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The Challenges and Opportunities of Honey Production Systems in Ada Berga District,West Shoa Zone, Oromia, Ethiopia

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Abstract
The study was designed to identify the challenges and opportunities of honey production systems in the study area. Four peasant associations (PAs), namely, sire Berga, Gatira Nabe, Haro Boro and Sambaro Sago of Ada Berga District PAs was selected based on variations in agro-ecology (high land, mid land and low land). Beekeepers in the study area and the country as well are challenged by several honey production Constraints. Such constraints are; Honey bee pest and predators, misuse of pesticides and herbicides, honey bee diseases, colony absconding and shortage of bee forages. Some of the opportunities associated with the study area are; Availability of honeybee floral resources, Availability of honeybee resource, Increasing hive products' demand and Increasing attention and focus from the government.
Keywords*:* Ada Berga, honey production, bee forage, Challenges, diseases

1. INTRODUCTION

Beekeeping or apiculture entails the rearing or keeping of bees with the aim of exploiting its products (such as honey, pollen grain, propolis, and brood) (Onwumere *et al*., 2012). Whereas, Belets Gebremich and Berhanu Gebremedhin (2014) reported that apiculture is a promising off farm enterprise, directly and indirectly contributes to smallholders' income in particular and nation's economy in general. In addition, Takele Gina (2014) reports indicated that Ethiopia is one of the countries in the continent that has the largest honey bee population and owns a big honey production potential in its varied ecological and climatic zones. Specifically, Ethiopia is the largest and leading honey producer in Africa and tenth largest honey producer in the world.

Unlike many other commodities such as crop and livestock, honey products generate multiple market opportunities, and are also nutritious foods. In addition, the production process is not in competition with any other form of agriculture and it can be integrated positively (Aravindakshan *et al.,* 2011; Gallmann & Thomas, 2012).The same to that, honey production is also considered as a natural resource conserving and environmentally friendly activity Gidey Yirga and Mekonen Teferi (2010) through its plant pollination services. Thus, it should be one of the most important intervention areas for sustainable development among poor countries like Ethiopia (Gibbon, 2001).

Based on the level of technological advancements, three types of beehives (traditional, intermediate and frame hives) are used for honey production in Ethiopia. Despite the long beekeeping tradition in Ethiopia, the highest bee density, being the leading honey producer and one of the largest beeswax exporting countries in Africa, the share of the sub-sector to the Gross Domestic Product (GDP) of the country has never been commensurate with the huge resources and the country's potential for beekeeping. Productivity has always been low, leading to higher domestic hive products utilization and relatively low export earnings. With this, even if efforts are still on-going, most of the on-station based adaptive research works which were carried out for the last few decades couldn't improve hive productivity and honey production so far. However, even if Ada Berga district is believed to have diversified vegetation, cultivated crops composition and considered as beekeeping potential, a detailed and comprehensive research data on honey production systems, challenges and opportunities in the area is not available so far (Workeneh Abebe, 2011) .

Therefore, this study was conducted to give an insight into the honey production potential constraints and opportunities in Ada Berga district, Oromia region, Ethiopia.

1.1. Statement of the problem

Beekeeping by its nature doesn't need huge investment (financial asset), large size of land and complicated technical knowledge. Beekeeping strengths and supports the rural community livelihoods to become less vulnerable to different shocks and avert risks. However, the individual poor beekeeping farmers in particular and the country in general still could not harvest honey to the required amount which in turn income from this sector to the producer, trader and the country is generally low in honey. In general, it believes that there are different honey production challenges which couldn't enable the beekeepers to maximize beekeeping outputs.

This work, therefore, had tried to magnify and suggest possible solutions against production constraints and identified some major challenges that are obstacles to product maximization in the study area.

