JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF BIOLOY

OPORTUNITIES AND CONSTRAINTS OF BEEKEEPING PRACTICES IN BEDELE DISTRICT, ILLU ABA BORA ZONE; SOUTHWEST ETHIOPIA

BY

KETEMA YADETA

A THESIS SUBMITTED TO DEPARTMENT OF BIOLOGY, COLLEGE OF NATURAL SCIENCES AND SCHOOL OF GRADUATE STUDIES FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS OF MASTERS DEGREE OF SCIENCE IN BIOLOGY

OCTOBER, 2015

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Dedication

This M.Sc. Thesis work is dedicated to my sons Eyuel and Liulseged Ketema and my little daughter Finot Ketema with best fever to my wife Aregash File.

Name: Ketema Yadeta

Place: Jimma University, Jimma

Date of Submission: October, 2015

Signature ……

Declaration

I, the under signed, declare that this thesis is my own original work, has not been presented for award of any degree in any university and that all sources of materials used for the thesis have been duly acknowledged. This thesis is deposited at Jimma University library to be made available to borrowers under the rule of the library.

Name: Ketema Yadeta
Place: Jimma University, Jimma
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Signature ……

List of acronyms

ARD: Agricultural Research Development

ARSD: Apiculture Research Strategy Document

BC: Before Christ

BDRAD: Bedele District Agricultural and Rural Development

BSCIS: Bangladesh Small Cottage Industries Corporation

CAS: Central Statistical Authority

DA: Development Agent

EARO: Ethiopian Agricultural Research Organization

EEPD: Ethiopian Export Promotion Development

ETB: Ethiopian Birr

FAO: Food and Agricultural Organization

FGD: Focus Group Discussion

HBRC: Holeta Bee Research Center

IPMS: Improving Productivity and Market Success

KTBH: Kennya Top Bar Hive

Mm: Millimeter

MoARD: Ministry of Agriculture and Rural Development

NGO: Non Governmental Organizations

TIKA: Turkish International Cooperation and Development Agency

TTBH: Tanzania Top Bar Hive

Abstract

The study was conducted to assess opportunities and constraints of beekeeping practices in Bedele District, Illu Aba Bora zone; Southwest Ethiopia. Personal observations and discussion

with animal development and health Officer and development agents of Bedele District were used to identify the study sites. Twelve (30%) of the 41 kebeles in the district were selected purposefully for this study. The sample size was calculated to be 124 using (Yamane, 1967 sited in Israel, 2012) simplified formula to select the respondents among the beekeepers. Key informants and focus group were also selected by purposive sampling technique. Observations, semi-structured questionnaire and focus group discussions were implemented for data collection. The data were entered into computer to check consistency and completeness. Microsoft excel spread sheet was used to present frequencies and proportions and descriptive statistics was employed to analyze the results in terms of tables and figures. Three types of beekeeping namely, traditional, transitional and modern (frame) beekeeping were documented in the study area. Traditional beekeeping was the dominant (54.55%) practice in the district. Even though the district has high potential for apiculture, the sector was not fully developed to benefit the beekeepers due to the prevailing constraints of beekeeping in the area. Lack of awareness and motivation in adopting modern hives and developing professional competence, lack of modern hives, basic knowledge of beekeeping, beekeeping equipments and enough land; access to training, credit and market were some of the constraints reported in the study area. Facilitating means of getting modern hives, training and capacity building, credit, transportation and market accessibility were recommended to improve beekeeping practices and honey production. Moreover, implementing strategies like awareness raising, technical aid, introduction of new technology, experience sharing, follow up and supervision to the beekeepers and encouraging good performance were also recommended to develop the sector and increase the future opportunities.

Key words: Beekeeping, constraints of beekeeping, Honey Production, Bedele District

1. INTRODUCTION

1.1. Background and justification

Beekeeping is the art of caring for bee colonies for mans' economic benefit or managing, nursing and manipulating colonies of honeybee, in order to collect and store quality honey (as site in BSCIC, 2010). Beekeeping is also defined as maintaining healthy colonies of honeybee in a hive or it is the subsequent producing and harvesting of bees' product (as sited in HBRC, 2005).

Nobody knows exactly when beekeeping was started. However, (Crane, 1976) noted that beekeeping probably started when man learned to safeguard the future of the colonies of bees found in hollow tree trunk, rock crevices or elsewhere, by a certain amount of care and supervision. The pattern of modern beekeeping was established between 1850 and 1900 A.D. (Crane, 1990).

Beekeeping is now spread over all the habitable parts of the world and is practiced over many areas of the globe. FAO (2009) reported the existence of 65 million honey bee colonies in the world and these produce an estimated amount of 1.5 million tones of honey each year. Ethiopia has the largest bee population in Africa with over 10 million bee colonies (Nuru, 2007).

In Ethiopia, beekeeping is a very long-standing, deep rooted and an integral part of the life style of the farming communities (Adebabay, 2008). It is an important activity for many rural people; both men and women carried out in home garden in all parts of the country (Adebabay, 2008). Ethiopia is a country having different topography. Nuru (2007) described that because of its varied ecological and climatic conditions, Ethiopia is home to the most diverse flora and fauna in Africa, making it highly suitable for sustaining a large number of bee colonies.

Based on the level of technological advancement, three types of bee hives are used for beekeeping practices in Ethiopia. These are traditional, transitional and frame hives (Beyene and David, 2007). Beekeeping that farmers practice in Ethiopia is predominantly traditional (Amsalu *et al.*, 2004).

Regardless of the long traditional beekeeping practice in Ethiopia having the highest bee density and being the leading honey producer as well as one of the largest bee wax exporter in Africa,

the share of the sub-sector in gross domestic production has never been proportionate with huge number of honey bee colonies and the country's potential beekeeping. Production has been low leading to low utilization of hive products domestically and relatively low export earnings. Thus, the beekeepers in particular and the country in general are not advantageous form the sub-sector (Tessega, 2009).

Dessalegn (2001) noted that Ethiopia as one of the sub-tropical countries has been exposed to different constraints such as diseases, pest and predators, drought, deforestation, chemical (pesticides) that under estimated the contribution of beekeeping. Moreover, lack of knowledge, shortage of trained manpower and beekeeping equipment, poor management, inadequate research and extension services have been well described to reduce the apiculture sub-sector production (Dessalegn, 2001; Kerealem *et al.*, 2011).

Bedele, one of the districts found in Illu Aba bora Zone, Southwest Ethiopia is rich in natural resources (varied vegetations including annual and perennial crops, water resources and large bee colonies) and favorable conditions to undertake beekeeping activities. In spite of the high potential the area has for apiculture, the benefit from the sector to beekeepers is not proportional to the district's potential for beekeeping. In the district, no study has been conducted to identify the prevailing constraints of beekeeping practices and opportunities to promote the adoption of modern hives. As a result, the sub-sector is still practicing with traditional low productive system. Hence, conducting comprehensive study in identifying the prospects and the constraints of beekeeping of the area is imperative. Therefore, the purpose of this study was to assess the opportunities and constraints of beekeeping practices in Bedele district.

1.2. Statement of the problem

Beekeeping researches carried out in Ethiopia are though hopeful but did not cover to describe and document the apicultural resources and associated constraints of the sector for its proper intervention and utilization to specific potential regions (Chala *et al.,* 2013). The study area has high potential to under take beekeeping activities. However, no study has been conducted to answer opportunities and constraints of beekeeping practices of the area. Thus, the constraints affecting beekeeping sector were not well identified to take appropriate measures and improve beekeeping practices and honey production in the area.

Therefore, the present study was conducted to identify opportunities and the major constraints (factors) affecting beekeeping practices in Bedele district through answering the following questions.

- What are the major constraints (factors) affecting beekeeping activities of the study area?
- What attempts must made to improve beekeeping activities of the area?
- What is the current status of beekeeping practice in the area?
- What are the future opportunities of beekeeping and honey production in Bedele district in general?

1.3. 0bjectives

1.3.1. General objective

- The general objective of this study was to assess opportunities and constraints of beekeeping practices in Bedele District.

1.3.2. Specific objectives

- To assess the current status of beekeeping practice in the study area
- To evaluate the knowledge of the beekeepers of the area on beekeeping activities
- To identify the existing constraints (factors) affecting beekeeping activities
- To identify the attempts made by the government (ARD of the district), the NGOs and the beekeepers of the area to overcome the existing problems

- To examine the future prospects of the sector to contribute in poverty reduction in the study area

1.4. Significance of the study

Bedele District is one of the potential areas for beekeeping activities and the production of honey and other hive products. Regardless of the high potential of the area for apiculture, the sector was still at its low level. This might be due to the beekeeping system and the constraints associated with it like lack of the knowledge of appropriate methods of beekeeping in the area.

Therefore, the present study would:

- Recommend on the constraints of beekeeping management to develop strategy on how to reduce the constraints related to beekeeping and honey production
- Provide information on beekeeping constraints of other referred areas to compare the factors with the study area
- Provide study findings and recommendations for those who are working on beekeeping activities in the study area or for the nearby districts
- Serve as an input for those who are interested to conduct further study on beekeeping activities and constraints in the study area

1.5. Scope and limitations of the study

The study was focused on constraints of beekeeping practices in Bedele district. There are 41 kebles in the District. Because of time and budget constraints not all the kebeles and the bee keepers in the district were assessed. Therefore, to make the present study manageable and feasible, the study area was delimited to 12 (30%) of the 41 kebeles found in the district.

