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Apiculture Constraints and Opportunities in Diga and Wayu Tuka Districts, East Wollega Zone, Oromia National Regional State, Ethiopia.

Amsalu Arega[1], Hailu Mazengia[2] and Muse Haile melekot[2]
[1]Bako Agricultural Research Center
[2]Bahirdar University, College of Agriculture and Environmental Science
Corresponding Author: *amsaluarega04@gmail.com*

Abstract

The study was conducted in Diga and Wayu Tuka Districts to determine the constraints and opportunities of beekeeping. Questionnaire surveys was administered to 146 beekeepers (97.1% males). Majority of the respondents started beekeeping after 2010 (28.03%) by catching colonies as honey bee colony source (54.8%). The major dearth period of the area was late march to early may. The trend of bee keeping in the study area was shifting from traditional to modern beekeeping and the trend of honeybee colony and its yield was decreasing due to honeybee health problem of the area (pests, predators, pathogenic disease, high cost of bee equipment and agrochemical application). In the study area the major pests and predators considered as challenges were ants, beetles, wax moth, varroa destructor and some predators like honey badgers, honeybee eater birds, dead head hawks moth, lizards, wasps and birds respectively. For the reason of time restraint in this study area, farther study on the driving force of challenge and opportunity of beekeeping is suggested by monitoring throughout the year.

Keywords: Honeybees, opportunity, constraint, Oromia

1. Introduction

Beekeeping is a long-standing practice in the rural communities of Ethiopia (Gidey Yirga and Mekonen Teferi, 2010) and the beekeeping sub-sector has been an integral part of agriculture in Ethiopia. It has been contributing to the household income and poverty alleviation and national economy through export. The country has huge apicultural resources that made it the leading honey and beeswax producer in Africa (Gemechis Legesse, 2014). Ethiopia is known for its tremendous variation of agro-climatic conditions and biodiversity which favored the existence of diversified honeybee flora and huge number of honeybee colonies (Nuru Adgaba, 2007).

The country is also one of the four largest beeswax producing countries and this commodity is one of the major exportable products and in 2010/2011, about 620,101 kg of honey was exported (CSA, 2011) and annually an average of 420 million Ethiopian Birr is obtained from the sale of honey. The total number or population of honeybee colonies of the country is estimated to be about 10 million, of which about 7.5 million are tamed and the remaining exist as feral colonies in the forest (SNV, 2005).

Constraints in the beekeeping development of the country are complex and to a large extent vary between agro-ecological zones and production systems. Variations of production constraints also extend in socio-economic conditions, cultural practices, climate (seasons of the year) and behaviors of the bees (Adjare 1990).The current problem of beekeepers isthere is a shortage method for efficient assessment of beekeeping constraint and opportunities. Accordingly, in East Wollega Zone there is no research information on beekeeping constraints and opportunities in the area. Therefore, this study was conducted to assess the constraint and opportunity of beekeeping.

2. Objectives

To magnify Beekeeping Constraints and Opportunities in selected districts of East Wollega Zone.

3. Materials and Methods

The study was conducted in East Wollega Zone, Oromia Regional state at about 332km away from Addis Ababa, the capital city of Ethiopia. It is bordered on the southwest by Buno Bedele Zone, on the west by the Didessa River, which separates it from West Wollega, on the northwest and north by the Benishangul Gumuz Region by the northeast by Horo Guduru Wollega, on the east by West Shoa, and on the southeast by the Gibe River which separates it from Jimma Zone. The zone is located in the area stretching from 36 0 30’00” to 36 0 45’00’’longitude and 9 0 05’00’’ to 9 0 15’00’’ latitude with elevation ranging from 1000m to 3207m. The range of annual rainfall of the zone is from 1500mm to 2200mm with mean annual temperature 15-20 degree centigrade. The study was specifically conducted in two districts; Diga and Wayu Tuka.

