**ADDIS ABABA UNIVERSITY**

**SCHOOL OF GRAGUATE STUDIES**

**COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCE**

# Socio-Economic and Socio-Cultural Value of Highland bamboo (*Yushania alpina*) Plant and Its Contribution to Rural Livelihood in Banja District, Awi Zone Ethiopia

**Sirawdink Asfaw Mekonnen**

**A Thesis Submitted to the Department of Biology Presented in Partial Fulfillment of the Requirements for the Degree of Master of Science (Biology)**

**August 2017**

**Addis Ababa, Ethiopia**

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# APPROVAL SHEET I

# ADDIS ABABA UNIVERSITY

## SCHOOL OF GRADUATE STUDIES

This is to certify that the thesis prepared by Sirawdink Asfaw entitled: ***Socio-Economic and Socio-Cultural Value of Yushania alpina Plants and Its Contribution to Rural Livelihood in Banja Distract, Awie Zone Ethiopia*** and submitted in partial fulfillment of the requirements for the degree of Master of Science (Biology) compiles with the regulation of the University and meets the accepted standards with respect to originality and quality.

**Signed by the Examining Committee:**

**Examiner_____Signature_____Date___/___/___**

**Examiner_____Signature_____Date___/___/___**

**Advisor _____ Signature _____Date___/___/___**

**Department Head _____ Signature _____Date___/___/___**

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# ABSTRACT

**Socio-Economic and Socio-Cultural Value of-Highland Bamboo Plants and Its Contribution to Rural Livelihood in Banja Distract, Awie zone Ethiopia**

**Sirawdink Asfaw Mekonnen**

Addis Ababa University, 2017

*Bamboo forestry is being promoted to increase socio economic, socio cultural and also enhancing ecological benefits. The main reason of this study was to fill information gaps to characterize highland bamboo cultivating farmers' knowledge and further promote the processing, utilization and marketing. The main objective of this study was to promote highland bamboo sociocultural and socio-economic use of bamboo plant, and its contribution to the livelihood the people in Banja district, Awie Zone, Amhara regional state, Ethiopia. Three sample kebeles were identified based on the distance to the main road. Accordingly, KEBELEs 4kms, between 4 and 8 kms, and further 8 kms away from the main road were selected. A total of 270 (31.2% of the bamboo growers) households participated in this study. The households were selected on the basis of their wealth status. Thus, rich, medium and poor wealth categories were represented. Data collection involved field observation to farm level bamboo inventory. Interviews, Focus group discussion and questionnaire were the ethnobotanical tools used in this study. Bamboo inventory was conducted on 81 selected HHs from those households used for survey. Descriptive statistics were used to analyze the data. Three type of highland bamboo farmers' variety (TIKUR, KEY and ZEGER) were identified in the study area. The TIKUR farmers' variety was dominantly growing in the study area. The trend of bamboo plantation and harvesting was increasing through time. Sample HHs harvest bamboo an age 2-5 years and 12% of respondents had a trend of processing bamboo culms in to different product types and most of them are found in proximal KEBELE (5.6%). Although bamboo is not the main income source to the society, it contributes about 7.2% of the total HH income. The households categorized under poor wealth status benefit (13.2%) better from bamboo than the rich (10.3%) and medium (8.7%) wealth status category of the community. Similarly, female headed HHs (12.5%) benefit higher than the male headed HHs (10%). From this study it is concluded that bamboo cultivators prefer the TIKUR farmers' variety to plant than the KEY and ZEGER farmers' variety. The expansion of bamboo plantation has been increasing over the last five years. Farmers living close to the main road have better experience of planting and managing bamboo, processing bamboo Culm to other products and have gained better bamboo income than distant KEBELEs.*

Key words:- Livelihood , processing, marketing, farmers' variety, income generation

# TABLE OF CONTENTS

**Contents** **Pages**

LIST OF FIGURES ..... vii

LIST OF TABLES ..... viii

LIST OF APPENDICES ..... ix

ACRONYM ..... x

CHAPTER ONE ..... 1

1. INTRODUCTION ..... 1

1.1. Background ..... 1

1.2 Statement of the Problem ..... 3

1.3 Objectives of the Study ..... 4

1.3.1 General Objective ..... 4

1.3.2 Specific Objectives ..... 4

1.4 Research questions ..... 5

CHAPTER TWO ..... 6

2. Literature Review ..... 6

2.1. Bamboo Plant for Forestry System ..... 6

2.2 Botanical Description ..... 7

2.3 Bamboo Distribution, Resource Base and Natural Habitat ..... 9

2.4 Highland Bamboo Landraces and its Distribution in Ethiopia ..... 12

2.5. Contribution of Bamboo for Livelihood Diversification ..... 12

2.5.1 Income Generation ..... 13

2.5.2. For Making Traditional Materials ..... 13

2.5.3. Bamboo Used as Food ..... 14

2.5.4. Bamboo for Charcoal Making ..... 14
2.5.5 Bamboo for Charcoal Making ..... 15
2.5.5. The Socio-cultural Value of Bamboo ..... 15
2.5.6. Highland Bamboo (Yushania alpina) for Cultural Environmental Conservation ..... 16
CHAPTER THREE ..... 18
3. MATERIALS AND METHODS ..... 18
3.1 Description of the Study Area ..... 18
3.1.1 Geographical Location ..... 18
3.1.2 Topography and Soil ..... 19
3.1.3 Climate ..... 19
3.1.4 Land Use ..... 19
3.1.5. Socio-economical Activity ..... 20
3.2. Methods ..... 20
3.2.1. Study Site Selection ..... 20
3.2.2. Key Informant and Focus Group Selection ..... 21
3.2.3. Households (General informant) Selection ..... 22
3.2.4 Data Collection Tools ..... 23
3.2.5 Secondary Data Collection ..... 24
3.2.6 Methods of Data Analysis ..... 24
CHAPTER FOUR ..... 25
4. RESULTS ..... 25
4.1. Household Characteristics and Economic Condition ..... 25
4.1.1. Demographic/Household Characteristics ..... 25

4.1.2 Economic Characteristics of Households ..... 26
4.2. Highland Bamboo Farmers' Variety ..... 28
4.3. Farmers' Knowledge on Bamboo Utilization, Processing and Marketing ..... 29
4.3.1. Utilization of Bamboo ..... 29
4.3.2. Bamboo Processing ..... 31
4.3.3 Marketing ..... 33
4.4 Income Obtained from Different Livelihood Activities ..... 33
4.4.1 Bamboo Income Share of Households ..... 35
4.5 Socio Cultural Activity of Bamboo ..... 36
4.6 Traditional Environmental Conservation of Bamboo ..... 38
CHAPTER FIVE ..... 39
5. Discussion and Recommendation ..... 39
5.1 Discussion ..... 39
5.1.1 Highland Bamboo Farmers' Variety ..... 39
5.1.2. Farmers Knowledge on Utilization, processing and marketing of Highland Bamboo ..... 40
5.1.3. Contribution of Bamboo to Households Livelihood ..... 41
5.1.4. Socio-cultural value of high land bamboo ..... 41
5.1.5. Traditional Environmental Conservation of Bamboo ..... 42
5.2 Conclusion and Recommendation ..... 43
5.2.1 Conclusion ..... 43
5.2.2 Recommendation ..... 45
REFERENCE ..... 46
Appendices ..... 53

# LIST OF FIGURES

Pages

Figure 1: Geographical location map of the study area. Source (Banja Woreda office of Agriculture) ..... 18

Figure 2: Type of three local highland bamboo farmers' variety (a) ZEGER, (b) KEYE and (c) TIKUR ..... 28

Figure 3: Traditional bamboo products Processing ..... 32

Figure 4: Contribution of different livelihood activities to households income in the study site ..... 34

# LIST OF TABLES

Pages

Table 1: Wealth Ranking Criteria Used For Classification of HHS ..... 22

Table 2: Household characteristics of respondents at study are ( N=270) ..... 26

Table 3: Households landholding and means of getting land (N= 270) ..... 27

Table 4: Number of livestock population owned by respondent households (N=270) in the study kebeles across wealth status. ..... 27

Table 5: High land bamboo farmers' variety inventoried HHs((N=81). ..... 29

Table 6: Lands Covered by Highland Bamboo Land Race at Different niches HHs (N=270)..... 29

Table 7: Bamboo utilization trends during the last 5 years in the kebeles (N=270)..... 30

Table 8: farmers knowledge on bamboo harvesting and age for harvesting (n=270) ..... 31

Table 9: Household close to road side have shown a relatively better activity on bamboo processing HHs( N=270) ..... 32

Table 10: Market availability of high land bamboo with percentage of HHs(N=270)..... 33

Table 11: The trend of income obtained from different sources by sampled HHs from 2017-2018 (N=270) ..... 35

Table 12: Cultural important of bamboo to local communities by percent of frequency (n =270)..... 37

Table 13: Environmental conservation of bamboo to local communities by percentage of frequency [ n =270]..... 38

# LIST OF APPENDICES

Pages

Appendix 1: Randomly selected bamboo growing KEBELEs and GOTTS ..... 53

Appendix 2: Key Informants selected from CHEWSSA KEBELE ..... 55

Appendix 3: Selected key information for SURTA KEBELE ..... 56

Appendix 4: Selected key informant for AKENAGIFI KEBELE ..... 57

Appendix 5: Total population number of sample KEBELEs and number of bamboo planters ..... 59

Appendix 6: Checklist for focus group discussion ..... 60

Appendix 7: Checklist for key information ..... 61

Appendix 8: Question for household interview ..... 62

Appendix 9: Bamboo inventory data collection sheet ..... 74

# ACRONYM

| | |
|---|---|
| BOA | Bureau of Agriculture |
| BWADO | Banja Woreda office of Agriculture development organization |
| DAS | Development Agents |
| EABP | Eastern Africa Bamboo project |
| FA O | Food and Agriculture Organization of the United Nation |
| FGDs | Focus Group Discussions |
| GO | Governmental Organization |
| GOs | Governmental Organizations |
| Ha | Hectare |
| HHs | Households |
| HLB | High Land Bamboo |
| INBAR | International Network for Bamboo and Rattan |
| KEFRI | Kenya Forest Research Institute. |
| KFRIP | Karala Forest Research Institute Peach |
| KI | Key Informant |
| Km | Kilometer |
| LHLBVs | Local high land bamboo varieties |
| Max | Maximum |
| Min | Minimum |
| NGOs | Non-Governmental Organizations |
| UNIDO | United nation Industrial Development Organization |

# CHAPTER ONE

# 1. INTRODUCTION

## 1.1. Background

.Many of the most useful bamboo species can occupy much the same ecological niche as trees are well suited for agroforestry. Among the woody perennial grass species bamboo is a uniquely suited plant to agroforestry (Diver, 2001). As reported by Maxim et al. (2005) and FAO (2007), bamboo is an extremely diverse plant which easily adapts to different climatic and soil conditions. It is an extremely versatile strong renewable and environment friendly plant species. It grows on marginal and degraded lands elevated zgrounds along field bounds and river banks Maxim et al. (2005) and FAO (2007)In bamboo based agroforestry system other woody and non-woody plant species are intercropped as cash crops. In this system bamboo also generates the medium term income while cash crops can generate income in the short term (Maxim et al. (2005) and FAO (2007)). Bamboo provides more than 1500 uses e.g. from food, construction material, housing and bridges to household articles and use in agriculture, fisheries, transportation and in village industry (Rao, 2004; Nath et al., 2009). This makes bamboo one of the non-timber forest products which contribute to the livelihood of millions of the rural people in many countries including Ethiopia, solving problems of housing and furniture and providing job opportunities. The contribution of bamboo depends on the type of species involved in a given agroforestry. For example Behari (2001) developed seven successful agroforestry models with three bamboo species (*Bambusa bambos* Druce, *B nutans* Wall. ex Munro and *B. stricta* Roxb.) by intercropping bamboo with soybean (*Glycine max* (L.) Merr), Niger (Guizotia abyssinica (L.f.) Cass.), moong (*Phaseolus aureus* Roxb.), wheat (*Triticum aestivum* L.), urad (*Phaseolus mungo* L.) pigeon pea (*Cajanu.s cajan* (L.) Druce) and mustard (*Brassica campestris* Hegetschw) to restore degraded agricultural lands. The arrangement of the models was: Bamboo-Niger, Bamboo-Bamboo-mustard Bamboo-wheat, Bamboo-urad, Bamboo-Pigeon pea and Bamboo-mustard.

In Ethiopia there is a relatively good experience in growing highland bamboo by individual farmers and rural communities though information is lacking on variety types, and its management (LUSO, 1997). With regard to research undertakings on highland bamboo there is limited effort except on: suitability of highland bamboo for oriented particle board (Seyoum, 2005; Seyoum et al., 2007 ); vegetative propagation of highland bamboo (Tesfaye et al. 2005); Ecological and resource management aspects, Biomass and nutrient distribution of highland bamboo (Kassahun, 2000; Kassahun, 2001; Kassahun et al., 2003 ; Kassahun et al., 2005); economic and environmental contribution of highland bamboo (Yenesew, 2012); growing and biomass of Arundinaria alpina as affected by farmers' variety, environment and silvicultured management (Yigardu, 2012).

In Awi zone and the Amhara National Regional State, bamboo is an integral part of the day to day life of many households and it is source of income for many farmers and urban inhabitants engaged in off-farm activities (BoA, 2012). Highland bamboo is widely grown in the traditional agroforestry systems in many districts of the Awi zone at different niches including backyard, farm boundary and gully sides, woodlots, and around the river banks (personal observation). In this zone, highland bamboo is well recognized by farmers and it is common to see bamboo clumps and small plantations in most of the homesteads and farmers making some local furniture and other agricultural equipment using mostly bamboo (EABP, 2009; BoA, 2012). Despite the pervasive role that bamboo plays in the livelihood of the local community, less attention has been given in the research particularly with regard to its socioeconomic and cultural value.