1.6. Ethical Considerations

The participant's consent to participate in the research must be voluntary, free of any coercion or promises of benefits unlikely to result from participation and no group was disadvantageous by being excluded from consideration. With this notification, the purpose of the study was informed to the respondents that the information obtained were only used for the study and confidential.

REVIEW OF THE RELATED LITERATURE

2.1. Overview of beekeeping in Ethiopia

There is no well documented evidence that indicate when and where beekeeping practice started in Ethiopia. However, according to Ayalew (1990) beekeeping has started in Ethiopia between 3500-3000 B.C. But, later studies show that beekeeping in baskets have started about 5,000 years ago in northern regions of Ethiopia along with the early settlements (Gezahegne, 2001). Now, the practice of beekeeping is deeply rooted within the country's farming community. It is an inherited tradition in Ethiopia and estimated 1 in 10 smallholders keep bees (Messely, 2007; MoARD, 2007).

Beekeeping activities involve both genders at different stages of honey and bee wax processing and making. Traditionally, men are responsible for honey harvesting which is normally carried out at night because they are scared of honeybees during the day and the location of hives are mostly on trees in the forest. However, the dominance of men in beekeeping activities have downplayed the role and contribution women have made with respect to managing bee reserves and habitats, harvesting of crude honey, and processing of bee products (Lalika and Machangu, 2008).

Ethiopia is endowed with various climatic conditions, topography and a wide range of altitudes favoring the presence of different natural vegetation that includes dense forests, bushes, herbs, weeds and undergrowths. These different types of natural vegetation have made the country the best home for honey bees. In the area where there are various kinds of honeybee plants, better honey yield is certain than the area with poor natural vegetation (Amssalu, 2000). Mathewos *et al*. (2004) stated that there are 6,000 -7,000 plant species that have been identified to exist in the country, out of which some are endemic. These plant species are able to support a large honeybee population. Some of these plant species are found predominantly in south and southwest part of the country. In south and southwest parts of the country where there is high vegetation cover and high honeybee population density, apiculture is very important activity for the development of the region in general and the rural households in particular (Nuru, 2007). In these areas beekeepers can obtain better yield of honey, beeswax and other hive products (Amssalu, 2000).

Owing to varied ecological and climatic conditions, Ethiopia has the largest bee population in Africa with over 10 million bee colonies, out of which 7.5 million are confined in hives and the remaining exist in the forest (Nuru, 2007). Ethiopia is the principal honey and beeswax producer world wide and the regional leader in Eastern Africa in bee product business development due to its high number of bee colonies and surplus honey flora. In terms of volume of honey and beeswax harvested and traded, Ethiopia exceeds other countries in Africa (MoARD, 2007). Even though 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 (Beyene and David, 2007).

The exact number of people engaged in beekeeping sub-sector in Ethiopia is not well known. However, it is estimated that around one million farm households are involved in beekeeping business (Beyene and David, 2007). Based on the technological advancement, three types of beehives are used for beekeeping in Ethiopia. These are traditional, transitional and frame hives. The traditional beekeeping accounts for more than 95% (Beyene and David.2007).

2.2. Types of Beekeeping in Ethiopia

Three different types of beekeeping have been exercised in Ethiopia, namely traditional, transitional (intermediate) and improved (frame) beekeeping (Beyene and David, 2007).

2.2.1. Traditional Bee keeping system

In Ethiopia, traditional beekeeping is the oldest and richest practice, which has been carried out by the people for thousands of years. Traditional beekeeping is categorized into two, namely forest beekeeping and backyard beekeeping (Mamo, 1973).

Forest beekeeping is the intermediate stage between honey hunting and backyard beekeeping. It is placing hives in the forest on very long trees for the occupation of hives by the bees. Such beekeeping is common in Russia, Germany, and England. It is also exercised in Ethiopia especially around forest covered areas of the country. Backyard beekeeping is keeping bees in a fixed comb hives as in forest type of beekeeping but with some sort of safeguarding made for the bees. It is very common and widely practiced method of bee keeping in different parts of the world including Ethiopia (Mamo, 1973).

According to CSA (2008), about 4,688,278 bee hives are estimated to be found in the rural sedentary areas of Ethiopia, of which 4,580, 303(97.7%) are traditional hives. CSA (2008) described that beekeeping is practiced as tradition, which means that most of the farmers in rural areas have traditional hives. The beekeepers preferred traditional hives over transitional and modern hives mainly because of the cost of purchasing and constructing of transitional and modern hives and due to lack of harvesting and processing equipments (Mehari, 2007).

As noted by Tessega (2009), the materials from which traditional bee hives made in Ethiopia are variants of basic design such as hollowed logs, bark hive, bamboo or reed grass hive mud (clay) hive, animal dung (mixed with ash) hive, woven straw hive gourd hive, earthen pot hive. The beekeepers that are experienced and skilled in using these hives could do many operations with less facility. This rich old traditional knowledge is passed from generation and used for bees keeping (Tessega, 2009). For most men and women beekeeper farmers, the major sources of knowledge and skills were parents and their previous experience. Very few availed trainings organized by World Vision and Office of ARD (FAO, 1990).

2.2.2. Transitional beekeeping system

Transitional (intermediate) beekeeping is one of the improved methods of beekeeping (i.e. between traditional and modern methods of keeping bees). The type of transitional hives used are Kenya Top Bar Hives (KTBH) and Tanzania Top Bar Hive (TTBH) (Nicola, 2002). A report from CSA (2008) indicated that, of the 4,688,278 hives found in rural areas of Ethiopia, about 29,421(0.62%) are transitional hives.

Transitional hives have many advantages than traditional hives; easy to construct using hand tools, allows using as one technological options for low income groups, it will also serve as bridge to transferring from traditional to box hive beekeeping (Nicola, 2002).

2.2.3. Modern (frame) beekeeping system

In modern (frame) beekeeping, different types of frame hives are used. Some of these frame hives being used in Ethiopia are Zander and Langstroth in common and Dandant, M. Zanedr and Segeberger (Foam hive) in rare areas. Modern moveable frame hive consists of precisely made rectangular box hives (hive bodies) superimposed one above the other in a tier. The number of box hives (hive bodies) superimposed vary seasonally according to the population size of bees

(Nicola, 2002). Of the total of 4,688,278 hive found in rural Ethiopia, about 78,554 (1.68%) are modern beehives (CSA, 2008).

Frame hive beekeeping provides increased honey production potential and management simplicity avoiding risks of climbing trees for hanging up hives (Abadi, 2014). Moveable frames allow colony management and use of a higher level of technology with larger colonies, and can give higher yield and quantity honey but are likely require high investment cost and trained man power (Meaza, 2010).

2.3. Economic importance of beekeeping in Ethiopia

Beekeeping plays a significant role in the national economy of the country mostly in the part of rural area (Nuru, 2007). Beekeeping requires little land or labor thus, it is accessible to many rural community and is promoted as a pro-poor income generation activity. It is considered a major tool in combating food insecurity and as a strategic means of export income generating, while protecting the environment of the country (MoARD, 2007).

2.3.1. Honey production

Honey production is believed to play a significant role and one of the possible options to the smallholder farmers in order to sustain their livelihood. It does not only serve as a source of additional income, but also quite a number of people entirely depend on honey production and honey selling for their livelihood. (Nuru, 2002) reported that honey bee and their products provide direct cash income for beekeepers. In areas where honey production is not attractive, beekeepers can sell their colonies in the market. In this regard honeybees serve as 'near cash' capital which generate attractive money. In some tribes the entire livelihood of a community solely depends on the honey production and honey selling (Tessega, 2009).

Honey has been highly prized for its flavor as well as nutritional and medicinal values by the local communities (Benjamin & McCallum, 2008). Honey is good for healing wounds, skin treatment (Bradbear, 2004). According to information compiled in the National ARSD (2000), Ethiopia ranks 10^{th} and 4^{th} in the world in honey and wax production, respectively. The country produces about 53,000 tones of honey annually (HBRC, 2007; CSA, 2012b). With this level of production the beekeeping farmers of the country gain approximately ETB 450 million annually.

Domestic honey prices in Ethiopia differ substantially by region, season and type of honey. The highest prices for honey are observed in Tigray, where the white honey is most popular (CSA, 2012b). However, these resources are underutilized due to the traditional beekeeping methods that currently prevail in the country (ARSD, 2000; Hartmann, 2004). In Ethiopia, honey is almost exclusively used for local consumption, and to a very large extent for brewing of mead, locally called 'Tej'. Almost no wedding or other cultural, religious and social events can be imagined without the honey wine 'Tej' in the past (Beyene & David, 2007).

2.3.2. Bee wax

Bee wax is one of the 12 major exportable agricultural products in Ethiopia (Mammo, 1973). Beeswax is largely collected from traditional hives rather than the moveable frame hives. The wax yield from traditional hives is estimated to be 8–10% of the honey yield, compared to 0.5–2% from frame hives (Mammo, 1973). Different studies indicated that the current annual production of wax in Ethiopia is estimated to be 38,000 tones CSA (2012b). Despite such potential the apicultural production of the country is not yet well developed to fully benefit. From the many factors for such underutilization is the absence of a well developed value chain for the farming, collecting and processing and marketing of bee products are the major ones (Tessega, 2009). It is estimated that about 25% of the total beeswax production is lost due to selling of honey with the wax. With all this wastages, Ethiopia still stands 4th in the world in wax production (Girma, 1998; EEPD, 2006).

