St. Mary's University,

School of Graduate Studies

Institute of Agriculture and Development Studies

CONTRIBUTION OF MODERN BEEKEEPING TECHNOLOGY ON THE INCOME OF HOUSEHOLD IN TOLAY AREA OROMIA REGION, ETHIOPIA

By

Lulseged Belayhun

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Addis Ababa, Ethiopia

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A thesis submitted to St. Mary's University Institute of Agriculture and Development Studies for Partial Fulfilment of Master of Art in Rural Development

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APPROVED BY BOARD OF EXAMINERS

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External Examiner Signature

DECLARATION

This thesis is my original work, and it has not been presented for a degree in any other universityand the source materials used for the thesis are fully acknowledged.

LulsegedBelayhun
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Date: _____

ENDORSEMENT

This study Contribution of Modern Beekeeping Technology on the Income of house

hold in Tolay area Oromia Region, Ethiopia was done under my supervision and guidance as partial fulfillment of a Master degree in Rural Development.

Name of Advisor _____

Signature _____

Date _____

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Addis Ababa

Ethiopia

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ACRONYMS

ANRS Amhara National Regional State

ARSD Apiculture Research Strategy Document

CSA Central Static Agency

EEPD Ethiopian Export Promotion Department

ESAP	Ethiopian Society of Animal Production
EPA	Environmental Protection Authority
FAO	Food and Agriculture Organization
ICIPE	International Center of Insect Physiology and Ecology
IDE	International Development Enterprises
IPMS	Improving productivity and market success
SNV	Netherlands Development Organization
m.a.s.l	Meter above sea level
MoARD	Ministry of Agriculture and Rural Development
MT	Metric tone
NGO	Nongovernmental Organization
SNNPR	Southern Nation Nationality People Region
OESPO	Oromia Economic Study Project Office

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ABSTRACT

The study examined the comparative analyses of modern and traditional beekeeping in

Tolay area, Oromia Regional state. It considered as objectives the comparative analyses of the contribution of modern bee hives verses the traditional one towards improving the income of beekeepers.

84 bee keepers 37 modern, 29 traditional18 both modern and traditional bee hives owners were involved in the study. Data were collected using structured questionnaire and oral interview. Beekeeping activity in the study area is highly dominated by men (89.3%) as compared to women (10.7 %).The result showed that the average honey production from modern hives per hive per year was 18.03 kg while the traditional hive was 5.15 kg. The average annual income from modern beehives was estimated to be Birr 9346.45. This was significantly (198.3%) higher than the estimated average annual income from traditional beehives.

Investment in modern bee keeping has increased significantly in the study area. The government, ICIPE and Biovision were contributing technical and financial support for the improvement of income for Tolay communities. Thus, it is highly recommended that bee keepers should be encouraged to practice modern beekeeping technology by providing financial and technical supports in order to boost their income at household level.

CHAPTER ONE:

1Introduction

- **Background**

1.1.1 Beekeeping Genesis

Beekeeping was founded as one of the most primal emotions of early human beings.It was their lust for adventure, sweetness and survival that drove the origins of beekeeping. (http://www.beeologics.com). Currently, there are more than 20,000 species of bees in the world. Many of them are in solitary (e.g., Mason bees), and otherslive in colony and rear their young in burrows (e.g., bumblebees).

In Europe, Americaand Africa the species *Apis mellifera* is widely found. This species has several sub-species or regional varieties, such as the Italian bee (*Apis mellifera ligustica*), European dark bee (*Apis mellifera mellifera*), and the Carniola honey bee (*Apis mellifera carnica*). In the tropics, there are also other species of social bee that are managed for honey production, including *Apis cerana*.

In Ethiopia, currently, the available bee colonies are grouped into five different honeybee species occupying different ecological areas: *Apis mellifera jemenitica* in the northwest and eastern arid and semi-arid lowlands; *Apis mellifera scutellata* in the west, south and southwest humid midlands; *Apis mellifera bandasii*, in the central moist highlands; *Apis mellifera monticola*in the northern mountainous highlands; and *Apis mellifera woyi-gambella* in south western semi-arid to sub-humid lowland parts of the country (Amssalu et al 2004).

Apiculture in Ethiopia has been an old practice. It has been known even during the rule of king Ezana in the third century AD (Melakuet al, 2008). The honey production in Ethiopia is dominantly a traditional one and is based on indigenous knowledge that is passing over from one generation to the next.

Ethiopia has the largest bee population in Africa with over 10 million bee colonies, out of which about 4.6 million are confined in hives and the remaining exist in the forest (CSA 2007).It is also the fourth largest beeswax (3200 tons per year)producer after China, Mexico and Turkey (Aby 2009). About 95% of honey production is harvested by means of indigenous methods from traditional hives (CSA 2007)

1.1.2 Production of honey bee

The production, productivity and quality of honey in Ethiopia are very poor in general the production is below the national potential (Gezahegn, 2001).Currently it is produced mainly by the smallholders who have limited access to market due to low level of productivity; poor product quality and market barriers, such as poor infrastructure, lack of favorable trade policy and shortage of finance and lack of collective bargaining power (Melakuet al, 2008).

In 1960's, the government of Ethiopia started an apiculture development program centered on improved hives (Kerealem, 2005).These hive did not only increase the quality and quantity of honey to be harvested from a colony, but it also offered easily inspection opportunity of the hives to determine the honey maturity and carry out harvesting accordingly .For instance, The national average honey produced for the year 1997 to 2004 was estimated 30 thousand metric tons, which accounted over 23 per cent of the total African production and about 2 per cent of world honey production (MoARD, 2005). Production of beeswax was three thousand tons per annum placing the country among the four largest world beeswax producers (MoARD, 2005).

In terms of volumes of honey and beeswax harvest and trade in Ethiopia exceed far other African countries. According to CSA (2013) livestock data indicated total honey production in the country 45,905,201kg per year, of which 41,742,903, 1,086,990 kg, and 3,075,308kgis from traditional, transitional and modern hives, respectively.
Beekeeping in Ethiopia is a reliable revenue generating sector to complement income of poor households of the urban and rural of the communities. It is also playing very significant roles in maintaining the natural environment and bio-diversity in a sustainable manner.

Honeybees are also playing a crucial role as important pollinators for many plant *species* including food crops to and conserving the bio-diversity through pollination.

