Mekelle University

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Honey and Beeswax Value Chains Analysis: The Case of Adwa and Ahferom Districts, Central Tigray, Ethiopia

BY

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A Thesis

Submitted in Partial Fulfillment of the Requirement for the Master of Science Degree in Livestock Production and Pastoral Development

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December, 2015

Mekelle, Ethiopia

Declaration

This is to certify that this thesis entitled **"Honey and Beeswax Value Chains Analysis: The Case of Adwa and Ahferom Districts, Central Tigray, Ethiopia"** submitted in partial fulfillment of the requirements for the award of the degree of M.Sc., in Livestock production and Pastoral Development to the School of Graduate Studies, Mekelle University, through the Department of Animal, Rangeland and Wildlife Sciences, done by Abrehet Gebrekristos, ID. No. CDA/PR/001/06 and an authentic work carried out by her under my guidance. The matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of my knowledge and belief.

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Biographical Sketch

The author was born in Adwa woreda Central Zone of Tigray Regional State on September 1, 1987. She attended her elementary school in Mariam Shewito Elementary School (1996-2003) and secondary school education in Adwa Queen Sheba Comprehensive secondary school from (2004-2007). Then, she joined Axum University in 2008 and completed with B.Sc. Degree in Range management, Animal Science and Marketing in July, 2010. After graduation, she worked in Adwa Woreda Office of Agriculture and Rural Development for about two years and six months. Finally, she joined in Mekelle University since 2014 to pursue her MSc. degree in Livestock Production and Pastoral Development.

Acknowledgement

Above all, I would like to thanks to my almighty God for his help in passing me through the complicated situations and for his help and strength during my whole study time.

I primarily desire to express my special appreciation and heartfelt gratitude for the guidance, support and inspiration of my Advisors Yaynshet Tesfay (PhD), Kebede Manjur (Asst. Prof.) and Mohammed Tilahun (MSc) for their critical comments starting from the research proposal to the final thesis writing.

I would like to thank to ILRI project for the financial support to pursue my MSc degree and supporting the entire field work. Moreover, it was a great pleasure to extend my appreciation to staff members of ILRI project for their facilitation of the study process and encouragement. I would like to thank all staff members and development agents of Adwa and Ahferom woredas Agriculture and Rural Development Offices for their cooperation to access the available data from woreda offices and all sample respondents for this study. My special heartfelt thank to my instructor Tikabo Gebremariam for his valuable support and encouragement in my endeavor.

Abbreviation and Acronomy

CSA	Central Statistical Agency
DAs	Development Agents
DCSI	Dedebit Credit and Saving Institution
E.C	Ethiopia Calendar
ETB	Ethiopian Birr
FAO	Food and Agricultural Organization of the United Nations
FTC	Farmers Training Center
G.C	Gregorian calendar
HABP	Household Asset Building Program
HH	Head of the Householder
ILRI	International Livestock Research Institutions
IPMS	Improve Productivity and Market Success
Km	Kilometer
LPM	Liner Probability Model
NGOs	Non Governmental Organizations
OoARD	Offices of Agricultural and Rural Development
PA	Peasant Association
PSNP	Productive Safety Net Program
REST	Relief Society of Tigray
TAMPA	Tigray Agricultural Marketing Promotion Agency
TARI	Tigray Agricultural Research Institute
TLU	Tropical Livestock Unit

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Abstract

Beekeeping is an appropriate and well-accepted farming activity which directly and indirectly contributes to smallholder income generation in Adwa and Ahferom districts. But there are a number of problems in honey and beeswax value chains that can be faced from production up to consumption. This study aimed at honey and beeswax value chain analysis in Adwa and Ahferom districts with specific objectives of describing and characterizing the different value chain functions, actors and service providers; identify factors affecting honey and beeswax value chain; and determine socio economic contribution of honey and beeswax value chain. Multi-stage sampling technique was used to identify the sample respondents. Data were collected from multiple sources including farmers, traders, processors and service providers by using semi structured interview, key informants interview, group discussion and field observation. Data were computed to descriptive statistics, probit regression models and triangulation. In this study there are multiple actors and service providers that directly and/or indirectly involve in the honey and beeswax value chains. The major factors that influence adoption of beekeeping technologies were age, education, extension service and total land size. From the result, there was significance mean difference in annual income between beekeepers and non beekeepers (p=0.001) with better income of the beekeepers. Benefit of beekeepers from white honey is higher than Amber/golden honey. The major problems in honey and beeswax value chains along each stage were shortage of modern beekeeping equipments, lack of beekeeping skill, lack of market linkage and lack of extension support. Generally, there are different value chain actors and service providers along the value chain. Honey and beeswax value chains used as source of food, income and employment moreover, total income of beekeepers was higher than non beekeepers. Honey and beeswax value chains were found to be influenced by different household, institutional and bio-physical factors despite its substantial economic and social values. Hence, addressing these constraints will be pertinent to maximize the benefits of honey and beeswax value chain.

Key-Words; Honey, Beeswax, Value Chain, chain Actors, Service Providers

Chapter one: Introduction

1.1. Backgrounds and Justifications

Beekeeping is an appropriate farming activity that is suited to extensive systems in tropical Africa. Ethiopia is known for its large variation of agro-climatic conditions and biodiversity which includes good survival of diversified honeybee flora and large number of honeybee colonies (Adgaba, 2007). Because of this, Ethiopia is a leading country in Africa and ninth in the world in honey production. Considering beeswax production, it is the first in Africa and third in the world (FAO, 2005).

Ethiopia has potential natural resources to produce 500,000 tons of honey and 50,000 tones of beeswax per annum. Currently, honey and beeswax productions are 53,675.36 tons and 3,000 tones, respectively (CSA, 2011). From the total honey production over 97% is sold through formal and informal domestic spot markets, and 85% of this is purchased by brewers of *tej* (CSA, 2011).

Beekeeping is a promising farm activity which directly and indirectly contributes to smallholder income and national economy. It has been a way of diversifying income of subsistence for landless smallholder farmers in Ethiopia (Belets and Berhanu, 2014). From the total honey produced in the country beekeepers are estimated to earn about 360-480 million Birr per year (Nuru, 2002). Beekeeping is also important for creating job to landless peoples (Melaku *et al*., 2013).

Tigray is one of the major honey producer regions in Ethiopia. Tigray region accounts about 4 % of the total honeybee colonies (206,040) and 5.8% of the total honey production of the national beekeeping potential (CSA, 2011). Central zone of Tigray region is potential for beekeeping practices and the yield of honey from improved and traditional types of beehives is high. This is attributed to substantial and continuous public work on natural resource rehabilitation, rich indigenous knowledge, innovation practices of beekeeping, fragmented landholding that is not used for crop cultivation, heterogynous landscape and good vegetation cover (Teweldemedhn, 2011). In central zone of Tigray region, Adwa and Ahferom districts have also diversified types

of vegetation and cultivated crops potential for beekeeping activities. In the region beekeeping is considered as essential to improve the livelihood and nutrition of the smallholders. To improve the honey production thousands of improved beehives, as intervention package, have been introduced in the region. Number of honeybee colony increased by 4.2% and the honey production has increased by 13.2% over the period of 1996-2011 (CSA, 2011). As a result increased honey production and productivity has been achieved under the smallholder farmers. Despite the multitude of efforts has been done in promoting beekeeping and increasing production, there still exist a limitation attributable to each value chain node in the whole honey and beeswax value chain analysis. Beekeeping input are expensive and not widely available (MoA and ILRI, 2013). There is poor market linkage between potential producers and consumers as well as poor extension service on beekeeping activities (Assefa, 2009). Generally, there is no adequate and organized study on honey and beeswax value chain analysis. This study may serve for detail understanding of the honey and beeswax value chains and their contribution to value chain actors and helps in improving the honey and beeswax production and marketing in the two selected districts in central zone of Tigray region, northern Ethiopia.

1.2. Statements of the problem

In Ethiopia beekeeping can play significant roles in poverty reduction, achieving sustainable development and conservation of natural resources. Beekeeping is important for the society as food, income generation for both domestic market, export markets, as employment opportunity and other cultural aspects. Around two million farm households of the country are involved in beekeeping business using the traditional, intermediate and improved beehives (Oxfam, 2011). It is also observed that a large number of people (collectors and retailers) participate in honey collection and retailing (at village, district and zonal levels) and thousands of households are engaged in *tej*-making (Beyene and David, 2007).

Honeybee products are economically important in central Tigray. Honey and beeswax for smallholder farmers and other value chain actors have key economic and social values despite the absence of organized information regarding the value chains. Most of the previous studies in Tigray region were done on beekeeping adoption strategies to climate change (Melaku *et al*., 2013), market chain analysis of honey production (Assefa, 2009), honey market constraints and

opportunities (Tezera, 2013), adoption of improved box hive (Werkneh, 2007; Belets and Brhanu, 2014; Gidey and Mokonen, 2010). There is no study on honey and beeswax value chain especially in Central Zone of Tigray. There is no complete and reliable information on honey and beeswax value chain. The tendency to address to value chain actors and service providers in a holistic manner is poorly understood. The factors that determine the honey and beeswax value chain are not well identified and the socio-economic benefit of honey and beeswax value chain is not identified. For this reason, it has remained difficult to design and implement integrated honey and beeswax value chain development in the study areas. Therefore, this study will have paramount importance in analyzing the value chains and setting baseline information regarding honey and beeswax value chains and socio-economic important to value chain players.

1.3. Objectives of the study

1.3.1. General objective

The general objective of this study is to analyze honey and beeswax value chain and its socio-economic contribution in Adwa and Ahferom districts.

1.3.2. Specific objectives

1. To describe and characterize the different functions, actors and service providers along the honey and beeswax value chain
2. To examine factors affecting honey and beeswax value chains in the study areas
3. To determine the socio- economic contribution of honey and beeswax
4. To identify the challenges and opportunities in honey and beeswax value chain development

1.4. Research questions

1. What are the contributions of honey and beeswax value chain actors and services providers?
2. What looks like the map of honey and beeswax value chain?
3. What are the factors affecting honey and beeswax value chains?

4. What are the socio-economic benefits of honey and beeswax for value chain actors?
5. What are the challenges and opportunities in the honey beeswax value chain development?

1.5. Significance of the study

This study will generate useful information on honey and beeswax value chain which has significant have importance of various actors dealing with honey production, processing and marketing. Policy makers can use the information in designing beekeeping development strategic plan and program. Moreover, the study is expected to serve as an input for researchers interested to undertake further research, analysis and development appropriate extension systems on honey and beeswax value chains.

1.6. Scope and limitations of the study

Because of resources constraints this study was conducted in two districts in the central zone of Tigray. The information was also collected from limited sample households of selected peasant associations (PAs) of the district in the study areas. Besides, scope wise the value chain analysis only focuses on input–output, services and governance aspects of value chain. However, this limitation does not limit the applicability of the finding for other similar area of the region where the procedures are scientifically rigorous.

1.7. Organization of the study

The thesis is organized in to five chapters. It starts with the introduction, which includes statement of the problem, objectives, significance and limitation of the study. The second chapter reviews literature that deals with concepts and epical findings. The third chapter explains research methodology including description of the study area, sampling techniques, methods of data collection and analysis. In the fourth chapter, the main findings are reported and discussed. Finally, conclusions and recommendations are presented in chapter five.

Chapter two: Literature Reviews

This chapter includes definition and basic concepts of value chain, beekeeping value chain, value chain mapping, value chain analysis, value chain influencers, actors, service providers and value chain governance. Moreover, it contains such as honeybee production system in Ethiopia, honey and beeswax production, honey and beeswax marketing, socio-economic contribution of honey and beeswax and constraints of honey and beeswax value chain.

2.1. Concepts and definitions

Value chain: Is the full range of activities such as design, production, marketing and distribution businesses go through to bring a product or service from conception to their customers. For producers that produce goods, the value chain starts with the raw materials used to make their products and consists of everything that is added to it before it ends up being sold to consumers (Kaplinsky, 2000).

Beekeeping value chain: Honey and beeswax are the two main products generated by the beekeeping subsector. Honey is the highest volume and value honeybee product trade in the chains. The economic value of beekeeping products has also risen over time with increasing prices. The economic and cultural value of honey is reflected in its selling price and differs by region. Production is affected by labour, type of beehive and processing equipment, taxes, transport, storage and packaging costs (Ingram, 2014).

Value chain mapping: Is a value chain analysis systematically mapping the actors participating in the production, distribution, processing, marketing and consumption of a particular product or products. This mapping assesses the characteristics of actors, profit and cost structures and flows of goods throughout the chain, employment characteristics and volumes of domestic and foreign sales (Kaplinsky, 2000).

Value chain analysis: Is a method for accounting and presenting the value that is created in a product or service as it is transformed from raw inputs to a final product consumed by end users. Value chain analysis facilitates an improved understanding of competitive challenge that helps in

identification of relationships and coordination mechanisms and assists in understanding how chain actors deal with powers and who governs or influences the chain (FIAS, 2007).

Value chain actors (players): Value chain actors are those individuals or institutions who take ownership of a product, through the exchange of money or equivalent goods or services, during the transaction process of moving the product from conception to the end user. The term value chain actors summarizes all individuals, enterprises and public agencies related to value chain, in particular that value chain operators, providers of operational services and the providers of support services (GTZ, 2007).

Value chain influencers: It influences the operations of the chain by providing the regulatory and administrative conditions that have to be met all players with in the value chain. The concepts of the value chain influencers are extended to consider the social and physical environments with in which the farmers operate (Roduner, 2007).

Service providers: Service providers are individuals or firms providing a service without taking ownership of the product are considered as service providers. Support service providers are essential for value chain development and include sector specific input and equipment providers, financial service, business management service, and market information access and dissemination, technology suppliers, advisory service, and etc (Kaplinsky, 2000). Support service for small-scale farmers involved in beekeeping need to be importantly accessible. Service providers are such as extension offices, research institutions, NGOs, projects, financial institutions and private sectors (Martin *et al*., 2012).

Value chain governance: Governance with in value chain refers to the structure of relationships and coordination mechanism that exist between actors in value chain (Gebremedhin *et al*., 2012). Governance is important from a policy perspective by identifying the institutional arrangement that may be needed to be targeted to improve capability in the value chain, remedy distributional distortions, and increases value added in the sector (McCormick and Schmitz, 2001). There are also international and national regulatory authorities and support actors including development and conservation NGOs and research organizations. The actors in a chain control their own activities and controlled by other actors directly or indirectly. The pattern of direct and indirect control in value chain is called its governances (Kaplinsky, 2000).

2.2. Beekeeping production system in Ethiopia

Ethiopia is the leading honey producer in Africa and ninth honey-producing countries in the world. Farmers practice their beekeeping activity in different beehives with different honey bee management systems. Beekeeping production systems identification was done based on the types of technology and management practices used by the beekeepers. Based on these criteria three types of beekeeping production systems identified in Ethiopia called as traditional, transitional and improved **(**Tessega, 2009).