In several regions of the country, beeswax collection is not significant and the beeswax produced by bees which could be harvested by beekeepers is wasted. The wax is mostly left or thrown away because beekeepers do not bother to collect it and the people do not know the local beeswax is generating attractive money (Fichtl and Admasu, 1994). Bee wax is useful primarily for honey comb, cosmetic industries, ointment and cream, varnishes and polishes, creating special forms and surfaces for artistic sculptures and for queen cups preparation to be used for queen rearing to develop and multiply bee colonies. In addition, wax as candle lighting in churches has a long history in Ethiopia (Ayalew, 2006).

2.3.3. Pollination

Honeybee believed to play a significant role in the economy of Ethiopia through pollination services. Pollination is one of the most important factors that affect seed production in agricultural crops. In Ethiopia, an experiment was conducted to evaluate the effect of honeybee pollination on Niger (*Guizotia abyssinica*) and the result revealed that honeybees increased the seed yield of Niger by about 43% (Admassu and Nuru, 2000). This indicated that honeybees have a vital role in increasing food production and overall agricultural productivity. Self-sterile (cross-pollinated) plants require pollinating agents to maintain viable seed. Crane (1990) stated that honeybees can increase the yield of Citrus sinensis by 30%, water melon by 100% and tomato by 25%. Admassu *et al*. (2004) also reported that onion yields increased by 94% due to honeybees pollination. Thus, honeybee colonies are essential for sustaining the environment by pollinating natural plants and increasing yields of crops in quantity and quality. The absence of pollinators mainly honeybees can cause high decrease in the yield of vegetables, seed crops and trees (Buchmann and Nabham, 1995). The pollination of bees also helps for effective seed set and survival of the plants in the ecosystem (Benjamin and McGregor, 2008; Bradbear, 2009).

The role of honeybees in crop pollination is even more important than their role as producers of honey and other products. Previous studies by Mcgregor (1976); Crane (1990) and the recent by Brdbear (2009) indicated that beekeeping is vital in plant pollination and hence in maintaining plant biodiversity.

2.4. Opportunities of beekeeping in Ethiopia

Beekeeping is a sustainable form of agriculture, which is beneficial to the environment and provides economic reasons for the conservation of native habitats and potentially increased yield of food and forage crops (Kerealem *et al.*, 2011). However, the challenges and constraints of beekeeping influence the apicultural resources to fully benefit the beekeepers and the country in general (Dessalegn, 2001). Regardless of the challenges and constraints mentioned there are also opportunities for beekeeping development. Some of the opportunities are:

1. The availability of many local beehives and suitable environment with different agro-ecology (Ayalew and Gezahegn, 1991).

2. The presence of many species of flowering plants which are used as bee feed
3. Farmers willing to promote beekeeping practices in the area
4. The presence of micro finance institutes to provide credit access
5. The establishment of bee products development and marketing cooperatives and union.
6. The high demand for hive products particularly organic honey, and
7. Recently the Government and some NGOs are giving more attention to the sub sector than ever before as an important intervention areas to support the poor and particularly the women (Haftu and Gezu, 2014).

2.5. Major constraints of beekeeping practices in Ethiopia

The prevailing constraints in the beekeeping development of Ethiopia are complex (EARO, 2000). Variations of production constraints also extend in socio-economic conditions, cultural practices, climate (seasons of the year) and behaviors of the bees (Adjare, 1990).

2.5.1. The shortage of foraging plants

The existence of more bee forage results for the sustainable life of bees and high honey production provided that other factors are suitable for honey production. IPMS (2005) reported that the major source of feed is from the natural forest and the rest is from home prepared pulse flour and sugar. Shortage of bee forage due to population pressure, lack of land use policy and the high demand for farmlands put pressures on mountainous areas to be used for crop production and livestock grazing. These create deforestation, soil erosion and irreversible ecological degradation. Moreover, burning of undergrowth and destroying of forest land for expansion of farmland could trigger a reduction of bee foraging areas (Ayalew, 2006).

The elimination of good nectar and pollen producing tree species in many areas makes it difficult to maintain bee colonies without feeding (Kerealem, 2005). Shortage of bee forage also causes the honey bee colony to abscond to areas where resource is available for their survival. Several studies showed that shortage of bee forage is the major constraint of beekeeping in Ethiopia (Kerealem, 2005; Ayalew, 2006).

2.5.2. Pests and predators

Ethiopia, as one of the sub-tropical countries, the land is not only favorable to bees but also for different kinds of honeybee pest and predators that are interacting with honeybees (Desalegn, 2001). The existence of honeybees' pests and predators affect the honeybees' life, which leads them to absconding or the total movement of honeybee colony by leaving the hive (Workneh, 2007).

Desalegn & Amsalu (2001) from their Survey of honeybee pest in Southeast parts of Ethiopia reported that the major honey bee pests in the country are honey badger, ants, spiders, mites, birds and wax moth. Kerealem (2005) who studied honeybee production system, opportunities and challenges in Enebse Sar Midir woreda (Amhara region) and Amaro special woreda (SNNPR) reported that beetle is the most harmful pest and predator affecting beekeeping activities. FAO (1990) suggested that the success or failure of beekeeping with the common honey bee depends largely on the ability of the beekeeper to take suitable measures to control these natural enemies: insects, birds and mammals affecting bees.

2.5.3. Chemical poisoning

The use of chemicals for crop pests, weeds, Tsetse fly, mosquitoes and household pests control brings in to focus the real possibility of damaging the delicate equilibrium in the colony, as well as the contamination of hive products (Sanford, 2003; Lemma & Woldeamanuel, 2005). Of the different kinds of chemicals, insecticides and herbicides are now major problems to the beekeepers. There are two circumstances in which bees are killed on plants by chemicals, these are: insecticides applied to non-crop pests such as mosquitoes and Tsetse flies and herbicides applied to plants on which the bees are foraging (Lemma & Woldeamanuel, 2005).

Insecticides have a much more dramatic effect on population of bees thus the important contribution made by bees to the production of food and human nourishment is being jeopardized. On the other hand, herbicides which are commonly not toxic to bees destroy many plants that are valuable to bees as source of pollen and nectar (Lemma & Woldeamanuel, 2005).

2.5.4. Poor honey harvesting system

Traditional hives allow every comb to be used both for egg lying by the queen and honey and pollen storage by the workers. Extracted honey, therefore, includes brood and pollen, which is destructive and contaminating. Destroying broods while harvesting slows regeneration of bee populations and impedes sustainable production (Melaku *et al*., 2008).

Traditional beekeepers and honey hunters have developed various ways of harvesting and utilizing honey and other hive products. In the 'frost period', for instance, most of the inexperienced or unqualified beekeepers harvest without retaining enough honey in the hive for honeybee colony maintenance (Kebede & Lemma, 2007).

2.5.5. Poor management system

Some of beekeepers visit their hive properly and the rest visit to check if the hive was occupied with bees. Interval hive inspection is not well known by beekeepers in Ethiopia (Kebede & Lemma, 2007). Some Beekeepers cleaned their apiary and put ash around the apiary or under tree holding the hives to avoid small ant and ant like insect from climbing the tree and get access to hives while the rest did not clean their apiary or under tree (Kebede & Lemma, 2007). Some of the modern beehives did not have hive stand rather they are kept on inappropriate stone and woods and are about to loge down due to unsuitability of stands or they were not fenced and placed on bare land without shade and totally surrounded by grasses and shrubs. This could affect bees from entering into and coming out from hives, waste pollen they collected while they struggle to enter the hives and also kill bee working time (Kebede & Lemma, 2007).

2.6.6. Lack of skilled manpower and training institutions

Kerealem *et al.* (2011) reported that beekeeping is one of the practices suffering from the lack of skilled manpower, trainers, training materials and training institutions. As a result, the majority of the beekeepers in Ethiopia lack the knowledge of appropriate methods of beekeeping and beekeeping is still remains in traditional system and about 94 to 97 percent of bees are still kept in local hives with its various limitations.

2.6.7. Level of technology used

Introduction of improved beekeeping technologies to the rural communities are beyond the buying power of the farmers and not easily available for those who can afford it (Kerealem *et al.*, 2011). Gezahegne (2001) also reported the lack of appropriate technologies for collecting, processing, packing and storage of honey to keep its natural quality. Because beekeepers have limited knowledge, they do not try to make any changes in the quality of their product. Presentation of quality honey is generally poor. Most honey come to market is un-extracted, unstrained and poorly managed. The beekeepers also lack tools that would be needed for private work like bee veil, hand gloves, smoker, chisel, and overall beekeepers suit (Kerealem *et al.*, 2011).

2.6. 8. Technical constraints

Technical constraints in beekeeping activities include poor extension systems (absence of coordination between research, extension and farmers), lack of credit service, shortage of records and up-to-date information, shortage of reading materials regarding to beekeeping, and lack of research stations to address the problems related to apiculture (Kerealem *et al.,* 2011).

3. THE STUDY ARE AND METHODS

3.1. The Study area

The study was conducted in Bedele District, Illu Aba bora Zone; Southwest Ethiopia. The district lies between latitude 8^0 20' - $8^0$35' North and longitude $36^0$15' - $36^0$30' East. It covers a total area of 1,387 km^2 and has forty one (41) kebeles (BDARD, 2015). It borders Dabo hana district and East Wellega Zone to the North, Chora district to the Southwest and Gechi district to the East (Figure 1).