1.2. Major Challenges and Opportunities in Beekeeping

Ethiopia has enormous and untapped potential for promoting beekeeping; both for local use and for export purposes. Like any other livestock sector, beekeeping has been ceased by complicated constraints such as low quality products, unpleasant behaviors of bees (aggressiveness, swarming tendency, and absconding behaviors), lack of skilled manpower and training institutions, low level of technology used, high price of improved beekeeping technologies, drought and deforestation of natural vegetation, poor hive products' post-harvest management, misuse of agro-chemicals, honeybee disease, pests and predators, poor extension services, absence of coordination between research, extension and farmers, lack of policy application in apiculture, shortage of records and up-to- date information, and inadequate research institutions to address the problems were also identified potential constraints in the previous years (HBRC, 1997; Ayalew Kassaye, 2001; Edessa Negera, 2002).

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3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was conducted in Ada Berga district which is located in Oromia National Regional State, West Shoa administrative zone at about 88 Kms West of Addis Ababa and bordered by Walmara in the South , Ejerie in the Southwest, Meta Robi in the West, and Mugher River in the North and East which separates the district from North Shewa zone. The altitude extends from 1,400 to 3,500 meters above sea level. The average rain fall ranges from 918 to 1,450 mm and its agro ecology is represented by highland (29%), midland (37%) and lowland (34%).

3.2. Survey Design and Sampling Techniques

For this study, the district was stratified into three using elevation as a criteria and it is generally believed that and revealed in many studies that farming systems, mode of life and many more characteristics vary across altitude zones (Cochran, 1973). The three altitude strata were high land (2300-3300) mid land (1500-2300) and lowland (800-1500) (Fikre Girma *et al,* 2015*).* Ada Berga district has 36 peasant associations (PAs, lowest Administrative units) and these PAs were divided into the three altitude groups.

Four PAs (1 from highland, 2 from mid land and one PA from the lowland) were selected purposively for the study together with experts and development agents which was based on the potential of bee keeping. From these PAs, a total of 160 households who keep a minimum of 3 and above bee hives were selected randomly.

3.3. Method of Data Collection

Data essential to the study were collected from secondary sources, undertaking group discussions and formal survey and field observation.

3.4 .Secondary data

The secondary data necessary for the investigation were collected from organizations and PA administrations.

3.5. Focus group discussions

Focus group discussions were conducted in the study area with purposively selected community representatives such as: elders are having rich indigenous knowledge in beekeeping, PA leaders, DAs, bee experts and women representatives. In order to gain a greater insight into the topics during the formal survey and to validate or check the data collected. Each of the focus group discussion consisted of 8 to 15 individuals and 3 group discussions were undertaken in the study area (one in each altitude zone).

3.6. Formal survey

A formal survey was conducted using structured questionnaire, with open-ended and closed-ended

questionnaires with the help of trained enumerators. Potential, challenges and opportunities of beekeeping in the area: harvesting time, dearth period and amount of honey harvested, honey storage facilities, honey selling situation ,potential honeybee plants and flowering time, poisonous plants, water resources availability, honeybee pests and predators, herbicides, insecticides and other chemicals applications have been collected.

3.7. Data Analysis

The statistical analysis used in the study varied depending on the type of variables and information required. Descriptive statistics such as means, standard deviation, frequency and percentages was used to analyze the quantitative data using SPSS version 23 software were mainly applied.

4. RESULTS AND DISCUSSIONS

4.1. Demographic and Socio-Economic Characteristics

The demographic characteristics beekeepers were summarized in terms of gender, marital status and age, education level.

4.1.1. Gender of the respondent

Out of the total respondents, about 18.1% in the high land, 54.4% in the mid land and 20% in the low land of were males, whereas 6.6% in the mid land and .6% in the low land were females.

Table.1. Respondents by Gender

Variables	Altitude					
	High land		Mid land		Low land	
	F	%	F	%	F	%
Gender						
Male	29	18.1	87	54.4	32	20
Female	-	-	11	6.6	1	.6

4.1.2. Marital status of the respondent

Marital status of the sample respondents indicated that about 17.5 % in the high land, 61.3 % in the mid land and 18.8% in the low land was married. Whereas 0.6% in the high land, in mid land1.9% while in the low land was single respondents.