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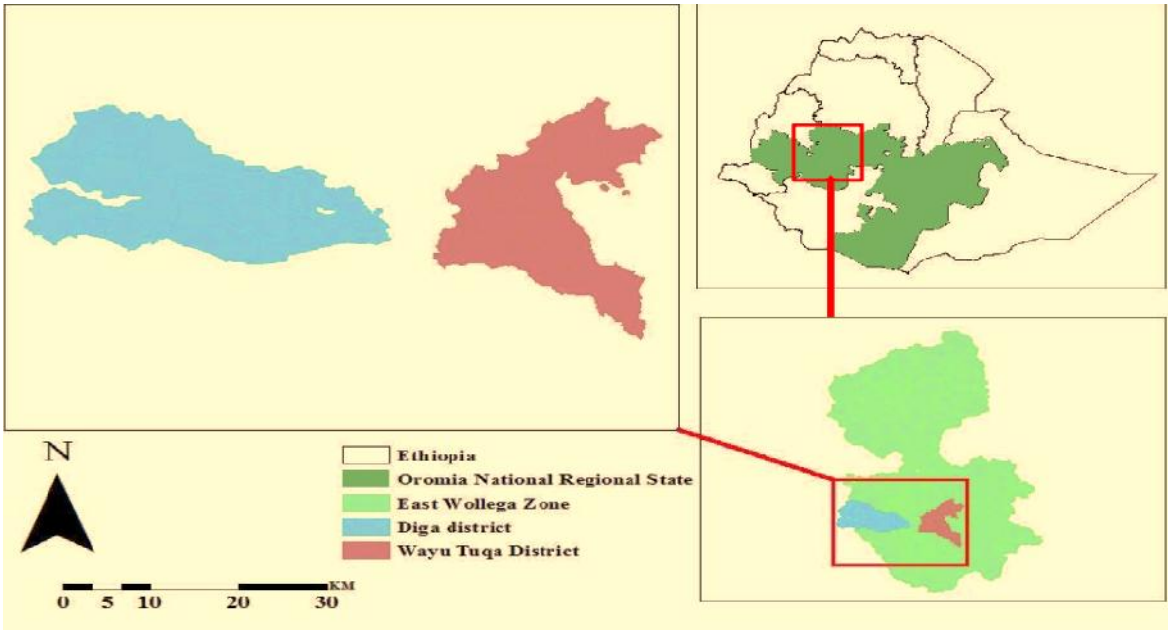


Figure1 Map showing the location of the study area.
(Source:Ethiopia: Oromia Region Administrative Map, 2013)

3.2. Data sources and methods of collection

In this study, both primary and secondary sources of data were used. The primary data was collected from sample household beekeepers through a semi-structured questionnaire, field examination and secondary data was obtained from various sources through desk review.

3.4. Sampling technique and sample size determination

A multistage sampling procedure was employed to select beekeepers and honeybee colonies. In first stage two districts were selected from the administrative zone using purposive sampling method based on their possible for beekeeping potential and accessibility. In second, stage six rural villages (six beekeeping site) selected from each districts based on their potential beekeeping. In the third stage, twelve beekeepers were selected in each rural village by using random sampling method. In total 144 beekeepers respondents were taken from Diga district were taken.

3.6. Data management and statistical analysis

The collected data were stored in Microsoft Excel and SPSS software programs (SPSS @, version 20) for analysis. The data collected through semi structured questionnaires were analyzed using descriptive statistics and the ranking of the different types of beekeeping constraints, Common Cause of honeybee colony and yield decrease, control method of bees from agrochemicals and the effect of pest and predators on honeybee colonies obtained in the study were done by using the rank index formula as described by (Musa *et al.,* 2006):

Rank index=sum of (5 X number of household ranked first + 4 X number of household ranked second + 3 X number of household ranked third + 2 X number of household ranked fourth + 1 X X number of household ranked fifth) for an individual reason divided by the sum of (5 X number of household ranked first + 4 X number of household ranked second + 3 X number of household ranked third + 2 X number of household ranked fourth + 1 X number of household ranked fifth) for overall reasons.

4. Results and Discussion

4.1. Socio-demographic characteristics of the respondent

4.1.1. Sex of respondents

Of 146 sample households, about 2.9% and 97.1% were female and male headed in Wayu Tuka district respectively and 3.8% and 96.2% were female and male headed in Diga district respectively (Table 1). The survey result indicates that beekeeping activity in the study area was practiced dominantly by male. About 70.6% of respondent's age in Wayu Tuka district ranges from 18 to 42 years and(76.9%) of respondent's in Diga district aged between 18 to 42 years (table 1). This result shows that beekeeper in the study areas were more in productive age. The survey result indicated that marital status of most beekeepers in Wayu Tuka (89.7%) and Diga (88.5%) were married.

In terms of education level 32.4%, 22.1% and 7.4% of respondent beekeepers in Wayu Tuka district have attended elementary, secondary school and diploma respectively while 38.2% of respondent beekeepers cannot read and write. Similarly about 44.9%, 19.2% and 1.3% of the beekeepers in Diga district have attended primary, secondary school and diploma respectively and remaining 34.6% of respondent beekeepers cannot read and write (table 1). Beekeeping activity in the study area was practiced by both educated and non-educated beekeepers, but beekeepers with better educational background are more productive since they are quicker adopters of beekeeping technologies than that of non-educated ones.

So that the educational level of the beekeepers were taken as a good proxy indicator of management abilities. It was assumed that those who have attained secondary or primary level education might be better skilled and productive than those without formal education. Education increases the ability of beekeeper to access and use information relevant to the beekeeping. A higher level of education was therefore expected to increase the production level (Ajiao and Oladimeji, 2013).