Figure 1: Map of Bedele District. Adapted from World Vision Ethiopia Bedele (2015)

The district has warm to hot climatic conditions. Its mean annual temperature ranges between 10 to 28^0c and rainfall from 1,900 to 2,300 mm (BDARD, 2015). The district is characterized

mainly as middle land or woyina dega (99%) and low land or kola (1%) and has an elevation of about 1,692 meters above sea level (BDARD, 2015).

Forest and cultivated crops cover large area of the district. This creates good opportunity for bee keeping activities as it houses bee forages which contribute to honey production (Table 1) (BDARD, 2015).

Table 1: Land use

Type of land		Coverage in hectare
Cultivated (covered by annual and perennial)		35,889
Irrigated		2,035
Vegetation:	Natural	6,000
	Manmade	850
Grazing		11,000
Uncultivated (wet and stony)		58,283
Total		114,057

Source: Bedele district ARD report (2015)

Agriculture is the main economic sector of the district. The system of production is characterized by a crop-livestock mixed farming. The major crops produced in the area include maize, sorghum, teff and milate. The animal farms are cattle, equines, sheep, goats and poultry. The study area is known in coffee production and oil crops such as sesame. Beekeeping and honey production is also the other sub-agricultural sector being practiced in the area (BDARD, 2015)

3.2. Reconnaissance survey and study site selection

Before conducting the actual research, field survey and discussion was made with the Bedele district animal development and health officer and the development agents on the purpose of the present study, selection of study site and key informants. The survey and discussion were undertaken from April – June, 2015. Based on the information obtained, 12(30%) of the forty one (41) kebeles found in the district were selected purposefully for the study considering their beekeeping potential and honey production because this could help to identify the associated beekeeping constraints of the area. These kebeles were Urgessa, Mirgamute, Oddoo, Yeballa,

Kerero, Kankecho, Dabena deru, Sota, Teba chebeli, Gemeda, Raso yura and Doreni teba. Twenty four (24) beekeepers (two beekeepers per study kebeles) were also selected purposefully considering their long beekeeping experiences or indigenous knowledge on beekeeping where twelve (12) of them were key informant and the remaining twelve (12) were focus group.

3.3. Sampling Technique and Sample size

Based on the information obtained from the district's animal development and health officer and the development agents during discussion on the purpose of the study and study site selection, each twelve (12) key informants and focus group were selected purposely from the study kebeles (2 Beekeepers per kebele). Regarding respondents of the questionnaire, a total of one hundred twenty four (124) were determined to be sample size of the study among hundred eighty (180) beekeepers found in the twelve (12) selected kebeles by using Yamane (1967, sited in Iserael, 2012) simplified formula:

$$n = \frac{N}{1+N(e)2} \quad ,$$

Where: n= sample size

N = the population size

e = the level of precision and e=0.05.

Finally, the computed sample size was allocated depending on the proportion of the beekeepers in the respective study kebeles.

3.4. Source of data

In the present study, both primary and secondary data were used. The primary information was gathered using different approaches. These include a focused group discussion, interview with key informants and questionnaire. The secondary data were reports of Agriculture and Rural Development Office, NGOs and beekeeping associations of the district.

3.5. Methods of data collections

To collect information for the current study, observations, questionnaire and focus group discussions (FGD) were employed. The data that were focused on perception of beekeepers

towards beekeeping, beekeeping practices and related constraints of beekeeping activities in the study area were collected from the beekeepers.

3.5.1. Observations

Check list related to the type of hives (traditional, transitional or modern), hive conditions (sheltered or shelter less, backyard, hanged up on the tree in the forest or near homestead on the bed), feeding conditions (provide or not supplementary feed) were prepared and observations and household survey were made in the study area.

3.5.2. Questionnaire

Close and open end questions in questionnaire related to access to modern hives, training, credit, transportation and market were prepared in English and distributed to the participants of the study. The respondents were those who engaged in beekeeping activities; they may not read and write to fill the questionnaire. Interpreting the questionnaire into Oromo language and interviewing the sample beekeeper through the questionnaire was needed in order to fill the required information and the filled questionnaires were collected.

3.5.3. Focus group discussion (FGD)

In order to gather the required information, discussions with twelve (12) focus group (FG) that were selected based on their long beekeeping practices or indigenous knowledge were made on their beekeeping practices and constraints with emphasis on the type and number of hives owned, year of beekeeping practices, access to improved hives, training, credit, attempts made to solve the related constraints and their suggestion on the future opportunities of beekeeping of the area.

3.6. Data analysis

The quantitative and qualitative data collected from primary and secondary sources were analyzed using different statistical tools. The collected data were entered into a computer, checked for consistency and completeness. The data were analyzed using Microsoft Excel Spread Sheet with respect to beekeeping practices, opportunities and constraints of beekeeping. Descriptive statistics was employed in order to present the data using tables and figures. Percentages and frequency distributions were used to describe socioeconomic characteristics,

beekeeping practices and constraints. The quantitative and qualitative data collected from direct observations and focus group discussions were also analyzed using descriptive statistics. Finally, the finding results were illustrated in terms of tables and figures.

4. RESULTS OF THE STUDY

4.1. Socio-economic characteristics of the households

Among the study respondents, 104(83.87%) were male, 20(16.13%) were female and they were in the age range of 18 and 70 years. Regarding their marital status, 86(69.35%) of them were married, 38(37%) were single. About 42% (52) of the respondents attended only primary education, 34 % (43) were 5-12, 19% (23) basic education and few about 5% (6) were not attended education (Table 2).

Table 2: General characteristics of the respondents

Item		Respondent (n=124)	
		n	%
Sex	Male	104	83.87
	Female	20	16.13
Age	18-30	26	20.97
	31-40	43	34.67
	41and above	55	44.35
Marital status	Single	38	38.65
	Married	86	69.35
	Not attended	6	4.84
Level of education	Basic education	23	18.55
	1-4	52	41.94
	5-8	30	24.19
	9-12	13	10.48
	Tertiary education	0	0.00

4.2. Beekeeping experience, type and number of hives

Among the study participants, about 27% (34) of them started beekeeping before the year 1990 E.C and had long beekeeping experiences (more than seventeen years) while about 73% (90) of the respondents had six to nine years of beekeeping experiences. Regarding the type and number of hives, about 72% (89) started beekeeping with traditional hives and about 28% (35) of the respondent started beekeeping with modern (frame) hives. Regarding the number of hives at the beginning, 83% (103) traditional, 17% (21) were modern (frame) and no report on transitional hives (Table 3).

Table 3: Beekeeping experience

Item		Respondent (n=124)	
		n	%
Year started beekeeping	Before 1998	34	27.4
	1999-2008	44	35.5
	2009-2015	46	37.1
	Total	124	100.0
Types of hive started with	Traditional	89	71.8
	Transitional	00	00.0
	Modern (frame)	35	28.2
	Total	124	100.0
Number of hives at the beginning	Traditional	103	83.1
	Transitional	00	00.0
	Modern (frame)	21	16.9
	Total	124	100.0

4.3. Type of traditional hives on use and materials used for construction

From the total of 660 hives reported by the respondents of the study, 54.55% (360) of them were traditional hives. The percent share of frame and transitional hives were 36.36% (240) and 9.09% (60) respectively. Regarding the materials of which the traditional hives constructed, 70.00% (252) were made of *Vernonia lasiopus* (Soyoma), 19.44% (70) were made of tree

bark/twigs, and10.56% (38) were made *of Arundinaria alpina* (bamboo) and no report for traditional hives made of mud or other material (Table 4).

Table 4: Materials used for traditional hive construction

Types of materials	Hives (n=360)	
	n	%
Mud	00	00.00
Vernonia lasiopus (Soyoma)	252	70.00
Tree bark/twigs	70	19.44
Arundinaria alpina (bamboo)	38	10.56

4.4. Access to bee hives and apiary site

Concerning access to bee hives, 42.74% (53) of the respondents prepare the hives by themselves while 28.23% (35) buy from the local market. The report revealed that improved hives were expensive and the price is in the range of 800-1000 ETB for transitional and 1500-2000ETB for modern (frame) hives as compared to traditional hives that were 30-50 ETB. The respondents also replied that some beehives were provided by ARD of the district on free of charge and NGOs' like world vision and beekeeping associations of the area on credit. Regarding hive placement, 42.57% (63) of the respondents keep their hives in the forest, 33.78% (50) keep at backyard and 23.64% (35) keep the hives under formally constructed apiary sites (Table 5).

Table 5: Access to bee hives and hive placement

Source of the hives	Respondent (n=124)	
	n	%
Prepare own self	53	42.74
Buy from local market	35	28.23
ARD	10	8.10
NGO	21	16.90
Beekeeping association	5	4.03
Hive placement	n	%
Keep- In the forest	62	42.57
At backyard	50	33.78
At formal apiary site	35	23.64

4.5. Honey production

4.5.1. Seasons of honey production

According to the participants of the study, three distinct seasons of honey production/harvesting are recognized. The first season is November - December, the second; January - February and the third; May - July. The study participants indicated that the first season is associated with the flowering of diversities of herbs such as *Bidens spp*, the second season is associated with few flowering of plant species like *Vernonia amygdalina* while the third season is largely associated with flowering of major tree species including *Cordia Africana* and *Croton macryusacshys* and the honeys harvested are known as Tuffo', 'Girawa' and 'Sendere' respectively and the major honey flow season was reported to be November - December (Table 6)

Table 6: Seasons of honey harvesting/ production

Harvesting periods	Respondent (n=124)	
	n	%
November - December	80	64.52
January - February	20	16.13
May - July	24	19.35

4.5.2. Type or color of honey produced

The respondents reported that three types of honey were harvested/produced in the study area, namely red, white and dark honey. The common type of honey harvested in the study area was red honey (Table 7).