Forest beekeeping has important economic, social and cultural roles in the lives of many local communities of Ethiopia. Honey and other hive products do not only meet basic substantial needs, they also provide income opportunities contributing up to 95 %of a household annual cash income (SNV, 2011)

1.1.3Beekeeping in Oromia region

Oromia region has an area of 36.7million hectares out of which 7.9% (3 million hectares) is covered by forest. It is rich in biodiversity owing diversified agro-ecological zones with altitude, rainfall, and temperature ranges from 500 to 4570m a.s.l., 200 to 2500mm/year and 10 to 30^0c respectively(Debissa Ebissa 2007**).** This makes Oromia as one of the major honey producing regions in Ethiopia.
Oromia region is having a large share of honey production that amounts to 41% of total country's production (Debissa Ebissa 2007). As part of the effort to encourage and increase honey production the regional government disseminates considerable number of modern (box) hives to farmers.

Beekeeping is also an old aged traditional agricultural system practiced in Oromoia region. According to OESPO (2000), 6.7 million honey bee colonies are found in this region. But, the communities are not using the potential because of; lack of awareness, little knowledge on modern beekeeping technology, variations in hive productivity, destructive harvesting practices, lack of knowledge in queen rearing and colony-split, diseases and pests like wax moths, and use of agro-chemicals.

Tolay is a locality situated along the Gibe river basin at Choraboter woreda in Jima Zone, Oromia Regional State. This is the research site that has been identified and potentially fit as to be the target site for this study.

In this woreda, the communities working with modern bee hives introduced from different organizations have considerably helped to maximize the income of beekeepers. To achieve this, the traditional beekeepers were given training on modern beekeeping technologies and able to substitute the traditional hives by the modern ones.

Modern beekeeping is an alternative technology that is environmentally friendly and cost effective community based forest conservation strategy for sustainable

development. This ecology helped to produce quality and good volume of honey which provides healthful food commodity and income for urban and rural resource poor community members.

Therefore, the importance of this study assessed the contribution of modern beekeeping technology to improved production and income of the rural community in the target area.

1.2 Statement of the problem

Ethiopia has an estimated ten million bee colonies of *Apis mellifera* (CSA 2007). Most of these bee colonies are kept in locally made traditional hives without using appropriate technologies. In addition to that, this *species* are very aggressive to domesticate at bee yard level to be utilized for honey production (Amssalu2000).In addition those who are hunting honey in the forest didn't managed properly. They obliterate the development of honey bee and honey production in the country. All these factors are major constraints for the development of honey bees in Ethiopia. Inability to produce quality honey, lack of market access, lack of skilled man power and inadequate technology are some of the bottle necks to the development of the sector.

However, the practice of beekeeping is deeply rooted within the Ethiopian farming community. The use of honey as food and medicine (Benjamin and McCallum 2008), and that of wax for candle lighting in churches has a long history in Ethiopia (Ayalew 2006). At present, beekeeping is largely an income generating activity that fits well into the concept of smallholder agricultural development in rural Ethiopia. It can also be easily integrated into on-going resources conservation and rehabilitation of development activities in the intervention woreda. This is because honey is high value commodity and a non-perishable product if stored properly (Robinson 1980; Gentry 1982; MAAREC 2004; Somerville 2007). Furthermore, smallholder farmers usually consider honey as cash crop, rather than a subsistence commodity (IPMS 2005). These characteristics make honey an attractive product for commercially oriented smallholder beekeepers.

The Boterbecho forest is one of the mid land tropical rain forest found along the Ghibe river basin this forests has a great potential for beekeeping since it comprises diversified bee flora from which the local communities derive their livelihoods. Beekeeping is one of the main sources of income generating activities next to coffee.

In this Woreda, many honey hunters destroy the brood and combs during honey harvest due to lack of skill and knowledge. This also slows regeneration of bee population and impedes the sustainable development of the sector. In addition to this forests are also destroyed during the honey hunting time by bush fire, which as a result causes degradation of forest which has its own adverse effect on the biodiversity of the area and the environment in general.

To bridge at these challenges, the introduced modern beekeeping technology conserve the environment and improve the income of Tolay community. However there had not been an adequate study to assess the contribution of modern bee hives to improved income within the Tolay community.

1.3Basic research questions

In this study it is aimed at to generate evidenced by assessing the income from modern bee hives. The following research questions will be addressed.

- Does the contribution of modern beehives increase honey production compared to the traditional?
- Is there any change in the income by beekeepers using modern beehives?

• Objective of the study

General objectives

The overall objective of the study was to assess the contribution of modern beehives verses the traditional one towards improving the income of beekeepers in the rural community in Tolay area.

Specific objectives

- Is to compare the production of honey between modern and traditional bee hives.
- Is to assess the contribution of modern beekeeping on the income of owners.

• Research hypothesis

- The community produces quality and quantity of honey through modern beekeeping technology.
- Modern beekeeping technology improves the income of beekeepers compared to the traditional beekeeping

• Significance of the study

The result of this study has been helpful for policy makers and development professionals by providing woreda level information regarding the impact of modern beekeeping technology on honey and wax production and house hold livelihoods .The findings of the study also has been used for further investigation by various researchers on the subject area.

CHAPTER TWO: REVIEW LITERITUE

2.1 General concept of Apiculture (Beekeeping)

Apiculture (beekeeping) is the keeping and management of honeybees for various products: honey, beeswax, royal jelly, propolis, bee pollen and brood, as well as for pollinating flowering agronomic or tree crops (Ayers, 1992).

Qaiser et.al. (2013) defined beekeeping or apiculture is an applied science of rearing honey bees man's economic benefits and it's the maintenance of honey bee colonies, commonly in hives, by humans. A beekeeper keeps bees in order to collect honey and bee wax to pollinate crops, or to produce bees for sale to other beekeepers .A location where bees are kept is called an apiary or 'bee yard'

Apiculture (Beekeeping) is a promising non-farm activity for the rural households. It directly and indirectly contributes to the incomes of households and the economy of the nation. The direct contribution of beekeeping includes the value of the outputs produced such as honey, beeswax, queen and bee colonies, and other products such as pollen, royal jelly, bee venom, and Propolis in cosmetics and medicine (ARSD, 2000;

Gezahegn, 2001). It also provides an employment opportunity in the sector. The indirect, but very important contribution of beekeeping is through plant pollination and conservation of natural environment. According to Gemechiset al,(2012) Apiculture is one of the agricultural subsectors that most suits the rural poor and also contributes significantly to income diversification for those who are better off. It is simple and relatively cheap to start, as it requires a very low level of inputs (land, labor, capital and knowledge in its simplest form).The bee products and byproducts supply income that contributes to the improvement of the livelihood of the rural people

Apiculture is a positive program that not only contributes to the uplifting of the rural communities but also protecting the trees thereby enhancing the protection of our planet earth through conservation of the natural resources. It has a long tradition in Africa dating back several centuries when beehives were first used for producing honey in ancient Egypt. It promotes economic self-reliance and has become a life sustaining source of income and livelihoods particularly for the poor. Beekeeping is an ecologically and traditionally appropriate form of income generation for communities in some of the poorest areas in African countries such as Mozambique, Malawi, Kenya and Zimbabwe just to mention a few (Bernard, 2012).