There are still some limitations on farmers' knowledge with respect to bamboo socioeconomic and cultural value to local community. There is also lack of empirical information or evidence on the contribution of bamboo to the livelihoods of local communities. Therefore, this study was carried out to fill information gaps with regard to high land bamboo economic and cultural value to local community.

## 1.2 Statement of the Problem

Bamboo growing in the study area is an age old tradition and the plant is found in agricultural and grazing landscape. The long time intimacy to the plant is an opportunity to obtain useful information about the plant with respect to livelihood importance and its contribution to furnish the environment. However, it has not been supported by improved technological packages. As the researcher observation, growing of bamboo is not given due attention in the study area. There is no regular follow up of bamboo triggering to improve its productivity. On the other hand, no documentation is found about highland bamboo of the Awie zone. Generally, no empirical information or evidence on the contribution bamboo to the livelihoods of local communities, cultural and environmental conservation was known from the area. Though, local communities use bamboo resources for various purposes such as fencing basketry, house construction, cash income, etc., limited information has been documented with respect to the contribution of bamboo to the livelihood. Thus lack of motivation to advance the planting and conservation of this useful plant resource. This study therefore designed to assess perception of indigenous knowledge on bamboo varieties, marketing, processing and utilization of bamboo, bamboo products and the overall contribution of bamboo to the livelihood, in addition to cultural and environmental conservation for the local community.

## 1.3 Objectives of the Study

### 1.3.1 General Objective

General objective of this study is to assess socioeconomic, sociocultural values of Yushania alpina plant together with its contribution to rural livelihood improvement of the local community in Banja District, Awi Zone.

### 1.3.2 Specific Objectives

1. To identify highland bamboo local landraces or farmers' varieties used in the traditional plantation practices based on farmers perception.

2. To assess farmers' knowledge on processing, utilization and marketing of highland bamboo.

3. To estimate the livelihood contribution of highland bamboo and compare with other income in local community.

4. To describes the contribution of highland bamboo for cultural use and traditional environmental conservation in Awi zone.

## 1.4 Research questions

So as to recommend some sort of possible solutions for the problems and to address the above issues the following basic questions were assessed in the study

- Do bamboo growers in Banja District Awi zone identify different varieties of bamboo?
- How is the perception of farmers on the morphological difference among highland bamboo farmers' varieties used in the traditional plantation practice?
- Is there any difference among different highland bamboo farmers' varieties with regard to requirements processing and utilization? And do really farmers perceive differences in these variables?
- How does highland bamboo contribute to livelihood of local community?
- How is the processing, utilization and marketing of bamboo plants?
- How do the contribution of high land bamboo for cultural and environmental conservation?

# CHAPTER TWO

# 2. Literature Review

## 2.1. Bamboo Plant for Forestry System

Forestry is defined as dynamic, ecologically based, natural resources that through the interaction of trees in farmland and rangeland diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels (Leakey,1996). Trees play an important role in ecosystem in all terrestrial ecosystems and provide a range of products and services to rural and urban people. Farmers have practiced agro forestry since ancient times (Salil, 2008). A variety of trees and shrubs are identified as fertilizer trees for land regeneration , soil health and food security; fruit tree for nutrition trees to cure diseases and trees for minor products viz gums, resins or latex products. Many of these trees are multipurpose providing a range of benefits (Salil, 2008).Like other agro forestry trees many of the most useful bamboo species occupy much the same ecological niche as trees and are well suited for agro forestry for its ecological adaptability, and wide range of uses ,bamboo can be an essential component of many agro forestry systems.

Globally bamboo grows on different niches like riverbanks dam sites, lakes and ponds boundaries to bind and protect the soil from erosion along boundaries of farms as wind barrier and shelterbelt homesteads and farmlands banks of water bodies and in degraded lands (Rao, 2004) in north east India in the initial years farmers grow crop along with bamboo species to reclaim the degraded land and once the stand is established the farmers manage the farm with pure bamboo stand for collection of bamboo shoots as food (jha and lainunmawia, 2004). Agroforestry system with bamboo species consists to a sustainable land use option in different countries like the doge caocatchment in Northern Vietnam (Nguyen,2004).seshdri(1985) observed that growing of soybean as an intercrop of bamboo during the first six years is technically feasible and economically viabilities reported that in keralal (southern India), bamboo (Bamusa bamboos) holds the second position in termes of profitably (benefit-cost ratio)among the cropping groups

mixed cropping home gardens (krishnankutty,2004).Intercropping of bamboo in fruit orchard is common in thailand,in tea estates in Bangladesh and a large number of mushrooms are also raised in china in bamboo stands (Rao,2004). Bamboos of different heights and growth characters may be used as windbreaks and thereby protect gardens and other agricultural system from the demining effect of either winds or the frosts that roll of the hillside (Nath *et at.,2009*) Bamboo can also play a primary role in providing forage to livestock during the dry season. cooper (2007) reported as bamboo traditional use as animal in Japan. . Miah and hussain (2001) in Bangladesh revealed that animal can consume both twigs and leaf of bamboo. Leaf and small twinges of high land bamboo are also used for animals feed during the dry season. When there is a shortage of feed (Yeshambel et al., 2011).

## 2.2 Botanical Description

Bamboo comprises more than 1500 species 90 genera in the distributed throughout the world. Bamboo are perennial woody Grasses of plant species belonging to the family poaceae (Gramineae) and subfamily Bambusoideae (ohrnberger, 1999; Rao, 2004 ;Zehui, 2007).

The bamboo plant is made up of underground axis which comprises rhizomes, Root, buds and above ground axis comprise stems, branches and foliages (KERFI, 2007) .the folaceousi organ consists of the Culm sheath which covers the young shoot during development and it gives protection from mechanical damages and keeps the high humidity to provide a suitable environment for the rapid height growth. The foliage leaf which stares to grow when the young branches cease to develop is composed of a leaf blade and a leaf sheath (Zehui, 2007). The branches are formed from the buds that develop alternatively on the node when the young Culm reaches a certain height, the number of branches on each node varies from genera to genera. forexample ,the species belonging to genus sasa ; sasamorpha, possess one branch on each nodes ,while genus arundinaria ,semiaarundinaria has three and more branches (Zehui ; 2007). the cull is the most utilized part of the bamboo plant .it is cylindrical and is divided into section of nods. As bamboo gets mature, it lignifies and become harder and stronger (EABP, 2009 ).

Most bamboo plants flowers only once in their lifetime and die soon after ( LUSO, 1997; kassahun, 2003 ). On the bases of flowering behaviors bamboos are categorized in to two groups ;(1) those that flower gregariously and periodically, for which the whole plantation will die off after flowering in a few years; and (2) those that flower irregularly or sporadically ,for which only the flowering individuals die off and the whole plantation keep alive (Zehui, 2007 ). Bamboo can emerge from germinating seeds if the site is not severely disturbed by detrimental factors such as rodents ,fire etc. These Phenomena were observed in the lowland bamboo forest of pawe, south western Ethiopia where the whole forest flowered and died (kassahun, 2003).This is how every not always the same for all bamboo space (LUSO, 1997).As noted by Yigardu (2012) farmers in north western Ethiopia (choke mountain) harvest culms immediately after flowering so as to get new shoots from the rhizome during the next rainy season.

Bamboo rhizome is a modified stem in bamboo stem in bamboo with short internodes that growth horizontality below ground ,commonly stories food materials ,and produce root ,scale leaves ,and suckers irregular along its length and not just at nodes ( Bystriakova et al., 2004). There are two main bamboo rhizomes systems which are known as a lemptomorph (monopodium) and pachymorph (sympodal).The former is giving raise to a single stemmed clumps apart from each other and the latter develops into group of clustered culms of clumps, but there are some kinds of bamboos which have both characteristics of rhizome branching and are referred to as amphipodial (Liesse,1985; KEFRI,2007). The total length of monopodium bamboos of rhizome varies from 50- 100 km/ha(Lies, 1985) and they are usually found in temperate regions and tend to be invasive while sympodal are predominant in tropics ,, and generally more productive than monopodium species (FAO, 2007; FOA, 2009 ). KEFRI(2007 ) that reported that buds on the rhizomes may develop into shoot that emerge from the ground and elongate vertically into a main stem or Culm until it attains its full height and completes its growth in one growing season .Though the life of a Culm varies from species to species it becomes fully mature after 3 or 4 years. As mature culms grow older ,they deteriorate and eventually die and rot. There is a controversial branching pattern of rhizome of highland bamboo from Ethiopia is sympodal ( Yigardu, 2012;

Kigmo, 2007) while pattern of high land bamboo monopodium( Kassahun et at., 2005). reported as monopodium.

Based on the difference of the origin and the function the root of bamboo, the root systems could be classified in to three types; 1) the culm roots developing from the nodes of the basal part are responsible for anchoring the developing shoot and the mature Culm later, and provide nutrients for shoot growth and the Culm development; 2) the rhizome root developing from the nodes of the rhizome function mainly absorbing water and nutrients and 3) for some species the aerial root develop from nodal part of aerial Culm or from the basal part of the branches (Zehui, 2007).

Bamboo is one of the fastest growing plant species with a growth rate ranging from 30-100 cm per day in one growing season and attains maximum height of more than 36 m with a diameter of1-30 cm (diver,2001;nath et al., 2009). Bamboo get mature ,strong and ready for utilization after 3 to 4 year (Kassahun ,2003;KEFRI, 2007).The new bamboo shoot are produced every rains season and attain full height and diameter in about 3 months (kassahun,2003;KEFRI,2007). As mature culms grow older, they deteriorate and eventually die and rot .the life of bamboo plant is however sustained by the new shoot and culms (Ensermu et at., 2000) . The growth rate of bamboo varies with species variation and in some species bamboo culm grows several meters , in others a few centimeters (zehui,2007).

## 2.3 Bamboo Distribution, Resource Base and Natural Habitat

Bamboo vegetation covering an estimated area of 36 million ha has is naturally distributed in the tropical and subtropical belt between approximately 46 north and 47 south latitude , and is commonly found in Africa ,Asia and central and south America .some space also grow successfully in mild temperate zones in Europe and North America. Bamboo is an extremely diverse plant, which easily adapts to different climatic and soil conditions (Rao, 2000;Maxim et al., 2005). Because of its diverse usage and the high ecological and economic values bamboo was planted at large scale and the artificial bamboo forest was developed since the $20^{th}$ century worldwide (Zehui, 2007). The total forest area on the land surface decreased from 25% to 17% in a recent years and on the

contrary the area of bamboo forest increasingly expands, at a steady annual rate 3% ((Fungal et al. 2004 as cited in Zehui, 2007). In terms of bamboo diversity Asia stands first and followed by Latin America and Africa in second and third place respectively. In terms of area coverage about 65% grows in Asia, 28% in America and 7% in Africa (FAO, 2007) During the last 20 years bamboo was introduced to Europe, North America and Australia making the global distribution even (Zehui, 2007).

The major bamboo producing countries in are India (having almost 11.4 million hectares) and China (with over 5.4 million hectares) followed by Indonesia (2 million hectares) and the Lao people's Democratic Republic (With 1.6 million hectares) (FAO ,2007), in Latin America , there are at least ten countries have significant bamboo resources of these, Brazil, Chile, Colombia ,Ecuador, Mexioc have the richest bamboo recourse (FAO, 2007).

Africa has only 45 species and 11 genera occurring on 1.5 million ha. Of these, approximately 40 species are mainly found in Madagascar While the remaining 3 are in mainland Africa (Kigmo, 1988; Ohrnberger;1999; Tesfaye, 2007). Another report by FAO (2007) shows that six African countries (Ethiopia, Kenya, Nigeria, Uganda, the United Republic of Tanzania and Zimbabwe) have in total over 2.7 million hectares of bamboo and regarding diversity of bamboo in the region a little higher than 13 genera and less than 40 species are reported in the countries.

The highland bamboo can grow at altitudes ranging from 2200 to 3200m. a.s.I. and average annual temperatures of 10 -20$^0$ C with annual rain fall of 1700-2200 mm (LUSO, 1997). According to Phillips (1995), the highland bamboo is distributed in Cameroon (Mt. Cameroon), Zaire (Kivu), Rwanda, Burundi , the Sudan and the mountains of Uganda Kenya, Tanzania and Malawi (Nyika plateau). The African alpine bamboo (Arundinaria alpina k. Schumann) and the monotypic genus lowland bamboo Oxytenanthera abyssinica (A. Richard)Munro are the two bamboo species indigenous to Ethiopia and endemic to Africa (Kassahun,2003; Tesfaye, 2007). The existing information about the distribution and coverage of bamboo in Ethiopia is rather limited and varied .There is a generation that Ethiopia has about 1 million ha of highland and

lowland bamboos (LUSO, 1997 and Kassahun , 2003), the latter is estimated to be more than 800,000ha out of which only 480,510 ha was mapped. Regarding the highland bamboo resource base the total mapped naturally grown highland bamboo is 129,626 ha and the area planted by farmers is estimated to be about 19,00 ha, together, summing up to 148,626 ha (FAO and INBAR, 2005). Thus 67% of African bamboo resources and more than 7% of the world total are found in Ethiopia. However the country has ample resource though it is not scientifically managed and utilized.

In Ethiopia high land bamboo is distributed in Agaro, Bore, Ambo-Shenen, Bale, Gera, Jibat Mountain, Harena Forest, Degaga Munesa Shashemene Enterprise in Oromiya National Regional State; Awi Zone in Amhara National Regional State; Awi Zone in Amhara National State ; Hagere selam

Ameya, Baha-Chapa, Bonga, Chincha, Gecha-Masha, Indibir, Indibir-Jembero and Jembero in SNNPR (Tesfaye, 2007; and EABP, 2009).