Table 1. Socio- demographic characteristics of households

Character of respondents	Category	Diga District		Wayu Tuka District	
		N=78	Frequency in (%)	N=68	Frequency in (%)
Sex	Female	3	3.8	2	2.9
	male	75	96.2	66	97.1
Age	18-42	60	76.9	48	80.6
	43-55	13	16.7	11	16.2
	56-68	3	3.8	5	7.4
	>69	2	2.6	4	5.9
Education level	Cannot read	27	34.6	26	38.2
	elementary	35	44.9	22	32.4
	secondary	15	19.2	15	22.1
	diploma	1	1.3	5	7.4

4.2. Beekeeping Practice

4.2.3. Honeybee forage farming practice

Majority of the respondent did not practice bee forage plantation (59.6%) in both Diga and Wayu Tuka districts during the study period and only (40.4%) of house hold beekeeper participated in bee forage plantation practice (table 4). This Poor bee forage management resulted to weak colonies that are more susceptible to various honey bee disease and pests and honeybee colonies absconding during dearth period. Due to these and other reasons, beekeepers of the study areas were suffering from loss of their honeybee colonies. Less honeybee forage planting practice of beekeepers in the study area during the study period were attributed to number of factors of which the main ones are shortage of farmland and improved bee forage seeds.

4.2.4 .Factors affecting bee forage farming in the Diga and Wayu Tuka Districts

The major factors that hinders household beekeeper for bee forage farming practice were lack of improved bee forage seed (28.1%), shortage of farm land (17.2%) and soil fertility problems (15.8%) in the study area (figure 2).

Not only bee forage there is different factors cause agricultural productivity to decrease. These areweather, the capacity of a given farm, pests, available equipment, the supply and demand in the market (Wise G, 2015).

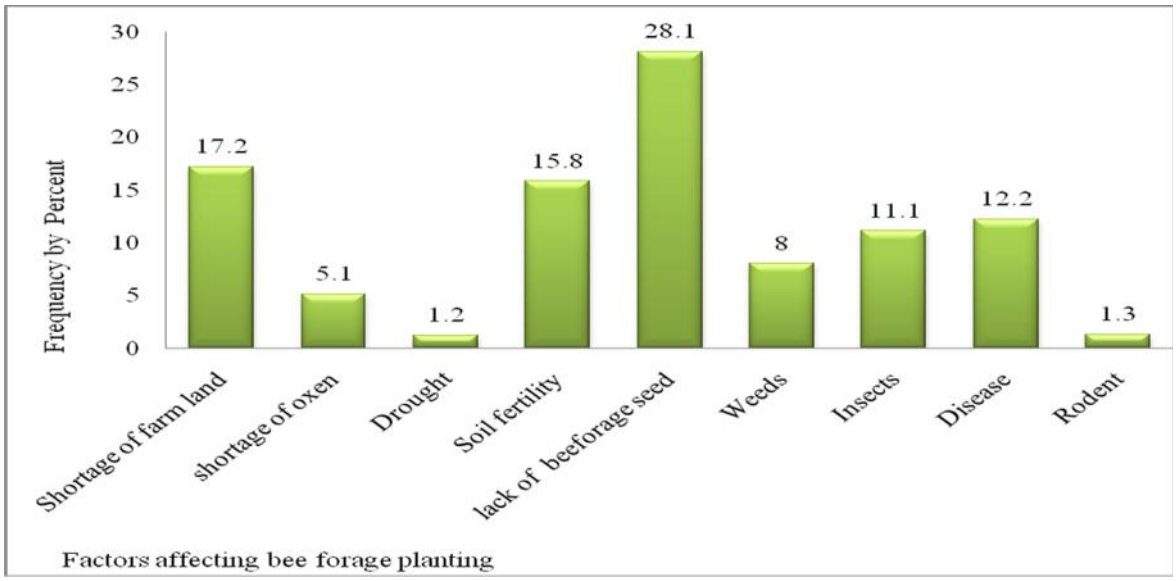


Figure 2 Factors affecting bee forage planting in theDiga and Wayu Tuka.

4.2.5. Beekeeping activities and potentials

Based on respondents and visual observation the beekeeping activities in Wayu Tuka and Diga districts have been practiced sideline with other agricultural activities. There were no any respondents who depend only on beekeeping. Most beekeepers in Wayu Tuka and Diga districts were started beekeeping before 2000(3.80%),2001-2005 (10.89%), 2006-2010 (18.41%)and after 2011(28.03%)in increasing respectively (table 5)and this indicate these beekeepers were related within age of between 31-42 years. Based on household respondents, beekeeping practice was increasing in the studyarea with beekeeping technology, majority of beekeepers started after year 2011.

Table 2. Beekeeping starting time in the Diga and Wayu Tuka

Year	Frequency	Percent
Before 2000	9	3.80
2001-2005	26	10.89
2006-2010	44	18.41
After 2011	67	28.03

4.2.6. Sources of honeybee colony

Before beginning beekeeping, beekeeper decides on source of honeybee colonies according to availability. In the study area during interview with respondents, the result revealed that the capture of natural swarms (54.8%) was common technique which was practiced almost by all beekeepers in the study area and others got honeybee colonies from their parents and both (from parents and catching swarms) source, 31%, 25%, respectively as a source of colony for honey bee colony increase (Table 6).

The result is related to the study by (Asaminew Tassew, 2015) that indicates the sources of colonies were mainly by catching swarms and gifts from parents, but, nowadays catching swarms and buying colonies are the common practices.

Table 3.Source of honeybee colonies in Diga and Wayu Tuka Districts.