Table 2. Marital status of Respondents

Variables	Altitude					
	High land		Mid land		Low land	
	F	%	F	%	F	%
Marital status						
Married	28	17.5	98	61.3	30	18.8
Single	1	.6	-	-	3	1.9

4.1.3. Age of the respondents

Of the sampled households, about 5.6 % in the high land, 10% in the mid land and 8.1% in the low land were under the age range of 15 to 30, whereas 38.1% in mid land and 7.5% both in the high land and low land were in the age range from 31 to 50 and 13.8% in the mid land, 5% in the low land and 4.4% in the high land were above 50 years old respectively.

Table3. Age of Respondents

Variables	Altitude					
	High land		Mid land		Low land	
	F	%	F	%	F	%
Age						
15-30	9	5.6	16	10	13	8.1
31-50	12	7.5	61	38.1	12	7.5
>50	8	4.4	22	13.8	8	5

4.1.4. Educational background of the respondents

In terms of educational back ground, about 8.1% ,28.1% and, 4.4% of the beekeepers in the high land, mid land and lowland respectively, were within the grade level of 1-6, while 3.8% in the high land,10% in the mid land and 2.5 % in the low land beekeepers were within the grade level of 7-10 and 0.6% in the high land,1.8 % in the mid land and 1.3% in the low land , beekeepers were grade 11 and above whereas the remaining did not get any formal or informal education.

Table 4. Educational background of Respondents

Variables	Altitude					
	High land		Mid land		Low land	
	F	%	F	%	F	%
Education						
Illiterate	9	5.6	35	21.9	22	13.8
Grade 1-6	13	8.1	45	28.1	7	4.4
Grade 7-10	6	3.8	16	10	4	2.5
Grade ≥ 11	1	.6	2	1.3	-	-

4.2. Challenges and Opportunities of Honey Production Systems in the study area

4.2.1. Challenges of Honey Production Systems in the study area

Beekeepers in the study area and the country as well are challenged by several honey production constraints. Beekeepers have also understood that colony number in their respective area is decreasing from time to time. However, in order to utilize outputs from the beekeeping sub- sector, identifying and characterizing the existing challenges and looking for possible solutions shall take a significant priority in the area. Accordingly, respondent beekeepers have identified the following major challenges which they want to have immediate interventions.

4.2.1.1. Honeybee pests and predators

Honeybees are exposed to a broad range of various environmental stressors, which can be having an impact to apiculture. Most beekeepers distinguished the problem of their bee colonies and the time at which this problem occurred. According to the respond of beekeepers, birds, ants, spiders, wax moth, mice, lizards, small hive beetles and honey badger were identified as the major honeybee pests and predators. The current data shows that 1.3% in the high land, 20% in the mid land and 6.3% in the low land of beekeepers in the study area reported the problem of pest and predators. The amount and problem of those pest and predators are not different with the variation of altitude. Beekeepers in the study area used different methods to control those pests and predators. The bee eater birds as a predator of the honeybees and difficult to control have been identified as a serious problem (challenge) for beekeeping in the area. The beekeepers used different methods to control the birds. Such as keeping their apiary in the morning, remove the constant place of the bird if it is around home and destroying the nest of birds. To control wax moth from the hive, beekeepers in the study area clean the hive and its environment .These pests cover the comb and destroy bees in the hive. Ants, the most important annoying insect has been disturbing the colony which has forced a lot of colonies to abscond and be aggressive.

To control the ant the beekeepers in the study area used such methods; - controlling overgrowths grass under hive stand and environment, dusting ash under the hive stand, finding the original house of ant and killing the queen of ant found in the hole, and covering the hive stand with plastic materials. Spiders cover through their webs on the ways of the bees is trapping the honeybees and prey on them. Beekeepers in the study area control spiders only by cleaning the hive mouth/entrance and its environment always in the morning or afternoon.

4.2.1.2. Misuse of pesticides and herbicides

The use of different agro-chemicals or pesticides is an important and common practice in crop production to fight against most crop damaging pest populations and diseases to produce high quantity of food round the world. However, if they are not used properly (according to their prescription for time of application and dosage), they bring about very crucial damage to pollination fauna (the honeybees in our case), environment and human health. As a result, reduction in pollinating insect population, quantity and quality reduction in hive products and crop yield reduction are some of the associated risks encountered.