In the Amhara National Regional State 27 bamboo growing districts are reported are reported by BoA (2012) and cover about 27,390.59 ha (i.e, highland bamboo 7351.78 ha and lowland bamboo 20,038.81 ha). The high land bamboo is distributed in Guagusa Shikudad, Injibara Town Administration, Fagita Lekoma,Ankesha and Banja districts in Awi Zone; Sinan and Bibugni districts in East Gojjam Zone; Farta and Estie districts in south Gondor Zone;

Tarmaber (Debre Sina) in North Shoa; Sekela, Dega Damot and Quarit in west Gojjam Zon (Bereket, 2008; BoA,2012). Whereas the lowland bamboo is distributed in Jawi Guagusa and Ankesha in Awi Zone; quara, Metema, Tach Armachiho and Adiarkay in North Gondor Zone (Bereket, 2008).

## 2.4 Highland Bamboo Landraces and its Distribution in Ethiopia

The term farmers' variety refers to a local variety of a domesticated plant which has developed by adaptation to the natural and cultural environment in which it lives. It differs from a cultivar which has been selectively bred to confirm to a particular standard of characteristics. Negri et al. (2009) defined farmers' variety as a variable population which is identifiable and usually has local name years.

Highland bamboo farmers' variety mainly varying in their growth characteristics, morphological attributes and wood working properties are present in Ethiopia (LUSO, 1997) Near Masha, one of the bamboo growing areas in Ethiopia, there are two types of natural highland bamboo showing different colors of the culm (LUSO, 1997). Near Kosober, major portion of the stands (about 60%) have green color culms while minor portion (about 40%) have yellow culms (personal observation and discussion) The variation in wood working properties is also recognized by the local craftsmen who use culms to produce different bamboo products (SIM, 2002). and Yigardu (2012) reported four bamboo farmers' variety (locally known by the community as Wonde, Welele, Tifro and Enkotkot) in Choke Mountain, of East Gojam Zone which are differing in their morphological characteristics, utilization, Contribution of bamboo for livelihood diversification and management need from one another are recognized by the community.

## 2.5. Contribution of Bamboo for Livelihood Diversification

Bamboo provides different economical, ecological and social uses in areas where it naturally grows and established by man. The uses of bamboo make significant contribution to rural livelihood and employment (KEFRI, 2007). As reported by Rao (2004) and Nath et al., (2009), bamboo provides various uses such as food, construction materials, housing and bridges to household articles and use in agriculture, fisheries, transportation and in small scale/kitchen industry. Therefore, bamboo is one of the non timber forest products which contribute to the livelihood of millions of the rural poor in various countries. In Ethiopia, highland bamboo is used for fences, constructing of

propels, vessels for carrying and storing water, water pipes, splits for baskets, beehives, hats, mats, furniture, walking-sticks, flutes, household utensils, animal fodder and agricultural tools. Split bamboos, with edges trimmed sharp are used as raw meat cutters in areas where there are no knives available (Ensermu et al., 2000). The silica stored in the stem is used as a medicine for many diseases (INBAR, 2011). More importantly, market for bamboo culms and bamboo products has developed for long years in Awie zone of Amhara Region.

Many landless individuals buy bamboo from farmers and get engaged in producing mats, fence and furniture and they sell the products along the roadsides. For these households, highland bamboo is the major source of income**.**

### 2.5.1 Income Generation

Bamboo and its related industries provide income; food and housing to over 2.2 billion people worldwide (Cherla, 2008). FAO (2005) report reveals the investment return for a new bamboo plantation is 3-5 years thereby signifying that it is a critical element of an economy. In comparison with other forms of natural resources, investment in bamboo is highly profitable

### 2.5.2. For Making Traditional Materials

Bamboo is a major construction material in many countries particularly in rural areas. It can be used for construction of almost all parts of houses, including posts, roofs, walls, floors, beams trusses and hand fences and also it is used to produce mats, baskets, tools, handles, hats, traditional toys, musical instruments and furniture (FAO, 2007). For instance high land bamboo is used for build bamboo houses for residence and shade, construct frames of doors and windows construct, fences, make beehives and furniture (Enserm et al., 2000; EABP, 2009; INBAR, 2011).

High land bamboo culms in Awi Zone Amhara Region are used traditionally for construction of house, fences and beehives in the villages (Ensermu et al., 2000). Many of the landless men buy bamboo from farmers and engage in producing mat chairs, sofas and baskets that they produce and sell by the roadside and for these households bamboo

is the major source of income (Ensermu et al., 2000; UNIDO, 2007; EABP, 2009). It also provides fodder for the livestock in the area of Awi (Yeshambel et al., 2011).

### 2.5.3. Bamboo Used as Food

The young bamboo stems (shoots) are used as food source and becoming more popular in different bamboo growing countries (FAO, 2007). Production of edible bamboo shoots is common in oriental countries especially China, Japan, Taiwan and Thailand (KEFRI, 2007; EABP, 2009). Many hotels and Asian restaurants serve bamboo shoots as vegetable dishes. Shoots of high land bamboo are consumed by communities around Mount Elgon in Uganda and, to a lesser extent in Kenya. In other countries of Africa, there are markets for bamboo shoots and some of the recently introduced bamboo species in East Africa produce good quality shoots (KEFRI, 2007; EABP, 2009).

Bamboo shoots contain several nutritive substances that human body needs such as carbohydrate, protein, fat, fiber and other inorganic nutritious natural food (Zehui, 2007). It also contained both macro and micro nutrients including calcium, Iron, magnesium, phosphorus, potassium (Pratima and Lakshmi, 2008)

### 2.5.4. Bamboo for Charcoal Making

The calorific value of bamboo charcoal is almost half that of oil of the same weight and the absorption capacity of excess moisture is six times that of wood charcoal of the same weight (FAO, 2007). Bamboo charcoal is traditionally used as a substitute for wood charcoal. According to FAO (2005) bamboo charcoal is produced from small sized and old tops and roots of bamboo which are not fit for making other bamboo products and residues from bamboo processing industry. Because of special porous microstructure of bamboo, bamboo charcoal has a very strong absorption capacity (Zehui, 2007), and it is six times that of wood charcoal of the antipollution purposes (Hunter, 2003). It can also be used for absorbing unpleasant odors; as a deodorant in refrigerators bathrooms and pools; for refining wines of high grade and edible oil; for purifying water due to its micro–porous structure it can also be used to treat drinking water in eliminating organic impurities and offensive smell; for purifying air and to absorb harmful chemicals such as

phosphorous dioxide, carbon monoxide and hydrogen sulfide released to the atmosphere (EABP, 2007). As reported by INBAR (2003), bamboo charcoal contains many microelements like calcium, magnesium, aluminum and calcium etc. In Asia it is known as “Black Diamond”. Bamboo charcoal products are well received in Japan, Korea and Taiwan (Suneel, 2008).

### 2.5.5 Bamboo for Charcoal Making

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### 2.5.5. The Socio-cultural Value of Bamboo

Bamboo is a special plant known for its strength, straightness, lightness, etc. Combined with the extraordinary hardness, range of size abundance, short period in which they attain maturity, make them suitable for a variety of purposes and uses (Nath et al., 2009). In ancient African countries like Ethiopia, bamboo has been an integral element to religions ceremonies, art, music and daily life. It is the paper the brush and the inspiration

of poems and paintings. Bamboo pens, brushes and musical instrument were invented and have been in use since 300 years ago (EABP, 2009). The first paper was produced from bamboo in China in the ninth century. Bamboo culture is an essential part of human history and civilization especially in Asia (FAO, 2007).

The Northeastern region of India has a climate favoring bamboo outgrowth and bamboo is interwoven with the life of the people in this part of the region with certain meanings and cultural connotations. Bamboo is used extensively in making different items as required for domestic purposes, food, hunting, as items in life cycle rituals etc. Syiemleih (1995) in his work mentioned that the believers of Seng Khasi religion have a peculiar belief of hanging a bamboo basket fastened by strings and portions of sacrificial animals kept above the corpse which was suppose to serve as a food to the departed soul. The use of bamboo trunks to carry water from the mountains to the fields (Rizui and Roy, 2006). Furthermore, the authors described the ancient use of bamboo by the Nagas people who utilize bamboo in almost all the activities of daily life. They make houses of bamboo, use the young shoots as fodder, supplement their diet by using bamboo weapons and implements for fishing and hunting, cook by burning bamboo fuel, store water in bamboo containers, construct bamboo fences to domesticate animals and provide them with bamboo leaves as food etc. When a child is born, it is considered a very special event and the umbilical cord is removed without most care using a tiny sharp blade made of split bamboo. The uses of such blades are considered to be quite effective in healing the wound while causing less infection to both the mother as well as the baby. Further, when a person dies, bamboo mats are used to wrap the body of dead people. These traditions are no longer exist due to expansion of modern life style in the area.

### 2.5.6. Highland Bamboo (*Yushania alpina*) for Cultural Environmental Conservation

Bamboo is a multifaceted non-timber plant with a considerable potential to the socio-economic development and environmental protection (Sharma et al., 1998). Bamboo forests are characterized by complex network of root system making them more efficient than other forest species in holding soil particles together and carbon sequestration

(Kassahun, 2003). Therefore, bamboos are excellent in preventing soil erosion, promoting water percolation, and in sheltering the soil from wind erosion and sun drying (Kassahun, 2003; KEFRI, 2007). Further bamboo litter fall improves soil structure and fertility (Fanshawe, 1972). Furthermore, bamboo plant is a very good material source for bioenergy

# CHAPTER THREE

# 3. MATERIALS AND METHODS

## 3.1 Description of the Study Area

### 3.1.1 Geographical Location

This study was carried out in Banja district. It has 20 kebeles which is one of the seven districts of Awi Administrative Zone of the Amhara Regional State, Ethiopia. It is located 120 km south of regional capital city to Bahir Dar and about 436 km west of Addis Ababa along the main road from Addis Ababa to Bahir Dar it lies in the latitude range of $10^0$52’00” to $11^0$2’ 44”N and longitude $36^0$ 38’ 26” to $37^0$ 7’ 8” E and it is bordered in the south by Ankesha, Guagusa and Gougusa Shikudad in the west by Guangua, in the north by Fagta Lakeoma, and in the east by Sekela districts .(Fig 1)

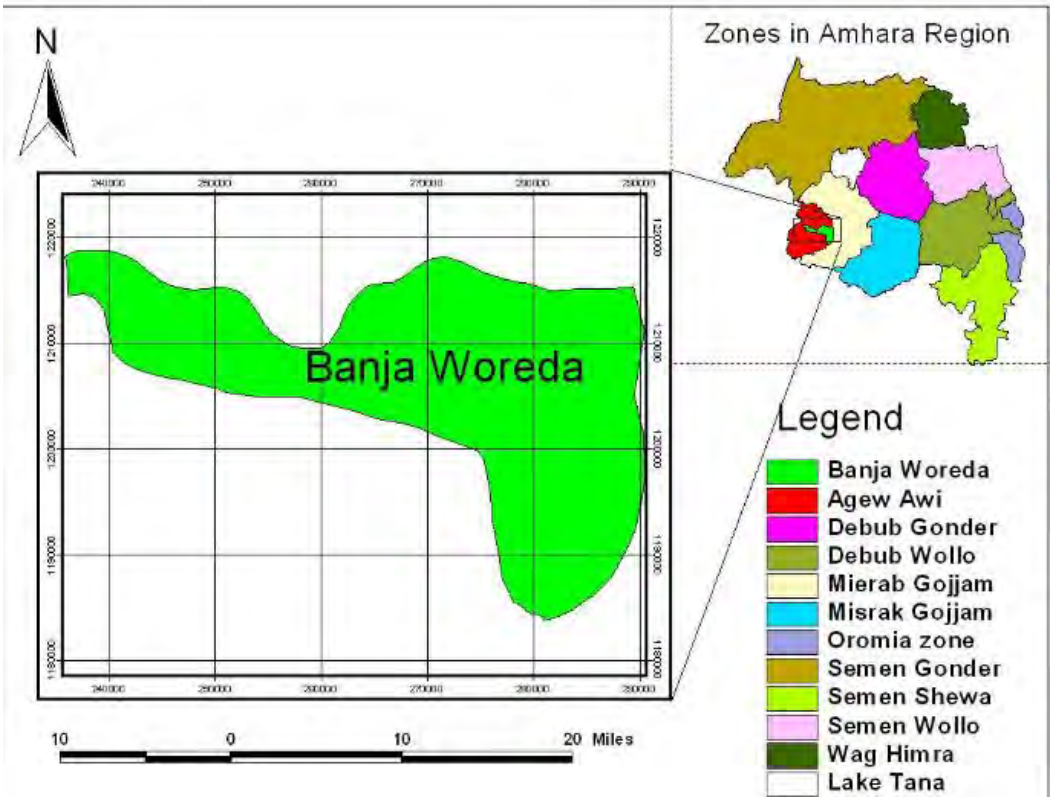


**Figure 1: Geographical location map of the study area. Source (Banja Woreda office of Agriculture)**

### 3.1.2 Topography and Soil

The topography of the district is described as mountains (25) undulated sloppy (60%), valley (14%)and others (1%) and others (1%) (BWADO, 2012). The soil of the study area is categorized as Acrisols with soil $P^H$ OF 4.81, total N of 0.03% and organic carbon of 3.5% (Yihenew, 2002) the soil is deep and constitutes medium clay with a low in cation exchange capacity and high accumulation of Al and Fe.

### 3.1.3 Climate

The study area comprises two major climatic zones namely the cool highland (80%)and locally known as dega and the warm temperate mid highland (20%) and locally known as woina degea .The altitude ranges from 1,850 to 2870 m a.s.I. The mean annual rainfall of the area is between 2,200 and 2,400 mm. The rainfall distribution pattern is unimodal and it starts in May and extends to the end of October. The mean annual temperature varies between the maximum of $19^0$c and minimum of $11^0$c (BWADO,2012).