Beekeeping is an aerial agricultural activity that does not occupy cultivated land, requires less investment and benefits can be obtained quickly, besides it being a nonpolluting intensive agriculture (Conrad, 2007). This means that there is sustainability and availability of beekeeping requirements as it is based on locally available resources which utilize both the traditional and modern hives. Apiculture or beekeeping has to do with the preservation of honey bees' colonies in hives by humans. The collection of honey products and those of the hive such as bees wax, propalis, pollen and royal jelly is central to beekeeping. This type of farming is also crucial for the pollination of crops as well as producing bees for sell to other beekeepers, (Kerealem, Ejigu, & Preston, 2009).

Beekeeping is a long-standing practice in the rural communities of Ethiopia and appears as ancient history of the country (Ayalew and Gezahegn, 1991). It is environmentally sustainable activity that can be integrated with agricultural practices

like crop production, animal husbandry, horticultural crops and conservation of natural resources. Thus, it would be one of the most important intervention areas for sustainable development of poor countries like Ethiopia (Gibbon, 2001).

Beekeeping is a useful means of strengthening livelihoods because it uses and creates a range of assets. According to Meaza (2010), these assets include natural (bees, a place to keep them, water, sunshine, biodiversity and environmental resources); human (skills, knowledge, good health and strength, and marketing expertise); physical (tools, equipment, transport, roads, clean water, energy and buildings); Social (help from families, friends and networks, membership of groups and access to a wider society, market information and research findings; and financial (cash, savings and access to credit or grants).

Through its role as a source of supplementary earnings, food, and employment, beekeeping could be linked to the livelihood of people around the world. Pete et al., (1998) highlighted the following key points regarding the arguments that beekeeping is a key element in promoting rural self-reliance in African countries:

- Beekeeping promotes rural diversification and hence is an alternate source of income and employment. This is especially true in areas where arable land is restricted and demographic growth is resulting in insufficiently profitable landholdings;
- Beekeeping is an activity that has successfully been adopted by women in many parts of the continent;
- Beekeeping allows for a degree of risk avoidance by providing a reliable, high-value product including beeswax that enables rural farmers to survive in times of economic crisis;
- Beekeeping clearly is a low-cost, sustainable undertaking with a low environmental impact. The spin-off of enhanced plant pollination is an invaluable one; and
- Honey can be used as a dietary supplement.

According to Mehari (2007), beekeeping is an important activity for rural communities in Ethiopia. It was reported that every nationality in Ethiopia does have beekeepers and beekeeping, and the collection and selling of honey and other bee

products, is a major economic activity. A study by SNV (2011) indicated that honey and other hive products help households meet their basic needs and provide cash income opportunities.

2.2 Concept of modern and traditional beekeeping technology

Based on the level of technological advancement, three types of beehives are used for honey production in Ethiopia. These are traditional, intermediate, and modern hives. A total of about 4,601,806 hives exist in the country of which about 95.5 per cent are traditional, 4.3 per cent transitional and 0.20 per cent modern hives (Beyene and David, 2007). Traditional beekeeping accounts for more than 95 per cent of the honey and beeswax produced in the country (Beyene and David, 2007). The national average honey produced between the years 1997 and 2004 was estimated at 30 thousand metric tons, which accounted for over 23 per cent of the total African production and about 2 per cent of world honey production (MoARD, 2005).(Table 1)

Table 1Type of bee hives

Type of beehives	Number	%
All bee hives	4601806	100
Traditional bee hives	4394725	95.5
Intermediate bee hives	197878	4.3
Modern bee hives	9204	0.20

Source CSA 2007

According to CSA 2012/2013 data the number of modern bee hives increasing by 2.7 percent and traditional hives 0.4 percent is comparing data from (Beyene and Devid, 2007) ,but the number of transitional hives are reducing by 3.2 percent. Generally the number of bee hives is increasing by 8.8 percent from 2007(see Table 2)

Table 2 Ethiopian bee hives distribution

Type of beehive	**Number**	**%**
All bee hives	5,207,300	100
Traditional beehives	4,996,933	95.96
Intermediate beehives	54,991	1.06
Modern beehives	155,376	2.98

Source. CSA2012/2013

Ethiopia, having the highest number of bee colonies and surplus honey sources of flora, is the leading producer of honey and beeswax in Africa. On a world level, Ethiopia is fourth in beeswax and tenth in honey production (Ayalew, 2001).

2.3 Traditional beekeeping and honey production

Ethiopia has a huge natural resource base for honey production and beekeeping is traditionally a well-established household activity in almost all parts of the country (Admasu 1996; Fitchel and Admasu 1994; Gezahegn 2007; Gidey and Mekonen 2010; Gidey et al 2011). Beekeeping is one of the most important income-generating activities in the rural communities and it provides an employment opportunity for many Ethiopians (Ejigu et al., 2009; Gidey et al, 2011).

Traditional Beekeeping also contributes to the country's economy through foreign exchange earnings. Yet, about 97% of the production system is traditional beekeeping system using basket hives made from different local materials in various shapes and volumes (CSA, 2008; 2009). While the CSA (2013) data indicated honey harvested from traditional hives is 41,742,933 kg it is about 91 % from the total production.

Fig 1 Honey production and types of hives

Source CSA 2013

Traditional hive is used only for one harvest if care is not taken while taking it down from the tree in which it hangs for harvesting. But many farmers practice careful handling of hives during harvest. In this case, one traditional hive could be used for more than one time. However, it is not possible to get more than one harvest per year from traditional hives because of time required for bee colony to set foundation. This is one of the important factors that caused the country not to exploit the enormous potential it has in beekeeping.

Farmers produce crude honey only from traditional hives which is mixed with wax and the largest buyers are local “Tej” makers.