Table 7: Type (color) of honey

Type of honey	Respondent (n=124)	
	n	%
Red	63	50.80
White	36	29.00
Dark	25	20.20

4.5.3. Honey yield

As reporte by the study participants, honey produced per hive from each type of beehives was variable between seasons and sometimes very samll amount of honey was produced/ harvested. The range of honey yield for each type of beehives was indicated to be 2-5kg for taditional, 3-7kg for transitional and 10-15kg for modern (frame) hives (Table 8).

Table 8: Honey yield in each type of beehives

Types of hives	yield per hive in kg	Mean per hive in kg
Traditional	2-3kg	2.5kg
Transitional	3-7kg	5.0kg
Modern (frame)	10-15kg	12.5kg

4.5.4. Honey production of the study kebeles

According to the study respondents honey productions amomg the study kebeles were varied. The list of of twelve selectd kebeles in order of their honey production during the study time were presented in (Table 9).

Table 9: Honey production among the study kebeles

No	List of kebeles	Total honey production/hive/year/ kg	Rank
1	Sota	>171 kg	1st
2	Teba chebeli	161-170 kg	2nd
3	Doreni teba	151-160 kg	3rd
4	Raso yura	141-150 kg	4th
5	Gemeda	131-140 kg	5th
6	Dabene deru	121-130 kg	6th
7	Kankecho	101-120 kg	7th
8	Oddoo	91-100 kg	8th
9	Kerero	81-90 kg	9th
10	Yeballa	71-80 kg	10th
11	Mirga mute	61-70 kg	11th
12	Urgessa	50-60 kg	12th

4.5.6. Purpose of honey production

Regarding the purpose of honey production in the study area, 54.0% (67) of the respondents use the honey for both sale and consumption at home while 46.0% (57) use only for sale or income generation (Table 10).

Table 10: Purpose of honey production

Purpose of production	Respondent (n=124)	
	n	%
For consumption at home only	00	00.0
For sale	57	46.0
Both for sale and consumption	67	54.0

4.6. Training access

4.6.1. Bee keeping training and type of training offered

Regarding access to the beekeeping trainings, 69.3% (86) of the study participants responded that they had no any beekeeping training while 30.7% (38) had limited access availed by the AGP (Agriculture Growth Program) under the supervision of ARD of the district and the NGO like world vision. The study participants replied that honey bee colony management, honey processing and handling were some of the trainings offered (Table 11).

Table 11: Beekeeping trainings offered

Type of training	Respondent (n=124)	
	n	%
Honeybee colony management	10	8.1
Honey extracting and handling	18	14.5
Honeybee feeding	10	8.1
Nothing	86	69.3

4.7. Beekeeping associations and their role

All of the respondents of the current study reported that there are bee keeping associations in their respective kebeles in which most of them 75.0% (93) were member of the associations. However, the respondents of the study indicated that these associations were not active in facilitating members need like access to improved hives, training, experience sharing (Table 12).

Table 12: Role of beekeeping associations

Facilitate access to	Respondent (n=124)	
	n	%
Training	8	6.5
Market	0	0.0
Credit	0	0.0
Hive	34	27.4
Promote the sector	45	56.3
Do nothing	37	29.8

4.8. Market access and honey price

Concerning markets and marketing honey, most of the study participants 83.9% (104) sell honey for local consumption at the nearest town or village market and had no better market access to big cities and towns (national level) and very few 16.1% (20) had limited access facilitated by NGOs such as 'Boka'. According to the respondents, the prices of honey in the study area vary and generally governed by color and taste. During the time of this study, the price of crude red honey was about 45 – 50 ETB/kg, and the price of white crude honey was about 35 – 40 ETB/kg. However, the price of extracted red and white honey was about 60 – 80 ETB/kg.

4.9. Credit access

The participants of this study reported the presence of credit service organizations like Oromia Credit and Saving Share Company in the study district. However, distance of the organizations from the beekeeping area and the requirements of crediting were reported disabling the access to the beekeeping farmers.

4.10. Availability of beekeeping equipments

Regarding the availability of beekeeping equipments, 64.5%(80) of the respondents had no basic beekeeping equipments bee honey extractor and overall beekeepers suit except very few who can

afford to buy from local market while about 35.5% (44) of the respondents had standard (modern) beekeeping equipments availed by the ARD and NGO like world vision (Table 13).

Table 13: Availability of beekeeping equipments

Source	Respondent (n=124)	
	n	%
Buy from local market	18	14.5
NGO on credit	00	00.0
NGO on free of fee	20	16.1
ARD	24	19.4
Homemade (traditional)	60	50.0

4.11. Availability and bee colony stay in the hive

All the respondents of the current study indicated that there are no institutions that provide the farmers with the bee colonies and the only means of getting the bee colonies in the study area were by self capturing. According to the respondents, the average year bee colonies stay in hive was in the range of 5-10 years (maximum 5 years for traditional hives and up to 10 years for improved hives)

4.12. Beekeeping practices

4.12.1. Hive inspection and experience sharing practices

Among the study participants, 62.9% (78) did not regularly inspect their hives. Only 37.1% (46) had hive inspection habits. Regarding experience sharing, 72.58% (90) of the beekeepers did not share their experiences. However, some 27.42% (34) had occasional experience sharing facilitated by AGP (Agriculture Growth Program) and world vision in the area.

4.12.2. Trend of honey production

According to the report obtained regarding honey production of eight consecutive years (2008-2015) from the sample kebeles, the trend of honey production in the area showed fluctuation from the year 2008 to 2011 and the total honey production was in the range of 50-200kgs.

However, the study participants reported that there was a steady increase in the production of honey from 2012 to 2015 (Figure 2).

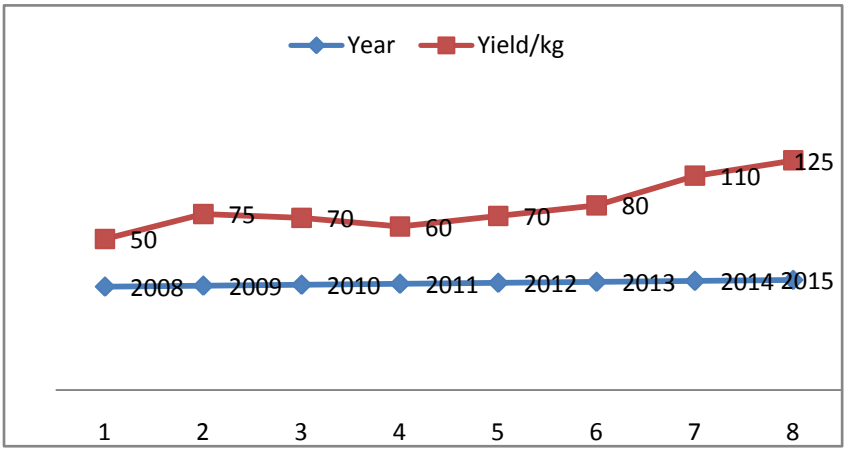

Figure 2: Trend of honey production in the study area

4.12.3. Annual income from honey production

The study participants indicated that the average annual income from the sale of honey in the study area is in the range of 1000 to 4000ETB (Table 14).

Table 14: Annual income of respondents from honey

Income in birr	Respondent (N=124)	
	n	%
1000– 1500	74	59.67
1501– 3000	15	12.10
3001– 3500	15	12.10
>3501	20	16.13

4.13. Major constraints of beekeeping activities

4.13.1. Honeybee pests and predators

According to the study participants, the major pests and predators of the area were ant, black hive beetle, termite followed by wax moth, spider and honey badger. Termites were reported to damage the hives particularly traditional hives made of grasses (Table 15).

Table 15: Occurrence of honeybee pests and predators

Honeybee pests and predators	Respondents (n=124)		
	n	%	Rank
Ant	53	42.74	1st
Black beetle	30	24.19	2nd
Termite	22	17.74	3rd
Wax moth	17	13.71	4th
Spider	14	11.29	5th
Honey badger	6	8.84	6th

4.13.2. Honeybee pests and predators control method

Among the participants of the study, 57.3% (71) use traditional methods of control like cleaning the apiary site, dusting ash under the hives, digging in to the ground to form gully between the apiary site and the open land, destroying nest of the ants, birds, spiders, 12.9% (16) of the participants use modern medicine (put pesticides into the pests nest) while 29.8% (37) of them use both traditional and modern methods (Table 16).

Table 16: Honeybee pests and predators control methods

Honey bee pest and predator	Respondent (n=124)		Control methods
	n	%	
Ant	53	42.72	Cleaning the apiary site, dusting ash under the hives, putting burned gasoline
Black beetle	30	24.19	Inspecting and cleaning the apiary site
Termite	22	17.74	Cleaning the apiary site, destroying its nest
Honey badger	14	11.29	Hunting, digging ditch around the apiary site
Bee eater bird	6	4.84	Inspecting and destroying its nest

4.13. Chemicals

All the participants of the study indicated that chemicals (herbs and pesticides) were used in the area for crop protection. The respondents indicated that chemicals especially herbicides were important in affecting the life of honey bees.