Traditional beekeeping system: In Ethiopia, traditional beekeeping is the oldest and the most practice, which has been carried out by the people for thousands of years. Several million bee colonies are managed with the same old traditional beekeeping methods in almost all parts of the country. Traditional beekeeping is mostly practiced with different types of traditional hives. The beekeepers that are experienced and skilful in using these hives could do many operations with less facility. Harvesting is achieved with minimal cost and labor, and it is important to people living a marginal existence (Gezahegne, 2001). In 2009/2010 the average honey production in Tigray region was 8-15kg/hive (Gidey and Mekonen, 2010). One advantage of traditional beekeeping, it needs low cost. However, the main weakness in traditional beekeeping is during harvesting many bees are killed, brood and honey combs are harvested together because it is difficult to separation, difficult to feed bee colony during time of food shortage, not easy to inspection and low productivity (Gallmann and Thomas, 2012).

Transitional beekeeping system: Transitional (intermediate) beehives can be constructed by the farmers themselves using locally available materials and its productivity per hive approaches to the modern beehive but it is not durable like the modern beehives. The productivity from one top bar hives in Amhara region has a mean of 10.66kg/hive ranging from 7kg to 18kg/hive (Tessega, 2009). This type of beekeeping production system important to increase productivity of these beehives only through good management practices with using the opportunity of favorable beekeeping environment (Dayanandan, 2015).

Improved beekeeping system: Improved beekeeping methods aimed to obtain the maximum honey crop season after season, without harming bees. The number of boxes is varied seasonally

according to the population size of bees. In many countries, improved hives have proved to be convenient for handling and management (Nicola, 2002). Average honey production from improved beekeeping system in Tigray region in the year of 2009/2010 was 20-30kg/hive (Gidey and Mekonen, 2010). The main advantage is beehives can be managed efficiently, beehives are easy to visit, harvest, treat, feed and honey and beeswax production is good quality and quantity. But, the main weakness of improved beekeeping is high cost of equipment, more knowledge and skill will be required (Gidey and Mekonen, 2010).

Generally, the amount of honey produced from one beehive per season varies from places to places. In most cases it is determined by the existences of plenty pollen and nectar source plants and the level of management and input (Biruk, 2014). On average honey productivity in Ethiopia, beekeepers harvest 15.5kg of honey per improved beehive, 5 kg per traditional and 7 kg per transitional beehives in the production year 2013/2014 (Dayanandan, 2015). Beeswax production from traditional beehive is about 8-10% weight of the honey, from modern beehive is about 1-2% weight of the honey yield and from transitional beehive is about 8% weight of the honey (Gezahegne, 2001). According to CSA (2006), the average beeswax production in Ethiopia is 0.95kg / hive and the annual average value of beeswax is estimated at about 125 million Birr (Nuru, 2002).

Honey and beeswax marketing: According to CSA (2011), the total volume of annual honey production in Ethiopia was 53,675.36 tons in which around 99.2 percent were consumed domestically while 0.8 percent was exported. Domestic honey price in Ethiopia vary among the regions and type of honey. From the total of honey production in Tigray region 57.88 % sold in market and 42.12 % was used for home consumption. In central zone of Tigray, 63.88% of the honey produced sold in the market and 36.12% was used for home consumption (CSA, 2013). Among the regions of Ethiopia the highest prices for honey is in Tigray region. In the local market producers sell the white honey reached ETB 120-130per kg (CSA, 2011). The selling price of white honey from collector/traders in Tigray was 170 ETB/kg in the year of 2010. The local market price of yellow honey was lower reaching a maximum level of 60 ETB/kg where as a national average price around 39.45 ETB/kg. Most current price for yellow honey in the Tigray area was around 90 ETB/kg (CSA, 2011). Local market price for Amber honey which is mainly used for tej production is typically lower than prices for white and yellow honey. In Tigray area,

the price for Amber honey ranged 30 ETB to 50 ETB/kg for crude unprocessed honey and 40 ETB to 60 ETB/kg for purified honey depending on the area. Selling prices for amber honey ranged from 40 ETB/kg for totally unprocessed crude honey sold to tej houses to 60 ETB/kg for purified honey to be used for consumption purposes. The average price of honey in Tigray region ranges between 40.67–76.44 ETB (CSA, 2011).

2.3. Socio-economic importance of beekeeping

Beekeeping plays important role in food security and poverty alleviation in Ethiopia. If crop production is reduced because of shortage rainfall, beekeepers will harvest the honey and earn money to purchase grain for their household food. Beekeeping is not affected this much by irregular rainfall conditions as that of growing annul crops (Melaku *et al*., 2008). Beekeeping in Ethiopia is an important activity for many rural people both men and women and is also carried out in home gardens and even houses in all parts of the country (Meaza, 2010).

Food: Honey is appreciated in all places as a sweet and tasty food. During food shortage it is useful carbohydrate source that contains trace elements and adds nutritional diversity to poor diets. Honey often has an important role in traditional food preparation. As cultural food, honey is widely used as a source of sugars for making honey wines and beers. Honey also has a high cultural value eating honey or using it for anointing is part of many traditional birth, marriage and funeral ceremonies (Brad, 2003).

Source of income: Producers generate substantial income from beekeeping products annually. Honey is sources of cash for almost all beekeeping households. Honey and beeswax play a big role in the cultural and religious life of the people in the country. Honey and beeswax are the important agricultural export products in Ethiopia. It is used in the manufacturing of cosmetics, candles, foundation sheets for modern hives, medicines, polishes etc (Nuru, 2002).

Employment: Beekeeping is an important livelihood which served as job creation in both rural and urban areas (Melaku *et al*., 2008). Ethiopian people intensively work in organizing jobless urban and landless rural youth and women to involve them in honeybee equipment production and beekeeping activities. A significant number of people are currently engaged in honey and

beeswax collection, *tej* making, honey and beeswax processing and marketing (MoARD, 2007). Around two million people are involved in the honey value chain (Oxfam, 2011).

2.4. Constraints of honey and beeswax value chains

There are different constraints in each stage of honey and beeswax value chains hence described as follow.

Input supply: Improved beehives constructed by private wood workshops which receive orders from the OoARD. The OoARD in coordination with multipurpose cooperatives then distributes beehives in bulk to each district. Farmers observed a difference between frames and a modern hive box but there is problem in quality of the improved beehive (Yigzaw *et al*., 2010). There is shortage of beekeeping equipment supply such as honey extractor, casting mold and other body protective material not much distributed for each producers as well as improved packaging materials for example, new glass jars with lids for honey are not commonly available in many areas and their cost can be high (Abebe *et al.*, 2010). Increasing in price of improved beehive and its accessories is one constraint which hinders members from diversifying their production (Biruk, 2014).

Production: Honey and beeswax production is small due to low productivity because of poor technical knowhow on bee management and harvesting techniques and widespread use of traditional beehives. Honeybees are affected by agrochemicals application. The problem becomes more severe because of unsystematic utilization of these chemical type and time of application (Tilahun *et al*., 2010).

Honeybee pests, predators and diseases are the challenges for both the honeybees and beekeepers. The major pests and predators are ants, wax moth, beetles, spiders, wasps, prey mantis, lizard, snake, honey badger and birds. Those pest and predators killed the bee colony and caused reduction in honeybee production (Tessega, 2009). This challenge of promoting improved technical information and knowledge results in a competitive disadvantage for small scale farmers. Conducting trainings and distributing training materials in remote and rural areas is a challenge as its costs are high as a result of dispersed small-scale farmers (Weldewahid *et al*., 2012).

Marketing: The constraint on honey and beeswax marketing in the country is price variation on honey in local markets. Most honey that come to market is not extracted, unstrained and poorly managed. There was absence of organized market channel, transportation problem, lack of appropriate technologies for collecting, processing, packing and storage of honey to keep its natural quality and the market information is not sufficiently expanded along the all market actors (Meaza, 2010). The major challenges in the beehive products marketing cooperative include a threat by honey traders who usually select to buy honey with higher price in reference to the collection price in which the cooperative buys from farmers (Yigzaw *et al*., 2010). Honey collection centers faced challenge in setting up as they require, not only some form of physical structure like a building and its related costs, but also good management and financial investments by its members. Collection center requires initial funding, travel time and good communications among small-scale farmers (Martin *et al*., 2012).

Processing: In connection to honey and beeswax processing problem like lack of value chain value addition along the supply chain, financial resources for investment in honey processing, lack of honey processing skill, honey processing equipments and poor honey handling. The apiculture cooperative may be considered as private shops and/or the union shop. At farm household level basic processing of bee products may be traditionally managed (Abebe *et al.*, 2010).

Chapter three: Materials and Methods

This chapter discusses the research methodology used in the study including description of the study areas, sampling procedures, method of data collection and analysis.

3.1. Descriptions of the study areas

This study was carried - out in Adwa and Ahferom districts which are located in central zone Tigray and the description of each study district is provided below.

Location of the study area: Adwa and Ahferom districts are located in central zone of Tigray Region, Northern Ethiopia at a distance of 225 and 186 kilometers from the regional state capital city of Mekelle, respectively. Geographically location of Adwa and Ahferom districts lies between 38^0 53'55"E to 38^0 57' 30" E longitude and 14^0 08' 43" N to14^0 11' 47 "North latitude and between 38° 56’ 30″ to 39° 18′ 00″ East longitude and 14° 06’ 30″ to 14° 38’ 30" North latitudes, respectively (OoARD, 2015). Figure 1 shows map of the two study districts.

Topography: Adwa district is bounded by Mereb-leke from North, Ahferom and Weri-leke from East, Werileke and Laelay-Maichew districts from South and West. While Ahferom district is bounded in the North by Eritrea, in the East by Ganta-Afeshun and Gulo-Mekeda districts, in the South by Worei-leke district and in the West by Adwa district (OoARD, 2015).

Climate: According to both districts Offices of Agricultural and Rural Development annual report 2010/2011, has a combination of agro-climatic zones in Adwa is 32.2% in Kolla (lowland) and 67.8% Weinadega (midland) and Ahferom district also 8.37% Kolla (lowland), 81.63% Weinadega (midland) and 10 % Dega (highland). The annual mean rainfall ranges between 600 to 850 mm and 538 to 700 mm for Adwa and Ahferom districts, respectively. Annual average temperature is ranged from 12 ^{0}C to 27^0C and 22^0C to 27^0C Adwa and Ahferom districts.

Demographic characteristic of the study areas: Total human population in Adwa and Ahferom districts was 112,987 and 173,651, respectively. The number of household headed Adwa and Ahferom districts are 25,165 and 46,395, from those 17,645 and 28,469 are male household headed, respectively (OoARD, 2015).

Socio - economic features of the area: The main economic activities of the study area is mixed farming practiced by the small holder farmers (crop cultivation and livestock rearing). Livestock population were cattle 30,091 and 31,382, sheep and goat 131,831 and 110,389, equines 12,198 and 3,649, chicken 132,773 and 255,794 in Adwa and Ahferom, respectively. Numbers of honeybee colonies are 16,659 and 38, 307 for Adwa and Ahferom, respectively. From those 5187 and 31,090 are in traditional beehives while the rest 7708 and 7217 hived in improved beehives, respectively. The dominant crops produced in the area are cereals (Teff, wheat, mixture of barley and wheat, finger millet, sorghum and maize), vegetables (onion, tomato, garlic, cabbage, carrot and lettuce) and oil crops (linseed) and nug (Niger seed). Little irrigation and forestry activities served as the sources of livelihood next to crops. There are also some supportive activities like food/cash for work in governmental and non-governmental organizations and other off-farm activities. Similarly, in Ahferom district the livelihoods of local farmers mainly depend on mixed faming of crops and livestock. The major crop grown includes Teff, wheat, sorghum, finger millet, Barley and maize. Livestock, crop and beekeeping are the main sources of income for the farmers in the districts. During the years with crop failure, most households used income from livestock, beekeeping and food aid (OoARD, 2015).

Vegetation cover: The vegetation cover of Adwa district is degraded for long period of time. Recently, it is becoming regenerate. Out of the total area of the district which is 65,531ha; 33.8% and 36.9% are cultivated area and area of ex-closure and the rest 21%, 3.5%, 2.3%, 2.5% are (farmland, free grazing, settlement, and miscellaneous, respectively). The most dominant plant species of the area are *Acacia abyssinica*, *Acacia lehay*, *Acacia seyal*, *Eucalyptuscamaldunesis (Keyh Bahrzaf), Eculeashimperi (Kliaw), Dodonea angustifolia (Tahsus), Cordia Africana (Awhi), Ziziphesspina-Chrisf*ic (*Geba*), and *Olea Africana (Awlie)* (OoARD, 2015). While Ahferom district has a total area of 133,500 hectares that accounts 25.40% arable land, 12.05% grazing land, 32.41% forest and woodland, 30.15% residence and other non-productive land (OoARD, 2015).

Water source: The area has plenty of ground and surface water that uses for irrigation, industry and household consumption. There are 5 perennial rivers, 17 modern diversions, 94 traditional diversions, 128 check dam ponds, 1 dam, 122 tankers, 2,851 hand dug wells for irrigation and 470 hands dug wells for potable water. While in Ahferom district the sources of water are 5058

shallow water pumps, 8413 ponds, 18 diversions and 179 chek-dam ponds. In the year of 2011 irrigated area is 8528ha (OoARD, 2015).

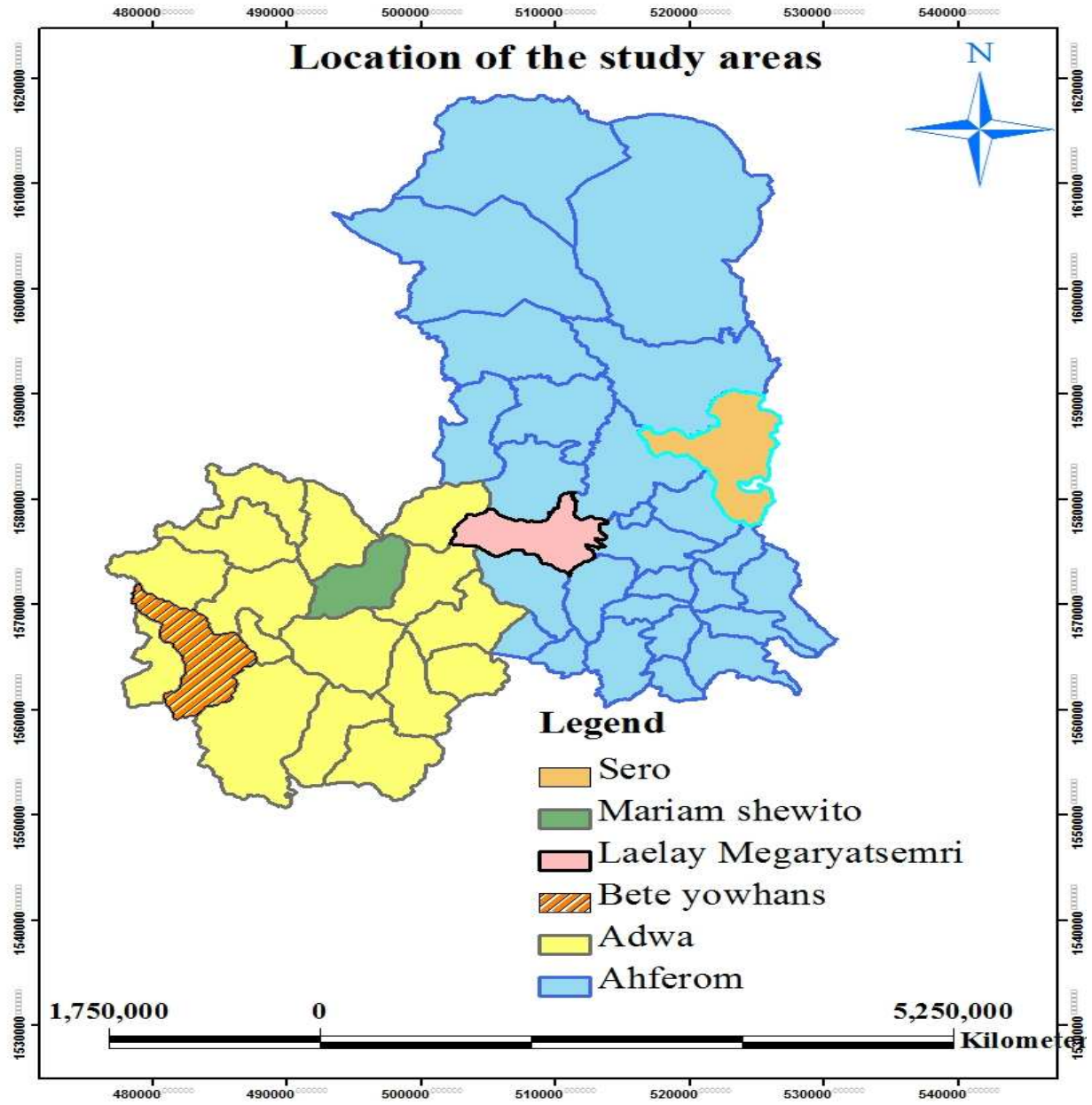


Figure 1. Map of the study area

3.2. Sampling procedures

Multi stage sampling procedure was used to select respondents of the study. In stage one, the two districts (Adwa and Ahferom) were selected purposively from the nine districts of central zone of

