between believes and some cultural practices could probably influence one's own traditional culture. For example, Gada System is one of the main cultural administrative practices in Oromo community including this particular study site, as some respondents listed on their responses' the factors that influenced the use of plant species material culture were the ignorance of some cultural believes and Gada System, which utilize many plant made materials for their ritual celebrations. Therefore, now a day this noble administrative system (Gada System) was ignored by many Christian and Muslim religions followers. And many plants made traditional material

culture were also ignored altogether. Out of total informants, 32 respondents (40%) were Muslim, 29 respondents (36.25%) were Orthodox Christians and 19 (23.75%) were Protestant Christians.

Table 5: Religion of the informants in the study area

Religion of the informants	**Gender**		**Total**	**Percentage**
	Male	**Female**		
Muslim	25	7	32	40.00
Christian (Orthodox)	21	8	29	36.25
Christian (Protestant)	14	5	19	23.75
Total	60	20	80	100

3.3. Data collection tools

Ethnobotanical data on the use of plant species material culture including their local names, cultural use, parts used, conservation status and processing manner were collected and organized between 20 February and 30 May, 2015. Ethnobotanical data collection tools applied were open-ended and semi-structured interviews documentation guided by outline of questions was carried out for house and field interviews with plant specimens and plant artifacts (Appendix 4). These useful tools used to record information in a systematic way on pre-prepared data sheets, robust field books and simple digital camera (with permission from the informants involved during the course of study). Kremen *et al*. (1998) and Reyes-Garcia *et al*. (2006) recommended guided field walk, direct observation and focus groups discussion were additional methods applied for reducing researcher subjectivity and intrusiveness, establishing rapport, and matching the statements of research participants with their actions.

Questionnaires for the interview were structured and conducted by the researcher based on the information obtained from reconnaissance survey. Semi-structured interview, guided field walk, group discussions, and observation, with randomly selected informants and key informants were applied based on a checklist of questions using local language (Afaan Oromo) to obtain indigenous knowledge of the local people on the plant species of material culture. These research

questions and the responses obtained from the informants were translated into English language for data analysis and final report writing (Appendix 4).

A total of 40 knowledgeable key informants and 40 randomly selected informants were chosen from the local residents and involved during the course of study. At the beginning of the interview a formal introduction was made with the participants, the importance of the study and its goal was also explained for each participant before receiving verbal consent. And in order to minimize the risk of confusing identity of plant species used for material culture most of the interviews were conducted in the field during data collection trips. During the course of study some of the plants material culture and the study site environmental set ups were photographed using digital camera so as to document information. In addition, information from informants, like lists of local names of ethnobotanically important plants and their respective parts processed for production of material culture and the application of these material cultures was compiled and documented.

3.4. Ethnobotanical data collection and identification

Ethnobotanical data collection of plant species for material culture, including their local name, parts used, processing methods to produce material, owner of knowledge to make particular objects or artifacts were done side by side. And voucher specimens were collected according to standard practice (Martin, 1995; Alexiades and Sheldon, 1996; Cotton, 1996) including roots, flowers, and fruits where possible. Based on ethnobotanical information provided by informants, fresh plant specimens were collected, numbered or coded, and local name on the collection site were given. And then pressed and dried for identification and preserved in Botany laboratory of Jimma University. Identification was done in the field as well as by comparison with specimens, illustration and taxonomic keys of various volume of the flora of Ethiopia and Eritrea (Edwards, *et al*., 1995; Edwards, *et a.,* 1997). Finally, both unidentified and the identified specimens were reconfirmed by a taxonomic experts.

3.4.1. Materials and chemicals used for specimen collection

During plant specimen collection, a pair of scissors for cutting the, plastic bags of different sizes for holding the specimens, and a ruler used for measuring the specimens were used. Then plant

specimens were pressed in a plant press, which consists of a wooden frame for rigidity, corrugated cardboard ventilators (to allow air to flow through the press), blotter paper (to absorb moisture), and folded paper, typically a news paper (to contain the plant material). Each collection of the specimen was assigned with collection number on the folded paper (news paper), and data from each collection site (altitude and geographical location) were recorded on a field note book. Then plant press was finally tightened and transported for identification and preservation.

3.5. Ethical consideration

Ethical issue should be considered when one engaging in an ethnobotanical survey and gathering information on indigenous botanical knowledge. This was achieved as letter of cooperation written from the department of Biology, Jimma University, to all concerned bodies. Then Limu Bilbilo district administrative was passed the information to Limu-Bilbilo agriculture office, Limu-Bilbilo Culture Tourism and Government Communication Affairs and to all kebeles involved in the study. In addition to this the researcher need to take extra care to ensure that the information they provide are helpful, understandable and considering ethical issues such as cultural sensitivity and to respect each person's pace. The culture and norm of indigenous peoples were also respected.

3.6. Data analysis tools

Ethnobotanical data structures played a key role in conducting the correct analysis with qualitative data through quantitative methods. Data structure referred to the way in which the data were visualized and categorized in different ways, largely as a result of data collection method. In addition to the structures of data, the component of any analysis approach was driven by the need to fulfill the research objectives, so the researcher considered a wider set of his research objectives.

As Martin (1995) and Cotton (1996) recommend ethnobotanical data were analyzed using both quantitative and qualitative methods. Sorting data into their respective category was the primary work in data analysis. For instance qualitative data were data collected from interview with open ended questions, focus group discussions, observations and others. The first basic steps in the

analysis of qualitative data were hence answers to open-ended questions, listing, ordering in relation to the objectives of the study and coding. Then based on categories of the data, the results were presented in tables and figures and finally, interpretation, discussion and summarization were done.

3.6.1. Descriptive analysis and Pearson's correlation coefficient test

A descriptive statistical method such as percentage and frequency were employed to analyze and summarize the data on plant material culture, associated knowledge, management methods, use and conservation. The most useful information gathered on traditional material culture reported by local people: types of material culture, uses of material culture, processing method, plant species, part(s) and habit, habitat of plants, owner of indigenous knowledge (sex and age) were analyzed through descriptive statistical analysis. In addition, 22 main use categories of plant and relative frequency of plant species was tabulated and analyzed statistically. For example measuring of frequency was computed for: plant species and their respective parts, particular material culture, processing manner or knowledge, botanical family and genera reported. And measuring of percentage for total plant species recorded and their respective part(s) utilized, growth habit, processing manner, segment of community involved in processing (sex, age, educational status, and religion) were computed, and finally bar and pie charts were also drown for growth habit and life forms, and gender knowledge. These measures were computed for sampled population after collected ethnobotanical information were entered into Microsoft Office Excel and SPSS (Statistical Package for Social Science) version 20 software to describe the socio demographic profile of participants and ethnobotanical information described above.

Ethnobotanical knowledge of informants involved in the study of plant material culture was computed by considering their gender and age, to investigate plant species knowledge by their local name; types, uses and processing methods of plant based material culture, these measures were computed for sampled population using SPSS to describe the ethnobotanical knowledge. To compute this, the most widely used measure of association between two variables, age and ethnobotanical knowledge, is the Pearson correlation coefficient denoted by ρ (rho) for the population and by r for the sampled population. This measure is named after Karl Pearson, a

leading British statistician of the late 19th and early 20th centuries, for his role in the development of the formula for the correlation coefficient (Cox, 1996).

Pearson's **r** is used to illustrate the relationship between two continuous variables, for instance as age of informants increase and ethnobotanical knowledge, thus, the purpose of the correlation coefficient (r) is to determine whether there is a significant relationship (i.e., correlation) between two variables or not. The correlation between any two variables using Pearson's r will always be between -1 and +1. The closer a correlation coefficient is to 0.00, the weaker the relationship is and the less able you are to tell exactly what happens to one variable based on knowledge of the other variable. The closer a correlation coefficient approaches plus or minus 1.00 the stronger the relationship is and the more accurately you are able to predict what happens to one variable based on the knowledge you have of the other variable.

3.6.2. Preference ranking

In this ethnobotanical investigation preference ranking represent an ordering of a list of different plants species according to their importance for the particular plant material culture under consideration. Preference ranking approach was conducted following Martin (1995) practice for the most important plants species used in the construction of traditional plants material objects. Some informants were selected to identify the best-preferred plant species, plants growth form, and the part of the plants preferred most for material culture. Martin (1995), noted preference ranking techniques as useful for gathering information on the different needs, feelings and priorities of different categories of individuals within a community to make and use plants' made material culture and a numerical value is assigned to each item. Following this method, preference ranking was conducted for ten most important plants used for making traditional farm implements in Oromo ethnic groups of Arsi Zone (Table 10) and other ten most important plant species used for traditional house construction in Oromo ethnic group of Arsi Zone (Table 11). Fifteen key informants (10 men and 5 women) were randomly selected from 40 key informants to select the best preferred plant species for traditional farm implements and traditional house construction. Each informant was provided with ten plant species reported to be used for material cultures and asked to assign the highest value (10) for plant species most preferred for the particular purpose and the lowest value (1) for the least preferred plant species against these materials and in accordance of their preference for the remaining eight plant species. Some

plants may have equal preference or priority for particular material culture as that condition informants were allowed to score the same value. Finally each value given by those selected 15 key informants was summed up and rank given to each plant species.

3.6.3. Direct matrix ranking

A common form of preference ranking uses a direct matrix ranking to evaluate the multipurpose functional plan species**.** Direct matrix ranking exercise was done following Martin (1995) and Cotton (1996) in order to compare multipurpose use of a given plants species and to relate this to the extent of its utilization versus its dominance and the degree of existing threats related to their use values. Based on information gathered from informants, ten multipurpose plant species were selected out of the total plants species used for material culture and eight use categories of these plants were listed for 15 randomly selected key informants (10 men and 5 women) to assign use values to each species. The eight use categories of these selected plant species were: traditional farming implements, fencing, household objects, beehives making and honey production, traditional house construction, timber production, kitchenware and weaponry (Table 12).

Fifteen key informants were chosen to conduct this activity and each key informants was asked to assign use values (5 = best, 4 = very good, 3 = good, 2 = less used, 1 = least used and 0 = not used). Using numerical scale in which the highest number is equal to the most preferred item whereas, the lowest number is equal to the least preferred items. And zero value was given for non-preferred plant species for particular plants material culture. Then, the informants were asked to rate their preferences. Finally, the average score of each species were summed up and rank were given for multipurpose plant species. And the average score was also summed up and ranked for particular material culture to indicate it was constructed from many alternatives plant species (Table 12).

3.6.4. Paired comparison

Paired comparison can be used to compute the relationship of preference for a particular issue under consideration. Therefore, paired comparison can be used for evaluating the degree of preferences or levels of importance of certain selected plants species (Nemarundwe and Richards, 2002). A list of the pairs of selected items with all possible combinations was made and sequence of the pairs and the order within each pair was randomized before every pair is

presented to randomly selected informants and their responses were recorded and total value was summarized.

For this technique, 10 randomly selected men key informants were informed to indicate the efficacy and popularity of eight plants species used for house construction and traditional agricultural implements. And finally ranks were made based on the reports from 10 randomly selected key informants. Then total orders were obtained by summing the number of items each time they indicate. In a paired-comparison task, respondents were presented with pairs of plant species and instructed to select the more preferred plant for making household objects and traditional agricultural implements from each pair. With N items, there are N' = [N (n- 1)]/2 pairs of items. For instance, N'= 28 pairs can be constructed with N= 8 items.

4. RESULTS AND DISCUSSION

4.1. Plant resources of the study area and their uses

In this study, a total of 79 plant species were identified and documented for their cultural importance from Arsi zone of Limu-Bilbilo District. Those species were distributed in 74 genera under 49 families. The family reported with the highest number of plant species were Poaceae reperesented by six species (7.59%), Rutaceae represented by four species (5.06%), Rosaceae, Myrtaceae, Fabaceae, and Asteraceae represented by three species (3.80%) each, whereas Boraginaceae, Cucurbitaceae, Euphorbiaceae, Lonaniaceae, Lamiaceae, Meliaceae, Myricaceae, Myrsinaceae, Myrtaceae, Rubiaceae, Araliaceae, Oleaceae, Ranunculaceae, Solanaceae and Urticaceae each represented by two species (2.53%) each. The remaining 29 families have only one species (1.27) each (Table 6).

Several of these plant species were catering to basic human needs, such as traditional house construction, for food preparations, clothes and to make agricultural implements. In addition to these uses, the people in Limu-Bilbilo District use various plant species to make timber to make furniture, fence, kitchen utensils, basketries, containers, traditional ornaments and decoration, tooth cleaning twigs, house hold objects, bathing brush, tool handle, weapon and sticks, traditional tattoos, beehives, cart, foot bridge, traditional weaving material, musical instruments, torch, traps and for social or religious ceremonies (rituals).

The recorded plant species from Limu-Bilbilo District, Arsi Zone were cross checked with the findings of previous researchers in Ethiopia and elsewhere in the world. Out of 79 plant species recorded in the District for material cultures, 31 species were listed by Yassin *et al*. (2015), 21 plant species were reported by Abera (2013), five species were reported by Bahru *et al.* (2012) from Ethiopia, and four similar plant species were recorded by Choudhary (2008) from India. Although some similarity of material culture reported by those authors, the community in the study area have a lot of indigenous cultures and knowledge to be conserved.

Table 6: Botanical Families of plant species used for material culture in Arsi Zone, of Limu-Bilbilo District

No	Botanical family	Genera		Species	
		Number	Percentage (%)	Number	Percentage (%)
1	Poaceae	6	8.11	6	7.59
2	Rutaceae	4	5.41	4	5.06
3	Rosaceae	3	4.05	3	3.80
4	Fabaceae	3	4.05	3	3.80
5	Myrtaceae	2	2.70	3	3.80
6	Asteraceae	2	2.70	3	3.80
7	Myrsinaceae	2	2.70	2	2.53
8	Myricaceae	2	2.70	2	2.53
9	Urticaceae	2	2.70	2	2.53
10	Solanaceae	2	2.70	2	2.53
11	Boraginaceae	2	2.70	2	2.53
12	Rubiaceae	2	2.70	2	2.53
13	Cucurbitaceae	2	2.70	2	2.53
14	Euphorbiaceae	2	2.70	2	2.53
15	Lamiaceae	2	2.70	2	2.53
16	Meliaceae	2	2.70	2	2.53
17	Loganiaceae	2	2.70	2	2.53
18	Araliaceae	1	1.35	2	2.53
19	Oleaceae	1	1.35	2	2.53
20	Ranunculaceae	1	1.35	2	2.53
21	Hypericaceae	1	1.35	1	1.27
22	Linaceae	1	1.35	1	1.27
23	Malvaceae	1	1.35	1	1.27
24	Menispermaceae	1	1.35	1	1.27
25	Moraceae	1	1.35	1	1.27
26	Musaceae	1	1.35	1	1.27
27	Oliniaceae	1	1.35	1	1.27
28	Pittosporaceae	1	1.35	1	1.27
29	Podocarpaceae	1	1.35	1	1.27
30	Rhamnaceae	1	1.35	1	1.27
31	Rhizophoraceae	1	1.35	1	1.27
32	Acanthaceae	1	1.35	1	1.27
33	Cupressaceae	1	1.35	1	1.27
34	Cyperaceae	1	1.35	1	1.27
35	Ericaceae	1	1.35	1	1.27
36	Anacardiaceae	1	1.35	1	1.27
37	Apocynaceae	1	1.35	1	1.27
38	Flacourtiaceae	1	1.35	1	1.27
39	Arecaceae	1	1.35	1	1.27

Table 6 continued…

40	Santalaceae	1	1.35	1	1.27
41	Sapindaceae	1	1.35	1	1.27
42	Brassicaceae	1	1.35	1	1.27
43	Capparidaceae	1	1.35	1	1.27
44	Sterculiaceae	1	1.35	1	1.27
45	Thymeleaceae	1	1.35	1	1.27
46	Tiliaceae	1	1.35	1	1.27
47	Ulmaceae	1	1.35	1	1.27
48	Barbeyaceae	1	1.35	1	1.27
49	Verbanaceae	1	1.35	1	1.27
	Total	74	100	79	100

4.2. Plant categorization

4.2.1. Habitat of plants used for material culture

Of the 79 plants species recorded in the study area, 56 (70.9%) species were predominantly obtained from natural wild, 13 (16.5%) species were found in cultivated fields and home gardens, they were considered as both cultivated and wild because they are currently found in private farm lands owned by the owner of the farm site and kept from deforestation or they were restricted to home garden which are either planted by family members of the home or kept because of their special purposes like shade and medicinal value, where the remaining 10 (12.6%) plant species used as material culture are directly cultivated for their special values.

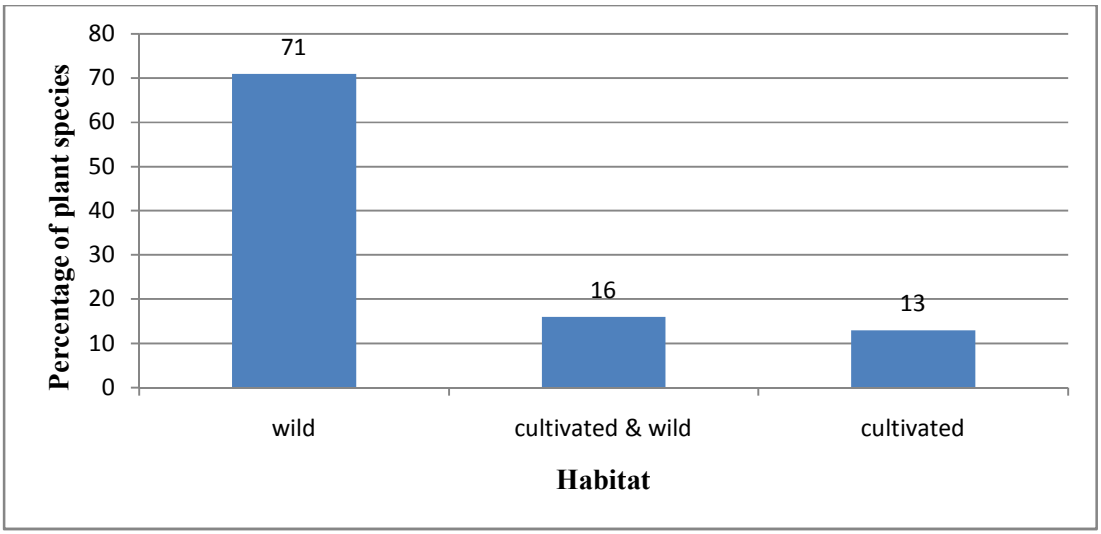

Figure 2: Bar chart depicting habitat of plants used for material culture

In In agreement with this finding (Figure 2), the people living in Masha and Yeki District of southwest Ethiopia obtain 82% of plant from natural wild Yassin *et al*. (2015).

4.2.2. Plants growth form

In this study, a total of four different life forms of plants were recorded, being distributed 33(41.77%) species are tree contributed the highest proportion of growth forms, of which the majority of them are used for house construction and to make farm implements, 27(34.18%) species were shrubs which are highly utilized as fencing purposes and to make tool handles, 14 (17.72%) species were herbs which are preferred for roof thatching and to make household utensils, and 5(6.33%) were lianas which are mainly used as rope for tying house fence wall reinforcing beams (Figure 3). The finding by Abera (2013) and Yassin *et al.* (2015) also reported tree as the highest growth form used for carving material cultures. On the other hand, finding by Bahru *et al*. (2012) indicated Shrubs contributed the highest proportion of growth form used for material culture in Afar and Oromo Nation, East Ethiopia.