### 3.1.4 Land Use

The total area of Banja district is estimated at 30,217 ha, of this the total area of 12,190 ha is used for cultivation of annual crop 3,443.1 ha for grazing 12,373.4 ha is forest and shrub land of which 732 ha is highland bamboo stand 1,616 ha occupied by village and 507.3 ha for other land use types (BWADO, 2012). The forest cover also comprises one of the national forest priority areas known as Kahtasa forest. The most dominant tree species found in the study area include: *Eucalyptus globules* Labill, *E.camaldulensis* Dehnh, *Cupressus lusitani*ca Mill, *Albiza gummifera* C.A.Sm., *Cordia africana* Lam., *Croton macrostachyus* Hochst . Ex Delile, *Ficus sur* Forssk, Hagenia *abyssinica* (Bruce) J.F.Gmel., *Erythrina abyssinica* Lam., *Juniperus procera* Hochst. ex Endle., Millettia ferruginea Hochst. *Prunus africana* (Hook.f.) Kalkman. *Yushania alpina* (K.Schum.) W.C. Lin., *Acacia abyssinica* Hoscht. ex Benth., *A decurense* Willd. *Grevillea robusta* A. Cunn. ex R.Br., *Meytanus obuskura* (A.Rich.) Cufod. Apodytes dimidiate E.Mey. ex Arn., *Arundo donax* Georgi. and many others bushe and trees species are available in the area (BWADO, 2012).

### 3.1.5. Socio-economical Activity

The population of the study area is estimated about 98, 210 (of which males are 48,620 and 49, 590 are female) with population density of 320 persons/km$^2$ (BWADO, 2012). In the district mixed farming, comprising crop production and livestock husbandry are the predominant farming system. Barley, potato, oat, teff, wheat and that of perennial crops are apple, coffee, lemon, sweet orange, mango, avocado and peach are food crops produced in the study area. The major livestock in the area include cattle, equine, poultry and sheep but the productivity of livestock is low principally due to shortage of livestock feed resources and lack of improved breeds. The main environmental problems encountered in the district are land degradation, soil erosion, low soil fertility, soil acidity, crop pest and diseases, and livestock diseases which all are collectively affecting the food insecurity of the local community. Households tend to keep more livestock. They are also engaged in sale of wood and other off-farm employments opportunities to cope up incidences of food shortage.

Land holding in the district ranges from 0.25to 2 ha: many households with small land holdings face severe food deficit the growing human population and the small and holding coupled with the growing number of landless people seems to have forced the landless to encroach fragile ecosystems to produce enough yields and this intervention is aggravating natural resource degradation.

## 3.2. Methods

### 3.2.1. Study Site Selection

The rationale for the choice of BANJA district for the study was based on its wide spread cultivation of highland bamboo in different land uses and in areas accessibility to the main road. In addition there are a number of people engaged in bamboo handicrafts in the locality. A total of 20 bamboos growing KEBELS in the study district were identified with the help of natural resources development experts at district levels and were clustered in three categories based on the proximity to the main road from the bamboo resources (Appendix1). From clustered group established, the study KEBELS were selected

randomly one KEBELE located up to 4 km the others located 4-8 km, and more than 8 km away from the main road the study KEBELE more or less share similar attributes in terms of livelihood activities, topography and land use system. From each study KEBELE three GOTTS a total of nine GOTTS (a cluster of human settlement or community with a population ranging from 30 to 50 households) were randomly selected to facilitate data collection from sample households.

### 3.2.2. Key Informant and Focus Group Selection

**Key informant**

In this study, key informants (KIs) and households were involved to explore the technical knowledge. KIs are defined as persons who are knowledgeable about highland bamboo based forestry the previous and current situation and its contribution to sustain livelihood of local community and who lived there at least for continuous 25 years. KIs were selected by purposive sampling techniques based on the above definition. Three KIs were selected at each GOTT. A total of 27KIs were selected from nine GOTTS, Those selected KIs were used to classify farmers in the study GOTTS into the three major wealth categories (Appendix2).

**Focus group selection**

Focus group with 7-15 members having common interest and information were identified for discussion. Accordingly, seven individuals from non-bamboo planters and seven from women group members in each KEBELE, fourteen members from handicraftsmen (seven from KESSA and seven from Injibare towns which are found in the district ) and eight expert groups from Zone, district and KEBELE. Total 64 focus group were selected for discussion.

### 3.2.3. Households (General informant) Selection

Bamboo growing male and female households at three gots from each kebele totaling nine gots having more than two bamboo clumps with ages greater than one year were identified and listed with the help of the key informant kebele and got leaders and Extension Agents. This was followed by categorization of households in to wealth classes (rich, medium and poor) based on criteria set by key informants as indicated in Table 1. The wealth ranking criteria was developed based on the potential variability among households in terms of asset endowment and livelihood strategies in the study area .A total of 270(31.12%) sample households were randomly selected from 1013 households listed in three KEBELE of 9 GOTTS as sampling frames. Of the total sample households 28(10.4%) are female headed households (Table2). With regard to wealth status the total number of sample size was equally allocated (90 sample) for rich, medium and poor households.

**Table 1: Wealth Ranking Criteria Used For Classification of HHS**

| Wealth class | Criteria used by key informants |
|---|---|
| Rich | Owned more than 1 hectare of land ,<br>Owned more than 0.25 hectare of wood lot ,<br>Owned one pair of oxen or more,<br>Owned more than 6 cattle ,<br>Owned more than 12 sheep<br>,Owned more than 2 equine ,<br>Some of them owned corrugated iron sheet from town or kebele or got<br>Have capacity to purchase inputs<br>Few of them owned gain mills |
| Medium | Owned less than 1.0 hectare of land<br>Owned less 0.25 hectare of wood lot<br>Owned one pair of oxen<br>Owned cattle up to 3-6<br>Owned 5-12sheep<br>Owned more than 1-2 equine<br>Most of them have capacity to purchase in puts |
| Poor | Owned land less than 0.5 hectares : less than 0.125 hectare of wood lot: have one or no oxen<br>Owned 1-2 cattle less than 1-2 sheep owned 2-3 chicken<br>Rented out part of his/her crop filed and home garden<br>Daily worker, Have one or no equine |

### 3.2.4 Data Collection Tools

#### Field Observation

Field observation was conducted in proposal time schedule in the three study KEBELES (KESSA CHEWSSA, SURTA and AKENA JIFI) to observe the physical and socio – economic activities (livelihood activities community resources geographic features infrastructure, bamboo distribution etc) and this helped the researcher to understanding the general situations and practical activities in the study area.

#### Focus Group Discussion (FGD) and Key Informant Interview

Focus group discussion was held to supplement and confirm information that was generated in the house hold questionnaire and in depth interviews with key informants. In the study three kebeles 64 focus group members involved in separate groups of experts handicraftsmen, women and non-bamboo planters having good knowledge of their locality and natural resource were used for discussion and 27 kl members were also involved in interview. The issues addressed in the focus group discussion and kI information interview are indicated in (Appendices 6 and 7) respectively.

#### Households Interview

To achieve the objectives of the study a structured questionnaire was designed to include range of issues that could provide an insight into the socio- economic and sociocultural system of household and livelihood contributions (Appendix 8) .After setting the questionnaire, a formal pilot test was carried out on 20 household to check the ease plot test with which respondents react to the questions, to make sure that the questions are relevant and easily understood by the interviewee and also to estimate the time it requires for completion .Three data collectors were given one day training to enable them understand the question and also to provide them the skill on how to approach individual households during the interview. The data collectors were supervised by researcher during data collection. The questionnaire addresses two major issues. The first part deals with the socio economic aspects of the household mainly on demographic and economic attributes including land holding and livestock husbandry and land use. This

section aimed to establish local endowments and livelihood options pursued by households. The variables were used to assess how to study households differ in terms of asset endowments and also test associations between resource endowments and perceptions on bamboo and its role in the livelihood of farmers (socio-economical and socio cultural) and improvement for the local community. The second part addresses technical aspects of bamboo processing, marketing, utilization, the institutional support to promote the technology (if any). The questionnaires were distributed to the actual sample households, which were totally 270.

## Bamboo Species Inventory

The questionnaire survey was complemented by bamboo species inventory focusing on individual household bamboo planting, identification and characterization of bamboo varieties, etc. From the total sample households used for questionnaire survey 30% (81 ) of the households (27 from poor, 27 from medium and 27 from rich) were randomly taken for bamboo resources inventory. From each household accordingly, for irregular bamboo plantation niches like wood let, river bank, home stand and gully side plant.

### 3.2.5 Secondary Data Collection

The secondary data and information on socioeconomic, socio cultural features, land use, land cover , bamboo coverage , number of bamboo growth , extension support, etc. was compiled to corroborate the data collected using other data sources.

### 3.2.6 Methods of Data Analysis

The data collected from household survey and bamboo inventory were checked, corrected, coded and encoded computer then analyses were conducted. For the collected quantitative and qualitative data various analyzing techniques were used. The quantitative data collected from household survey and bamboo inventory were analyzed using Descriptive statistics. The results were presented using charts, table and frequency distribution. The qualitative data collected from the key informants interview and focus group discussion were narrated and summarized. Both diverging and converging issues on particular issues were identified and used for analysis in line with the research objectives.

# CHAPTER FOUR

# 4. RESULTS

## 4.1. Household Characteristics and Economic Condition

### 4.1.1. Demographic/Household Characteristics

In this study from the total of 270 sampled HHs interviewed 89.6% were male headed and the rest 10.4% were female headed (Table2). The average age of the respondent HHs was 54.14 years with ages ranging from 25 to 85 years. Of the total sample HHs those in the production age class (15-64 years) comprise about 75.2%. All of the respondents belong to the same religion (Orthodox Christianity). Regarding the marital status about 87.4% were married followed by 7.8% widowed and 4.4% divorced (Table 2). The average family size of the respondent HHs in the study area was 6 persons, with minimum and maximum of 1 and 12 respectively.

In terms of literacy level of the respondent HHs, about 54.1% were illiterate followed by those who were able to read and write (34.4%) and only 8.5% had attended elementary school (grade 1-6). With respect to the HHs in the community high proportions of household (67%) responded that they were involved in many development activities in their communities. About 12.2 HH respondents had served as community leaders, 8.65% were religious leaders and 11.55% were involved in traditional institution administrating like IDIR and MAHIBER.

**Table 2: Household characteristics of respondents at study are ( N=270)**

| Household characteristics | Parameter | Frequency | Percent(100%) |
|---|---|---|---|
| Sex | Male | 242 | 89.6 |
| | Female | 28 | 10.4 |
| Age of HHs | 15-64 year | 203 | 75.2 |
| | 65 years and above | 67 | 24.8 |
| Marital status | Married | 236 | 87.4 |
| | Divorced | 12 | 4.4 |
| | Windowed | 21 | 7.8 |
| | Single | 1 | 0.4 |
| Religion | Orthodox | 270 | 100 |
| Education | Illiterate | 146 | 54.1 |
| | Read and write only | 93 | 34.4 |
| | Elementary (grade 1-6) | 23 | 8.5 |
| | Secondary (7-12) | 8 | 3 |
| HHs role in the community | Member | 182 | 67.4 |
| | Leader of community | 33 | 12.2 |
| | Religious leader | 23 | 8.5 |
| | Other leader (EDIR, MAHIBER) | 31 | 11.5 |

### 4.1.2 Economic Characteristics of Households

The average land holding of the sample household in the three study KEBELEs was 1.17 ha with minimum and maximum size of 0.125 ha and3.25ha respectively (Table 3). Of the respondents about 0.4% have below 0.25 ha, some 53.7% own 0.25-1.25ha, and about 42.8% have 1.25-2.25 ha, and few (3.3%) have above 2.25 ha. The majority of the respondents got their land through the formal land allocation procedure by state (78.9%),some inherited from parents (4.8%) and others got land in the form of gift from

their parent and relatives and also from land allocation (16%), and very few by renting for 25 years (0.4%).

**Table 3: Households landholding and means of getting land (N= 270)**

| Economic characteristics | Land holding size | Frequency (%) |
|---|---|---|
| Total land holding | Below 0.25ha | 1(0.4%) |
| | 0.25-1.25ha | 145(53.7%) |
| | 1.25-2.25ha | 115(42.8%) |
| | Above 2.25ha | 9(3.3%) |
| Means of the HHs to get land | Formal allocation | 213(78.9%) |
| | From parents | 13(4.8%) |
| | By gift | 28(10.4%) |
| | Other | 1(0.4%) |
| | Land allocation and gift | 15(5.6%) |

Livestock is integral part of the framing system in the study kebeles and of the major livestock are cattle, sheep, equines and poultry (table 4). Thus in this study the cattle population holds the highest share followed by sheep and equine population. Households who have more livestock population need to be forced to allocate more land for grazing land and discouraged bamboo planting

**Table 4: Number of livestock population owned by respondent households (N=270) in the study kebeles across wealth status.**

| Wealth status | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| Livestock type | Rich | | Medium | | Poor | | | |
| | N | Share(%) | N | Share (%) | N | Share (%) | N | Share(%) |
| Cattle | 511 | 50.5 | 335 | 33.1 | 166 | 16.4 | 1012 | 33.0 |
| Sheep | 387 | 46.3 | 264 | 31.6 | 185 | 22.1 | 836 | 27.8 |
| Goat | 2 | 11.1 | 12 | 66.7 | 4 | 22.2 | 18 | 0.6 |
| Equine | 381 | 48.2 | 265 | 33.5 | 145 | 18.3 | 791 | 25.8 |
| Poultry | 178 | 43.8 | 119 | 29.3 | 109 | 26.8 | 406 | 13.3 |
| Total | 1459 | 47.6 | 995 | 32.5 | 609 | 19.9 | 3063 | 100 |

## 4.2. Highland Bamboo Farmers' Variety

Assessment of the highland bamboo conducted in the study areas showed that there are three types of highland bamboo farmers' variety and these are identified as TIKUR, KEYE and ZEGER farmers' variety as shown in Figure 2. Of the sampled HHs, the majority (72.2%) of the respondents had the TIKUR farmers' variety followed by KEY farmers' variety (Table 5). The inventory result reveals that the total average land covered by highland bamboo farmers' variety across wealth status indicates that TIKUR bamboo was higher for rich households followed by medium and poor, while KEYE type of the farmers' variety was higher for medium households followed by poor, and rich, and farmers' variety of ZEGER type was grown by the poor and medium wealth categories in similar proposition. Of the three farmers' variety, the highest proportion of bamboo plant was covered by TIKUR farmers' variety as shown in Table.5.