As a matter of fact, honeybees visit flowering plants in search of nectar, pollen or both and fly from one plant to another. In this process, the honeybees are foraging on flowering plants on which some agro-chemicals have been applied for different reasons. Moreover, indiscriminate use of pesticides and herbicides has negative effects on the environment and the life of all pollinating insects. Sometimes, the effects of these chemicals on human beings are observable from different points which have been understood also by the local beekeepers.

From the result, teff, wheat, pea, barley, maize and different horticultural crops were some of the most common crops grown by the farmers in the district whereby they need different agro-chemicals for the control of different plant pests and diseases. 2.5%, 14% and 4.4% of interviewed beekeepers themselves confirmed to use agro-chemicals for different purposes, majority for the control of weeds in their crops .This observation (affected of honey bee colonies by agro-ecology ,due to the use of agro -chemicals on the crops) coupled with our results clearly could elucidate that the local farmers in the study area doesn't have any information of the risks of indiscriminate use of chemicals and/or do not know how to use the chemicals appropriately with minimum damages. We hope, responsible bodies could understand our explanations here so that appropriate intervention shall be in place both from the extension wing and decision makers.

As an option to minimize risks of chemical use on honeybees specifically and pollinating insects and the environment generally, we would like to suggest that extension and research wings should collaborate with local

administration bodies in awareness creation among the local farmers including the beekeepers on appropriate use of chemicals only for targets crops. Moreover, some of the possible practical options which could be advised include use of chemicals before flowering, late evening and/or early morning application, appropriate preparation of the chemicals according to their dosage and time of application, closing hive entrance for 1 or 2 days and transporting colonies for very few days away from the chemical application area. In this case, respondent beekeepers have confirmed that even if they are applying the agro-chemicals in the early morning and late evening, the other crop farmers are applying the chemicals at any time of the day in general and around the mid-day in particular. We could, therefore, understand here that not only local crop farming farmers but also significant numbers of beekeeping farmers do not know the importance of honeybees other than hive products production.

We found, thus, awareness creation on the pollination services of honeybees and other pollinating insects which is enabling us to survive on earth is an immense important activity demanding urgent intervention. Furthermore, respondent beekeepers complained that even if the misuse of chemicals and its associated risks are well known phenomena in the study area at all levels; no satisfactory solution (educating both beekeepers and non -beekeeper farmers in the study area about advantage of honey bee colonies on pollination service, feed the colony during agro chemical application) has been put in place so far.

The reasons to cause these risks are: - formation of the agrochemical is more advantageous in the sun than in the cloud time. Farmers which have no bee colony are no nous for bees. Thus, at this point, we suggest that all the stakeholders should participate and work together to discriminate misuse of agro-chemicals and encourage farmers to integrate the use of chemicals with beekeeping so that they could benefit from their business.

4.2.1.3. Honeybee diseases

As we know, honeybee diseases are causing a significant effect on the health status and well-being of the honeybees. Even if they couldn't identify the common name of the disease and which is, 9.4% in the high land and 11.2 % in the mid land and 5% in the low land areas of the respondent beekeepers have confirmed the presence of honeybee disease in their apiaries and can be detected once in a while. As the beekeepers respond the sign of the disease such as bees fail to fly, crown on the ground in front of hive, we probably say that these disease called virus. Fortunately, the most important brood and adult bee diseases (like the American and European foul brood diseases and some major viral diseases) nominated as killers of a colony have not been identified in the country in general and in the study area in particular. To know and control the disease from the study area the government should take the measurements such as identifications of the disease, means of transmission, season of prevalence and by what method it controlled.

4.2.1.4. Colony absconding

As one of the major problems in beekeeping, colony absconding was identified by only about 0.6% in the high land 5% in the mid land and 1.9 % in the low land of respondent beekeepers . In addition, they have explained that colony absconding is happening at any time of the year regardless of the hive types because of continues colony disturbances from different factors in which pest infestation is the most common cause. Off course, this has been also a self-explanatory problem happening because the majority of the beekeepers are not inspecting their colonies frequently. This is also because; most local beekeepers believed that opening colonies in any time of the year will increase absconding which needs to be changed. As a suggestion beekeepers should have always follow their bee hives to know, the colony problem and control it from bee enemies. Seasonal management such as feeding in dearth period, follow after transferring, reducing the space/super, were essential for transitional and frame hives.