Source of colony	Percentage of respondents	
	Frequency	Percent (%)
From parents	31	21.2
By catching swarms	80	54.8
By Buying colonies	5	3.4
From parents and catching swarm	25	17.1
From parents and buying colonies	2	1.4
By catching swarms and by buying colonies	3	2.1

4.2.7 Season of active and dearth period

Based on respondent's frequency, there were two major active seasons and one less active season. This was based on estimation of respondent by flowering season majority of honeybee flora species of the area flower in first (September to November) in Diga (51.1%) and (53.6%) in Wayu Tuka and in the second season(December to February) in Diga (31.4%) and 29.6%)in Wayu Tuka districts. These indicatethere were two main honey flow season, the next honey flow season (end of May to June) and March to early May was dearth periodduring the study periods (figure 12).

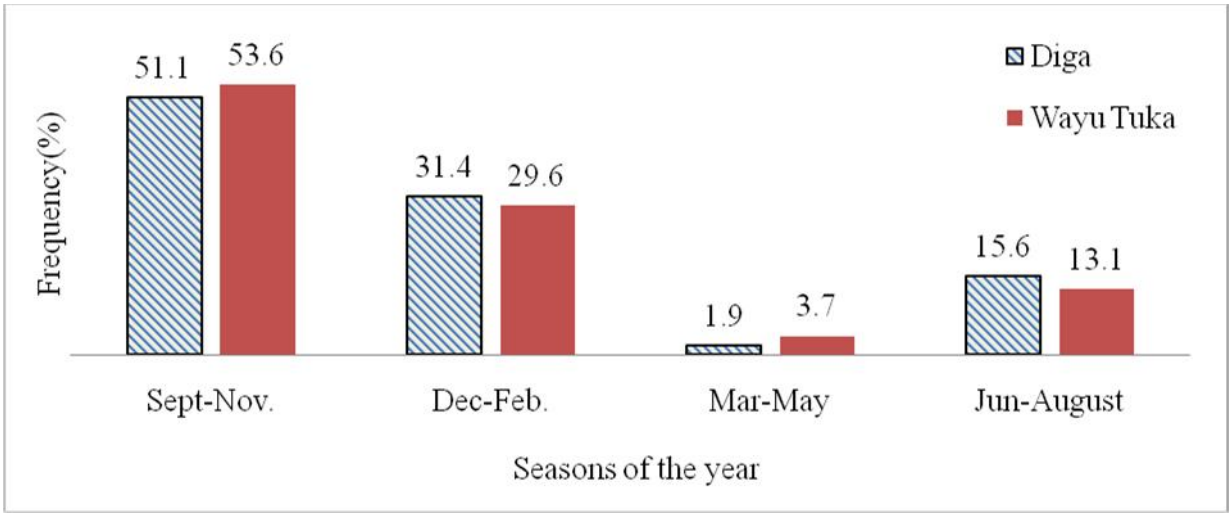
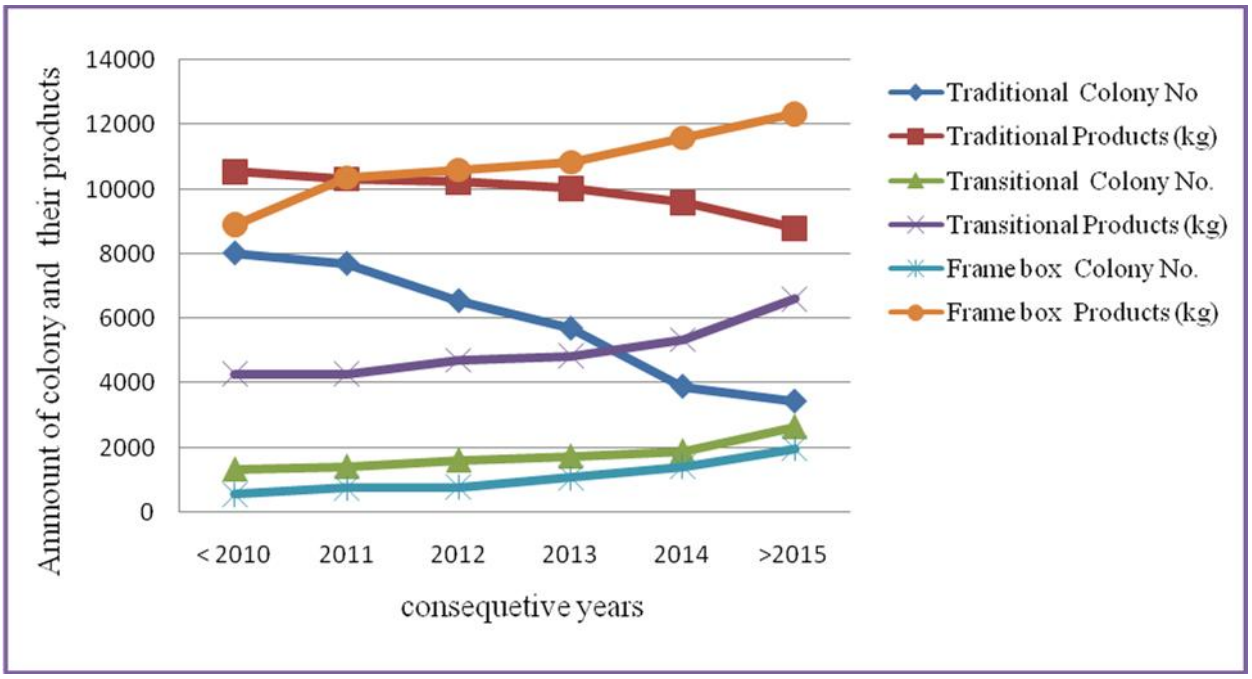


Figure 1.Season of active and dearth periods in Diga and Wayu Tuka Districts.