4.14. Summary of some major constraints of beekeeping activities

The respondents were asked to list out and rate the major constraints of beekeeping in the area. Accordingly, some of the major constraints were listed and rated in accordance of their importance and the detail was presented in table as follows (Table 17)

Table 17: Summary some major constraints of beekeeping activities

Contents	Respondent (n= 124)								
	SA	%	R	A	%	R	DA	%	R
Shortage of bee hive	103	83.10	1	21	16.90	12	00	00.00	
Market access	90	72.60	2	34	27.40	11	00	00.00	
Use of Chemicals	73	58.87	3	51	41.13	9	00	00.00	
Lack of enough land	70	56.55	4	54	43.55	8	00	00.00	
Access to new technology	63	50.80	5	61	49.20	7	00	00.00	
Absconding	51	4.13	6	73	58.87	3	00	00.00	
Limited floral type	37	29.84	7	74	59.68	2	13	10.48	5
Land cleaning for agriculture	35	28.23	8	78	62.90	1	11	8.87	6
Drought	32	25.80	9	62	50.00	5	30	24.20	3
Wax moth	32	25.80	10	62	50.00	5	30	24.20	3
Shortage of bee colony	13	10.50	11	70	56.50	4	41	33.00	2
Back burning (wild) fire	0	00.00	12	48	38.71	10	76	61.20	1

AS=strongly agree, A=agree, DA=disagree, R=rank

4.15. Future beekeeping development of the area

Interviews and the focus group discussions made revealed that the availability of many local beehives, diversified species of flowering plants that can support large honey bee colonies and varied agro-ecology suitable for apiculture. Respondents agreed in that the future development of the sector in the area is promising.

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5. DISCUSSION, CONCLUSSION AND RECOMMENDATIONS

5.1. Discussion

The result of this study revealed that both sexes (male and female) single or married with different age group and educational level were involved in beekeeping activity in the study area. This is in line with the result of study conducted at Amhara region by Kerealem *et al.* (2011), Atsbi Wemberta and Kilte AwlailoWoredas of Eastern Tigray by Mehari (2007), Adaa-Liben Woreda, Oromia Regional State by Melaku *et at.* (2008), Tanzania by Lalika *et al.* (2008), and Botswana College of Agriculture by Lepetu *et al.* (2009) who reported that beekeeping is undertaken by the young and old men and women; it is a gender inclusive activity.

In the present study more males were found participating in beekeeping activity than the females. This might be because of traditional beekeeping system which commonly require hanging up the hives on the tree in the forests or near home stead and which much of its activities are more suitable for males than females. There is also cultural influence and most of the communities in the study area have less understanding the role that females play in beekeeping activities. The dominance of males in bee keeping is also evident in other African countries. This is in agreement with Lalika and Machangu (2008) who reported that while men specialize in the construction of the hives and honey harvesting; women are involved in carrying unprocessed honey home from the forest. This type of practice has an impact on females' contribution to the beekeeping sector. A report from Lalika and Machangu (2008) also indicated that the dominance of men in beekeeping activities have downplayed the role and contribution women have made with respect to managing bee reserves and habitats, harvesting of crude honey, and processing of bee products.

Most of the respondents of this study were literate with only few 6(4.8%) not attended. Nevertheless, they have lack of awareness to perceive beekeeping is as important income generating sector as crop production. This is similar to the study findings of Kerealem (2005) who reported that the majority of the beekeepers lack the knowledge of appropriate methods of beekeeping.

The current study revealed that three types of hives are on use in the study area. Among the 660 bee hives reported by the respondents, 360 of them were traditional, 240 modern (frame) and

only 60 were transitional hives with the traditional hives predominantly used. This is in agreement with the report from Beyene and David (2007); CSA (2008) that described in different parts of the world and in Ethiopia as well three different types of bee hives have been under exercise.

The study identified that most of the beekeepers prefer traditional hives over transitional and modern (frame) hives because of the cost of purchasing and construction of the hives. The cost of traditional hives in the study area ranges 30 – 50 ETB, while the cost of transitional and modern (frame) hives ranges 800 – 1000 ETB and 1500 – 2000 ETB respectively which means expensive. This is line with a study conducted at Atsbi Wemberta and Kilte AwlailoWoredas of Eastern Tigray by Mehari (2007) who reported that the modern beekeeping productions require more expensive establishment cost, accessories and skill training although yield better quantity and quality honey and a study report from Amhara region by Kerealem *et al*. (2011) who reported the introduction of improved beekeeping technologies to the rural communities are beyond the buying power of the farmers and not easily available for those who can afford it.

According to the current study, some of the beekeepers in the study area get the bee hives from ARD of the district and NGO (world vision). However, the majorities prepare their own or buy from the local market. Different materials were use to prepare the hives and these includes *Arundinaria alpina* (bamboo), tree bark/ twigs, and *Vernonia lasiopus* (soyoma). This is in agreement with Tessega (2009) who reported materials from which bee hives are made in Ethiopia are variants of basic design such as hollowed logs, bark hive, bamboo or reed grass hive mud (clay) hive, animal dung (mixed with ash) hive, woven straw hive gourd hive, earthen pot hive. Despite the large number of traditional hives in the study area, the mean honey production from the traditional hives was small (2kgs/hive) as compared to modern (frame) hives (12.5kgs/hive).

The result of the study indicated that the types of hive used and the method of honey harvesting employed determine the quality of honey production. For instance, the traditional hive allows every comb to be used both for egg lying by the queen and for honey and pollen storage by the workers. Extracted honey, therefore, includes brood and pollen, which is destructive to the bee colonies and the production of honey. This is similar to the study findings of Melaku *et al*.

(2008) who reported destroying broods while harvesting not only slows the regeneration of bee populations but also impedes quality and sustainable production of honey.

The current study revealed that honey could be harvested three times per year in the study area (November-December, January-February and May-July). However, the trend of production showed fluctuation among the beekeepers. This might be due to traditional system of production, availability of plant species or knowledge level of the beekeepers. The peak harvesting season or major honey flow of the area was November- December. This is in agreement with Kerealem (2011) who reported the major honey flow season is from October to November and the minor flow season is from May to June. Because different plant species flower in different seasons, these harvesting seasons are characterized by color or type of honey produced. The first season is known with red honey, while the second and the third seasons are known with brown and white honey respectively. These seasons also vary in their potential of flowering plant species. This is in agreement with the report from Kerealem, (2005) shortage of bee forage (bee feed) causes the honey bee colony to abscond to areas where resource is available for their survival.

The market system of the study area has many problems. Most of the local markets are far away from the beekeepers and are inaccessible. On the other hand, there is lack of market information. As a result, most of the honey produced in the study area was used for consumption at home and some sold at local/village market for making beverages. This go with Hartmann (2004) who reported the huge amount of harvested honey, about 80% of the honey produced in Ethiopia is used for the preparation of the favorite national drink called tej which shows that there is poor honey marketing system.

The result of this study indicated that the price of crude red honey was in the range of 45-50ETB and crude white honey was 35-40ETB while that of the extracted red and white honey was in the range of 60-80 ETB/kg. Crude red honey was a little bit expensive than crude white honey because crude red honey was preferred by the local people for its color for local alcoholic drink called ‘tej’. As reported by the respondents red honey needs no adding artificial color for brewing tej. Crude honey is produced in the study area because the beekeepers have lack of honey extracting equipments and limited knowledge of the preferences of their target market to make changes in the quality of their product and presentation of quality honey is generally poor. This is in agreement with the study result of Kerealem *et al.* (2011) who reported that most

honey come to market is un-extracted, unstrained and poorly managed. Thus, the price of honey changes widely based on the good will of buyers. Thus, the price of honey differs region to region on the basis of its color and seasons of production. The highest prices for honey are observed in Tigray, where the white honey is most popular (CSA, 2012b).

The annual income of the beekeepers from the sale of honey in the study area was in the range of 1000-4000ETB. However, the production of bee wax was not significant because the respondents reported that they have less knowledge about the importance of bee wax. This is similar to study findings of Gezahegne (2001) who reported that there is lack of appropriate technologies and skilled trainers in the Ethiopia for collecting, processing, packing and storage of honey and bee wax.

Beekeeping training develops the beekeepers' self-confidence because it could back promotion of beekeeping technology. Training based production increases the productivity of the beekeepers and makes the sector profitable. However, the current study indicated the majority of the beekeepers in the study area lack the knowledge of appropriate methods of beekeeping. Very few availed trainings were organized by ARD of the district and NGO (world vision) working in the area. Therefore, most of the beekeepers in the study area still depend much on their indigenous knowledge. This is in agreement with the report of FAO (1990) that noted for most men and women beekeeping farmers, the major sources of knowledge and skills were parents and their previous experiences.

The organization of the individual beekeepers in to associations is important in that it is possible to facilitate short trainings, experience sharing, access to modern hives, markets, credit and the like so as to promote the sector. Although the study conducted indicated that there are beekeeping associations in the study area organized by the ARD and NGO (world vision) in which 93(75.0%) of them were a member and 31(25%) were not, the associations were not active in facilitating collaborative work. This indicates that there is information gap and lack of support from the government, NGOs and the private sectors. This in agreement with the study conducted at Adaa-Liben Woreda, Oromia Region by Melaku *et al.* (2008) who reported that limited knowledge about the potential of the area, lack of knowledge and skill on honey bee, lack

of established system, and lack of institutional linkage and information gaps were the major constraints of beekeeping activities of the area.