4.2.1.5. Shortage of bee forages

Like other living organisms, honeybees need adequate nectar and pollen to survive, reproduce and honey production. Moreover, as the presence of bee forages varied from place to place and all plants are not equally important for bees in supplying both nectar and pollen resources, it should be understood that honey plants are home for bees and provide basic nutritional requirements for the survival and reproduction of honeybees. However, currently, misuse of honey and pollen source plants in the environment through significant deforestation has brought about shortage of bee forages endangering life on earth in general and in the study area in particular.

In this case, even if only 2.5% in the high land and 4.4% in the midland of respondent beekeepers do understand shortage of bee forage is a problem in their respective localities, this problem has been pronounced to be a nationwide most important problem endangering the beekeeping sub sector. However, very few beekeepers from each of the sampled (agro-ecology) explained that they are working on bee forage development around their apiaries.

Though honeybees support the human kind through their immense pollination services in various agricultural crops, the role of honeybees in this regard is less understood by the local community in particular and among the country's farming community at large. Thus, this indispensable service from the honeybees in our agricultural economy, we strongly suggest, should be pronounced to encourage farmers for sustainable use of

plant resources and their pollinators.

4.2.2. Opportunities of Honey Production Systems in the study area

Some of the opportunities associated with the study area and described by the respondent beekeepers are presented below:-

4.2.2.1. Availability of honey bee floral resources

As a matter of fact, the country at large and the study area in particular have been described as rich in floral resources (data from Adaberga Livestock Agency). The availability of multipurpose trees and shrubs in the study area has been identified not only as major sources of pollen and nectar for honeybees but also provide different services to the community. Of course, the interdependency between honeybees and floral resources also enables the reproduction, productivity and diversification of plants on earth. Very recently, establishment of apiaries near a forest, closure and religious areas is a common practice in the study area. That is, we believe, because of the fact that beekeeping farmers have understood the values of floral resources for increased honey production and survival rate of the honeybee colonies.

4.2.2.2. Availability of honeybee resource

To start beekeeping; one person must find the colony by any means which is simple way to him/her. From all methods of catching swarm, obtaining from the environment is more advantageous than the other methods because it does not incur cost, and one can catch several colonies in one season. In the study area, most beekeepers start beekeeping by catching the swarm from the environment and following by gift from their parents and also from their relatives. This explains the environment has good access to honey bee resource.

4.2.2.3. Increasing attention and focus from the government

To strength the apiculture sector and to produce the hive products and benefit from the activities of honey bees the attention of government is very important. Now days the government of Ethiopia focused on the apiculture sector by interconnection with natural resource conservation. In the study area, both government and non – government organizations undertake many activities in the form of training and helping the top beekeepers by providing them some modern bee hive.

4.2.2.4. Increasing hive products' demand

The rising of hive product is depending on many reasons:-management, floral resource, knowledge of honey flow period and so on. To increase the hive products, one beekeeper should update his/her knowledge by working many years with honey bee and have technology training from government and non –government organizations. From the study area, the production of honey increased from the year to the year because of increased intensity and frequency of giving training in the area.

5. CONCLUSIONS

Honey production in the study area has been faced with multiple constraints (the effect of agro chemicals application on crops, pest and predators, bee disease, absconding, shortage of bee forage, shortage of water, absence of market center,) but study area has a lot of opportunities (availability of bee flora, honeybee resource, attention and focus from the government and non-government).

6. RECOMMENDATIONS

From this study the following recommendations can be prepared for the present and future works in apiculture sub sector in the study area.

- To spray applications such as pesticides especially on crops, it is first important to evaluate the time of application in such a way that it does not have an effect on the bees.
- The effect of wax moth is difficult to control by beekeepers hence, the method which is approved for this pest is that all hives which have wax moth are removing and melted the infested comb and making the new foundation sheet should be addressed and supported by government and non-government.

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