**Figure 2: Type of three local highland bamboo farmers' variety (a) ZEGER, (b) KEYE and (c) TIKUR (PHOTO COURTSEY: Sirawdink, 2017)**

**Table 5: High land bamboo farmers' variety inventoried HHs((N=81).**

| inventory report | | | | |
|---|---|---|---|---|
| Landrace Type total | Rich | Medium | Poor | Total |
| Black | 38(43.7%) | 27(31.0%) | 22(25.3%) | 87(72.5%) |
| Red | 9(2.0%) | 8(25.8%) | 14(45.2%) | 31(25.8%) |
| Strip | | 1(50.0%) | 1(50.0%) | 2(1.7%) |

According to house hold responses bamboo planting niches covered by farmers' varieties. TIKUR land race was higher 64.4% respondents grow at farm boundary as well as road side followed with the KEY landrace 52.9% respondents grow grazing land and river bank and followed by ZEGER(Table6)

**Table 6: Lands Covered by Highland Bamboo Land Race at Different niches HHs (N=270)**

| No | Niche types | Tikur | Key | Zeger |
|---|---|---|---|---|
| 1 | Home stand | 150(55.5%) | 54(20%) | 32(11.8) |
| 2 | River bank | 120(44.4%) | 132((48.7%) | 23(8.5) |
| 3 | Grazing land | 130(48.1%) | 142(52.9%) | 42(15.6%) |
| 4 | Farm boundary | 174(64.4%) | 60(22.2%) | 32(11.8) |
| 5 | Roadside | 160 (59.2%) | 43(15.9%) | 40(14.8%) |

## 4.3. Farmers' Knowledge on Bamboo Utilization, Processing and Marketing

### 4.3.1. Utilization of Bamboo

Views related to proximity indicated that there is an increasing trend in this respect due to better access to roads resulting in more utilization particularly in Kessa chewsa(28.9%) followed by surta (27.8%) and akena jifi (23.7%) (table 7).

**Table 7: Bamboo utilization trends during the last 5 years in the kebeles (N=270)**

| Trend of utilization | | kebele | | | | |
|---|---|---|---|---|---|---|
| | | | Kessa chewsa | surta | akena jifi | Total |
| Bamboo Utilization trend | Increased | N | 78 | 75 | 63 | 217 |
| | | % | 28.9 | 27.8. | 23.7 | 80.4 |
| | Decreased | N | 1 | 0 | 3 | 4 |
| | | % | 0.4 | 0% | 1.1 | 1.5 |
| | No Change | N | 14 | 12 | 21 | 49 |
| | | % | 5.2 | 4.4 | 8.5 | 18.1 |

From the above table analysis the knowledge of bamboo harvesting season and age important to get quality and better volume of bamboo culm. About 93.3% of the respondents had a good knowledge of harvesting season. The farmers in the study area harvest bamboo at different age. The majority of respondents (87.9%) harvest bamboo culms at the age 2-5 year, about 25.7% beyond age 5 and few (8.5%) confirmed that selective harvesting method was applied in bamboo stands .As shown in table7.

**Table 8: Farmers knowledge on bamboo harvesting and age for harvesting (n=270)**

| Kebele | | | | | | |
|---|---|---|---|---|---|---|
| Knowledge on bamboo harvesting season and age | | | kessa chewsa | surta | akena jifi | total |
| Harvesting season | Yes | N | 86<br>31.9 | 89<br>33 | 77<br>28.5 | 252<br>93.3 |
| | No | % | 4<br>1.5 | 1<br>04 | 13<br>4.8 | 18<br>6.7 |
| Harvesting age | | | | | | |
| < 1 year | Yes | N | 5<br>1.9 | 0<br>0% | 18<br>6.7 | 23<br>8.5 |
| | No | % | 85<br>31.5 | 90<br>33.3 | 72<br>26.7 | 247<br>91.5 |
| 2-5 year | Yes | N<br>% | 89<br>37.6 | 84<br>31.1 | 64<br>23.7 | 237<br>87.9 |
| | No | | 1<br>0.4 | 6<br>2.2 | 26<br>9.6 | 33<br>12.2 |
| >5 year | Yes | N | 50<br>18.7 | 12<br>4.5 | 7<br>2.6 | 69<br>25.7 |
| | No | % | | 78(28.9)<br>28.9 | 83(30.7)<br>30.7 | 201(74.4)<br>74.4 |

### 4.3.2. Bamboo Processing

The study tried to assess value addition practice on bamboo culms such as producing bamboo products like bamboo mat, furniture, baskets, different sized table and chairs shown(Table 9) majority of respondent household (88%) sell bamboo culms without processing, and it was only the 12% who carry out preliminary processing as shown Table 6 and Figure 3.

**Table 9: Household close to road side have shown a relatively better activity on bamboo processing HHs( N=270)**

| Bamboo utilization condition | Kebele | | | | | |
|---|---|---|---|---|---|---|
| | Kessa chewsa | | Surta | Surta | Akena | Total |
| Processing bamboo culms to other products (table, chair, mate etc..) | Yes | N | 15 | 6 | 11 | 32 |
| | | % | 5.6 | 2.2 | 4.1 | 12% |
| | No | N | 75 | 84 | 79 | 238 |
| | | % | 28.1 | 31.5 | 29.3 | 88% |

With regard to employment opportunity 15 youth at INJIBARA town and 20 youth and households at KESSA town were engaged on production of bamboo products (Researcher's observation).

**Figure 3: Ttraditional bamboo products Processing (Photo Courtsey: Sirawdink, 2017)**

### 4.3.3 Marketing

With regard to market outlets for bamboo about 55.9% of respondent households indicated that the market is available at the plantation site, 71.1% stated availability of market within the KEBELE and 19.6% of the indicated selling of bamboo culms by transporting to market places within the district, other 65.2%% sale along the roadside. Almost all the sampled respondent households have no experience of selling bamboo culms and its products outside the district (Table10)

**Table 10: Market availability of high land bamboo with percentage of HHs(N=270)**

| Market place | Number of informants | Percents of informants |
|---|---|---|
| Plantation site | 151 | 55.9% |
| Within kebele | 192 | 71.1% |
| District market | 53 | 19.6% |
| The roadside | 176 | 65.2% |
| Outside the district | 2 | o.7% |

## 4.4 Income Obtained from Different Livelihood Activities

Bamboo stood 4$^{th}$ in the assessment of income sources of the households following the income from livestock, crop production, and tree production species as shown in Figure 4.

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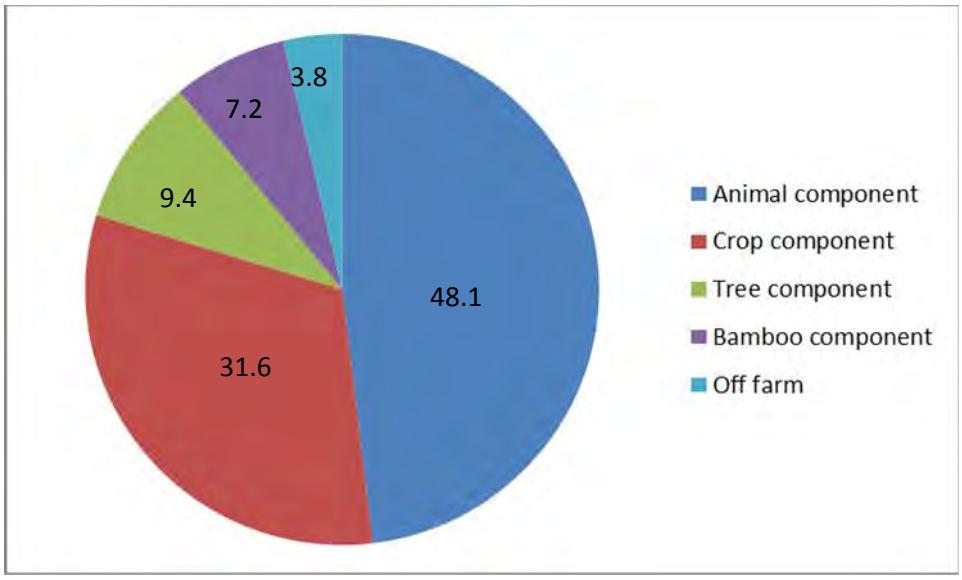


**Figure 4: Contribution of different livelihood activities to households income in the study site**

The income trend obtained from crop, animal, tree and bamboo culms in the last two years (2017-2018) as perceived by respondent households was assessed and the study result is presented in (table11). The majority of respondent households felt that is increasing by animal sale (65.1%).followed by livestock products (61.1%) and by bamboo culm sale (60.9%). A significant percentage of the respondent households (61.1%) expressed that the income obtained from crops has been showing decreasing trend followed by income from forest tree sale and that of in come from none and off-farm activities. On the other 67.3% of the respondents expressed that the income from off-farm activities and 63.8% from forest trees sale showed no change and followed with bamboo product sale (58.7%) as shown in table11.

**Table 11: The trend of income obtained from different sources by sampled HHs from 2017-2018 (N=270)**

| Income source type | Trend in come obtained | | |
|---|---|---|---|
| | Increased N (%) | Decreased N (%) | No change N (%) |
| Crop | 91 (33.7) | 165(61.1%) | 14 (5.2%) |
| Animal sale | 173 (65.1%) | 38 (14.1%) | 59 (21.9%) |
| Animal products | 165 (61.1%) | 40 (14.8%) | 65 (24.1%) |
| Forest tree sale | 79 (29.3%) | 19 (7%) | 172 (63.7%) |
| Bamboo culm sale | 162 (60.9%) | 7 (2.6%) | 101 (37.4%) |
| Bamboo product sale | 95 (35.2%) | 16 (5.9%) | 159 (58.9%) |
| Off farm | 49 (18.1%) | 39 14.4%) | 182 (7.4%) |

### 4.4.1 Bamboo Income Share of Households

The average annual income obtained from bamboo culm and product sale by respondent households was 1589.47 birr. This sum accounts about 7.2% of total livelihood activity income. The share of bamboo income from the total income was higher for poor households (13.2%) followed by the (10.3%) and of medium HHs (8.7%) as shown in Table 12. Across gender the share of bamboo income from all income was higher for female headed households (12.5%) compared to male headed households (10%) (Table 12)

With respect to proximity to the main road the share of bamboo income from the total income to bamboo cultivators for KESSA CHEWSSA KEBELE was (13.6%) higher than SURTA (6.6%) and AKENA JIFI (4.8%). While the annual income of SURTA KEBELE was one half time greater than AKENA JIFI KEBELE (Table 12). The contribution share of bamboo income from the total livelihood income was significantly different among the wealth categories group and across proximity to the main road.

**Table 12: Mean annual income disaggregated by wealth status gender group proximity to main roads amount with Birr (N= 270)**

| Household Characteristics And proximity Class | Total mean Income of Livelihood Activities | Total Bamboo Income | Share of bamboo Income Contributing to HHs (in %) | Income ratio | |
|---|---|---|---|---|---|
| Wealth status | | | | | |
| Rich | 29312.15 | 3014.78 | 10.3 | R/m | 1.6 |
| Medium | 21817.55 | 1902.85 | 8.7 | M/p | 0.97 |
| Poor | 14933.34 | 1970.04 | 13.2 | R/p | 1.5 |
| **Gender** | | | | | |
| Male | 22215.06 | 2229.01 | 10.0 | M/f | 0.9 |
| Female | 20343.84 | 2535.59 | 12.5 | | |
| **Proximity** | | | | | |
| KESSA | 28511.43 | 3872.22 | 13.6 | KESSA/SURTA | 3.0 |
| SURTA | 19259.49 | 1274.94 | 6.6 | SURTA/AKENA | 1.5 |
| AKENA | 18292.11 | 876.89 | 4.8 | KESSA/AKENA | 4.4 |

## 4.5 Socio Cultural Activity of Bamboo

As shown in table 13 below the majority respondents utilize bamboo plant for the following cultural activities like; Mugid (Akemballo), Cotton roping, Basket, Fodder, Housing, Boundary marker, Agricultural tool, Bed, Sweep floor, Fence, Fire wood, Grain store, and Behieve respectively. According to the minority informants Bamboo plant is also a good source charcoal, furniture, poles, flooring, and musical instrument, agricultural tools, local pipe (used for irrigation). In addition, its leaves used as fodder and have medicinal value to human. The roots are cooked with meat and the soup drunk

for general illness, while the Barks can be pounded, added to cold water and the liquid drunk as a remedy for diarrhea and stomach-ache and the likes.

**Table 13: Cultural importance of bamboo to local communities by percent of frequency (n =270)**

| No | Cultural use of bamboo frequency | Number of informants | Percents of uses | Precents of informants |
|---|---|---|---|---|
| 1 | Medicine | 30 | 0.9% | `11.1% |
| 2 | Fuel wood | 150 | 4.1% | 55.5% |
| 3 | Agricultural tool | 220 | 6% | 81.5% |
| 4 | Chair | 90 | 2.5% | 33,3% |
| 5 | Bed | 176 | 4.8% | 65.2% |
| 6 | Musical instrument | 65 | 1.8% | 24.1% |
| 7 | Local pipe | 25 | 0.7% | 9.3% |
| 8 | Housing | 245 | 6.7% | 90.7% |
| 9 | Fence | 157 | 4.3% | 58.1% |
| 10 | Basket | 255 | 7% | 92.6% |
| 11 | Behieve | 135 | 3.7% | 50% |
| 12 | Cutting meat | 78 | 2.1% | 28.9% |
| 13 | Tooth bursh | 86 | 2.4% | 31.9% |
| 14 | Charcoal | 123 | 3.4% | 45.5% |
| 15 | Bridge | 60 | 1.6% | 22% |
| 16 | Fodder | 245 | 6.7% | 90.7% |
| 17 | Boundary marker | 234 | 3.7% | 86.7% |
| 18 | Crones frame | 43 | 1.2% | 15.9% |
| 19 | Coffee ceremony | 65 | 1.8% | 24.1% |
| 20 | Green store | 143 | 3.9% | 53% |
| 21 | Cooking stick | 110 | 3% | 40.7% |
| 23 | Food | 47 | 1.3% | |
| 24 | Umbrella | 55 | 1.5% | 20.4% |
| 25 | Cotton roping | 253 | 6.9% | 93.7% |
| 26 | Mugid (Akemballo) | 265 | 7.3% | 98.1% |
| 27 | Sweep floor | 170 | 4.7% | 63% |
| 28 | Distillation tube | 123 | 3.4% | 45.6% |
| **Total** | | | **100%** | |

## 4.6 Traditional Environmental Conservation of Bamboo

Ecologically the highland bamboo plants are employed in soil-conservation activities, improve soil fertility, shade or shelter, boundary marker, wind break, and protect slop land since it is ever green and attractive. In this study all the informants agree that bamboo has a great importance as farm boundary and wind break Thus, it is often planted in most churches and private houses for this purpose in addition to the other ecological uses (Table14 ).