Fig.2 Traditional hives

2.4 Modern Beekeeping and honey production

The design of all modern beehives is based on the discovery, by the father of modern beekeeping, Lorenzo Lorraine Langstroth, that when bees build their combs they

always leave exactly the same amount of space (the bee space) between them (Stephen, 1990). On the basis of this finding, Langstroth invented a hive with frames separated by this bee space, in which the bees could build their comb. The frames are so arranged that they can be removed individually without disturbing other combs and without crushing bees, and the sides and bottom of the frame provide very good support for the comb.

Langstroth also found that several communicating hive boxes can be stacked one above another, and that the queen can be confined to the lowest, or brood, chamber, by means of a queen excluder. In this way, the upper chambers (called supers) can be reached only by the workers, and therefore contain only honey-comb. This made hive inspection and many other management practices possible, and turned the art of beekeeping into a full-scale industry (Stephen, 1990).

Almost all commercial hives in use today operate on the Langstroth pattern, although they may contain from 10 to 13 frames. Other bee enthusiasts have given their names to similar hives that are essentially modifications of the original Langstroth, and these frame hives are in general use throughout Europe, North America, Australia, and parts of South America and Asia, as well as in some northern and southern African countries (FAO, 1990).

Improved box hives have been introduced and promoted in Ethiopia for the last 40 years yet adoption rate is low (Kerealem, 2005). Modern beehives allow honeybee colony management and use of a higher-level technology, with larger colonies, and can give higher yield and quality honey (Crane, 1990). Moreover, improved box hive has advantages over the others in that it gives high honey yield in quality and in quantity. High yield, quality honey, ease for inspection and harvesting of products are the major relative advantages of modern beehives compared to the traditional one. The probability of adoption of a new technology will depend on the difference in profitability between the new and old technologies (Schultz, 1995).Although the annual production of both honey and wax in Ethiopia is large compared to other African countries, the system of production commonly exercised in the country is traditional. Productivity of honeybees is very low and only an average of 8-15 kg of

honey could be cropped per hive per year. However, in areas where improved technology has been introduced, an average of 15-20 kg/hive/year has been recorded.

Generally modern beekeeping practices using frame hives have:

- Produced wax, royal jelly, pollen, bee- venom and propolis which are highly marketable products.
- Increase the yield through bee mediated pollination service
- Provided the small holder especially women, with a profitable and nutrition enhancing activity (Raina, 2004).

Fig.3 Modern beekeeping apiary site

2.5Honey production, productivity and income

Honey is the natural sweet substance produced by certain species of bees, from the nectar of plants, from secretion of living part of plant. The bee collect this sugary

substance of their own, deposit, reduce the water content, store and leave it in honey combs or honey pots to ripen and mature for their own consumption (Alimentarius, 1989).

Honey is composed primarily of the sugars, glucose and fructose while its third greatest component is water. It also contains numerous other types of sugars, acids and minerals. The sugars found in honey can be classified as monosaccharide (glucose, fructose), sucrose and oligosaccharides (White, 1980).

Honey is a semi liquid product, which contains a complex mixture of carbohydrates, mainly glucose and fructose. Other sugars are present as traces, depending on floral origin. Moreover, organic acids, lactones, amino acids, minerals, vitamins, enzymes, pollen, wax, and pigments are present which are important properties used to determine quality of the honey (Crane, 1990, 1975; Yaniv and Rudich, 1996; Silici, 2002). Honey having high water content is more likely to ferment. The mineral content indicates botanical origin of honey; the blossom honey has lower mineral content than dew honey (Vorwohl et al., 1989).

Honey hunting has been a very common practice even up to present generation in many parts of Africa, including Ethiopia. In southwestern parts of Ethiopia, some households entirely depend on honey hunting and forest beekeeping for their entire livelihood (Tessega Belie, 2009)

Honey is produced mainly as a cash crop, which is serving as a source of additional cash income for hundreds of thousands of farmer beekeepers. Honey is mainly produced for market in Ethiopia. More than 95% of the total produce is marketed, while the remaining is used for home consumption. In addition, a significant number of people are engaged in production and trading of honey at different levels and selling of honey wines (local beverage *tej*) which create job and self-employment opportunities for large number of citizens. Export of honey and beeswax is estimated to contribute an average of 1.6 million USD to the annual national export earnings (Ethiopian Customs Authority and Export Promotion Agency, 2006).

Honey production and beekeeping are environmentally friendly practices and relatively easy to engage in. These non-farming business activities have the potential to provide a wide range of economic contributions. Two main economic values could be derived from engaging in beekeeping: income generation from marketing honey and its by-products (beeswax, royal jelly, pollen, propolis, bee colonies, and bee venom) and the creation of non-gender-based employment opportunities.

Additional benefits from beekeeping are associated with the purely biological nature of bees' activities, such as plant pollination and conservation of natural flora. Because of its relatively low labor requirements, when properly handled, beekeeping can coexist almost effortlessly with regular farming activities, such as growing crops, horticulture production, and animal husbandry.

The central Statistical agency 2011 data indicated that the total production of honey from 2007- 2011 produced 163,257,420. And the total export and conception of honey was 1,297,717 and 161,959,703 kg respectively.

Table 3. Honey production and exports versus domestic consumption, 2007–2011

Year	**Total production volume (in kg)**	**Total export volume (in kg)**	**Total domestic consumption (in kg)**
2007–2008	42,180,346	219,889	41,960,457
2008–2009	39,660,647	143,412	39,517,235
2009–2010	41,524,967	414,115	41,110,852
2010–2011	39,891,460	520,301	39,371,159
Total 2007–2011	**163,257,420**	**1297717**	**161,959,703**

Source, CSA 2007-2011

Ethiopia has strong historical links with traditional beekeeping practices. Oromia, Amahara, Southern Nation and Nationalities People and Tigray regions were represented by small-scale honey producers and cooperatives as well as large cooperatives and private producers. Ethiopia is in fact the world's ninth largest honey-producing nation and Africa's biggest, and yet the Ethiopian Apiculture Board reveals the national annual capacity is 500,000 tons of honey compared to the 459,052 tons

2013 produced. As one of the world's poorest countries, this represents a great potential to increase the livelihood of small-scale producers, but many need assistance in increasing product quality and marketing for the local and international market. As FAO statically data 2012 indicates Ethiopia has a great potential produce honey and first in Africa.