The result of the study revealed that hive inspections were problems of the study area. The majority of the beekeepers do not regularly inspect their hives from lack of awareness while some from fear of the bite of honey bees since the majority do not have the basic tools required for the bee keeping activity like overall beekeeping suit. A similar result was reported by Kerealem *et al.* (2011) that most of the local beekeepers lack the basic tool that would be needed for private work like bee veil, hand gloves, smoker, chisel, and overall beekeepers suit. Failure to inspect the hives properly could lead to bee absconding although absconding can also happen due to several other reasons.

Experience sharing involves learning from individuals with a cumulative knowledge developed over years. Experience sharing helps an individual to learn more and think in a better way. Workineh (2007) reported that beekeepers with longer experience are better to adopt the use of modern (improved) hives than beekeepers with short beekeeping experience. The current study revealed that the habit of experience sharing is poor in the study area because most of the beekeepers were not willing to share their cumulative knowledge and skill and cultural influence that if someone has come and visit their hives the bees would leave. FAO (2005) described that common knowledge is held by all people, shared knowledge is by many and specialized knowledge is held by few people indicating that the importance of experience sharing.

Beekeeping holds potential for creating sustainable income and food security for rural beekeepers (households). To this end, the study area is conducive to undertake beekeeping activity. This is in agreement with the study findings of Mathewos *et al. (*2004) and IPMS (2005) who stated there is a good potential for beekeeping development in Ethiopia due to suitable weather conditions and availability of various natural bee forage resources. However, the beekeeping and honey production of the study area has limitations with regards to transportation, market and other facilities. This is in line with the findings of Messely (2007) who reported that the existing potential of beekeeping is hardly tapped because the products do not have access to infrastructures and organizational systems to allow them to reach the niches markets.

The participants of the study reported that honey bee pests and predators were affecting beekeeping activities in the study area. The major honey bee pests and predators were ant, large black beetle, spider and wax moth. This is in agreement with study finding of Desalegn & Amsalu (2001) who reported that the major bee pests in Ethiopia are honey badger, ants, spiders, mites, birds and wax moth. Desalegn (2001) and Workneh (2007) were also reported that Ethiopia, as one of the sub-tropical countries, the land is not only favorable to bees but also for different kinds of honeybee pest and predators that interact with honeybees.

Chemicals were reported to be used by the beekeepers and the non-beekeepers in order to protect weeds and agricultural crops pests. The respondents noted that there are two circumstances in which bees are killed on plants by chemicals, these are: insecticides applied to non-crop pests such as mosquitoes and tsetse flies and herbicides applied to plants on which the bees are foraging and have negative impact on bee farm. The study findings of Sanford (2003); Lemma & Woldeamanuel (2005) documented a similar result that the use of chemicals for crop pests, weeds, Tsetse fly, mosquitoes and household pests control brings in to focus the real possibility of damaging the delicate equilibrium in the colony, as well as the contamination of hive products. Thus, the use of chemicals and pests affect beekeeping as a sustainable form of agriculture for income generating and means of food security

Although there are efforts made by the government (ARD of the district), NGOs and private sectors involved in the beekeeping sector in the study area to reduce the constraints of beekeeping activities, the results of the current study indicated that lack of access to modern hives, training, new technology, honey marketing, lack of skilled manpower, lack beekeeping equipments, problem during honey harvesting; pests and predators, chemical poisoning and absconding were the major constraints of beekeeping activities of the study area. This is in agreement with the findings of Dessalegn (2001), Kerealem *et al.* (2011), Tesfaye *et al.* (2012) and Abadi (2014) who stated that, Ethiopia as one of the sub-tropical countries has been exposed to different constraints such as diseases, pest and predators, drought, deforestation, pesticides or chemicals that underestimated the contribution of beekeeping.

Moreover, lack of knowledge, shortage of trained manpower and equipment, inadequate research and extension services were indicated to reduce the apiculture sub-sector production. This is in agreement with Melaku *et al.* (2008) who reported that limited knowledge about the

potential of the area, lack of knowledge and skill on honey bee, lack of established system and institutional linkage and information gaps as the major constraints affecting beekeeping activities

5.2. Conclusion

The present study revealed that the area has varied climatic conditions making it suitable for apiculture to support large bee colonies. However, the apicultural resources are underutilized due to the prevailing constraints of beekeeping activities and the traditional beekeeping system in the area.

Three types of beekeeping, namely traditional, transitional and modern (frame) beekeeping observed being practiced at back yard. Traditional beekeeping was very common and widely practiced beekeeping observed. *Vernonia lasiopus* (soyoma) and *Arundinaria alpina* (bamboo) were the common types of materials used for making the traditional hives in the study area. The preference of traditional hives over modern hives might be due to their low cost to buy or prepare.

Three types of honey (red, brown and white) were produced in three distinct honey harvesting seasons (November-December, January- February, and May-June). However, the major honey flow season was November- December. This might be due to variation in flowering periods of different plant species. Most of the beekeepers use the honey both for consumption at home and sale at local market for income generation.

The present study indicated that the trend of beekeeping and honey production in the study area was increasing, but not as the potential of the area allows. This might be due to lack of access to improved hives, training, new technology, beekeeping equipments and chemical poisoning and the presence of pests and predators that affect beekeeping activities; endangering honey bee life and lowering the benefit obtained from the beekeeping sector of the s area.

5.3. Recommendations

On the basis of the results of the study and conclusions drawn, the following recommendations were forwarded:

1. To keep large number of bee colonies and increase honey production of the area, the government (ARD) and the NGOs' involved in beekeeping sector in the study area should facilitate means of getting modern hives.
2. To encourage the adoption of improved or frame hives and modernize the beekeeping practices interested investors, NGOs particularly ARD of the district should implement different strategies like awareness raising, technical aid and introduction of new technology.
3. To reduce the major constraints related to beekeeping activities of the study area, the concerned ARD of the district and the NOGs' involved in the sector should encourage the beekeepers horizontally communicate with different beekeepers (individual or associations) and facilitate visit and experience sharing opportunities.
4. To develop the basic beekeeping knowledge of the beekeepers and make competent in the quantity and quality of honey production, the government and non governmental institutions or any interested body should facilitate continuous and updated training opportunities, financial support, transportation and better market.
5. It is also recommended that there should be continuous follow up and supervision and motivation of good performance of the beekeepers.

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Appendices

Appendix I: Plates

Plate 1: Interview with the district's DA (Photo taken during field observations)

Plate 2: Discussion with focus group

Plate 3: Key informants

Plate 4: Shaded less hives covered with grasses (Photo taken during field observation)

5a

5b

Plate 5: Miss handled or inappropriately put modern and traditional hives (**a** and **b**)

Plate 6: Backyard Bee keeping

Plate 7: Properly handled modern hive

Plate 8: Transitional hives

Plate 9: Bee protecting wear, frame and honey extractor

Plate 10: Harvested honey

Plate 11: Extracted honey

Plate 12: Tasting honey

Plate 13: Honey storing equipments

14**a**

14**b**

14**c**

Plate 14a, b and **c:** Photo taken during experience sharing

Appendix II

JIMMA UNIVERSITY

College of Natural Science, School of Graduate Studies

Department of Biology (Zoology)

Questionnaire to be filled by Bee keepers

Dear Respondents:

The main objective of this questionnaire is to collect relevant data to the entitled "Assessment of Bee Keeping Management and Constrains in Bedele District, Illubabor Zone, South west Ethiopia". So your genuine responses are crucial for the success of the study. Therefore, you are requested to respond to the questionnaire by putting "x "mark for the closed end questions and by writing your opinion for the open end questions on the space provided . Be sure that your responses will not be used for other purpose and is kept confidential.

Note that you do not need to write your name on the questionnaire.

Thank you!