**Table 14: Environmental conservation of bamboo to local communities by percentage of frequency [ n =270]**

| NO | Bamboo conservation frequency | Number of informant | Percents of use | Percent of informant |
|---|---|---|---|---|
| 1 | Water conservation | 85 | 4.5% | 31.5% |
| 2 | Protect erosion | 243 | 13% | 90% |
| 3 | Replace degraded land | 150 | 8% | 55.6% |
| 4 | Farm boundary | 255 | 13.6% | 94.4% |
| 5 | Wind break | 248 | 13.3% | 92% |
| 6 | Protect slop land | 75 | 4% | 27.8% |
| 7 | Boundary marker | 135 | 7.2% | 50% |
| 8 | Recovery gully side | 80 | 4.3% | 29.6% |
| 9 | Home stand | 256 | 13.7% | 94.8% |
| 10 | Church stand | 270 | 14.4% | 100% |
| 12 | Protect Sun dry | 73 | 3.9% | 27% |
| 13 | Total | 1870 | 100% | 692.5% |

# CHAPTER FIVE

# 5. Discussion, Conclusion and Recommendation

## 5.1 Discussion

### 5.1.1 Highland Bamboo Farmers' Variety

In this study, highland bamboo farmers' variety namely TIKUR, KEY and ZEGER were indentified. At the study site TIKUR farmers' highland bamboo variety was the most preferred by majority (72.5%) of household respondents. Yigardu (2012) reported four bamboo farmers' variety (locally known by the community as Wonde, Welele, Tifro and Enkotkot) in Choke Mountain, of East Gojam Zone which are differing in their morphological characteristics, utilization, Contribution of bamboo for livelihood diversification and management need from one another are recognized by the community.

The preference view focus group discussion and KIs informant was also in line with households view. Moreover, the view of the respondents, KIs and focused groups for TIKUR farmers' variety was associated to its provision of more uses, better workability (easy to slice or twist), large internodes length, and better resistance to insect attack than other two verities. At the early stage the color of the TIKUR variety is deep green but when it matures the color changes to black. On the other hand the KEY variety is thicker than the other two farmers' variety and produces more shoots per clump per one growing season and provides more slices for making baskets and mat.

Bamboo cultivators living close to the main road plant more bamboo than those who were at distant areas .Similar trend was also reported by Yenesew (2012). The difference could be associated to the increasing market demand for bamboo and better knowledge/skills on bamboo processing and utilization by communities close to the main road. However, the majority household respondents living far from the main road could not get technical support to maximize the benefit of Tikur bamboo to the extent of it high productivity compared to other varieties.

### 5.1.2. Farmers Knowledge on Utilization, processing and marketing of Highland Bamboo

Process bamboo culm in bamboo cultivation is a typical tradition of community LUSO, (1997). At the study site, the average work experience of household respondents were 21.6 years with minimum and maximum of 2 - 65 years respectively. This shows that they have a good deal of traditional knowledge in managing highland bamboo at different niches on privately owned and up slope plantation or around farm area as live fences. In the study area bamboo is harvested during the dry season especially in January and February. This is because in the dry season the starch content of bamboo culm will be less so that bamboo product will be less sensitive to insect and pest attack (EABP, 2009) this is also supported by Tran (2010) further elaborating harvesting should be carried out during the dry season when the culm nutrient and starch are the lowest with the aim to prevent culms being attacked by borers in addition newly sprouting shoots will not be damaged when bamboo is harvested during this time.

Good harvesting age for bamboo culms ranges from 2 to 3 years as approved by the majority (89.7%) of household respondents. However, in the study area, farmers harvest bamboo at the age of 2 to 5 years. According to group discussion and KIs interview bamboo could attain its maturity and better quality culm within this age class. When the age is greater than 5 years bamboo may deteriorate in its quality and it might be infested by fungal diseases. When harvested at early stage (less than 2 years ) the newly sprouting shoot could be damaged as well the harvested culms could be easily damaged by insects.

The study indicated that the majority (88%) of household respondents approved that they could not process and add value to get better price. Moreover, as assured during the discussion, majority households who live far from main road did not fully benefited from the resource due to lack of modern knowledge and technical skills to process and add value on the products.

With regard to market outlets for bamboo about 19.0% of respondent households indicated that the market was available at the plantation site as assured by 34.0% availability of market within the KEBELE and 9.3% of respondents were indicated that

selling of bamboo culms transporting to market places within the district, other 65.2% stated that market available at roadside. As approved by group discussion and KIs, most bamboo harvesting farmers could not sale their products by reasonable price because of lack of market linkage. .

### 5.1.3. Contribution of Bamboo to Households Livelihood

As confirmed by pie chart from figure 4 highland bamboo has been a significant source of livelihood improvement for sample households. The annual overall mean income of sample HHs from bamboo was 2264.69 birr with contribution of (7.2%) of the total income with other means of income HHs in BANJA DISTRICT. This was found to be better when compared to the income generation in Masha (3.4%) (Zenebe, 2014) and was less than the SHEDEM area in Bale(47%) (Arsema, 2008).

The annual contribution of bamboo in generating income for poor HHs was higher than the rich and medium wealth category similarly the annual contribution of bamboo in generate income for female was greater than that of the male, Similarly, bamboo cultivators who are living close to the main road have significantly gained better bamboo income share than those living at distant KEBELE. This relation is supported by Hegde (2000)

Nevertheless, the income volume was found to be insignificant compared to the potential of the area under the study because of the traditional way of harvesting and processing. This urges the concerned body to promoting and advancing the capacity of the poor households and the female households to uplift their incomes.

### 5.1.4. Socio-cultural value of high land bamboo

The results of this study indicated that the people in the study area have developed a very good cultural intimacy to highland bamboo due to the various uses of the plant in their life. Bamboo is a major construction material in many countries particularly in rural areas. It is used to produce many of the household furniture, musical instrument, basketry or storage, traditional sticks (important for elderly people), etc. In addition it provides a very good raw material for house construction. This is similar to other bamboo growing

community elsewhere in the vicinity of the study area. The same is true in other parts of the world confirmed by other authors (Ensermu *et al*., 2000; EABP, 2009; INBAR, 2011; FAO, 2007). However, according to the researcher's observation and as per the approval of the focus group discussion, the socio cultural materials produced traditionally and manually in a very backward manner. No respondents replied that they produce sophisticated cultural products like sofa, shelf, cupboard, TV stands etc. which maximize the incomes of the households and improves their lives.

### 5.1.5. Traditional Environmental Conservation of Bamboo

As confirmed in the study, highland bamboo plants are employed in soil-conservation activities, improve soil fertility, shade or shelter, boundary marker, wind break, protect slop land, it is also evergreen and attractive for the environment. The result is strongly supported by the previous researchers as Bamboo forests are characterized by a complex network of root system making them more efficient than other forest species in holding soil particles together and carbon sequestration (Kassahun, 2003), Moreover, bamboos are excellent in preventing soil erosion, promoting water percolation, and in sheltering the soil from wind erosion and sun drying (Kassahun,2003; KEFRI, 2007). Further, bamboo litter fall improves soil structure and fertility (Fanshawe, 1972**).** Even though the respondents know the traditional environmental conservation very well, it was approved and agreed up on during the KI and group discussion that little attention was given to grow bamboo widely and scientifically in the study area. Awie zone is very mountainous and exposed to erosion and degradation. However, as the researcher's observation, significant portion of area is seen bare and deforested while bamboo plant is easily grown and very vital to protect the environment from any kind of soil erosion. As indicated by the authors in the review literature, there are very vital experiences in the world that intercrop bamboo with the other crops is widely used since its capacity for keeping soil fertility is high. But, bamboo intercrop plantation is not practiced in the study area.

## 5.2 Conclusion

### 5.2.1 Conclusion

- Three farmers' varieties were identified in the study area; namely, TIKUR. KEYE and ZEGER. Of the three varieties, TIKUR variety is more popular and widely used and preferred by the farmers than other two because of its productivity, better workability, provision of numerous uses and morphological characteristics. Although not enough, Farmers close to the main road get better support and technical assistance by professionals and as the result, they utilize the plant in a better ways. However, the majority household respondents living far from the main road could not get technical support to maximize the benefit of bamboo plants particularly, Tikur bamboo to the extent of its high productivity compared to other varieties. Therefore, it is possible to finalize this result by saying that farmers are in need of plenty of supports to maximize their benefits particularly, from TIKUR bamboo which are more productive compared to others.

- Even though bamboo cultivators in the study area have long experiences of cultivating and managing bamboo plants as well as the trend of its expansion has been increasing through time, Majority households particularly living far from the main road could not process and add value to get better price. In addition to that they couldn't get market access to sell their products and to earn fair income. From the study, it was also assured that less attention was given to provide trainings, technical supports and advices to the farmers about bamboo management, utilization and processing. Therefore, it is possible to conclude that due to the many constraints, the majority households harvesting highland bamboo plants did not fully benefited from the resource in Banja district, Awie zone.

- When compared to other sources of income, the annual volume of income contribution of bamboo plant is very insignificant. The study clearly indicated that female and poor bamboo cultivators earn better income when compared with male and rich cultivators. However, the income volume was found to be insignificant compared to the potential of the area under the study because of the traditional way of harvesting and processing. Hence, a lot should be done to increase the benefit from the potential of bamboo plant to improve the livelihood income.

- Bamboo plants have so many traditional and cultural uses in Awie zone and in the entire world. Some of the cultural uses are furniture, musical instrument, basketry or storage, traditional sticks (important for elderly people) and provides a very good raw material for cultural house constructions. However, the study indicated that the cultural materials produced are manually in a very backward manner while so many modern and sophisticated cultural products like sofa, shelf, cupboard, TV stands and so on are produced all over the world. In this regard, it is true that the households/farmers in Banja district, Awie zone are not.

- As emphasized in the study, all farmer's variety bamboo have very crucial benefit in the environment conservation such as soil-conservation activities, improve soil fertility, shade or shelter, boundary marker, wind break, protect slop land, it is also ever green and attractive for the environment, intercrop bamboo with the other crops and the likes. The farmers in Awie zone more or less exercise some of the above benefits in relation to environmental conservation. Contrary to the multiple contributions of bamboo plants to protect the environment, the mountains in Awie zone are seen bare and degraded. As the result, erosion is very savior in the area. Therefore, it is possible to conclude that the communities are not fully utilizing the environmental benefits of bamboo plant.

### 5.2.2 Recommendation

Based on the findings of the study and the final conclusions of the result, the following recommendations were forwarded:

- Farmers particularly living far from the main road were not able to produce/Planting bamboo to the needed level. Therefore, the Agriculture Bureau and all other concerned bodies should assist and provide technical supports to the farmers to increase the productivity specially the highly productive farmers' variety/ TIKUR variety.

- Farmers should get trainings, technical supports and must be assisted with improved technologies for better utilization and processing as well as chain of market access should be created in order to increase their income and improve their lives

- Households in the study area should be supported to improve their cultural products so that Authorities and professionals in Awie zone had better to introduce technologies that could enable them to produce more or less modernized products

- Farmers harvesting bamboo plant should be promoted and encouraged to widen their cultivation/Plantation of bamboo and also the local government should mobilize the people to cover all degraded and eroded landscapes with bamboo plants.