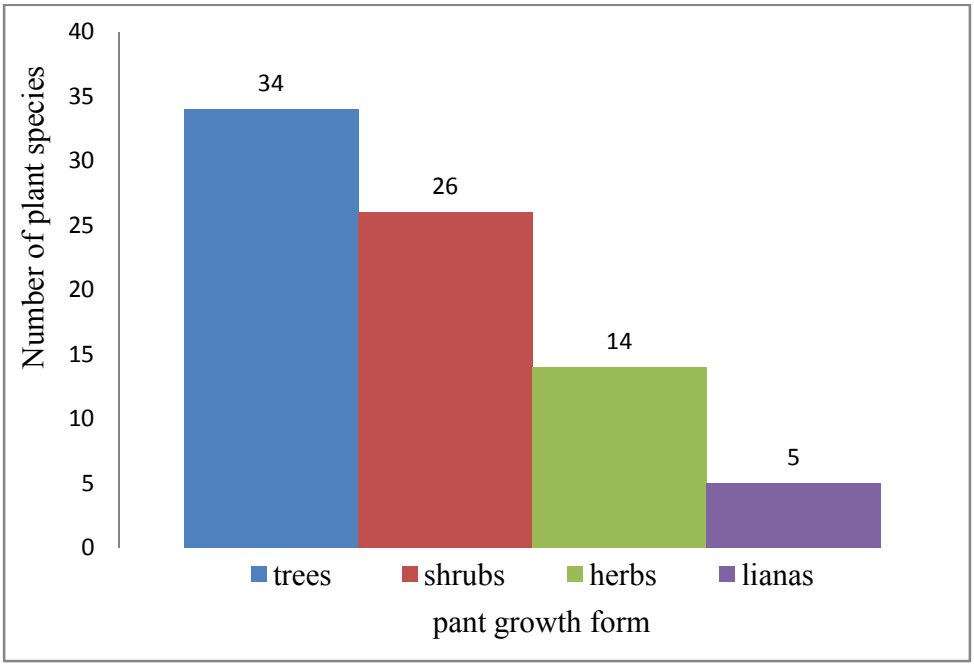

Figure 3: Histogram showing growth form of plant identified for material culture

4.3. Plant part(s) and conditions used for material cultures

4.3.1. Plant part(s)

Different parts of the plants are used for making different kinds of plant material culture. One particular plant part may be used for a number of materials and different parts of the plant may also be used for a single material culture. And some plant species are used for making more than one material culture. Out of 11 different plant parts reported to be used to make different kinds of plant made material objects in Limu-Bilbilo District, the most widely used plant part for the preparation of plant material culture was the stem, which account for 60 (55.56%) plant species followed by leaves 18 (16.67%), bark 7 (6.48%), branches account for 6 (5.56%) of the plants reported for material cultures (Figure 4). This result is in agreement with the report made by Yassin *et al*. (2015) from Masha and Yeki District of southwest Ethiopia, Abera (2013) from plants used in material culture in Jimma Oromo community, Southwest Ethiopia, and Bahru *et al*. (2012) recorded from the indigenous knowledge of plant species material culture of Oromo and Afar Nations, East Ethiopia.

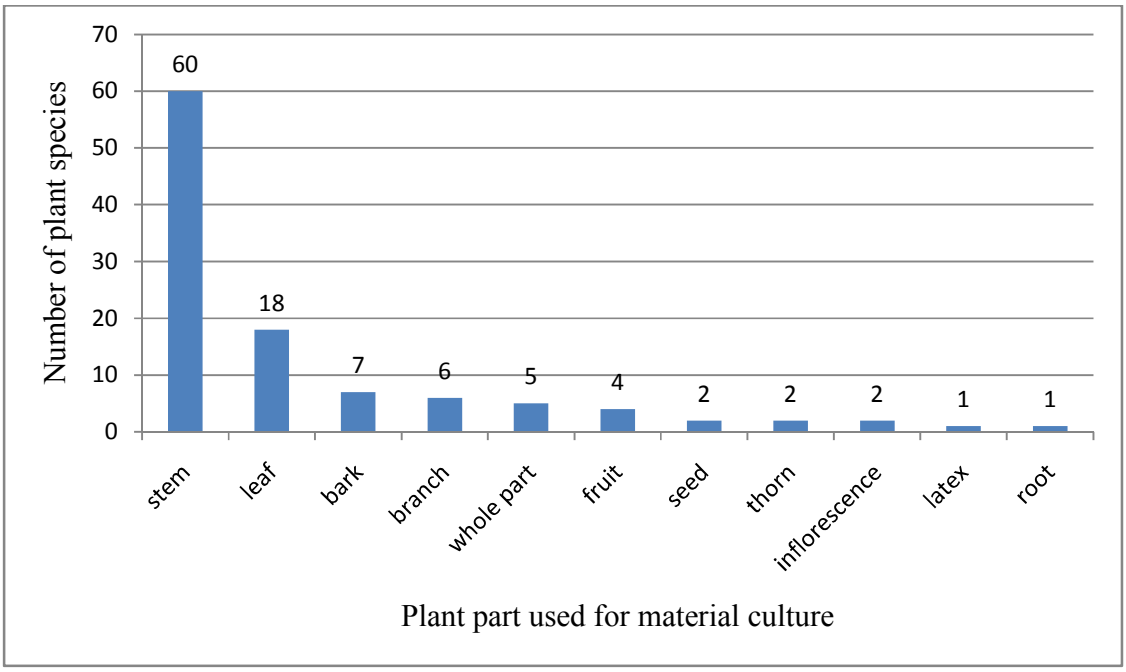

Figure 4: Bar chart showing frequency of plant part(s) used for material cultures

4.3.2. Conditions (forms) of plant parts used in the preparations of material culture

Out of 79 plant species reported and 11 main parts used for the production of material culture 34 (43.03%) species were reported to be used in both fresh and dried form for making material culture. And 25 (31.64%) of the plants and its part(s) were identified to be used in dried form, the rest plant parts 20(25.33%) were reported to be used as fresh form only (Figure 5). The information obtained from different informants on the conditions of plant parts used in the preparations of material culture has its own advantages and disadvantages on the quality and durability of plant made material objects. Most plant species used for making different farm implements and household utensils are preferred in dried form, because the dried woody-stem used to make farm implements has light weight, which is easy for transportation and farming practices. Similarly dried form of plant parts are used for roof thatching and to make tool handles, because the dried form of plants don't lose its size (or compactness) as time goes and more durable than the wet fresh forms. But, some plant parts are preferred in wet fresh form because of their flexibility to form different shapes (or reshape) and to curve them easily to the shape of interests. Whole plant parts are also used at a site where they are planted. Few plant species were reported to be used as life fence and for shading, so this can be categorized as fresh form. And other plant parts can be used in both fresh and dried form but different parts of the same plant can be utilized in different forms or the same part of a plant can be used to make different material culture in different conditions (Appendix 1). In agreement with this finding, report made by Yassin *et al.* (2015) also indicated, dried and fresh conditions are the most plant parts processed for material culture in southwest Ethiopia.

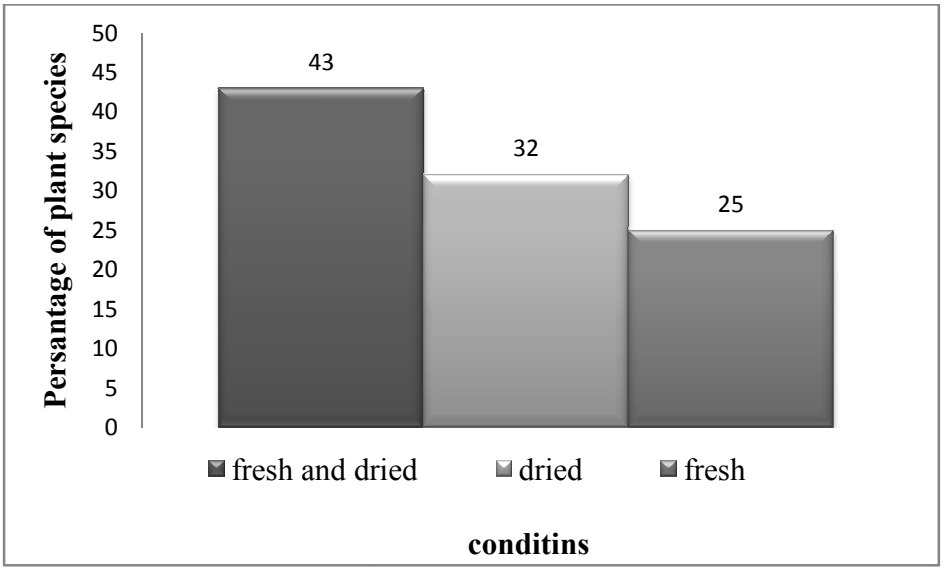

Figure 5: Histogram showing forms (conditions) of plant parts used in the preparations of material culture

4.4. General processing manner of plant material culture

For the preparation of materials, the plant parts are processed in various forms. It is difficult to speak specifically every particular steps and procedures during processing of plant materials and their manipulation to construct different material culture. This is because information reported by the community is dynamic, and are continually influenced by internal creativity of individual person. Some plant parts also require considerably more processing than others, on the other-hand some materials described in the study area are worked in simple ways which are easy to work. One plant species was reported to use for many material cultures and processed in different conditions and processing skills. However, it is useful to look at the most basic processes in light of their purpose and effect on the materials. A great deal of indigenous knowledge is available on the processing, construction, decoration, and use of material culture, based on first-hand observation, informants' repots , and actual properties of material culture. Out of the preparation processes recorded, large number of plants 39(21.79%) were processed by splitting, carving 30(16.76%), hewing 13(7.26%), burrowing (boring) and and sawing were reported for 12 species (6.70%) and 11(6.15%) respectively (Table 7). But, many ethnobotanical studies (Abera, 2013; Yassin *et al*., 2015; Paul, 2000) reported woodcarving as the most important art form in processing material culture.

Table 7: General processing manner of plant material culture

Modes of preparation of material culture	**Frequency of plant species reported**	**Percentage (%)**
Splitting	39	21.79
Carving	30	16.76
Hewing	13	7.26
Burrowing (boring)	12	6.70
Sawing	11	6.15
Adzing or stripped of leaves	11	6.15
Peeling	10	5.59
Weaving	7	3.91
Planting new seedling for fence	7	3.91
Pounding or crushing	6	3.35
Smoothing (or rubbing)	5	2.79
Threshing	5	2.79
Mowing	4	2.23
Soaking	3	1.68
Heat treating	3	1.68
Shortening and trimming	3	1.68
braiding	3	1.68
Sharpening	3	1.68
Painting	2	1.12
Sewing or stitching	2	1.12
Smoking	2	1.12
Oiling	2	1.12
Beading	2	1.12
Slicing	2	1.12
Extracting latex	1	0.56
Broke loses of cotton	1	0.56
Total processing method cited for all species	179	100

4.5. Plants material culture used in Limu-Bilbilo District, Arsi Zone

The Oromo ethnic group in Limu-Bilbilo District uses several plant species to produce different kind of material culture by non-specialist households on a regular basis of daily life for making material culture. The local people in the study sites are highly dependent on different plant species for various construction purposes such as: traditional house construction and agricultural implements, household utensils, tool handles, roof thatching, dry and live fencing, weapons and sticks, teeth cleaning twigs and many other purposes. These species were used for a wide variety of purposes that have been categorized into 22 major use categories and 64 particular traditional materials were reported to be utilized. These main important use categories, preferred plant species and their respective part(s), knowledge utilization (or processing methods) and the use value of each material culture were described (Appendix 1).

4.5.1. Traditional farm implements

Agriculture is one of the most important occupations of the community in the study area. It is the main occupation every descendent takes after his/her parent. Indigenous people in and around the study area use 27 (34.18%) plant species to make various traditional farm implements, but the degree to prefer one species from the other depend on strength, accessibility and durability. The agricultural implements identified in the study include plough, *waanjoo* (yoke), *digaree* (plank), *halazaa* (strong curved stem to hold the yoke and oxen together), *irfii* (plow handle), xiqartee (thin strong small stem used to connect planks with plough), *funyee* (strong stem used to connect plough and yoke together), "*lammeedaa*" spoon like woody material used during threshing, *"manshii"* fork like branches with three or more forked stem, "*qancee"* threads woven for plough-man's whip, "*furisaa*" sling shoot to through stone driving birds from sorghum and other animals from crops, handles of axe and "*digger*". Their processing is supplemented with locally made metal objects (Figure 5C).

Nooyee (Plough) - is a device pooled through the ground in order to break it open into furrows (or trench cut in the soil) for planting. The woody stems of *Olea europaea*, *Allophylus abyssinicus*, *Cassipourea malosana, Prunus africana and Teclea nobilis* are used to make plough. The stem of those plants 5-6 meter long are peeled and dried by burrowing in animal dung to prevent them from cracking. Then the two ends are bored using *maroo* (metal chisel) to

reinforce it with plough handle, *xiqartee* and funyee. According to a paper presented at 5th International Workshop for African Archaeobotany by Blench and Dando (2006), plough is the characteristic of Ethiopia, an art which fractures and disturbs the soil. Similarly, Abera (2013) from Jimma Zone, Southwest Oromia and Adal (2004) from North Shoa, of Ethiopia have also reported the form and application of the same agricultural implements (Figure 5).

Waanjoo **(yoke) –** is a bar or frame of wood by which two oxen are joined at the necks for working together. It is structured by which a plough is tied to it at median point and bored in circular shape to hold a pair of "*halazaa*" for each ox. The indigenous community in the study area prefers dried strong stem with less weight to make "waanjoo". It is made from *Hagenia abyssinica, Nuxia congesta* and *Schefflera volkensi* (Figure 5A).

Digaree **(plank)** –is a long, broad and thin piece of timber held to plough with "xiqaree" and "*wagalaa*" (a piece of metal twisted and carved at one end) on the plough handle to make wide trench per turn. Generally to add weight or load the farmer stand on "*digaree*" with one leg to make wider and deeper trench while the oxen pull it forward. Plank is made from *Acacia abyssinica, Olinia rochetiana, Eucalyptus globulus and Allophylus abyssinicus.*

Halazaa **(carved stem keeps oxen necks under yoke) -** it is made from naturally curved or by curving woody branch of *Vepris dainelli, S. volkensi* and *O. europaea* which involves first heating to make the material pliable enough to be bent without breaking. A pair of halazaa is needed to keep each ox in position under yoke.

Irfii (plough handle) – is strong woody stem sharpened at one end to be inserted with sharpened metal "marashaa" and handled by the farmer to keep in the right track during ploughing the land. It seems the Amharic term for "maresha" has been borrowed into Afaan Oromo language of Oromo ethnic group in Arsi zone. "Irfii" is made from *N. congesta*, *Galiniera saxifraga* and *Eucalyptus globulus.*

Xiqartee **(planks and plough connectors) and** ***funyee*** **(yoke and plough connector)**

"Xiqartee" is strong stem branch used to connect planks with plough on left and right sides and sometimes made of metals, while "funyee" is thin wood stem used as pin to connect plough and

yoke together by using strong fiber or leather made string, are made of *Olea africana, Olinia rochetiana* and *Galiniera saxifraga.*

Manshii **(Pitchfork):** is forked stem used to separate straw during threshing. It is made from naturally forked wooden stick used to lift straw for trampling (pitching). Naturally forked branch or stem with 3-4 forked branches are modified into pliable shape by first heating to carve without breaking. Baumann (1944) reported a similar farm implement from the Oromo community in southern Ethiopia. It involves moving a solid wet plant stem into a new curved and forked shape. It is used to separate larger broken straws from fine seeds holding minute straw during threshing of barley and wheat, the main crops produced in and around the study area. This farm implement is made from many woody stem with forked ends, but many farmers prefer *O. africana*, *N. congesta* and *G. saxifraga* because of their strength and durability.

Laamedaa **(spoon like woody material for blowing out minute or fine straw)**
Minute straw and grains are scooped up and blow off in air to separate fine straw from grains during threshing. And this scoop is made from woody stem by carving a woody plant material into a new spoon like shape by molding or modeling into the shape of interest. This important farm implement is made from *E. globulus, Podocarpus falcatus* and *Schefflera abyssinica*.

Gumbii/ gotaraa **(Grains storage or granary) -** is a large round basket like storage of grains. Granary has various sizes and shapes in which different kinds of grains are stored. It is constructed by using different plant species like *Stephania abyssinica, Urera hypselodendron, Phoenix reclinata, Myrsine africana, Arundinaria alpina* and *Oxythenanthera abyssinica.* For example, large grain silo "*saqallaa*" to store grain for long period of time (more than a year) is constructed by splitting *A. alpine* and *O. abyssinica* into small pieces, which are held together by cords. Circular lid plastered with clay soil is used to cover "*saqallaa*" to keep the normal moisture of grain and to avoid weevil. The interwoven granary plastered with clay soil is then, allowed to dry in the sun and finally painted with animal dung before filling with grains. Most of the time, granary or grain silo is placed in a separate room; this room also serving as bedroom for adolescent males.

Figure 6: Photos showing traditional farm implements: A-Yokes; B-Baskets (Shaalii); C-ploughs and plough handles; D- Planks (Photo taken by Million Tebassa, differen farm implements produced by Dame Wayessa (A,C & D) for trading/marketing purpose, Liemu Burkitu Kebele, 2015).

Qancee **(threads woven for plough-man's whip)** - is a length of braid cord on a handle, used to beat or urge oxen to keep them in correct trench or furrow or to pull the plow forward quickly. It is sometimes made of leather cord because of its durability, but most of the time the bark from *Dombeya torrida, E. globulus, Justicia schimperiana* and *Urtica simensis* are used. The fibres of *Ensete ventricosum* was also reported to make plough man's whip. As a person whirs it and produce a whirring sound the oxen move forward in appropriate direction as quickly as possible.

Furisaa **(sling for throwing stones)** - is shoot made of fibers extracted from plants like *U. simensis*, *E. venticosum* and of fiber extracted from barks of *E. globulus* and *D. torrida*. It is used for throwing stone for driving away birds and other wild animals from crop plantation. It has a broad collar in the middle forming a sort of loop that looks palm of hand to hold smaller stones to be slung forward by producing whirring sound. The whirring sounds and stone would help in driving away birds and other wild animals from crop fields. Sling and plough man's whip are braided from the bark of similar plant species.

Axe and digger handles: Wood-working is often a difficult, time-consuming task for people without metal tools. Production of traditional implements like agricultural tools, household objects, constructions, and weaponry requires special knowledge and adequate materials and working techniques. Most of the working materials are tools with wooden handles, which are used in a rural/farm setting and constructions. In building a shelter, for example, pieces of wood from *O. europaea, E. globulus* and *Prunus africana*, about the right size and shape are used for the task, processing of the object is very simple because of axes and adzes.

The axe is a simple hand tool, which consists of cutting edge and an eye for fixing of a handle. It's multipurpose cutting tool used for felling and splitting of logs for firewood and dressing of logs for timber conversion. Small axes are also used for clearing of bushes. Socket hoes are blunt end axe used for digging the ground to make canal in farm land and to dig land difficult to reach using animal power. Both axe and digger handles are made of naturally curved stem. For operation, the operator holds the handle with both hands at a convenient position and the tool is raised to suitable position and struck with force against the work. But, these metal tools are not terribly efficient without handles made of woods. Many of the metal made tools (axe, adze, sickle, knife and so on) used by the people in Arsi Zone are handled by objects made from *Acacia abyssinica, Olea europaea, Rhamnus prinoides, Croton macrostachyus, H. abyssinica, E. globulus, Vepris dainelli and Rhus vulgaris*. Modifying naturally curved plant stem or curving through heat treatment and boring (or making a hole using metal chisel) are the approaches to make tool handles for different functions.

4.5.2. Traditional house construction

The Arsi people highly depend on plant materials for the construction of their houses. Out of the species recorded for material culture in this study, 43(54.43%) of the species were reported to be used in constructing different types of traditional houses (Figure 6). Different part of the house are constructed with different plant species; for example: sidewalls, wall reinforcing beams, roof supports, load-bearing house pole, tying of walls and roofs, roof thatching or covering, doors and windows, daubing the wall of the house need particular plant species. The following are the main plant species used in house construction and the specific purposes of each species during house construction of Oromo community of Arsi Zone in Limu-Bilbilo District.

***Utubaa* (Load bearing pole or pillar)**

Pole is the first to be forced into the ground after the total area of the house is measured through footsteps. Pole is usually forced into the ground at the center of the house by the owner of the house usually husband or elder male son. Female is not allowed to do this in Arsi Oromo culture. Pole is hewed (or shaped by chopping) into cylindrical shape. At the top of the pole circular flat timber with 2-3 meter in diameter is bored and inserted to connect the main pole with sidewalls by roof supports in circular traditional roof. Or sometimes two poles connected by rectangular

flat timber in non-circular traditional house. As reported by community in the study area six species (7.60%) are more preferred for traditional house pole, for instance: *Cassipourea malosana*, *Celtis africana, Juniperus procera, Podocarpus falcatus and Prunus africana* are the most preferred plant species.