Tigray region. In stage two, four tabias were purposefully selected from Adwa district Bet yohanse and Mariam Shewito while from Ahferom district Sero and Lalay Migaria Tsemri, on the basis of their suitability and potentiality for beekeeping production. In stage three, respondents were stratified in to beekeepers and non beekeepers. In stage four, beekeepers were further stratified based on the type of beehives as traditional and improved beehive owners. Finally, 180 sample respondents were selected using simple random sampling techniques, 100 from beekeeper (50 improved and 50 traditional beehive owners) and 80 from non beekeepers. Among the selected beekeepers, about 20% were female honey producers and from those 55% females own improved beehive while, 45% own traditional beehives. Additionally, 3 tej makers, 8 honey traders, 3 colony suppliers, 2 private and 4 public services providers were included using purposive sampling techniques. Sample sizes from each area described in Table 1.

Table 1. Sample size distribution from each tabias

Tabia	Beekeepers HH	Non Beekeepers HH	Total HH	%	Total sample
Bet yohanse	421	570	991	21	37
M/Shewito	535	600	1135	23	42
Sero	786	750	1536	29	52
L/ Migaria Tsemri	688	725	1431	27	49
Total	2430	2645	5075	100	180

HH = Headed Households
Source: own computation, 2015

3. 3. Method of data collection

The data used for this study were collected both from primary and secondary sources. Primary data on the production and marketing system collected from producers, input supplier, traders, processors and service providers using semi-structured questionnaires (Appendix 2) and group discussion with key informants. The primary data that were collected from farmers focused on inputs use, honey and beeswax production, market information, credit access, number of beehives owned, honey production cost, annual return from honeybee products, extension service, factors affecting honey production, annual income from non bee product source and demographic characteristics of the household. Moreover, the questionnaire for traders includes type of business, buying and selling system, source of initial capital and demographic

characteristics of the traders. The questionnaire for the processors includes buying price, cost for transportation, labour cost, selling cost, amount of processed per year, total income per year. Checklist was prepared for the discussion purpose with key informants (Appendix 2). Four data collectors were employed, one data collector was assigned to handle one tabia. Strict supervision was done by the researcher to ensure close follow up and minimize errors. Secondary data were collected from different published and unpublished reports such as the district Office of Agriculture and Rural Development (OoARD), Tigray Agricultural Marketing Promotion Agency (TAMPA) and websites.

3.4. Methods of data analysis

The data collected from different sources were analyzed using descriptive statistics and econometric analysis. Descriptive statistics such as frequency, percentages, means and standard deviations were used to characterize honey and beeswax value chain actors, functions and service providers and in analyzing socio-economic importance of honey and beeswax value chain. In order to compare the influence of the explanatory variables on adoption, mean, standard deviation, frequency of occurrences and percentage were computed for each practice and category (adopters and non-adopters to beekeeping) by using independent t-test and cross-tabulation (x^2-test) considering the objectives of the research.

Econometric analysis, when one or more of the explanatory variables in a regression model are binary, we can represent them as dummy variables and precede in linear regression analyses. However, the application of linear regression model when the dependent variable is binary is more complex (Pindyck and Rubinfeld, 1981). Binary-choice models assume that individuals are faced with a choice between two alternatives and their choice depends on their characteristics. Thus the purpose of a qualitative choice model is to determine the probability that an individual with a given set of attributes made one choice rather than the alternative.

The inadequacy of the LPM (Liner probability model) suggests that a non-linear specification may be more appropriate. The candidate in this case was an S-shaped curve bound in an interval 0-1 (Pendyck and Rubinfeld, 1981; Gujarati, 1995). The authors suggests that the S-shaped curve satisfying the probability model are those represented by the cumulative logistic function and the

cumulative normal distribution, where as the probit probability model is associated with the cumulative normal distribution. In this respect, a choice made between logit and probit models. However, the statistical similarities between the two models made such a choice difficult. The choice of any model was not dominate and may be evaluated a posteriori statistical grounds although in practice there is no strong reason for choosing one model over the other. Gujarati (1995) and Pindyck and Rubinefeld (1981) illustrated that the Logistic and Probit formulating are quite comparable, the main difference being the former has slightly fatter or heavier tails; i.e. normal curve approaches the axes more quickly than the latter. Hence, for this study binary probit model is used because the data is normally distributed.

Specification of the Probit Model

The Probit model was employed to analyze determinants of honeybee technology adoption decisions, since it was believed to offer better explanation on underlying relationship between the decision to adopt in a given household and its determinants independently. Adoption of beekeeping technology refers to the decision made by individual farm households during 2014/2015 production season of honeybee. The dependent variable in this case is dummy (Yi), which takes a value of YF= 1 if a given farmer adopts honeybee, otherwise 0. The probit model is mathematically described as indicated below.

Probit: $Pr(Y=1|X) = \Phi (X'\beta)$ (Cumulative normal pdf)

Where, Φ is the cumulative density (or distribution) function of the standard normal distribution.
β = coefficient
pdf= probability density function

3.5. Definitions of variables

Dependent variable

Adoption of beekeeping technology; This is the dummy variable representing the dependent variable. In simple terms, this tells whether respondent participates in beekeeping production or not.

Independent variables

1. Family size: Family size of a respondent is a continuous variable proposed to influence production participation. The more number of family members an individual had the more probable to participate in beekeeping technology.

2. Land size: This variable is continuous measured in hectare. Land is an asset for crop, livestock production and for beekeeping. Household with large land holding will have good attention to honeybee production. Therefore, this variable is expected to influence honeybee participation positively.

3. Livestock own: Is a continuous independent variable indicating total livestock holding of the household by convert into TLU (Appendix 1). This variable is expected to influence beekeeping adoption technology.

4. Age of the household head: Age is demographic variable and is measured in years. The expected influence of age is assumed positive; it is a proxy measure of farming experience of household. Aged households are believed to be wise and acquired skills in beekeeping hence produce much and supply more.

5. Sex of the household head: This is dummy variable that takes a value of 1 if the household head is male and 2 otherwise. Both men and women participate in beekeeping. Male households have been observed to have a better tendency than female household in beekeeping production due to obstacles such as lack of capital, and access to credit and extension services (Assefa, 2009).

6. Distance to market (DistMt): It is a continuous variable and is measured in kilometers which farmers spend time to sell their product to the market. If the farmer is located in a village or far-away from the market, he/she is weakly accessible to the market. The closer to the market the lesser would be the transportation cost and time spent.

7. Access to extension service (Extensm): This variable is measured as a dummy variable taking a value of 1 if the beekeeping household has access to honey production extension service and 0 otherwise. It is expected that extension service widens the household's knowledge with regard to the use of improved modern beehive technologies. Farmers that have frequently contact

with DAs (development agents) will have better access to information and they could accept better technology that would increase their marketable supply of honey.

8. Education level of the household (Edun): It is a continuous variable. Those household heads who had formal education determines the readiness to accept new ideas, improvement and easy to get supply, demand and price information and this enhances farmers' readiness to honeybee participation.

Chapter four: Results and Discussions

4.1. Demographic and socio-economic characteristics of respondents

This section provides an overview of the honey and beeswax value chain analysis sample respondents in Adwa and Ahferom districts. Demographic characteristics included for farmers, traders and tej makers. The results presented and discussed entirely to the sampled households.

4.1.1. Demographic and socio-economic characteristics of farmers

Age - The average age of the respondent was 50.5 (±10) years. The average age of beekeepers and non beekeepers was 47.5 (±9.5) and 54 (±9.6) years. An independent sample t-test was conducted to determine the mean difference between beekeepers and non beekeepers. The result shows that the mean difference in age between beekeepers and non beekeepers was statically significant at (p=0.001) (Table 32). This result is in line with Tezera (2013) who stated that, as majority of households in younger age are more likely be energetic in handling their honey production and marketing activities in Tigray region. The average age of the respondents dealing with improved and traditional beekeeping was 45 (±9.5) and 50 (±8.9) years old, respectively. The mean difference age in beekeepers between improved and traditional beehive owners was statically significant at (p=0.001) (Table 2). Workneh (2007) and Belets and Brhanu (2014) reported similar results in Tigray region that traditional hives continue to be owned by older beekeeper and improved beehives have relatively good acceptance by younger generation beekeepers hence older farmers not easily accept to new technology.

Family size - The average family size of beekeepers and non beekeepers respondents was 5.52 (±1.9) and 4.86 (±1.7) persons, respectively (Table 2). The minimum and maximum family size of beekeepers was 1 and 9, while the family size of non beekeeper was 1 and 8, respectively. The mean difference in family size between beekeepers and non beekeepers was statically significant at (p=0.01) significant level. From the result, average family sizes of beekeepers are greater than non beekeepers. This result is similar with Workneh (2007) his result implied technology adoption to increases honeybee products which contribute to satisfy the need of their family due to availability of labour in Tigray region. The average family size of beekeepers that owned

improved and traditional beehives was 5.64 (±2.1) and 5.4 (±1.8), respectively. This result shows that, the average family sizes of beekeepers owned improved beehives were greater than the traditional beehives. But an independent sample t-test was conducted and obtained as the mean difference in family size between beekeepers that holds improved and traditional beehives was not statically significant.

Size of arable land holding - The overall mean of land holding of the respondents was 0.74 (±0.33) and 0.51 (±0.19) hectare per household for beekeepers and non beekeepers, respectively (Table 2). The minimum and maximum land holding for beekeepers 0.25 and 1.75 hectare per household while that of non beekeepers the values were 0.25 and 1 hectare, respectively. An independent sample t-test was conducted for testing the mean difference between beekeepers and non beekeepers and the result shows the mean difference in land size between beekeepers and non beekeepers was statically significant at (p=0.00). Average land holding among beekeepers who owned improved and traditional beehives was 0.77 (±0.36) and 0.72 (±0.31). The result shows the mean difference in land size between respondents which owned improved and traditional beehives was not statically significant.

Off-farm activities - The major off-farm activities of the respondents were salary employment, trading and construction. From the total of respondents 27% and 36.2% of the beekeepers and non beekeepers participated in off-farm activities, respectively (Table 2). From the result non beekeepers was higher participated in off-farm activities. However, the analysis shows the mean difference between beekeepers and non beekeepers with respect to average income off-farm is found to be statistically non significant. Regarding the improved and traditional beekeepers 38% and 16% were participated in off farm activities. This result indicated beekeepers that owned improved beehives were higher participant in off farm activities than beekeepers owned traditional beehives. However, the analysis shows the mean difference between beekeepers that kept improved and traditional beehives with respect to average income off-farm was found to be statistically non significant.

Total Livestock holding Unit- All beekeepers were seen to keep livestock within the average of 4.2 TLU/household and 96% of the non beekeepers owned about 2.9 TLU per household. The average TLU owned per beekeeper household was higher than non beekeepers. The mean

difference in livestock holding between beekeepers and non beekeepers was statically significant at (p=0.00) (Table 2). Average TLU in beekeepers who owned improved beehives was 4.4/household but for beekeepers that had traditional beehives was 4.1/household. The independent t- test analysis shows the mean difference between beekeepers owned improved and traditional beehives with respect to livestock holding obtained statistically non significant.

Table 2. Demographic and socio-economic characteristics of respondents

Variables	Beekeeper that own					Total beekeeper		Non beekeeper		T-test
	Improved beehive		Traditional beehive		T-test					
	mean	SD	Mean	SD	p-value	mean	SD	mean	SD	p-value
Age (year)	45.04	9.51	50.04	8.92	0.00	47.54	9.51	54.15	9.67	0.00
Family size (number)	5.64	2.12	5.40	1.86	0.54	5.52	1.987	4.86	1.74	0.01
Education(grade)	4	2.55	4	2.13	0.80	4	2.36	5	2.22	0.04
Land size (Hectare/HH)	0.77	0.36	0.72	0.31	0.49	0.74	0.33	0.51	0.19	0.00
Off-farm (Br/HH)	7,607	2,691	9,768	6,584	0.22	8,379	4,486	8,349	3,280	0.97
TLU/HH	4.1	1.6	4.4	1.5	0.4	4.2	1.6	2.9	1.4	0.00

SD= Standard Deviation, HH= Headed Household,

Source: Own computation from survey result, 2015

Education level – From the total beekeepers 17%, 8% and 75% of them were under illiterate, informally literate (church education) and formally literate category. The corresponding figures for non beekeepers were 42.5% illiterate, 1.2% church educated and 56.3% had formal literate from grade 1 to 10. From this result the percentage of formal literate beekeepers was higher than non beekeepers. For the formal literates an independent sample t-test was conducted and resulted in the mean difference in formally literate between beekeepers and non beekeepers was statically significant (p=0.04) (Table 2). This is in line with Kerealem (2005) who stated that educational level of the farming households may have significant importance in identifying and determining the type of development and extension service approaches in Amhara region. The role of education is obvious in affecting household income, adopting technologies and as a whole the socio-economic status of the family as well. From total beekeepers (producers) owner of improved beehives consist of 8%, 6% and 86% were illiterate, church educated and with formal education while from traditional beehive holders 26% were illiterate, 10% church educated and 64% received formal education (Table 3).

Table 3. Education level of respondents between beekeepers and non beekeepers

Education level	Beekeepers				Total beekeepers		Non beekeepers	
	Having improved		Having traditional					
	N	%	N	%	N	%	N	%
Illiterate	4	8	13	26	17	17	34	42.5
Church educated	3	6	5	10	8	8	1	1.2
Formally educated	43	86	32	64	75	75	45	56.3

N= Number of respondents
Source: Own computation from survey result, 2015

From this result percentage of learned in beekeepers that holder's improved beehive were higher than the traditional beehive owners. However, the statistical analysis determined the mean difference between improved and traditional beehive owners with respect to formal literate was found statistically non significant (Table 2).