1. Personal information

1.1. Sex____1.2.Age _____ 1.3.Religion _____1.4. Marital status: Single_____ Married_____

1.5. Level of education: 1.Ilitrate_____ 2.Basic education____3. 1-4. _____ 4.5-8_____

5. 9-10_____ 6.11-12 _____7. Diploma & above_____

. **2. Beekeeping practice survey question**

2.1. Do you keepbees? Yes____ No____

2.2. When did you start beekeeping? Year_____

2.3. What kinds of hives did you start with?

1. Traditional_____ 2.Transitional_____ 3.Modern_____

2.4. Where did you get the hives?

1. By preparing own self_____ 4. From non-governmental organization_____

2. Buy from local market_____ 5.From Beekeeping Association_____

3. From Agricultural and Rural Development_____

2.5. W hat types of traditional hives are on use in your area? Hives made of:

1. Mud____ 2. Bamboo_____3.Tree bark/Twigs _____ 4. Sticks _____

2.6. Where did you start beekeeping?

1. At back yard_____ 2.On the tree in the forest _____ 3. In formal apiary site_____

2.7. How many hives did you have at the start? 1.1-8_____2.11-20_____3.20 & above_____

2.8. How many times do you harvest per year? 1. Once_____ 2.Twice _____ 3. The times_____

2.9. When is the most harvesting period? 1. Nov-Dece_____2.Jan-Feb_____3. June-July_____

2.10. How much kg of hone do you harvest per hive per year?

1. Traditional hive _____2.Transitional hive_____ 3. Modern hive_____

3. Honey bee colonies

3.1. Are there enough honey bee colonies in your area? 1. Yes ____ 2.No____

3.2. If your answer is 'yes', how many honey bee colonies do you have?

1. Traditional hives _____ 2.Transitional hives _____ 3. Modern hives_____

3.3. If your answer is 'no', where do you get the bee colonies?

1. From Agriculture and Rural Development ____

2. From non-governmental organization _____

3. From bee keeping association _____

4. By self capture/ colony transfer_____

3.4. For how many years do your keep colonies stay in your hives?

1. Traditional _____ years 2.Transitional _____ years 3. Modern _____year

4. Honeybee products

4.1. What kinds of bee products did you produce?

1. Honey bee colony _____ 2. Honey and bee colony _____ 3.Crude honey _____

4. Crude honey and bee wax _____5.Crude honey, Colony and bee wax_____

4.2. What type of honey do you produce?

1. Red honey ____ 2. White honey _____ 3. Dark honey _____

5. Bee keeping training access

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

5.2. If your answer is yes for the above question, who offered you the training?

1. Agricultural and Rural Development Office (ARD) _____

2. Non-Governmental Organization (NGO) _____

3. From indigenous knowledge_____

5.3. On what area did you get the training?

1. Honey bee colony management _____ 3. Bee forage management _____

2. Honey processing and handling _____

5.4. What benefit did you get from the training? _____

_____

6. Beekeeping association and other institutions

6.1. Is there Bee keeping Association in your kebele? 1. Yes _____ 2. No _____

6.2. If your answer is 'yes' for question 6.1, are you a member?1.Yes_____2. No_____

6.3. If your answer is 'no', what is your reason? _____

_____

6.4. What is the main role of the association?

1. Facilitate training program _____ 4. Facilitate access to hives_____

2. Facilitate market access _____ 5. Teach/aware its objectives_____

3. Facilitate credit access _____

6.5. Is there any rural Credit Association in your local area? 1. Yes _____ 2. No _____

6.6. If your answer is 'yes' for the above question, what kind of support are you getting from it?

Specify _____

6.7. If your answer is ‘no’ where did you get financial support? Specify _____

_____

7. Market accessibility

7.1. For what purpose do you use your honey?

1. Consumption at home _____ 2.Sale _____3. For both consumption and sale _____

7.2. Do you have market access? 1. Yes _____ 2. No _____

7.3. If your answer is ‘yes’, what type is it? 1. Local _____ 2. Regional _____

3. Other (specify)_____

_____

7.4. Do you have any contract agreement with it? 1. Yes _____ 2. No _____

7.4. If your answer is ‘no’ for question 7.2, where and for whom do you sale your honey?

1. At home for consumption _____ 2. At local market for beverage, such as tej _____

3. For traders_____

8. Beekeeping management practice

8.1. Do you have protective equipments that can be use during honey harvesting?

1. Yes _____ 2. No _____

8.2. If your answer is yes, where do you get them?

1. Buy from market _____ 4. ARD_____

2. NGO on credit _____ 5. Use traditional wear_____

3. NGO on free of fee _____

8.3. Do you share experience with other bee keepers? 1. Yes _____ 2. No ___

8.4. If your answer is ‘no’, what do think is the reason? _____

_____

9**. Honey Bee disease**

9.1. Is there disease affecting your honey bee colonies? 1. Yes _____ 2. No _____

9.2. If your answer is ‘yes’, how could you treat it?

1. Use traditional medicine _____2. Use modern medicine _____3. Nothing used_____

9.3. How often do you inspect your bee hives and colonies?

1. Always_____ 2.Sometimes_____ 3.Not at all_____

10. Pests, predators and other challenges

10.1. What are the major pests and predators that threaten your colonies?

1. Ant_____ 2.Black beetle_____3. Honey bird_____ 4.Spider_____5.Roach_____

10.2. What mechanisms would you apply to manage these pests and predators?

1. Traditional method_____ 3. Modern medicine_____

2. Use plastic covering_____ 4. Nothing used_____

10.3. What other challenges do you face that affect bee keeping practices in your area? Rate in accordance of its importance.(SA=Strongly agree, A=Agee, DS= Disagree agree)

	Item	SA	A	DA
10.3.1	Lack of enough land			
10.3.2	Land clearing for agricultural purpose			
10.3.3	Limited floral type			
10.3.4	Drought			
10.3.5	Fire (back burning and bush or wild fire)			
10.3.6	Use of pesticides			
10.3.7	Shortage of bee hive			
10.3.8	Shortage of bee colony			
10.3.9	Honey bee disease			
10.3.10	Poor (traditional) honey harvesting			
10.3.11	Market access			
10.3.12	Access to new technology			

11. In your opinion, what do you think should done to improve bee keeping activities in the future? _____

_____

_____

Appendix III

JIMMA UNIVERSITY

College of Natural Science, School of Graduate Studies

Department of Biology (Zoology)

An interview guide line for Bedele District Agricultural and Development office and Development Agents.

Dear Respondent:

The main objective of this interview is to gather relevant information to the entitled "Assessment of Bee Keeping Management and Constrains in Bedele District, Illubabor Zone, South-West Ethiopia" and suggest solutions for the improvement of this sector. Your participation is so crucial for the success of the study. Therefore, you are kindly requested to give your genuine responses to the questions outlined. Be sure that your responses will not be used for other purpose and is kept confidential.

Thank you!

1. General information:

1.1. Name of the respondent _____

1.2. Sex _____ 1.3.Age_____1.3.Region _____ 1.4. Zone _____

1.5. District _____ 1.6. Kebele _____

1.7. Marital status: 1. Married _____ 2. Single_____

2. Are there enough beekeepers in your District inspected under your office?

3. If your answer is yes, what is their total number? _____

4. Which types of bee hives are dominant in the District?

1. Traditional _____ 2.Transitional _____ 3. Modern _____

5. Do you provide the beekeepers in your District with modern hives? 1. Yes ____ 2.No ____

6. I f yes, on what basis do you provide them?

1. Fee of fee _____ 2. Credit _____

7. If no, what is the problem behind it? Specify _____

8. How is the current status of bee keeping in your District? It is:

1. Increasing _____ 2. Decreasing _____3.No change _____

9. What is the productivity of the hives in kgs?

1. Traditional hive _____ 2.Transitional hive _____ 3. Modern hive _____

10. Is there Beekeeping association in the district? 1. Yes _____ 2. No _____

11. If yes, do you provide the members with the new technology? 1. Yes _____ 2. No _____

12. What kind of training do you provide them? Specify.

13. What are the major problems regarding honey production and market access in the district?

1. Transport access due poor road _____

2. Quality of honey due to traditional production system _____

3. Low price of honey due to market access _____

4. Number of Bee colony due to disease, pest etc., _____

5. Other (specify) _____

_____

_____

14. What do you think should be taken to improve Bee keeping activities of the District in the future? _____

_____

_____

Appendix IV

JIMMA UNIVERSITY

College of Natural Science, School of Graduate Studies

Department of Biology (Zoology)

Key points to be discussed with the focus group

Dear Respondent:

The main purpose of this discussion is to get relevant information to the entitled "Assessment of Bee Keeping Management and Constrains in Bedele District, Illubabor Zone, and South-west Ethiopia" and suggest solutions to the improvement of this sector. Your participation is so crucial for the success of the study. Therefore, you are kindly requested to take part on the discussion. Be sure that your responses will not be used for other purpose and is kept confidential.

Thank you!

1. General information:

1.1. Name of the respondent _____

1.2. Sex _____1.3. Age_____ 1.4.Region _____ 1.5 Zone _____

1.6. Kebele _____ 1.7. Marital status: 1. Married _____ 2. Single _____

2. How is the current status of Bee keeping practice in your kebele?

3. Do you share experience with other Bee keeping colleagues?

4. Do you have any support (training, credit, access etc,) provided to you from the Agricultural and Rural Development office?

5. How is your access to adopt and use improved Bee keeping technology?

6. How do you see the difference between traditional, transitional and modern (frame) Bee keeping?

7. What are the major problems of Beekeeping activities in your District?

a. Access to modern hive

b. Low market price

c. Inaccessibility of the area

d. Honey Bee pests and predators

e. Honey Bee diseases

f. Other (specify)

8. How do you overcome the problems you encountered?

9. What do you want the Agricultural and Rural Development office of the District does to you?

10. What do you suggest to improve Bee keeping management and benefit the Bee keepers?

Appendix V

Field Observation check list

1. Type of Hive ; Quantity
   a. Traditional _____
   b. Transitional _____
   c. Modern _____
2. Hive Conditions:
   a. Housed_____
   b. Un housed_____
3. Hive placement :
   a. Hanged up on the tree in the forest_____
   b. On stand at apiary site_____
   c. At back yard hanged under roof_____
4. Supplementary feed
   a. Supplementary provided_____
   b. No supplementary feed_____
5. Site of hive
   a. Near road_____
   b. away from road_____
6. Foraging area and water availability
   a. Near hives_____
   b. Far from hives_____

Appendix VI

Mathematical calculation to determine the sample size of questionnaire respondents of the study

To determine the sample size of the questionnaire respondent of study, the following formula was applied:

$$n = \frac{N}{1+N(e)2},$$

Where: n is sample size

N is the population size

e is the level of precision and e=0.05.

The total bee keepers of the study area (N) =180

The precision level at 95% (e) = 0.05 hence,

$$n = \frac{180}{1+180(0.05)2}$$

$$= \frac{180}{1+180(0.0025)}$$

$$= \frac{180}{1+0.4}$$

$$= \frac{180}{1.4}$$

$$= 124.13 \sim 124$$