Sidewalls

Regarding the number of plants species involved in house construction, 17 species (21.52%) were reported for sidewall construction. Plants used for sidewall construction is selected based on its durability and termite resistance, based on this *Gatraa* (*J. procera*) is the most preferred one but, due to the scarcity of this species people in the study area use different woody plant species for building their houses, sidewalls are made by splitting large thick woody stem of *Allophylus abyssinicus, Arundinaria alpina, Ekebergia capensis, E. globulus, Eucalyptus camaldulensis, H. abyssinica, J. schimperiana, J. procera, Hypericum revolutum, Myrica salicifolia, N. congesta, O. africana, Olea capensis, Pittosporum viridiflorum, Syzygium guineense, Trichilia dregeana* and *V.dainellii.*

Wall reinforcing beams (*magaraa*)

Wall of traditional house in the study area is reinforced to keep and hold walls in a particular upright direction. Reinforcement of wall is made with many plant species. For instance, *Rytigynia neglecta*, *E. globulus, Myrsine africana* and *O. europea* are used to make house reinforcing. Similarly, studies conducted in different part of Ethiopia, Adal (2004) from North Shoa, Ethiopia, Bahru *et al.* (2012) from East Ethiopia, Abera (2013) (southwest Ethiopia) and Yassin *et al*. (2015) from southwest, Ethiopia, have reported the making and application of the same traditional house construction from some common plant species. For instance, Abera (2013) reported the use of woody stems of *Adansonia gregori, Cordia africana, Eleutine jaegeri, Juniperus procera, Olea welwitschii* for house wall construction in Jimma Zone, southwest Ethiopia.

Rafters (roof supports) and ceilings

In traditional house building roof support running from the top of the roof down to the house walls, beams are stems selected from termite resistance species. Out of the plants reported for material culture 5 (6.33%) of them are used for roof support and to make roof ceiling. For example, the stem of*: A. alpina, Capparis tomentosa*, *Justicia schimperiana, S. volkensii, E.*

camaldulensis are used to make roof supports and ceilings. In traditional roof ceiling different parts of the roof are held together without nails using cordage made from the bark of seven species (8.86%) like: *Barbeya oleoides, D. torrid*a, *C. africana*, *Gnidia glauca*, *Urera hypselodendron, Rubus steudneri* and *J. schimperiana*.

Roof thatching

Roofs were thatched with straws of various grasses of and cultivated crops species, the most commonly used were *Pennisetum schimperi, Eragrostis tef*, *Hordeum vulgare* and *Linum usitatissimum*. Roof thatched with straw from barley, wheat and other crops are not serving more than one year, but roof thatched with *Pennisetum schimperi* can serve for many years without renewed. On the other hand, a study conducted in east Ethiopia revealed roofs were thatched with a variety of grass species, the most commonly used being *Cymbopogon pospischilii*, which is commonly used by pastoralists for house construction by Afar and Oromo Nation (Bahru *et al.,* 2012).

Doors and windows

Obviously doors and windows are made from timber, but the most preferred plant species to make traditional door and window are *H. abyssinica, Cordia africana, E. globulus* and *Podocarpus falcatus.* The same plant species with slight thikness are used to make the frame of door and windows.

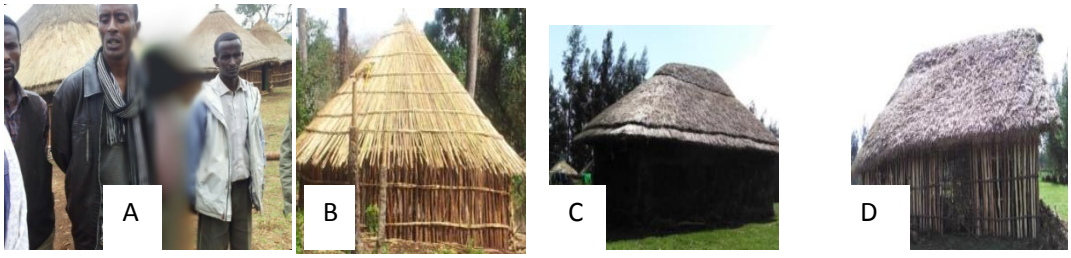

Figure 7: Traditional house construction of Arsi Oromo in LimuBilbilo District: A- group of informants in Chiba Michael kebele; B- traditional house under construction with one pillar from Ulule harchasa Kebele; C- house with two pillars in Chiba Michael kebele; D- traditional house (Mulaalee) without particular pole, but long and strong sidewalls support the roof, from Koma Ketara Kebele) Photo taken by Million Tebassa, 20015.

Daubing of house walls

Daubing and plastering with mud need some straws reaming after threshing crops, for example *E. tef* and *H. vulgare* kneaded with mud and used for daubing of house wall.

***Godoo* (Hat)**

Small hat separated from the main home is very common in the study area for the storage of fodder for the dry season, which and sometimes serves as grain storage. The hats have generally only one room without window. The hat is constructed from different plant species like *Eucalyptus* species, and *P. falcatus* for making side wall whereas, small branches of *Capparis tomentosa* and *J. procera* are used to make roof ceiling. Roof thatching with *P. schimperi* and straw from *H. vulgare* and *L. usitatissimum* are very common.

***Godoo* ciidhaa (Nuptial hat)**

Hat is constructed few days before weeding program for bride and bridegroom in their own family compound. This hat is constructed with similar plants for Godoo, but this hat is not plastered with mad; it is simply covered by small leafy branches of *Clausena anisata* to give aromatic smell. And the leaves from the same plants spread on the ground. Bride and bridegroom are blessed in this hat by the elders and parents in this hat. And they also enjoy their honeymoon ceremony with their friends in this hat. According to Tamene *et al*. (2000), in honeymoon houses both the sidewalls and the roofs are constructed and decorated by *Typha domingensis, Cyperus digitatus, Phragmites australsis,* and *Echinochloa pyramidalis* in Cheffa, Ethiopia.

Wedge for splitting large stem

Strong stems like *Olea europaea Rhus vulgaris* and *Prunus africana* are used to make wedge for splitting woody stems, and to mark the position on the ground.

Cordage (tying materials)

In traditional house construction, tying with cords made of plants or plant products is very common in the local community. For instance, *Barbeya oleoides, Dombeya torrid*a, *C. africana*, *Gnidia glauca*, *U. hypselodendron, R. steudneri*, *J. schimperiana*, *Urtica simensis* and *E. ventricosum* are the most preferred species for tying of walls and roofs. For example, tying material produced from plants like doobii and warqee are tough fibers that were twisted, by repeated rubbing on the thigh, into longer strands that could be used to make cordage. But now-

a-days these plant resources became scarce, so people prefer to use nails than finding them for tying purposes.

4.5.3. Fencing material

This finding showed that, more than 29 (36.71%) species of plants recorded in the study area are used for fencing purposes. Stems with thorny branches are used for fencing around the home garden and farmlands, because thorny branch and small stems are being strung between the poles to keep livestock from wandering in. Woody stems of selected plant species are preferred for the front part of the home garden. Out of 29 species reported for fencing purposes, six species were reported for cordage or tying purposes, for example: *Urera hypselodendron, Schefflera abyssinica, R. steudneri, Clematis simensis, longicauda* and *E. capensis,* and four other plant species were documented for life fencing since the community in the study area deliberately planted them for fencing post based on some properties like defensive character of spines (thorns), easily (vegetative) growing property of life fencing. For example, *Capparis tomentosa* and *Dovyalis abyssinica* which are equipped with thorns (spines) are more preferred for life fencing. And plants like *Discopodium penninervium* and *Vernonia auriculifera* are preferred for their easily growing properties. The others remaining plant species were preferred from other species in their area based on properties like strength and durability. During fencing home garden or farmland, the simplest tools in use are digging stick with a sharp pointed end for penetration "dongora", and digging sticks with metal end, both are used for making holes for standing the main poles from *A. abyssinicus, A. alpina, Buddleja polystachya, C. malosana* and *R. vulgaris* (Appendix 1). Similarly, a study conducted in east Ethiopia use various types of dry fencing by piling up branches of thorny plant species particularly *Acacia, Ziziphus and Cadaba* species*, Balanites aegyptiaca, Commiphora habessinica* and *Prosopis juliflora (*Bahru *et al.,* 2012).

Mooraa hoorii (Byre or barn)

The other common use of plants reported in the study area is the construction of byre (or barn). Byre is normally considered as fence for livestock that function as livestock enclosures, and used daily as livestock brought in at night. In some households both cattle and equine (horse and donkey) are kept in the same byre, but a few households own well constructed and separated enclosures livestock and equine. In some households byre is simply indicated by horizontal

placed plant stem tied on few column poles. This fence separated animal's enclosure from garden and other space of the homestead. The people in the study area use almost similar plant species with fence construction with the construction of byre.

Fencing around homestead is not without the entrance or main gate (karraa dallaa) constructed from timber made of *Eucalyptus* species*, H. abyssinica* and *P. falcatus*. The gate is constructed by burrowing and planting two thick flat columns 2-3 meters apart. Then, the upper and lower step is connected with the vertical columns and the timber with proportional area connected by leather made cordage through the holes without using metal nails. This gate is sometimes covered by roof thatching. However, from informant's reports and field observation, it is clear that many fences around the homesteads in the study area were built by exotic tree species such as *E. globulus* and *E. camaldulensis* due to the lack of most indigenous tree species reported for fencing.

4.5.4. Household utensils and other traditional arts

Barcumaa **(seat or stool) and tables:** Many different kinds of seats and tables are produced from different plant species by Arsi Oromo of Limu-Bilbilo District. For example, rectangular and circular tables with three or four legs are used for dishes (or dining) and drinking. Bucket seat or *"barcumaa irkoo"* is a seat with four legs that have support for arms and back. This kind of seat is owned a by husband and provided to elder men and women guests. And *"Tessoo"* or stool with three legs without support for arm and back are very common in most homes. This kind of seat is allowed for everyone to use at home and provided when a group of elders make discussion on some issues "*jarsuumaa*". From useful plants reported for material cultures of the District, seven species (8.86%) namely, *Cordia africana*, *Nuxia congesta*, *Rhus vulgaris, Synzygium guineense, Vepris dainellii, Arundinaria alpina* and *Erythrina brucei* were reported to be used for making stools and tables. Seats with four or more legs used as seats for more than one person made by splitting and interweaving of *A. alpina* was very common in the household of the study areas (Figure 7A). Other small flat traditional seats constructed from *E. brucei* are used by small children and females in the kitchen. It is used by females around fireplace while they are preparing food for their family, milking cows and churning milk to make butter.

***Siree* (Bed) and *Hafaa* (Mattress)**

Men who have reached adolescence stage before marriage make very long bed just near to the roof from outside using long forked woody stem of *C. africana* and *P. falcatus* and cover it with leaves as to make mattress from leaves of *E. globulus* , straw of *Eragrostis tef* and *Linum usitatissimum* and sedge like *Cyperus papyrus*. Other family members use beds made from timber of *Eucalyptus* species, *H. abyssinica, P. falcatus* in their bedroom which are covered by mattress covered by smooth animal hide (leather). But, now-a-days in most households, traditional mattress is replaced by grass and straw made foam or synthetic foam.

***Boraatii* (pillow)**

Traditionally, pillow can be made from *E. tef* straw or *L. usitatissimum* straw filled in sewed pillowcase made from cotton clothes similar to modern foam pillow, and wooden pillow is made from carved stem of *Schefflera volkensii*, *H. abyssinica*, *Maesa lanceolata* and *Pittosporum viridiflorum*. Wooden pillow is sometimes covered by animal hide and preferred by adults to rest head in bed (Figure 7C). In Cheffa people culture mattresses and pillows are made from stem of *Isolepis costata* and *Schoenoplectus maritimus* and ripen flowers of *Typha domingensis* and *Aerva lanata.* Stem of several *Cyperus* species are gathered to weave into baskets and mats (Tamene *et al.,* 2000).

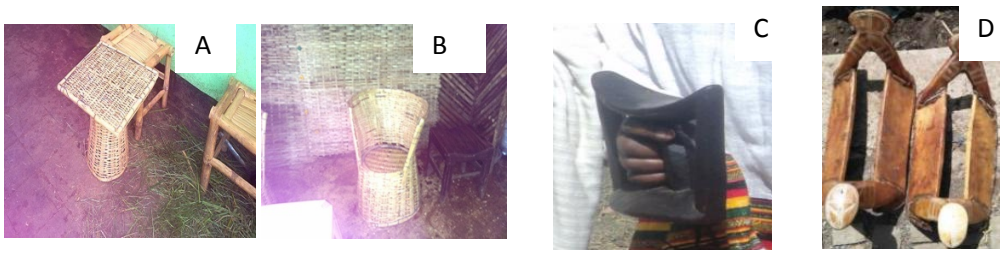

Figure 8: Photos depicting some furniture: A and B- traditional stool and table made of *Arundinaria alpine*; C-pillow; D/-saddle

Kooraa fardaa (Saddle)

Kooraa is a seat (tack) for a rider placed on the back of a horse or mule. It is very common to use horse and mule for transportation in Arsi Oromo community, in which saddle make comfortable seat for a rider (Figure 7D). It is made from *E. brucei* and *S. volkensi* by carving or remolding the woody stem using different adz and axes. According to the report from the informants the leather

used to cover the part of saddle is also prepared by using leaves from *G. lamprantha* to remove hairs from hides and fruits from *Ricinus communis* used to smooth the leather.

Baskets

Basket work is the common practices by many cowherds and peasants in Arsi Zone. It is a stiff container that is used for carrying different material and grains from or toward market places. Baskets are woven from the leaves and midribs of the *P. reclianta* and from strong jute or fibers of *E. venticosum "qaacaa warqee"*.

Mat

Sigaajaa/saleenii is the local name given to a piece of carpet made from the leaves of *P. reclinata* (mexii) which is put on the floor for decoration, sleeping, or comfort**.** It is a mat made by weaving dried soaked leaves of "*mexiii*" in different size and colors. The coloring agent gives decoration for the floor mat and regularly cleaned by family members and sleeping mat is used for bed cover. It is also common to weave hut from mexii by peasants and cowherds. Floor mat can be also made from *A. alpina*, which has very rough surface and cannot be used for bedding purposes.

Gooroo hindanqoo **(chickens nesting box)**: Chicken nesting box is a basket in which mother chickens are kept to lay eggs and it also serves as box from incubation period through hatching eggs. It is also designed to protect chickens and hens from cat, dog and eagles. And it is used as shelter until newly hatched chicks grow up. Cordage from the bark of *P. africana* and *E. globulus* and the stem from *Schefflera abyssinica, A. alpina* and *Clematis simensis* are used for interweaving the box in appropriate shape and size. The box has only one entrance and hanged at some distance from the ground to avoid ants.

Pestle and mortar Is a device used since ancient times to prepare ingredients or substances by crushing and grinding them into a fine paste or powder. The mortar is a bowl, typically made of hard wood. The pestle is a heavy club-shaped object, the end of which is used for crushing and grinding. The substance to be ground is placed in the mortar and ground, crushed or mixed using the pestle. There are two types of mortars and pestles. The one used for crushing and grinding coffee and spice into a fine powder is smaller in size when compared to larger pestle and mortar that is used for pounding and grinding grains like barley, maize, wheat and oats. The leaves of *R.*

prinoides are also crushed into pieces by large pestle and mortar to make local drinks like "Farsoo and Araqee". Plant species like *O. europaea*, *C. africana*, *and R. vulgaris* are used to make pestles of different size for different purposes. Whereas *E. brucei* and *C. africana* are the most common plant species preferred to make larger mortars for pounding and grinding grains, in other case *G. saxifrage* and *Croton macrostachyus* are used to make smaller mortars for coffee and spices.

According to the report from informants and group discussion reports, good mortar and pestle-making plant species should be hard enough to crush the substance rather than be worn away by it. And they cannot be too brittle either, or they will break during the pounding and grinding. The part of these plant species should also be cohesive, so that small bits of the mortar or pestle do not get mixed in with the ingredients. Smooth and non-porous plant materials are chosen to avoid absorbing or trapping the substances being ground. Because in food preparation, a rough or absorbent material may cause the strong flavor of a past ingredient to be tasted in food prepared later. When dealing with foods and spices, the previously prepared food item may interact or mix, contaminating the currently used food or spices ingredients. Abera (2013) also reported some common plant species (*C. africana* and *E. brucei*) to make pestles and mortars in Oromo community of Jimma Zone, Southwest Oromia. But, Bahru *et al*. (2012) in Oromo and Afar Community from East Ethiopia and Yassin *et al.* (2015) from three ethnic groups in Sheka Zone of Southwest Ethiopia reported completely different plant species of this finding for pestles and mortars making (Figure 9).

Figure 9: Photos showing: A- mortars made of *C. Africana;* B- mortar (*C. africana*) and pestle made of *E. globules;* C- mortar with its lid for spice and coffee

4.5.5. Kitchen utensils

Cilfaa (**wooden dipper**) is a dipper made from stem of *C. malosana, P. africana* and *S. volkensii*. It is prepared by cutting the suitable part of the stem and smoothed for picking up local food like porridge and "iittoo" from clay sauce pan.

Falaana **(paddle)** – this is stirrer made from the stem of *P. Africana, S. volkensii* and *R. vulgaris* similar to dipper but, smaller in size and used for stirring ‘‘iittoo’’ and used for eating porridge "marqaa".

Elemtuu **(Milking) and** ***Madaala*** **(Churner)**

Local milking and churning materials are very common in every household of Arsi Oromo of Limu-Bilbilo District. Since livestock keeping is one of the main activities in the study area, these materials are very important in their daily life. *Pennisetum schimperi***,** *Phoenix reclinata* and *Cucurbita pepo* are the most reported plant species used to make "*elemtuu*" which are being replaced by pitcher made of synthetic plastics currently. Churner or "*Madalaa*" is traditional utensil in which cream curd is churned to make butter. It is covered by a circular lid made from *P. schimperi* and *P. reclinata*. It is very common to see churner made from *C. pepo* and sometimes clay pot is also used for the same purpose. Rounded, mature, and dried fruits of *C. pepo* are collected from the mother plant and sealed mouth is made at one narrow end to make the opening. After cleaning the inside seeds and fibers, different decorations using colored *P. schimperi* and leather made hanger scaffold is sewed on it. Fruits with medium size are used for storing fermented butter or "Sammaa" for longer period of time. This type of butter is used for special ceremonies. The study from Cheffa people, Ethiopia revealed that, milking and milk containers are made either carved woody stem or woven from *Agave sisalana* and *Cyperus digitatus, C. distans, C. alopecuroides (*Tamene *et al.,* 2000*).*

Wooden bowl

It is a roughly hemispherical container used to hold, mix or present food. A large wooden bowl is used to make dough while the smaller bowl is used to hold food for herdsman or to present porridge for the family members. A circular flat bowl is also used to present local foods like bread and "biddeena". These traditional household utensils are made from *C. africana, G.*

saxifraga, *H. abyssinica, S. volkensii* and *S. guineense*. And boat like long wooden bowl "gongaa" made from *S. abyssinica* and *R. simensis* is also used to present water and lees for cattle and sheep in the home garden. Cattle feed and drink from the bowl being in row. But now-a-days these cultural utensils are replaced by materials made of metals and plastics, for example platters, bidet, which is due to easy availability of these synthetic materials and shortage of plants that are used to make the local materials.

Figure 10: Photos depicting: A- traditional food and wooden dipper; B-traditional food and wooden paddle; C- Milking utensils (Elemtuu); D- traditional food and wooden bowl (photo taken on Arsi Oromo traditional wedding ceremony).