4.2.8. Trends of bee hives type, colony number and honey productivity

According to beekeeper household the amounts of traditional beekeeping and their products decreasing while transitional and modern beekeeping increase but the honeybee colony population was decreasing. In terms of beekeeping system, frame box and transitional beekeeping with product is increasing due to awareness of honeybee management system and most of beekeepers were shifting traditional beekeeping to transitional and frame box beekeeping (figure 13).



No=Number, Kg= Kilogram

Figure 2.Trends of honeybee hive type, colony number and honey productivity

4.2.10. Trend of honey bee colony and products

Based on majority of respondents the trend of honey bee colony and its Products was decreasing in traditional, transitional and frame box beekeeping (31.80%) without any harvest (4.18). Some of beekeepers also respond to honeybee colony and yield increasing (19.25) and others responded to stable (table 8). Based on visual observation during survey most of the respondents (5.86) were shifting their traditional beekeeping to transitional and frame box beekeepingsystem. This decrease is more obvious in area since there is no more practice of queen rearing. Sometime the colony population and products was decreasing with various factors. As the result of data, most beekeepers faced with shortage of food for their honey bee colony and faced with no products.

Table4.Trends of honeybee colony and products in Diga and Wayu Tuka Districts.

Trend of honey production	Frequency	Percent
No Harvest	10	4.18
Increasing	46	19.25
Stable	14	5.86
Decreasing	76	31.80

4.2.11. Agents of increasing honey bee colony population and products

In the study area there were an increase in honey bee colony population and products in each respondent's site because of the use of new technology of beekeeping (52.05%), use of new technologies with availability of good market price (25.34%) and availability of good marketing bee products (22.60%)and the use of both (figure14).

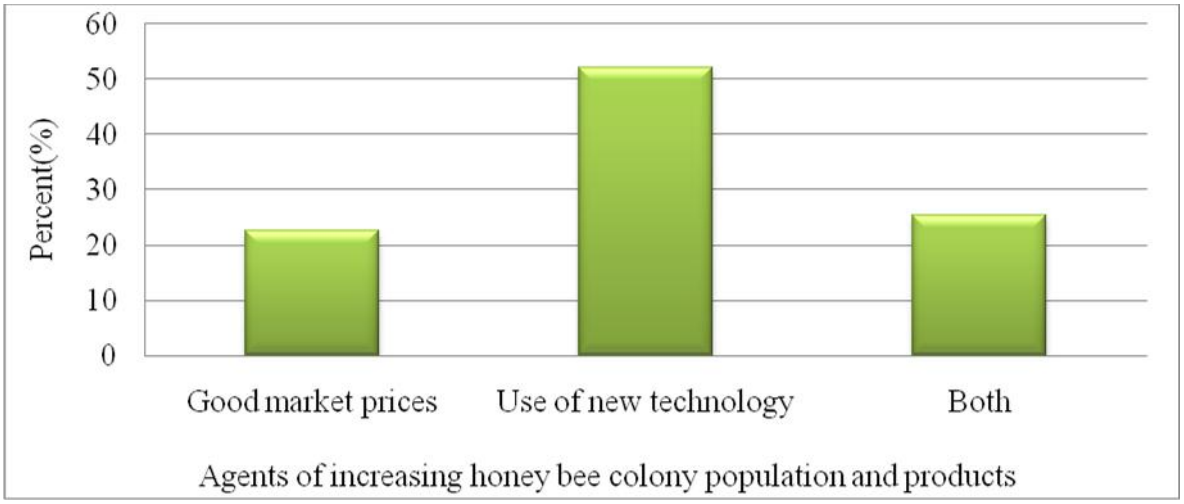


Figure 3. Cause of increasing honey bee colony population and products.

4.3 Challenge of beekeeping

The major Cause of honeybee colony and yield decrease was stated by respondents by ranks were lack of bee forage (as 1st), pest and predators (as 2nd) and Honeybee diseases (as 3rd) and others (Table 9) and all these cause the decrease in productivity and honeybee colony population. The result is agreement with (Kerealem Ejigu *et al.*, 2009) shortage of bee forage is ranked first 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 forestland for expansion of farmland could trigger a reduction of honey producing floras and foraging areas.