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# Appendices

**Appendix 1: Randomly selected bamboo growing KEBELEs and GOTTS**

| No | KEBELEs | Name of GOTTES | Randomly selected GOTTS | Total number of selected GOTTS |
|---|---|---|---|---|
| 1. | KESSA CHEWSA/3GOTT/ | KUALAKULTA | | 3 |
| 2. | | GEHIRTA | | |
| 3. | | SAHARTA | 1.SAHARTA | |
| 4. | | AMARTA | | |
| 5. | | ZENGENA GIS | 3. ZENGENA GIS | |
| 6. | | SAWI | | |
| 7. | | ASURTA MAMUTA | | |
| 8. | | KES MENDER | | |
| 9. | | WAJIRA | | |
| 10. | | WAYITA | 2.WAYITA | |
| 11. | | ADGUTA | | |
| 12. | | AKINA | | |
| 13. | | ZENGNA GUBITI | | |
| 1. | Akena gifi | KILAJ | | 3 |
| 2. | | DANGIYA | | |
| 3. | | SURTA WELETISTA | 2.SURTA WELETISTA | |
| 4. | | MIRKITA | 3. MIRKITA | |
| 5. | | BUNGISI | | |
| 6. | | ABOYISTA | 1.ABOYISTA | |
| 7. | | KUAK | | |
| 8. | | BER | | |
| 1. | Surta | MESKELA | | 3 |
| 2. | | GIRAYITA | | |

| | | | | |
|---|---|---|---|---|
| 3. | | YIFUSI | | |
| | | | | |
| 4. | | SORTAYITA | | |
| 5. | | MESKELTA | | |
| 6. | | LIGIDI | 1. LIGIDI | |
| 7. | | GUNDIL | | |
| 8. | | GORGOYITA | 2. GORGOYITA | |
| 9. | | AKISTA | 3. AKISTA | |
| | Total | 30 | | 9 |

## Appendix 2: Key Informants selected from CHEWSSA KEBELE

| No | Name of candidate for key information s election | Sex | Age | Got | Tally of the candidate | Total number of tally | Rank | Selected key information |
|---|---|---|---|---|---|---|---|---|
| 1. | Ato melakneh mengiste | M | 40 | Tseherta | ///// ///// ///// ///// | 20 | 2 | Melakneh mengiste |
| 2. | Ato endalew kasse | M | 60 | Tseherta | ///// ///// ///// | 15 | 5 | Ato endalew kasse |
| 3. | Ato werku tebeje | M | 62 | Tseherta | ///// ///// / | 11 | | |
| 4. | Ato abebe alemu | M | 53 | Tseherta | ///// ///// ///// // | 17 | 4 | Ato abebe alemu |
| 5. | Ato simeneh k asse | M | 52 | Tseherta | ///// ///// | 14 | | |
| 6. | Ato asega syume | M | 60 | Tseherta | ///// ///// ///// ///// | 19 | 3 | Ato asega syume |
| 7. | At o alene fentahun | M | 61 | Tseherta | /// /// /// | 9 | | |
| 8. | Ato birhanu kasse | M | 53 | Tseherta | ///// ///// ///// ///// // | 22 | 1 | Ato birhanu kasse |
| 9. | Ato birhan tebeje | M | 55 | Tseherta | ///// ///// | 10 | | |
| 10. | Ato bezabih desta | M | 70 | Tseherta | /// /// /// | 9 | | |
| 1 | Ato alemu misikir | M | 45 | Wayita | //// //// //// //// | 16 | 2 | Ato alemu misikir |
| 2 | Ato molla abiyu | M | 65 | Wayita | ///// ///// //// | 14 | 4 | Ato molla abiyu |
| 3 | Yenew fenta | M | 60 | Wayita | /// /// /// | 9 | | |
| 4 | Ato rekegn mondim ta | M | 70 | Wayita | ///// ///// //// | 19 | 1 | Ato rekegn mondim ta |
| 5 | Fantahun mekonen | M | 61 | Wayita | //// //// //// //// | 16 | 2 | Fantahun mekonen |
| 6 | At o werkineh beley | M | 60 | Wayia | ///// ///// | 10 | | |
| 7 | Ato alene yalew | M | 60 | Wayita | ///// ///// /// | 13 | 5 | Ato alene yalew |
| 8 | Ato tamire berehun | M | 62 | Wayita | /// /// /// | 9 | | |
| 1 | Mihiret chekol | M | 35 | Zengena giss | ///// ///// /// | 13 | | |
| 2 | Ato amare mengist | M | 50 | Zengena giss | ///// ///// ///// //// | 19 | 2 | Ato amare mengist |
| 3 | Ato moges fantahun | M | 35 | Zengena giss | ///// ///// ///// // | 17 | | |
| 4 | Ato ayalew abeb | M | 53 | Zengena giss | ///// ///// ///// /// | 18 | 5 | Ato ayalew abeb |
| 5 | Ato alamineh tsega | M | 60 | Zengena giss | ///// ///// ///// ///// | 20 | 1 | Ato alamineh tsega |
| 6 | Ato ashenafi arega | M | 52 | Zengena giss | ///// ///// ///// //// | 19 | 2 | Ato ashenafi arega |
| 7 | Ato gedefa deressa | M | 70 | Zengena giss | ///// ///// ///// // | 17 | | |
| 8 | Ato adera defersha | M | 48 | Zengeda giss | ///// ///// /// | 13 | | |
| 9 | Ato alene agidew | M | 40 | Zengena giss | ///// ///// / | 11 | | |
| 10 | Ato asmare gete | M | 45 | Zengena giss | ///// ///// ///// ///// | 20 | 1 | Ato asmare gete |

**Appendix 3: Selected key information for SURTA KEBELE**

| No | Name of candidate for Key information | sex | age | Got | Tally of the candidate | Total number of tally | rank | Selected key information |
|---|---|---|---|---|---|---|---|---|
| 1. | Ato tiruneh kasse | M | 70 | Gorgoyita | ///// ///// //// | 14 | | |
| 2. | Ato bayih bere | M | 58 | Gorgoyita | ///// ///// ///// //// | 19 | 1 | |
| 3. | Kess getaneh mekinnen | M | 35 | Gorgoyita | ///// ///// ///// // | 17 | 3 | |
| 4. | Ato fetene mengist | M | 50 | Gorgoyita | ///// ///// ///// / | 16 | 4 | |
| 5. | Ato amanu kebede | M | 42 | Gorgoyita | ///// ///// ///// /// | 18 | 2 | |
| 6. | Ato getachew adimass | M | 38 | Gorgoyita | ///// ///// ///// / | 16 | 4 | |
| 7. | w/r assay abelneh | F | 32 | Gorgoyita | ///// ///// ///// | 15 | | |
| 1. | Ato workineh ayenew | M | 46 | Ligidi | ///// ///// ///// ///// /// | 18 | 1 | |
| 2. | Ato atinaw mihiretie | M | 46 | Ligidi | ///// ///// / | 11 | | |
| 3. | w/r chekolech amogne | F | 45 | Ligidi | ///// ///// ///// / | 16 | 3 | |
| 4. | Ato dessa beyene | M | 40 | Ligidi | ///// ///// /// | 13 | 5 | |
| 5. | Ato alehegn mekureya | M | 46 | Ligidi | ///// ///// ///// // | 17 | 2 | |
| 6. | Ato tilaye tsehyi | M | 50 | Ligidi | ///// ///// | 10 | | |
| 7. | Kess milikit workineh | M | 51 | Ligidi | ///// ///// ///// / | 16 | 3 | |
| 8. | Ato yimenu beyene | M | 32 | Ligidi | ///// ///// | 9 | | |
| 1. | Ato bele mehon | M | 48 | Arsta | ///// ///// ///// ///// / | 21 | 1 | |
| 2. | Ato gedif belay | M | 52 | Arstas | ///// ///// ///// /// | 18 | 3 | |
| 3. | Kess animut beyene | M | 38 | Arsta | ///// ///// // | 12 | | |
| 4. | Kess aweke mengest | M | 65 | Arsta | ///// ///// ///// ///// // | 17 | 4 | |
| 5. | Ato yetwale ayalew | M | 44 | Arsta | ///// ///// //// | 14 | | |
| 6. | Kess mekurya addis | M | 41 | Arsta | ///// ///// //// | 14 | | |
| 7. | Ato bogale mengisit | M | 60 | Arsta | ///// ///// ///// ///// | 20 | 2 | |
| 8. | Ato getnet tesfa | M | 46 | Arsta | ///// ///// ///// / | 16 | | |
| 9. | Kess mekonnen chere | M | 70 | Arsta | ///// ///// ///// | 15 | 5 | |
| 10. | Ato ayalew emere | M | 66 | Arsta | | | | |

**Appendix 4: Selected key informant for AKENAGIFI KEBELE**

| No | Name of candidate for key informant selection | sex | age | GOTT | Tally of the candidate | Total number of tally | rank | Selected key informant |
|---|---|---|---|---|---|---|---|---|
| 1. | Ato layichal hunegnaw | M | 50 | SURTA | ///// ///// ///// ////// | 21 | 1 | Ato layichal hunegnaw |
| 2. | w/r zeyite freed | F | 65 | SURTA | ///// ///// /// | 13 | 5 | w/r zeyite freed |
| 3. | Ato bere alemayehu | M | 50 | SURTA | ///// ///// / | 11 | | |
| 4. | Ato ayichal mekonnen | M | 47 | SURTA | ///// ///// ///// / | 16 | 4 | Ato ayichal mekonnen |
| 5. | Ato addis birhan | M | 47 | SURTA | ///// ///// //// | 13 | | |
| 6. | Ato tamire woldie | M | 65 | SURTA | ///// ///// ///// / | 16 | 4 | Ato tamire woldie |
| 7. | Ato tilahun fenitahun | M | 69 | SURTA | ///// ////// ///// //// | 19 | 2 | Ato tilahun fenitahun |
| 8. | Ato enyew tessema | M | 55 | SURTA | ///// ///// ///// //// | 18 | | |
| 1. | Ato mekonnen kasse | M | 65 | MIRKITA | ///// ///// ///// / | 16 | 1 | Ato mekonnen kasse |
| 2. | Ato kinde mengist | M | 59 | MIRKITA | ///// ///// ///// / | 16 | 1 | Ato kinde mengist |
| 3. | Ato adugnew tiruneh | M | 48 | MIRKITA | ///// ///// ///// | 15 | 3 | Ato adugnew tiruneh |
| | | | | | | | | Tiruneh |
| 4. | Ato sema ayalew | M | 59 | MIRKITA | ///// ///// | 10 | | |
| 5. | w/r mulu melese | F | 70 | MIRKITA | ///// ///// /// | 13 | | |
| 6. | Ato alemayehu tessema | M | 75 | MIRKITA | ///// ///// | 10 | | |
| 7. | Ato tamir akalu | M | 70 | MIRKITA | ///// //// | 9 | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8. | Ato wondim ayana | M | 65 | MIRKITA | ///// //// | 9 | | |
| 9. | Ato fekadu getahun | M | 49 | MIRKITA | ///// ///// ///// | 15 | 4 | Ato fekadu getahun |
| 1. | Ato belayineh mulat | M | 52 | ABOYISTA | ///// ///// ///// / | 21 | 1 | Ato belayineh mulat |
| 2. | Ato birhanu kinde | M | 67 | ABOYISTA | ///// ///// ///// | 15 | | |
| 3. | Ato getnet mekonnen | M | 48 | ABOYISTA | ///// ///// ///// /// | 18 | 3 | Ato getnet mekonnen |
| 4. | Ato tewabe alemayehu | M | 50 | ABOYISTA | ///// ///// ///// ///// | 19 | 2 | Ato tewabe alemayehu |
| 5. | Kess abel wondim | M | 42 | ABOYISTA | ///// ///// ///// // | 17 | 4 | Kess abel wondim |
| 6. | Kess yihun mengiste | M | 68 | ABOYISTA | ///// ///// //// | 14 | | |
| 7. | Ato molla tiru | M | 43 | ABOYESTI | ///// ///// //// | 14 | | |
| 8. | Ato Ayenew kassa | M | 58 | ABOYISTA | ///// ///// ///// / | 16 | 5 | Ato ayenew kassa |

**Appendix 5: Total population number of sample KEBELEs and number of bamboo planters**

| No | Name of KEBELE | No . gots | Total household of KEBELEs | | | No . of bamboo planters in the KEBELEs | | |
|---|---|---|---|---|---|---|---|---|
| | | | M | F | total | M | F | Total |
| 1. | Kesasa CHEWSSA | 13 | 839 | 166 | 1005 | 444(52.9%) | 48(28.9%) | 492(48.9%) |
| 2. | Akena | 8 | 551 | 106 | 657 | 214(38.8%) | 25(23.6%) | 239(36.4%) |
| 3. | Surta | 9 | 648 | 129 | 777 | 263(40.6%) | 19(14.7%) | 282(36.3%) |
| | Total | 30 | 2030 | 401 | 2439 | 921(45.2%) | 92(22.9%) | 1013(41.6%) |

**Appendix 6: Checklist for focus group discussion**

**Expertise**

1. The existing local high land bamboo varieties and their differences morphological characteristics.
2. The productivity differences of local high land bamboo varieties.
3. Challenges and opportunities for high land bamboo cultivation processing and utilization in the last five years.
4. Is farmer preferred of bamboo from other trees by community?
5. For what purpose farmers use bamboo?.
6. Does the trend of bamboo development and utilization of bamboo by local community in the last five years increasing/ decreasing? Why ?
7. Does production of bamboo increasing or decreasing ? why ?
8. Does income generated from bamboo is increasing or decreasing ?why?
9. Is there The market availability for bamboo culms and bamboo products ?
10. Local criteria for wealth ranking.
11. The GOs and NGOs extension services for bamboo development and utilization

**Handicraftsmen**

1. When did you start bamboo processing?
2. What type of bamboo products did you produce ?
3. Where did you get row materials to produce different bamboo produce ?
4. What type of local high land bamboo varieties used for batter workability ?
5. The market availability for bamboo produces.
6. Employment opportunity of bamboo in bamboo processing
7. Is there any material and technical GOs and NGOs support for your work?
8. The current price of bamboo Culm .
9. Does the price of bamboo Culm increasing or decreasing in the last two years (2017-2018)? Why ?
10. The current price 0f bamboo products,
11. Cultural or traditional use of bamboo.
12. Traditional environmental conservation of bamboo.

## Appendix 7: Checklist for key information

1. Types of high land bamboo varieties existing in the study area
2. The workability differences of bamboo verities for different purposes.
3. The existing types of ownership of high land bamboo resources in the study area.
4. Why do you plant high land bamboo?
5. Types and method of processing and utilization practices of highland bamboo in the study area.
6. The trend preferences bamboo from other tree species.
7. The existing challenges and opportunities for bamboo cultivation processing and marketing.
8. Types of bamboo products produced in the local community.
9. The trend of bamboo products increase or decrease. Why?
10. Income generated from bamboo (for bamboo growers and non bamboo growers )
11. The major types of tree species commonly used to livelihood for the local community
12. The types of crop commonly used to livelihood for the local community.
13. The types of livestock and their products used to livelihood for the community.
14. What is the trend of income generated from different household livelihood sources?
15. Does it increase or decrease through time ? why ?
16. do market condition for bamboo culms and products./access, market chain/
17. Do bamboo growers have an experience of value addition during selling of high land bamboo?
18. The existing employment opportunity on bamboo sector.
19. The locally accepted criteria used wealth ranking.
20. GOS and NGOs/ INGOs involved in providing the extension service for bamboo plantation and benefits gained from bamboo production.
21. Types of extension services that have been give to bamboo grower in planting, processing, utilizing and marketing bamboo resources.
22. Is there any additional information regarding bamboo based socio economic. socio culutural and its contribution to livelihood?