***Gonbisaa* (lid of clay oven for baking)** is a very common baking utensil in every kitchen. It is made by intertwining or weaving lianas like *Clematis longicauda*, *Stephania abysinica*, and stem of *A. alpina.* The constructing process is preferred when the plant parts start to wilt before becoming too dry. Flame heating produces steam which is very important for cooking or baking, so the lid is plastered with clay mud to keep steam inside cooking oven. Leaves are also important part of cooking in the community, for example the leaves from *Ensete ventricosum*, *Myrsine melanophloeos,* and *Croton macrostachyus,* are used by women to prevent over heating of bread during baking on pans (clay oven), while the leafy stem of *L. adoensis* are used for roosting meat to give good flavor. Seeds and fruits from *R. communis* and *Solanum incanum* are used to make the clay oven during baking greasy or oily. *Maazooraa* is a funnel made from the fruit of *Lagenaria siceraria* used to spread dough over clay stove to make local food called *bidennaa.* Curved stem from *O. europaea* and carved stem with flat end from the same plant are used for roasting grains and rolling bread.

***Gundoo* (Basketwork disc) and *Gingishaa* (Sieve)**

Pennisetum schimperi and *Phoenix reclinata* are plant species used to make basketwork disc and sieve by weaving their sheath sheet. The first longer joints (stem) are collected from the field by cow herds or women at the end of rainy season (September-October). Soon after, the stem sliced into equal parts, then tied in bunch and allowed to dry on the roof. The bunch of dried *P. schimperi* are collected from the roof and soaked in water for flexibility. Staining is possible if different colors are needed to be displayed on the utensils. The stained one is called '*allalaa'* which is decorated with designs done in weaving arts. Basketwork called *'Aagalgilii'* is also reported tool from *P. schimperi and P. reclinata*; it is a common tool for holding cooked food during long journey and for storing plant and animal material that needed to be kept off the ground and away from pests. Some aagalgilii or basketries are small and open while others are larger with rigid walls covered and decorated by animal hide and lids. It is frequently hanged from the rafters of the dwellings and assumed places of honor in the house as cherished heir looms (Figure 10C).

A lot of kitchenwares are produced by women in the study area. For example, Gundoo has a lot of uses in Arsi Oromo community; it is a tray for serving foods. In addition to presenting foods, it is also used for winnowing grains. And sieve is used to separate grains, especially *E. tef* from other foreign substances and flour from non grinded grains according to their size differences. The same plant species are also used to make food table *"Masoobii"* to hold foods used for various dining times and small woven basket for decorative "*Mudaayii*" hanged on the wall and to keep other females' decorative ornaments. Besides its fundamental framework, sieve woven from these plant species are used for malting purposes.

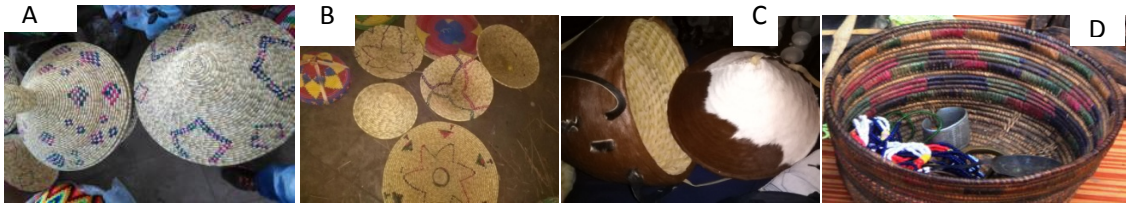

Figure 11: Photos showing: A- Food table "Masoobii"; B- Basketwork disc (Gundoo); C- Aagalgilii; D-Mudaayii (A and B photo taken from market area " Gabaa Sanbataa")

The grains for malting is soaked in water and placed on sieve covered by leaves from *D. penninervium* and *C. macrostachyus*. Reports did not indicate any information why they prefer the leaves from these two plant species for malting.

Masabaa/Qasamii **(Pipe for local drink making)**

Pipe made from dried stem of *Arundinaria alpina* over coiled by fibers made from *Ensete ventricosum* and *Urtica simensis* to cool down the heat from the steam inside which condenses into liquid alcohol (ethanol) locally called "*araaqee"*.

Muka Oofcoo **(Hand grinding mill stands*)***

Generally, two forked woody stems from *Galiniera saxifraga, Olea europaea* and *Rhus vulgaris* with about 60cm long above the ground are planted in the ground. Millstone or qoo'aatii (flat shaped sandstone) is held in between the forks at the upper end with slight inclining downward from the front side.

Matotii **(Coffee-pot stand)**

Matotii is circular coffee pot-stand made by winding the fibers from *E. venticosum* and *Cyperus papyrus*. It is made by women and cow herds without formal art requirements. Similar material is made for the stand of pot and pitcher.

4.5.6. Beehives

As informants reported, the practice of owning and taking care of honeybee (beekeeping) is one of the important economic activities in the study area. It employs a number of people and provides an opportunity for impoverished families to supplement their income by marketing their bee products such as honey and beeswax at local markets. Many people own beehives and produce honey for their own consumption and commercial activity. They use a diversity of plant species for making and hanging beehives to produce honey (Figure 11). For example, fibers and stems obtained from *A. alpina*, *Clausena anisata, Erythrina brucei*, *Olea capensis, Schefflera abyssinica*, are very important to weave and make beehives. Beehive is constructed by either splitting or using thin branches interwoven with cords in-between wedges to make cylindrical shaped beehive. Then beehives are plastered with cow dung from the inside and covered by straw from *Eragrostis tef*, *Hordeum vulgare* or *Pennisetum schimperi* from outside.

Then, beehive hanging is the next steep to have a swarm of bees. Beehive hanging is preceded by brushing and smoking it with bark of *Ekebergia capensis* and *Carissa spinarum* to attract honeybees. Some flowerings plants like *Acacia abyssinica, Croton macrostachyus, Erythrina brucei, Schefflera abyssinica, Schefflera volkensii* and *Vernonia auriculifera* are preferred for beehives hanging. Likewise, Abera (2013) also documented the most selected plant species that highly attract bees for honey production are *E. brucei, Euphorbia ampliphylla, J. procera, Croton macrostachyus, Vernonia auriculifera* and *Vernonia leopoldii* are plant species preferred for making beehives in Oromo community of Jimma, Southwest Oromia.

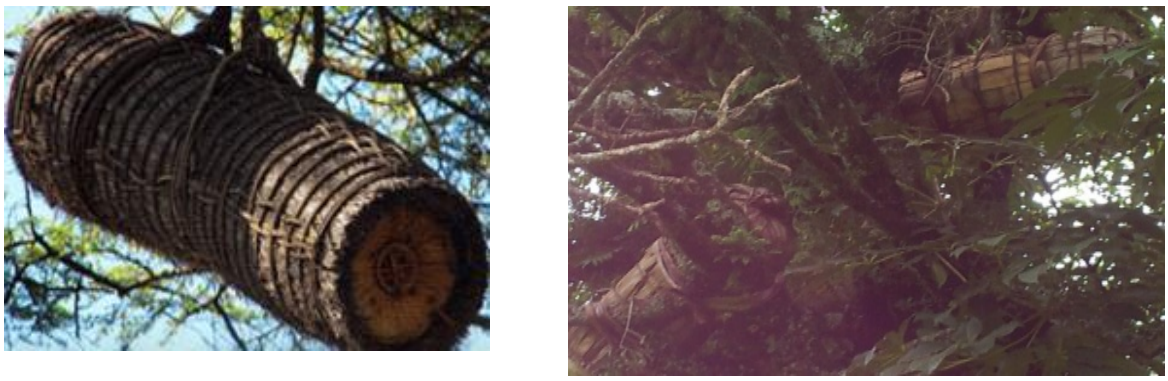

Figure 12: Photos showing traditional beehive hanged on flowering plants (*Schefflera abyssinica*).

4.5.7. Brooms

This material culture seems not totally replaced since it is still in use in many households in the study area. A broom is a kind of brush with a long handle used for sweeping home floor and threshing floor. It is made from the culms, twigs, fronds of some species or even the whole plant part in case of certain herbs that are tied into which serve as brooms. Various kinds of plant species are used for making local brooms. For example, fronds or leaves of *Phoenix reclinata* are tied into bundle to serve as broom, small branches of *C. anisata, Brassica carinata and Myrsine africana* are tied together and used to sweep threshing floor, one or two stem(s) with twisted or forked branches from *O. europaea* are used to remove straw during threshing and the whole part of *P. schimperi* are mowed and tied together to use as broom.

4.5.8. Vessel cleaning and fumigation

Milking and churning vessels are scrubbed or brushed with leaves of *Ruta chalepensis*, *Lantana trifolia* and *Zehneria scabra* and fumigated with dried stem of *Olea europaea* to give pleasant taste and smell whereas fumigating milking vessels with *Synzygium guineense* was reported to prevent milk from sourness. Clay pots for making local drinks are washed by leaves from *Rhamnus prinoides*, *Olea europaea* and *Vernonia amygdalina*. The scent of those leaves gives good test for the drinks after fermentation. Fumigating clay pot used for making local drinks with dried stem from *O. europaea* is also very common before any fermentation process begins. All these processes are used to keep or increase the flavors of milk (or yogurt) and local drinks produced. In line with this, beehives are fumigated with dried bark from *Ekebergia capensis*. Reports have also shown, *R. chalepensis* is used to clean coffee pot and flavoring coffee. Gums and resins from *J. procera* is used to fumigate living room during coffee ceremony.

4.5.9. Bathing brush and natural perfuming

Buds and leaves from *Osyris quadripartita* and *Zehneria scabra* are used for bathing brush for women after delivery. It's is believed to give her strength, good health and pleasant smell. It is also very common in Arsi Oromo culture, females are always fumigated or '"*Qayyachuu*" with the stem from *Olinia rochetiana*. The fumigation process is carried out in separate room using a circular hole *"boola qayyaa"* with 20cm wide and 40cm deep. The hole is surrounded by broken clay pot and the opening is plastered with clay mud. Then, the piece of aromatic plant is put into the hole and the fire was set starting smoking, but controlled to avoid flames. As it starts to smoke woman use small stool to expose her body to the aromatic smoke by covering herself with blanket or animal hide, by keeping her head out of covering, but a glance to control the flame. The perfume can stay more than a week on her body. In Arsi Oromo culture this traditional perfuming activity gives sense for selecting woman for marriage. Similarly, report by Bahru *et al*. (2012) from east Ethiopia indicated the smoke bath from *Terminalia brownii* wood with other ingredients (e.g. *Boswellia papyrifera* incense, sandals) is commonly used by women to scent their bodies and clothes as well as to flavouring milking utensils.

4.5.10. Weapons and sticks

***Eeboo* (Spear) and *Bangaa/Guraadee* (Sword)**

Spear and sword played a role in warfare in ancient times, but now-a-days men in the study area reported, they are using spears and sword to protect themselves from wild animals and sometimes for hunting. In addition to defending themselves, spear is used during show for some cultural ceremonies, for example, during funeral for war cry *''Gerarsaa''* when famous man died. And the same is true for sword. Eeboo are more common than sword in most households, the handles for both weaponry are made of *Grewia mollis* and *Oxytenanthera. abyssinica.* Sword has handle and sheath or a case similar in shape to cover its blade (Figure 12A).

***Mukaa qawee* (shotgun handle) and *qollaa shuguxii* (pistol sheath)**

Shotgun and pistol are modern weapons, but the community in Limu-Bilbilo District can repair their shotgun in case when its handle is broken and can make a sheath made of wood for their pistol. The plant called sukee or *P. africana* can be easily carved into shotgun handle and sheath (figure 12B).

Ullee (Walking sticks and herding sticks)

Species like *O. abyssinica*, *Grewia ferruginea,* and *Olea europaea* are used for walking and/or herding sticks by men with various ages. For example, most adolescent and adult men hold walking sticks during long journey and at night as self defense tools (weapons), strength is very important in this case, and old persons use as support to stand up from seat and for walking. But most cowherds use sticks to protect themselves and their livestock from wild animals and sometimes for hunting purposes (Figure 12C). In other cases, most women hold very thin stick made of *Clausena anisata* on hand during long journey alone. And old women use for supporting their body in upright position. *''Ullee-qilee''* is stick used by cowherds to play Christmas-game, the one with curved end is more preferred, and it is made from *O. europaea* and *Calpurnia aurea*.

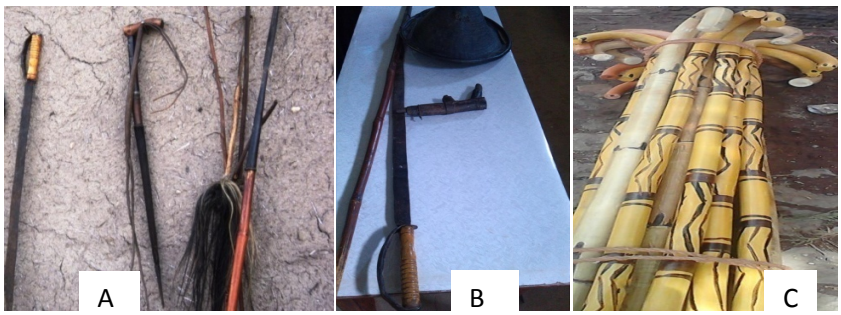

Figure 13: Photos showing weaponry and walking sticks: A- (swords, fly whisk and spear); B- (stick, sword, pistol sheath and (buckler is not plant based material); C- walking sticks (at market place)

***Cirraa* (Fly whisk handle)**

Cirraa is small handled bunches of animal hairs whipping to protect flies from the body. It is mostly used by older person. The handle for whisk is preferred from the stem of *O. europaea* and *R. vulgaris*.

4.5.11. *Rigaa* (Teeth cleaning twig)

Rigaa is a teeth cleaning twig made from a very small thin branch that grows out from a main branch (or root) of a plants. This traditional toothbrush (rigaa) or chewing stick is deeply rooted cultural use of plants in the community of the study area. According to the reports from the informants, peeled twigs of four plant species are used as toothbrushes due to their whitening effect on the teeth. Most teeth cleaning twigs are twigs with a frayed end used to brush against the teeth made from branches from *C. anisata*, *R. sprinoides*, *O. europaea* and *R. chalepensis* by shortening and trimming them to give good shape. Yassin *et al.* (2015) also reported *C. anisata* and *R. chalepensis* for tooth brush in Sheka Zone of Southwest Ethiopia, while *C. anisata* was reported by Abera (2013) from the study on Oromo community of Jimma Zone, Southwest Oromia.

4.5.12. *Kiiyoo* or traps for partridge (*gogoorii*) and bush duiker (*kuruphee)*

Many cowherds use traps to capture partridge and bush duiker. If they are lucky they take it home to enjoy the food with their families. The trap for partridge is made from very strong fibers of *E. ventricosum* and *U. simensis.* It is tied to any plants stem allowing to be jumpy cringed

when they become in-contact. While the trap for bush duiker seems more complex and involves fencing to lead prey toward the target by using a lot of camouflage. And still very strong rope made from burlap or jute of *Urtica simensis* and *Ensete ventricosum* is in use.

4.5.13. Traditional clothes

Reports showed that spinning and weaving to make traditional clothes from cotton is the ancient and oldest practice of the community in the study area. And still the majority of the population living in the rural areas of the District produces a significant part of its textile needs from the traditional methods of spinning and weaving. Other finding by Muleta *et al*. (2011) also reported clothes that are woven from cotton are popular in urban areas of Ethiopia.

There are a lot of weavers "shamannee" in the study area, but weaving is not their solitary job, because they mainly depend on agricultural activities to support their lives. *Gossypium hirsutum* is the only plant processed to make traditional clothes in the study area. The process of weaving is preceded by "saasa'u" broke loose (or treating cotton wool with the finger to remove cottonseeds) and "foo'u" making fiber wool using spindle. The shaft of the spindle is made from *Arundinaria alpina* and *Oxytenanthera asyssinica* and the circular whorl is made from dried fruits of *L. siceraria*. Finally, the fiber wool is weaved by weaver using weaving utensils like distaff and others to make traditional clothes. *"Buulukoo*" (heavy cotton blanket) is honorable wearing in Arsi Oromo, used by clan leaders, *"abaa-qaaluu"* or religious leaders and elder men. "*Gaabii*" is also a traditional cloth similar to "*bulukoo"* but smaller in size and weight. Females also use light over-wear clothes (*baaqee*) and "*sabbataa*" sash, or article of dress encircling the body usually at the waist. In Arsi culture bride and bride groom use cultural clothes on their wedding.

4.5.14. Cart (horse-drawn)

The various parts of the cart are made from different kinds of plant species, but the very common and the main frame of the cart is made from the woody stem of *C. africana***.** Obviously the wheels and the rims at many places are fixed using iron.

4.5.15. Traditional tattoos and ornaments

Tattoos Females decorate their gum and cheek by using fresh thorns from *Carissa spinarum* and *Dovyalis abyssinica.* The thorns from these plants are also preferred for ear piercing, because their thorns are believed to be non-poisonous and the wound heals faster.

Fillaa (combs)

Plants are the source of every household in Arsi Oromo Community, but now a-days some of the artifacts and household utensils are replaced by synthetic products. For example, *''Fillaa''* or combs for both males and females are very common decorative tools that are mad from *Hagenia abyssinica, Juniperus procera* and *Schefflera volkensii*. This decorative tool is almost replaced by a fabricated one, and everyone can find the synthetic combs in most houses and only few reported to have plant made traditional combs.

Jumuree / Oka'ee (Necklaces / Beads)

Women and children collect red matured seeds from plant called "*walennaa*" in local language *(Erythrina brucei)* and *Podocarpus falcatus* when they are collecting firewood and edible fruits. They use their pockets and simply tied into a knot in one's dress. This traditional necklace (jumuree) is made when bored seeds arranged on very strong fibers of *Ensete ventricosum* and *U. simensis.* It is used to be common practice to display objects, which would commonly be described (and worn as) necklaces by children in the study area. Oka'ee is also hanged on walls in a fashion similar to displaying paintings or other works of decorative art. Another reason for making a necklace was to give it away as a present, for the purposes of forming a bond or a connection between the giver and the gifted (Figure 13A, B and C).

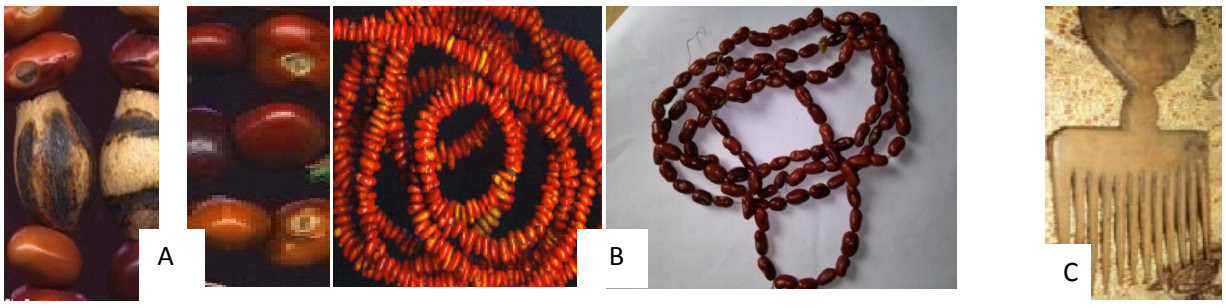

Figure 14: Photos of traditional beads/necklaces: A- (*okaa'ee*) beads from matured seeds of *E. brucei;* B-*(jumuree*) necklace from seeds collected at early stages before maturation; C- comb

4.5.16. *Riqichaa* (Foot Bridge)

There are many rivers in Limu-Bilbilo District of Arsi Zone, of which only few of them have modern bridges. But many rivers in the study area are filled with flood after heavy rains which limit the movements of people. To avoid this, big trees like, *Eucalyptus* species*, Podocarpus falcatus, Prunus africana* and *Nuxia congesta* are placed horizontally across rivers before rainy season. Two or more horizontally placed woody stem are used for Foot Bridge.

4.5.17. *Kortoo* (ladder)

One can use "*Kortoo*" to climb up to the roof of a hut by leaning against the wall of the hut and to climb up big tree to collect honey from beehives hanging on it. Two kinds of wooden ladders could be seen in the study area, the one with two long parallel stands and with three or four legs made of *C. africana* and *Eucalyptus* species.