Absence of the bee flora calendar in most parts of the country is another severity to the development of honeybee feeding development strategies. Cultivation of bee forage is not practiced in the country. This problems results critical honeybee forage scarcity and hindering the production and productivity increment of honeybee in the country. Absence of the bee flora calendar in most parts of the country is another severity to the development of honeybee feeding development strategies (Mulisa Faji and Fekadu Begna, 2017).

Application of chemicals such as fungicides, pesticides and herbicides hinder the productivity and production of honey bee colonies. Deforestation was under way in some parts of the districts and this cause one of the problem raining season irregularity that reduces nectar and pollen source for honeybee colonies.

Honeybee colonies and their products are susceptible to various diseases, parasites and pests. The honey bee disease is serious problem on honey bee colony population and productivity. The major types of honeybee pests and predators, magnitude of their damage, and some possible solutions to minimize the damage they cause on bees and their products were discussed in Ethiopia (Desalegn Begna, 2001).

Shortage of bee forage causes the honeybee colony to abscond to areas where resources are available for their survival. Shortage of bee forage directly associated with off flowering period of major honeybee forages. The respondents reported the occurrence of sever feed shortage following harvesting time. Almost all sample respondents indicated that there is no provisions of supplementary feeds at the time of sever feed shortage. This is relating with the traditional practices of forest beekeeping. From this we can conclude that, in the study area honey bee colony population and production were in a decreasing trend (Kidane Mollaw, 2014).

Table 5.Cause of honeybee colony and yield decrease in Diga and Wayu Tuka Districts.

Common problems	Relative degree of importance						
	1st	2nd	3rd	4th	5th	index	Rank
Lack of bee forage	9	11	14	13	30	0.093	6
Lack of water	0	0	0	3	24	0.015	8
Drought	0	0	0	0	3	0.002	9
Absconding	11	11	14	8	28	0.092	7
Agrochemicals	13	18	38	12	2	0.138	3
Pests and predators	61	14	22	3	0	0.216	1
Decrease in price of honey	15	8	23	34	1	0.122	5
Honeybee disease	19	21	24	5	0	0.13	4
High price of bee equipment	32	45	11	4	0	0.19	2

Index = Sum of (5*ranked 1st+ 4* ranked 2nd+3* ranked 3rd+2* ranked 4th+1* ranked 5th) for individual reasons divided by the sum of (5*ranked 1st+ 4* ranked 2nd+3* ranked 3rd+2* ranked 4th+1* ranked 5th) for over all reasons.

Similarly with (Desta Abi, 2017) indicated that the Presence of honeybee pests and pathogen, prevailing bad weather (prolonged precipitation and freezing and heavy wind speed etc.), Lack of knowledge and skill of honeybee Pest and diseases control, application of agrochemical (direct spray of pesticide on bee visited agricultural crops), Shortage of bee forage, poor or absence of practice of hive shading, Lack of practice of Hive inspection and Shortage of improved hive types were ranked in the decreasing order of their importance.

Major pests and predators in Wayu Tuka and Diga

Among all constraints of beekeeping, these natural bee enemies were known to cause great damage to honeybee colony life and products. In the study area the major pests and predators considered as challenges ranked with their relative degree of importance were ants, beetles, wax moth (figure15), honey badger, bee eater birds, dead hawks moths, bee lice and some predators like, lizards, wasps and spiders (table 10).

The result is current with (*Bekele Tesfaye et al., 2017)*, report in assessment of pests and predators in Bale zone, pests and predators were a major challenge to the honeybees and beekeepers in the study area and respondents were reported that the presence of Honey badger, spider, bee-eating birds, bee lice, Beetles, wasps, Death Head hawks moth, Mice and lizards in order of their decreasing importance.

Table6. Honeybee pest and predatorsin Diga and Wayu Tuka Districts

Pest and predators	Relative degree of pests and predators effects					Index	Rank
	1st	2nd	3rd	4th	5th		
Ants	87	39	9	0	0	0.256	1
Wax moth	17	32	48	14	5	0.162	3
Bee lice	0	0	0	26	39	0.038	8
Beetles	31	59	18	13	1	0.196	2
Dead head hawks moth	1	6	15	32	29	0.069	6
Spiders	0	4	12	11	29	0.043	7
Wasps	0	0	3	21	24	0.031	9
Bee eater birds	3	6	23	41	24	0.089	5
Lizard	0	0	0	5	11	0.009	10
Honey badgers	4	7	39	43	9	0.108	4

Index = Sum of (5*ranked 1st+ 4* ranked 2nd+3* ranked 3rd+2* ranked 4th+1* ranked 5th) for individual reasons divided by the sum of (5*ranked 1st+ 4* ranked 2nd+3* ranked 3rd+2* ranked 4th+1* ranked 5th) for over allreasons.

Figure 4 Major pests and predators in Diga and Wayu Tuka Districts

4.4. Agrochemical application and its effects on honeybees

The term pesticide covers a wide range of compounds including insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides, plant growth regulators and others (Wasim *et al.,* 2009). In the study area agrochemical was used to manage agricultural products at farm land and storage area. The major agrochemicals in use are pesticide and herbicide**.**

4.4.1. The use of agrochemicals

Based on survey result all respondents (100%) were using agrochemicals to increase yields of agricultural products, to protect at store and less spoilage during storage. However, the use of certain agrochemicals has also been associated with some important environmental and ecological problem (Govinda, 2014).