Sex - The proportion of males and females in both beekeepers and non beekeepers group was 80% and 20%, respectively. Among the beekeeping groups, 78% males and 22% females keep

improved beehives while 82% males and 18% females depended on traditional beekeeping production. From this result the percentage of female participation in beekeeping was lower than males (Table 4). This finding is similar with Tessega (2009) who noted that, the participation of females in beekeeping is 1.7% individual that females less than lower than males in Burie district of Amhara Region. This may be due to the headed household mostly representing by male even though the beekeeping activities done by female but those considered as work of males because the respondent is named by the male as he is headed household.

Access to credit - Only 5% of the beekeepers and 3.8% non beekeepers used loan from DCSI in the year of 2014 with an average loan size of 3832 Birr for beekeeper and 5333 Birr for non beekeepers with the interest of 15%. Beekeepers used the credit in order to purchase bee colony and beekeeping equipment. Non beekeepers used the money for purchasing dairy cows and oxen for fattening. Beekeepers that holders of improved and traditional beehives were took credit a quantity of 6% and 4%, respectively. From total respondents 4.2% and 5.6% of male and females got a credit service, respectively. Generally, the percentage of credit application from beekeepers and non beekeepers was low. This is in line with Assefa (2009) who reported that the short repayment period and high interest rate of the service was not suitable to tack credit the by individual respondents in Atsbiwemberta district in Tigray region.

Extension services – In beekeeping activities extension service is provided by the public district Office of Agriculture and Rural Development. From the sampled respondents about 82% of beekeepers got access to extension service and 25% of non beekeepers got access to extension service. From the total beekeepers 13%, 21% and 66% got extension service weekly, monthly and yearly, respectively, while the non beekeepers 10.5% and 89.5% of them got the extension service monthly and yearly, respectively. From this result most of the non beekeepers concerning the frequency of contact with extension service was yearly. As a result, x^2-test calculated as a significant differences ($p=0.00$ in extension service among beekeepers and non beekeepers (Table 4). From the total sampled beekeepers 82% of improved and traditional beehives owners got extension service similarly. The frequency of farmers got to extension service for beekeepers holds improved beehives was 16% weekly, 24% monthly and 60% yearly. On the other hand, for beekeepers with in traditional beehive 10%, 18% and 72% got the extension service weekly, monthly and yearly, respectively. From total of sampled respondents 58% and 50% of male and

female, respectively was got extension service. There was significant differences in extension service among beekeepers that owned improved and traditional beehives (p=0.00) (Table 4). This result is in line with Assefa (2009) and Taye **(**2014) who found that, frequent provide extension services on beekeeping to farmers can increase the quantity and quality of the honeybee product at household level in Atsbiwemberta Tigray region and in South West Shoa Zone of Oromia region.

Access to market information - With regard to access to market information on price of their products, 87% of the sampled respondents of the beekeepers were beneficiaries. From the beekeepers 88% and 86% of the respondents owned improved and traditional beehive, respectively, got access to market information. From sampled respondents of beekeepers 48.6% of male and 47.5% females had access to market information. There was a significant difference in access to market information among beekeepers that owned traditional and improved beehives at (p=0.00) (Table 4).

Experience in beekeeping - The average experience of the sample respondents was 9.23 year. The average years of beekeeping experience for improved and traditional beehive owners were 7.52 and 10.94 years, respectively. From the total of beekeepers 51% have experience 5-10 years on beekeeping activities. From this result experience of beekeepers owned traditional beehive was higher than improved beehives. There is significant difference in experience between beekeepers that owned improved and traditional beehives at (p=0.03) significant level. This result is similar with Mokonen *et al*. (2011) who reported that majority (52%) of the beekeepers had more than 6 years of beekeeping experience in Enderta districts of Tigray region. This is may be due to traditional beekeeping system starts before 100 years ago but, the improved beekeeping system in study area was introduced / started in 2004 G. C.

Table 4. Gender, institutional and experience characteristics of respondents

Variables	Response category	Beekeepers					Total beekeeper		Non beekeeper		X^2-test
		Improved		Traditional		X^2-test					
		N	%	N	%	p-value	N	%	N	%	p-value
Sex	Male	39	78	41	82	0.88	80	80	64	80	1
	Female	11	22	9	18		20	20	16	20	
Extension	Yes	41	82	41	82	0.00	82	82	20	25	0.00
services	No	9	18	9	18		18	18	60	75	
Market	Yes	44	88	43	86	0.00	87	87	0	0	0.00
information	No	7	14	6	12		13	13	80	100	
Credit access	Yes	3	6	2	4	0.81	5	5	3	3.75	0.68

Experience year	Improved (N=50)		Traditional (N=50)		Total (N = 100)	
	N	%	N	%	N	%
<5year	12	24	2	4	14	14
5-10	23	46	28	56	51	51
11-20	15	30	17	34	32	32
>20	0	0	3	6	3	3
x^2 – test				0.03		

N= Number of respondents

Source: Own computation from survey result, 2015

4.1.2. Characteristics of traders

The demographic characteristics of honey traders summarized in terms of sex, marital status and educational level. Age of the trader ranged from 37 to 63 with an average 49 years old. The survey result indicated that all the sampled males honey traders were married. All of the sampled traders were educated with 1 to 5 grades. The traders have an average of 9.75 years experience on honey trading.

4.1.3. Characteristics of processors

Demographic characteristic of processors was described in terms of sex, age, education level and marital status. Honey processors in the study area were local tej processors who were females with an average age of 49 years, married and educated up to grade four. According to the respondents, they have not used credit during their business process. The tej makers have average of 6 year of experience on tej making.

4.2. Description and characterization of value chain functions, actors and services providers along the honey and beeswax value chain

4.2.1. Honey and beeswax value chain functions

Value chain function is the main processes of honey and beeswax value chains. Honey and beeswax value chains function in the study area include input supply, production, trading, processing and consumption. Those functions are performed by the chain actors. The major beekeeping inputs are beehive, bee colony, beeswax and other accessories. The respondents find the major beekeeping inputs from different sources.

A. Beekeeping equipment supply

Table 5 shows the type of beekeeping equipment frequently used by the sampled respondents. From the total of improved beehives only 6% of the respondents purchased from their own pocket. On the other hand, 84 % and 10% of the respondents used beehive from OoARD and

NGOs, respectively, in the form of credit. In this study NGOs grant the beehive for some poor farmers without interest rate to repay in the form of birr or in kind after three years. All of the respondents with traditional beehive used both made hives from locally available materials. According the respondents, traditional beehives are not sold in the market. The other accessories of beekeeping including smokers, gloves, bee veils, boots, water sprayer, bee brush, knife and honey containers are purchased from local market or freely obtained free of charge from NGOs. About 32% of the bee respondents own bee smoker; of which 56%, 31% and 13% obtained smoker by purchasing from their own cash money, from credit services and from NGOs grant, respectively. From the total respondents 33 farmers used bees veil of which 30%, 12% and 58% respondents got bee veil from credit, NGOs gifts and purchased by their own money respectively. From the sampled respondents, with beekeeping equipments like boots, water sprays and overall/suit/ were 7%, 5% and 3%, respectively. The main source of boots, water spray and overall/suit/ 100% was from the market purchasing by their own money. Moreover, all respondents bought knife and honey containers purchased from the market from their own money. However, other beekeeping accessories such as honey extractor and casting mold were distributed free of charge by the OoARD for demonstration purposes and usually kept in FTC under the DAs control. During the harvesting and foundation sheet preparation, producers use that equipment freely from the FTC. This result indicates there is poor seasonal honeybee management system due to low availability protected materials.

Table 5. Sources of beekeeping equipments and their average service in years

Equipment	Adwa								Ahferom								Average services year of equipment
	Home made		Purchase by own money		From credit				Home made		Purchase by own money		From credit				
					GOs		NGOs						GOs		NGOs		
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
Bee hive	19	100	1	5	18	90	1	5	31	100	2	7	24	80	4	13	12.11
Smoker	-	-	12	100	-	-	-	-	-	-	6	30	10	50	4	20	4.69
Bee Veil	-	-	12	100	-	-	-	-	-	-	7	33	10	48	4	19	4.24
Boots	-	-	7	100	-	-	-	-	-	-	-	-	-	-	-	-	3.71
Water sprayer	-	-	5	100	-	-	-	-	-	-	-	-	-	-	-	-	2.40
Bee brush	-	-	6	100	-	-	-	-	-	-	-	-	-	-	1	100	4.17
Queen excluder	-	-	1	5	18	90	1	5	-	-	2	7	24	80	4	13	11.80
Knife	-	-	39	100	-	-	-	-	-	-	61	100	-	-	-	-	7.65
Honey container	-	-	39	100	-	-	-	-	-	-	61	100	-	-	-	-	4.99
Overall/suit	-	-	3	100	-	-	-	-	-	-	-	-	-	-	-	-	4.24

NGOs = Non Governmental organizations, N = Number of respondents

Source: Own computation from survey result, 2015

Colony supply: The demand for bee colony increased as a result of introduction of a large number of improved beehives and awareness of the community about the importance of improved beekeeping production. Bee colony multiplication practice like splitting method was mostly dominant in Ahferom district. There are experienced honeybee colony multiplier farmers and hence they sell to the local producers in Ahferom districts. The average price of one colony was recorded as 1105.5ETB with minimum of 800 and maximum of 1300 ETB.

Table 6. Sources of bee colony for start beekeeping activities

sources of colony	Adwa		Ahferom		Total	
	N	%	N	%	N	%
Grant from NGO	0	0	3	8.2	5	5
Purchase from own cash	28	71.8	31	50.8	59	59
Purchase from loan cash	7	17.9	19	31.1	26	26
Gift from parent	4	10.3	6	9.8	10	10
Total	39	100	61	100	100	100

N= Number of respondents, NGO = Non Governmental Organization
Source: Own computation from survey result, 2015

Beeswax: The beeswax supplied by OoARD is basically obtained from other nearby producers in the district. Besides, the regional OoARD buy the beeswax from other regions and distribute for each districts of OoARD. Farmers produced small quantity of beeswax from their own beehives and use it for their own improved beehive. The survey result shows that beeswax production of sampled producers was estimated to be about 105.25kg, of with 42.25kg (40%) was sold to other farmers but 63 kg (60%) used for their honeybee colony. Most of the producers do not consider beeswax as important beehive product especially from traditional beehive and thus leave as waste product. The current price of crude beeswax supplied from OoARD is about 190 ETB per kg. However, the prices of beeswax from producers ranged from 48 to 70 ETB per kg beeswax. The price of beeswax variation happen may be due to beeswax sold by producer is not well processed than beeswax supply from OoARD.

B. Honey and beeswax production

The overall mean of honey productivity from traditional and improved beehives was 14.85kg/hive and 24.91kg/hive, respectively. Honey productivity from improved beehive was higher almost by 10kg from traditional beehive. Honey productivity was computed with independent t-test and obtained as statistically significant difference at (p=0.00) significant level. This result is similar with Belets and Berhanu (2014) who stated as the average honey production from improved and traditional beehive was 26.04kg and 12.56kg in Ahferom district. Gidey and Mekonen (2010) found from improved beehive about 20-30kg/ hive and from traditional 8-15kg/hive in Tigray region.

From the total beekeepers (n=100) only 35% collect beeswax but the remaining producers do not collect the beeswax. The average beeswax production from improved and traditional beehive was estimated at 0.75 kg/hive and 0.97kg/hive, respectively. The average beeswax production in traditional beehive is larger than improved beehive. This is comparable with CSA (2006) that reported as the average beeswax production from one beehive about 0.95kg (Table 7).

Table7. Average honey and beeswax production of traditional and improved beehives

Districts		Honey production		Beeswax production	
		Improved beehive	Traditional beehive	Improved beehive	Traditional beehive
Adwa	N	20	19	10	7
	Min	10	8	0.25	0.5
	Max	30	20	1.25	2
	mean ± SD	24.4 ± 7.0	14.78 ± 3.4	0.71 ± 0.32	1.11 ± 0.50
	p-value	0.00		0.08	
Ahferom	N	30	31	8	10
	Min	14	9	0.39	0.5
	Max	37.5	22	1.25	1.38
	mean ± SD	25.25 ± 5.7	14.88 ± 6.8	0.80±0.32	0.88 ± 0.23
	p-value	0.00		0.50	
Total in both districts	N	50	50	18	17
	mean ± SD	24.91±6.2	14.85±5.7	0.74±0.31	0.97±0.36
	p-value	0.00		0.06	

SD= Standard Deviation, N = Number of respondents

Source: Own computation from survey result, 2015

The average bee colony hived per household in Ahferom and Adwa districts was 3.11 and 3.05. An average bee colony holding in improved and traditional beehives of the sample respondents were 3.34 and 2.84, respectively.

Honey harvesting season: From the survey result the main harvesting months in both districts are September, October, November, December and June. Based on Table 8, beekeepers harvest their honey on the months of October and November with a percent of 29% and 37%, respectively. This result indicates harvesting season is mainly depending on the flowering season of the year.

Table 8. Honey harvesting months

Harvesting month	Adwa				Ahferom				Both district	
	Improved		Traditional		Improved		Traditional		Both beehive	
	N	%	N	%	N	%	N	%	N	%
December	2	10	3	15.79	1	33.33	5	16.13	11	11
November	8	40	9	47.37	8	26.67	12	38.71	37	37
November and June	0	0	3	15.79	2	6.67	5	16.13	10	10
October	2	10	4	21.05	14	46.67	9	29.03	29	29
October and June	6	30	0	0	0	0	0	0	6	6
September and November	2	10	0	0	5	46.67	0	0	7	7
Total	20	100	19	100	30	100	31	100	100	100

N= Number of respondents
Source: Own computation, 2015

Honey harvesting frequency: From the total sampled respondents 82% of them harvest honey once per year while 18% of them harvest twice per year. The average harvesting frequency was 1.18. The independent t-test result indicates the existences of significant difference between improved and traditional beehives in harvesting frequency at ($p = 0.001$) significant level (Table 9). This difference is may be due to the way of management system based on type of beehive improved beehive is easy for additional feeding on the dry season. This finding is similar with other researchers (Giday *et al*., 2010). Where this probably related with the natural flora of the localities or harvesting season and harvesting frequency are depended on the plants of natural

resource. This implies that planting honeybee flora and water prepare with full management for bee colony can increases the harvesting frequency.

Table 9. Harvesting frequency along the two districts in both beekeeping production

Harvesting frequency	Adwa		Ahferom		Total
	Improved	Traditional	Improved	Traditional	Beekeeper
N	20	19	30	31	100
mean	1.40	1.16	1.23	1	1.1.8
SD	0.50	0.37	0.43	0	0.38
T – test (p- value)	0.09		0.00		0.002

N= Number of respondents, SD= Standard Deviation
Source: Own computation, 2015

C. Processing and grading of honey and beeswax

About 27% of the beekeepers extract their honey using honey extractor. Table 10 describes some of the reasons why some farmers do not extract the honey. Almost 80% of the respondents sell crude honey without extraction as consumes suspect potential adulteration on extracted honey. These happen may be due to lack of honey cooperatives and lack of marketing linkage along the market actors. About 13.7% and 6.8% of producers were unable to process their honey due to lack of materials and knowledge. From the total sample producer's 35% separate and collect beeswax from the honey. Those results shows that, most of the producers sell their honey without extracted /fresh honey/ and beeswax sold together with the honey.