4.5.18. Traditional musical instruments

***Ullulee* (flutes)**

Arundinaria alpina is the most popular and perhaps the only plant of which the community in the study area make flutes. "*Ullulee*" has several sizes (with the varying length and diameter) along with the number of holes (4-6) at the opposite end of the mouth. It is played by blowing air across an aperture at one end of the flute which is regulated with the help of fingers, which allow creating different tones/ sounds. This musical instrument is mostly played by cowherds.

***Dibbee* (Drum)**

Dibbee is a percussive musical instrument spanned with a thin goat hide covering on at least one end for striking with hands or drumsticks during weeding song. It is made from *E. brucei* and *S. volkensii* by carving the woody stem using different adz and axes.

***Kaballaa*:** Kaballaa is a local musical instrument played by girls on weeding ceremony and different holyday programs. It is played like violent, but it needs to impact directly with another. Girls hold a pair of kaballaa on their both hand and make sound by colliding them together. Kaballaa is made by carving the woody stem of *C. macrostachyus* and *V.dainelli.*

Figure 15: Photos of traditional musical instruments: A- (Drum); B-Kaballaa

4.5.19. *Ujumoo Gaayyaa* (tobacco smoking pipe) and traditional torch

Arundinaria alpina is the most common plant species used by people in the study area to make tobacco smoking pipe. Dried hollowed fruit shell of *Lagenaria siceraria* is used to make Gaayyaa to hold water as cooling vacuum and fire to ignite flame and tobacco. The dried pounded-rolled fresh leaves of "tamboo" tobacco (*Nicotiana tabacum* L.) are smoked with holed pipe made of *A. alpina.* Leaves from tamboo is also crushed and put in the mouth to feed cattle through saliva.

People living in the study area prepare traditionl torch made from *Erica arborea* and other shrub species. The people use this traditional torch to make light in case they use it at dark night to find lost animals, to frighten wild animals no to intrude in to the compound and to celebrate the finding of true cross among Christian belivers.

4.5.20. *Baaxiyyaa/Gasaa* (Rain hood)

The rain hood made from different sedge species was replaced by synthetic plastic bag, since it is available from the inside covers of every fertilizers bag, so no one looks for the traditional *''gasaa''*. Accessibility and portability of synthetic plastic rain hood is more preferred by cowherd. As reports indicated, some years ago, *''gasaa''* was made by cow herds from *Cynodon dactylon* and *P. reclinata*. It was elongated winnowing fan in shape to cover the person from rain above the knee.

4.5.21. Ritual and Cultural value

The lives of local people in the area are generally tied up with the plant species, not only as a means of livelihood but in its socio-cultural value. Thus, this is an important indirect use component of natural plant resources in the area. The local people celebrate different festivals

and perform different ritual ceremonies using selected plant species and under respected trees like *Ficus vasta*. Similar reports (Bahru *et al*., 2012) from East Ethiopia showed that Karaayuu and Ittuu Oromo clans living around Awash National Park and Oromo Community of Jimma Zone, Southwest Oromia prefer the shade of *Ficus vasta*, tree for traditional rituals and to hold meetings. In Arsi Oromo holding bud stem of *Buddleja polystachya* during wedding ceremony to indicate wishing of long life together in marriage and the grass species called *Cynodon dactylon* is used for ritual values like traditional belief and cultural practice. Elder women cut and hold on hand during *"hatete"* ritual and also used by elders during marriage question and arrangement on *"jaarsuumaa"* or the cultural practice in the study area when the elder men from the son family and clan leaders ask formal marriage questions for their son and *"sadetaa"* is another meeting arranged for the decision of marriage program and date. It is taboo to use *Osyris quadripartita* as firewood, because it is believed to keep delivered mothers from evil sprite and also used to bless animal's body or meat if injured or bitten by wild animal (hyena). Moreover, the forest called *"Bossoona Hajii Nasiir''* is protected in Kojii Kakaa Kebele from deforestation because of the traditional belief of local community.

4.5.22. General use categories of plant material culture

Out of 79 plant species reported for material cultures during the course of study, the majority of the plant species that were reported had multiple uses, for example; *Olea europaea* reported for 14 different material cultures whereas some were reported for a single use *(Barbeya oleoides* and *Bidens borianiana*)(Appendix 3). Since plant material culture includes a wide use of varied group of plant parts from many species, over 64 different material cultures were reported from the total species identified. And about 22 of general use categories of plant material cultures were recorded during the course of the study. Some of the major use categories are: traditional house constructions, dry fencing post and live fencing, traditional household objects (utensils) (Table 9).

Table 9: General use categories of material culture in Limu-Bilbilo District

S. No	Types of Material Objects made from plants	Number of plant species used by community	Percentage (%)
1	Traditional house constructions	43	17.84
2	Traditional household objects (utensils)	39	16.18
3	Dry fencing post & live fencing	29	12.03
4	Traditional agricultural implements	27	11.20
5	Kitchenware	21	8.71
6	Local beehives making and beehives hanging	15	6.22
7	Fumigation and vessel cleaning brush	10	4.15
8	Ritual (or cultural value) and shading	9	3.73
9	Basketries and containers	6	2.49
10	Tooth cleaning twigs	6	2.49
11	Weaponry and sticks	5	2.07
12	Traditional ornaments and decoration	5	2.07
13	Musical instruments	5	2.07
14	Natural perfuming and bathing brush	3	1.24
15	Foot bridge	3	1.24
16	Traditional weaving utensils and clothes	3	1.24
17	Miscellaneous use	3	1.24
18	Traditional tattoo	2	0.83
19	Smoking pipe and vessel	2	0.83
20	Trap	2	0.83
21	Cart (horse-drawn)	2	0.83
22	torch	1	0.41
	Total	241	100

As shown in Table 9, the people in the District use 43 different plant species for house constructions, 41 species for fencing purposes and 39 species to make different household objects. And the miscellaneous use categories described in this Table includes the use of plants for purpose other than material culture but related functions. For instance, the extract from bark of tree is used as chewing gum for children and to fix old book together, the leaves from *Gnidia glauca* and seeds of *Ricinus communis* are used to remove hairs and to soften hides respectively. On other hand, hides are used as a part of material made from plant and to decorate some household material cultures. In addition to these, ceremonial or ritual values are also inseparably reported to be included as a function of plant species material cultures in the community.

In agreement with other findings (Yassin *et al*., 2015; Rainver *et al*., 2011) the Oromo Community in Lemu-Bilbilo District build their house with a diversity of plant species including

trees and shrubs for pillar, sidewalls, and ceiling roof, climbers for tying purposes, and herbs for thatching the roof (Appendix 2). Construction is always carried out by men from the same family members or any volunteer neighbors. The owner of the house collects and makes ready different plants for construction before calling anyone for construction. Foods and local drinks are also provided by the owner of the house for a group of men building the house. But in case one loses his home through fire accident, ever individual in the village contribute their own wood for construction, timber and grasses and construction appointed within few days. According to Abbiw (1990), the two primary requirements that the materials for construction purposes must satisfied are strength and durability. In line with this the community in the study area considers availability, durability and strength. The same criteria applied to selecting plants for farm implements and timber.

4.5.23. Marketability of traditional material cultures

Out of four market areas visited including the largest market place held in Bekoji Town (eventhough the study did not include Bekoji Town, most of the kebeles involved in the study in sell their products there), all market places provided sorts of material cultures for their customers. The three market `areas are located in the kebeles included in the study areas namely Gabaa Jimataa, Gabaa Sanbataa and Gabaa Lemuu. As reported by vendors, selling of material cultures has become the source of income. They also reported that, in previous time only urban community use their products and they used to produce and provide only few products for markets, but now-a-days community from different rural areas also needs their products and they have started to produce large number of materials to satisfy their customers. When they justified this, the scarcity of plant species to make different material culture and lacks of interest to carve and weaves some agricultural implements and basketry works. During the visits and from the interviews conducted with vendors in some markets places, a lot of finished products of material cultures were observed. For example, farm implements like plough with its handle, yoke, plank, pitchfork, laamedaa and granary were sold in the market places. But, the availability of those implements depends on the season of the year. Some agricultural implements like, grain storages, pitchfork and lamedaa are highly available in market during autumn. In other cases, most material cultures can be available in every season of the year. Household utensils and kitchenware such as, wooden tool handles, cordages (ropes), stools, saddle, milking and churning vessels, mortar and pestle, basketwork disc and sieve, walking sticks, teeth cleaning twig, mats,

traditional clothes**,** lid of clay oven are processed material cultures sold in the local markets. In addition to this unprocessed leaf from *Ensete ventricosum* and *Ruta chalepensis* and dried golden stem of *O. europaea* are also sold in some market places.

4.6. Preference Ranking

4.6.1. Preference ranking of ten most important plant species used for agricultural implements

When there are different plants species in their area, people show preference for one over the other to make or construct different materials. Strength and durability are the most common criteria for preferring one over the other. In the present study preference ranking of ten plant species that were reported for producing traditional agricultural implements after selecting 15 key informants. Preference ranking of ten plant species for traditional agriculture implements as shown in Table 10, *Olea europaea* ranked first. According to the reports obtained from some key informants *O. europaea* is a very strong that fits for any type of farm implements and it's durable for many years. But its preference is not without limitation, plough with 2.5-3 m length have more than 15 kg weight, while other plants with the same size weigh much less. And it is not easy to hold for remote farm lands. The second, third, fourth and fifth most preferred plant species for agricultural implements are *O.capensis*, *Galiniera saxifraga*, *Synzygium guineense* and *Nuxia congesta* respectively. While the least preferred species compared to the other were *Acacia abyssinica* and *Ehretia cymosa.* As reporters indicated they use those least preferred and many other plant species when other alternatives are in scarce.

Table 9: Preference ranking of ten most important plant species used for making traditional agricultural implements for people living in Limu-Bilbilo District.

Species name	Respondents (A-O)															Total	Rank
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O		
Acacia abyssinica	5	7	8	8	7	7	6	7	5	7	8	5	9	4	8	101	9th
Cassipourea malosana	4	6	8	6	8	9	8	6	8	7	7	8	9	6	7	107	7th
Cordia africana	7	9	6	10	7	8	9	9	7	8	6	8	6	9	7	116	4th
Ehretia cymosa	6	8	8	5	5	7	7	8	8	4	6	8	8	6	3	97	10th
Galinieria saxifraga	8	8	7	8	7	6	9	8	9	7	6	8	9	9	8	117	3rd
Nuxia congesta	9	8	7	8	9	8	6	8	5	8	8	8	6	7	4	109	6th
Olea europaea	8	8	9	9	10	8	9	7	8	8	9	10	9	9	7	129	1st
Olea capensis	9	8	9	7	8	6	8	7	8	8	9	9	7	8	9	120	2nd
Prunus africana	8	4	7	6	5	10	8	7	6	5	8	8	7	8	6	103	8th
Syzygium guineense	10	5	8	7	9	8	7	9	8	6	7	9	6	8	9	116	4th

4.6.2. Preference ranking of 10 important plant species used for house construction

As shown in Table 11, people living in the study area highly prefer *O. europaea* for various material cultures. Besides its strength and durability, its termite resistance and easy availability in the study area gives it the highest priority ranking. The second most preferred plant species for traditional house construction was *J. procera*; it was almost equally preferred with the first ranked species by its termite resistance, durability and availability. But now-a-day *J. procera* is in scarce when compared with *O. europaea* and other plant resources in the study area. This indicates that the plant was known for its construction purposes and this could be associated directly with the cause of its depletion in the study area. It also indicates that special focus should be given for conservation of these plants since they are being widely exploited for timber trading. The third, fourth and fifth most preferred plants for traditional house construction are *P. africana*, *C. africana* and *E. capensis* while, the least preferred species compared to the other are *A. alpina* and *C. longicauda*.

Table 10: Preference ranking for ten most important plants used for traditional house construction in the study area

Species name	Respondents (A-O)															Total	Rank
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O		
Allophylus abyssinicus	8	4	7	6	5	6	8	7	6	5	8	8	7	3	6	94	7th
Arundinaria alpina	6	5	7	7	6	4	7	6	5	6	5	5	6	1	5	81	9th
Cordia africana	4	6	8	6	8	9	8	6	8	7	7	8	9	6	7	109	4th
Cassipourea malosana	5	4	6	4	7	6	9	9	7	8	4	6	6	4	1	86	8th
Celtis africana	6	8	8	5	5	7	7	8	8	4	6	8	8	6	3	99	6th
Clematis longicauda	3	5	5	2	4	5	3	7	4	5	4	6	7	9	8	77	10th
Ekebergia capensis	7	8	7	8	9	8	6	5	5	8	6	8	6	5	4	102	5th
Juniperus procera	8	9	10	8	8	10	9	8	9	9	10	9	10	8	9	134	2nd
Olea europaea	9	10	9	9	10	9	8	10	8	10	9	9	9	7	10	135	1st
Prunus africana	10	7	8	10	7	7	10	7	10	7	7	10	9	10	7	126	3rd

4.7. Direct matrix ranking and paired comparisons of multipurpose plant species

4.7.1. Direct matrix ranking of common use categories and multipurpose plant species

In the present study, a number of plants were found to be multipurpose specie being utilized for a variety of uses. The eight commonly reported use categories were traditional farming implements, fencing, household objects, beehives making & honey production, traditional house construction, timber production, kitchenware and weaponry. And ten multipurpose plant species were involved in direct matrix ranking exercise in order to evaluate their relative importance and direct use values to the local people (Table 12).

Table 12: Direct matrix ranking for the most multipurpose plants in Arsi Zone of Limu-Bilbilo District.

Multipurpose plant species	**Seven use categories**								**Total**	**Rank**
	Farming implements	Life and dry fencing	Household objects	Beehives & honey production	House construction	Timber production	kitchenware	Sticks and weaponry		
Arundinaria alpina	1	5	5	5	5	0	4	0	25	6th
Phoenix reclinata	0	2	5	5	3	0	3	0	18	9th
Eucalyptus globulus	4	4	4	2	4	4	2	3	27	3rd
Erythrina brucei	2	3	5	5	2	1	4	0	22	7th
Olea europaea	5	5	3	1	5	0	4	5	28	1st
Juniperus procera	2	5	4	1	5	5	3	1	26	4rd
Croton macrostachyus	3	2	3	2	1	0	2	0	13	10th
Hagenia abyssinica	3	4	5	2	5	5	4	0	28	1st
Vepris dainelli	4	5	4	1	5	2	3	2	26	4th
Podocarpus falcatus	2	5	4	1	4	4	2	0	22	7th
Total	26	40	42	25	39	21	31	11		
Rank	5th	2nd	1st	6th	3rd	7th	4th	8th		

As shown in Table 12, *H. abyssinica* and *O. europaea* are species of the highest value with the sum of 28 each (ranked 1st), and hence are the most preferred plants by local people for those eight use categories. *E. globulus, J. procera, V. dainelli* and *A. alpina* are highly utilized or multipurpose species and ranked 3rd, 4th and 6th respectively. *E. brucei* and *P. falcatus* are species with total sum of 22 each and ranked 6th, whereas the least ranked species in multipurpose aspect from those ten species were *P. reclinata* and *C. macrostachyus*. Thus, the least ranked species are the less threatened and commonly widely distributed species in the area. *C. macrostachyus* with the least rank is not as strong as other woody plants and *P. reclinata* is not utilized for purpose like timber and farm implements at all.

Similarly, the values for use reports across the selected species were summed up and ranked. The results show that the local people depend on ten multipurpose species mainly for household objects, dry and life fencing, traditional house construction, kitchenware, traditional farming implements, beehives making & honey production and timber production with the rank of 1st, 2nd, 3rd, 4th, 5th, 6th and 7th respectively. The least ranked use category from those multipurpose plants is sticks and weaponry. Thus, the long-term survival of the top- ranked species are under question, as the daily demand of the local society is usual and continuous with lesser rate of indigenous species reforestation. This is evidenced by the high rate of loss of *J. procera* and *H. abyssinica* in the area.

4.7.2. Paired comparisons of plant species for material cultures

4.7.2.1. Paired comparison of plant species for traditional house construction

In this study, ten informants were selected to conduct pair wise ranking exercise of eight plant species used for traditional house construction. The result of this comparison shows that *J. procera, O. europaea, P. africana, H. abyssinica*, *E. globulus* and *E. capensis* were ranked 1st, 2nd, 3rd, 4th and 5th respectively. In this comparison *H. abyssinica* and *E.globulus* are selected four times each and similarly *O. capensis* and *G. saxifraga* were preferred only once in comparison made among eight species (Table 13).

Table 12: Paired comparison on eight plants species used for traditional house construction in Oromo community of Arsi Zone, Limu-Bilbilo District reference to durability and termite resistance ability.

	Plant species	Respondents (R1-R10)								Frequency	Rank
		Olea welwitschii	*Prunus africana*	*Hagenia abyssinica*	*Ekebergia capensis*	*Olea africana*	*Juniperus procera*	*Eucalyptus globulus*	*Galineria saxifrage*		
Respondents (R1-R10)	*Olea capensis*	-	Pa	Ha	Ow	Oa	Jp	Eg	Gs	1	6th
	Prunus africana	-	-	Pa	Pa	Oa	Jp	Pa	Pa	5	3rd
	Hagenia abyssinica	-	-	-	Ha	Oa	Jp	Eg	Ha	3	4th
	Ekebergia capensis	-	-	-	-	Oa	Jp	Ec	Ec	2	5th
	Olea europaea	-	-	-	-	-	Jp	Oa	Oa	6	2nd
	Juniperus procera	-	-	-	-	-	-	Jp	Jp	7	1st
	Eucalyptus globulus	-	-	-	-	-	-	-	Eg	3	4th
	Galiniera saxifraga	-	-	-	-	-	-	-	-	1	6th

4.7.2.2. Paired comparison of plant species used for making agricultural implements

Individual farmers in the area as observed during the course of study penetrate the forest and plant left as remnants of forest in agricultural field with their axes. Here, the scenario is people need plants for material cultures mainly farm implements for the next rainy season. Thus, here is the time for comparison of one plant against the other if alternative species are there. Similar comparison method was conducted with 10 randomly selected key informants provided with ten common multipurpose plant species (Table 14). According to the comparison made for identifying the most preferred plant species for constructing their agricultural implements, *O. europaea* was selected seven times as the most preferred species for agricultural implements and ranked first out of 10 multipurpose plants. The same result was obtained in preference ranking of 10 different species ranked by 15 randomly selected key informants. *Prunus africana* and

Table 13: Paired comparison of eight plant species used for making traditional farm implements in Arsi Zone, Oromia reference to strength.

Plant species		Respondents (R1-R10)								Frequency	Rank
		Olea welwitschii	*Prunus africana*	*Hagenia abyssinica*	*Ekebergia capensis*	*Olea africana*	*Juniperus procera*	*Eucalyptus globulus*	*Galineria saxifrage*		
Respondents (R1-R10)	*Olea capensis*	-	Ow	Ow	Ec	Oa	Ow	Eg	Gs	3	4th
	Prunus africana	-	-	Pa	Pa	Oa	Pa	Pa	Pa	5	2nd
	Hagenia abyssinica	-	-	-	Ec	Oa	Ha	Eg	Gs	1	5th
	Ekebergia capensis	-	-	-	-	Oa	Ec	Ec	Ec	5	2nd
	Olea africana	-	-	-	-	-	Oa	Oa	Oa	7	1st
	Juniperus procera	-	-	-	-	-	-	Eg	Gs	0	6th
	Eucalyptus globulus	-	-	-	-	-	-	-	Eg	4	3rd
	Galiniera saxifraga	-	-	-	-	-	-	-	-	3	4th

E. capensis selected five times each and ranked second. While *E. globules* was selected fourtimes and ranked 4th, *O.capensis* and *G. saxifrage* were ranked 5th since the later two species were selected three times each. *H. abyssinica* was selected only once against the other species where *J. procera,* the most preferred species for traditional house construction, was totally ignored for agriculturalimplements.

4.8. Ethnobotanical knowledge of plant material culture

4.8.1. Age and gender knowledge of traditional material cultures

In this course of study, 20 women and 60 men were involved for individual interviews on indigenous knowledge of plants material cultures. And finally 20 key informants from men and 10 key informants from women were reselected from the same informants to gather information to be computed for direct matrix ranking, preference ranking and paired comparison methods (Table 10-14).