Based on agricultural activity of the area majority of the respondents uses agrochemicals for weed control (47.3%), crop pest control (23.3%), Malaria Control (15.8%) and (13.7%) for tsetse fly control(Figure 16).

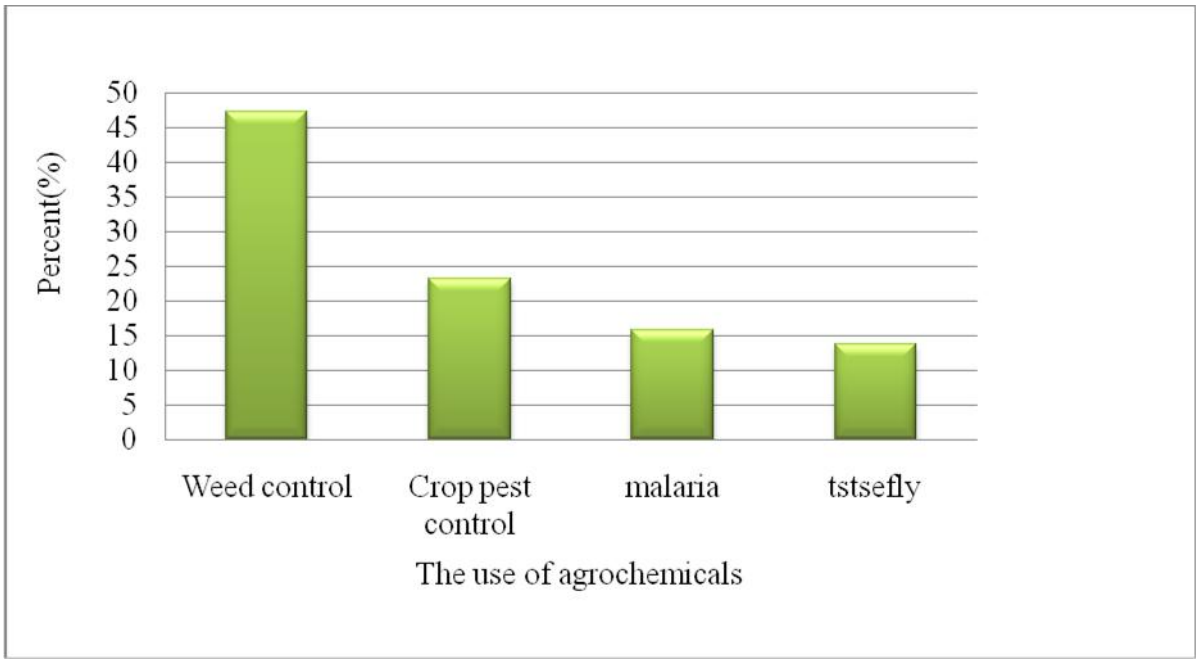


Figure 5. Agrochemical application in in Diga and Wayu Tuka Districts

A factor that has received a lot of attention has been the use of pesticides in agriculture, particularly insecticides. Insecticide sprays were responsible for a number of fatal incidents with honeybees and the introduction of new insecticides must reduce (Oliver, 2012). The application of agrochemical is occurring in the summer season and usually due to agricultural misuse of certain pesticide products (AFSSA, 2009).

Agrochemicals (pesticides and fertilizers) are looked upon as a vehicle for improved crop production technology though it is a costly input. Balance use, optimum doses, correct method and right time of application of agrochemicals ensures increased crop production. The requirement of fertilizers and pesticides for crops differ according to soil and meteorology (Bhandari, 2014)

4.4.2. Types of agrochemicals used by beekeepers

The agrochemicals most frequently used by respondents were 2, 4-D (24.9%), Malathione (11.6%), Roundup (19.2%), DDT (10.2%, Mancoze (12.1%). In the area farmers serve as the main unit of pesticide application. Hence, their degree of awareness of pesticide residues that affects honeybee colony was their methods of pesticide application (Figure 17).