Table 10. Reasons of respondents for not processing honey and beeswax

Products	Reason why not process honey and beeswax	Adwa		Ahferom		Both district	
		N	%	N	%	N	%
Honey	Lack of confidences due to adulteration	30	83.3	28	75.7	58	79.5
	Lack of material or equipments	5	13.9	5	13.5	10	13.7
	Lack of knowledge	1	2.8	4	10.8	5	6.8
Beeswax	Shortage of knowledge on how to extract beeswax	18	78.3	32	74.4	50	75.8
	Lack of awareness on availability of beeswax market	3	13	5	11.6	8	12.1
	Shortage of equipments for extraction	2	8.7	6	14	8	12.1

N= Number of respondents

Source: Own computation from survey result, 2015

D. Honey and beeswax marketing

According to the data collected from the total amount of honey production almost 84.6% is sold. The price of honey varies depending on seasons of the year, color and taste of the honey. During the study period the average price of white honey was estimated as 127ETB/kg while the mixed and Amber honey is 94 ETB/kg and 50ETB/kg, respectively. The local market price is essentially related to honey supply, as demand appears to remain relatively constant throughout the year. The highest price of honey accounts on April and March months while the lowest price appears on from October to January (during harvesting season). The price of honey is perceived to be high by the beekeepers that mean, if the farmers supply large quantity honey to the market the price of the honey is low. The average price of beeswax and bee colony in the study area is 52.5ETB/kg and 1,105.5ETB/colony, respectively.

The major market center of producers (Adwa and Ahferom) was Adwa town, Ahferom town, Aksum, Mekelle and Addis Ababa. Of the total honey collected from beehives by producers about 89% sold in the local market. The producers in Adwa district sold their honey 69% in

Adwa town, 25% Aksum and 6% Addis Ababa while the producers in Ahferom sell their honey 66% in Ahferom town, 20% Adwa town, 6% Aksum, 4% Mekelle and 4% Addis Ababa (Figure 2).

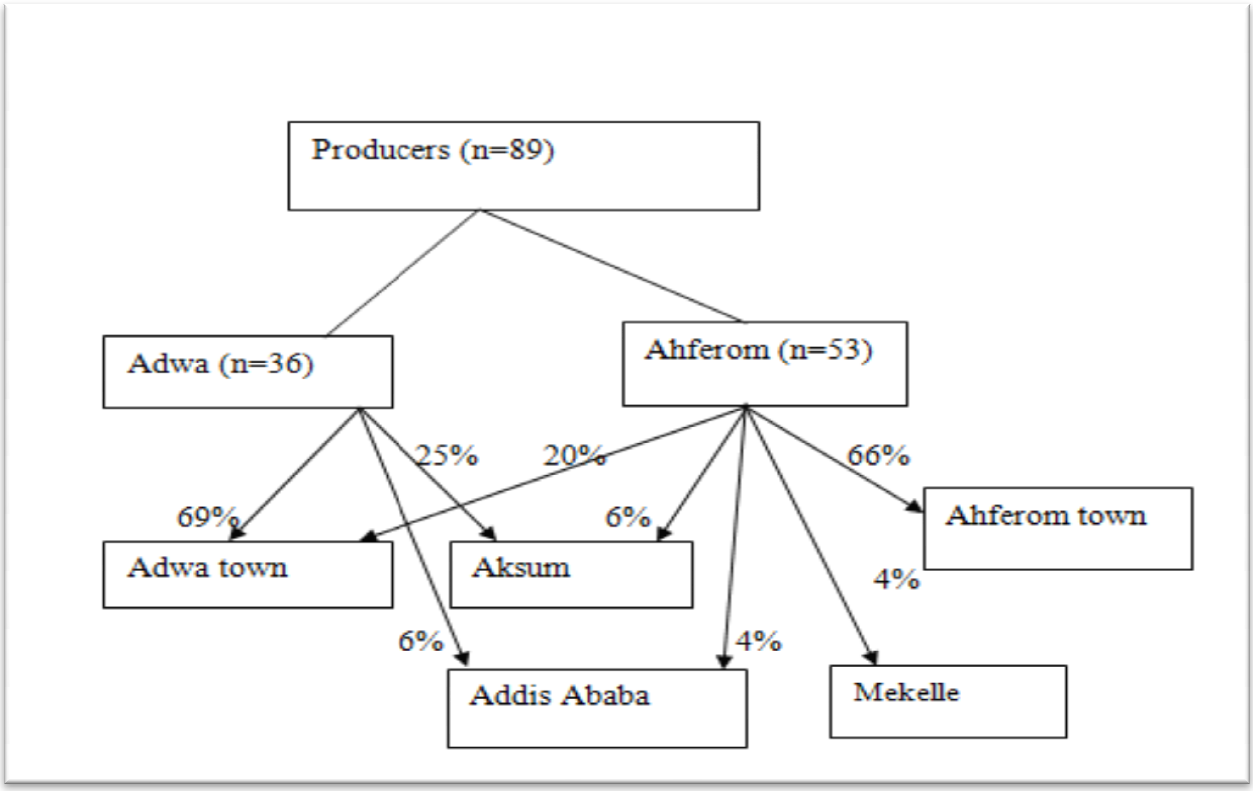


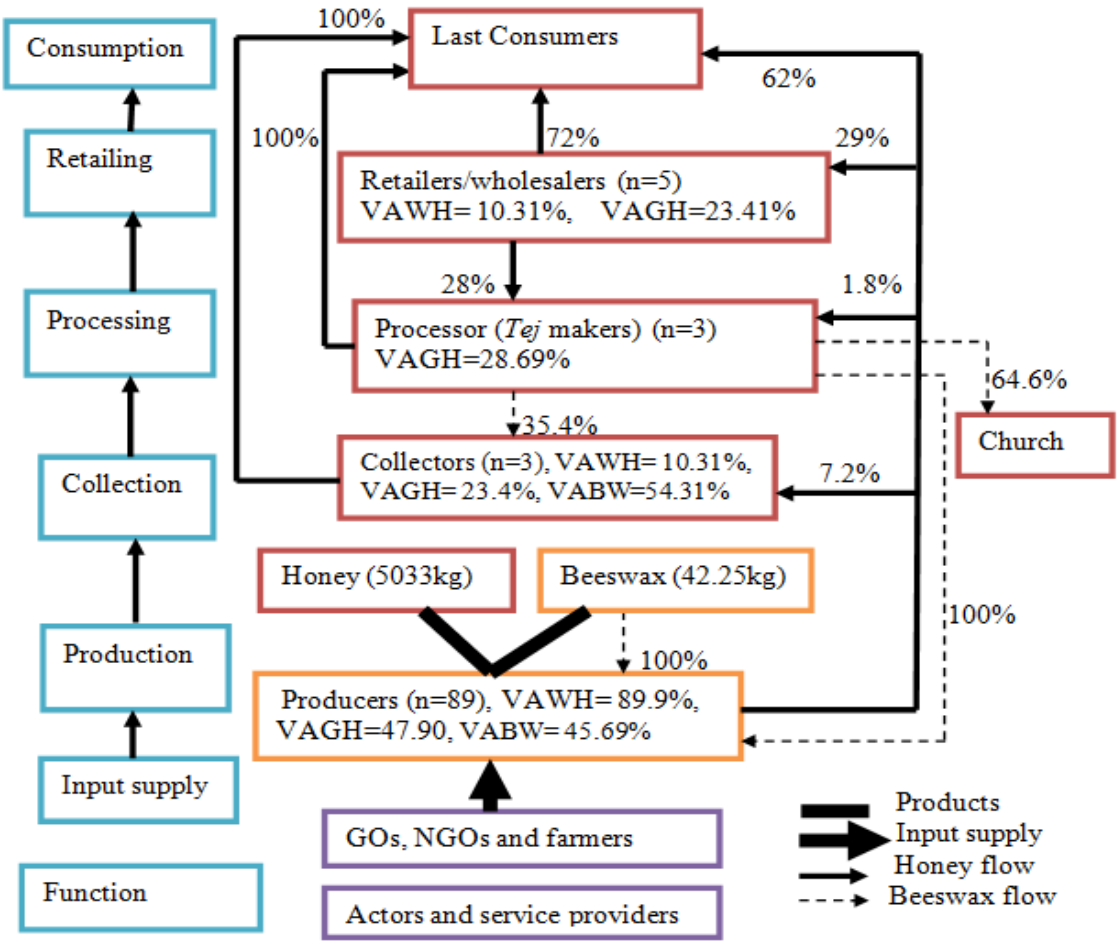
Figure 2. Honey selling areas

Source: Own computation from survey result, 2015

4.2.2. Honey and beeswax value chain map

Based on the response of the producers, the input suppliers for beekeeping production in the study area are NGOs, GOs and farmers. The amount of total honey production from the sampled respondents of Adwa and Ahferom was 2504 kg and 3445 kg, respectively. Of these about 2205 kg and 2828 kg honey were sold from Adwa and Ahferom district, respectively. Honey producers sold honey 7.2% to collectors, 1.8% for *tej* makers, 29% for retailers and 62% to consumers directly. The sources of beeswax are mainly from producers and *tej* makers. The majority of collected honey sold directly to consumers this is resulted from the lack of formal market linkage between all other market actors. Due to this reason most farmers prefer to sell their product directly to consumers. The total beeswax production from sampled producers was

about 105.25kg. From this 42.25 (40%) kg beeswax was sold to other producers while the rest 63kg (60%) used for their own bee colony in site. Producers are major suppliers of beeswax to consumers, as the later prefer crude honey for fear of adulteration. Tej makers produce tej and 104.5kg beeswax as byproduct. Tej sold directly to consumers, while the beeswax 64.6% sold to church and 35.4% sold for collectors. Value addition of honey and beeswax at each value chain actors are; 89.9%, 47.9% and 45% producers gain profit from white honey, amber honey and beeswax. Traders profited 10.31%, 23.4% and 54.31% from white honey, amber honey and beeswax. While the processors value added 28.69% from amber honey. Figure 3 shows the current honey and beeswax value chain map of the study area.



n= Number of respondents, VAWH= percent of value addition from white honey, VAGH=percent of value addition from golden/ amber honey, VABW= percent of value addition from beeswax

Figure 3. Honey and beeswax value chain map of the study area
Source: Own computation from survey result, 2015

4.2.3. Honey and beeswax value chain actors and their contribution

Throughout the study, the main actors in honey and beeswax value chain were identified as input suppliers, beekeepers (producers), collectors, processors, retailers and consumers. Each value chain actors and their functions described as follow:

Inputs suppliers: At this stage of the value chain there are many actors who are involved in beekeeping input supply in the study area. Currently, OoARD and NGOs are the main source of input supply. Beekeepers also participate in this stage especially for supplying honeybee colony in Ahferom district. There are some inputs suppliers that provide inputs specifically such as beehives, honey extractors, smokers, gloves and casting mold. The improved beehives and their accessories are usually supplied by OoARD (livestock input suppliers and cooperatives), REST, Farm Africa, International Livestock Research Institutions, Tigray Agricultural Research Institute.

Producers: They play great role in the two districts (Adwa and Ahferom districts) in production of different honeybee products, harvesting, transporting and selling at local markets. Beekeepers sell crude honey for tej makers, traders and consumers at the local market. Additionally, producers sell the beehive products beeswax for other beekeepers (producers). The producers make their traditional beehive by using local materials in order to hive bee colonies.

Collectors: The main activities of collectors in the study area are to collect the honey from producers, grade and sale to the local market directly for the consumers. They also collect the beeswax and sold to other beekeepers.

Tej brewers: Tej brewers are process of the crude honey to produce tej and beeswax. Their primary aim was to produce tej out of crude honey. Tej producers remove the crude beeswax (called *sefef*) from the tej and they allow it to dry. The total beeswax collected from sampled tej maker is estimated to be 104.5kg/year. Tej makers sell the beeswax directly to their customers like, beeswax collectors and other people in church for candle making with the price of 48 ETB/kg.

Retailers: Retailers are key actors in honey and beeswax value chain in both districts. In the study area retailers serve as important connector between producers and consumers. They buy the honey from producers and sell to consumers and tej makers in the local markets. Honey sold in these outlets is packaged in plastic and metal jars. Mostly, collectors and wholesalers in the study areas serve as retailers because they buy and sell small quantities of honey directly to consumers.

4.2.4. Honey and beeswax value chain service providers and their contribution

According to the group discussion, services providers support farmers in the way of input supply, technical advices and training, give credit and market linkage in beekeeping production. There are many service providers that help for producers to produce high quality and quantity honey and beeswax in Adwa and Ahferom districts. Public and private service providers in the study areas listed with their activities bellow.

1. Farm Africa; Is NGO provides service to poor farmers and land less youth in Ahferom district. Their contribution is to maximize the improve beehive supply and support for the poor farmers and landless youth by giving improved beehive with bees colony. It introduces about 640 improved beehives with their bee colony for the farmers from 2012-2013G.C. Besides, it supports in training for DAs and farmers to develop their honeybee management skill.

2. REST (Relief Society of Tigray); Is service provider in both districts which helps for the farmers with beekeeping equipment supply, honeybee forage like *shuf (Helianthus annuus)* and improved beehive supply for some farmers and youth groups. It plays a great role in training for the farmers in order to develop beekeeping skills in both districts.

3. LIVES-ILRI (International Livestock Research Institutions); The contribution of Livestock and Irrigation Value chain for Ethiopian Smallholders (LIVES) is in the form of facilitating knowledge management events and organizing capacity development as well as demonstrating useful innovative technological and institutional/organizational arrangements. In both district, LIVES demonstrating 14 top bar beehives (intermediate beehives) (9 in Ahferom district and 5 in Adwa district) to maximize both honey and beeswax beehive products. The

project also popularizes the importance of planting for honeybee flora *tebeb (Becium grandiflorum)* by planting on different land of farmers and nurseries.

4. HABP (Household Asset Building Program); HABP stared operation in both Adwa and Ahferom districts in 2009 G.C. It supports for farmers with preparation of business plan on the selected commodity and credit accessibility from different credit services providers. The contribution of HABP is to support farmers by giving training on beekeeping development activities and market information on honey to improve their products. It introduced about 31 improved beehives, 30 bee colonies and beekeeping equipments such as 12 honey extractors, 22 smokers, 36 gloves, 24 bee veils, 8 water sprays, 10 brushes and 16 casting molds by supporting for farmer in farmer training center /FTC/ from 2010-2013 G.C. Farmers use those equipments for training, for honey harvesting and inspection of their bee colonies.

5. PSNP(Productive Safety Net Program); This was introduced in 2004 G.C in both districts and its contribution is supporting for poor farmers by giving crops and money/capital/ to user as base and to work harder to become food secure in the household level. Farmers have their own role on conservation of natural resource to minimize deforestation of the plants that used as source of honeybee's flora. Farmers use the money to purchase the honeybee colonies and other beekeeping equipments.

6. OoARD (Office of Agricultural and Rural Development); Is the core of service providers directly to the farmers acting as a center for connection of the other service providers with farmers. Most of the time farmers directly contacted with OoARD in order to get different technical supports. OoARD supported the farmers with supply of beekeeping equipments and beeswax of beehive product. In each districts, there is one beekeeping expert and one beekeeping technician for four peasant associations (PAs). Those give all extension services for the farmer in the form of technical and theoretical training to expand improved beekeeping production activities and to improve beekeeping products in different farmers. Woredas beekeeping exports prepare a plan for training the beekeepers one time per year at farmer training center. However, informally visit the beekeepers especially in the transferring and harvesting season.