The reports from the informants showed that; women in the study area bear most of the burden of daily food preparation, looking after their young baby, searching for firewood, water and other more responsibilities. This study also revealed that labor division between genders played great role for the variation of TBK between male and female. For these and other factors women were able to list only few plants for house construction and farm implements (males job), but they were observed to list plants for weaving or sewing (needlework) for households utensils and plants for food flavoring and cooking purposes (considered as feminized job). And the converse was true for men, they reported, recognized and utilized more plants for farm implements, house construction, fencing and fewer plants for flavoring food and local drinks and failed to reports some plants for bathing and vessel cleaning. Moreover, as noted by Ponderosa *et al.* (2012), a number of more recent ethnobotanical studies further corroborate the importance of gender-distinct knowledge. For example, exploring the distribution of local plant knowledge in rural communities in Brazil argue plant knowledge to be intimately related to use patterns, with women generally having greater knowledge of medicinal plants and men having greater knowledge of timber resources and other plants used for construction.

Following the same logic, men have greater knowledge of utilizing different plant species to produce different material cultures. As reports indicated men in the study area regularly gathering most large construction material such as; thatch, cordages (rope fibers), timber, pillar, rafters and unprocessed stems to make farm implements and household objects. When gender compared to own knowledge of material culture from various plant species, the skill of processing and transferring knowledge are widely held by male (Appendix 1).

Although women could list the same plants species used for construction as men, their knowledge was less detailed and often refers other person to explain the processing methods and the particular material culture produced from each. And at the same time, they knew the names of the plants, but confused to show the named plant in the field. The knowledge of naming (or listing) of local plant, use of plants, part(s) utilized and processing for utilization were also shown to be influenced through age and gender (Table 15). Analysis of data using SPSS (Statistical Package for Social Science) version 20 software based on reports from 80 informants included in this Ethnobotanical study from Limu-Bilbilo District (Appendix 2) seemed to support the traditional assumption that ethnobotanical knowledge increases with age. SPSS was run to

determine the relationship between 20 females' age and knowledge of plant species, plant based material culture, and processing methods of material cultures. The SPSS output indicated that; there was a moderately strong positive correlation between age and knowledge of plant species ($r = .711$, $N=20$, $p < .001$)." On the other hand, the correlation coefficient ($r = .543$, $N=20$, $p < .05$) for age and knowledge of plant based material culture, and ($r = .449$, $N=20$, $p < .05$) for material culture processing methods (Table 15), suggests that the age and ethnobotanical knowledge of female participants have a strong positive (although barely so) linear relationship.

Table 14: SPSS output of Pearson Correlation for female participants on age versus ethnobotanical knowledge

Correlations[a]

		Age of informants (yrs)	No of plants species cited	No of material culture cited	processing methods of material culture cited
Age of informants (yrs)	Pearson Correlation	1	.711**	.543*	.449*
	Sig. (2-tailed)		.000	.013	.047
	N	20	20	20	20
No of Plants spp cited	Pearson Correlation	.711**	1	.308	.398
	Sig. (2-tailed)	.000		.186	.082
	N	20	20	20	20
No of Material culture cited	Pearson Correlation	.543*	.308	1	.555*
	Sig. (2-tailed)	.013	.186		.011
	N	20	20	20	20
processing Methods of MC cited	Pearson Correlation	.449*	.398	.555*	1
	Sig. (2-tailed)	.047	.082	.011	
	N	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Sex of informants = Female

P -value is less than .05, then the correlation is considered to be significant, meaning that the researcher can be 95% confident that the relationship between age and knowledge of identifying plant species, processing material culture and knowledge of plant based material culture is not due to chance.

"A Pearson's correlation coefficient (r) was computed to analyze the correlation between ethnobotanical knowledge gap (or knowledge of identifying plant species, plant based material culture and processing of material culture) due to age differences of male informants. And thus, as SPSS output demonstrated there was a perfectly strong positive correlation between age and knowledge of processing plant based material objects (r= .820), knowledge of identifying plant species by their local name (r= .811) (Table 16).

Table 15: SPSS output of Pearson Correlation for male informants on age versus ethnobotanical knowledge

Correlations[a]

		Age of informants (yrs)	No of plants species cited	No of material culture cited	Processing methods of material culture cited
Age of informants (yrs)	Pearson Correlation	1	.811**	.367**	.820**
	Sig. (2-tailed)		.000	.004	.000
	N	60	60	60	60
Number of Plants species cited	Pearson Correlation	.811**	1	.258*	.966**
	Sig. (2-tailed)	.000		.046	.000
	N	60	60	60	60
Number of material culture cited	Pearson Correlation	.367**	.258*	1	.294*
	Sig. (2-tailed)	.004	.046		.023
	N	60	60	60	60
Processing methods of material culture cited	Pearson Correlation	.820**	.966**	.294*	1
	Sig. (2-tailed)	.000	.000	.023	
	N	60	60	60	60

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Sex of informants = Male

As shown in the table, there are some other evidence to believe that ethnobotanical knowledge is linearly correlated with age of informants; that is the p-value for this test as being .000 ($p < .001$ for identifying plant species and processing of material culture) indicate that there are very strong evidence to believe that as age increased knowledge of identifying plant species by their local name and knowledge of processing material culture also increased. From this it can be concluded that the correlation between age informants and knowledge of identifying plant species and processing methods of material culture are stronger for males than females. And in particular, it seems that the female participant knows more number of plant based material than male ($r = .543$, $p < 0.05$).

In line with this finding (Dalle and Potvin 2004; Camou-Guerrero *et al*., 2008; Abera, 2013) also reported gender and age patterns resulted in heterogeneous patterns of botanical resource use, knowledge and value within the community, and in general ethnobotanical knowledge simply increases with age. The results did clearly support that the knowledge of identifying plant species and their particular purposes increased with age.

4.8.2. Mode of knowledge transfer among the community

According to Quanash (1998), Indigenous knowledge (IK) is defined as the cumulative body of strategies, practices, techniques, tools, intellectual resources, explanations, beliefs, and values accumulated over time in a particular society. The reports from the study area showed IK of plant material culture is learned during a lifetime by realizing the interconnectedness of plants and their functions and through firsthand observation from elders. IK of plant material culture tends to be collectively owned and takes the form of agricultural practices, identification of plant species, cultural values, beliefs, rituals and community laws and transmitted orally (in verbal consent) from generation to generation. It is not privileged or secret knowledge in the way that certain cultural knowledge like, healing and magical knowledge. It is freely demonstrated to the young and they are allowed to practice through observation and independently at herding field. But as reports indicated it is difficult to rely on verbal consent from the elders because the new generation is attracted to modern technology products than traditional tools and arts. The present study revealed that rapidly declining of TBK from time to time. In agreement with this study, Dalle *et al*. (2005) and Abera (2013) also reported the rapid declining of TBK in generation from

the study held at Oromo Community of Jimma, Southwest Oromia and Borana Pastoralists in Southern Oromia respectively.

4.9. Local threats and conservation of plant resource in the study area

4.9.1. The local pressures on the plant used for material culture in Limu-Bilbilo District

In the study area, various factors that were considered the main threats for plants resources were recorded by interviewing the informants. The major factors claimed were deforestation, agricultural expansion, timber making, deliberate fire, firewood and charcoal trade and over grazing. Of all factors, the main threatening factor reported for plants called Hexoo *(H. abyssinica)* and Gatiraa (*J. procera)* was timber trading, the main income generating practice from plant resource in the study area. Similar factors were reported by Seyani and Chikuni (1997) elsewhere in Malawi and Yassin *et al.* (2015) from Ethiopia. They reported that the need for agricultural land and population pressure severely threatened plant recourses in general. And now-a-days, the world is losing plants every minute due to deforestation, for agricultural expansion, firewood, construction material, timber making, over grazing (Seyani and Chikuni, 1997). According to Sofowara (1982) these common human induced anthropogenic factors besides some natural factors resulted in loss of genetic diversity and threatening the very survival of human kind with erosion of some lifesaving medicinal plants of wild genes and indigenous knowledge associated with plants.

Table 17: Local threats and conservation of plants resource in the study area

Major factors threaten plant resource of the study area			**Conservation strategy reported**		
Factors reported	**No**	**Percent**	**Strategy**	**No**	**Percent**
Deforestation for timber	48	39.02	Creating alternative income generations	32	38.55
Agricultural expansion	29	23.58	Community awareness raising	27	32.53
Firewood and charcoal	21	17.07	Community participation	13	15.66
Over grazing	18	14.63	Responsible local administration	7	8.43
Fire	7	5.69	Strong legal protection	4	4.82

As shown in the Table 16, deforestation for timber trading (39%) was highly threatening plant species in the study area. Timber production for business increased the rate of exploitation of plant species like *H. abyssinica* and *J. procera.* Deforestation for agricultural land expansion practice by the younger generation (23%), fuelwood use for their own consumption and for

trading and traditional charcoal production (17%) are the other anthropogenic factors that threatening many indigenous plant species in the study area.

Respondents also explained that, traditional conservation practice may not maintain plant species from over exploitation. Hence, there is a need to integrate formal and traditional practices to save vegetation cover of the study area. However, prevention of threats through creating alternative income generations for the community depends on plant resource (38.55%) was the most reported solution by the community in the study area, followed by developing community awareness on the wise use of plant resource for socio-economic and environmental wellbeing (32.53%) informed by 27 residents involved in research, while involvement of community in conservation strategy policy (15.66%) was also the other alternative strategies reported by the local community to save plant resource of their environment(Table 16).

4.9.2 Traditional management and conservation of plants resources

Bosoona Hajjii Naassiir literally means the forest of Hajji Nassir, is traditionally protected forests (sacred and cultural forests) of the study area. It seems to harbor a high number of plants species, most of them with very old trees having medicinal values. Hajji Nassir was a respected religious leader in the past and still has many followers. There are many plants species in this forest, for example *Juniperus procera, Olea europaea, Prunus africana* and *Hagenia abyssinica* are common species, but *J. procera* seems a very dominant species. Those plant species are protected through taboos and beliefs. As informants explained, this man believed to have power from God (*Rabbii*) and settled at the center of this forest and passed a command against the use of this forest for any types of purposes except for medicinal values. Cutting a piece of leaf from this forest is often prohibited except with permission from the ritual heads and requires ritual performance. This forest has great respect from the society due to the cultural and spiritual role it plays as center of worship and burial sites for ritual heads. It is believed that anyone who violates the command and destroys plants (forest) may produce bad omens that can result in outbreaks of disease, deaths, or loss of cattle. A fear of snake bite and wild animals is another frightening character of the forest. But as reports indicated from some respondent violation of this traditional belief become increasing from time to time and logging of Hajjii Nassir Forest for timber production is the main problem in the area. But believers (or followers) still respect the rule and protect it from loggers.

Malkaa is a place where water comes out from the ground and acts as a place where river start to flow downstream. It is a place where ritual of *Iirrechaa* or *Waqefanaa* (a belief in the existence of a supreme being) is carried out. *Waqefanaa* is reported as traditional belief of the community in the study area before Christianity and Islamic religions. The location of the tree is regarded as a sacred place where trees and plants were allowed to grow undisturbed and birds and animals are free living freely without fear of poaching or interference by man. Groves of this tree are sacred and hence no axe may be laid to any tree, no branch broken, no firewood gathered from this area. The same traditional conservation is given for *Abdaarii;* it is area for worships and shade in some kebeles of the study area. In agreement with the present study, many authors have made similar reports about the roles of beliefs, ritual and spirits and taboos of traditional communities (Tamene, 2000; Yassin *et al*., 2015). In agreement with the present study, Cotton (1996) has mad similar conculusions about the roles of, magical and religious beliefs and environmental perception on the use and management of plant species. So, these rituals and beliefs highly play great role to preserve the remaining remnant forest and associated indigenous knowledge.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

An Ethnobotanical study on indigenous knowledge of plant species of material culture used by Arsi Oromo in Limu-Bilbilo District resulted in the documentation of 79 plants species which belonged to 74 genera under 52 families. Among these 79 species, 56 species were documented from wild vegetation, 13 species from both wild and cultivation area and 20 plant species cultivated for their special values. Regarding their life form, 33 plant species are utilized from tree, 27 species from shrubs, 14 species are herbs and the reaming 5 species from lianas. Different parts of these species are processed for different type of material cultures, from which the most frequently used part is woody stem of 60 plants species followed by leaves 18 species, bark seven species, branch six species, whole part five species, fruit four species, seed, thorn and inflorescence (flower) two species each, whereas root and latex (liquid extract) reported for only one plant species each. Concerning the conditions of plants parts to be utilized or processed 34 plants species and their different parts were recorded to be processed in fresh and dried form, 25 species used in dried form and 20 plant processed in fresh form only. Respecting the knowledge of community to process the material from plant resources, 39 plant species were processed by splitting, 30 species by carving, 13 species by hewing, 12 plant species by burrowing (boring) whereas 11 species were reported to be processed through sawing and adzing.

The present study showed that the communities in the study area have indigenous knowledge in conserving and utilizing 79 different plant species and their part(s) in which one plant species may be used for several purposes. In this study 64, types of plant made material cultures were recorded which were categorized into 22 main use categories. The major use categories were traditional house construction which utilized about 43 plant species, life and dry fence constructed by the people in the study area involving about 29 plant species, traditional household objects (utensils) carved from 39 different plant species, traditional agricultural implements is another main category constructed from 27 different plant species, kitchenware, objects for serving and cooking foods, reported from 21 plant species while 15 species were reported for local beehives and beehive hanging.

The study also revealed that indigenous people of the study area prefer one plant from the other by their own criteria. Durability, strength, termite resistance and cultural references are the main criteria considered by the people of the study area. Referring to these criteria multipurpose plant that ranked first for traditional house construction and farm implements are *Olea europaea* and *Juniperus procera*. Regarding ethnobotanical knowledge, the present study concluded that males are more skilled than females and ethnobotanical knowledge of a person increases with age of experience.

Timber production, agricultural expansion, firewood and charcoal production and overgrazing are the major threat factors for plant resources in the study area. Though there are several threat factors, the people of the study area have good attitude, cultural norms and indigenous knowledge of conservation practices. In addition to this, they also put other alternative methods for conservation of plant resources, alternative income generation, raising community awareness and participating community in protecting their resources are the most useful conservation strategy forwarded by the people in the study area.

5.2. Recommendations

- The results of current study would have significant contribution towards documentation of multipurpose plant species and material culture of the community in the study area. The use of different plant made material culture in each kebele is shown to decrease and replaced by synthetic plastic and metal works. Plant material culture is biodegradable product, but synthetic plastic pollute the soil, water and environment. So raising people awareness on the wise use of plant resourse to produce and utilize their own cultural material should be given attention by the concerned bodies.

- There are many ritual and cultural tools in the study area, but they are almost going to be ignored by the younger generation. Therefore, educating the younger generation to keep and preserve their culture and documentation of those beautiful cultural tools need further studies.

- Plant resources are integral to the life of all biota, as they are the primary food producers. Thus, indigenous people of the study area should be involved in conservation and management plans of plant resources or their indigenous knowledge in their locality.

- Although the reported traditional plant resource conservation in the study area was cultural and ritual practices and cultural beliefs, the sustainability of these practices is seriously threatened. This stems from the rapid changes in the belief systems. So protecting of ritual and spiritual areas, which are rich in plant resource are necessary.

- Government and non-governmental organizations should fund integrated social and biological research at several locations in Arsi Zone, particularly in the study area to promote a better understanding of traditional plant resource management practices.

- Currently, little detailed scientific research was done on plant material culture in Ethiopia. Thus, to promote the field more works are expected from the researchers in that field of study.

- Ethnobotanical study on plant material culture within such short period of time is not enough to document the material objects, plant species and the knowledge of the community under investigation. So, extra time and financial support is needed for the future when this kind of study is proposed.

- The data about the variety of plants traditionally used to make material culture and the ways in which they are used according to the specific characteristics of the area are important for ethnobotanical knowledge and they contribute to preserving the world's human's traditional experience as well as national identity. So, such study should be motivated by scholars and government bodies.

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APPENDIXES

Appendix 1: List of plant species as a raw material for material culture used by Arsi Oromo in Limu-Bilbilo District, Arsi Zone. Key: Habit (Ha) [C-Climber; H-Herb; S-Shrub; T-Tree; Sex: F-female; M-male; F and M- both male and female; and NW-conserved at natural wild area, Cu= cultivated and B=found in wild habitat and also cultivated.

No	Scientific name (Family)	Local name (Afaan Oromo)	Habit	Part used	Form used	Processing manners	Knowledge owner (gender)	Habitat	Types of Material culture and uses
1	*Acacia abyssinica* Hochs ex. Benth. (Fabaceae)	Laaftoo	T	Stem	Fresh and dried	natural bent stem cut and heating to curve more, carving and boring to make hole	M	NW	Tool handles (axe), farm(plank) implements, dry fencing around farm land , beehives hanging, and to make traps, shade
2	*Allophylus abyssinicus* (Hochst.) Radlk. (Sapindaceae)	Sarijii	T	Stem and smaller branches	Dried	Splitting and carving, boring to make hole	M	NW	To make farm implements (plough, yoke, and plank) and to construct house and fence
3	*Arundinaria alpina* K. Schun (Poaceae)	Lemoo/ shamboqoo	S	Stem (Culm), twigs	Fresh and dried	Adzing or stripped off leaves, splitting, weaving and bored/ drilled	M and F	B	Beehives, floor mat, lid of clay oven, house construction, grain storage, weaving cotton, tobacco smoking pipe, pipe for local drink making (kasamii), musical instruments (ululee), to make distaff for weavers, fencing, stools/chair and tables
4	*Barbeya oleoides* Schweinf. (Barbeyaceae)	Adaaddo	S	Stem	Fresh	Peeling and splitting	M	NW	Rope; to tie the main pole of the house (very durable).