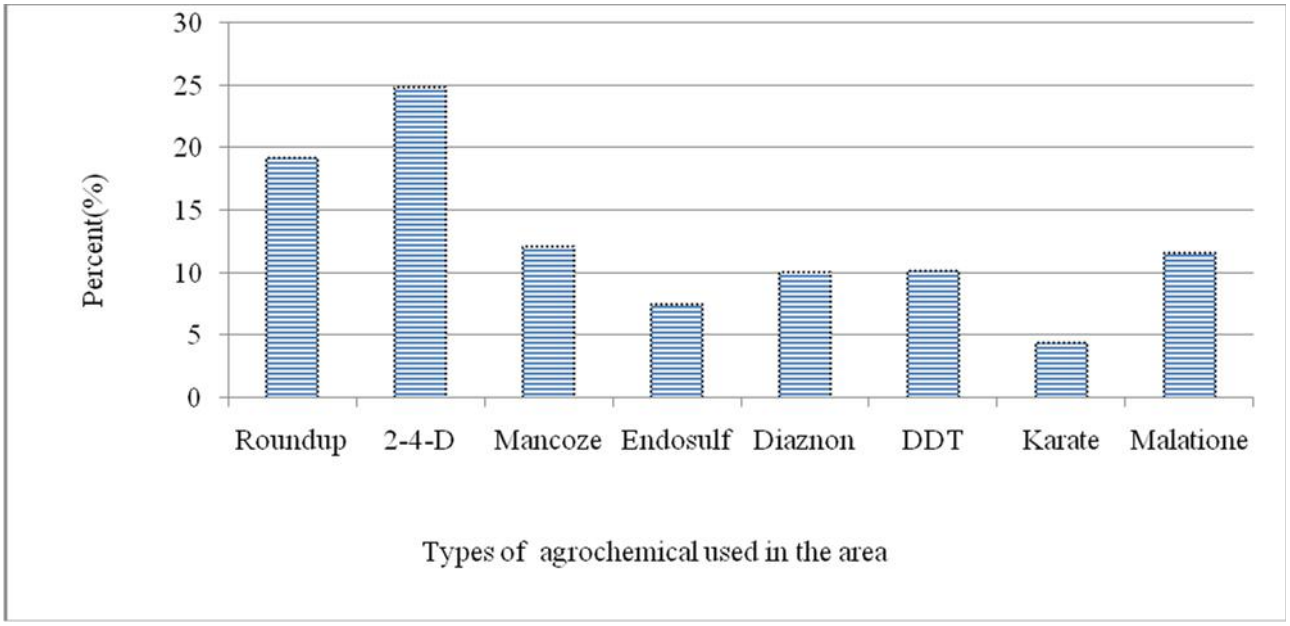


Figure 6. Types of Agrochemicalsin Diga and Wayu Tuka Districts

Pesticides include chemically synthesized compounds, devices or organisms that are routinely utilized in agriculture to manage, destroy, attack or repel pests, pathogens and parasites. Pesticides include both organic and inorganic moieties and may be classified into different groups based on their chemical composition (Govinda, 2014).

4.4.4. Local control method of agrochemicals

Total 146 household representatives were interviewed during the survey for local control of agrochemicals from honeybee colony by ranking indicate as 1st adjusting season of spraying (before flower blooms), 2nd adjusting time or hour of application, and 3rd feed their colonies during application (Table 13)

Table 7.Local control method of agrochemicals in Diga and Wayu Tuka Districts.

Control methods	Relative degree of importance					Index	Rank
	1st	2nd	3rd	4th	5th		
Covering hive entrance when spraying	0	0	11	23	24	0.094	4
Adjusting spraying hour	24	35	3	1	3	0.249	2
Season of spraying	52	29	14	8	0	0.395	1
Feeding colonies during spraying	6	9	38	6	0	0.175	3
Moving colonies to other place	0	1	3	9	27	0.053	5
Other methods	0	0	0	19	1	0.035	6

Index = Sum of (5*ranked 1st+ 4* ranked 2nd+3* ranked 3rd+2* ranked 4th+1* ranked 5th) for individual reasons divided by the sum of (5*ranked 1st+ 4* ranked 2nd+3* ranked 3rd+2* ranked 4th+1* ranked 5th) for overall reasons.

Respondents themselves were the main agent of agrochemical application in the study area. Therefore the awareness of agrochemical application and control method reduce the negative effect on honeybee colony and yield. Whether they apply pesticides in a standardized method affects the generated amount of pesticide residues, thereby ultimately influencing the safe production of agricultural products (Bo and Linhai, 2010).

5. Conclusion and Recommendations

Beekeeping is an important to rural communities by providing a variety of goods honey, wax, pollen, royal jelly, propolis in particular and enriching ecosystem by pollination. However honeybee colony and its products decrease due to honeybee health, poor management, lack of improved bee equipment, lack of bee forage, absconding and improper application of agrochemical.

The most common pests and predators revealed in the study area were ants, beetles, wax moths, dead head hawks moth, bee eater birds and honey badgers and these were major problems on honeybee colony health and production the study areas.

According to the result of this study, some of the suggested issues that require consideration by beekeepers and any development organizations are high lightened below:

- To save honeybee colony form agrochemicals, beekeeper and others in mind chemicals which are not harm full to honey bees and the application should not match with flowering season to minimize the poisoning effect on honey bee.
- Scientific information of honeybee pests and parasites in addition, standards evaluation of honeybee disease and pest with their prevalent/incidence rate is needed to evaluate the health of honeybee colonies.
- Awareness creation for beekeepers in terms of internal and external inspection for honeybee disease symptoms and report the status to laboratory for diagnosis.
- Beekeepers should maintain strong and healthy honeybee colonies enable the natural prevention of honeybee from disease and pest.
- For the reason of time restraint in this study, farther study on economic threshold of honeybee disease and pests is suggested by monitoring throughout the year.

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