7. Woreda Trade and industry Offices; It helps for the traders by give training and licenses to participate on honey trading activities. There eight known traders (5 retailer/whole sellers and 3 collectors) in both woredas.

8. Women Affairs; The contribution of women affairs is to mobilize and support women to engage in beekeeping production activities and to improve their house hold income source in different ways.

9. Woreda Administrative; It helps for the farmers in the form of mobilization theoretically to engage in beekeeping technology to improve their household income source.

12. DCSI (Dedebit Credit and Saving Institution); Helped for the farmers through giving credit to purchase improved beehives, other beekeeping equipments and bee colonies in the study area. The approved loan for one farmer in 2014 G.C was five improved beehives for 1364 ETB/hive while one bee colony 1000ETB. However, the actual mean price of one colony was 1100 ETB. The repayment period is three years with 15% interest rate.

13. TARI (Tigray Agricultural Research Institute); It helps farmers by giving training and technical support and also to improve traditional beekeeping in which though introduce of intermediate beehives. In Ahferom district, it introduced about 30 intermediate beehives with honeybee forages. Table 11 summarized the contributions of services providers in study areas.

Table 11. Service providers and their contributions in the study areas

No.	Service providers	Function
1	Farm Africa	Modern beehive supply for poor farmers and youth and training to farmers
2	REST	Modern beekeeping equipment supply Training for farmers and youth to develop beekeeping skill
3	LIVES	Facilitating knowledge management events and organizing capacity development Improvement of traditional beekeeping system and introduction of intermediate (Top bar beehives) in both districts Popularized the important of planting honeybee flora *tebeb* with planting in different farmers and nurseries
4	HABP	Helping farmers with training to develop business plan on their selected commodity and introduction of modern beekeeping equipments to farmer training center.
5	Productive Safety Net Program Project	Supports for poor farmers with crop or money to become farmers active in their own contribution on natural resources conservation to minimize deforestation
6	OoARD	Directly helping to farmers with supply of the beekeeping equipments, giving training and technical support to farmers and helping as a center to connect with the other service providers
7	Trade and industry	Helping for honey traders with license
8	Women Affairs	Supporting females to engage in beekeeping production activities
9	Woreda Administrative	Motivating farmers to participate in beekeeping production
10	Dedebit Credit and Saving Institution	Supporting for farmers by giving credit for purchasing the beekeeping equipments
11	Tigray Agricultural Research Institute	Introduction of the intermediate beehives and providing technical support for farmers

Source: Own computation from survey result, 2015

4.3. Factors affecting farmers participation in honey and beeswax value chains

This section reported results of the econometric analyses of determinants on beekeeping adoption technology. For the sake of clarity and ease of understanding, variables used in the analyses were listed (Table 12).

Table 12. Explanatory variables used in the probit regression models with their expected signs

Independent variable	Type of variables	Measurement variable	Expected sign
Gender	Dummy	1=male, 2=female	+
Age	Continuous	years	-
Family size	Continuous	number	+
Education	Dummy	1=illiterate,2= literate	+
Land size	Continuous	hectare	+
TLU	Continuous	number	-
Extension service	Dummy	1= yes, 2= no	+
Distance from market	continuous	km	-

TLU= Tropical Livestock Unit, km= kilometer

The model result indicated that the present of valuable information, from the data eight explanatory variables were hypothesized to determine adoption of beekeeping technology. The hypothesized 8 variables were namely gender of the household, age of the household, family size, education level of the household, land size, extension service, TLU and distance from market. Among these variables age, education level, land size and extension service were statistically significant while the remaining 4 variables (sex, family size, distance from market and TLU) were not significant on beekeeping technology adoption (Table 13).

Table 13. Probit estimation on determinants of beekeeping technology adoptions

Variables	Coef.	Std. Err.	Z	P>|z|	dy/dx
Sex	-0.49	-0.21	0.43	0.622	-.0674801
Age	-0.06	0.02	-2.88	0.004**	-.0194798
Edun	-0.12	0.07	-1.83	0.067*	-.0393094
Family	0.16	0.10	1.64	0.102	.0521763
Land	2.36	0.76	3.09	0.002**	.759592
Extensm	-3.40	0.54	-6.32	0.000***	-1.09344
TLU	0.19	0.12	1.54	0.123	.0599389
Mrktdn	-0.19	0.27	-0.69	0.489	-.0598325
_cons	6.97	1.93	3.61	0.000***	

N = 179, Log likelihood = -37.050853, P = 0.000, X^2=172.02, Pseudo R^2 = 0.6989

Significant difference at p<0.01= ***, p<0.05= **and p<0.1=*
Source: Own computation from survey result, 2015

Age – In the study area, age was negatively and significantly differenced in beekeeping adoption at (p=0.004) significant level. From the results of the marginal effect, as the age of the farmer's increases by one year the probability to participate in beekeeping technology were decreases by 1.9%. This result may be due to older households have less labor for the management of honeybees since the most of their adult children's are married and started their own family. This result is similar with Belets and Brhanu (2014) who reported that the person aged from 48 years the adoption for improved technology were decreases.

Education of household head – Education affects on beekeeping participation negatively and statistically significant at (p=0.067). As year of schooling increase by one year the probability in beekeeping participation were decreases by 3.9%. The reasons for the negative sign may be due to lack of modernized beekeeping system with quality and full beekeeping equipments. Hence, they preferred to engage in other off- farm activities and income source activities.

Total land size: Land size affects beekeeping adoption positively and shows significantly difference at (p=0.002) significant level. When land size of farmers increases by one hectare, beekeeping technology participation becomes increased by 75.9% on margin. The degree of

positive sign shows that, land availability in farmers has a great contribution for participation in beekeeping production rather than landless farmers. This result is in line with Berihun *et al*. (2014) reported that people who owned an arable land could be taken as best prerequisite to adopt and employ agricultural technologies as farmers could incur a cost.

Extension service_ Extension service were negatively influenced and significantly associated with adoption of beekeeping technology at (p=0.000) significant level. Table 13 shows as the extension services increased, the number of farmer's participation in beekeeping technology become decreased by 109%. The possible reason for the negative sign result may be due to the way of giving system variation and narrow focus/ biased of the extension system on crop and its component packages rather than diversifying farmers to different agricultural production system. Therefore, extension service provided to the farmers may push them to produce more crops rather than beekeeping. Similar to studies was done by Kebede *et al.* (2014) stated that an extension service is significant and negatively influence the choice of off- farm and non-farm livelihood strategy of users. This may be due to the narrow focus of the extension system on Agriculture peruse as rural development is generalized approach rather than diversifying on multiple options for risk aversion.

4.4. Socio-economic contribution of honey and beeswax value chain

Throughout the study, the main beehive products honey and beeswax are important for the society as source of nutrition, income generation and job creation. The source of income for people of the study area is from mixed crop-livestock farming production system, off-farm activities and beekeeping production activities. Regards to household income, there is a significant difference at (p=0.001) in annual income from crop and livestock productions between the beekeepers and non beekeepers. The average annual income of beekeeper and non beekeepers was 24,591ETB and 19,687ETB. The t-test result also indicates the existence of significances difference in average annual income between beekeeper and non beekeepers at (p=0.001). This may be due to the additional income obtained from beekeeping (Table 13). The study shows the people who participated in beekeeping technology were higher in income generation than non beekeeper. Farmers engaged in honey and beeswax production became more benefited than the non participant one. This result is similar with Amanuel (2011) who found

beekeepers confirmed additional food was purchased from the additional income earned from honey and it was the main reasons for the increment of meal frequency per day in Ginbo woreda southern Ethiopia.

Table 14. Income source of the sampled respondents along the two districts

Sources of income	Respondents category	Adwa			Ahferom			Total			T- test
		N	Mean	SD	N	Mean	SD	N	Mean	SD	p- value
Income from crop yield	Beekeeper	39	12,475	4,508	54	12,422	3,831.3	93	12444.4	4,104.9	0.00
	Non beekeeper	39	9,766.6	3,196.5	37	9,656.1	4,159.2	76	9712.8	3,671.9	
Income off- farm	Beekeeper	11	7,789.1	2,216.2	17	8,760	5,521.9	28	8,378.6	4,485.7	0.97
	Non beekeeper	13	7,790.7	2,799.9	15	8,832	3,672.6	28	8,348.6	3,279.9	
Income from livestock	Beekeeper	39	11,567.2	4,270.8	61	10,490.2	3,786	100	10,910.2	3,995.9	0.00
	Non beekeeper	40	8,273.4	3,940.1	37	6,819.6	2,953.8	77	7,574.8	3,554.4	
Income from beekeeping	Beekeeper	39	9016.2	15,150.2	61	7,709.9	5,199.4	100	8,219.3	10,241.9	
Total annual income	Beekeeper	39	26,239	7,643	61	23,521	8,133	100	24,591	8,018	0.00
	Non beekeeper	40	20,927	7,902	40	18,447	7,716	80	19,687	7,958	

N= Number of respondents, SD= Standard Deviation
Source: Own computation from survey result, 2015

Food and income generation; From the total 5949kg honey production of sampled respondents about 84.6% was sold in local market but 15.4% was used as food directly or in the form of tej or *Birzi* on their house. This result is not online with CSA (2013) reported that from the total honey production 66.23% use for sale while the rest 33.77 % use for home consumption in central zone of Tigray region. This difference is may be due to the price increment of the honey from time to time, so as the price of the honey increases the amount of selling increase rather than using for home consumption. From the total beeswax production in the sampled households 105.25kg about 40% used for selling in market and 60% for home usage. This is similar with the report of CSA (2013) in which about 59.11% of beeswax production in Tigray region for home consumption. This indicates producers need to change their honeybee products to money in order to purchase crop for food, school fees, house construction, saving, and purchase house equipment. Besides, beekeeping is the main sources of income in the study area. This result is similar with the finding of Assefa (2009) who reported that honey is the major cash income commodity in Atsbiwemberta, Eastern Tigray.

Expenditure of income obtained from honey and beeswax; Figure 4 shows, the application of money collected from selling of beehive product honey, 69% used for home consumption (crop purchase), 15% for children school fees, 6% for purchasing house equipments, 4% for saving and 6% used for house construction. This result is resembles with Kerealem *et al.* (2009) who reported as many poor farmers sell their honey to the local markets and use as income source to purchase livestock, agricultural inputs, food crops, as a diet and other household items in Amhara region.

Figure 4. Expenditure of income from honey, beeswax and bee colony
Source: Own computation from survey result, 2015

Employment: According to the group discussion, among the advantages of beekeeping served as source of job creation opportunity (self employment) of in the study area. During harvesting season farmers have ability to harvest honey especially in improved beehive a man may harvest by paying about 50 ETB for each beehive but in transfer of bee colony they offered 40ETB per honeybee colony. Beekeeping production served for the landless youth as job creation and sources income. In Adwa and Ahferom districts about 1424 and 1842 youth engaged in beekeeping production activities in the uncultivated land through cooperation in group. Beyond that some other people participated in honey trading and processing, they got benefits in source of income and extra work employment.

Income share of beekeeping: Total annual income of the respondents from crop cultivation, livestock rearing, off - farm and beekeeping was 11,216 ETB, 9,459 ETB, 8,364 ETB, and 8,219 ETB, respectively. Table 15, shows the contribution of honey and beeswax on the annual income which was about 22% of the total income of the respondents. This implies that beekeeping plays a significant role in increasing and diversifying the incomes of rural communities.

Table 15. Average annual income/HH and contribution of beekeeping income generation

Source of income	Average household annual income (ETB)	Proportion (%)
Crop	11215.98	30.10
Off - farm	8363.57	22.45
Livestock	9459.22	25.39
Beekeeping	8,219.34	22.06

HH = Headed Household, ETB= Ethiopian Birr

Source: Own computation from survey result, 2015

4.5. Economic analysis of honey and beeswax value chain

As shown in Table 16, the average white honey production cost was estimated 22.53 ETB per kg. The major cost belongs to inputs and labour in honey production. Producers selling price is 126.75 per kg. Marketing cost of producers was estimated at 0.87 ETB per kg making the producers profitable about 103.35 ETB per kg. Value chain actors added a total value of 115.22 per kg from white honey. Producers added 89.7% of the total value of white honey in the area while traders added only 10.31%. This value addition process was depending on the differences in sales price and cost of inputs at each stage of the value chain. Value chain actors added a total value of 56.46 per kg for amber honey. Producers added 49.7% of the total value of amber/golden honey while processors and traders added the next values 28.69% and 23.41%, respectively. Marketing margin in beeswax was highest in traders 54.31% than producers 45.69%. As a result, from this farmers are more profitable from selling of white honey rather than amber/golden honey. This is may be resulted from high demand and best quality of white honey in the local market.

Table 16. Marketing margin honey and beeswax value chains on producers, processors and traders

No	Item	White honey			Amber/golden honey				Beeswax		
		Producer	Trader	Total margin	Producer	Trader	Processor	Total margin	Producer	Trader	Total margin
1	Material cost	-	-	-	-	-	-	-	-	-	-
	cost of production/1kg	22.53	-	-	22.53	-	-	-	1.19	-	-
2	Purchase cost/1kg	-	126.75	-	-	50.43	67.67	-	-	52.5	-
3	Total material cost/1kg	-	-	-	-	-	1.58	-	-	1.57	-
4	Marketing cost/1kg	0.87	4.03	-	0.87	4.03	0.20	-	0.05	-	-
5	Total cost/1kg	23.4	130.78	-	23.4	54.46	69.45	-	1.24	54.07	-
6	Selling price/1kg	126.75	142.65	-	50.43	67.67	85.64	-	52.5	115	-
7	Margin or value added/1kg	103.35	11.87	115.22	27.03	13.21	16.19	56.43	51.26	60.93	112.19
	% of value added/1kg	89.69	10.31		47.90	23.41	28.69	-	45.69	54.31	-

Traders indicate wholesaler/ retailers and collectors

Source: Own computation from survey result, 2015

4.6. Challenges and opportunities of honey and beeswax value chain development

4.6.1. Challenges of honey and beeswax value chain development

There are factors that hinder the production of honeybee in the study area. The majority of the sampled beekeepers respond that lack of beekeeping equipment, pesticide application and pest and predators (ants, birds, toads and lizard). Drought due to deforestation and shortage of beeswax supply are the major challenges of beekeeping production system while colony supply problem is only in (Adwa district) as described in the woreda. This finding share with findings of Gidey and Mekonen (2010) who described that most beekeepers in Tigray region do not visit their bees regularly; farmers do not have any type of beekeeping equipment and did not bother about their colonies during harvesting. The place where beekeepers put their beehives also considered as the major constraints. Besides, the critical constraints that affecting honey production include inadequate production technologies, limited availability of honeybee flora mainly due to deforestation, lack of beekeeping knowledge (skill) and poor extension service.

Table 17. Major constraints in beekeeping production along the two districts

No	Constraints	Adwa	Ahferom	Total	rank
		N	N	N	
1	Shortage of beeswax supply	18	12	30	4th
2	Shortage of bees colony supply	7	0	7	6th
3	Shortage of bee equipment supply	39	56	95	2nd
4	Pesticide application	31	58	89	3rd
5	Pest and predators	39	61	100	1st
6	Drought	9	6	15	5th

N= Number of respondents

Source: Own computation from survey result, 2015

The major constraints of beekeeping production in Adwa and Ahferom districts are discussed below.