Appendix 1 continued…

5	*Brassica carinata* (West.) Rupr. (Brassicaceae)	Raafuu/ goomanz ara	H	Fruits and dried leafy stem	Dried	Roasting and crushing seed and tying dried leafy stem	M and F	Cu	Dried leafy stems as brooms to be used to clean house and threshing floors. Seed is used to greasy the clay stove for cooking bread and
6	*Buddleja polystachya* Fresen. (Buddlejaceae)	Bulchaan aa	T	Small branches	Fresh and dried	Cutting and sharpening	M and F	NW	Fencing, ritual values during weeding, male and female grooms hold on hands indicating good lucks, flowers for honey bees
7	*Calpurnia aurea* (Ait.) Benth. (Fabaceae)	Ceekaa	S	Stem	Dried	Peeling, carving and smoothing	M	NW	Farm implements (manaqee) and Plough handle, walking stick, stick for X-mass game (curved end).
8	*Capparis tomentosa* Lam. (Capparidaceae)	Haranga-ma gurachaa	S	Stem and seedling	Fresh	Planting the seedling for fencing and splitting	M	B	Life fencing by planting seedlings in line, dry fencing around home garden and farm land, and for making roof ceiling
9	*Carissa spinarum* L. (Apocynaceae)	Hagamsa	S	Stem and Thorns	Fresh	Cutting stem for fence and thorns for tattoos	M and F	NW	Dry fencing around home garden & farm lands, dried stem smoking during honey collection, thorns for tattoos ear-ring hole piercing
10	*Cassipourea malosana* (Baker) (Rhizophoraceae)	Xillooo/ lookoo	T	Stem and branches	Dried	Burrowing and splitting	M	NW	Woody stem used to make house hold tools, plough, house construction (pole) and fencing.
11	*Celtis africana* Burm. f. (Ulmaceae)	Mataqoo ma	T	Stem	Dried	Hewing, sawing & splitting	M	NW	House construction (pole& sidewalls), timber making for window, door, tool handles and bed making

Appendix 1 continued…

12	*Clausena anisata* (WIlld.) Benth. (Rutaceae)	Uluma'e	S	Stem, Leafy stem and young stem	Fresh	Shortened and trimmed (to give good shape for tooth brush)	M and F	NW	walking stick for female, tooth-brush, over bed cover, to make small hat for honeymoon ceremony (nuptial house) and rituals, making broom for sweeping, beehives making
13	*Clematis longicauda* Steud ex A.Rich. (Ranunculaceae)	Hidda fiitii	C	Stem	Fresh	Stripped off leaves and soaking if dried	M	NW	For tying purposes during house construction and for fencing, chickens box
14	*Clematis simensis* Fres. (Ranunculaceae)	Hida fardaa	C	Stem	Fresh	Adzing stripped off leaves	M	NW	Rope for house and fence construction, basket for chickens
15	*Cordia africana* Lam. (Boraginaceae)	Waddees sa	T	Stem	Fresh and dried	Peeling, splitting, boring, hewing and sawing	M	NW	About 2 meters long woody stem with various thickness is used to make pestle and mortar for grinding and pounding coffee and grains. Timber for bed and households utensils, ladder, cart, house pole, farm implements
16	*Biden borianiana* Sch. (Asteraceae)	abaaboo masqalaa	H	Inflorescence	Fresh	Broke off flower	M and F	B	Flowers are picked by children at the new year celebration spread on the floor
17	*Croton macrostachys* Del. (Euphorbiaceae)	Bakanisa	T	Stem, leaves and root	Fresh and dried	Carving and burrowing or making bore	M	NW	Agricultural implements (yoke), smaller mortar, leaf for malting and cooking, knife & sickle handles(root), musical instrument " kaballaa" beehives hanging

Appendix 1 continued…

18	*Cynodon dactylon* (L.) Pers (Poaceae)	Cooqorsa	H	Whole part	Fresh	Mowing	M and F	NW	Ritual: Elder women cut and hold on hand during (hatetee ritual) and marriage question & arrangement by elders (jarsuumaa sadetaa)
19	*Cyperus papyrus* L. (Cyperacee)	dhalandu	H	leaf	Fresh and dried	Mowing and weaving	M	NW	Bedding (mattress), rain hood, for coffee-pot stand making (matotii) & spread out on the floor
20	*Discopodium penninervium* Hochst. (Solanaceae)	Maaraa-roo	S	Whole part & leaves	Fresh	Planting and stripped off leaves	M and F	B	Leaves used to germinate malt and the whole plant part planted in line for live fencing
21	*Dombeya torrida* (J.F. Gmel.)P.Bamps. (Sterculiacae)	Daanisa	T	Bark	Fresh	Peeling	M	NW	To make fibers and rope, bark peeled to make a rope used for different functions like roof & fence constructions
22	*Dovyalis abyssinica* (A.Rich) Warburg. (Flacourtiaceae)	Koshommii	S	Leafy stem & thorns	Fresh & dried	Planting & collecting thorn	M and F	B	For fencing & thorns to make traditional tattoos
23	*Ehretia cymosa* Thonn. (Boraginaceae)	Uragaa	T	Stem	Dried	Carving	M	NW	Woody stem to make farm implements and tools handles
24	*Ekebergia capensis* Sparrmam (Meliaceae)	Somboo	T	Stem & bark	Dried	Splitting, hewing, sawing and peeling	M	NW	Woody stem for timber and house construction, fencing, and dried bark for smoking (fumigating) beehives to attract bees and farm implements

Appendix 1 continued…

25	*Ensete ventricosum* (Welw.) Cheesman (Musaceae)	Warqqee	H	Leaf and main mid-vein	Fresh and dried	Adzing or stripped off leaves and Braiding of ply	M and F	Cu	For cooking bread over clay stove, threads woven for plough-man's whip & rope for tying purpose, basketry, trap, to make fiber strand
26	*Eragrostis tef* (Zucc.) (Poaceae)	Xaafii	H	straw	Dried	Mowing, Threshing (trampling), thatching & daubing	M	Cu	Straw remaining after threshing is used for roof thatching and it is made by skilled man (Thatcher), to make mattress, it also mixed with mud for daubing the wall of the house.
27	*Erica arborea* L. (Ericaceae)	Saatoo	S	Whole part	Fresh & dried	Tying together the whole dried branches	M	NW	Fencing and to make torch for ceremony during " ayyyana masqalaa" the finding of true cross
28	*Erythrina brucei* Schweinf. (Fabaceae)	Waleena a	T	Stem & seeds	Fresh & dried	Burrowing stem & beading of seeds for necklace.	M & F	B	Seat during coffee ceremony, mortar of different size to grinding coffee & grains, for beehives, beaded necklace made of seeds, fencing saddle(koraa),drum(diibee),
29	*Eucalyptus camaldulensis* Dehn. (Myrtaceae)	Baargam o diimaa	T	Stem branches	Fresh & dried	Splitting, Hewing, sawing	M	C	House construction (sidewalls and roof supports), bed & pillow making, farm implements (plough, planks & yoke), fencing
30	*Eucalyptus globulus* Labill. (Myrtaceae)	Bargamo adii	T	Stem & bark	Fresh & dried	Hewing, sawing, Splitting & peeling	M	C	Beam of plough, tools handles (axes), fencing, timber, house construction, pestles, home furniture (bed, Pillow, box) , ladder & bark for tying fence as rope, hand cart

Appendix 1 continued…

31	*Ficus vasta* Forssk. (Moraceae)	Qilxuu	T	Stem & liquid extract	Dried	Splitting, carving, "qo'uu" to release sticky extract	M & F	NW	Woody stems splitting for house & fence post as well as the extract from bark of the tree as chewing gum for children & to fix old book together. Ritual value during blood money agreement. It is very rare in the study area, shade
32	*Galiniera saxifraga* (Hochst.) Bridson (Rubiaceae)	Simarar-uu	T	Stem	Fresh and dried	Carving and burrowing	M	NW	To make tool handles, mortar for coffee and spice, household objects, and to make yoke and plough (farm implements), millstone stands
33	*Gnidia glauca* (Fresen.) (Thymeleaceae)	Diddiss-aa	S	Whole part and leaves	Fresh and dried	Peeling, weaving & stripped off leaves	M and F	NW	Rope; bark used to make rope for traditional house & fence construction. Leaves to remove hairs from hides and to smoothening them.
34	*Gossypium hirsutum* L. (Malvaceae)	Jirbii	S	Hairy fruit	Dried	Broke loose (treated cotton with the finger), spinning and weaving	F	Cu	Spinning of cotton and weaving traditional clothes, like (buluko gabi, bidiqo hatete etc)
35	*Grewia mollis* A. Juss. (Tiliaceae)	Harore-ssa	S	Stem	Dried	Smoking, Smoothing and Oiling	M	NW	Walking sticks, herding sticks, spear and sword handles
36	*Hagenia abyssinica* (Bruce) J.F. Gmel. (Rosaceae)	Heexoo	T	Stem	Dried	Splitting, hewing Sawing and carving	M	NW	Household utensils, house construction, bed & pillow, timber making, tool handles, to make farm implements (yoke) and combs

Appendix 1 continued…

37	*Hordeum vulgare* L. (Poaceae)	Garbuu	H	Straw	Dried	Mowing, Threshing (trampling), thatching and daubing	M	Cu	The lower portion of dried straw is mowed after the upper portion of the straw is mowed and collected for the barley seed and used as thatching roof, straw remaining after threshing is mixed with mud for daubing the wall of the house.
38	*Hypericum revolutum* Vahl (Hypericaceae)	Garamb-aa	T	stem	Dried	Hewing, sawing and splitting	M	NW	House construction, to make timber and house frame beam
39	*Juniperus procera* Hochst. ex. A. Rich. (Cupressaceae)	Gaattiraa	T	Stem, extract	Dried	Splitting, hewing, sawing and carving	M	B	Wall & roof of the house, fencing, timber making, beehives hanging, foot bridge, frame of the main out gate (maqannii kara), to make comb for hair. Aromatic for fumigation (hixaana)
40	*Justicia schimperiana* (Hochst. ex Nees) T. *Anderson* (Acanthaceae)	Dhumuu -gaa	S	Stem and bark	Fresh and dried	Peeling bark splitting branches	M	NW	Rope; bark peeled and used as rope for construction to attach fence & the wall fragments. Small branches fitted reinforcing beam for house wall & roof ceiling
41	*Lagenaria siceraria* (Molina) Standl. (Cucurbitaceae)	Buqqee	H	Fruit	Dried	A sealed mouth is made at one narrow end scooped to clean the inside	F	C	Vessels for milking and filtrating or churning milk to make butter, hold and carry cultural foods, used for drinking water and milk, as funnel for kitchenware and smoking vessels (gaayaa)
42	*Lantana trifolia* L. (Verbanaceae)	Sukaay-ee	H	Leafy stem	Fresh and dried	Adzing or stripped off leaves	F	B	For roosting meat (flavoring) and washing milk and yogurt containers, for melting and purifying butter.

Appendix 1 continued…

43	*Leonotis ocymifolia* (L.) R. Br. (Lamiaceae)	Bokolluu	S	Stem and Leafy stem	Fresh	Plantation, cutting and sharpening	M and F	NW	Woody stem for fence posting and byre making.
44	*Linum usitatissimum* L. (Linaceae)	Talbaa	H	Stem/ straw	Dried straw	Mowing with sickle, threshing & filling straw in sack	M	Cu	To make mattress (straw foam) and pillow and sometimes for roof thatching
45	*Maesa lanceolata* Forssk. (Myrsinaceae)	Abbayyii	S	Leaves and stem	Fresh and dried	Adzing (removing leaves) and splitting	M and F	NW	Women use the leaves to roll the dough in before putting it in the oven so that it does not burn. The seeds are crushed and the oil is used to grease the baking plate before baking. Woody stems for house (not durable) and fence construction
46	*Myrica salicifolia* Hochst. ex A. Rich. (Myricaceae)	Xoonaa	T	Stem	Fresh and dried	Splitting and carving	M	NW	House construction, dry fencing and to make tools handles
47	*Myrsine africana* L. (Myrsinaceae)	Qacama	S	Stem with branches	Fresh and dried	Tying arranged stem together	M	NW	To make brooms used in threshing floor to separate straw from grains, granary, and to construct roof ceiling in hat and traditional house construction
48	*Nuxia congesta* R. Br. ex Fresen. (Loganiaceae)	Biixxann -aa	S	Woody stem	Dried	Cutting, splitting and carving	M	NW	House construction, fencing, and to make seat with three legs, and to make agricultural implements (yoke and plough handle), foot bridge

Appendix 1 continued…

49	*Olea europaea* L.Subsp. Caspidata (Walle Don) Cif (Oleaceae)	Ejersa	T	Stem and Branches	Fresh and dried	Carving heating to bent more and splitting	M	NW	House construction, tooth brush, sticks, fencing, farm implements (plough), pestle, roof and wall reinforcing beam, fumigation, roasting sticks, bread roller, stakes for splitting woody stem. Tool handles for whip, sword and fly whisk handles, millstone stands.
50	*Olea capensis* Subsp. Macrocarpa (Oleaceae)	Gagamaa	T	Stem	Fresh and dried	Splitting and carving	M	NW	To make farm implements and for house construction, fence and hut construction. To construct beehives and to make tool handles.
51	*Olinia rochetiana* Gilg. (Oliniaceae)	Gunaa	T	Stem and bark	Dried	Splitting and carving	M and F	NW	Woody stem used to make tool handles, farm implements "lolosoo", sticks & pestles. Dried stem & barks used as perfume and cleaning steam "qayaa" for females to have good pleasant
52	*Osyris quadripartite* Wall.ex Wight (Santalaceae)	karoo	S	Leafy branches	Fresh	Cutting leafy stem and crushing its fresh leaves	M and F	NW	Females wash their body with the leaves just after birth. And to bless animals meat if eaten by hyena. It is not allowed to use this plant for firewood.
53	*Oxytenanthera abyssinica, (A. Rich) Munro* (poaceae)	Shiimala	S	Stem	Dried	Smoking, smoothing, painting and oiling with bone marrow	M	NW	Walking sticks, granary, spear and sword handles, spindle for weaving cotton, tools handles (knife & sickle).
54	*Pennisetum schimperi* A. Rich. (Poaceae)	Migira	S	Whole part and stem above the 1st joint	Dried	mowing / breaking fresh stem, vertical splitting, Slicing and sewing or stitching	M and F	NW	Basketwork disc for winnowing grain, food-table (masob), sieve(gingisha), muday (small woven basket decorative), roof thatching, rope for tying purpose, brooms for home floor

Appendix 1 continued…

55	*Phoenix reclinata* Jacq. (Arecaceae)	Mexii	S	Leaf, stem, midrib and sheath	Fresh and dried	Adzing, slicing, weaving and sewing	M and F	NW	Making broom, fiber, floor mat, baskets, granary, sleeping mat, milking utensils, hat making, hut ceiling, rain hood, basketwork disk and sieves, food tables
56	*Pittosporum viridiflorum* Sims. (Pittosporaceae)	Aaraa	T	Stem and branches	Fresh and dried	Cutting, splitting, shortened and trimmed	M & F	NW	Woody stem for house construction and fencing, whereas small branches for toothbrushes.
57	*Podocarpus falcatus (*Thumnb.)Mirb. (Podocarpaceae)	Birbirsa	T	Stem and seeds	Dried	Sawing, hewing, Splitting, beading necklace and painting	M	NW	Main beam of the house, timber, frame of door & window, for home furniture pillow and bed, seeds to make ornaments (necklace)
58	*Prunus africana* (Hook. f.) Kalkman (Rosaceae)	Sukkee	T	Stem and Bark	Fresh and dried	Splitting, burrowing, Peeling and weaving	M	NW	Woody stem for house construction and "muka qawee" the stem used to make weapon handle and sheath for pistol" qolaa shuguxii", foot bridge. Rope from bark for tying, beehives hanging and to make chicken nesting box , farm implements
59	*Myrsine melanophloeos* (L) (Hochst. ex DC)Mez (Myrsinaceae)	Tulaa	T	Leaf Stem	Fresh and dried	Adzing (removing leaves) and splitting	M and F	NW	Leaves for cooking bread, woody stems for house construction (but not durable) and dry fencing
60	*Rhamnus prinoides L'Hér* (Rhamnaceae)	Geeshoo	S	Stem and leaves	Fresh	Shortened and trimmed, stripped off leaves	M and F	Cu	Toothbrush (small stem) & leaves for clay pot washing, larger stem for tool handles (sickle & knife)

Appendix 1 continued…

61	*Rhus vulgaris* Meikle (Anacardiaceae)	Dabobe-saa	S	Stem	Fresh and dried	Carving and splitting	M	NW	Tools handle (knife, axe & sickle) & fly whisk handles, millstone stands. 3-legs seats and home garden fencing
62	*Ricinus communis* L. (Euphorbiaceae)	Qobboo	S	Seed	Dried	Seeds pounded or crushed under flat rolled	F	Cu	Softening strap of leather used in fastening a load and leather made farm implements, seeds are crushed and the oil extracted to grease the baking pans
63	*Rubus steudneri* Schweinf. (Rosaceae)	Hidaa	C	Stem	Fresh	Winding	M		Fencing and house ceiling
64	*Ruta chalepensis* L. (Rutaceae)	Cilaadd-ama	H	leaf	Fresh	Stripped off leaves	M and F	Cu	Leafy buds put in hot coffee for flavoring and washing coffee pot as brush and to make toothbrush
65	*Rytigynia neglecta* (Hiern.)Robyns (Rubiaceae)	Miixoo	S	Stem	Fresh and dried	Splitting and carving	M	NW	For roof construction and side wall reinforcing and fencing home garden
66	*Satureja* species (Lamiaceae)	Xoosiny-ii	H	Whole part	Fresh and dried	Planting and stripped off leaves	M and F	B	Used as spice for food & tea flavoring and as spice for "baso" (roasted and ground barley) and cultivated for animal feed since cattle feed on it give good quality meat.
67	*Schefflera abyssinica* (Hochst. ex A.Rich) Harms. (Araliaceae)	Gatamaa	T	Stem and flowers	Fresh and dried	Splitting, carving, hewing and sawing	M	NW	To make farm implements (yoke but if other plants in scarce) and beehives hanging, and timber (not preferred much) making, flowers for honey for hanging beehives

68	*Schefflera volkensii* Harms. (Araliaceae)	Aanshaa	T	Stem	Dried	Carving and burrowing	M	NW	Woody stem used to make farm implements (yoke "hallaaza") and household tools, saddle (koaraa), drum(diibee) and comb making for combing hair, fence post and house roof construction, beehives
69	*Solanum incanum* L. (Solanaceae)	Hiddii	H	Fruits and whole part	Fresh	Crushing fruits and planting	M and F	NW	Fruits crushed and the extracted used to grease the pans (clay stove) for baking bread & "Bidenaa" .
70	*Stephania abyssinica* (Quart.-Dill. & A. Rich.) Walp. (Menispermaceae)	Gaalee kalaala	C	Stem	Fresh and dried	Splitting fresh stem and soaking dried stem for weaving and tying	M	NW	To make beehives, granary, to tie house post and fencing, to make containers for milking and as rope for hanging beehives, chickens nesting box, clay oven lids
71	*Syzygium guineense* (Willd.)DC. (Myrtaceae)	Badeessa a	T	Stem	Fresh and dried	Cutting and carving	M	NW	Woody stem to make home furniture like seats, fencing, sometimes to make farm implements(plough, yoke) and for house construction, fumigation of milking utensils
72	*Teclea nobilis* Del. (Rutaceae)	Hadhees saa	T	Stem	Fresh and dried	Carving and burrowing	M	NW	House hold tool (pestle), woody stem used to make ploughs.
73	*Trichilia dregeana* (Forsk.) (Meliaceae)	Luyyaa	T	Woody stem	Fresh and dried	Splitting and carving	M	NW	House and fence construction

Appendix 1 continued…

74	*Urera hypselodendron (*Hochst ex A Rich) Wedd. (Urticaceae)	Halillaa	C	Whole part	Fresh	Stripped off leaves	M	NW	Cordage for tying during fencing and hat construction
75	*Urtica simensis* Hochst. ex Steud. (Urticaceae)	Doobbii	H	Dried bark with ply	Dried	Peeling and braiding	M	B	Rope making for tying purposes, threads woven for plough-man's whip, strap for fastening a load.
76	*Vepris dainelli* (Pici Serm) Kokwaro (Rutaceae)	Kooralla a	T	Stem and branches	Fresh and dried	Splitting and carving	M	NW	House construction, fencing, roof ceiling, and to make seats (three legs), to make traditional musical instruments "kabalaa", plough, "hallaaza" and tools handles
77	*Vernonia amygdalina* L. (Asteraceae)	Eebicha	T	Leaf	Fresh	Stripped off leaves and pounding	F	B	Cleaning clay pots to make local beverage fresh lea grinded and sprinkled about the home believed to avoid bad occurrence
78	*Vernonia auriculifera* Heirn (Asteraceae)	Reejjii	S	Whole part and flower	Fresh and dried	Planting in line	M and F	B	Planting inline around home garden to make life fence and bees use its flower during dry seasons and for reinforcing beams for hat and fence constructions, less durable, not preferred much.
79	*Zehneria scabra* (L. f.) Sond. (Cucurbitaceae)	alolaa fitii	C	Stem	Fresh	Crushing leaf	F	NW	Leaves used for washing dishes and when giving birth the delivering mother's body washed by this plant's leaves

Appendix 2: Plalant species collection sites (kebeles) in which particular species are (are) reported for material culture and from where they were collected for identification. KEY: 1= Tamegni Awarie, 2= Ulule harchasa, 3=Chiba Michael, 4= Koma Ketara, 5= Bedi Michael, 6= Koji Chefa, 7= Liemu Dima, 8=Bekoji Negeso, 9=Liemu Burkitu, 10= Koji Kaka. NB: These selected study sites are located in various geographical cordons (locations) and in different altitudinal ranges (Table 1).