Table 4.Production of honey (tons) in Africa

Rank	**Country**	**Honey**
1	Ethiopia	45,300
2	Kenya	24,000
3	Angola	22,900
4	Central Africa Republic	15,974
5	Egypt	7,455
6	Madagascar	4,479
7	Cameroon	4,200
8	Tunisia	4,000
9	Morocco	3,500
10	Algeria	3,300

Source, FAOSTAT data, 2012

These all imply that the contribution of beekeeping in the country particularly in drought prune areas has paramount importance in reducing vulnerability and improving livelihood of the farming community. Ethiopia is the seventh top world

honey producer. (Table 4)

Table 5Top world honey production countries in 2012

Rank	**Country**	**Production (tons)**
1	China	398000
2	Turkey	81,115
3	United State of America	79,788
4	Ukraine	70,900
5	Argentina	59,000
6	Mexico	55,684
7	Russian Federation	54,000
8	Iran (Islamic Republic)	47,000
9	Ethiopia	45,300
10	Brazil	44,600

Source.FAOSTAT data, 2012

CHAPTER THREE: RESEARCH DESIGN AND METHODOGY

3.1 Description of research area

Tolay is a locality situated along the Gibe river basin at Choraboter woreda in Jima Zone, Oromia Regional State. This is the research site that has been identified and potentially fit as to be the target site for this study.

In this woreda, the communities working with modern bee hives introduced from different organizations have considerably helped to maximize the income of beekeepers. To achieve this, the traditional beekeepers were given training on modern beekeeping technologies and able to substitute the traditional hives by the modern ones.

It is located at a greed reference of (East 037^0 21.512' North 08018.051') and it is 243 km South-West part of Addis Ababa. The altitude ranging from 1100 to 2500 meters above sea level (m.a.s.l.) the mean annual temperature ranges from 21^{o}C to sometimes greater than 30 ^{o}C. The mean annual rainfall varies from 400 to 900 mm/ year. The dominant soil type of the sub zone is black cotton and clay loam. In general the soil is fertile and potential to grow various crops, coffee and different types of tree *species.*

The woreda has potential for mixed agriculture, reforestation, agro forestry, livestock production and mechanized irrigation. Rain fed agriculture is the major activity in the area. Some field crops such as sorghum, maize, sesame, teff, pepper and niger seed are cultivating in the area and at the end of rainy season the farmers also grow chickpea.

Tolay

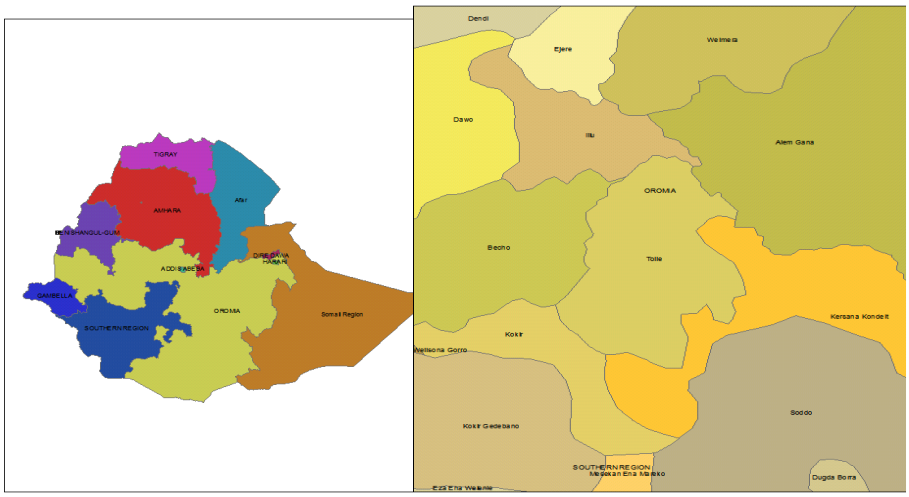

Fig.4 Map showing Tolay

The research was carried out starting from February to May, 2014 and survey method to determine the real difference between traditional and modern beehives and compare the benefits gained from those hives by the target beekeeping communities.

- **Sample size and Sampling method**

The purposive sampling technique was used to select the beekeepers in Tolay area due to the intensity of modern beekeeping technology and honey producers relevant to the study. A total of eighty four respondents were selected randomly from five hundred respondents of which twenty nine respondents were from those that were using only traditional hives and produced crashed honey, thirty seven respondents were from that were using only modern bee hives produced processed honey and the other eighteen respondents were using both traditional and modern hives produced processed and crashed honey in Tolay villages.

Sampling methods were used for the purpose of accurate and detailed comparative analysis by selecting villages where apiaries are located.

Colony and honey production potential as well as market access and capacity building were considered. The selected individual beekeepers were interviewed and the pretest and group discussion were also done. The sample size determined the following

formulas.

$n= N/1+Ne^2$

n- Sample size = 84

N- Total population = 500

e – Confidence level 90% margin error = 0.1

- **Method of data collection**

Structured questionnaires and personal interview was used to collect data for the study. The questionnaires were designed to obtain information on: the socio-demographic characteristics of the beekeepers in the study area, their level of crop production and economic contribution in terms of benefits that accrue to honey producers and source of income.

Secondary data were taken from Choraboter Agriculture office, international research organization and NGOs engaged in beekeeping activity in Tolay area.

Primary data were collected from randomly selected beekeepers that used traditional and modern bee hives. The beekeepers those who have modern hives and using modern beekeeping technology enlisted for the comparison of quality honey production in the study area. During data collection, the individual beekeepers were interviewed and group discussion also conducted

- **Methods of Data Analysis**

Descriptive statistical analysis was employed to analyze the role of modern beekeeping technology on the income, production and productivity of rural communities in Tolay area of Ormoia region. The collected data was analyzed using the SPSS software and statistical measures such as mean, ratio or percentage and standard deviation were generated. Also, qualitative analysis was employed to identify constraints and opportunities with respect to modern beekeeping technology.

CHAPTER FOUR: RESULTS & DISCUSSION

- **Demographic Characteristics of Respondents**

4.1.1 Respondents' Gender

Of the total 84 beekeepers interviewed, 75 (89.3 %) were male headed and the remaining 9 (10.7%) were female. The total numbers of family members of the sampled households were 523, out of which 47.6 % were male and 52.4 % were female. This suggests that the beekeeping activity was dominated by male respondents. (Table 6)

Table6: Respondents' gender

Gender	**No. of respondents**	**Total (%)**
Female	9	10.7
Male	75	89.3
Total	84	100

4.1.2 Age Distribution

Age distribution is an important indicator of the demographic characteristics of the respondents. Survey result in Fig 5 indicated that of the total sampled beekeepers in Tolay area the majority of them (48.8%) were between 18 to30 age groups. Additionally these age groups are using modern bee hive. Also, the adult populations in the age group of 31-50 accounted for 40.5% of the respondents' whiles the elderly are less than 10.7% fig 5. This indicates that the youth groups are more involved in beekeeping as one of the income generation activities compared to the adult and the elderly. The minimum, maximum and average age of the respondent was 18, 68 and 30 years, respectively.