Supply of beekeeping inputs: Among the total samples of respondents, almost 95% respondents mentioned as a limited access for beekeeping equipment, 30% low quality beeswax and 7% limited access to bee colony supply (Table 17). As per the group discussion, the main weakness in input supplies of study the area are shortage of beekeeping equipment and poor quality and queen less bee colonies supply in the local market. In improved beehive, absconding of the bee colony occurs and this might be due to mismanagement of frames regarding sanitation and placement in beehive. Besides, there are problems like shortage of input supply, high input price and low quality of beekeeping inputs.

Production: Based on the qualitative data, the main constraints in beekeeping production is low productivity due to inadequate access of improved beekeeping equipments and use of more traditional beehives. Lack of technical knowledge on honeybee seasonal management's like inspection and harvesting technique, pest and predators such as birds, ant, lizard, toad, and wax moth are the main reason for absconding of the bee colonies in the study area. The other problem was vegetation deforestation for fire wood in both districts that can be led reduction of the honeybee flora. Similar result was reported by Gidey and Mekonen (2010) who suggested as the deforestation process is practiced in every part of Ethiopia. Pests and predators are directly related to beekeeping management problems. The major pest and predators in the study area was ant, wax moth, lizard, toads and birds. The same problem was mentioned by other researchers (Adeday *et al*., 2012; Haftu *et al*., 2015). This shows that most farmers are using poor management systems because of poor skill on honeybee management. Inadequate skills and knowledge of farmer on production and farm management creates such problems. This is mainly related with poor extension service in the areas.

The application of pesticides and herbicide in both districts is also the main problem. Farmers use pesticides to control their crop from different hazardous herbs and weeds at the flowering time. From the total of sampled beekeepers about 89% of the beekeepers responded pesticide application as the main factor that poison honeybees and decreases honeybee colonies population in users (Table 17). Conflict may be raised between beekeepers and non beekeepers due to

informal application of pesticides by non beekeepers without getting the consent of bee colonies problem.

Processing: The main constraints in honey and beeswax beehive products are shortage of processing equipment, packaging materials and lack of skill on how to process honey. Local processors (tej makers) stated that the purchasing price of honey is high as well as price of tej is high as a resulting in the consumers to prefer other drinks with low price (Table 18). There is poor market linkage of honey and beeswax between producers and large processers in the study area. There is also a problem in price of the honey between producers and large processors. The producers in Adwa and Ahferom are not willing to sale honey to the large processors because of the low price that they received from a unit of honey. According to the respondents, large processor preferred to purchase honey from Atsbiwemberta, Hagere-selam, Worei-leke and others rather than Adwa and Ahferom. This happen may be due to lack of specific price of honey throughout the value chain actors. Creating honey cooperative in the study areas may resolve the existing problem.

Marketing: Farmers produce honey and beeswax and sold in the local market for various consumers and traders. According to the producers, the major honey marketing problems are 50.6% lack of trust by buyers due to adulteration, 14.6% honey price variation and 25.8% both lack of confidence in adulteration and price variation. During honey marketing the major problems happen in traders are buyers' lack of confidences with honey adulteration and high tax. According the respond of traders, the major honey marketing problems are 75% of trader's adulteration and 25% of traders with high tax and adulteration (Table 18). The adulterations often occur by unlicensed traders. The results caused due to lack of market linkage starting from producer up to last consumer. Therefore, it needs policy for controlling either to stop or to become licensed the unlicensed honey traders. Marketing linkage between each actors participated in marketing of the honey is a solution to minimize adulteration and to increases profitability for all the value chain actors.

Table 18. Challenges in honey and beeswax value chain actors along the two districts

Market actors	Type of challenges	Adwa		Ahferom		Total	
		N	%	N	%	N	%
Producers	Consumers lack of confidence with adulteration	3	8.3	42	79.2	45	50.6
	Honey price variation	12	33.3	1	1.9	13	14.6
	Both lack of confidence adulteration and price variation	18	50	5	9.4	25	25.8
	Never	3	3.8	5	9.4	8	9
Traders	Adulteration					6	75
	High tax and adulteration					2	25
Processors	High price of honey and low demand (Tej consumer)					3	100

N=number of respondents, Source: Own computation from survey result, 2015

4.6.2. Opportunities of honey and beeswax value chain development

There are different opportunities available for the development of honey and beeswax value chain in the two districts. The study areas have potential and diversified natural bee forage, suitable agro-ecology and indigenous knowledge for beekeeping to produce honey and beeswax hence, all farmers have probably to engage in beekeeping activities. Availability of indigenous knowledge for beekeeping and local supply of beehive, bee colony and beeswax are good opportunity to develop honey and beeswax value chain development. Availability of government and non-governmental organizations which supports for value chain actors by introducing of improved beehive, beeswax, other beekeeping equipment and technical support to expand improved beekeeping system is the main opportunities of input supplies. Availability of credit service in both Ahferom and Adwa open for all farmers is other opportunity. Honey is not easy perishable in short time they can store and sell at the season of prices increases. Increasing population in urban and rural areas also good opportunities for increases demand of honey in the local market are the opening in beekeeping production and marketing. Increasing demand and prices of honey from time to time in local market also other opportunities for developing honey and beeswax value chain development in the study areas.

Chapter five: Conclusions and Recommendations

5.1. Conclusions

The results indicated that, honey and beeswax value chain functions in the study areas are input supplies, production, trading, processing and consumption. Those value chain functions are performed by the chain actors. The major beekeeping inputs are beehive, honeybee colony, beeswax and other beekeeping accessories and these are supplied by GO, NGOs and farmers. The productivity of honey from improved beehive of the study area was twice of traditional beehive. From the total honey production around 85% is sold in the local market and the majority of those honey production (62%) is sold to consumers directly this is may be due to lack of formal market linkage among all market actors. The average price of white honey was higher than the amber/golden honey by 43.5%.

Based on probit regression model results age, education, land size and extension service were found as important determinants to affect farmers in adoption of beekeeping technologies. It was found that beekeepers with old age, educated and those who received extension service had more resistance to adoption of beekeeping technologies.

Honey and beeswax value chains are important as source of food, income and employment for value chain actors. The total annual income of beekeepers was higher than non beekeepers. The contribution of beekeeping on household income was 22% of the total annual income of the respondents indicates that, beekeeping play a significant role in increasing and diversifying household incomes of beekeepers from their own honeybee production. Profit of producers from one kg of white honey is higher than amber/golden honey and beeswax may be due to high demand of white honey by consumers. At the farm level, beekeepers are faced with challenges such as lack of modern processing and packaging equipments supply and other predators and pesticide applications are the main problems on beekeeping. On marketing, lack of market linkage between producers, traders and large processors as well the illegal traders are the major problems related with adulteration of honey. Generally the major constraints in honey and beeswax value chain are shortage and poor quality input supply, poor management system, lack of honey and beeswax cooperatives.

5.2. Recommendations

For the development of honey and beeswax value chains in the study area possible recommendations that could be suggested on the basis of the study to be considered in the future intervention strategies of honey and beeswax value chain of the study area are listed as follows:

- There was lack of improved beekeeping equipment supply, low honey and beeswax productivity. More efforts need to distributing full and good quality improved beekeeping equipment into farmers and apply good management system is essential to increase honey and beeswax production.
- The finding of this study shows the existences of honey and beeswax marketing problems and there was poor marketing linkage on honey and beeswax beehive products. Effort need to establish honey and beeswax cooperative and to encourage collective action of products at different level and expanding the licensed trader to control adulterations
- Based on probit regression model results, old age, educated, landless and those who received extension service had more resistance to adoption of beekeeping technologies. Hence, strengthen area specific extension system on beekeeping supporting by giving continuous capacity building trainings and separating DAs extension work from other administrative activities, introduce modernized beekeeping system and motivation farmers by giving uncultivated land for beekeeping activities to increase beekeeping technology participation.
- Based on the economic analysis, profit of producers from white honey was higher than amber/golden honey. Hence, promoting farmers to produce white honey in order to be more profitable from their product could be good solution by introducing diversified honeybee flora like *tebeb* (*Becium grandiflorum*) could be best solution to produce white honey.
- The result of this finding shows, adverse effect of agro-chemicals on honey and beeswax production. Hence, actors working on honey and beeswax sectors if possible introduces proper management practices otherwise they should promote knowledge and practices of on proper use of agro-chemicals.

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Appendix

Appendix1

Conversion factor of livestock unit (TLU)

No	Animal	Conversion factor
1	Calf	0.25
2	Heifer	0.78
3	cow/ox	1
4	Sheep	0.1
5	Goat	0.1
6	Camel	1.2
7	donkey	0.8
8	mule	0.8
9	Chicken	0.01

Source; FAO, 2003

Appendix 2

Questioner

Part 1. Basic Household head information **code_____**

1. Name of the Household Head: _____

2. *Tabia*: _____ 3. *Kushet* _____

4. Sex of the household head 1. Female headed 2. Male headed

5. Age of the household head _____years

6. Educational status of the household head 1.lliterate 2. Informally literate 3.formally literate

7. If formally literate years of schooling 1. Grade 1-4 2. Grade 5-8 3. Grade 9-12
4.others specify _____

8. Marital status 1. Single 2.Married 3.Widowed 4.Divorce

9. How many persons belong to your household members' (permanently living or family including head)? _____

10. Family member sex and age exclude headed household

No	Age category	Sex		
		Male	Female	Total
1	Up to 14			
2	15-64			
3	>65			

11. How many children do you learn _____

Part 2. Household economic status

1. Do you have land? 1. Yes 2. No

2. If yes total land size_____ ha: own _____ha shared in _____ha rent in_____ ha

3. Would you please tell me the type and yield of the crop you grown last season?

No	Crop grown	Area(ha)	Yield(q/t)
1			
2			
3			
4			
5			

4. Were there any members of your family working on off-farm activities?
1. Yes 2. No appreciate

5. If your answer Q4 is yes, in each approximately for how many weeks per month did members of your family engage in each of the following activities? _____

No	Type of off activities	In which use thick X	Total estimated income in birr per week	Total estimated income in birr 2005/2006E.c
1	Construction			
2	Selling of fire wood			
3	Hand craft			
4	Weaving			
5	Petty trading			
6	Local brewing			
7	Salary employment			
8	Carpentry			
9	Others			

6. Would you please tell me the type and number of livestock you posses last year?

S.N	Types of livestock	Number of animals at the end of the year 06 (Yes=1 No=0)	Income obtained from sell 2005/2006E.C
1.	Oxen		
2.	Bulls		
3.	Cows		
4.	Heifers		
5.	Calf		
6.	Sheep		
7.	Goats		
8.	Horse		
9.	Mule		
10.	Donkey		
11.	Camel		
12.	Chicken		
13.	Honey colony		
14.	Egg, Milk and butter sold per lactation period		
15.	Others, specify		

Part3. Household headed participation in Agricultural extension

1. Participation in Agricultural extension

No	Items	yes =1 no=0	Remark
1	Frequency of contact with Development agent per year		_____days
2	Have you ever read of agricultural matters from manuals?		
3	Have you ever been a model farmer?		
4	Listen radio on agri. program?		
5	Hove you participant beekeeping extension		
6	Attended any farmers' demonstration/ field day arranged by development agent?		

Part 4. Beekeeping Activities

1. Do you keep honeybees? 1. Yes 2. No

2. If yes Q1, when did you start beekeeping? _____

3. What are the major inputs used in your beekeeping activities? Select one or more 1. Modern beehive 2.Bee colony 3. Beeswax 4. Honey bee forage 5. Processing equipment 6.If other specify___

4. Where do you obtain these inputs?

5. What are the pro and con of using such inputs?

6. How do you start beekeeping and the source of bees?

No	Sources	Type of hive	
		Traditional number	Modern hive number
1	Gift from parents		
2	Buying/purchase		
3	swarming/Capturing		
4	Splitting		
5	Others specify		

7. Where did you keep your bee colonies? Tick X for types.

No	Site or placement of your hive	Type of hive	
		Traditional	Modern hive
1	Backyard		
2	Under the eaves of the house		
3	Inside the house		
4	Hanging on trees near homestead		
5	Hanging on tree in forests		
6	Others (specify)		

8. What criteria do you follow to select apiary site? Circle one or more

1. Availability of flora 2.Free of pesticides and herbicides 3.Road availability 4. Water availability 5.Ease of access for management 6.others (specify) _____

9. What are the major honeybee floras in your area? _____

10. What are the sources of water for your honey bees? (Circle one or more) 1. Streams 2.Rivers 3. Lakes 4.Ponds 5.Water harvesting structures 6. Others (specify) _____

11. Do you give supplementary food to your bee colonies? 1. Yes 2.no

12. If yes Q11, when do you feed bee colonies? (Circle one or more) 1. During dry season 2.when the bees are weak 3.when the colony affect by diseases 4.when you intend to rear queen 5.when you intend to transport colony 6. Others (specify) _____

13. If yes, what are the supplementary foods and quantity given to bee colony?

No	Supplementary food type	Quantity (kg)	Cost of food
1	Sugar		
2	Honey		
3	*Shiro*		
4	*Thehni (Barley flour soaked in water)*		
5	Others		

14. Did you ever get beekeeping training? 1. Yes 2. No

15. If yesQ14, from where did you have the training? 1. Research center 2.Agricultural and rural development 3.Non Governmental Organization (NGO) 4.Any other (specify) _____

16. If yes, on what area did you get training? 1. Colony split 2.Honey bee colony management 3. Processing, handling & storage 4.Market information and linkage 5.Input utilization 6.Bee forage development 7.Other specify_____

17. How often do you get extension services on beekeeping? 1. Monthly 2.weekly 3.Rarely 4.Daily 5.Never

18. Who receives such extension services 1.HH head 2.Spouse of the HH head 3.Any family member 4. Others (specify) ____

19. How often did you get technical advices on marketing by extension? 1. Monthly 2. Weekly 3. Daily 4.never

20. Are you satisfying by the services get from services provider?

1. Yes 2. No

21. What do you improve in your beekeeping activities from services providers support you?

1. Improve the management system of colony 2.improve the honey harvesting system 3.improve wax extract from honey 4. Split colony to multiple honey bee 5. If other specify_____

22. Do you inspect your apiary site? 1. Yes 2. No

23. If yes how often? 1. Daily 2.weekly 3. Monthly 4.year

24. If no, why? _____

25. For how many years your colony stayed in the hive?

1. Traditional: Minimum _____year (s) Maximum _____years

2. Modern hive: Minimum _____ year (s) Maximum _____years

26. Currently do you rear queen bee artificially? 1. Yes 2. No

27. Which of the following beekeeping equipments /materials do you have?

No	Material	Home made	purch ased	Provide credit (purchased)	Donated by NGOs(name) or GOs	Prices		services period (years)
						Rent	Purc hase	
1	Hives							
2	Smoker							
3	Bee Veil							
4	Boots							
5	Water sprayer							
6	Bee brush							
7	Queen excluder							
8	Honey extractor							
9	Knife							
10	Honey container							
11	Casting mold							
12	Overall/suit							
13	Chisel							
14	Others specify							