S. NO	Scientific name of Plant species	Number of Material cultures reported from	Kebele in which they found/ reported	Field collection codes:
1	*Olea europaea* Mill.	14	1, 3, 4, 5, 6, 9	PSP. 18
2	*Arundinaria alpina* K. Schun	13	3, 4 & 5	PSP. 6
3	*Phoenix reclinata* Jacq.	13	2, 3, 4, 6, 8	PSP. 22
4	*Eucalyptus globulus* Labill.	10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 2
5	*Erythrina brucei* Schweinf.	9	3, 4, 5, 6, 7	PSP. 33
6	*Clausena anisata (*Willd.) Benth.	8	1, 2, 4, 8	PSP. 8
7	*Croton macrostachys* Del.	8	3 & 4	PSP. 9
8	*Eucalyptus camaldulensis* Dehn.	8	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 68
9	*Hagenia abyssinica (Bruce)* J.F. Gmel.	7	3, 4, 5, 6, 7, 8	PSP. 5
10	*Pennisetum schimperi* A. Rich.	7	1, 2, 3, 4, 6	PSP. 27
11	*Podocarpus falcatus (*Thunb.)Mirb.	7	1, 2, 3, 4, 6	PSP. 25
12	*Schefflera volkensii* Harms.	7	2, 4, 5, 6, 7, 9	PSP. 43
13	*Vepris dainelli* (Pici Serm)Kokwaro	7	5, 6, 7, 9	PSP. 67
14	*Acacia abyssinica* Hochst ex. Benth.	6	1, 2, 3, 4 & 7	PSP. 16
15	*Juniperus procera* Hochst. ex.. Arich	6	1, 4, 5, 6, 8 & 10	PSP. 13
16	*Lagenaria siceraria (Molina) Standl*	6	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 12
17	*Olea capensis* (Knobl.);Gilg.& Schellenb.	6	3 & 5	PSP. 75
18	*Oxytenanthera abyssinica,* (A. Rich) Munro	6	No life specimen found in the study area	PSP. 21
19	*Prunus africana* (Hock. F.) Kalkman	6	3 & 4	PSP. 40
20	*Rhus vulgaris* Meikle	6	2, 3 & 5	PSP. 1
21	*Allophylus abyssinicus* (Hochst.) Radlk.	5	3,4, 5, 7 & 8	PSP. 72

Appendix 2 continued…

22	*Celtis africana* Burm. f.	5	1, 3, 5, & 6	PSP. 36
23	*Ensete ventricosum* Welw.	5	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 19
24	*Galiniera saxifraga* (Hochst.) Bridson	5	4 & 5	PSP. 77
25	*Nuxia congesta* R. Br. Ex Fresen	5	2, 3, 4, 5 & 9	PSP. 63
26	*Olinia rochetiana* Gilg.	5	2, 3, 4, 5 & 8	PSP. 78
27	*Stephania abyssinica* (Quart.-Dill. & A. Rich.) Walp.	5	1, 2, 3, 5, 6, 7 & 8	PSP. 34
28	*Syzygium guineense* (Willd.)	5	2 & 3	PSP. 41
29	*Calpurnia aurea* (Ait.) Benth.	4	1, 2, 4, 6, 7 & 9	PSP. 10
30	*Carissa spinarum* L.	4	1, 2, 4, & 7	PSP. 7
31	*Cassipourea malosana (*Baker	4	4 & 5	PSP. 39
32	*Cordia africana Lam.*	4	3, 4, 5 & 6	PSP. 54
33	*Ekebergia capensis* Sparrmam	4	3 & 5	PSP. 56
34	*Ficus vasta* Forssk	4	1	PSP. 50
35	*Grewia mollis* A. Juss.	4	Reported in all kebeles	PSP. 77
36	*Maesa lanceolata* Forssk.	4	3, 4, 5 & 7	PSP. 69
37	*Buddleja polystachya* Fres	4	3, 5, 6 & 8	PSP. 68
38	*Cyperus papyrus* L.	3	6, 7 & 9	PSP. 23
39	*Clematis longicauda* Steud ex A.Rich	3	1, 2, 3, 4, 5, 6, 8, 9 & 10	PSP. 32
40	*Gossypium hirsutum* L.	1	No life specimen found	PSP. 11
41	*Clematis simensis* Fres	3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 48
42	*Brassica integrifolia* (West.) Rupr.	3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 35
43	*Gnidia lamprantha* Gilg.	3	3, 4, 5 & 8	PSP. 69
44	*Lantana trifolia* L.	3	1, 3, 4, 6, 7, 8 & 10	PSP. 20
45	*Justicia schimperiana (*Hochst. Ex Nees) T. Anderson	3	1, 3, 4 & 6	PSP. 52
46	*Myrica salicifolia* Hochst. ex A. Rich	3	4 & 5	PSP. 71
47	*Myrsine africana* L.	3	1, 3, 4, 5, 6 & 8	PSP. 44
48	*Pittosporum viridiflorum* Sims.	3	3, 5, 6 & 7	PSP. 64
49	*Myrsine melanophloeos* (Hochst. ex DC)Mez	3	2, 3, 4, 5 & 7	PSP. 45
50	*Rubus steudneri* Schweinf.	3	4, 8 & 9	PSP. 66

Appendix 2 continued…

51	*Rhamnus prinoides* L'Hér	3	1, 2, 3, 4, 5, 6, 7 & 8	PSP. 14
52	*Schefflera abyssinica* (Hochst. ex A.Rich) Harms.	3	4 & 5	PSP. 76
53	*Urtica simensis* Hochst. ex Steud	3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 49
54	*Vernonia auriculifera* Heirn	3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 59
55	*Capparis tomentosa* Lam.	2	1, 2, 3, 4, 5, 8 & 9	PSP. 15
56	*Discopodium penninervium* Hochst.	2	2, 3, 4, 6 & 8	PSP. 26
57	*Osyris wightiana* Wall.ex Wight	2	2, 3, 4 & 7	PSP. 79
58	*Dombeya torrida (*J.F. Gmel.)P.Bamps.	2	1, 2, 4 & 6	PSP. 73
59	*Dovyalis abyssinica* (A.Rich) Warburg.	2	2, 3, 4 & 6	PSP. 63
60	*Ehretia cymosa* Thonn.	2	4	PSP. 42
61	*Erica arborea* L.	2	8, 9 & 10	PSP. 61
62	*Hordeum vulgare* L.	2	2, 3, 4, 5, 6, 8 & 9	PSP. 53
63	*Hypericum revolutum* Vahl	2	3, 5, 6 & 7	PSP. 31
64	*Linum usitatissimum* L	2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 51
65	*Ricinus communis* L.	2	1, 2, 3, 4, 5, 7, 8 & 10	PSP. 28
66	*Ruta chalepensis* L.	2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 29
67	*Rytigynia neglecta* (Hiern.)Robyns	2	3, 4, 5 & 7	PSP. 74
68	*Satureja* species	2	2, 5, 7, 9 & 10	PSP. 60
69	*Teclea nobilis* Del.	2	4 & 6	PSP. 38
70	*Trichilia dregeana* (Forsk.)	2	2,4 & 7	PSP. 37
71	*Urera hypselodendron* (Hochst ex A Rich)	2	7, 8 & 9	PSP. 70
72	*Vernonia amygdalina* L.	2	4, 7 & 8	PSP. 24
73	*Eragrostis tef*	2	1, 2, 3 & 4	PSP. 55
74	*Barbeya oleoides* Schweinf.	1	4, 6,7, 8 & 10	PSP. 30
75	*Bidens borianiana* Sch.	1	1, 2, 3, 4, 5, 6, & 8	PSP.46
76	*Cynodon dactylon* (L.) Pers	1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	PSP. 17
77	*Leonotis ocymifolia* (L.) R. Br.	1	2, 3, & 5	PSP. 44
78	*Solanum incanum* L	1	1, 2, 3, 5, 6, 8 & 10	PSP. 57
79	*Zeneria scabra* (L. f.) Sond.	1	1, 2 & 3	PSP. 47

Appendix 3: Lists of Informants in the study area (information on their sex, age, marital status & occupation) key to abbreviations: Sex (M-male, F-female), Educational status (Te=traditional education, Me=modern education), Marital status (Md-maried, Si-single, Di-divorced, Wi-widowed) and the "sign * as superscript" at the top of informants' name indicate the key informants. NoSpc=No of species cited, NoPMCc= No of plant material culture cited, PmMC= Processing method of material culture

No	Name of informants	Sex	Age	Marital status	Educational status	Occupation	Religions:	No Spc	NoPMCc	PmMC	Study-area (kebele)
1	Abdi Ejerssa*	M	56	Md	Te	Farming	Protestant	49	29	24	Koji Kaka
2	Abdulmalik Hajinur	M	47	Md	Me	Farming	Muslim	46	21	23	Tamegni Awarie
3	Abdulshukir Abdela*	M	32	Md	Me	DA(development agent)	Muslim	29	11	11	Ulule harchasa
4	Abdulshukur Abdela	M	54	M d	Te	Farming	Muslim	50	23	23	Chiba Michael
5	Abdurazak Shune	M	42	Md	Te	Farming	Muslim	40	24	20	Koji Chefa
6	Adem Jibril*	M	61	Md	Te	Farming	Muslim	45	28	20	Tamegni Awarie
7	Ahmad Husen	M	44	Md	Me	Farming	Muslim	45	18	22	Koma Ketara
8	Alemu Rebisisa*	M	32	Md	Me	Masonry	Orthodox	30	13	11	Bekoji Negeso
9	Ansha Abdela*	F	39	Md	Te	House wise	Muslim	20	16	9	Liemu Dima
10	Arabe Aliyi	M	40	Md	Me	House wife	Muslim	36	19	18	Chiba Michael
11	Ararisa Miecha*	M	53	Md	Te	Farming	Protestant	48	21	23	Koji Kaka
12	Asefa Mesfin	M	48	Md	Me	Farming	Orthodox	45	17	23	Liemu Dima
13	Ayano wako *	M	65	Md	Me	Clan leader	Orthodox	48	28	24	Bekoji Negeso
14	Ayantu Hordofa*	F	40	Di	Te	Local drink maker	Protestant	19	14	12	Koma Ketara
15	Ayelu Wakijira	F	43	Md	Me	House wife	Orthodox	21	21	12	Ulule harchasa
16	Bacha Nanecha*	M	62	Md	Te	Farming	Protestant	48	24	24	Liemu Dima
17	Bado Jiru	M	34	Md	Me	Farming	Orthodox	32	21	13	Liemu Burkitu
18	Bashadu Gemada*	F	39	Md	Te	Local drink maker	Orthodox	17	20	7	Liemu Dima
19	Bekele Gabissa	M	37	Md	Me	Farming	Orthodox	34	22	15	Bekoji Negeso
20	Bose Mohammed*	F	51	Md	Te	House wife	Muslim	53	21	13	Koji Chefa
21	Chala Kediro	M	37	Md	Me	Farming	Muslim	35	26	16	Koji Kaka

Appendix 3 continued…

22	Chaltu Lema	F	51	Md	Te	House wife	Orthodox	49	22	12	Koma Ketara
23	Dadi Gabissa	M	26	Si	Me	Farming	Orthodox	16	16	7	Chiba Michael
24	Dame Wayessa	M	49	Md	Te	Farming	Protestant	48	20	24	Liemu Burkitu
25	Daniel Melka	M	31	Si	Me	Farming	Orthodox	28	22	10	Ulule harchasa
26	Dayassa Feyissa	M	49	Md	Te	Farming	Orthodox	48	24	24	Koji Chefa
27	Dekeba Gadissa*	M	48	Md	Me	Farming	Protestant	47	25	24	Koji Kaka
28	Dereje Melka	M	50	Md	Te	Farming	Protestant	52	23	25	Koma Ketara
29	Dibaba Gudeta*	M	58	Md	Te	Farming	Orthodox	52	22	24	Chiba Michael
30	Dibaba Jiru	M	40	Md	Me	Farming	Orthodox	37	25	19	Bedi Michael
31	Dibaba Jote	M	42	Si	Me	Farming	Orthodox	41	19	20	Bekoji Negeso
32	Dinkitu Tufa	F	38	Md	Te	House wife	Protestant	13	27	11	Liemu Burkitu
33	Fatuma Bariso	F	44	Md	Te	House wife	Muslim	23	28	12	Koji Chefa
34	Fikadu Lencho*	M	58	Md	Me	Farming	Orthodox	51	25	24	Koji Kaka
35	Gachana Dirba*	M	29	Si	Me	Carpenter	Protestant	21	18	8	Koma Ketara
36	Gadefa Diro*	M	59	Md	Me	Farming	Orthodox	48	20	24	Ulule harchasa
37	Gadise Moti*	F	58	Md	Te	House wife	Orthodox	49	25	12	Tamegni Awarie
38	Geda Gosa	M	44	Md	Me	Farming	Protestant	46	18	22	Bedi Michael
39	Gelane Tafa*	F	56	Md	Te	House wife	Protestant	50	21	14	Liemu Dima
40	Gemechu Jima	M	35	Md	Me	Farming	Muslim	33	27	14	Liemu Burkitu
41	Gemedo Idris*	M	67	Md	Te	Farming	Muslim	51	26	24	Liemu Dima
42	Getu Seifu*	M	65	Md	Te	Farming	Orthodox	50	25	24	Bekoji Negeso
43	Giditu Qoricha*	F	68	Md	Te	House wife	Orthodox	22	23	12	Chiba Michael
44	Gishu Huluka*	F	29	Md	Me	Health extension	Orthodox	16	16	6	Bedi Michael
45	Gutema Shuguti	M	43	Md	Me	Farming	Orthodox	43	19	21	Koji Kaka
46	Hajihussen Mustefa	M	42	Md	Te	Farming	Muslim	42	29	20	Koji Chefa
47	Hassan Mako	M	70	Md	Te	Clan leader	Muslim	46	27	24	Ulule harchasa
48	Hirpho Gemechu	M	61	Md	Te	Clan leader	Muslim	47	28	24	Tamegni Awarie
49	Jalane Hajisultan*	F	35	Md	Me	House wife	Muslim	11	27	11	Liemu Burkitu
50	Jobir Hamda*	M	52	Md	Te	Farming	Muslim	47	28	24	Koma Ketara
51	Kaftamu Feyissa*	M	62	Md	Te	Farming	Protestant	49	18	24	Liemu Burkitu
52	Kedir Abubeker	M	48	Md	Te	Farming	Muslim	48	22	24	Koma Ketara

Appendix 3 continued…

53	Kemal Ibrahim*	M	40	Md	Me	Teacher	Protestant	38	24	19	Liemu Dima
54	Ketema Jajaro*	M	33	Md	Me	Kebele manager	Protestant	31	25	12	Tamegni Awarie
55	Kibu Dechassa	F	24	Md	Me	House wife	Orthodox	8	27	7	Bedi Michael
56	Lelisa Edae	M	51	Md	Te	Farming	Orthodox	50	23	24	Chiba Michael
57	Lomi Dekeba	F	46	Md	Me	House wife	Protestant	19	27	13	Koji Chefa
58	Mariama Fekensa	F	42	Md	Te	House wife	Muslim	21	25	20	Bekoji Negeso
59	Maskalu Amansisa	F	46	Md	Te	House wife	Orthodox	20	26	8	Koma Ketara
60	Matensa Soressa*	M	55	Md	Te	Farming	Orthodox	48	21	23	Liemu Dima
61	Medina Geleto*	F	42	Md	Me	House wife	Muslim	14	19	8	Bedi Michael
62	Mohammed Haji	M	29	Si	Me	Farming	Muslim	23	28	8	Ulule harchasa
63	Mohammed Tusa*	M	48	Md	Me	Farming	Muslim	47	31	24	Bedi Michael
64	Mohhamed Kemal*	M	69	Wi	Te	Religion leader	Muslim	36	24	23	Chiba Michael
65	Muhidin Dedefo	M	76	Si	Te	Farming	Muslim	49	21	24	Koji Kaka
66	Mulugeta Irko*	M	78	Md	Te	Farming	Protestant	53	24	24	Liemu Burkitu
67	Mustefa Jamal*	M	38	Md	Me	Kebele manager	Muslim	36	22	17	Tamegni Awarie
68	Muztefa Tusa	M	40	Md	Me	Farming	Muslim	39	23	19	Bedi Michael
69	Sa'ada Sufian	F	36	Md	Me	House wife	Muslim	13	31	7	Koji Chefa
70	Soressa Amansissa*	M	49	Md	Me	DA(development agent)	Orthodox	50	27	25	Bekoji Negeso
71	Suleman Jawaro	M	40	Md	Me	School guard	Muslim	38	21	19	Bedi Michael
72	Tadelu Batu*	F	60	Md	Te	Farming	Protestant	48	24	11	Ulule harchasa
73	Tadesse Badada	M	37	Md	Me	Farming	Protestant	34	28	16	Tamegni Awarie
74	Teka Dida	M	29	Si	Me	Farming	Orthodox	25	19	9	Liemu Burkitu
75	Teshome Hordofa*	M	43	Md	Te	Farming	Orthodox	43	19	21	Koji Chefa
76	Umar Kedir*	M	56	Md	Me	Farming	Muslim	51	21	24	Koji Kaka
77	Umar Tayir*	M	29	Si	Me	DA(development agent)	Muslim	27	27	9	Bekoji Negeso
78	Worku Tolassa	M	31	Md	Me	Farming	Orthodox	28	29	10	Ulule harchasa
79	Yusuf Hussen*	M	55	Md	Te	Farming	Muslim	47	29	24	Chiba Michael
80	Zerihun Gazimu*	M	43	Md	Te	Farming	Protestant	44	25	21	Tamegni Awarie

Appendix 4: Format for collecting ethnobotanical information (Checklist of semi-structured questions for interviewing informants)

I. Information on informants:

1. Date___/___/2015 locality (kebele)_____
2. Have you lived for more than 10 years in this kebele? Yes_____ No____
   Only respondents who lived in this particular area for decade or more will be considered.
3. Respondent's full name_____
   3.1. Sex____ Age____ Occupation_____ Language_____
   Marital status_____

   Educational status_____ Religion_____

II Ethnobotanical data

II. Data on lists of plant species material culture (MC) habits, part of the plant used, Indigenous knowledge or processing manner (PC), gender involved (WI) sex & age gap, current conservation status of plant and habitat (natural wild, cultivated or both)

1. Material culture (Botanical name and family, and habit of the plants were filled by the researcher)
   1.1. Traditional house constructions

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.2 Roof thatching

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.3 Brooms for cleaning purposes

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.4 Timber making for various functions

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.5 Fence posts; dry fencing, life fencing, byre and enclosure for cattle

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.6 Household objects including mortars and pestles and kitchen utensils used for cooking, eating, drinking, etc

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.7 Farm implements and any agricultural related practices like: farming, threshing, digging, etc

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.8 Tool handles

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.9 Rope, fiber for tying purposes

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.10 Tooth cleaning twigs & bathing brushes

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.11 Beehives making & beehive hanging purposes

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.12 Tools to make containers for milking & similar dairy products holds & cleaners

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.13 Ritual and cultural values (including: weeding, religious, mourning…etc)

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.14 walking/herding sticks, spear, bows, arrows, sword & weapons

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.15 plant spp. Used for: Foot-bridge, ladder, cart, torches, traps and any related functions

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.16 plants used to make traditional musical instruments

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.17 Bed and pillow making (and plant made mattress)

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.18 Plants used to make chicken nesting box

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.19 Plants used to make basketries & water bottle

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.20 Plants used to make ornaments, traditional tattoos/marks and decoration

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

1.21 List other cultural uses or function of plants in the community

Vo. No	Local name	Scientific name	Family	Habit	Part used	Processing manner	Who (Gender) involved in processing	Current conservation status

2. What is the current status of plant made material objects utilization of the community? (Increased, the same as before or decreased)_____

2.1 If decreased explain the factors _____

3. Which materials do you prefer more? Plant made traditional materials or synthetic plastics & metal made materials? Explain your reasons: _____

4. Is there any economic group/s that makes and provides material culture for the market to earn money? _____

5. How is the indigenous knowledge of material culture practice passed from elders to younger peoples in your locality? _____

5.1 What is the feeling of younger new generation to acquire this indigenous knowledge from the elders? _____

6. What are the main criteria to prefer one plant species from the other to make the same material culture? (E.g.to makes plough, yoke, tool handles, house constructions, etc).

_____

6.1 Based on your criteria show degree of preference (rank) plant species for the list of particular material given to you.

7. What are the major threats (pressures) of plants in your locality?

_____

7.1 Are there ways of preventing threats to the plant species in your local area? If yes please specify _____

8. Is there any traditional management and conservation practices of plants resources in your locality? If yes, please specify _____

Thank you