Fig 5: Age structure of sampled household

4.1.3 Education Background of the Respondents

Concerning educational backgrounds, 33.3% of the respondents were higher primary (grades 5-8) followed by high school complete which account for 29.8 %.Illiterate, and read and write category account 11.9% and 10.7%, respectively (Table 7). The highest share accounted by higher primary and high school complete reflects the increased recognition of the income generation potential of modern beekeeping in Tolay area. The increased involvement of the educated in modern beekeeping is also quite important from technology adoption perspective.

Table 7: Educational Background of the Respondents

Educational status	**No. of Respondents %**	**Percent from total respondents**
Illiterate	10	11.9
Reade and write only	9	10.7
Grade 1-4	12	14.3
Grade 5-8	28	33.3
High school complete	25	29.8
Total	84	100

4.1.4. Marital Status

The survey revealed that the majority of the respondents (79.8%) were married and the single account for 16.7% of respondents. (Table 8)

Table8: Marital Status the Respondents

Marital Status	No. of respondents	Percent from total respondents
Married	71	84.5
Single	13	15.5
Total	84	100

4.1.5 Family Size

Most of the respondents (51.2%) have a small family size (1-4). The dominance of low family size may signal relatively lower dependency ratio in the sample households and followed by a family size of 5-8 (40.5%) (Table 9).From the total respondent big family size (9-11) account for 8.3%. The minimum, maximum and average family size of the respondents stood at 1, 11 and 3.96 respectively.

Table 9.Family Size of respondents

Family size	No. of respondents	Percent from total respondents
1-4	43	51.2
5-8	34	40.5
9-11	7	8.3
Total	84	100

4.2. Economic Characteristics of Respondents

4.2.1 Occupation

Of the total respondents 85.7%of them were farmers. This highlights the importance of beekeeping in income generation of the farming community. Limited number of sample respondents (7.1%) reported that their occupation is traders whereas (2.4%) were employees in different public and private organizations and (1.2%) laborers and (3.6%) students. (Fig 6)

Fig 6. Occupation of the respondents

4.2.2 Land Holdings

Most of the respondents 57.1% have their own lands while13.1% use leased land for their agricultural activities and 7.1%of the respondents use leased and owned land. The rest 22.6 % of the respondents have not land. Beekeeping is one of the main incomes of for these landless and unemployed peoples. (Fig 7)

Fig7. Land Holding of the Respondents

The total cultivable land owned by respondents was estimated to be 111ha with an average land holding size of 2ha. The minimum and the maximum land holdings were0 ha and 4 ha, respectively. 23.8 % of the respondents owned a land between 0.5-1 ha, and those households who owned a land size between 1.5 and 2 ha accounted for 29.8 % of the total sampled households. Those who owned land size between 2.5 - 3 ha account for 11.9 % while the remaining 9.5 % owned a land size between 3.5- 4 ha the remain 25% of the respondents have no land . (Fig 8)

Fig8. Land holding size

4.2.3 Ownership of Beehives

Almost all (91.7%) of the beekeepers have their own apiaries. Most of the respondents who are using traditional bee hives are keeping bees at the backyard.

Some of them (8.3%) are hanging the hives on the tall trees fig 9

A closer examination of ownership revealed that 37 respondents use modern hives while 29 respondents use traditional hives. Those owning both modern and traditional hives accounted for 18 respondents. (Fig 9)

Fig 9.Ownership of hives

4.2.4 Traditional hives

48 respondents owned tradition hives. Of this, most of them (43.8%) own 1-5 hives followed by those who own 6-10 hives (20.8%). The trend indicated that the number of modern hive users increased than the number of traditional hive user's (Table 10).

4.2.5 Modern hives

53 respondents owned modern beehives. From this, those who have 1-5 hives account for 86.8% of the respondents followed by 11.3% who own 6-10 hives. The remaining 1.9% owned 16-30 hives.(Table 10)

Table: 10 Number of traditional and modern hives owned in Tolay

Ownership of hives	Number of respondents owned traditional hive	Number of respondents owned Modern hive	Percent of traditional hive	Percent of modern hive
1-5	21	46	43.8	86.8

6-10	10	6	20.8	11.3
11-15	7	0	14.6	0
16-30	8	1	16.7	1.9
31-45	2	0	4.2	0
Total	48	53	100	100

- **Contribution of Modern Beekeeping , Production and Income in Tolay**

4.3.1 Honey Production

Modern beekeeping is expected to increase yield and production of honey and improve quality. This in turn will lead to better income to the beekeepers as it will fetch better prices in the market. The result provided an outcome in line with this argument. Average honey yield for modern beehives stood more than double (18.03 kg/hive) to that of traditional beehives (5.15 kg/hive). The average number of modern beehives was 5.28, which was quite lower compared to 13.38 for traditional beehives. Given this, the average honey production using modern hives stood at a level which was much higher than the traditional ones, i.e95.5 kg from 5.28 modern beehives compared to 68.23 kg from 13.38 traditional beehives. This signified the increased contribution of modern beekeeping technology to honey production vis-à-vis traditional practices. (Table 11)

Table 11: Comparison of honey Yield and Production of Modern and Traditional Beehives

Particular	**Modern Beehives**	**Traditional Beehives**
Average number of hives (No.)	5.28	13.38
Average honey production per hive per year (kg)	18.03	5.15
Average honey production per year (kg)	95.1	68.23

4.3.2 Honey Consumption and Sales

Since most of the honey production in traditional hives have low quality (crushed honey), market demand is normally lower compared to honey produced through modern hives. So, producers consume the honey at home in the absence of better market opportunity and attractive prices. The average yearly home consumption of honey from traditional hives is higher (14.23 kg) compared to modern beehives (6.88 kg).As a result, the average sales of honey produced by owners of modern beehives were higher (93.84 kg) than that of traditional hives (63.82 kg.). Reflecting the relatively better quality, the average price for honey produced from modern beehives was more than double (Birr 99.60 per kg) of the honey produced using traditional hives (Birr 49.10 per kg) Accordingly, the average annual income for people engaged in modern beehives was about Birr 9346.45. This was significantly (198.3%) higher than the estimated average annual income from honey produced through traditional beehives (Table 11).