Credit

28. Did you have access to credit services in the last 5 years? 1. Yes 2. No

29. If the answer Q28 is yes, amount of credit taken _____birr

30. Did you use credit services 2005/06E.C? 1. Yes 2. No

31. If yes, write the source, amount and purposes of the credit

No	Source	Amount	Purpose
1	*Dedebit*		
2	Cooperatives		
3	Bank		
4	Local money lender		

32. Of the amount of credit taken in 2005/2006E.C how much of it was used for honey bee related issue? _____

33. What is the loan repayment period? _____

34. Are users of the credit service satisfied/dissatisfied of the current services? 1. Yes 2.no

35. What should be maintained and improved? 1. Increases number of hive 2. Complete suite 3. Honey equipments 4.If others specify----------

36. What is strong /weak about the credit services you received?

Honey bee production

37. Number of hive, harvesting frequency, month, amount and the use of product

No	Hive type	no/ hive	Harvesting frequency	Harvesting months	Amount of harvesting		Home use		Sold	
					Honey	Wax	Honey	Wax	honey	Wax
	Modern									
	Traditional									

38. What is the major advantage of beeswax in the area? _____

39. Did you use honey extractor in 2005/2006E.C? 1. Yes 2. No

40. Do you process your honey? 1. Yes 2. No

41. If yesQ40, what material do you use for processing? _____

42. If yes Q40, why do you decide to process? Circle one or more. 1. More market prices 2.to earn other products 3. No market for honey comb 4.consumer preference 5. To make long life 6.Others specify _____

43. If no, why (Circle one or more)? 1. No market for extracted honey 2.does not increase market price 3.Lack of knowledge 4. Consumers prefer honey comb 5.Lack of materials 6. Other specify_____

44. Do you separate the beeswax from the honey? 1. Yes 2. No

45. If yes Q44, what is the amount of beeswax per kg of honey?

Type of hive	Honey(kg)	Beeswax(kg)
Modern hive		
Traditional hive		

46. If not, what are the reasons (up to 3 reasons in ranking order) for not processing crude honey?

No	List the reason	Rank
1		
2		
3		

47. Which are the constraints of your beekeeping production?

No	Constraints	Yes=1 no=0	If yes rank
1	Shortage of honey bee flora		
2	Lack of beeswax supply		
3	Lack of marketing information		
4	Pesticides application		
5	Drought (lack of rainfall)		
6	Diseases		
7	Shortage of hive supply		
8	Shortage of colony supply		
9	Processing equipment		
10	packaging equipment		
11	Ants		
12	Wax moth		
13	Bee lice		
14	Wasps		
15	Toads		
16	Lizard		
17	Monkey		
18	Birds		
19	Others specify		

Market

48. Distance of your house from your District _____hrs
49. Distance of your house from the main road/upgraded road __hrs
50. Distance of your house from FTC_____ hrs
51. Distances of your house from market _____hrs
52. Do you get to market information? 1. Yes 2. No
53. Do you sell your beehive product? 1. Yes 2. No
54. If yes Q53, for who do you sold their product and what is price?

No	Products	Product sold in kg					Selling place/area	Prices /unit
		Consumer	Collector	Retailer	Wholesaler	Processor		
	Honey							
	Beeswax							
	Colony							

55. Did you get to market all the quantity you produced to sell in 2005/2006? 1. Yes 2.No

56. If the answer Q55 is no how long do you store until you get to market? Tick X

No	Products	Storage period				
		3 month	6month	1year	2year	>2year
	Honey					
	Beeswax					
	Colony					

57. What are the factors that govern the prices of the honey in your locality? (Circle one or more)
1. Season of the year 2. Color and taste of the honey 3.distances from the market 4.Others specify___

58. During the harvesting season what is the price of 1 kg of honey?

No	Color of honey	Price of honey (Birr/kg)	When
1	White		
2	Amber		
3	Mixed		
4	Other		

59. How do you evaluate the local market price, demand and supply along the year? Tick X

No	Local market	Months											
		Septe mber	Octo ber	Nove mber	Dece mber	Janu ary	Febr uary	ma rch	Ap ril	Ma y	Ju ne	Jul y	Aug ust
1	**Price**												
	High												
	Mediu m												
	Low												
2	**Dema nd**												
	High												
	Mediu m												
	Low												
3	**Suppl y**												
	High												
	Mediu m												
	Low												

60. What problem does face on the market during sale your honey? 1. Consumers lack of confidences with adulteration 2.price variation 3. If other specify_____

Checklist for producer in the form of table

Production; honey (kg/hive) ----------beeswax--------- (kg/hive)
Input use, cost of inputs and cost of production

No	Type of input in modern beehive	Unit	Amounts	Cost (birr)	
				Cost /unit	Total cost
1	Material cost				
	Hive	No			
	Colony	No			
	Wax	Kg			
	Honey extractor	No			
	Smoker	No			
	Bee veil	No			
	Boots	No			
	Bee brush	No			
	Knife	No			
	Casting mold	No			
	Water spray	No			
	Forage seed	Kg			
	Supplementary food	Kg			
	Others				
2	Labour cost				
	Apiary site preparation	Birr			
	For transportation hive	Birr			
	For transportation colony	Birr			
	For honey harvesting	Birr			
	For colony transfer	Birr			
	Bee inspection	Birr			
	Wax comb preparation	Birr			
	Honey transport to market per 25kg				
	Total cost expenses				
3	Production sale:	Kg			
	Honey				
	Beeswax	Kg			
	Colony	No			
	Total revenue/ return	Birr			
	Profit	Birr			

Production; honey_____ (kg/hive) wax _____ kg/hive

Input use, cost of inputs and cost of production

No	Type of cost in traditional beehive	Unit	Quantity	Cost (birr)	
				Cost/unit	Total cost
1	Material cost				
	Hive	No			
	Colony	No			
	Smoker	No			
	Bee veil	No			
	Boots cost	No			
	Bee brush	No			
	Knife	No			
	Supplementation food	Kg			
	Others				
2	Labour cost				
	Apiary site preparation	No			
	For transportation hive	No			
	For transportation colony	No			
	For honey harvesting	No			
	Bee inspection	No			
	Honey transport to market				
	Total cost expenses				
3	Production sale	Kg			
	Honey				
	Beeswax	Kg			
	Colony	No			
	Total revenue	No			
	Profit	Birr			

Checklist for processors (Tej house)

Name of the processer_____ District_____

1. Sex of the processor 1.male 2. female 2. Age _____
3. Marital status 1, Single 2,Married 3,Divorced 4,Widowed 5. Separated
4. Family size except households head 1= Male_____ 2= Female_____ Total
5. Education level of the Processors (circle one) 1.Illiterate 2. Grade 1-4 3.Grade 5-8
4. Grade 9-12 5. >12
1. From where do buy honey? _____
2. From whom do you buy the honey?_____
3. What quality/color of honey do you prefer? _____
4. How mach honey do you purchases per month minimum _____kg, maximum _____kg

5. How they recycle the processing? _____

6. Amount of processed per unit time _____litter

7. Purchased price of honey in the expensive _____Birr/kg, price of the honey purchase in the cheap _____ Birr/kg, average purchased prices of honey _____ Birr/kg.

8. Amount of other ingredients added

No	Type of ingredient/cost item	Amount needed per kg of the honey	Cost (Birr/kg)
	Gesho		
	Sugar		
	Yeast		
	Labour cost for processing		

9. Quantity of processed product and selling prices per one cycle

No	Type of product	unit	Quantity	Price/unit	How are the buyers use it
1	*Tej*	litter or *brle*			
2	Wax	kg			

10. Do you tack credit? 1. Yes 2. No

11. If the answer is yes for what purpose do you tack the credit? _____

12. How many birr do you tack in 2006E.C? _____

13. What are the qualifying requirements to approve loan applications?

14. What is the loan repayment period? _____

15. What is the interest rate? _____

16. What is the rent of the house? _____

17. What problem does occur during tack the credit? _____

18. What are the challenges in participating Tej making and selling business?_____

19. What are the Opportunities in participating Tej making and selling business?_____

Checklist for honey traders

Name _____ sex_____age_____education level_____marital status_____ family size _____Distirict _____type of trader_____

1. How long have you been in the honey collecting/treading business? _____
2. What was the source of your initial capital? 1. Own 2.loan 3.share 4. Other specify it___
3. From whom do you buy the honey?_____
4. From where do you buy the honey?_____
5. How many do you buy per months in kg?_____per year in kg_____
6. What type of honey do you buy? 1. White 2. Amber 3. Mixed 4. Yellow
7. What are the buying prices of honey per 1 kg in the expensive season? 1. White____ 2. Amber _____ 3. Mixed ____ 4. Yellow_____ Birr/kg

8. What are the buying prices of honey per 1 kg in the cheap season? 1. White____ 2. Amber_____ 3. Mixed ____ 4. Yellow _____ Birr/kg
9. What are the selling prices of honey per 1 kg in the expensive season 1. White_____2. Amber _____ 3. Mixed____ 4. Yellow_____ Birr/kg
10. What are the selling prices of honey per 1 kg in the cheap season? 1. White_____2. Amber _____ 3. Mixed____ 4. Yellow_____ Birr/kg
11. Where do you sale the honey?_____
12. For whom do you sell the honey?_____
13. How long do you store the honey?_____
14. What is your evaluation on market prices of honey along the year list in months?
    a. High_____
    b. medium _____
    c. low _____
15. What is your evaluation on market demand of honey along the year?
    a. High_____
    b. medium _____
    c. low _____
16. What is your evaluation on market demand of honey along the year?
    a. High_____
    b. medium _____
    c. low _____
17. Do you face any problem of honey adulteration during purchase from producer? 1. Yes 2. No
18. What material do you use for checking adulteration?_____
19. What material do you use for honey packaging?_____
20. What is the price of equipments? _____
21. What is the tax per year?_____
22. Transportation cost per year?_____
23. What are the challenges in honey collecting/trading?_____
24. Do you tack credit? 1. Yes 2. No
25. How many birr do you tack in 2006E.C? _____
26. What are the qualifying requirements to approve loan applications?_____
27. What is the loan repayment period?_____
28. What is the interest rate? _____
29. What problem does occur during tack the credit? _____
30. What is the total income per year from the selling of the honey?_____
31. How many birr do you save per year?_____
32. What type of material do you use to transport the honey? 1, Clay pot, 2, Plastic container, 3,stainless steel, 4, if others specify it
33. What are the challenges in participating in honey collecting and selling business?_____

34. What are the Opportunities in participating in honey collecting and selling business?____

_____

Check list for beeswax collector

Name _____ sex_____age_____education level_____family size _____
District _____type of trader_____

1. Do you participate in beeswax treading? _____
2. How long do you practice beeswax treading? _____
3. From whom do you collect the beeswax?_____
4. What is the buying price of beeswax per one kg? _____
5. How much wax do you purchase per months in kg?_____per year in kg_____
6. Where do you sale beeswax? _____
7. For whom do you sell the beeswax?_____
8. What is the selling price of beeswax per one kg? _____
9. What material do you use for beeswax processing?_____
10. What is the price of equipments? _____
11. What is the services year of the equipments? _____
12. Do you employ workers in your business? 1. Yes 2. No
13. If the answer is yes how many workers do you employ? _____
14. Transportation cost beeswax and other costs per year?_____
15. What are the challenges in beeswax collecting/trading?_____

    _____
16. What are the challenges in participating in beeswax collecting and selling business?_____

    _____
17. What are the Opportunities in participating in beeswax collecting and selling business?

    _____

Check list for Key informants, DAs and Experts

Woreda _____
Farming system of the Distr_____
Beekeeping farming; total bees hive/bee colonies in the Woreda _____modern beehive_____, traditional beehive _____
Farmers owned honeybees 2005/2006E.C

Farmer/headed householder /	Modern Beehive	Traditional Beehive
Male		
Female		
Total		

Total honey production 2005/2006E.C

Type of hive	Honey production /kg /year		
	Maximum	Medium	Minimum
Modern			
Traditional			
Total			

Total beeswax production 2005/2006E.C

Type of hive	Beeswax production		
	Maximum	Average	Minimum
Modern			
Traditional			
Total			

1. How much wax purchases from other areas in 2005/2006 E.C _____kg
2. What is the price of wax per kg? _____
3. From where do you purchase the wax? _____
4. What is the acceptances the purchased wax by the bees/farmers? _____
5. What should be done to improve wax supply? _____
6. From the total honey production what is the color in % ,white_____Amber____ _____mixed__yellow_____
7. From the total honey production how much marketed _____%, how much consumed _____%
8. What is the average price of honey per kg? _____
9. What is your contribution in the beekeeping to improve honey and wax production? _____
10. How many honey traders are present in the Woreda and list their names? _____
11. Do you have honey collectors in the tabias? _____
12. Do you have honey cooperatives in the area? _____
13. What is the market channel or marketing system of honey and beeswax in the area?
14. List services providers are give services /support for beekeepers? _____
15. Who is beekeeping equipment supplier in the Woreda? _____
16. List the various key actors who participated in developing honey and wax value chain?
17. What are the main reasons for honey marketing problems?_____
18. Where they process honey of Woreda? _____

19. What are the constraints/weaknesses and the opportunities along the value chain?

Functions/Process performed at each stage	Constraints	Opportunities
Input supply		
1		
2		
3		
4		
5		
Production		
1		
2		
3		
4		
5		
Processing		
1		
2		
3		
4		
5		
Trading		
1		
2		
3		
4		
5		
Consumption		
1		
2		
3		
4		
5		

Checklist for private services providers

1. Name of private service provider_____ Woreda _____
2. How long you haven in the Woreda? _____
3. What is your contribution in relation to beekeeping? _____
4. Do you give credit for beekeeping activities? 1. Yes 2. No

5. For what purpose do you give the credit? _____
6. How much credit do you give for beekeeping?
   For one modern beehive _____
   For one honey bee colony_____
   If for other equipment_____
7. How many birr do you give for one farmer maximum? _____
8. What are the qualifying requirements to approve loan applications from beekeepers?_____
9. What is the loan repayment period? _____
10. What is the interest rate? _____
11. How much credit do you give for the beekeeping in one year? _____
12. What problem does occur during give the credit? _____
13. What is the honey market channel in the Woreda? _____
14. What are the common problems on honey market in the Woreda? _____

Checklist for private input /bee colony/ supplier

Name _____ Woreda / town_____ *Tabia* _____

1. Sex of the Interviewer 1.male 2. Female
2. Age of the input supplier _____
3. Marital status (circle one) 1.Single 2.Married 3.Divorced 4.Widowed 5. Separated
4. Family size _____
5. Education level of the input supplier (circle one) 1.Illiterate 2.Church education
   3, Grade 1- 4 4, Grade 5-8 5, Grade 9-12 6, >12
1. When do you start colony multiply?_____
2. Who do you support you to do this?_____
3. Inputs in colony rearing in 2005/2006

No	In puts	amount use	source of input	Unit price in ETB	Total price in ETB	Total per year in ETB
1	Colony					
2	Hive					
3	Wax					
4	forage seed					
5	Other					

4. What is the transport cost of colony? _____
5. What are the opportunities regarding input supply? 1, infrastructure of the area 2, high access to input 3, high demand of the product in area 4, others specify_____
6. What are the challenges regarding input supply?
   1, problem in supply 2, problem of demand 3, transportation problem 4, others specify
7. Output from bees colony rearing in 2005/2006

No	out put	number of rear honey bee queen	Quantity produce per year	Unit price in ETB	Total price in ETB	for who do you sale the bee colony
1	bee colony					