## Appendix 8: Question for household interview

1. Name of enumerator ----------
   Signature----------
2. Date of interview----------
3. Name of district----------
4. Name of KEBELE administration----------got----------
5. Questioner no ----------

**Household characteristics**

6. Name of the household head----------sex:1=male:----------
   2=female
7. Age of household head----------
8. Household's family size:----------male----------female----------total--------
9. Marital status of the household: 1= married, 2= divorced, 3= widow, 4= single
10. Religion of household: 1= orthodox, 2= musilm, 3= protestant, 4= others
11. Education level, put(x) mark:- 1=lllitrare, 2=read and write, 3= primary(1-6,4=secondary (7-12),4=complete (grade12 and above)
12. For how long have you lived in this KEBELE?----------years
13. Wealth status of household in the community: 1= rich, 2= medium, 3=poor
14. Social role of household head in the community, put(x) mark: 1= ordinary citizen, 2= community leader, 3=religious leader , 4= other social leader (idir, mahiber etc)

**Economic information**

1. Land possession and land use
2. How much land do you own currently? 1/less than 0.25ha 3/1.25-2.25ha 2/0.25-1.25ha 4/greater than 2.25ha
3. Land use condition

   Farm land----------(ha) 4.grazing land ----------(ha)

   Forest land----------(ha) 5. Others----------(ha)

   Bamboo land----------(ha 6. Total----------(ha)
4. How did you acquire the land (the condition of access)? Circle the no.

   By distribution 3. gift

   Inheritance 4. Others
5. What are type and number of livestock do you have?

| Type of livestock | Number | Type of livestock | number | Types of livestock | Number |
|---|---|---|---|---|---|
| Cattle | | Equine | | Sheep | |
| Oxen | | Hoarse | | Goat | |
| Cow | | Mule | | Hen | |
| Calf | | Donkey | | | |
| Bull | | | | | |
| | | | | | |
| total | | Total | | | |

6. Type of house do you have?

   1=stone with tin 2=wood with tin, 3=wood with thach,

   4=stone with thatch 5=bamboo with thatch

**Income generation of household.**

1. What are family's major contributing sources of livelihood?

| No | Farm activity | Source of income | | If yes rank them according of level of contribution |
|---|---|---|---|---|
| | | 1.yes(x) | 2. No (x) | |
| 1. | Crop production | | | |
| 2. | Animal-rearing | | | |
| 3. | Forestry | | | |
| 4. | Off farm activities | | | |
| 5. | Others, specify | | | |

2.income obtained from crop production in birr(jualy2007-2008).

| No | Farm activity | Area ha | Amount of crop produced in Qt | Amount of crop consumed in Qt | Amount of crop sold in Qt | Amount of birr obtained from sell |
|---|---|---|---|---|---|---|
| | Crop Production | | | | | |
| | Teff | | | | | |
| | Wheat | | | | | |
| | Barley | | | | | |
| | Potato | | | | | |
| | Triticale | | | | | |
| | Pulse | | | | | |
| | Oilseed | | | | | |
| | Vegetable | | | | | |
| | Root crops | | | | | |
| | Others | | | | | |

3. What is the trend of crop productivity in the lasttwo years (2007-2008)?

1=increasing 2= decreasing 3= no change.

4. What is the trend of crop income in the last two years (2007-2008)?

1= increasing 2= decreasing 3= no change

Income from livestock production

5. Do you an experience of selling livestock?

1=yes 2= no

6. If your answer for question 7 is yes, what is income generated in birr (julay 2007-2008)

| NO | Livestock type | Yes(x) | No (x) | No livestock consumed | No of livestock sold | Income generated from livestock sold in birr |
|---|---|---|---|---|---|---|
| 1. | Cattle | | | | | |
| 2. | Goat | | | | | |
| 3. | Equine | | | | | |
| 4. | Hen | | | | | |
| 5. | Others | | | | | |

7. What is the trend of crop productivity in the lasttwo years( 2007-2008)?

1= increasing 2= decreasing 3= no change

8. What is income generated from animal products and services in birr (julay 2007-2008).

| No | Animal product/service type | Yes(x) | No (x) | unit | Amount consumed | Amount sold | Income generated from sold |
|---|---|---|---|---|---|---|---|
| 1. | Meat | | | | | | |
| 2. | Milk | | | | | | |
| 3. | Butter | | | | | | |
| 4. | Cheese | | | | | | |
| 5. | Eggs | | | | | | |
| 6. | Hides ahd skin | | | | | | |

9. What is the trend of the income generated from livestock products in the last two years (2007-2008)? 1= increasing 2=decreasing 3= no change

**Income from forest trees**

10. What is income generated from trees in birr(julay 2007-2008).

| No | Major type of species | Yes(x) | No (x) | unit | Amount sold | Income from sold |
|---|---|---|---|---|---|---|
| 1. | Eucalyptus globules | | | | | |
| 2. | Acacia decurrens | | | | | |
| 3. | Cupresses lusitanica | | | | | |
| 4. | Acacia abyssinica | | | | | |
| 5. | Juniperus procera | | | | | |
| 6. | Prunus Africana, | | | | | |
| 7. | Apodytes dimidiate, | | | | | |
| 8. | Meytanus obuskura | | | | | |
| 9. | Others | | | | | |

11. What is the trend of the income generated from trees the last two years (2007-2008)?

1= increasing 2= decreasing 3= no change

**Income from bamboo**

12. Income generated from bamboo in the last two years(2007-2008)

| No | Source of income | unit | 2007 | 2008 |
|---|---|---|---|---|
| 1. | Bamboo culm | | | |
| | Used for use | No | | |
| | Used for sale | No | | |
| | Income obtained from | Birr | | |

13. What is the trend of the income generated from bamboo the last two year (1007-2008)?

1=increasing 2=decreasing 3=no change

14. Do you process bamboo in to other products before you sale the Culm

1=yes 2=no

15. If your answer is yes what are the amount bamboo products and the income generated in birr from in the last two years (2007-2008)?

| No | Soure of income | Unit | 2007 | 2008 |
|---|---|---|---|---|
| 1 | Bamboo mat | | | |
| | Used for use | No | | |
| | Used for sell | No | | |
| | Income obtained from sale | Birr | | |
| 2 | Bamboo sofa | No | | |
| | Used for use | No | | |
| | Used for sell | Birr | | |
| | Income obtained from sale | No | | |
| 3 | Chair | No | | |
| | Used for use | Birr | | |
| | Used for sell | No | | |
| | Income obtained from sell | No | | |
| 4 | Table | Birr | | |
| | Used for use | No | | |
| | Used for sell | Birr | | |
| | Income obtained from sale | No | | |
| 5 | Shelf | No | | |
| | Used for use | No | | |
| | Used for sell | Birr | | |
| | Income obtained from sale | No | | |

16. What is the trend of the income generated from bamboo products the two year (2007-2008)?

1= increasing 2= decreasing 3= no change

17. Where do you get the bamboo raw material for processing local bamboo products?

| No | Bamboo raw material source | Yes(x) | No (x) | If yes rank them |
|---|---|---|---|---|
| 1. | Communal | | | |
| 2. | Own | | | |
| 3. | From individuals | | | |
| 4. | Church compound | | | |
| 5. | Others | | | |

18. Where did you sale bamboo and its products?

1 = on farm 2 = local market 3 = in district market centers 4. Outside the district

5 = not sell

**Income from off farm activities**

19. What is income generated from off-farm activities in birr (julay 2007-2008).

| No | Income source generated from off-farm activates | Yes(x) | No (x) | Amount of income obtained |
|---|---|---|---|---|
| 1. | Family aid | | | |
| 2. | Mile | | | |
| 3. | House rent | | | |
| 4. | Petty tread | | | |
| 5. | Daily laborer | | | |
| 6. | Other | | | |

20. What is trend of the income generated from bamboo product the last two years (2007-2008)?

1 = increasing 2 = decreasing 3 = no change

21. What is your family expenses of lasttwo years birr( julay 2007-2008).

| No | Expenses type | Yes(x) | No (x) | If yes how much in birr |
|---|---|---|---|---|
| 1. | Food expenses | | | |
| 2. | Seed purchase | | | |
| 3. | Fertilizer purchase | | | |
| 4. | Schooling | | | |
| 5. | Health expenses | | | |
| 6. | Clothing | | | |
| 7. | Land rent | | | |
| 8. | Special expenses | | | |
| 9. | Others | | | |

Information related to bamboo propagation, management, utilization and processing

22. Where did you get an experience of planting bamboo?

1=form parents 2=from neighbors

3=from friends 4=if other exist specify

23. What is the number of years you are started to plant bamboo? ----------years

24. What are the number appropriate planting seasons for bamboo plantation ----------

25. Do you prefer bamboo tree from other tree species?

1=yes 2=no

Information related cultural use of bamboo

26/ do people usebamboo for cultural perpouse ?

1. Yes 2. no

If your answer is yes what is the cultural use of banboo ranking them according toHHS

| No | Cultural use of bamboo frequency | yes | No | If yes ranking them |
|---|---|---|---|---|
| 1 | Medicine | | | |
| 2 | Fuel wood | | | |
| 3 | Agricultural tool | | | |
| 4 | Chair | | | |
| 5 | Bad | | | |
| 6 | Musical instrument | | | |
| 7 | Local pipe | | | |
| 8 | Housing | | | |
| 9 | Fance | | | |
| 10 | Basket | | | |
| 11 | Behieve | | | |
| 12 | Cutting meat | | | |
| 13 | Tooth bursh | | | |
| 14 | Charcoal | | | |
| 15 | Bridge | | | |
| 16 | Fodder | | | |
| 17 | Boundary marker | | | |
| 18 | Coffee ceremony | | | |
| 19 | Green store | | | |
| 20 | Cooking stick | | | |
| 21 | Food | | | |
| 22 | Umbrella | | | |
| 23 | Cotton roping | | | |
| 24 | Mugid [yeingera megageria]<br>265 | | | |
| 25 | Distillation tube<br>123 | | | |
| 26 | Cornes fram | | | |

Environmental conservation activities.

26. Do people use bamboo for environmental conservation?

    1 =yes 2=no

27. If your answer is yes what is the environmental conservation of bamboo please rank them according

| No | Conservation types | Yes | No | If yes rank them |
|---|---|---|---|---|
| 1 | Water conservation | | | |
| 2 | Protect erosion | | | |
| 3 | Replace degraded land | | | |
| 4 | Farm boundary | | | |
| 5 | Wind break | | | |
| 6 | Protect slop land | | | |
| 7 | Boundary marker | | | |
| 8 | Recovery gully side | | | |
| 9 | Home stand | | | |
| 10 | Church stand | | | |

28. Where do you plant high land bamboo on your farm land/ please rank them according to their abundance.

| NO | Niches of bamboo plantation | Yes(x) | No (x) | If yes rank them |
|---|---|---|---|---|
| 1. | Homestead | | | |
| 2. | Farm boundary | | | |
| 3. | Gully side | | | |
| 4. | Road side | | | |
| 5. | River bank | | | |
| 6. | Wood lot | | | |
| 7. | Other | | | |

29. What is the trend of bamboo planting in the last five years time?

1= increasing 2= decreasing 3= no change

30. What type bamboo locally known varieties you are growing on your farm land?

1 = red, 2 = black 3 = stripped

31. Is there any experience of growing bamboo with integrating crops/ animals?

1 = yes 2 = no

32. Is there any problems regarding on bamboo development and management

1 = yes 2 = no

33. Do you training of bamboo propagation, management and utilization in the five years (1999-2013)?

1 = yes 2 = no

34. If you or answer for Q 38 is yes what type of training and from whim you or your family gets the training? Put(x) mark

| No | Training type | Yes(x) | No (x) | Put(x)mark | | Remark |
|---|---|---|---|---|---|---|
| | | | | GOs | NGO/INGO | |
| 1. | Propagation of bamboo | | | | | |
| 2. | Bamboo utilization | | | | | |
| 3. | Bamboo processing | | | | | |
| 4. | Bamboo harvesting | | | | | |
| 5. | Bamboo post harvest handling | | | | | |
| 6. | Other (specify..) | | | | | |

35. What is the bamboo harvesting experience in the last twenty years?

1 = increasing 2 = decreasing 3 = no change

36. Do you know months of bamboo to harvested?

1 = yes 2 = no

37. If your answer for Q no 41 is yes list the months of bamboo to be harvested -

38. Do you know bamboo age to be harvested?

1 = yes 2= no

39. If your answer for Q NO 42 is yes what is the appropriate age of bamboo to be harvested------

40. What type of harvested methods do you apply? Put(x) mark

| Harvest type | Yes(x) | No (x) | If yes rank them |
|---|---|---|---|
| Total harvest method | | | |
| Selective harvesting method | | | |
| Both | | | |
| Other(list) | | | |

41. Do you use processing of bamboo culms in to different products (like bamboo mate, table, basket, chair etc) 1= yes 2= no

42. have you ever been supported by GOs and NGOs regarding bamboo planting, management, utilization and processing (with material, technical and others).

1 = yes 2 = no

## Appendix 9: Bamboo inventory data collection sheet

1. name of expert who conduct inventory----------
2. sample household number----------
3. total number of clump----------
4. total area of the household’s clumps----------ha
5. slop----------%
6. year of establishment of clumps----------year

# APPROVAL SHEET II

I, the undersigned, supervisor of Sirawdink Asfaw have read and evaluated her thesis entitled **'Socio economic, Socio cultural value of highland bamboo plants and Its contribution to Rural livelihood in Banja District Awi Zone Ethiopia'** and approved for submission in partial fulfillment of the requirements for the degree of Masters of science in biology.

| _____ | _____ | _____ |
|---|---|---|
| Name of principal | Signature | Date |
| Advisor | | |
| _____ | _____ | _____ |
| Name of Co Advisor | Signature | Date |