Fig10. Honey from traditional hives 50 birr/kg

Fig11. Honey from modern hives 100 birr/kg

Table12: Household honey consumption, sales and Income of the respondents

Particular	**Modern Beehives**	**Traditional Beehives**
Average household Honey consumption (kg)	6.88	14.23
Average honey sales (kg)	93.84	63.82
Average honey price/kg	99.60	49.10
Average annual income from honey sales (birr)	9346.45	3133.55

Modern beekeeping management training had been given by icipe /Biovisoin organization for both traditional and modern hive users. But the training doesn't have an effect on the honey sale in the local market. It depends of the quality both hives users have an access to sale their honey for fair price in the market. (Table 13)

Table 13 Effect of training on the amount of income from honey harvested from modern and traditional hives

Hive type	Amount sold in the market	Received training (%)	Chi-square
Modern	<1000 1100-1500 1600-3000	17.9 7.1 21.4	2.424 ns

	3001-6000 6001-17000	32.1 21.4	
Traditional	<1000 1100-1500 1600-3000 3001-6000 6001-12000	42.9 28.6 14.3 14.3 -	2.657 ns

Key: ns: not significant

4.3.3 Household income

Beekeeping is playing a crucial role in improving the income of the rural community. As indicated in Fig 12 income obtained from honey (17%) is next to crop (70%) but much higher than other income source including milk and milk products, poultry sales, fruit and vegetables animals (Fig 12)

Fig12: Household income

The training on beekeeping has a significant effect on the income from bee products than other incomes from crops, fruits, and animal production (Table 14)

Table 14 Effect of bee keeping training on farm incomes

Enterprise	Amount(Birr) sold in the market	Received training (%)	Chi-square
Crops products	<1000 11000-30000 31000-50000 >50000	48.0 40.0 8.0 4.0	2.176 ns
Live animals	<1000 1100-5000 5500-10000 >11000	63.6 18.2 18.2 -	3.426 ns
Bee products	<1000 1100-5000 5500-1000 11000-17000	8.3 66.7 13.9 11.1	6.569*
Milk products	<200 300-500 600-1000 1100-2400	- - 25.0 75.0	1.524 ns
Fruits and Vegetables	<500 600-1000 1100-2000 2100-3500	66.7 16.7 - 16.7	2.361 ns

Key: ns: not significant; *significant: 10%

4.3.4 Household expenditure

The total annual household expenditure of the area is estimated at Birr 589720. Given that the income from Honey is estimated at Birr 281,655, we could consider that income from honey is enough to cover 47% of the total household expenditure in the study area. Of the total household expenditure, 28.84 % was used for cloth and foot wear purchase and 23.96 %for household expenses. Spending on school fee, health, fertilizer and herbicide expenses account for 3.77%, 12.98% and 30.45% of total spending, respectively.

Fig 13.Household’s expenditure(in thousand birr)

CHAPTER FIVE: CONCLUSION &RECOMMENDATIONS

5.1 Conclusions

Both traditional and modern beekeeping methods are being practiced in Tolay area. For quite a while, traditional beekeeping has been the dominant practice compared to that of the modern one, however, currently because of the involvement of an international organization, icipe/Biovision beekeeping project, the number of modern beekeeping technology users is increasing in the community. This is because it results in higher amount and quality of honey production, higher income, and the better management of bees compared with the traditional.

Married men between 18-30 years of age were mainly responsible in beekeeping and honey production than women; however, the study has showed that there is a growing

trend in women involvement in bee keeping. Most of the beekeepers at Tolay are with smaller family size (1-4). This has implications on the dependency ratio in the household is lower than to the high family size. The beekeepers in the study area have small family size and better education.

According to the survey, the average number of modern beehives was 5.28, which was quite lower compared to 13.38 for traditional beehives. Given this, the average honey production using modern hives stood at a level which was much higher than the traditional ones, i.e95.5 kg from 5.28 modern beehives compared to 68.23 kg from 13.38 traditional beehives. This signifies the increased contribution of modern beekeeping technology to honey production vis-à-vis traditional practices.

As revealed in the survey, the average yearly own consumption of honey from traditional hives is higher (14.23 kg) compared to modern beehives (6.88 kg) (Table 12). As a result, the average sales of honey produced by modern hives were higher (93.84 kg) than that of traditional hives (63.82 kg.). Reflecting the relatively better quality, the average price for honey produced from modern beehives was more than double (Birr 99.60 per kg) of the honey produced using traditional hives (Birr 49.10 per kg).

The findings of the study revealed that income obtained from honey produced by modern bee hives is greater (over 198%) than the traditional bee hives suggesting that the modern bee hives are by far advantageous to the rural community than the traditional ones.

Beekeeping in Tolay as an income generation activity 17 % of the income gained from the sale of honey production this is contribute to improve the livelihood of rural community. At Tolay over 47 % of the household expenditure is covered from income generated from sale of honey alone.

5.2 Recommendation

The findings of the study revealed that productivity and income from modern

beekeeping is significantly higher than that of traditional practices. So, the Government should promote modern beekeeping by incorporating it as one of the strategies for reducing poverty and ensuring food security.

During the sample survey we have observed that the level of innovation adoption among the beekeepers is still low because of low contact with extension agents who are skillful in the field. Therefore, it is recommend assigning educated and experienced personnel in the area to help promote modern bee production practices.

Adequate supply of modern beehives, encouraging participation of households in beekeeping and increasing their production through planting bee forage plants, facilitating financial services and regular training are critically important to increase production of honey and wax on a sustainable basis in Tolay area . So, local authorities and NGOs should give attention towards the expanded supply of modern beehives together with innovative approach to enhance awareness and supply of the required facilities including finance.

In the study area, modern beekeeping is being practiced by the youth. Given this and considering the employment and income generation contribution of modern beekeeping, the Government should consider scaling-up of modern beekeeping though out the country to alleviate the problem of youth unemployment.

The survey revealed that women participation in beekeeping in general and modern beekeeping in particular is quite limited in the study area. So, the government should consider innovative approach to encourage women participation in modern beekeeping.

Modern beekeeping requires the promotion of improved honey production technologies, conservation of natural vegetation, introducing multi-purpose trees and potential bee forages. So, further training and technical assistance should be provided by the Government and NGOs at grass root level on regular basis to enable beekeepers benefit from modern technology adoption.

As highlighted in Chapter 4 above, traditional beekeeping is wide spread in the study area. Yet, the level of production and productivity is quite limited compared to the

number of hives. Hence, authorities should consider measures targeted at improving the honey yield in traditional beehives.

Reference

- AbyBerhane(2009).Prcess honey and beewax for export.http://www.tradeinvestafrica.com/investment_opportunities/997649.htm
- AmssaluBezabeh (2000).Livestock production and the environment implications for sustainable livelihoods. Proceedings of the 7th annual conference of the Ethiopian society of animal production (ESAP) held in Addis Ababa, Ethiopia, 26-27 may 1999.
- AmssaluBezabeh (2004).Participatory innovation research: Lessons for livestock development. AsfawYimagnuhal and Tamratdegefa(Editors). In: Proceedings of the 12th annual conference of the Ethiopian society of animal production (ESAP) held in Addis Ababa, Ethiopia, 12-14 august 2004. ESAP volume 2: technical papers.
- ArseGebeyehu, TesfayeKebede, SebsibeZube, TekalignGutu, GurmessaUmeta, Tesfaye Lemma and FeyisaHundessa (2007).Participatory rural appraisal investigation on beekeeping in ArsiNegelle and Shashemene districts of West Arsi zone of Oromia, Ethiopia
- AyalewKassa, (2006). The use of wax for candle lighting in churches and honey for the prestige of ruling classes has a long history in Ethiopia

- AyalewKassaye and GezahegnTadesse (1991). Suitability Classification in Apicultural Development, Ministry of Agriculture, Addis Ababa
- Ayers, G.S. 1992. A Simple Model for Viewing Bee Forage Plantings: American Bee Journal.132:703-706.
- Benjamin and McCallum,(2008).The use of honey as food and medicine
- Bernard Chazovachii1, Maxwell Chuma, AlimosMushuku, Leonard Chirenje,
  Leonard Chitongo&RaphelMudyariwa1(2012) Livelihood Resilient Strategies through Beekeeping in ChitangaVillage, Mwenezi District, Zimbabwe
- Beyene, T & David, P. (2007). Ensuring small scale producers in Ethiopia to achieve sustainable and fair access to honey markets. Paper prepared for international development enterprises (IDE) and Ethiopian society for appropriate technology (ESAT), Addis Ababa, Ethiopia.
- Crane E (1990). Bees and beekeeping: Science, practice and world resources. Comstock publishing associates (corneluniversity press), Ithaca, New York.
- Conarad, R. (2007). Natural Beekeeping: Organic Approaches to Modern Api-Culture. London: Chelsea Green.
- Central Statistical Agency(CSA ,2007). Agricultural sample survey of 2007. Volume II report on: Livestock and Livestock Characteristics. Central Statistical Agency, Addis Ababa, Ethiopia
- Central Statistical Agency(CSA ,2012/2013).Agricultural sample survey, volum II report on Livestock and Livestock Characteristics ,Addis Ababa Ethiopia
- DebissaLemessa(2007).Beekeeping: a livelihood strategy in southern Oromia and Somali regional states .
- Ethiopia Export Promotion Department (EEPD, 2006). Exports of honey and beeswax. Draft Report. EEPD, Ministry of Trade and Industry, Addis Ababa, Ethiopia
- Ethiopian Customs Authority and Export Promotion Agency (2006).

Annual Report for the year 2005.

- Environmental Protection Authority(EPA, 2003). State of environment Report for Ethiopia.Addis Ababa, Ethiopia
- Food and Agriculture Organization (FAO,1990).Beekeeping in Africa bulletin 68/6
- GazahegnTadesse (2001). Apiculture Development Strategies, Ministry of Agriculture and Rural Development, Addis Ababa, Ethiopia.
- GemechisLegesse, KibebewWakjira, AmssaluBezabeh, DesalegnBegna, AdmassuAddi (eds). Apiculture research achievements in Ethiopia, Oromia Agricultural Research Institute, Holeta Bee Research Center, 2012, Holeta, Ethiopia.
- Kerealem E (2005). Honeybee production system, opportunities and challenges in Enebsesarmidirworeda, Amahara region and Amaro special woreda(SNNPR),Ethiopia. Unpublished M.Sc. Thesis, Alemaya University, Alemaya.
- Kerealem, E, Ejigu, T. G., & Preston, T. R. (2009). Constraints and Prospects for Api- Culture Research and Development in Amhara region. Ethiopian, ARC.
- Martin hilmi ,NicolaBradbean, Danilo Mejia (FAO,2012). Beekeeping and sustainable livelihoods
- MeazaGebreyohanes, (2010).(unpublished) Mekeleuniversty thesis paper
- MelakuGirma, ShifaBallo, AzageTegengNegatuAlemayehu, LulsegedBelayhun (2008).Approaches, Methods and processes for innovative Apiculture Development ; Experience from Ada'aLibenWoreda, Oromia Regional State ,Ethiopia.(IPMS)Ethiopian Farmers project working paper No 8 ILRI, Nirobi, kenya . 48 pp
- Ministry of Agriculture and Rural Development(MOARD). 2006. Annual Reports Series 2005, 2006. MoARD, Addis Ababa, Ethiopia
- Ministry of Agriculture and Rural Development (MoARD. 2005). Annual Reports Addis Ababa, Ethiopia
- Oromia Economic Study Project Office(OESPO ,2000). Addis Ababa.

- Raina,S.K (2004). A practical guide for raising and utilizations and honey bee in Africa. Nairobi ,Kenya
- Schultz TW (1995). The value of the ability to deal with disequilibrium. J.Econ.Liter.13: 827-846.
- Segeren P (2004).Beekeeping in the tropics. Agromisa Foundation, Digigrafi, Wageningen, the Netherlands.Fifth Edition
- Silici, S. (2002). Further chemical and palynological properties of some unifloralTurkishHoney. *The first Germ an beeproducts and Apitherapy congress passau*, Germany, pp.23-27.
- Stephen O.Adjare (1990).Beekeeping in Africa. FAO agriculture service bulletin68/6 Rome.
- SOS–Sahel-Ethiopia(2006).Smallholder's apiculture development and trade promotion project terminal report. ANRS Food Security Program Coordination and Disaster Prevention Office, Addis Ababa, Ethiopia